ECOLOGY, LIVELIHOODS AND RIFT VALLEY FEVER DISEASE IN IJARA DIVISION, GARISSA COUNTY, NORTH EASTERN KENYA

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THESIS SUBMITTED TO THE INSTITUTE OF ANTHROPOLOGY, GENDER AND AFRICAN STUDIES IN FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ANTHROPOLOGY OF THE UNIVERSITY OF NAIROBI

NOVEMBER 2016

DECLARATION

This thesis is my original work and has not been presented for the award of degree in any University.

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This thesis has been submitted for examination with my approval as a university supervisor.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENT

This work would not have succeeded were it not for support and contributions received from different sources. First, I acknowledge with a lot of humility the financial support received from the International Centre for Insect Physiology and Ecology (ICIPE) through the International Development Research Centre (IDRC)-supported Eco-Health Project which enabled me to undertake PhD programme at the University of Nairobi. The support also catered for my field work for the programme in Ijara Division N.E Kenya. I am humbled by this institution's support because it helped make my years' old dream to pursue PhD Programme come true.

Secondly, I wish to express my sincere gratitude to the Eco-Health Research Team comprising Prof. Onyango-Ouma, Dr. Rosemary Sang', Dr. Hippolyte Affognon, Caroline Tigoi and James Wauna for the technical backstopping during proposal development and logistical support during field work. Special appreciation goes to Prof. Onyango-Ouma who as my supervisor not only took extra effort to come and supervise me in the field despite the long distance, poor terrain and harsh weather but also brought his admirable intelligence to bear on my work during his rigorous reviews. His in-depth mentorship during my entire PhD Programme work has left an indelible mark in me and will forever remain dear to my heart.

Thirdly, the cooperation of local community, local administration and government departmental officials in Ijara cannot go unrecognized. Specifically, I appreciate the assistance of Pauline Waweru who as Shangailu Health Centre Clinical Officer provided me with office space for community interviews over and above being my most dependable key informant, Chief Khalif and Chief Rashid for introducing me to the community and Mrs Rashid for accommodation and subsistence support.

Finally, I cannot forget the moral, material and spiritual support received from my family members and friends during the entire PhD Programme. Worth mentioning include my mother Anna Muga, my brother Benard Muga, Cousin Daniel Ogolla and friend Linda Gori. In a very special way, I also wish to acknowledge the support of my dear wife Lucy Achieng' who stood by me during my studies. The prayers, advise, inspiration and emotional support received from Lucy were very instrumental without which I would not have endured the rigours of academics to the end. In addition, her understanding and sacrifice to make ends meet during my absence from the family gave me extra power to complete the programme.

Thank you all.

LIST OF ABBREVIATION AND ACRONYMS

CDC	Centre for Disease Control
DVS	Department of Veterinary Services
EWS	Early Warning System
FAO	Food and Agricultural Organization
FGDs	Focused Group Discussions
GIS	Geographical Information System
GoK	Government of Kenya
GPS	Geographical Positioning System
ICIPE	International Centre for Insect Physiology and Ecology
IDRC	International Development Research Centre
ILCA	International Livestock Centre for Africa
ILRI	International Livestock Research Institute
KIIs	Key Informants Interviews
KNBS	Kenya National Bureau of Statistics
MDGs	Millennium Development Goals
MDNKAL	Ministry of Desertification Northern Kenya and Arid Lands
MoH	Ministry of Health
NGOs	Non-Governmental Organizations
RVF	Rift Valley Fever
RVFV	Rift Valley Fever Virus
WHO	World Health Organization

ABSTRACT

Although scholars have advocated for a multi-disciplinary approach to the study of human and animal health, available evidence suggests that such studies are still limited. This thesis attempts to bridge this gap by focusing on the anthropology of Rift Valley Fever. It explores the interactions of ecology, livelihoods and Rift Valley Fever in Ijara division, North Eastern Kenya. Specifically, the thesis examines the adaptive strategies of pastoralist system as a livelihood practice and their influence on Rift Valley Fever occurrence as well as the socio-cultural, economic and political drivers of vulnerability to Rift Valley Fever. The indigenous knowledge base pertaining to Rift Valley Fever and its implications on public health delivery approaches was also assessed.

The study was guided by the Eco-health Model by MacElroy and Townsend (2004) as its theoretical framework. A descriptive and cross-sectional study design involving quantitative and qualitative methods of data collection was adopted. Data was collected from 204 survey respondents, 15 key informants, 48 focused group participants (4 FGDs of 12 participants each) and 5 case narratives. A combination of quantitative and qualitative techniques was applied in data analysis.

The findings suggest a close interaction of ecology, livelihood and Rift Valley Fever in different but connected ways. The periodic and unusual heavy rains in Ijara find a flat topography, fragile alluvial soil and poor vegetation cover that are unable to hold the water. This situation results in massive floods and large swarms of *aedes* mosquitoes which hatch in the flooded basins, dambos and water pans thereby causing imbalance in the ecosystem. The *aedes* mosquitoes which are the

vectors for Rift Valley Fever Virus then infect both humans and livestock with RVF virus through bites resulting in an epidemic of the zoonotic disease. The transmission and spread in livestock and human population is accelerated by entry risk pathways such as consumption of raw blood and milk that constitute the daily livelihood practices of the pastoralists. The socio-cultural and economic drivers of vulnerability to RVF were found to include animal ritual sacrifices, animal sleeping arrangements, gender roles and lack of institutional capacity to timely respond to RVF outbreaks. Finally, the study shows that the pastoralists are adept at recognizing the risk factors and risk pathways associated with RVF. Findings suggest that while people possess immense knowledge on Rift Valley Fever, this awareness has not been translated into behavior change transformation such as the adoption of safer health practices during outbreaks. This is partly due to the deep-seated socio-cultural practices and lack of compensation during bans on animal slaughter and animal trade during Rift Valley Fever outbreak.

It is concluded that there is a close interaction of ecology, livelihood and Rift Valley Fever in the study area. The interaction and mutual influence of abiotic, biotic and socio-cultural environments as explained in the eco-health model and supported by cultural ecology was apparent. Since pastoralism remains the most viable livelihood activity in the dry land ecosystem, intervention programmes will need to understand the socio-cultural practices which are intertwined with livelihood activities. Public health advocacy therefore remains critical to enable the pastoralists shake off the deep-seated but unsafe socio-cultural practices that act as drivers of Rift Valley Fever disease.

CHAPTER ONE

BACKGROUND TO THE STUDY

1.1. Introduction

This chapter presents the background to the phenomenon of Rift Valley Fever (RVF) in terms of its cause and mode of spread across animals and human beings, history and spatial distribution of its outbreak. It also introduces the interactions of ecology and livelihoods in influencing the spread of RVF then proceeds to situate the field work setting by providing an ethnographic description of the Somali pastoralists of Ijara Division, North Eastern Kenya who suffered two major devastating RVF outbreaks in 1997/8 and 2006/7. Ijara Division which was the site of the study has therefore been categorized as one of the RVF hotspots in Kenya. The problem of study, study objectives and justification are also presented in this chapter.

1.2 The Epidemics of Rift Valley Fever

Rift Valley Fever (RVF) is a zoonotic disease that not only affects cattle, sheep and goats but also people and wildlife (Jost *et al.,* 2010). According to WHO (1998), RVF is disease that mainly affects disadvantaged populations that have limitations of accessing health services. Consequently, these populations suffer poor health status and destitution that exacerbate their disease load. Most infections in humans take the form of mild fever although a few cases degenerate to fatal haemorrhagic disease (Bird *et al.,* 2007; Labeaud *et al.,* 2007). In East Africa, RVF is mainly noted in arid and semi-arid areas as sudden, dramatic epidemics of the disease at intervals of approximately 10 years, associated with widespread flooding and the resultant swarms of mosquitoes (Linthicum *et al.,* 1999).

Of some 1400 species of infectious disease pathogens of humans, nearly 60% are derived from animal sources, hence the importance of recognizing the role of livestock, companion animals and wildlife in the interactions between animals and humans (WHO, 2012). In addition, two thirds of emerging pathogens are of zoonotic origin. Only by recognizing the importance of these human-animal interactions can we fully understand how to control these infections (Ibid). The virus that causes RVF - Rift Valley Fever Virus (RVFV) is a member of the *Phlebovirus* genus, one of the five genera in the family *Bunyaviridae*. It is related to mosquito–borne outbreaks and erupts during torrential down pours. RVF primarily affects livestock and can cause excessive morbidity, mortality and abortion in a large number of animals; a situation referred to as "epizootic," and is generally observed during unusually severe heavy rainfall leading to massive flooding. The excessive rainfall allows mosquito eggs, usually in the genus *Aedes*, to hatch. In human beings, RVF can cause fatal hemorrhagic fever (Hoogstraal, 1979; Mcintosh, 1980; CDC, 2007). When domestic animals are infected, the infection may or may not be accompanied by clinical signs (Davies, 2006).

In 1997/98 and 2006/07, massive outbreaks of RVFV occurred in East Africa, both associated with El Nino events (CDC, 2007; Woods *et al.*, 2002). In 2006/07 outbreak, over 1,000 people who were clinically tested were found with RVF virus and more than 300 victims succumbed to the disease (Breiman *et al.*, 2008). Infections in humans are caused by bites from mosquitoes that are infected with RVF Virus. Exposure to body discharges of infected animals can also lead to infection in humans. Primarily, RVF is transmitted by *Aedes* mosquito. However during epizootics, a large number of herds with the RVFV facilitate transmission by Culex and Anopheles mosquitoes as secondary vectors.

Humans get exposed to sick livestock during slaughter or treatment processes. Therefore, susceptibility to infection is highest when slaughtering during traditional sacrificial occasions which are common among the pastoralist communities (Davies, 2006). During the occasions, infected blood from the animals is released and this explains why RVF outbreak mostly affects the pastoralists whose main economic activity is animal keeping. a common practice in North Eastern Kenya.

Rift Valley Fever Virus (RVFV) was first detected in sheep in 1930 when there was an outbreak in a farm in Naivasha, Kenya (Doubney *et al*., 1931). The Naivasha outbreak has been followed by a series many other outbreaks at different times in different African countries namely Egypt, Senegal, Somalia, Tanzania and Saudi Arabia. Another landmark outbreak of RVF occurred in 1997/1998 when close to 20,000 persons tested positive to RVF and about 600 deaths occurred in Egypt (El-Akkad, 1977, cited in Woods *et al*., 2002). During the same period in December 1997, 170 haemorrhagic fever-associated deaths were reported in Garissa (WHO, 1998). Before the 1977 outbreak in Egypt, RVF was considered a disease of livestock with little impact on humans (Meegan *et al*., 1979) but subsequently, periodic outbreaks associated with widespread human infection resulting in acute febrile illness with hemorrhagic syndrome have been reported in many African countries.

Rift Valley Fever outbreaks in Kenya have mainly affected the nomadic peoples of North Eastern Kenya where pastoralism is the main source of livelihood. The term "pastoralism" refers to both an economic activity and a cultural identity, but the latter does not necessarily imply the former (Kratlis *et al*., 2013). As an economic activity based on animal production, pastoralism is

defined by a specialization to take advantage of the characteristic instability of most rangeland environments (ecological zones), where key resources such as nutrients and water for livestock can be relied on in the form of unpredictable and short-lived concentrations more than in uniform and stable distributions. All pastoralist production systems have in common the exploitation of ephemeral concentration of resources (Behnke *et al*., 2011). This activity has ecological implications as in pastoral system, the herders are mobile with the livestock to target the patchy availability of resources, while other household members might be sedentary for part or most of the year. Herders target areas of prime pasture with species combinations they know to be beneficial to their animals.

During these movements, the pastoralists exploit different ecosystems which predispose them to RVF resulting in impacts that have been aggravating over time. In Garissa, for instance, RVFV was first detected in livestock in 1961 and though 21 national outbreaks have been documented since then, only 6 of these occurred in Garissa district with 2 outbreaks (1997/98 and 2006/07) being the most notable in terms of public health and socio-economic impact (Murithi *et al.,* 2010), an indication of gradual worsening of the problem over time. Other than Garissa, the 2006/07 epidemic also struck Lamu and Ijara-the latter hotspot being the study site for this research project. The economic and social impacts caused by the morbidity and mortality of livestock and disruption of livelihoods, markets, and the meat industry that resulted from a ban of livestock slaughter were considerable (Rich and Wanyoike, 2010).

Since RVF was first detected in 1930, mitigation measures have largely drawn from the knowledge of veterinary and health professionals (Muga *et al.,* 2015). Furthermore, the measures

have been characterized by surveillance and compilation of reports for the authorities (Muga *et al.,* 2015). But as WHO (1998) observes, reducing the burden of disease must be undertaken in communities and populations within the framework of local settings and through coordinated multidisciplinary approaches and policies. This study seeks to bridge this gap by increasing understanding of the human-animal interactions through an investigation of the socio-cultural, economic and political contexts within which RVF occurs at community level as well the adaptive strategies of pastoralist livelihoods and how they may predispose communities to RVF risks within changing ecosystems. This analysis of human-animal interface will link anthropological research knowledge to practice in the delivery of public health for human and veterinary health services.

1.3 Problem statement

According to WHO (1998) zoonotic diseases share common characteristics associated with the conditions under which poor people live in the world's poorest countries. Despite the magnitude of people affected by the zoonotic disease, evidence still suggests that consideration of socio-cultural factors in the mitigation measures against RVF remains limited as there is continued emphasis on the veterinary and health perspectives. As Swift and Toulmin (1992) and Rich and Wanyoike (2010) have observed, these aspects have continued to remain a neglected research province despite calls by scholars such as Breiman *et al.,* (2011), Cohen *et al.,* (2007) and Rock *et al*., (2009) for interdisciplinary collaboration that incorporates behavioral studies in seeking to control the spread and minimize the impact of zoonotic diseases. For example, how does the lifestyle of the pastoralists drive RVF occurrence in both humans and animals? As WHO (1998)

affirm, these features are usually the result of social, economic, geographical and political forces (WHO, 1998 P: 1) which require socio-cultural investigation.

Plaen *et al*., (2003) similarly recognizes that social, cultural, economic and political factors play a role in disease and health seeking behaviour. Who becomes sick and why and what factors other than biology and adequacy of health services contribute to different prevalence rates across the gender or ages calls for involvement of social scientists to increase scientific knowledge on these factors.

Foods for the pastoralist are largely drawn from the animal products such as meat, fat and milk among others. Since scientists have found that exposure to the body discharges from sick livestock can lead to RVFV infection (Muga *et al.,* 2015), a deeper analysis of the Somali food and ritual practices is still needed to reveal the complexities around food handlings and the extent to which they could act as risk pathways to RVF infection. In terms of political factors, weaknesses in RVF preparedness and response could aggravate the consequences of an outbreak. In addition, the lack of proper coordination of communication messages was reported in the last RVF outbreak in 2006/07 (Jost *et al.,* 2010). This reveals gaps in the way the government and stakeholders utilize early warning systems to make decisions on response. These gaps require further investigation as they could continue to hinder timeliness of mobilization for detection and response during rift valley fever outbreaks.

Pastoralist production system employs adaptive strategies in response to the changing ecosystems (Keya, 2002; Reckers, 1997; Evers, 1994; Kratl *et al*., 2013). These strategies like

strategic mobility into different ecosystems such as forests have been documented in the literature (Kratli et al., 2013 and Tempia 2010) to have the potential of exposing the herds and communities to RVFV and the study generated more evidence in this regard. Furthermore, although it is contended that mobility of pastoralists is largely a response to the physico-biotic environment, it is important to establish whether other social, cultural and economic considerations such as availability of harmful insects (tsetse or biting flies) or animal diseases such as RVF and social networks are made when making choices to move to other areas.

Finally, there is a strongly established agreement among researchers and pastoralist communities that RVF imposes dire economic pitfalls and livelihoods disruption whenever it strikes after every ten years. But the community's indigenous knowledge on the disease and its support for current health delivery approaches are scarcely known (Jost *et al*., 2010) yet this could be instrumental in supporting an early warning system as well as informing human and animal health delivery approaches.

The paucity of research which shows the interactions of ecology, adaptive strategies of the pastoralists, socio-cultural, economic and political factors as well as the indigenous knowledge base of the pastoralists and its influence on RVF occurrence left glaring gaps that this study sought to bridge.

This study sought to answer the following research questions:

1. What are the adaptive strategies of pastoralist system as a livelihood practice within the changing ecosystems and their influence on Rift Valley Fever in Ijara Division?

2. What are the socio-cultural, economic and political drivers of vulnerability to Rift Valley Fever in Ijara Division?
3. What is the indigenous knowledge base pertaining to Rift Valley Fever and its implications for public health delivery approaches in Ijara Division?

1.4. Research Objectives

1.4.1 General Objective

To explore the interactions of ecology, livelihoods and Rift Valley Fever among the pastoralist communities of Ijara Division, Garissa County of North Eastern Kenya.

1.4.2 Specific Objectives

1. To identify and examine the adaptive strategies of pastoralist system as a livelihood practice within the changing ecosystems and their influence on Rift Valley Fever occurrence among communities in Ijara Division.
2. To investigate the socio-cultural, economic and political drivers of vulnerability to Rift Valley Fever among communities of Ijara Division.
3. To assess indigenous knowledge base pertaining to Rift Valley Fever and its implications for public health delivery approaches in Ijara Division.

1.5 Justification and significance of study

Owing to the multifaceted implications of RVF for the pastoral communities, the premise of this research is that a useful approach to addressing the problem of RVF in Kenya would be to adopt an integrated strategy that not only incorporates veterinarians, public health professionals, clinicians and epidemiologists but also social scientists particularly anthropologists who have proper grounding in socio-cultural studies. This strategy creates space for people with diverse disciplinary and multi-sector orientations to bring their core competencies, unique capabilities

and experiences to bear on the outcome of research and mitigation measures. As Rock *et al*., (2009) and WHO (1998) observed, zoonoses in as much as they are not prioritized in many national and international health programmes are not only influenced by environmental factors but by social conditions as well. Therefore, the multifaceted implications of RVF for the pastoral communities at micro level and the larger country at macro level reveals the importance of a multidisciplinary approach to the study of the disease so as to generate integrated approaches to its detection, prevention, control and management. This study adds value to this requirement by bringing out the socio-cultural, economic and political aspects of RVF to complement the findings of veterinarians, public health professionals, clinicians and epidemiologists resulting in a more comprehensive community-based disease surveillance, prediction and mitigation approaches. Furthermore, the research responds to the recognition by Plaen *et al.*, (2003) that these non-biological factors account for the differential prevalence rates of disease within relatively homogenous community.

Moreover, a documentation of the indigenous knowledge base of the pastoralists on Rift Valley Fever is instrumental in revealing the extent to which the communities can be useful in collaborating with the government to provide information to feed into the early warning system for prediction and response before disease outbreak. This study is of use to health service providers as it increases their understanding of the factors that influence access and barriers to human and veterinary health services within these unstable rangelands. Health interventions would benefit from the study findings that are grounded on the contextual factors to make them more effective and responsive in reducing the impact of RVF. This study was conducted within the IDRC Eco-health approach of assisting developing countries to improve their understanding

of the environmental and social drivers of emerging diseases and how they impact on poor communities. It is expected that sound policy interventions will be developed that demand the participation of the affected communities to prevent or adequately respond to emerging diseases.

Finally, this study is particularly significant as it elaborately adds more knowledge on the complex interaction of ecology, livelihoods and RVF- an endeavor that has not been adequately pursued by scholars before.

1.6 Scope and limitations of the study

The study was conducted in Gedilum sub-location in Ijara Division in North Eastern Kenya-one of the hotspots for RVF in both 1997/98 and 2006/7 outbreaks. It was cross-sectional and descriptive in design. The study population comprised all categories of people in Ijara Division. They provided information on the pastoralists' adaptive mechanisms and the extent to which they predispose people to RVF, the socio-economic factors of RVF and indigenous knowledge base of RVF. Ecology and Health Model by MacElroy and Townsend (2004) guided the study as its theoretical framework.

One of the key limitations of the study is that it was an anthropological study and hence did not involve laboratory research on Rift Valley Fever. Because of mobility of the herd owners (who were the survey respondents) to target the limited rangeland resources coupled with insecurity in Garisaa County where Kenyan authorities have declared risky due to the presence of Al-shabaab terrorist groups, a smaller manageable sample size of 204 as opposed to 385 (when accuracy level is held at $\pm$ 5%) was identified and sampled for interviews. The manageable sample size of

204 was derived by pitching the accuracy level at ±7%. Other reasons for the smaller sample size included the need for efficiency in data collection and contextual considerations such as expansive terrain. However, this accuracy level was balanced by the fact that the variables measured were standard across the sample population. Moreover, because of a smaller sample size and geographic focus of the study (Ijara division), the study findings can only be generalized for Ijara division and not beyond.

Finally, since the researcher was not a native of Somali community, the researcher relied on local interpreters versed in both Somali and English languages for both back and forth translation during data collection. Even though there was potential to lose a little detail during the back and forth translation, the use of local interpreters enabled a good understanding of the emic perspective of the Somali pastoralist culture.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of relevant literature on the thematic areas of pastoralism as an adaptation to dry land ecosystem in the context of climate change, the socio-cultural and economic context of RVF in Kenya and local people's knowledge on RVF. The objective of the documents review is to analyze the available knowledge in the subject matter of study and identify gaps that need further investigation and areas that require confirmation for more solid evidence. The chapter also presents the conceptual model used and its relevance to the study. Finally, assumptions of the study, definition of key terms and concepts in the study are outlined.

2.2 Pastoralism and adaptation to Dry land Ecosystem in the Context of Climate Change

The economic rationality and ecological sustainability of pastoral systems are adequately documented (Homewood, 2008) and are gaining focus in the current context of global interest in resilience and adaptability (e.g. African Union, 2010). Despite this renewed attention, there are still concerns by other scholars and authorities that pastoralism is no longer sustainable and holds back development for the pastoralists and to the livestock sector as a whole. In the 21st century, Kratl *et al*., (2013) asserts that this concern is driven by four crisis scenarios that have come to dominate global agricultural policies namely; climate change and the degradation of agricultural land; the fuel crisis; the financial crisis in the US and in Europe in 2005-2006; and finally the food security crisis.

Furthermore, according to Kratl *et al*., (2013), at the crossroads of these scenarios lies the ongoing global undertaking of incorporating communal land into commodity markets. Narratives of food insecurity, low productivity and vulnerabilities associated with pastoral dry lands should also be scrutinized so as to understand the crisis scenarios being debated (Levine, 2011).

Pastoralism as a production system is widespread and found in a diversity of climatic zones including deserts, dry plains, savannahs, steppes, tundra and high altitude mountain ranges. In all these zones, pastoralists are united under a lifestyle that revolves around the exploitation of scarce resources (Behnke *et al*., 2011). Asner *et al*., (2004) estimate that about 26 million square kilometres of land in these zones worldwide are under pastoralism.

Looked at from the perspective of cultural ecologists, pastoralism provides the device for adaptation to these diverse environmental conditions. Cultural ecology is characterized by a concern with adaptation at two levels: the first with regard to the way cultural systems like pastoralism adapt to their total environment and second as a consequence of this systemic adaptation- with regard to the way the institutions of a given culture adapt or adjust to one other (Steward, 1955). Cultural ecologists maintain that focusing on these adaptation processes allows one to see how different cultural configurations emerge, are maintained and become transformed.

In general, cultural ecologists have tended to emphasize technology and economics in their analysis of cultural adaptation, because it is these aspects of culture that differences among cultures, as well as the differences over time within a culture are most apparent. There is no disputing that man's control over his environment has increased enormously since the Paleolithic

era. This increase may be largely attributed to improvements in technological means available to man and to the growth of scientific knowledge (Steward, 1955).

According to Steward (1955), the method of cultural ecology has three aspects: (1) the analysis of the methods of production in the environment and (2) the pattern of human behavior that is part of these methods must be analyzed in order to (3) understand the relationship of production techniques to the other elements of culture. Man, unlike animals, in adapting to his environment, does not undergo wholesale genetic alterations but responds by playing an active role. The enabling device is what we call culture-the primary mechanism through which man begins by adapting to and ends by controlling his environment. Increasingly, this environment in which he lives has become a cultural environment (Steward, 1955).

Rass (2006) estimates about 120 million pastoralists/agro-pastoralists worldwide; 50 million of whom are in sub-Saharan Africa. Even though the economic importance of pastoralism has been muzzled in national statistics, of late some data have started to trickle in from country studies. It is estimated that 14.1 million animals worth US $ 860 million are kept in pastoral production systems in Kenya (Davies and Hatfield, 2007). According to the African Union (2010), pastoral systems are pivotal to national and regional economies and are the most viable economic activity in the dry lands.

2.2.1. Agro-ecological zones in Kenya

According to Orodho (1997), scholars have used a diversity of indicators like climate, vegetation and land use potential to assess land suitability for different uses. Climatic variables that have

been found to affect herbage growth are the intensity and duration of rainfall; the relationship between annual rainfall and potential evaporation; and the year-to-year variation in rainfall (Orodho, 1997). Using these sets of indicators, Kenya is divided into seven agro-climatic zones (Sambroek et al., 1982). Areas with moisture index that is greater than 50% have high potential for cropping, and are designated zones I, II, and III and account for 12% of Kenya's land area. Zones IV, V, VI, and VII range from semi-humid to arid regions and have indexes of less than 50% and an average annual rainfall of less than 1100mm. These regions are generally referred to as the Kenyan rangelands and account for 88% of the land area (Table 2.1). Ijara which was the site for this study falls under zone V-semi-arid land. All the seven agro-climatic zones are each sub-divided according to average annual temperature to identify areas suitable for growing of Kenya's major food and cash crops (Orodho 1997).

Table 2.1: Moisture availability zones in Kenya with rainfall and proportion of land

Agro-climatic zone	**Classification**	**Moisture index (%)**	**Annual rainfall (mm)**	**Land area (%)**
I.	Humid	>80	1 100-2 700	
II.	Sub humid	65- 80	1 000-1 600	12
III.	Semi-humid	50-65	800-1 400	
IV.	Semi-humid to Semi-arid	40-50	600-1 100	5
V.	Semi-arid	25-40	450-900	15
VI.	Arid	15-25	300-550	22
VII.	Very arid	<15	150-350	46

Modified from: Sombroek et al. (1982)

A majority of the high potential areas lie above 1200m altitude with a mean annual temperatures of below 18 degrees centigrade, while 90% of the semi-arid and arid zones lies below 1260m with a mean annual temperatures ranging from 22 degrees centigrade to 40 degrees centigrade. Orotho (1997) has identified four factors that determine the availability of pastures in the rangelands. These are variability in rainfall, the efficiency with which rainfall is transformed into useable forage, the use of pastures by the domestic and wild herbivores and the relationship between quantity and quality of the resources.

Zone V also referred to as the rangeland and which constitutes the study site has very limited crop production but is predominantly a pastoralist zone. Furthermore, about 50% of wildlife outside the national parks resides in this zone (Foeken 1994). Pastoralism thrives in this zone because of the prevailing ecological conditions, low population density and availability of the rangeland.

Sombroek (1982) has documented that the rangelands under zone V also lies within the wider North Eastern Kenya which is classified as a low potential zone. Along the Tana River basins stretching to Ijara, the soils are alluvial. The rangelands also have poor vegetation cover, fragile soils, high temperatures ranging from 20-38 degrees centigrade and frequent windstorms. Furthermore, shrub patches and open land savannah with vegetation cover of only 40-50% and land area of 15% characterize this zone (Sombroek, 1982). The main low trees and shrubs found here include *Acacia mellifera, Acacia tortilis, Acacia horrida, Acacia reficiens, Acacia nubica, Acacia paslii, Acacia Zanzibarica, Adansonia digitata, Terminalia pruoides, and Commiphora*

spp. Common grasses are Eragrostis superba, Cenchrus ciliaris, Cymbopogon spp., Bothriochloria spp. and *Heteropogon contortus* (Sombroek, 1982).

2.2.2. Pastoralist system of production and its contribution to food security

According to Gulliver (1972), a major characteristic of all pastoral nomads is movement of residence and of locale of pastoral operations. According to Kratli *et al*., (2013), the term "pastoralism" refers to both an economic activity and a cultural identity. As an economic activity based on animal production, pastoralism is defined as specialization that take advantage of the unstable rangeland environments, where key resources such as nutrients and water for livestock are scarce and unevenly distributed. Mobility of the herders is a key characteristic of pastoralism where the herders move with their livestock in search of water and pasture. Herders use their local ecological knowledge to target areas of prime pasture with species combinations they know to be beneficial to their animals. The goal of this "strategic mobility" (African Union, 2010) is to enhance production by keeping the livestock on a diet that is higher in nutritional value than the average value of the range (first recorded by Breman and Dewit, 1983). Hence specialized pastoralists keep animals that feed selectively on nutritious pasture (Kratli, 2008).

In order to get quality pastures, the herders work involves monitoring the range to spot where nutritious pasture exists (first recorded by Wilson and Clarke, 1976). This involves great deal of knowledge management and social capital (Kaufmann, 2007). The movement of the herders and their herd targets areas with relative abundance of nutrients and is more frequent during rainy season when returns are highest.

Gulliver (1972) similarly asserts that movement by pastoral nomads is a necessary response to poverty of resources in the physic-biotic environment relative to the economic requirements of the herds. Resources - principally pasturage and water - are scarce. The movement makes the pastoralists enables the pastoralists to view the rangelands as assets as opposed to sedentary farmers who would view them as unviable and problematic. Hence this mobility is, ultimately, what characterizes the pastoralist system.

It is argued that strategic mobility offers the highest returns although for the returns to be sustainable, it must be matched by large herds and intensive social networks. Households without robust social capital are unable to frequently move their livestock far away from their homesteads. Since poorer households with small herd sizes are unable to get into specialized pastoralism, short-term benefits become the main concern of the households (e.g., selling male animals before they reach the age and condition for the best market price) (Kratli *et al.,* (2010). The fact that less mobile herds have poorer nutrition and therefore lower returns, the condition impoverishes the households and the affected herd owners must increase their herd sizes to re-enter the mobile strategies of production.

It follows logic that reducing mobility of the herd severely lowers the productivity of the dry land animal production and waters down environmental sustainability (IUCN, 2012). Despite the odds in the dry lands, Steinfield *et al*.,(2006, p. 260) asserts that if properly managed, pastoral livestock production is the most environmentally sustainable livelihood activity in the range lands.

2.2.3. Socio-cultural causes of nomadic mobility in the rangelands

According to Gulliver (1972), the causes of pastoralists' movements have not been sufficiently and explicitly considered by anthropologists and others. There has been a tendency to over-emphasize a generalized environmental explanation. He contends that nomadic movement is a response not only to physico-biotic conditions and other features of socio-political kind in the total external environment of nomads; but it is also and importantly, a response to the internal context of the socio-cultural system of the people. Each occasion for movement is for the nomads an occasion for choice: the assessment of information and needs, the exercise of opinion and the making of decision.

Other than resource considerations, social factors are part of the total information to be assessed by a herdsman before a choice is made. Nomadic herdsman considers the resource possibilities in relation to the location and potential movement of certain other significant people. With whom is it useful or at least not harmful, to associate, and with whom is it desirable to avoid? Virtues of friendliness, cooperation, trustworthiness are considered when making decisions about movement (Gulliver, 1972). Other socio-cultural factors include the attraction of certain individuals, places and activities. Leaders of valued activities-political, military, ritual e.t.c. tend to draw other men towards them at times when those activities are important, periodically or ad hoc, in order to participate or gain particular advantages. External political factors also attract movements as a superior authority may open or close an area for grazing or inter-tribal warfare may close off certain areas (Stanning, 1957).

Hence nomadic social life has flexibility: the continual possibility of geographic movement and the continual association and disassociation. This flexibility is in itself of direct advantage economically in the pastoral regime for it allows the nomads continuous possibilities of adjustments to their highly variable undependable rainfall. This flexibility and the implications involved is at least partly an explanation of a number of general socio-cultural traits characteristic of nomads: the weaknesses or absence of authority, the pliability of group membership, individualism as a cultural value, the rarity of witchcraft accusation and the absence of operating concepts of territoriality.

2.2.4. Food production in the range lands

Studies by Pedersen and Benjaminsen (2008) on children from nomadic and sedentary population groups in Mali have shown that nomadic pastoralism as opposed to farming is the most adaptable source of livelihood in arid environments such as the northern Sahel. Similarly, mobile pastoral systems in both West and East Africa were found to have higher productivity than settled systems under the same conditions. A recent study from southwestern Uganda also confirmed these findings when it found that returns per hectare were found 6.8 times greater in pastoralism than ranches (Ocaido *et al*., 2009).

The pastoralists adapt to the unstable dry land environment by using a variety of strategies. These include strategic mobility, livestock feeding selectivity and herd diversification. The latter refers to keeping a variety of livestock species with different feed requirements and benefits to the household (e.g., small stock used to cover petty expenses and large stock for milk production

and incomes; breeds with low maintenance costs, high productivity and ability to tolerate long watering intervals) (Kratli et al., 2010).

2.2.5. Resilience of the pastoralists in dry land ecosystems

The term resilience is currently used in many sciences as a framework of explaining and understanding long term adaptation and transformation, in response to environmental and socio-economic and cultural shocks or adverse events (Anderson and Bollig, 2016). In trying to understand the causes of environmental change, scientific approaches have come to look at climate-human-ecosystem interactions as flexible systems in which adaptation and resilience play an important responsive role, mediating the impacts of environmental events and enabling socio-cultural responses that sustain livelihoods in adapted forms. Apart from climate change, other causes of environmental changes that result from human action include food insecurity, population pressure, poor infrastructure and water scarcity. These stresses have sometimes degenerated to a point almost giving way to collapse of production systems, or total destruction of local environments and permanent changes to ecologies (MaCann, 1999). However, scholars often reiterate the role of resilience and adaptation in responding and preventing possible collapse from the impacts of socio-ecological challenges.

According to Anderson and Bollig (2016), while resilience is apparent in all aspects of the social-ecological system, a combination of socio-cultural stresses with harsh environmental changes has driven this system towards collapse. Anderson and Bollig's thesis is relevant for analyzing adaptation and resilience in the savannah areas in eastern Africa, where specialist cattle pastoralism predominates and where this study was conducted. The notion of resilience

enables us to understand the sustainability of social-ecological systems in a more holistic way. When analyzing short-term changes at community level, resilience provides relief, a sense of recovery and sustainability that is based on previous learned experience. It has been found useful in explaining how communities respond to changing conditions such as drought, famine and violence (Anderson and Bollig, 2016).

The concept of resilience can be defined as the ability of a system to absorb stress while maintaining essentially the same function, feedbacks, structure and identity' (Anderson and Bollig, 2016). It is assumed that in resilient social-ecological systems, socio-cultural and environmental stresses have the potential to create opportunity for innovation and development.

Social resilience has been used to denote the "capacity of a community to respond collectively to adversity" (Anderson and Bollig, 2016). It is almost synonymous to terms such as 'coping strategy', 'adaptive capacity' and 'risk management' (Anderson and Bollig, 2016). The three types of capacities are necessary for understanding social resilience;

- At a local community level, coping/responsive capacity means the ability of the community to cope with immediate, short-term stresses and to restore its livelihood and production systems
- The adaptive capacity of a community to respond and address longer-term stresses and guarantee future livelihoods
- The transformative capacity of a community that addresses enduring stresses and produces structural changes to achieve better adaptation

Anderson and Bollig (2016) note that each type of capacity relies on social capital so as to be functional. They further outline four adaptive cycle phases through which a community might move in its responses to environmental and social-ecological stresses; exploitation, conservation, release and reorganization. Exploitation phase marks the point at which resilience develops then becomes institutionalized as a knowledge system at the conservation phase. Anderson and Bollig (2016) observe that disintegration of the socio-ecological system occurs at the release phase where system collapses due a lack of innovative responses to new stresses. This phase then gives way to reorganization phase where resilience becomes low as new strategies of social-ecological engagement are tested and developed (Anderson and Bollig, 2016). Understanding resilience and how it is built to help communities cope with adversaries is significant in this study as it explains how the Somali pastoralists cope with RVF epidemics.

2.2.6. Pastoralist production and other sectors

Pastoralism supports many livelihoods in non-pastoralist sectors. The growing urban populations owe their living to pastoralism through supply of meat for both domestic and export markets. It also feeds tens of thousands of people who are employed in livestock chains including auxiliary markets chains such as fodder, crop residues and water for livestock (Aklilu and Catley, 2011; Gertel and Le Heron, 2011). In most dry land parts of sub-Saharan Africa, pastoralist production system integrates with crop systems as is found where herds nourish on crop residues on the farms, either in exchange for manure or for cash (Powell *et al.*, 1994). Pastoralism also provides small-holder farmers with draft-oxen and manure for soil regeneration. The instrumental role played by pastoralist production in a country's economy means that interference with it

increases vulnerability, not only in the dry lands and among livestock primary producers, but all through to the other sectors that are dependent on it.

2.2.7. Pastoralism and vulnerability

2.2.7.1. Strategic vulnerability

Just as happens in other systems that operate under unstable conditions, pastoralist production also has inherent vulnerability the managing of which is the business of the pastoral system. Kratli et al., (2010) distinguishes between two types of vulnerabilities; baseline vulnerability which is normal and must be managed by the system itself and dysfunctional or non-strategic vulnerability that refers to sudden changes in the pastoralist system that makes it difficult to operate such as laws and disasters. For many household units, the latter increases as their capacity to operate pastoral production strategies decreases (Little *et al*., 2001). The two strategies enable sustainability of pastoralism. An outsider may be quick to see difficulties in operating the pastoralist system attributing the challenges to baseline vulnerability rather than obstacles to operate it (Kratli *et al.,* 2010). This understanding is becoming apparent for those interested in pastoralist studies. It is argued for example that in Kenya, household that are more impoverished are those that have fallen off the pastoralist production and engage in casual labour or petty trade in towns (MDNKOAL, 2010: 5).

2.2.7.2. Non-strategic /induced vulnerability

Catley and Aklilu, 2012 have noted that a number of processes and factors inhibit the pastoralists from smoothly operating their pastoralist system in the unstable rangelands. On top of these is the alienation of pastoral land, to conservation, commercial farming and biofuel plantations and

carbon trade speculation. Land ownership reforms that undermine production methods in pastoral systems and disregard to the pastoralists' socio-cultural values, norms, behavior and institutions are also to blame. Finally, is the replacement of diversity and complementarity between production systems with uniformity and competition which results in the generation of resource scarcity and increases the risk of conflict. It has been observed that these four processes and factors compromise the systemic and the ability of the pastoralist to harness the instability of dry land environments for animal production, setting off a vulnerability chain reaction, not only to droughts, but to any crisis, from disease outbreaks and conflict to the volatility of food prices.

2.2.8. Pastoralism in the future

As a way forward for pastoralism, studies have emphasized that policy makers must deliberately decide whether they consider the dry lands and pastoralism as riddled with deficits or, rather, by "unreleased potential" (MDNKOAL, 2010). There is need to develop pastoralism on its own terms, by turning instability into a resource. Research has also shown that pastoralism thrives on knowledge management and needs to operate with real-time intelligence (Kaufmann, 2007); (Muga et *al.,* 2015). Existing early warning systems should integrate the local knowledge of the pastoralists to make the system more relevant and effective for timely decision-making that responds to pastoralists' challenges (Muga *et al.,* 2015). This integrated system will efficiently aid in systematically collecting and analyzing information on pasture quality, market prices, and several other indicators that are of importance to pastoralist economy.

2.3 Somali People's knowledge on Rift Valley Fever

Studies to establish the local peoples' knowledge on Rift Valley Fever in epidemic-prone areas is still limited (Fyumagwa *et al.*, 2011; Jost *et al*., 2010). However, in a study conducted by Jost *et al.*, (2010) among the Somali pastoralists, it was found that the people had valid knowledge on RVF symptoms and risk factors namely heavy rainfall and mosquito swarms. The Somalis used the term *Sandik*, which means "bloody nose" to refer to Rift Valley Fever. They demonstrated clarity of recall when they reported that *sandik* occurred in 2006/7, the last time the disease struck the region. The animal keepers said that a bigger percentage of their herd had fallen sick in the course of the one-year duration (2006 – 2007), which coincided with the period of the epidemic.

The research showed that goats had the highest morbidity rate in the 2006/2007 outbreak. RVF was mentioned as common among cattle, sheep and goats. As revealed by the pastoralists, the other common diseases for all the four species included Lumpy Skin Disease, Tick-borne disease, RVF, and Foot and Mouth disease. Abortion and froth emanating from the nose were expressed by the pastoralists as the main symptoms of *sandik* which was also associated with heavy rain and mosquito swarms (Jost *et al.*, 2010). They noted that the mosquitoes were large and possessed white legs. Coughing, bloody diarrhea, salivation, lachrymation, pruritus and fever were also mentioned by the herders as other symptoms of RVF.

Jost's study showed that sheep were the most affected by the RVF outbreak in terms of mortality, fatality and incidence. Over 80 percent of sheep died during the outbreak compared with close to 60 percent of goats and 40 percent of cattle. In terms of abortion, the pastoralists

said that most affected were sheep as about 70% of pregnant sheep aborted during the outbreak in North Eastern Kenya followed by goats (62 percent) and cattle (47 percent). Moreover, according to the pastoralists, RVF was considered the disease that resulted in the heaviest losses of benefits for all the four livestock species.

The pastoralists of North Eastern Kenya were also found to have clarity of recall of events during the last RVF outbreak. Study data on timelines indicated that the average duration between the onset of torrential downpour and the initial emergence of swarms of mosquitoes was about 24 days. The average duration between the initial emergence of swarms of mosquitoes and the initial case of RVF in livestock was about 17 days.

On the other hand, a number of challenges were encountered by the veterinary staff in N.E. Kenya which compromised their timely response against RVF. These included poor roads due to floods, lack of vehicles, inadequate personnel and inadequate funds (Jost *et al.,* 2010). Interviewees reported that the Ministry of Health (MOH) officials responded late with their services which included livestock vaccination, treatment of sick animals, provision of insecticides and sample collection. A diversity of control measures were mounted including imposing movement controls and quarantines, closing of livestock markets and butcheries and providing advice warning against slaughtering animals, eating uninspected meat or drinking raw milk.

Timely outbreak response requires effective early warning and surveillance systems. Scholars have pointed out the important role that livestock keepers can play in veterinary surveillance

(Mariner and Paskin, 2000; Grace, 2008). Findings indicated that the Somali pastoralists were knowledgeable about the sudden torrential down pour and heavy floods prior to disease outbreak in their localities, observed unusual mosquito swarms (*Aedes spp*), and experienced unique high level of sickness and deaths in their animals pointing at RVF (Lithicum *et al*., 1999; Woods *et al*., 2002; Anyamba *et al.,* 2009). These facts were common knowledge among livestock owners well in advance of the detection of RVF by Veterinary Service surveillance systems (Breiman *et al*., 2008). This suggests that veterinary surveillance systems could detect RVF earlier by taking advantage of livestock owner observations through the integration of active syndromic surveillance such as Participatory Disease Surveillance (PDS) geared to the level of outbreak probability (Mariner and Paskin, 2000; Jost *et al*., 2007).

Jost *et al*., (2010) also revealed weaknesses in both RVF mobilization and response in the 2006/7 RVF outbreak. Due to late detection, the disease had entrenched itself in the animals prior to initiation of health interventions. Data from key informants indicated attempts to vaccinate areas beyond infected spots so as to stop the escalation of the disease. But it was realized that the disease had spread widely before vaccines could be mobilized.

Early warning indicators and the early warning processes need to be reassessed together with improved RVF preparedness and early warning systems. Kenya is now in the process of developing RVF preparedness plan (Geering and Glyn Davies, 2002). In order to be useful, the systems need to produce data a head of risk occurrence so as to give the authorities adequate lead time to mobilize and respond. Jost *et al*., (2010) study indicates that the observation by local communities of climatic, entomologic and clinical events consistent with RVF within the known

risk-prone areas were more timely and definitive risk indicators than the global early warning systems in place at the time of the 2006/7 outbreak. Furthermore, the use of vaccine in the emergency prevention and control of RVF outbreaks should be re-considered (ILRI/FAO, 2009). Vaccination in the 2006/7 RVF outbreak may have failed because of the challenges to timely mobilize and deliver vaccines. Routine preventive vaccination may epidemiologically be more effective than single but massive efforts to provide vaccination (Jost *et al.,* 2010). Clements *et al* (2006) also adds the need for staggered interventions which minimize mistakes in mobilization and response.

2.4 Socio-Cultural and Economic Context of Rift Valley Fever in Kenya

According to Muga *et al.,* (2015), a review of literature on the socio-cultural and economic perspectives of RVF is necessary for objective assessment and understanding of the implications of RVF and for planning and response to RVF. It is also a fundamental exercise to better inform public policy dialogues, advocacy and education campaigns against RVF in the country. The socio-cultural and economic perspectives will also map out the perceptions of the affected communities about RVF and its impact at household and national levels. This ambitious exercise is only at its preliminary stage, only comparable to a study recently conceived by Mariner *et al*., (2011) and International Livestock Research Institute (ILRI, 2008) since not many scholars have delved into this endevour.

Social components are analyzed within a triple-level framework proposed by Rushton *et al*., (2011), namely the value chain in which the disease circulates, the institutional framework and human behaviour. The economic dimension focusses on the impacts of RVF at both household

and national level, the capacity of government departments to detect and effectively respond to an outbreak and the challenges encountered by the authorities during mobilization.

2.4.1. The Social Context of RVF

The human actions and rules that drive the occurrence of a disease in a social context have become a subject of research on diseases as highlighted hereunder.

2.4.1.1. Effect of livestock sacrifice rituals on RVF epidemiology

Davies (2006) provides findings on the role of socio-cultural practices in RVF occurrence. Animal ritual sacrifices have been cited as a major predisposition factor to RVFV infection (Davies, 2006). These sacrifices are executed where there are multitudes of people, thereby exposing the people to attack by RVF virus especially where the animal was sick at the time of slaughtering.

During the haj festivals, there is invigorated trade on rams across Muslim countries of East and North East Africa and the Horn of Africa to Saudi Arabia, a practice that was found to be one of the drivers of RVFV occurrence (Davies, 2006). Overcrowding and the many herds of cattle butchered constitute a risk particularly if the animal fluids are infected. The virus gets transmitted to the people attending the rituals through contact with blood (Davies 2006: 138).

Similarly in Kenya, the practice of *Eid–al–Adha* among the pastoralists may enhance their vulnerability to RVFV. During *Eid–al–Adha,* animals are sacrificed and pieces shared with the poor in the society. In 2006–2007 epizootic, illegalization of this practice turned out to be effective in stemming sickness and death cases due to RVF (Breinman *et al*., 2010).

Similarly, one of the commonly practiced strategy among the nomads of North Eastern Kenya is to slaughter newly born lambs or kids to ensure that there is no drain on the lamb so that its chances of survival is increased (Keya, 2002). Should this occur during the outbreak of RVF, the practice exposes the persons involved to high risk of infection.

2.4.1.2. Gender perspectives of RVF infection and spread

Gender considerations have featured prominently in RVF research by virtue of the fact that the differential roles of men and women in pastoralist communities may differentially predispose them to diseases such as RVF. In Africa, literature abound pointing out that pastoral women enjoy a relatively inferior economic status when it comes to animal production (International Livestock Centre for Africa [ILCA], 1994). Milking and management of milk resources are constructed as women's roles and these may have a bearing on their exposure to RVFV.

According to Jokes and Pointing (1991), women in most African societies spend more time than their men in animal production. They therefore concluded that women are associated with livestock as "managers" while men are the "owners of wealth". This role differentiation and social relationship with the animal may predispose women to higher risks of RVFV infection than men as they get into contact with the animal fluids/milk. Women's role in animal production include milking, preparing ghee and milk fat and preserving hides and skins of the animals.

Pastoralist men and women in Africa are differently vulnerable to RVF infection depending on the gender roles constructed for them by the society. A study done by LaBeaud *et al.,* (2008)

pointed out that men were triple likely to be infected than women, a finding that was also observed by Woods *et al*., (2002).

In a study by LaBeaud and others, there was no difference in susceptibility to diseases between males and females. Instead, the higher infection rate observed among men was as a result of physiological factors (Hannah *et al*., 2008, cited in LaBeaud *et al.,* 2008). This finding indicates that it remains unclear how division of labour among women and men influence occurrence and control of RVF. The grey area between RVF and the gender of the victim is attributable to the lack of recognition of women's role in livestock production and healthcare of animals. It is argued that probably the reason there has been a gap on research on gender and health of pastoralist women is due to the low value placed on women's role in animal production. While women assume pivotal role in livestock production by, for example, milking which accords them the opportunity to detect illness in animals, this role is not often taken into consideration in health research (Bruggeman, 1994). In his study in Chad and Uganda, Bruggenman (1994) affirmed that women's role included gathering herbs for animal treatment and men recognized their expertise in this area and could from time to time consult them on animal health matters.

2.4.1.3. Drought-related risks aversion strategies and RVF epidemiology

For many years, pastoralists have adopted drought and disease risk management strategies to safeguard their animals. Nomadic pastoralists have used numerous strategies to cope with drought and disease. These include animal species diversification, herd dispersion, herds division and migration (Evers, 1994; Keya, 2002). These strategies have implications on both the herders' and animals' exposure to RVFV infection as described below.

In herd division, pastoralists separate the animals into smaller groups and drive them to separate pasture zones. Since the animals are separated thereby reducing proximity to one another and animal density, this strategy may help prevent RVF occurrence in the entire herd. There is scarcity of evidence to point out if this strategy has been included in public health campaigns at community level.

Nomadic pastoralists also practice herd dispersion which refers to regular exchange of herds between livestock owners to mitigate against the risks associated with disease outbreaks (Becker, 1997). Exchanging herds with pastoralists who live far away from each other safeguards the herd from diseases because regions are mostly affected differently. This strategy is made possible by establishing social networks in which exchange of animals occur (Dyson–Hudson, 1980, cited in Reckers, 1997).

In terms of herd diversification, livestock owners keep a variety of livestock species to spread the risk of losing the entire herd during drought or disease outbreak. This rational decision is primarily informed by the fact that livestock species have different levels of strength and immunity to diseases (Reckers, 1997). This also explains why there is a tendency to keep a bigger herd size in more arid areas. Herd diversification has other advantages such as making economic use of land, providing a diversity of animal products and guaranteeing a steady supply of food (Reckers, 1997). This is the reason behind the hesitation by the herd owners to dispose their herds when they know they will not obtain a good deal in return, a practice that may continue to drought periods.

Over time, mobility of the herds has remained a key strategy for pastoralism to avoid overexploitation of ephemeral resources of the rangeland. Both daily and seasonal mobility patterns are practiced. Under daily mobility, the herd owner based on his local ecological knowledge regularly identifies the direction to follow for pasture and water (Reckers, 1997). These daily mobility hardly exceeds 5km from the residence. Seasonal mobility exceeds 5km and is carried out by youthful and energetic men who traverse the rangeland with their herd in search of water and pasture. During seasonal movements, only lactating cows remain behind to sustain household members with milk. Shifting of households is another form of movement which Reckers (1997) defines as the periodic disbandment of residence and shifting to new locations as a result of climatic changes or disease outbreak. Mobility of the herd may expose the herders and their livestock to RVF when they come into contact with the wild animals in the forest or at water points. This is because studies have shown that close contact with the wild is a risk factor since the mosquitoes which are the vectors for RVF also infect the wild animals Tempia (2010). Therefore, where there are livestock and wild animals, vector preference is enhanced as the mosquitoes feed on both hosts thereby amplifying cross-transmission.

2.4.1.4. Traditional animal health care provision, labour organization and RVF epidemiology

A study conducted by Reckers (1997) among the Pokot community revealed that they continue to treat their animals with local plants in case of illness despite availability of modern medicine for animal health care. With regard to outbreak of RVF, there is need for evidence about this practice among the people of North Eastern Kenya especially as it resonates with or departs from the modern clinical measures put in place during the outbreak.

Studies have shown that nomadic pastoral work is highly labour intensive (Dietz, 1987). The tasks are performed largely by labour drawn from the family. Children are socialized on their role of taking care of the small stocks. Later they are assigned adult responsibilities in livestock rearing. The nature of labour division among the pastoralists means that everybody may be infected by RVF, yet most of the RVF interventions such as public health education have disproportionately focused on adults.

2.4.2. Economic dimensions of RVF

It has been documented that Rift Valley Fever occurrence has great impacts on the economy and causes serious deprivation to the pastoralists (Scholtel *et al*., 1996). Similarly, Toulbin (1986) observed that cattle keepers are rendered destitute by government ban on animal trade among other control strategies during the outbreak. A survey carried out after 2006–2007 RVF epidemic showed that in Garissa, a huge number of animals were lost to the disease (Department of Veterinary Services, 2007). In addition, effects of RVF on the prices of livestock are presented in table 2.2.

Table 2.2: Changes in the livestock prices at the Garissa Municipality Market, February 2007

Herd	Before the rains (Ksh.)	After the rains (Kshs.)
Camel	20,000 – 32,000	15,000 – 23,000
Cattle	12,000 – 18,000	6,000 – 10,000
Goats	1,600 – 21,200	1,000 – 1,300
Sheep	1,000 – 1,400	600 – 9000

Source: Department of Veterinary Services (2007a, p.3).

The situation presented on the table above reflects the economic impacts of RVF outbreak. According to the Department of Veterinary Services (2007a, p.8), the low prices presented in the table above were attributed to RVF epidemic and ban on livestock trade in Garissa Municipality.

In the same report, it was documented that the authorities imposed quarantine and closure of some of the livestock markets in Garissa following the outbreak of the RVF. These measures were taken by the authorities at a time when the pastoralists had fattened their livestock and were ready to fetch good prices in the market (Muga *et al.*, 2015). When RVF outbreak abated the cumulative costs incurred to the livestock sector were enormous running into billions of Kenya Shillings (Department of Veterinary Services *et al*., 2007).

2.4.2.1. Resource base and institutional capacity for RVF management in Kenya

The departments of veterinary services and public health mounted a series of interventions to respond to RVF outbreak of 2006/2007. They conducted continuous vaccination and education campaigns in the affected areas (Department of Veterinary Services, 2009). A few studies have pointed out that where there is institutional capacity, prophylactic vaccination campaigns in the high risk areas may be effective (Davies, 2006; Woods *et al*., 2002). However, this may be difficult to achieve in the Kenyan context since the capacity of the Department of Veterinary Services to respond to RVF occurrence through vaccination has been hampered by several factors the main ones being; shortage of vaccination tools and poor communication and coordination that were blamed on expansive terrain and flooded roads (Department of Veterinary Services *et al*., 2009). These led to delay of medical supplies and a drop in uptake of vaccination as communities had lost trust in the interventions.

According to the Department of Veterinary Services (2010) both active and passive surveillance of animals and human beings may yield great impact if adopted. Passive surveillance on one hand captures upsurge in abortions, haemorrhagic mortalities in young livestock. Active surveillance on the other hand requires alertness of response staff who exhaustively combs hot spot areas for the disease. The two types of surveillance are supported by the community who are involved to prioritize common diseases and conditions in their locality (Department of Veterinary Services, 2010).

The above literature provides detailed review and analysis of the socio-cultural, economic and political contexts of Rift Valley Fever, the indigenous knowledge base on the disease and pastoralist production system. Whereas the analyses have to some extent confirmed earlier research findings on Rift Valley Fever disease, it has identified paucity of social research on RVF. This finding is consistent with that of Muga *et al.,* (2015) in the review of work on RVF literature. This review similarly established that limited focus has been given to the socio-cultural and economic drivers of RVF occurrence. A majority of studies were heavily drawing from veterinary and health perspectives. The gender roles in pastoralist production and their influence on RVF remain unclear in the above literature. Similarly the review has brought to the fore gaps worth investigating which additionally make this research endeavor viable. The indigenous knowledge base of the pastoralists and its potential to inform response requires deeper investigation for comparison with those of other scholars such as Jost *et al* (2010).

The review indicates the need to reassess the established early warning processes and integrate local knowledge to reinforce timely detection and response. This is because reports by the

pastoralist on environmental changes were more accurate than the early warning establishments (Jost *et al.,* 2010). This shows the pivotal role of indigenous knowledge in animal and human health delivery approaches. This thesis has collected more evidence to bridge these gaps through empirical research that adds to the existing body of knowledge on RVF as well as policy and practice in Rift Valley Fever control and prevention.

2.5. Theoretical framework

This study employed the Ecology of Health Model propounded by McElroy and Townsend (1989). The model presented in figure 2.1, shows that the environment that impinges on people can be broken down into three parts: the physical or abiotic environment, the biotic environment and cultural environment. The parts are interdependent and continually in interaction; a change in one variable frequently leads to a change in another (this is what the ecosystem means). Although we may usually focus on the separate parts and think of them as causes and effects of change processes, it is possible to imagine all these individual spheres and variables functioning as a single unit. If one looks at the whole, you have a model of an ecosystem, a set of relationships among organisms and their environment. In analyzing the impact of people on their environment and the impact of environment on people, we can shift focus from individual to population and back depending on purpose.

According to MacElroy and Townsend (2004), health and disease perfectly fit into this model as a change in any of the variables in the model can lead to certain imbalances, contributing to disease and stress. For instance, a change in climate may lead to sharp decrease in human and animal food supplies. Erosion of soil may undermine agricultural or livelihood productivity.

Cultural ecologists like Julian Steward's concern with the way cultural systems adapt to their total environment and the way the institutions of a given culture adapt or adjust to one other reinforce the eco-health model by providing another lens of looking at the impact of cultural adaptation to the totality of the environment (abiotic, biotic and cultural). Cultural ecologists support this model by maintaining that focusing on these adaptation processes allows one to see how different cultural configurations emerge, are maintained and become transformed (Steward, 1955).

2.5.1 Relevance of model to the study

The Ecology of Health Model is relevant to this study in a number of ways. First, the model prescribes the conditions which must exist for livelihoods (in this case pastoralist livelihood) and health to be sustained in the pastoralists' ecosystem. The pastoralists who occupy dry land ecosystems must create survival-promoting relationships within an environmental system. These are relationships within the groups, with neighbouring agricultural communities, and with plants and animals of the habitat. A major premise of the model derived from medical anthropology is that the group's level of health reflects the nature and quality of these relationships. Hence for a population to be healthy, there must be an equilibrium maintained in the relationship among the pastoralist group with the other components of environment namely the abiotic, biotic and cultural.

Secondly, the model helps in understanding the risk pathways associated with RVF and their disruption of the ecosystem balance leading to human and livestock disease. Heavy rainfall leading to massive floods in the dry land ecosystem causes stress and destabilizes the ecological

balance by providing a conducive medium for hatching of thousands of eggs of flood water mosquitoes that sets off Rift Valley Fever transmission among surrounding livestock and humans. Hence, a change in the physico-biotic environment through heavy rains and emergence of vectors subsequently results in massive RVF outbreaks affecting residents/pastoralists, livestock and wildlife. Mosquitoes are key vectors to setting off transmission and their distribution among human and livestock settlements and survival is important in sustaining transmission. Finally, the model clearly underscores the notion that health is one measure of environmental adaptation, and that health can be studied through ecological models. Figure 2.2 further shows the conceptual framework as discussed above.

2.5.2 Assumptions to the study

The overarching assumption of this study is that there is an interaction of ecology, livelihoods and Rift Valley Fever. The other assumptions are:

1. Adaptive strategies of pastoralist production system influence occurrence of Rift Valley Fever among communities in Ijara Division.
2. Socio-cultural, economic and political factors influence vulnerability to Rift Valley Fever among communities in Ijara Division.

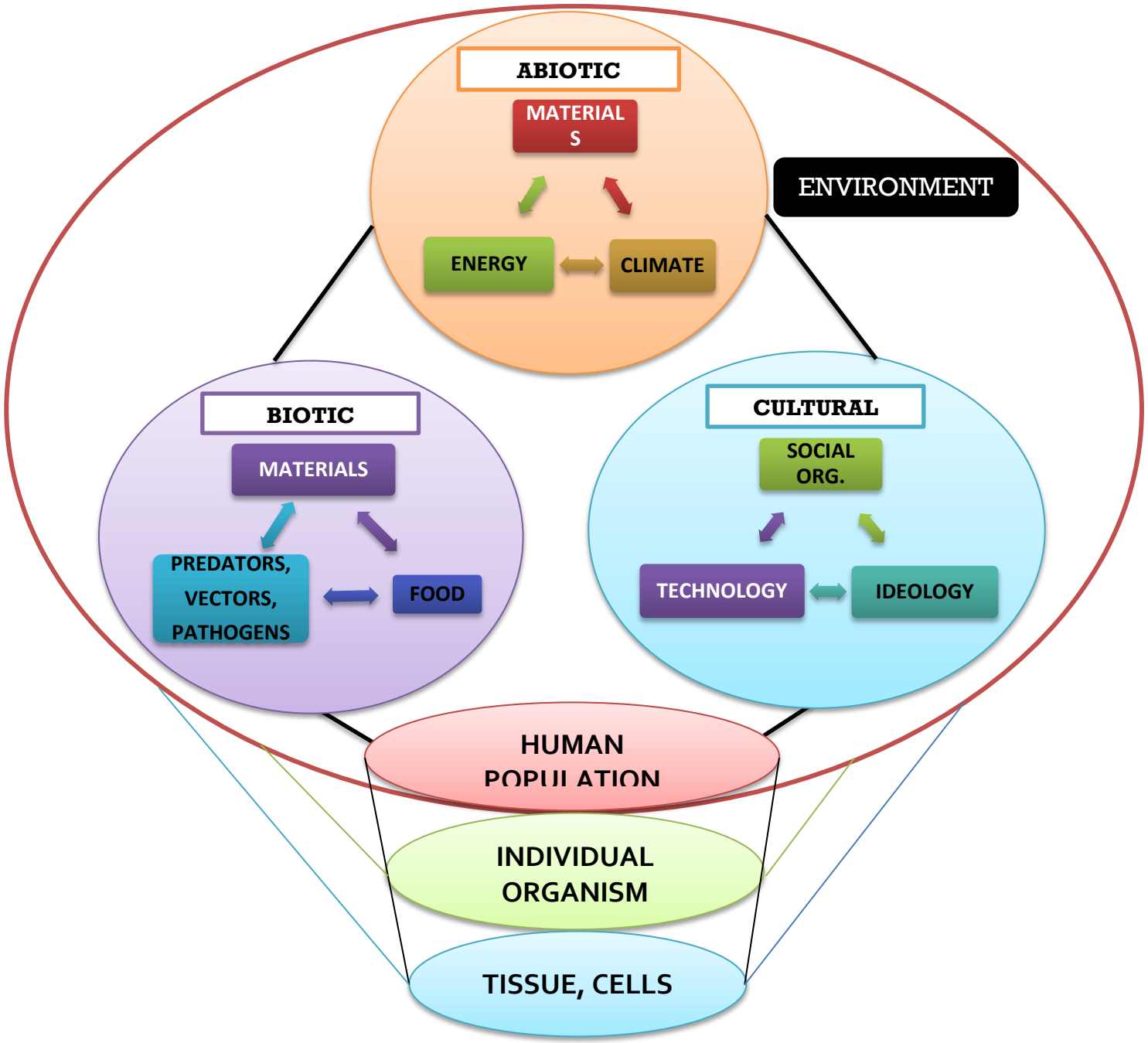


Figure 2.1: Ecology and Health Model by MacElroy and Townsend (2004) illustrating that the environment that affects human health is made up of physical, biological and cultural components forming a total ecosystem

3. Indigenous knowledge base pertaining to Rift Valley Fever has implications for public health delivery approaches in Ijara Division.

2.5.3. Definition of key terms

Adaptive strategies: In this study these refer to mechanisms and practices employed by the pastoralists to derive their livelihoods and adapt to the environment. These include pastoralism with its attendant features such as mobility of herders and herds, large herd production, herd separation, herd dispersion, mobility into the forest etc.

Ecology: In this study ecology refers to a system or a group formed by interaction of a community of organisms with their environment

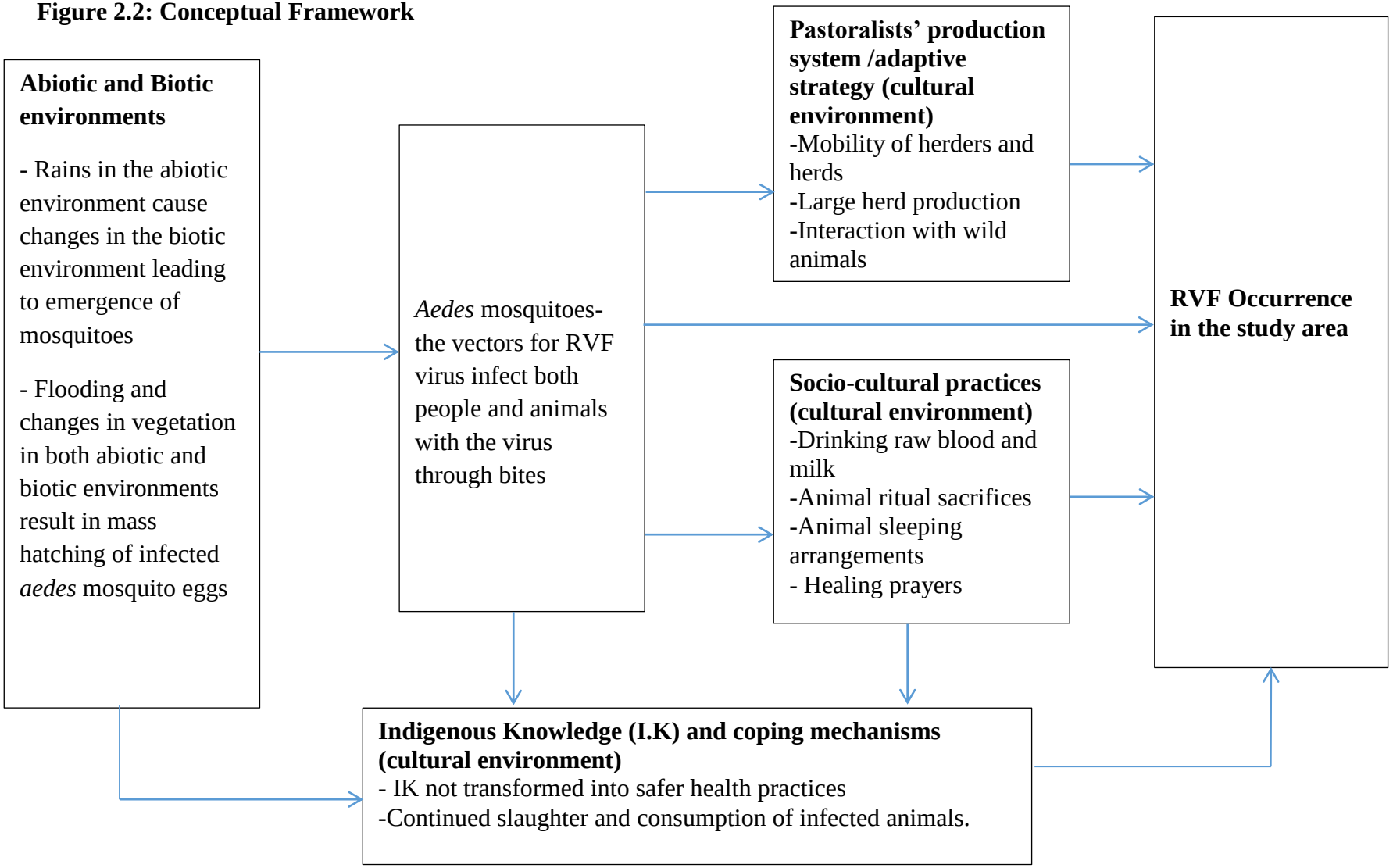
Ecosystem: According to this study, this means a biological community of interacting organisms and their physical environment

Indigenous Knowledge: In this study, this term refers to local peoples' knowledge related to pastoralism that is passed from one generation to another to help in adaptation to their environment.

Socio-cultural, economic and political factors: These include factors that influence RVF occurrence such as livestock ritual sacrifices, healing prayer meetings, animal sleeping arrangements, gender roles, Government resource base available for deployment to RVF detection, prevention and control, state of infrastructure of the study site, government decision-making processes during RVF epidemics and the economic impacts of RVF

Zoonotic diseases: Refer to diseases that affect both humans and animals

Figure 2.2: Conceptual Framework



CHAPTER THREE

METHODOLOGY

3.1. Introduction

This chapter describes the study site, study design, study population and the unit of analysis. It also presents the ethnography of Somali people by describing their origin and socio-cultural and economic lives among others. Sampling methods, sample population and methods of data collection and analysis are also presented in this chapter. Finally, ethical issues that were considered in the study as well as problems encountered and how they were resolved have also been captured in this chapter.

3.2 Study Site

3.2.1 Location

This research study was carried out in Gedilum sub-location in Ijara Division, Garissa County in the North Eastern part of Kenya (Figure 3.1). Ijara district was one of the major hotspot areas in North Eastern Kenya during the last outbreak of RVF in 2006/07 and this informed selection of Ijara division as the study site. Ijara district is also one of the seven districts that form N.E. Province and was curved out of Garissa in the year 2000. The district borders Fafi district to the North, Lamu district to the South, Tana Delta district to the South West, Tana River to the West and Republic of Somalia to the East. Ijara is also one of the four constituencies forming Garissa County. The others are Fafi, Dujis and Lagdera. The district lies approximately 1^0 7' S and 2^0 3 S and longitude approximately 40^0 4 E and 41^0 32'E (MDNKAL, 2010). It covers an area of 10,000 km^2 and is made up of seven divisions namely Ijara, Masalani, Shangailu, Hulugho, Kotile, Ruqa

and Bodhai. Out of the seven divisions, the study was conducted in Ijara division. The area is semi-arid located between Tana River and the boundary to Somalia.

3.2.2. Topography

Ijara District neighbours Garissa and as is characteristic of the entire County, the topography is plain from Garissa as it descends to the coastline. It is also dominated with river valleys and low lying elevations. This is a semi-arid region classified as zone V with an altitude ranging from 0 meters to 90 meters above sea level. The vegetation comprises savannah shrubs and acacia trees.

3.2.3. Climate

Ijara experiences two rainy seasons annually. Between March and April it records long rains with short rains coming between October and December. In terms of moisture, annual rainfall averages between 300mm and 500mm (Jost *et al*., 2010) although there are annual variations. The pattern of rainfall is not reliable and the region experiences occasional heavy downpours resulting in massive flooding of the valleys and open land. Being a semi-arid zone, it is hot with temperatures of between 20 and 38 degrees centigrade.

3.2.4. Population and Livelihood

Garissa County where Ijara falls covers 44,175 km sq. with a population of 623,060 out of which about 93,000 live in Ijara district. Approximately 11474 live in Ijara Division alone-the site of the study (KNBS, 2010). Over 90 percent of the inhabitants are Somalis who are dependent on cattle keeping as their chief source of livelihood (Woods *et al*., 2002). A majority of the

population live in the rural rangelands where nomadic herdsmen practice pastoralism although there are a few sedentary people living in the nearby small town centres.

Figure 3.1: Map Showing Ijara Division-Study Site

When the government declared cattle trade and movement as illegal in 2006/7 during the last RVF outbreak, serious economic losses of close to US $ 10 million were reported (Murithi *et al*. 2010). Notable challenges to pastoralist production system today include diseases, dilapidated infrastructure, pests and environmental stresses. Cattle rearing therefore make the best economic use of the land due to the prevailing ecological conditions, low population density and availability of rangelands.

3.2.5 The Ethnography of the Somali People

3.2.5.1 The origins, migration and settlement of the Somali people

Evidence today seems clear that the ancestral homeland of the Somalis together with affiliated Cushitic peoples was in the highlands of Southern Ethiopia, specifically in the Lake regions (Wikipedia.org/wiki/Somalis in Kenya -accessed May 18, 2013). According to modern linguists, the Somalis belong to a wide family of peoples called the Eastern Cushites although they were described earlier in some instances as Hamites (Wikipedia.org/wiki/Somalis in Kenya -accessed May 18, 2013). The Cushitic family belongs a broader linguistic group known as Afro-Asiatic which in turn includes Cushitic, the Hausa language of Nigeria and the Semitic languages of Arabic, Hebrew and Amharic.

The Somalis together with the Oromo and the largely nomadic Afar (Damakil) form the Cushitic group. In Kenya, the Cushites include the Rendile of Kenya and the Aweera (Boni) along the Lamu coast of Kenya. The Somalis are members of a sub-branch of the Cushites called the Omo-Tana group whose languages are mutually intelligible. The Omo-Tana group may have settled on the Omo and Tana rivers, in an area from Lake Turkana in the present day northern Kenya to the Indian Ocean coast (Wikipedia.org/wiki/Somalis in Kenya -accessed May 18, 2013).

Further down the lineage tree, the Somalis form a sub-group of the Omo-Tana called *Sam* (Wikipedia.org/wiki/Somalis in Kenya -accessed May 18, 2013). The Proto-sam may have spread to the rangelands of northern Kenya, where they seem to have followed Tana River and to have reached the Indian Ocean Coast well before the first century A.D. On the coast, the proto-sam splintered further, one group (the Boni) remained on the Lamu Archipelago, and the other

moved northward to populate Southern Somalia. Members of the proto-sam who came to occupy the Somali peninsula were known as the *Samaele* or *Somaal*, a clear reference to the mythical father figure of the main Somali clan families, whose name gave rise to the term *Somali.*

Kenyan Somali's population is slightly above 2 million people. They are also the fifth largest community in Kenya and the largest tribe among all of Kenya's Cushitic tribes. Other Cushitic tribes in Kenya include the Borana, Rendile, Gabbra and the Galla tribes (Wikipedia.org/wiki/Somalis in Kenya -accessed May 18, 2013).

3.2.5.2. Culture, Religion and Food of the Somalis

The Somali people are Muslims and many Somali customs are derived from this religion. Islam influence is manifested in the Somali way of dressing, which is very similar to that of the Swahili people. However, unlike Swahili men who wear a small white cap on their heads, the Somali men often wear a turban.

Polygyny is widely practiced among the Somalis as legitimized by the Islam laws that allow a man to have as many as four wives. The women's role revolves around the home taking care of their homes and their husbands, while men watch over the livestock in the rangelands. The Somalis of North Eastern province of Kenya are nomadic pastoralists who keep herds of camels, sheep, indigenous cattle, and goats. According to Jost *et al*. (2010), livestock play an important role in Somali life as they provide meat, milk, ghee and fat. Milk and meat form a big part of Somali diet. In addition, raw milk constitutes a bigger proportion of the food. Another Somali delicacy is *Pasta* which they adopted from the Italians as a result of acculturation in the colonial era. Livestock play an important role in Somali culture as they are used for sacrificial

ceremonies, food and exchange with other species to diversify the composition of the herd (Gulliver, 1972). Other benefits for keeping livestock include income from sales of fattened animals, transport for camels, and gifts and payment of bride price.

In recent times, many Somalis who are unable to operate pastoralist production system or who have been pulled by urbanization reside in other major towns in Kenya where they run businesses.

3.2.6. Health Facilities

There are health facilities serving the population of Garissa County although due to the vastness of the county, most inhabitants have to walk long distances to access healthcare. There are about 31 institutions comprising one district hospital, four health centres, seventeen dispensaries and nine private clinics serving the people (County Integrated Development Plan, 2014). Inadequate equipment, drugs and personnel are perennial challenges in this dry region compromising quality health provision.

3.3 Research Design

The study design was cross-sectional and descriptive combining quantitative and qualitative methods of data collection. Field work was conducted in two phases; the first phase involved survey research for quantitative data. This obtained baseline and quantifiable information on the demographics of the pastoralists. Survey data was also obtained on the pastoralists' production system, socio-cultural drivers of RVF and indigenous knowledge base on zoonotic disease. The second phase involved qualitative interviews using ethnographic methods to generate in-depth

data on the interaction of ecology, livelihood and Rift Valley Fever disease. All the study instruments were piloted and pretested outside the study site before actual data collection.

3.4. Study Population and Unit of Analysis

The study population included various categories of people in Ijara division. These were the herd owners, herders, women, health and veterinary officers working for both government and Non-Governmental Organizations (NGOs), local administrators, livestock officers and social development officers. The unit of analysis was the individual herd owner.

3.5 Sample Population and Sampling Procedure

The research team with the assistance of local administration identified a community central point within Gedilun sub-location in Ijara Division. The team then took the coordinates of the central point (S 01^0 22.832' E 040^0 42.201 E 117) and mapped out enumeration area within 2 KM radius from the central point. The geographic reference system ensured efficiency in getting respondents who are mobile pastoralists since the sample frame was unknown. It also gave each potential interviewee within the radius an equal chance of being interviewed. Convenience sampling strategy was then employed to identify two hundred and four (204) herd owners within the mapped radius.

The sample size was calculated based on the levels of precision, confidence and variability using Cochran (1963: 75) formula as follows:

$$n_o = \frac{z^2pq}{e^2}$$

Where:

n = the desired sample size (when the population is greater than 10,000)

z = the standard normal deviate, usually set at 1.96 (or more simply at 2.0), which corresponds to the 95 percent confidence level.

P = the proportion in the target population estimated to have a particular characteristic. If there is no reasonable estimate, then use 50 percent (.50)

q = 1.0 –p

e = degree of accuracy desired, usually set at .05

$$n = \frac{(1.96)^2 (.50) (.50)}{(.05)^2}$$

= 385 herd owners

However, the population under study is migratory posing challenges of finding a large number of samples of the magnitude of 385 within the duration of the field work. To address this, the precision/accuracy level was stretched from ± 5% (the standard) to ±7% and a manageable sample derived as follows using Yamane (1967:886) formula[1]:

$$n = \frac{N}{1+N(e)^2}$$

[1] Yamane (1967:886) provides a simplified formula to calculate sample sizes. The formula has also been used to generate Published Sample Tables (PST)which provide the sample sizes necessary for given combinations of precision, confidence levels and variability. A Published Table (Yamane 1967) for Sample Size for ± 3%, ± 5%, ± 7%, and ± 10% Precision Levels where Confidence Level is 95% and P=.5 was also used to get the sample size of 200 for this study.

Where:

n = Sample size

N = Population size

e = Level of precision

$$n = \frac{10000}{1 + 10000\ (0.07)^2} = \textbf{200 herd owners}$$

Although the sample size according to the above formula is 200, the researcher managed to sample 204 herd owners for survey.

3.6 Methods of Data Collection

3.6.1 Survey Technique

A standardized questionnaire (see Appendix 1) was administered to 204 herd owners who were randomly sampled within a radius of 2 KM from the community central point within Gedilun sub-location. The researcher used local data collectors and community leaders to facilitate identification of the herd owners. The instrument was translated into Somali language for ease of interview and responses translated and recorded in English. Baseline data that lend themselves to quantitative analysis were collected using this method. These included, demographics of herd owners, educational level, income, number and types of herds kept, livestock diseases prevalent in the community, level of knowledge on RVF, socio-economic, cultural and political factors of RVF and access and provision of human and veterinary health services in the division To allow for probing, precision and efficiency, both open and closed ended questions were used. This

method was found useful as it was flexible allowing administration of the tool at any place and time.

3.6.2 Key Informant Interviews (KIIs)

People who were knowledgeable in the livelihoods of pastoralists and Rift Valley Fever were the target of this method. An interview guide (see Appendix 2) was used to collect data from the Key Informants. Purposively sampled based on their expert knowledge, these interviewees comprised the health and veterinary officials from government and NGOs, local administration officials, social development officers, district development officers and local authority officials. Others were herd owners and people who suffered from Rift Valley Fever outbreak in 2006/7. A total of 15 key informants were purposively selected for interviews in the division. They gave valuable information on risk factors associated with RVF, local peoples' perception of RVF, Early Warning System (EWS), the impacts of RVF, adaptive and coping mechanisms, prevention and control measures as well as the challenges experienced in mitigating the epizootic disease.

3.6.3 Narrative Method

This method provided an account of people's experience with RVF. As such, people who suffered from the disease, had their livestock suffer from the disease or those who took care of RVF patients in the previous outbreak of 2006/7 were purposively sampled for interviews using this method (see narrative guide in appendix 2). The key informants mainly the local administration and health officials were contacted for identification of narrative interviewees. They brought out their life experiences with the disease to help the researcher glean into the

insights on RVF care practices, perceptions, access to health services, delivery of health services at the human and veterinary health facilities and coping mechanisms during epidemics. The stories were told in the local Somali language and local interpreters were used to translate the information in English. A total of 5 narratives were collected by this method.

3.6.4 Focus Group Discussions (FGDs)

This method was used to provide qualitative data to contextualize ecology, livelihood and RVF issues within the pastoralist community. FGD guide (see appendix 3) was used to facilitate the discussions. Forty eight (48) FGD participants who were herd owners and who did not participate in the survey were purposively sampled for discussions. This method was useful in providing in-depth information in an open and normal discussion setting thereby helping to clarify and contextualize some issues that were not adequately captured by the other methods. The themes discussed included pastoralist production system, causes of movements to different ecosystems, indigenous knowledge base on RVF, socio-economic and cultural factors of RVF, RVF prevention and control measures and access and provision of veterinary and human health care. A total of 4 FGDs (each comprising 12 participants) were conducted in the division (two with women and two with men). The local leaders and data collectors helped in identifying the FGD participants. Homogeneity of FGDs was observed by conducting women FGDs separately from those of men.

3.6.5. Secondary Data Review

Secondary data was reviewed throughout the study period to both provide background to the study and support findings obtained from field work. Sources of literature included journal publications, books, newspaper reports and unpublished reports from conferences and government offices.

3.7. Data Management and Analysis

Data management was a continuous process in the study. Data from different sources were reviewed, summarized, cleaned and stored in flash disks and compact disks. Printed hard copy materials were filed appropriately for continuous reference during the study. In terms of data analysis, qualitative data was analyzed by grouping the responses according to emerging themes in every study objective. These themes together with supporting quotations and comments were recorded in MS Word and further subjected to deeper review to reveal how they related with the study objectives and how they answered the research questions. Direct quotes and comments from the interviewees in the field helped in understanding the world view of the pastoralists, their real life experiences and emic perspectives particularly with regard to Rift Valley Fever. On the other hand, Statistical Package for Social Science (SPSS) version 20 was used to analyze statistical data. Descriptive analysis method was employed to perform statistical analysis and this yielded descriptive statistics mainly percentages, averages and frequencies of the measured variables. Data from different sources were triangulated to show the extent to which they related to one another in explaining the empirical world of the pastoralists.

3.8. Ethical Considerations

In line with research practice, confidentiality and privacy of study data was maintained by ensuring that the names of respondents and information provided is not shared with other people. Informed consent of the respondents was sought prior to data collection. Consent was also sought for direct quotations from informants to be used in the study reports, thesis and publications. Where informants were reluctant to allow the use of their quotations and names in the documents, anonymity was observed. Privacy of study subjects was ensured by conducting interviews in environments that are devoid of public interference so as to ensure privacy and promote freedom of expression. Moreover, study data was highly safeguarded with data stored in lockable drawers where access is only limited to the researcher. Finally, research findings were disseminated to the sponsors of the study-ICIPE and International Development Research Centre (IDRC) and also to the local stakeholders who included the herd owners and government officials. Two dissemination workshops were held for partners and stakeholders supported under the auspices-ICIPE/IDRC where the researcher made presentations on the study findings. Feedbacks from the participants were used to further shape the findings. Furthermore, one article from the study has been published in referred international journal as a way of disseminating study findings (see attached article).

3.9. Problems encountered and how they were resolved

Because of the mobility of herd owners, interviews were scheduled in the morning hours before they could move from the homesteads. The vast terrain and scattered homesteads made mobilization for FGDs difficult. To counter this, the researcher used local administration to help in passing the information to sampled interviewees to attend meetings at central locations. One

ICIPE staff who has worked in the community for many years and built rapport with the pastoralists and their leaders was also used to mobilize research subjects. Both the local administration and the ICIPE staff also gave the researcher company to the interviews for security reasons as the study site had experienced incidents of Alshabaab attacks prior to the study.

CHAPTER FOUR

PASTORALISM AS A MEANS OF LIVELIHOODS IN DRY LAND ECOSYSTEM AND ITS INFLUENCE ON RVF OCCURRENCE

4.1 Introduction

This chapter presents study findings on pastoralism as an adaptive strategy in dry land ecosystem. It covers an analysis and interpretation of interactions of ecology of the dry land, livelihoods and Rift Valley Fever, organization of pastoralist production, risk aversion strategies and division of labour. The chapter then proceeds to analyze aspects of pastoralist production that have implications on Rift Valley Fever occurrence in Ijara Division before delving into a presentation and analysis of the interaction of ecology, livelihoods and the zoonotic disease. Discussion on the findings in light of available literature and eco-health model has also been done in this chapter.

4.2 Organization of pastoralist production system

The study showed that pastoralist production system is closely intertwined with the cultural system of the pastoralists. Hence to better understand and contextualize the organization of pastoralist production system, a presentation of socio-demographic characteristics of herd owners is made in table 4.1. The table shows that a majority of herd owners in the community were men constituting close to 80% of the respondents. Women herd owners only accounted for 20% of those surveyed, a revelation that points at the patriarchal structure of the Somali society where men are the property owners and resource controllers. About 90% of the herd owners

never attended school and this partly accounts for the pastoralists' beliefs around Rift Valley Fever.

Table 4.1: Socio-demographic characteristics of herd owners:

Gender composition, education level, religion, marital status, age and income

Frequency		**Percent**
Sex		
Male	162	79.4
Female	42	20.6
Total	**204**	**100.0**
Highest Level of Schooling		
Never attended schooling	182	89.2
Did not complete Primary	15	7.4
Others	7	3.4
Total	**204**	**100.0**
Religion		
Muslim	204	100.0
Total	**204**	**100.0**
Marital Status		
Single	11	5.4
Married	170	83.3
Widow/Widower	15	7.4
Others	8	3.9
Total	**204**	**100.0**
Total	**204**	**100.0**

Age		
	18-24	3.9
	25-34	26.4
	35-44	29.4
	45-54	20.1
	55-64	14.2
	Above 65	5.8
Total	**204**	**100.0**

Average Monthly Income		
<5000	26	12.7
5001-10000	84	41.2
10001-15000	60	29.4
15001-20000	24	11.8
20001-50,000	9	4.4
No Answer	1	0.5
Total	**204**	**100.0**

Source: Survey March/April 2014

Slightly over half of the respondents (55.9%) were aged between 25 and 44 years old out of which 30% and 26% belonged to the age cohorts of 35-44 and 25-34 respectively. The two cohorts therefore comprised both the youthful and middle-aged herd owners. The elderly aged 45 and above constituted 40% of the herd owners. The youthful herd owners may have acquired the livestock through exchange for their labour for livestock as revealed in the quotation below:

> *In this community, a majority of the youths are employed as mobile herders by the elderly and well off herd owners. In return for labour, one is given a bull after three months of*

moving with the herds. (Source: A male key informant aged 24 and employed as a herder).

The young herd owners may have also been bequeathed with the animals from their older parents as is the practice in this patriarchal community. Because pastoralism is the main economic activity in Somali community, the youth who are employed as herders may start accumulating wealth at an early stage.

About 83% of the respondents (herd owners) were also heads of households. Of these, 79% were male further pointing to the patriarchal structure of Somali community. As male herd owners, they have the authority to make decisions on matters about the herd including the health of animals. Male herd owners are particularly responsible for treating the animals whenever they fall sick among other gender roles. This implies that targeting both herd owners and the youthful herders remains relevant for success of any public and veterinary health interventions especially during RVF outbreak. The occupation of moving with the herds exposes the youths to higher vulnerability to RVF during mobility in search of water and pasture.

All the herd owners surveyed relied on pastoralism as their main source of livelihood. Average herd size was about 50 animals. Large herd production is considered both as a better coping mechanism and economic practice in the dry land ecosystem (Muga *et al.,* 2015). In terms of monthly income, close to one half (46%) of herd owners earned over Ksh 10,000 (US$100) per month from livestock rearing, a finding that underscores the pivotal role played by livestock in the lives of the pastoralists. The income includes proceeds from milk and cattle sales and other animal products. Income from animal production is supplemented by business which accounted for 77% of other sources of income for pastoralists who had diversified their livelihoods.

4.2.1. Animal production

Survey data showed that 93% of herd owners considered livestock rearing as a sustainable and viable livelihood activity within the locality. The fact that the area is semi-arid with little annual rainfall to support any meaningful farming could be the main reason this response. Observation and FGD data affirmed that the Somali pastoralists keep a diversity of livestock species for a number of benefits. The economic and social benefits derived from the different species are varied as shown in table 4.2 below.

Table 4.2: Benefits of livestock species

Livestock species	Economic, socio-cultural and therapeutic benefits
Sheep	• Incomes from sales used to pay school fees for children • Slaughtered during Muslim celebrations such as *Eid Al Fitr, Eid Al Adha* etc • Fat drained from mutton is given to a mother who has given birth to clean the womb. It also used to treat gastro-intestinal conditions such as ulcers • Source of food (mutton) • Milk
Goats	• Source of food • Source of income (from sales) • Blood from goat used to wash and treat children suffering from yellow fever • Goat's skin used to cover a sick child for healing purposes • Hides and skins sold for income • Slaughtered during important cultural rituals such as weddings • Used to pay dowry
Cattle	• Used to pay dowry • Income from sales • Source of food (meat) • Milk • Ghee • Used to pay fines for settling disputes • Used as *"Zaka"*-tithe. Two heads of cattle are given out as tithe for every 100 heads of cattle owned.
Donkey	• Used for transportation

Source: Qualitative interviews March/April 2014

4.2.2 Strategic cyclical mobility and knowledge management

A major adaptive strategy of the pastoralists in the changing ecological conditions is the cyclical movement of cattle in search of pasture and water. Information from key informants and FGDs revealed a carefully planned and well informed annual pattern of cattle movement throughout the year.

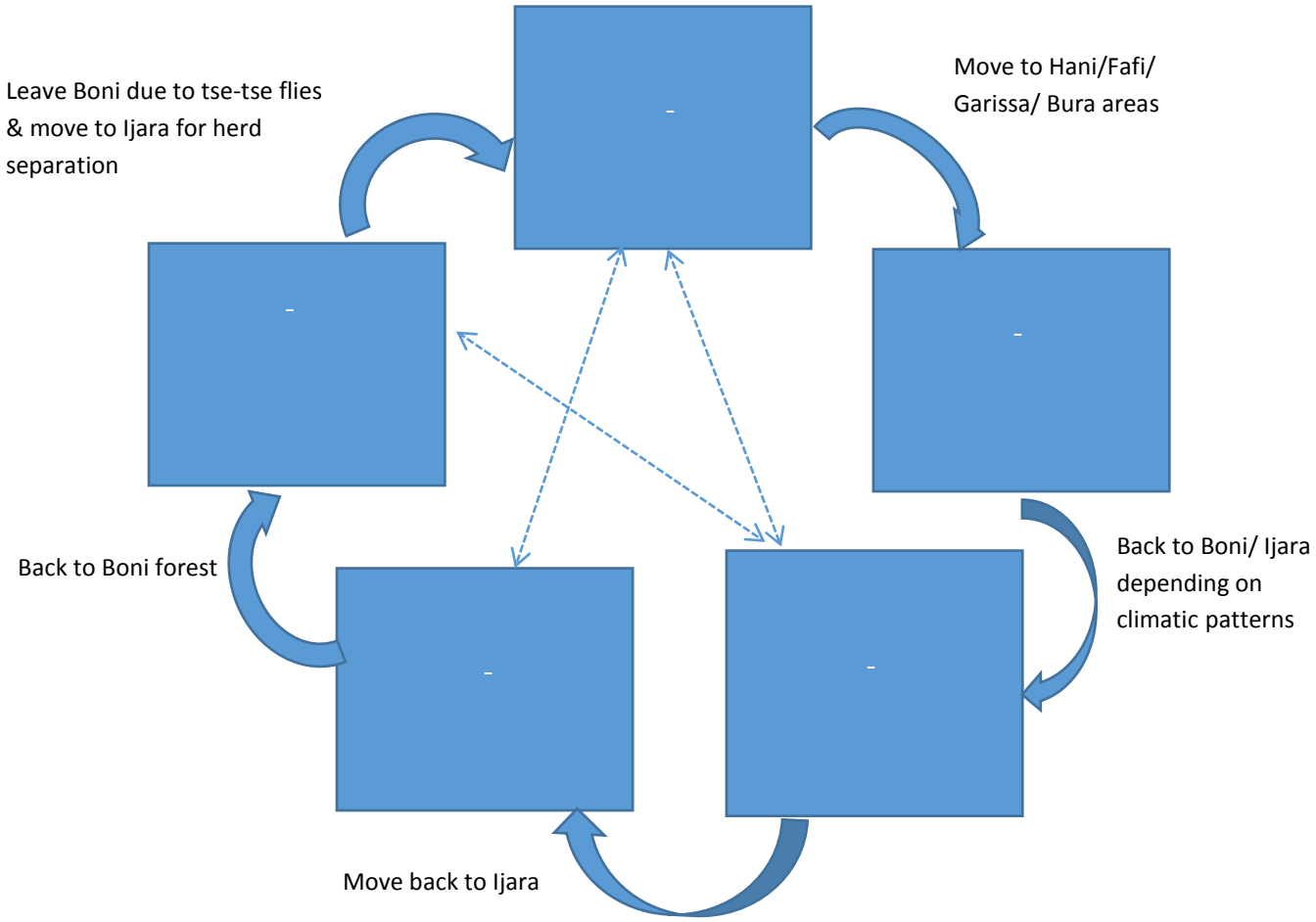
> *"During dry periods which starts in January to March, livestock is moved to the Boni forest (between Lamu and Ijara), Mangai, Milimani and Kyunga. When the rains start in April, they leave the forest because of tsetse and come down to Garissa, Bura, Fafi. They go closer to Garissa town purposely to sell the livestock that have fattened in Garissa market. A bull of 6 years with an average weight of 350 kgs fetches about Kshs 50,000. The herders graze around Garissa, Fafi, Bura from April to around June. From July to August, they come closer home in Ijara and Hulugho. During this period, there is no water in Garissa, Bura and Fafi so they come closer home for water. From September to Mid-December they go back to Boni forest. During the movements, the herders gather and exchange information through mobile phones. They also monitor the sky and when they see lightning, they are able to judge where the rain is. From mid-December to early January, they come to Ijara and Hulugho to separate the herd. They leave the calves and lactating animals in the Manyattas so as to provide milk to the family members. They also come for treatment and vaccination against diseases. The goats remain behind in the manyatta as they are more vulnerable to tsetse. Cattle and sheep are moved to Boni forest because they can withstand tsetse bites. They can be treated and survive. Goats adapt to dry environment by eating twigs found around the manyattas. The herd owner and his wife look after the goats and the young animals. The satellite herd (moving herd) is looked after by a herder who is paid an average of Kshs 20,000 after 6 months or given a bull of 3 years. The herd owner monitors the satellite herd, their movement and security using mobile phones".* (Source: A male key informant aged 58 in Shangailu Village).

The flow chart in Figure 4.1 shows the cyclical mobility.

It is clear from the above data that the pastoralists not only make strategic decisions on mobility based on shared knowledge management on availability of pasture and water but also disease and vector prevalence such as RVF and tsetse respectively. Hence cyclical mobility of the herders and their herds has implications on RVF occurrence and control. With continuous surveillance

for early detection of RVF, effective early warning system and robust information dissemination to the pastoralists, areas that have RVF outbreak may be avoided.

Figure 4.1: Cyclical mobility pattern of the Somali pastoralists



However, the fact that the movement pattern takes the herders to other ecological zones exposes the animals and herders to RVFV. Tempia (2010) also affirmed this finding when he reported that as the human population expands with corresponding increase in livestock ownership, range land resources begin to dwindle and this leads to encroachment into wildlife territories. The herders together with their livestock may then get caught up in the infection web involving wild

animals and mosquitoes. Furthermore, research has found some RVFV antibodies in wild animals, a fact that could mean that the wild animals may act as a repository for the RVFV during inter-epidemics and may scale up the virus during epizootic periods (Evans *et al.* 2008). Aagaard-Hansen *et al*., (2010) similarly documented that nomadic pastoralists are more vulnerable to diseases than sedentary people mainly because of their mobility even though Sheikh-Mohammed and Velema (1999) argued that this movement could also help them to evade some diseases. For years, cattle movement is a characteristic necessity for pastoralist production system as it ensures sustainable utilization of land resources. The highly organized movement takes two forms; daily and seasonal mobility. In daily mobility, the herder carefully selects the direction that leads him to fresh pastures. This mobility involves the small stocks and is kept within a radius of 5km from the settlement (Reckers, 1997). Seasonal migration spans several kilometers away from the residence and takes a longer duration. The youthful herders continuously monitor the environment and drive their herds to new locations with good pastures.

All the animals are moved during seasonal movement apart from the lactating cows that remain in the settlements to provide the household members with milk. The pastoralists also practice shifting of households as another form of movement (Reckers 1997). In this movement, the entire household changes locale for periods spanning over five years. This study argues that transmission and spread of RVF can occur if information on the areas affected by an outbreak is not availed to the pastoralists in good time so as to avoid such spots by moving their livestock to safer regions. Because of late detection during 2006/7 outbreak, it was observed that the disease had entrenched itself in livestock before authorities could mount the needed interventions (Jost *et al.,* 2010).

Furthermore, mobility of the herd has potential to expose the herder and the livestock to RVF since during the migration, the youthful herders almost solely depend on the raw milk and blood from the animals. Since the pasture zones are located away from conventional health care centres, timely detection and response to RVF is highly compromised. This exposes the herders and livestock to high risk of RVF infection especially if they continue to feed on the uninspected animal products.

4.2.3. Risk aversion strategies and RVF epidemiology

Pastoralists have over the time developed a diversity of mechanisms to minimize the risk of losing their herd to drought and diseases. The survey showed that the main risk mitigation mechanisms used against RVF include: vaccination of animals (87.3%), herds' dispersion (39.7%), herds division (39.2%) and herds' diversification (30.4%). These risk aversion strategies have implications on the pastoralists' exposure to RVFV infection and RVF control. Scholars such as Keya (2002) and Evers (1994) have also identified similar pastoral risk aversion strategies. These mechanisms may both prevent and expose pastoralists to risks associated with RVFV as explained under.

4.2.3.1 Herds' division/separation

Herd division/separation is a popular risk minimization mechanism employed by the cattle keepers in the unstable rangeland environments. The survey data indicated that 39.2% of the respondents adopted herd division as a risk mitigation mechanism against RVF. In this strategy, the pastoralists separate their livestock into smaller groups and drive them to different pasture locations. This strategy may help evade RVF infection in livestock during epidemic especially if

information on impending outbreak is passed to the pastoralists in good time. It is not clear from the evidence available whether this strategy of herd division has been integrated in public health education on RVF control.

4.2.3.2 Herd dispersion among pastoralists' social networks

Close to 40% of survey respondents said they practice herd dispersion to minimize risks associated with RVF. Hence it is disease-induced strategy that also reduces livestock size. This practice known as *"Jilli" or "Erman"* by the local community is whereby herds are regularly exchanged between herders within one's social networks to evade death of all the animals. This finding supports that of Gulliver (1972) who similarly reported that herd dispersion is an effective strategy of spreading the risks of epidemics.

Findings of this study confirmed that using distant networks minimizes risks of infection since areas are impacted differently by epidemics. This is captured in the quotation below from a key informant who stated that Shangailu was the most affected area in the entire district during the last RVF outbreak in 2006/7.

> *"2006/7 response was late. I came with the equipment one month late. We distribuited 3 nets per household in the whole district. Hospital staff initially were not prepared but later the tested patients were isolated. MSF erected tents in the hospital. The worst hit district was Shangailu".* (Source: A Male Public Health Officer in Masalani aged 44).

The pastoralists sustain dispersion strategy by invoking their established social networks in which cattle exchange is undertaken among acquaintances who have interest in a similar species of herd (Gulliver 1972; Reckers 1997). Kratli (2013) also observed that although strategic

mobility offers the highest returns, it requires relatively large herds and extensive social capital to be economically useful. This explains why livestock in poor households with narrow social capital is moved much less, both in frequency and intensity. In this respect, the dispersion of animals to networks in different places may save some animals from RVF infection as areas are affected differently.

4.2.3.3 Large herd production/herd diversification

The study has shown that the Somali pastoralists practice large herd production since 64.6% of the herd owners had herd sizes of >50 comprising different species of livestock (cattle, goats and sheep). Thirty percent (30%) of the respondents in the study further expressed that they adopt herd diversification to mitigate the risks of RVF. Herd diversification refers to keeping different species of livestock to increase chances of survival in the event of epidemics. The reason is each livestock species has different tolerance and immunity levels when faced with environmental shocks like disease epidemics hence the herd owner may be left with some animals. This rational decision by the pastoralists explains the common observation in the range lands where as one moves to more arid zones, the cattle keepers are found with bigger herd sizes (Reckers 1997). Moreover, herd diversification has other advantages such as securing ecological balance and food security for the household members. It makes optimum use of land, provides a variety food from the animal products and lowers competition for pastures among the animals.

Kratli *et al.,* (2013) similarly notes that when herds are too small for specialized pastoralism, the concern of households is limited to short-term benefits as opposed to long term investments (e.g. selling male animals before they reach maturity for the best market price). Owange *et al* (2014)

found in their study that keeping a large number of cattle was one of the perceived RVF risk factors in Ijara division. But the difference in livestock's vulnerability to RVF (Jost *et al.,* 2010) implies that keeping different species of animals may provide a safeguard against diseases and the herd owner may still be left with some animals during an epidemic. This evidence means that including herd diversification in public health education on RVF may help in the control and management of the zoonotic disease.

4.2.3.4 Animal treatment vaccination

This study found that pastoralists' rely on regular vaccination as a coping mechanism in dry land ecosystem. This is underscored by the following quotation:

> *"From mid-December to early January, they (*herders and their herd) *come to Ijara and Hulugho to separate the herd. They leave the calves and lactating animals in the Manyattas so as to provide milk to the family members. They also come for treatment and vaccination against diseases*". (Source: A male Community Animal Health Worker who is also a herd owner based in Shangailu and aged 46).

Eighty seven percent (87.3%) of herd owners surveyed said they regularly took their animals for vaccination to mitigate the risks of RVF among other diseases within their ecosystem. As seen in the quotation above, mobility of the herd is carefully planned such that after visiting disease prone areas, the herders bring back the animals to the villages/*manyattas* where veterinary services are available primarily for treatment and vaccination before they continue with the cyclical movement pattern. It is therefore apparent that this practice has a positive bearing on RVF control.

4.3. Division of labour in pastoralist production

Qualitative data with key informants and FGD participants showed a well organized labour division pattern among the Somali pastoralists. Quotation below illustrates this point:

> *"Women take care of sheep and goats while men look after cattle. When children are in school, the herd owners hire herds men a majority of whom are the youth to look after the animals. A herder is paid about Kshs 15000 or given a bull every 6 months for looking after the cattle and Kshs 1000 per month for the small stocks.*
>
> *Sheep and goats remain in the manyattas while cattle are moved away in search of water and pasture. Older men also look after the small animals especially when their herdsmen are away with the cattle.*
>
> *Women clean the compound, prepare food, milk the goats, sheep and cows and fetch water for the young calves. They also treat sick animals when the man is away with the herds.*
>
> *Children look after sheep and goats during non-schooling days. Herdsmen are fully responsible for the herd when they are away looking for pasture. They therefore make all decisions regarding movement and health of animals. The herd owner however makes regular contacts with the herdsmen using mobile technology to follow on the wellbeing of his livestock. At the manyatta, the man is the overall authority on issues to do with livestock. (*Source: A male key informant who works for the Ministry of Livestock as Animal Health Assistant based at Masalani).

The above finding partly confirms a study by Bruggeman (1994) who similarly reported that in Chad and Uganda, women are also responsible for the health of their animals. They gather and mix herbs for treating the animals and even men borrow heavily from their knowledge on ethno-veterinary medicine. It is therefore apparent that labour division in this pastoralist community is based on gender and age. Modern education however has led to social change by withdrawing the labour of children from the household (Muga and Onyango-Ouma, 2009). Most Somali children are currently going to school hence they can only support their parents during non-schooling days. This change has undoubtedly added labour for women and men especially those

who cannot hire external labour which is highly commoditized. The survey data on table 4.3 on selected gender roles also confirmed this observation.

It is instructive to note that under "Other", women assume more roles than men since 34% of the respondents said that they performed other duties (separate from the ones presented) as opposed to 7.2% for men. Qualitative data from FGDs and key informants revealed that the "other" roles for women included removing ticks and thorns from the animals, disposal of animal wastes from the sheds, attending to sick animal, fetching water for the young calves, construction of shelter and animal sheds and processing milk. It is therefore evident that women assume more roles than men in livestock rearing but men command overall authority over the herd, a fact that could be attributed to the patriarchal nature of Somali community.

The findings indicated that gender roles, among other factors, were closely associated with vulnerability to RVF. Herders, who are mainly young and youthful men tasked with the responsibility of moving with cattle in search of pasture and water were perceived by respondents (84.3%) to be more vulnerable to RVF.

Table 4.3: Gender role matrix in pastoralist production (N=100)

Gender Roles	% Response for Men	% Response for Women	% Response for Children
Moving with animals in search of pastures and water	33.2	0.6	26.6
Treating livestock when sick	31.4	1.5	1.1
Providing security for the animals	27.0	2.1	1.7
Milking	0.8	60.8	39.3
Other* (See below paragraph)	7.2	34.7	28.1
No Answer	0.2	-	3.2
Do not Know	0.2	0.3	-
Total	100	100	100

Source: Survey March/ April 2014

The herders were perceived to be most vulnerable to RVF due to the following reasons: the herders interact closely and regularly with animals as they look for pasture and water, they get exposed when slaughtering animals, they handle lactating animals while out in the rangelands, and they together with their herds interact with wild animals in the forest during their cyclical movement thereby multiplying transmission from the wild. While it is evident that women assume more roles than men in livestock rearing, the findings suggest that men become more susceptible to RVF than women. The roles of men predispose them more to RVF infection than women although a finding by LaBeaud *et al.,* (2008) deduced that the high infection rate among men may be traceable to physiological factors. Hence the findings of this study support those of

LaBead *et al.,* (2008); Aargaard Hansen *et al*. (2010); Sheikh-Mohammed and Velema (1999) and Wood *etal* (2002) who have attempted to unravel the grey area between disease occurrence and the sex of the victim. However, they also contradict those of other scholars like Dahl (1987) and Jokes and Pointing (1991) who also conducted similar studies.

According to Jokes and Pointing (1995) for example, women assume management responsibilities for the livestock while men because of mainly patriarchal reasons assume the role of the owner of the animals and therefore wealth. These differential social positions occupied by both gender mean that women may be more exposed to RVFV since their daily chores of milking among others bring them closer to the animals. Women's role in pastoralist production system is therefore varied and burdensome. These responsibilities (milking and processing milk and hides and skins) revolve around handling animal tissues and fluids and may differentially predispose them to RVF more than men. However, a study by LaBead *et al.* (2008) revealed that men are triple likely to get infection than women, a situation also observed in Kenya during the 1997 RVF epidemic (Woods *et al.*, 2002).

Drawing from the findings of this study and putting biological factors aside, vulnerability of men particularly the herders could be understood within the wider context of their role and food preparation and consumption practices. The role of the herders puts them in close proximity to the livestock when they are traversing the rangelands. While out in the fields, the herders depend on the cattle products mainly raw milk and blood which may present a health hazard as it increases their risk of contracting RVF than women and herd owners who remain in the homesteads. A study by Aagaard-Hansen *et al* (2010) affirms this finding when they also

reported that nomads have relatively higher chances of contracting Neglected Tropical Diseases (NTDs) compared to sedentary people. Conversely, Sheikh-Mohammed and Velema (1999) noted the mobility may also make them evade some diseases.

The seemingly differing findings and arguments on the connection between disease outbreak and gender of the infected persons could be pointing at the need to undertake more studies in this area for more evidence so as to inform public health interventions and policy.

4.4. Ecological conditions and Rift Valley Fever occurrence

Observation on ecological conditions of the study site showed that Ijara soils are generally loose, fragile and infertile hence vulnerable to floods and erosions during periodic torrential downpours (see figure 4.2). Sombroek (1982) and Foeken (1994) in their work on agro-ecological/ agro-climatic zonation provide a tool for assessing which areas are climatically suitable for various land use alternatives, with particular emphasis on the suitability for crop cultivation (Foeken, 1994). Ijara division which was the site for this study is categorized as agro-climatic zone V which is semi-arid (Sombroek, 1982). The region receives on average 300-500 mm of rainfall per year although there is high inter-annual variability with short periodic torrential down pours. Soils are loose, shallow and generally infertile, but variable as seen in figure 4.2 below. Field observations further revealed that there are man-made water pans and natural dambos (low lying grassland depressions) which serve the community as water points after collecting water during periodic rains (see figures 4.3 and 4.4).

Figure 4.2 Photograph showing loose fragile soil type and land cover of Ijara

As shown in the figures 4.3 and 4.4, the flat topography, fragile alluvial soil and poor vegetation cover combine with the periodic torrential down pours to cause massive floods in the flood plains, natural dambos and man-made water pans offering a good breeding medium/habitat for *aedes* mosquitoes-the vector for RVF virus. During Elnino events characterized by unusual heavy rainfall, floods and mosquitoes that emerge facilitate the transmission and spread of RVFV among the pastoralist population leading to RVF epidemic.

Figure 4.3 Livestock, natural dambos, shrubs and soils in Ijara

Figure 4.4 Man- made water pan which acts as mosquito breeding medium during heavy rains

In this interaction of ecology, livelihood and RVF, the relevance of the eco-health model in explaining health and disease conditions is apparent. A change in climate in the abiotic environment in this case torrential rains and massive floods leads to a change in the biotic environment by setting off sudden emergence of swarms of mosquitoes which cause Rift Valley Fever. These findings support those of Davies *et al.* (1985) which similarly found out that outbreaks of RVF in N. E. Kenya (Garissa district) have been associated with unusually heavy rainfall followed by extensive flooding of basins and low lying grassland depressions called dambos triggering a mass emergence of flood water *Aedes* mosquitoes. Owange et *al* (2014) also showed that the perceived entry risk pathways for RVF in Ijara district are infected mosquitoes, infected domestic animals, infected aborted fetuses and fluids and infected wild animals.

This chapter has focused on how pastoralism as an adaptive strategy and a means of livelihood in dry land ecosystem interacts to influence RVF occurrence. It has attempted to answer the overarching research question for this study which was to investigate how ecology interacts with pastoralism as an adaptive strategy and livelihood activity in dry land ecosystem to drive Rift Valley Fever occurrence in Ijara Division, North Eastern Kenya? It has also attempted to answer the research question on what are the adaptive strategies of pastoralist system as a livelihood practice within the changing ecosystems and their influence on Rift Valley Fever in Ijara Division?

The study has strived to achieve the above by covering the strategic cyclical mobility and knowledge management of the pastoralists as well as the ecological conditions of Ijara and how these facilitate the emergence of mosquitoes-the vector for RVFV during heavy rainfall. Disease-related risk aversion strategies and gender roles and vulnerability to RVF have also been covered

in the chapter. It has been argued that the pastoralists diversify livestock production to derive myriad benefits. Large herd production has also been found to mitigate risks associated with diseases such as RVF since different species of livestock have different levels of susceptibility to RVF. It may therefore, be useful to include this finding in public health education. Most importantly, the chapter has argued that although women assume more responsibilities in animal care than men, men are more vulnerable to RVF infection primarily because of their roles that put them in close proximity to the livestock when they are traversing the rangelands. Finally, the findings in this chapter are consistent with Eco-health model that provides the framework for analysis in this study. The chapter has demonstrated that pastoralism is a viable adaptive mechanism in the dry land ecosystem and the organization of pastoralist production interacts with the biotic and abiotic environment to influence occurrence of RVF. Although some aspects of the pastoralist production like cyclical mobility predispose them to RVF, the pastoralists also invoke disease risk-aversion mechanisms like large herd production and herd dispersion to mitigate against RVF occurrence and restore equilibrium and health in the total environment. The next chapter will focus on the socio-cultural and economic drivers of Rift Valley Fever.

CHAPTER FIVE

SOCIO-CULTURAL AND ECONOMIC DIMENSIONS OF RIFT VALLEY FEVER

5.1 Introduction

This chapter describes the socio-cultural and economic dimensions of RVF as revealed by study findings. The socio-cultural dimensions focus on practices that act as drivers of vulnerability to RVF as well as risk pathways. These include food preparation and consumption practices, gender roles, livestock sacrifice rituals, religious practices and beliefs and animal sleeping arrangement among others. The economic dimensions on the other hand detail the role and capacity of the authorities to fulfill their primary mandate of ensuring better health for humans and livestock. Hence the level of resources allocated for RVF control and the challenges encountered by the authorities are assessed. Finally, the impacts of RVF at household and national level are also covered under the economic dimensions. These findings are presented and discussed in light of available literature.

5.2 Socio-cultural dimensions of Rift Valley Fever

5.2.1 Food preparations and consumption practices

The survey data revealed that seventy two percent (72%) of the respondents asserted that Somali socio-cultural practices expose their animals and people to RVF risks. Qualitative interviews mainly FGDs unpacked and contextualized the socio-cultural practices considered to expose the people and livestock to RVF risks. Salient among them were the food preparation and consumption practices such as drinking raw blood and milk. As stated by a Community Animal Health Worker, there are varied perceptions on consumption of raw milk and blood:

> *The people here believe that they are healthier when they drink raw blood. They believe they will not get any disease and that they will be very strong. Even old men believe they will remain strong. For milk, they believe that if they boil the milk they will lose all the nutrients in it.* (Source: A Community Animal Health Worker in Shangailu).

The raw milk and blood are perceived by the cattle keepers to have more proteins and vitamins that give the herders the required energy to move over long distances with the animals. This practice, however, may predispose the young men to RVF should the animal products be infected with RVFV. Owange *et al* (2014) also reported that the entry pathways for RVF in Ijara district as mentioned by the pastoralists were through infected mosquitoes and infected domestic animals. Infected animal fluids and products such as raw milk and blood therefore undoubtedly act as conduit for RVF transmission from animals to human beings.

5.2.2 Livestock sacrifice rituals and RVF transmission

The Muslim pastoralists have a close symbiotic relationship with their livestock. As such livestock is central in their lives and plays a big role in ritual celebrations. The following quote underscores this finding:

> *We Muslims have so many celebrations during which time we slaughter animals to celebrate as we mark the occasions. The main one is Eid Al Adha. This is celebrated during the pilgrimage when the people access the holy place in Mecca. People back here in Ijara celebrate by slaughtering animals and giving the meat out to all the poor. Everybody slaughters as many animals as possible. There are people who even send money from outside the country to be used for the celebrations. The Sheikhs and Imams oversee the celebrations in a common place within the community. Another celebration is the Ramadhan-Eid Al Fitr which follows 30 days of fasting. This is celebrated at family level and each family slaughters at least one animal. Eid Al Adha is bigger than Eid Al Fitr.* Source: A male key informant who is a Kadhi in Shangailu Mosque)

The above quotation from a key informant points at how ritual sacrifices dominate Somali religious life. As Muslim faithfuls, the pastoralists mark the celebrations of key religious events by ritual sacrifices that revolve around slaughtering of animals. The livestock ritual sacrifices also take place during social events as captured in the following narrative:

> *We use them* (animals) *during various festivals. There are family festivals. Like when your child is sick or your wife is sick, Sheikh is called to recite the Quran to heal a family member. Also at community level, when there is a calamity or severe drought, people contribute animals which are slaughtered to bring people together and to make the Sheikhs happy. All types of animals are slaughtered in the occasion. Every 7 years we also have a feast. We slaughter 114 cattle in line with the Quran. The Quran is read 114 times to heal the community from diseases and safeguard them from calamities. People come together at a common point. Men do the slaughtering of cows. They cut the throat. They also skin the animals although in some cases women do the skinning. During marriage and wedding we also slaughter animals: In the past the groom's family slaughtered the animals. These days the family of the bride also slaughters the animals. The feast is done in the groom's family boma.* (Source: A village elder, age 53).
>
> *During 2006/7 when we had the last RVF outbreak, we also slaughtered animals to heal the community. The elders passed that we slaughter the animals because this is a must when somebody dies. We were told not to slaughter by health officials but we respected the elders who told us to slaughter the animals. So although people died, we continued to slaughter at the burial of the dead and we did not die. (*Source: A village elder, age 53).

The above narrative shows how Somali life is dominated by livestock ritual sacrifices for both religious and social roles. However, the livestock ritual sacrifices could act as drivers of vulnerability to RVF and risk pathways to human infection particularly if the animal slaughtered is infected with RVF Virus. Furthermore, the expansive terrain and the magnitude of such sacrifices often present a great mobility challenge to health and veterinary officials in their efforts to inspect the meat before preparation. This situation poses an eminent risk of infection. Studies like that of Davies (2006) have similarly affirmed this finding by indicating that contact

with the sick livestock can happen when slaughtering or treating the animals. Therefore, traditional animal sacrifices which are dominant among the Somalis present a health hazard where the risk of infection with RVF is escalated. These findings could therefore explain the reason why RVF outbreak is commonly associated with the pastoralists whose livelihoods primarily depend on livestock. They also reinforce the fact that there is a close interaction of ecology, livelihood and the zoonotic disease (RVF).

Consistent with the finding on animal ritual sacrifices, Davies (2006) provided details of how the supplies of rams for the haj festivals through inter--country trade in East and North East Africa and the Middle East predisposes the traders to RVFV. During such ritual festivals, the dense populations coupled with the many herds of livestock that are killed pose a health risk. In the event the sacrificial animal is suffering from RFV, the disease may be transmitted to the population through contact with the animal fluids (Davies, 2006:138).

5.2.3. Religious beliefs and healing prayer meetings to heal RVF victims

The study found out that religious beliefs and healing prayer meetings conducted to heal RVF victims in the 2006/7 outbreak had great potentials to drive susceptibility to infection. This is highlighted in the following quotations by a widow who lost her husband in 2006/7 RVF outbreak and a local male Sheikh:

> *You are asking me questions about what caused the death of my husband? Are you angels? It is only Allah who knows when and how somebody would die. Even if it is RVF that killed my husband, that was Allah's will-(Amri ya Mungu). We also ate the same meat with my husband but as you can see we are still alive.* (Source: A middle aged female key informant).

> *Some people here believe that RVF is a curse. For this reason and despite public health education, they continued to eat uninspected meat during the last RVF outbreak arguing that those who died of the disease had been cursed.* (Source: A male Sheikh in Matarba Village).

The above quotations reveal the deep-seated religious belief in Allah. The Muslims believe that Allah is the provider of life. He also predetermines a person's fate and destiny before birth. This belief in Allah is also captured in an interview with a Clinical Officer in Shangailu:

> *"Somebody gave birth at home and bled. She was brought to the facility but the husband refused blood transfusion. She was taken back home for a ritual prayer to be performed to cleanse her. The husband also argued that that was God's plan for the woman to bleed; it is a sign of womanhood. He said that if God planned that she would bleed to death so be it. The Muslims believe that Allah controls their destiny. So there is nothing one can do".* Source: A female key informant in Shangailu Dispensary.

While belief in Allah as the giver of life cannot be contested, the belief may blur some people from understanding that humans can invoke their agency to take charge of their health and life by adopting safer health practices and accessing conventional medicine when sick. This lack of understanding is particularly evident in the quotation when the woman emphasizes that they defied public health message and ate the same meat but never died. Traditional beliefs also accounted for the misconception that RVF is a curse. This may pose a challenge to behavior change transformation with the result that transmission and spread of RVF is exacerbated. Hence it may not be the low awareness level that is accountable for the transmission and spread of RVF. People may be knowledgeable on RVF but persistent deep religious and traditional beliefs, world view and cultural practices of the community may negate adoption of preventive measures.

Findings from key informants further indicate that healing prayer meetings were held by Sheikhs to heal the 2006/7 RVF victims. These prayer meetings involved livestock ritual sacrifices that were believed to bring healing to the community at the time of calamity. The following quotations from two informants reveal the intended purposes of the healing prayers:

> *During 2006/7 RVF outbreak we also slaughtered animals to heal the community. The elders passed that we slaughter the animals because this is compulsory when somebody dies. We were told not to slaughter by health officials but we respected the elders who told us to slaughter the animals. So although people died, we continued to slaughter at the burial of the dead and we did not die.* (Source: A women leader)

> *We also read the Quran to the sick in each village-Gedelun, Matarba etc. Sometimes we are called by the sick to read to them Quran and console them and then we advise them to go hospital. When we read to them the Quran, they have to go to hospital. They do not remain at home.* (Source: A male Key Informant who is also a Sheikh).

From the foregoing, it is evident that during the 2006/2007 RVF outbreak in North Eastern Kenya, the people held healing prayers that were overseen by the Sheikhs who acted on the advice of respected Somali elders. During the prayers, Quran was recited to cure RVF victims. Animals were also slaughtered to cleanse the affected and this heightened the likelihood of infection since these rituals coincided with a period of RVF outbreak in livestock. The healing meetings reveal the world view of the Muslims which appears to be heavily influenced by the belief in Allah as the provider of health. This world view may however mar the adherents' understanding of the pathogenic cause of illness. It may also prevent access to biomedical solutions and by extension the uptake of necessary control and preventive measures.

This health seeking behavior has been documented by Kleinman (1980: 50) who points out that people seek health within a local cultural system comprising three overlapping parts: the

professional, folk, and popular sectors (Kleinman 1980, p. 50). Kleinman observed that when patients decide to go for folk or professional practitioners, their choices are governed by the cognitive and value orientations of the popular culture. After receiving treatment, the patients go back to the popular sector to assess it, and decide the next steps (Kleinman 1980, pp. 50–51). In the case of the Somali, the prayer meetings could be viewed to belong to the popular sector. However, whereas reciting the Quran to the sick still remains a common practice in the community, its potential in delaying access to conventional medicine needs to be explored as some people particularly the uneducated (who are the majority) could think that it is sufficient thereby not taking the patients to hospital. Public advocacy in collaboration with the Muslim leaders could help in encouraging the people to move beyond the popular to the other two sectors to guarantee the patient timely treatment.

5.2.4. Animal sleeping arrangements

Observations showed that almost all homesteads had cattle sheds/Kraals which were fenced off using thorny bushes and sticks to guard against vulnerability to wild animal invasion. Observations also revealed that sick animals particularly the small stocks (goats and sheep) were sheltered in the same houses used by family members (see figure 6.1). The reason given for this practice is that sick animals are weak and therefore can easily fall prey to wild animals' attacks. The owners of such animals gave them shelter in their houses. However, sleeping with sick animals poses a severe threat of disease transmission and spread to people in the same dwelling unit. When the animal is infected with RVF, contact with animal fluids is enhanced and this could lead to human infection (Muga et al., 2015).

Figure 5.1: A sick sheep sheltered in a dwelling hut

Source: Field observation April/May 2014

Studies by other scholars like Anyangu *et al.,* (2010), Munyua *et al.,* (2010) and Nguku *et al.,* (2010) have similarly showed that risk factors for infection with RVF include sleeping with animal herds and providing care during birthing among others.

5.3 Economic dimensions of Rift Valley Fever

5.3.1. Government of Kenya Response during the 2006/7 Rift Valley Fever Disease Outbreak

Findings from qualitative interviews suggest that there was poor and uncoordinated response during 2006/7 RVF outbreak, a situation that was attributed to poor infrastructure, insufficient personnel, poor coordination between the veterinary and public health officials, lack of emergency funds and inadequate drugs. These are captured in the following quotation from a key informant:

> *The response was late. There is need for early preparedness with vaccination kits. There is also need to monitor early warning signs and mobilize for drugs. Medical personnel*

came late when disease had killed people and animals. They said that the roads were impassable and vehicles were also few. They did not detect RVF early and brought vaccines late. Vaccines were inadequate. There was also poor timing in response as they health officials came when livestock to be vaccinated had been moved to the forest. Source: A male Public Health Official in Masalani.

The survey also revealed the main reasons why measures by the veterinary officials were in effective (table 5.1).

Why measures by Public Health and Veterinary Departments were ineffective	**Percent (%) Responses**
The officials responded late when many livestock had died of the RVF	30.9
They lacked drugs to treat the sick animals	21.1
They did not have vehicles to move in the community	8.0
They lacked adequate personnel	26.3
They did not give clear messages on how to prevent RVF	6.9
No Answer	6.9
Total	**100**

Table 5.1: Responses on why measures by Public Health and Veterinary Departments were ineffective

Source: Survey March/April 2014

The above findings confirm those of Jost *et al.,* (2010) who also found out that the response by the Department of Veterinary Services in the 2006/7 epidemic fell short of expectations because of late supply of vaccines. Weaknesses in early warning system and preparedness for response were also faulted as accounting for the many deaths witnessed in the period. In addition, flooding, impassable roads, poor conditions of vehicles and poor communication were blamed for the ineffective interventions (Jost *et al.*, 2010). Due to these weaknesses, the cattle keepers

became unresponsive as their hopes were dashed leading low absorption of the interventions. These weaknesses in response point to the need to reassess Early Warning Indicators and processes so as to allow the authorities and other relevant actors sufficient lead time to mobilize resources and put in place a coordinated response mechanism.

5.3.2. Economic impacts of RVF

Table 5.2 presents key economic impacts of RVF outbreaks among the study population. The impacts extend to other pastoralist communities and the Kenyan economy in general through the economic supply chain.

Table 5.2: Economic impact of RVF

Economic Impacts of RVF	Percent Responses
Market closure	21.3
Loss of income	18.3
Loss of human and animal lives	22.8
Loss of family assets	10.7
Lack of food supplies	18.2
Imposition of quarantine	4.6
Other	2.0
No Answer	1.5
Don't Know	0.6
Total	**100**

Source: Survey March/April 2014

The survey data above suggest that pastoralists suffer heavy economic losses during RVF outbreaks. And since livestock rearing is the single-most source of livelihood for the Somali people, the effects aggravate the situation with the potential to cause more hunger-related deaths

over and above those related to RVF. These economic impacts of RVF have also been reported in other studies. Scholtel *et al.,* (1996) asserted that besides the perturbations, RVF epidemics can rapidly erode the economic gains made at family and country levels. Similarly, control mechanisms mounted by the government during the outbreak such as slapping sanctions on cattle trade and movement further impoverish the pastoralists (Toulmin, 1986). ILRI (2008) also estimated that in the 1997-1998 RVF epidemics, cattle keepers in Northern Kenya lost over 50% of their sheep and goats. Close to 30% of their cattle and camels also died.

It has also been found that communities may be reluctant to adopt RVF control strategies especially if there is no compensation strategy (Palmer *et al.,* 2010). For example, bans on slaughter and transport of livestock are difficult to enforce because these communities often depend only on livestock for their livelihood, which further perpetuates the spread of the disease (Rock *et al.,* 2009). In the 2006/7 epizootic in Kenya, since animals could not be sold or slaughtered in NE Kenya, they were transported to Kilifi district thus introducing RVF there (Nguku *et al.,* 2010). This shows that compensation should be considered to ensure adherence to these bans and minimize the economic impact from the losses (Marcotty *et al.,* 2009; Nguku *et al.,* 2010).

This chapter has shown the socio-cultural and economic drivers of Rift Valley Fever. Practices such as animal ritual sacrifices, animal sleeping arrangements and healing meetings combine with the strong belief in Allah to drive vulnerability to RVF among the study population. The economic factors mainly poor coordination of response mechanism by government, a weak early warning system, lack of emergency funds, and inadequate drugs accounted for the escalated

transmission and spread of the disease during the 2006/7 outbreak with serious economic consequences. These findings are consistent with the eco-health model that states that the cultural environment interacts with the biotic and a biotic environment to cause disease or health. As the findings have suggested, practices such as animal ritual sacrifices, drinking raw blood and milk and animal sleeping arrangements together with the deep-seated belief in Allah among others appear not to promote survival relationships within the pastoralist ecosystem since they predispose the study population to RVF. Public health advocacy for behavior change transformation is hence required to restore ecosystem balance and realize health outcomes for the people.

CHAPTER SIX

LOCAL PEOPLES' KNOWLEDGE ON RVF, COPING MECHANISMS AND IMPLICATIONS FOR PUBLIC HEALTH DELIVERY APPROACHES

6.1 Introduction

This chapter presents study findings on pastoralists' knowledge base on RVF by focusing on their understanding of signs and symptoms, risks factors and risk pathways associated with RVF transmission, spread and control. It also highlights the coping mechanisms adopted by the pastoralists during RVF outbreak. Implications of people's risk perceptions and coping mechanisms on public health delivery approaches are also analyzed and presented in this chapter. Finally, the findings are discussed in light of studies that have been conducted in the subject matter.

6.2 People's knowledge base on Rift Valley Fever

6.2.1 Knowledge on RVF signs and symptoms, risk factors and early warning events

Ninety eight (98%) of respondents affirmed that they knew RVF and could positively identify its signs and symptoms in cattle, goats and sheep as shown in figure 6.1. The risks and early warning events associated with RVF were also revealed by the respondents as presented in figure 6.2. A key informant interview with a community health worker further supported these survey findings:

> *"In 2006/7 RVF outbreak, there were torrential rains with floods. Water was everywhere and roads were impassable. Then one to two weeks after the floods, swarms of mosquitoes emerged. I remember also beginning the second week to the third week, animals particularly sheep started becoming sick. In the fourth and fifth week, animals started dying followed by humans".* Source: A male Community Animal Health Worker.

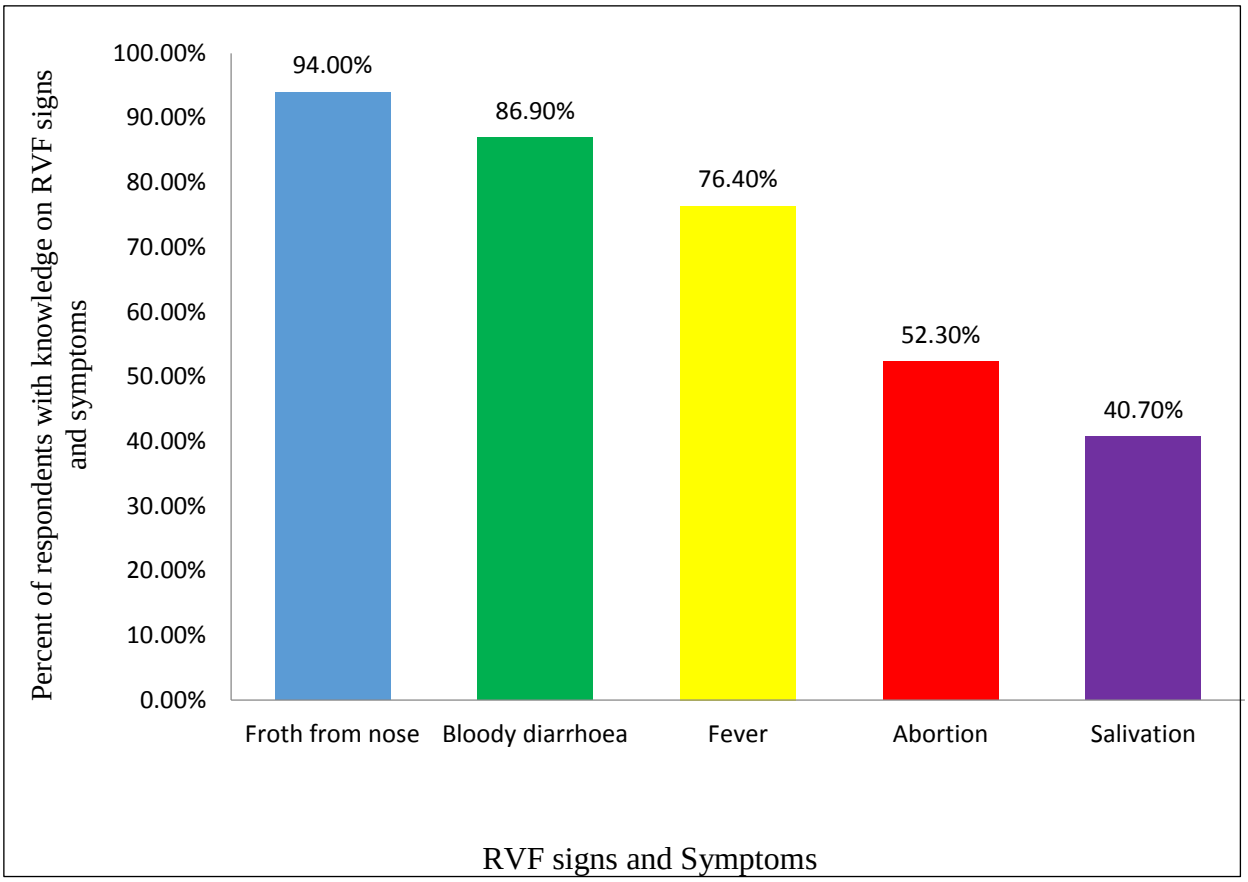


Figure 6.1: RVF Signs and Symptoms
Source: Survey March/April 2014.

The data from both survey and key informant interviews demonstrates that the community has valid local knowledge on RVF and can positively discern early warning events. This knowledge can effectively support early warning system established by the government for timely prevention and control of RVF outbreak. With an effective early warning system in place, pastoralists can be sensitized on impending outbreak so as to invoke coping and risk aversion mechanisms.

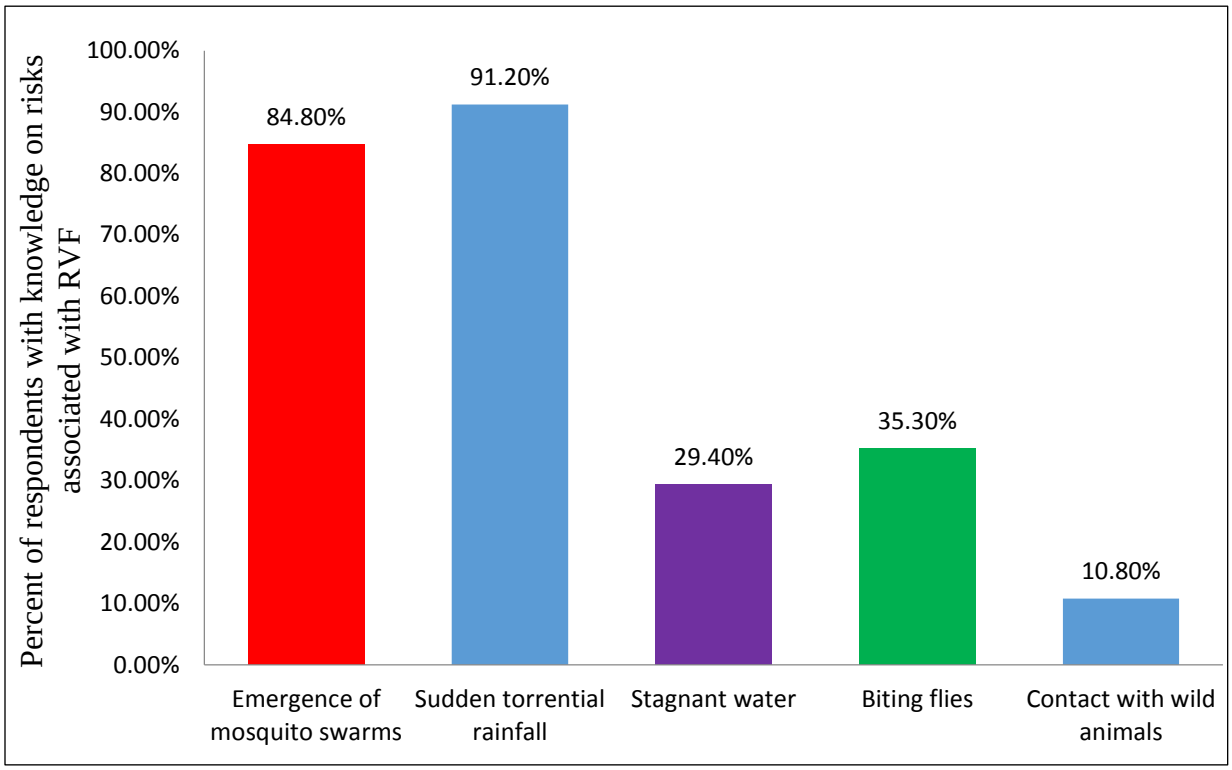


Figure 6.2: Risk factors associated with RVF

Source: Survey March/April 2014.

The above findings on RVF signs and risk factors are consistent with those of other scholars. Jost *et al.,* (2010) found that the cattle keepers had valid knowledge on symptoms of RVF and the associated risk factors mainly massive rains and mosquito swarms. They went on to add that the local people used the term *Sandik* to refer to "bloody nose", which was a condition associated with the zoonotic disease. The people recollected and acknowledged that RVF was dangerous and had struck the area before in 1997/98. The cattle keepers expressed that a majority of their livestock were again sick in the one-year period of 2006/7 outbreak. Abdi *et al.,* (2015) confirmed this finding when they reported that their interviewees in Ijara recognized that the disease (RVF) is dangerous (99%), and had a positive attitude towards vaccination of animals (77%). Similarly, Owange *et al.,* (2014) found out that availability of vectors, large number of

cattle, and high rainfall were rated as most important and /or important risk factors associated with RVF in the study district (Ijara). Anyangu *et al.,* (2010) also showed a strong association between severe infections of RVF and handling of a large number of animals, closeness to water points and mosquitoes in 2006/7 outbreak. However, in Owange's study, there were varied perception on soil types, *dambos*, bushy vegetation, wildlife and flat topography as risk factors.

These findings reveal the contribution that indigenous knowledge possessed by lay people can make in public health surveillance. However, this contribution was not considered in the 2006/7 epidemic but the authorities can benefit a great deal if it can be integrated into the early warning system as the cattle keepers had noted the changes in their environment and livestock prior to detection by public health surveillance systems (Breiman *et al.,* 2008). This finding therefore strongly implies that public health monitoring systems could be immensely boosted to timely detect disease by integrating the local knowledge of cattle keepers.

6.2.2 Risk pathways associated with RVF

The respondents were found to possess knowledge on RVF entry risk pathways as shown in figure 6.3. These findings support those of Owange *et al.,* (2014) who particularly observed that the perceived entry risk pathways for RVF in Ijara district according to the key informants were infected mosquitoes, infected domestic animals, infected aborted fetuses and fluids and infected wild animals. It is important to note that RVFV is endemic in Ijara district (Owange *et al.,* (2014). As a result, the likelihood of its entry into Ijara through other pathways may not be applicable since it is already present in the mosquitoes.

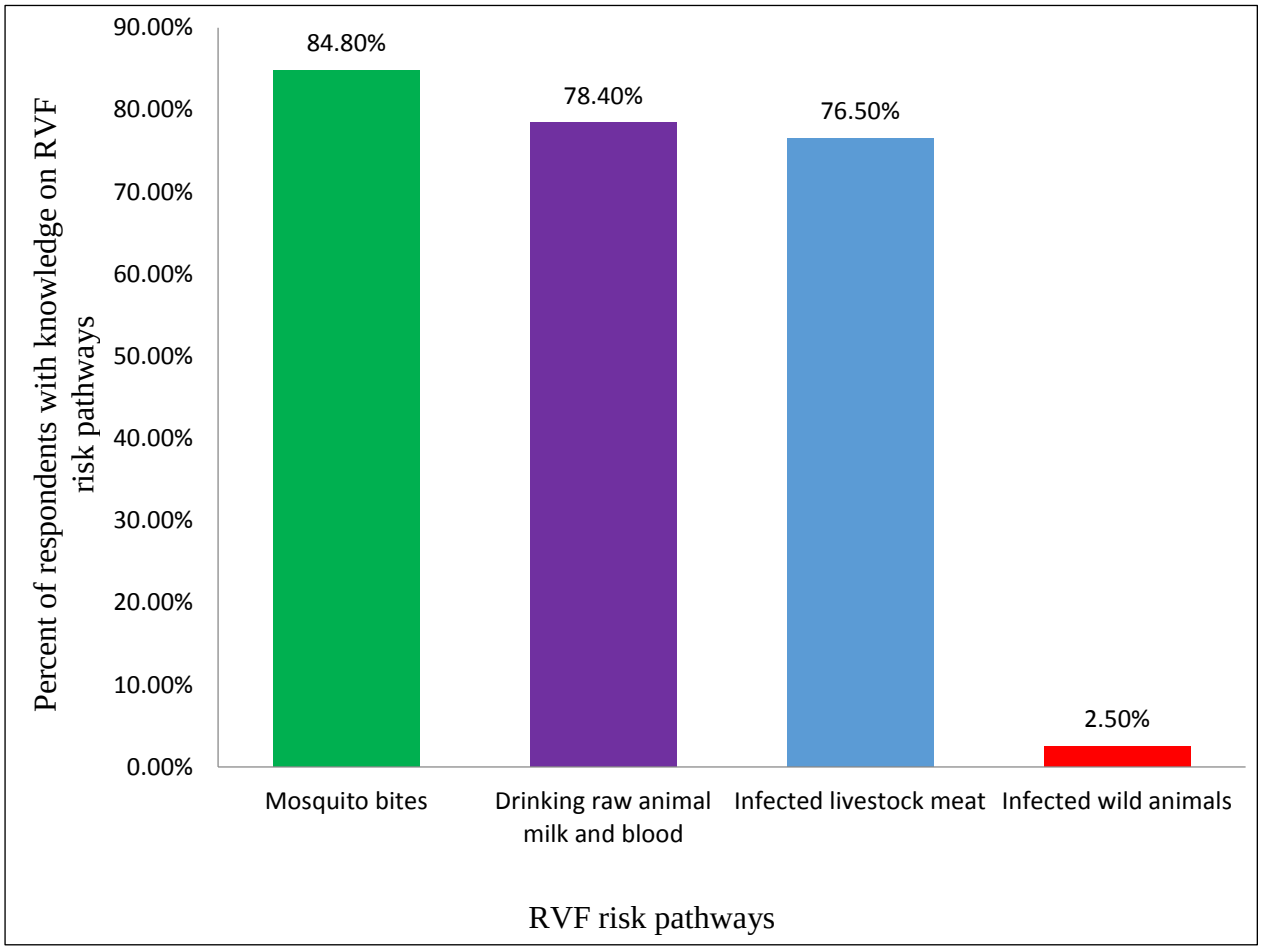


Figure 6.3: RVF risk pathways

Source: Survey March/April 2014.

The fact that RVF is resident in the mosquitoes explains why the communities' perception about the source and /or spread of RVF is the same, namely the role played by mosquitoes. Figure 6.4 further shows RVF endemic and epidemic cycle. It also illustrates the role played by the mosquitoes-the vector that causes RVF occurrence and which the respondents identified as the main risk pathway:

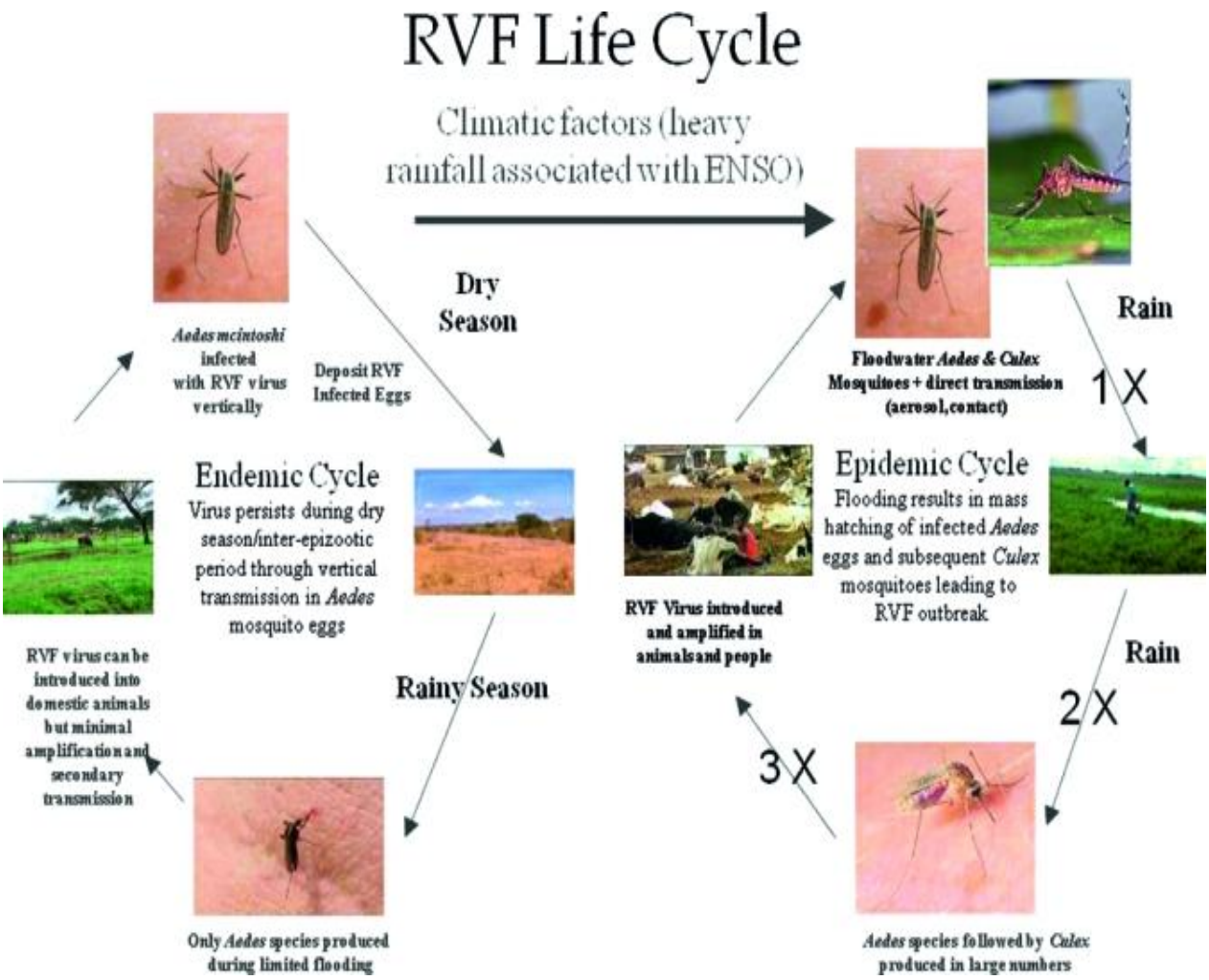


Figure 6.4: RVF Life Cycle

Figure 6.4. Endemic (on left) and epidemic (on right) life cycles of Rift Valley fever involving close association between heavy rainfall conditions, vector *Aedes* and *Culex* mosquitoes, domestic animals, and humans. The epidemic cycle is precipitated by excessive heavy rainfall associated with the El Niño/Southern Oscillation (ENSO) climatic phenomena. The three Xs depicted in epidemic cycle represent critical pathways, which can be interrupted by targeted and specific mosquito control activities.

Source: Adapted from Anyamba, A., Lithicum, J. K., Small, J., Britch, S. CC., Pak, E., De La Rocque, S. *et al., 2010:* "Prediction, assessment of the Rift Valley Fever activity in East and Southern Africa 2006-2008 and possible vector control strategies", *American Journal of Tropical Medicine and Hygiene 83 (suppl.2), 43-51.* http://dx.doi.org/10.4269/ajtmh. 2010.09-0289

The findings demonstrate that cattle keepers in Ijara are knowledgeable in RVF risk factors and risk pathways although Ng'ang'a *et al* (2016) contradict these in their study. They found that the pastoralists in Ijara believed that infections in humans occurred as a result of mosquito bites and had little to do with their consumption of meat, milk and blood from infected livestock. The participants in their study indicated that they had heard of the risks of acquiring the disease through consumption of livestock products but their experiences did not tally with the information they had received hence to them, Rift Valley fever was not transmissible through their dietary practices.

As revealed by this study, whereas the knowledge of the pastoralists on RVF needs to be integrated into the early warning system by the authorities, continuous awareness will still be relevant to transform some of the deep-seated socio-cultural practices associated with RVF such as drinking raw milk and blood. This is particularly so because anthropologists have emphasized that communities find it harder to change their value system than their material culture. And since drinking raw milk and blood sits squarely within the pastoralists' value system and cattle complex, it is misplaced to imagine that the high knowledge on RVF risks will automatically translate into safer health practices among the pastoralists.

6.2.3. Morbidity and mortality experience in the study population

Close to 73% of the respondents did not have a history of RVF in their households and hence gave information based on what they observed and experienced in the community. Only 26% reported that they and/or their family members had suffered from RVF. 52.8% of those who had a history of RVF in their households further said that they suffered from the zoonosis about 10

years ago. This period almost coincides with the 2006/7 RVF outbreak in N.E. Kenya thereby affirming clarity in recall and validity of data from those respondents who had cases in their households. This finding is consistent with that of Jost *et al.,* (2010) who noted that the cattle keepers gave accurate time lines of 2006/7 RVF events development that could have proved useful to the authorities to mount early response. The cattle keepers were also able to vividly recall duration of RVF evolution in their locality. They recalled that the duration taken from the onset of massive rains to the initial appearance of mosquito swarms was about three weeks whereas the duration taken from the emergence of mosquito swarms to the first detected case of RVF in cattle was about two weeks. These intervals based on community knowledge reveal sufficient lead time which can effectively be used by the authorities to mount early response. Hence documentation of peoples' experiences and the lessons learnt in 2006/7 remains valid for the authorities to use in informing interventions in terms of surveillance, establishment of decision-making support tool and management of future outbreaks.

The **t**op four livestock diseases were mentioned by the respondents as Contagious Caprine Pleuropneumonia *(hawadeeda)* (81.9%), Foot and Mouth Disease (*Cacbeeb or habeeb*) (80.9%), RVF (*Sandik*) (74%) and Trypanosomiasis (*bukaanka jiifka)* (56.9%) a fact that shows that RVF is one of the four diseases that the cattle keepers perceive as a big threat to their livelihood and health. This also underscores the importance of mounting preventive and control measures against RVF. This finding affirms that of qualitative data where key informants and FGD participants said that the community view RVF as "dangerous" hence the name "SAN DIK" meaning "a bloody nose". Blood is a sign of danger and is considered so in the community.

Furthermore, 92.6% of respondents said that sheep were the most affected by RVF. Qualitative data also confirmed that sheep were the most affected followed by goats and cattle.

Findings from FGDs (both men and women) and key informants revealed that the Government of Kenya (GoK) responded to the 2006/7 RVF outbreak by vaccinating the animals, providing treated mosquito nets to the community including herders in the forests, rolling out public awareness campaigns on RVF and treating people with malaria symptoms. Medicines Sans Frontiers (MSF) – an International Non-Governmental Organization (INGO) used a helicopter to supply drugs and airlift victims as the roads were impassable.

However, data from key informants and FGDs revealed that the responses including vaccination were late and found when the disease had established itself in the animals. Many livestock had died and people hospitalized. These findings confirmed those of survey. When asked why the GoK response was ineffective in 2006/7, these were the categories of responses: Veterinary Officials responded late when the animals had died (78.3%), the officials lacked adequate drugs (53.6%), they did not have vehicles to move in the community (20.3%), they lacked adequate personnel (66.7%), and they did not give clear messages on how to prevent RVF (17.4%). The reasons were the same for responses that targeted humans who suffered from RVF infection and many deaths were reported.

There is need for early preparedness dependent on an effective surveillance and early warning system which allows sufficient lead time for mobilization and response. An effective early

warning system which integrates community local knowledge should be established in partnership with various INGOs, research institutions and GoK departments.

6.3. Coping mechanisms of the pastoralists during RVF outbreak and their implications on RVF control

Rift Valley Fever epidemic presents a big challenge to the pastoralists as it severely interrupts the socio-ecological system. The situation calls for resilience which Anderson and Bolling (2016) define as the capacity of a system to experience shocks while retaining essentially the same function, structure, feedbacks and therefore identity. They further note that the concept of resilience has also been used to refer to coping mechanisms to withstand the stresses introduced into the system for continued operation of the system. Findings showed that the study population adopted a variety of coping mechanisms to respond to the adversities caused by Rift Valley Fever and climatic changes during epizootic period. The following quotation from a key informant reveals how the study population coped with the situation.

> *"During 2006/7 RVF outbreak, there was no food. We ate wild fruits like "Kamuthe" and depended on relief foods. Some people used mosquito nets others who did not have nets lit fire to drive away the mosquitoes from their manyattas. Some people used donkey-driven carts to go and get food items from Ijara which they brought here for sale. The prices were however, high like 1 kg of flour costed Kshs 500 up from Ksh 100 during normal periods".* Source: A male key informant who is also a Muslim Sheikh.

The above quotation vividly brings to the fore the vulnerabilities that were associated with RVF outbreak in 2006/7 and the myriad coping mechanisms employed by the Somali people to maneuver through the epizootic.

6.3.1 Use of Insect Treated Nets (ITNs)

Qualitative data showed that the study population used Insect Treated Nets (ITNs) to protect themselves from mosquito bites during RVF outbreak. The Government of Kenya and other development agencies mainly MSF supplied ITNs to the communities affected by RVF during the 2006/7 epizootic. There were also door to door campaigns on RVF during which time three mosquito nets were distributed to each household to protect its members from mosquito bites- a major risk factor for RVF (Jost *et al.,* 2010). There was however, no evidence available to show the utilization level of the nets within the households and also whether this mechanism resulted in sustainable behavioural transformation to safeguard the community from mosquitoes through use of the nets at all times. While this coping mechanism is effective in protecting people from RVF, collaboration between key stakeholders is needed to sensitize the community on the use of nets across all seasons.

6.3.2. Use of fire and smoke to drive away mosquitoes

Due to poor terrain, impassable roads, dispersed settlements and expansive rangeland, the Government officials and other stakeholders that mounted responses to the last RVF outbreak of 2006/7 could not distribute mosquito nets to all households in the wider Ijara district. Those who could not access the nets devised a local coping mechanism of lighting fire and using smoke to drive away mosquitoes from their manyattas. Even though the efficacy of this mechanism may need to be subjected to further investigation, from the community indigenous knowledge perspective, it helped to ward off mosquitoes and protected them from mosquito bites that transmit RVF Virus. This coping mechanism was mentioned by the community as cost effective

and locally appropriate and could be integrated into public health campaigns if found to be working.

6.3.3. Continued slaughtering of animals for food during RVF outbreak

> *When I was called that my son fell sick, I rushed to the home in Handaro where he was and found my son suffering from bloody diarrhea, vomit, cough and bleeding nose. I used a donkey cart to carry him from Handaro to Gedilun.*
>
> *He was aged 15 years and was employed as a herds boy by Mohammed Abdi. He was serving on a six-month contract at the expiry of which he was to be given money equivalent to half a bull (Kshs. 10,000). On reaching home, I alerted the chief who arrived immediately but unfortunately the boy died before we could give any medication or take him to hospital. He had only taken two days with illness. The herd owner supported the family with funeral expenses.*
>
> *When we saw the symptoms, we could not know which disease he was suffering from. MSF doctors visited the home a few days after the boy passed on and they are the ones who informed us that the boy suffered from a disease called RVF. They also told us that the disease is caused by mosquito bites.*
>
> *During the funeral, we slaughtered four goats and 2 cows as per our tradition as we did not know it posed any risk. Again we could notWe were only advised later by MSF doctors not to eat uninspected meat.*

(Source: Narrative by an elderly man whose son died of RVF in 2006/7 outbreak)

Another male key informant added:

> *"People continued to slaughter their animals even during RVF outbreak because the situation was very bad. There was scarcity of food and it was difficult to leave children hungry. We could not afford to throw away the animal meat. We were in a situation of hopelessness".*

The above quotations demonstrate that the community coped with the outbreak by continued slaughter of animals despite the high risk of infection during outbreak. Although the narrative reveals lack of awareness on the dangers posed by continued slaughter, the lack of compensation

for farmers during ban on livestock slaughtering and sale could also account for the defiance. Faced with vicious vulnerabilities that were associated with RVF outbreak such as hunger, impassable roads and lack of food supplies, some community members defied the health messages warning them against consumption of uninspected meat and continued to slaughter animals for food.

This finding confirms those of other scholars. Palmer *et al.,* (2010) observed that communities may be reluctant to adopt control strategies especially if there is no compensation strategy. For example, bans on slaughter and transport of livestock are difficult to enforce because these communities often depend only on livestock for their livelihood, which further perpetuates the spread of the disease (Rock *et al.,* 2009).

6.3.4 Treatment at health facility and self-treatment using ethno-medicine and conventional medicine

The survey data indicated that the Somali community engages in medical pluralism to treat RVF in humans. These include ethno-medicine (7.4%); buying conventional medicine from local shops (8.3%); treatment at health facility (93.6%) and other (24%). The results for animal treatment were the same. It is instructive to note that "other" scored higher (24%) compared to ethno-medicine and buying medicine from the shops. Qualitative data revealed that reciting the Quran to those who suffered from the 2006/7 outbreak was widespread and this could be part of the "Other" category.

In terms of ethno-medicine, qualitative data showed that the community uses fat from sheep to treat those suffering from RVF and other ailments (see table 4.2 on the benefits of livestock species). This finding is consistent with that of Ng'ang'a et *al* (2016) who reported that among the pastoralists, there is a perceived medicinal value attached to livestock products particularly sheep fat which is consumed to treat illnesses including patients manifesting RVF symptoms.

While the efficacy of mutton fat in treating these ailments is yet to be scientifically determined, its use in the community within the home sphere is perceived by the community to be curative. However, the condition of the patient may be compromised if medical professionals are not considered should the patient fail to respond to ethno-medicinal treatment. More risks to the patient may also abound if the belief in the ethno-medical treatment as the first line of action is so strong that it delays access to treatment at a formal medical facility.

These findings reveal plurality in medical care and confirm those of Janzen (1978, p. xviii) who defined medical pluralism as the existence in a single society of differently designed and conceived medical systems. Such systems exist together and may compete with one another (Fabrega 1982: 241–242). Leslie (1976: 9) sees ''medical systems as pluralistic structures of different kinds of practitioners and institutional norms.''

The health seeking behavior of the Somali pastoralists fits within the structural model of health care systems that was developed by Arthur Kleinman in 1980. Kleinman distinguished the three overlapping sectors within which people seek health care in different societies as: the professional, folk, and popular sectors (Kleinman 1980: 50). The professional sector consists of

the organized, healing professions. In most societies, this sector refers to the modern scientific medicine (Kleinman 1980: 53) also known as allopathic medicine or biomedicine. The folk sector, on the other hand, is the ‘‘non-professional, non-bureaucratic, specialist sector which shades into the other two sectors of the local health care system’’ (Kleinman 1980: 59) and which is either sacred or secular or a mixture of both. The popular sector is the lay, non-professional, non-specialist domain of society where illness is first detected and the first line of treatment offered, mainly at the household level. The popular sector ‘‘can be thought of as a matrix containing several levels: individual, family, social network, and community beliefs and activities’’ (Kleinman 1980:50). Noting the vulnerabilities inherent in dry land ecosystems especially when hit by RVF epizootic, the complexity of ethno-veterinary and ethno-medical pluralism calls for the integration of a pluralistic perspective into the planning and implementation of animal health care interventions and services. Nyamanga *et al.,* (2000) similarly established that cattle keepers seek health services from the many different sources available locally within their setting.

The above coping mechanisms constitute “social resilience’- a concept used by anthropologists, geographers and social sciences to denote the capacity of a community to respond collectively to adversity (Anderson and Bollig, 2016). The coping mechanisms belong to the responsive capacity typology as they enable the pastoralists to cope with immediate challenges posed by RVF epidemic. The responsive capacity also enables the community to address short-term perturbations, and to restore its livelihood and production systems in the wake of such adversity. The capacity is developed at the exploitation phase of the adaptive cycle which is characterized

by disease episodes, drought, and internecine warfare acting as social-ecological challenges that help to build resilience (Anderson and Bollig, 2016).

This chapter has presented peoples knowledge base on RVF and their coping mechanisms. The findings and discussions have implications on public health delivery approaches. The pastoralists have proved adept at recognizing the signs and symptoms of RVF together with the risk factors. This knowledge implies that the community may play a big role in supporting early warning system by reporting the signs and symptoms and entomological, climatic and vegetation changes to the authorities for timely mobilization of response. This would also mean involving the pastoralists in surveillance and monitoring processes for early detection of disease. The findings also imply that integration of a pluralistic perspective into the planning and implementation of animal and human health care interventions and services is needed. Furthermore, decisions regarding health care choices for livestock and humans are more or less the same as they are based on the perceptions of the cause of the health problem, belief in the efficacy of a given approach as well as the cost implications, particularly in resource poor households all of which need to be understood by the public health actors. Finally and most critical is the finding that the study population are aware of the risk pathways of rift valley fever which include drinking raw blood and milk and mosquito bites. However, this knowledge has not translated into appropriate behavior transformation. Public health advocacy that utilizes clear health messages to challenge the retrogressive cultural practices is required to realize better health outcomes for the population.

CHAPTER SEVEN

CONCLUSION AND RECOMMENDATIONS

7.1 Introduction

This chapter wraps up the study by drawing conclusions and outlining the main recommendations consistent with the study data. In addition, the chapter points out areas which need further research as revealed by the study.

7.2 Conclusion

The goal of this thesis was to explore the interaction of ecology, livelihoods and Rift Valley Fever in Ijara, Garissa County. Despite a paucity of social science research literature on RVF, this study has yielded rich anthropological data on zoonotic disease. This data has been analyzed, compared and contrasted with findings from the work of scholars from diverse backgrounds namely, public health, epidemiology, virology, social science and veterinary studies thereby bringing out a cross-disciplinary approach that was identified as bereft in previous researches.

The study specifically sought to identify and examine the adaptive strategies of pastoralist system as a livelihood practice within changing ecosystems and their influence on Rift Valley Fever occurrence among communities in Ijara Division. Findings have shown that the adaptive strategies and pastoralists' production practices in the area have implication for RVF occurrence. These include cyclic mobility of the herds and their herders, gender roles, herd dispersion and large herd production. Cyclic mobility brings herders with their herds to the RVF transmission chain of wild animals and mosquitoes. In terms of gender roles, the male youthful herders were

found to be more vulnerable to RVF than the elderly male herd owners and women by reason of their mobility and contact with the wild animals and their use of raw milk and blood which is perceived to be fresh and rich in energy. Furthermore, the results of the study revealed a close interaction of ecology, livelihoods and Rift Valley Fever. Field observation showed that Ijara soils are generally loose, fragile and infertile hence vulnerable to floods and erosions during periodic torrential downpours. Large swarms of *aedes* mosquitoes that hatch in the flooded basins, dambos and water pans infect both humans and livestock with RVF virus through bites resulting in an epidemic of the zoonotic disease.

The study also sought to investigate the socio-cultural and economic drivers of vulnerability to Rift Valley Fever. Findings suggested that the main socio-cultural and economic drivers of vulnerability to RVF include animal ritual sacrifices, animal sleeping arrangements, food preparations and eating practices and lack of institutional capacity to timely respond to RVF outbreaks. It has also been shown that animal ritual sacrifices that dominate Somali life could pose a serious health hazard especially when the slaughter for the many ritual occasions such as death, *Eid Al Adha* and wedding ceremonies are held within the context of RVF outbreak. Sharing houses with sick animals was also found to be a potential risk factor because of the possibility of contamination with the animal fluids. Dependency on raw milk and blood and the perception of the pastoralists that these raw food are fresh and have the necessary energy nutrients for the herders was found unsafe if the health condition of the animal is not known.

Finally, the study also sought to assess indigenous knowledge base pertaining to Rift Valley Fever and its implications for public health delivery approaches. The findings indicated that the

pastoralists are adept at recognizing, signs and symptoms, risk factors and risk pathways associated with RVF. The respondents mentioned bloody nose, diarrhea, foul smell and discharge of blood from the orifices - signs and symptoms that are consistent with RVF. Heavy rains and floods and sudden emergence of mosquito swarms were also cited as the major RVF risk factors while mosquito bites and contact with animal fluids during slaughter and obstetric procedures were mentioned as the entry risk pathways.

This thesis argues that the pastoralists are knowledgeable on RVF signs and associated risk factors. Their knowledge was definitive hence integration of the community into early warning systems and processes could prove very effective in providing the much needed information for timely mobilization and response. Since pastoralism is the most viable livelihood activity in the dry land ecosystem, intervention with policies and programmes will need to understand their socio-cultural practices which are very much intertwined with the livelihood activity itself. Appreciating this fact will mean that development issues pertinent to their economic wellbeing including health and disease will be addressed in a sustainable manner. The definition of pastoralism by Kratli et al (2010) as both a livelihood activity and a cultural identity is therefore in sync with this position and justifies the compelling need to understand the pastoralists' culture and value system before mounting any intervention.

7.3 Recommendations

Based on the study findings, the following recommendations can be made:

- The Government and development actors should tap into the local pastoralists' knowledge on RVF to strengthen climatic and entomologic monitoring. An effective early warning system which integrates community local knowledge should be established in partnership with various INGOs, research institutions and GoK departments.
- There is need for public health education on RVF and effective early warning and surveillance systems for timely response. These interventions will help stem the perturbations and deaths resulting from the zoonotic disease.
- A combination of livestock value chain analysis with risk analysis is required to identify the stages where the virus hibernates and gets released for targeted holistic interventions.
- Public health advocacy using a variety of targeted methods to pastoralists of low literacy level is required to realize appropriate behavioural and cultural changes consistent with better health practices. This will break the deep-seated socio-cultural practices that have potential to expose the population to RVF infection in the next cyclical outbreak.
- Use of local elders for public health and development information dissemination remains important in this Muslim community since they command immense authority in the community
- Compensation strategy needs to be considered during bans on livestock slaughter and transportation of livestock to ensure adherence and minimize economic impact from the losses.

- Cross-disciplinary research that is grounded on mutual partnerships between government health officials and social scientists is increasingly needed. This is likely to increase our understanding of all the dimensions of health and disease by bringing out the distal socio-cultural factors associated with diseases. The outcome of this collaborative effort will guide effective preparedness and response to RVF
- Finally, the study has provided evidence that gender roles have a correlation with disease occurrence particularly RVF. This study recommends more research to address the grey areas in which male-female disaggregated roles among pastoralist communities differentially expose women and men to infection and spread of RVFV

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APPENDICES

APPENDIX I: CONSENT FORM

INTERNATIONAL CENTRE FOR INSECT PHYSIOLOGY AND ECOLOGY (ICIPE)/UNIVERSITY OF NAIROBI

ECO-HEALTH PROJECT

ECOLOLGY, LIVELIHOODS AND RIFT VALLEY FEVER IN IJARA DIVISION N. E. KENYA

My name is Geoffrey Muga, a student at the University of Nairobi pursuing PhD in Anthropology. We are conducting a research study under ICIPE whose goal is to explore the interaction of ecology, livelihood and Rift Valley Fever in Ijara Division. We have identified you as one of our study participants and we would appreciate if you could spare some of your valuable time to give us your views and opinions.

We are aware that some questions are likely to be sensitive but we assure you that all the answers you give will be used for research purposes only. They will also be treated with utmost confidence and your identity and address will not be revealed to anyone. Participation in this study is voluntary and there will be no remuneration but you will be reimbursed Ksh 500 for your transport. However, your views are considered very important as they will not only help in this study but also the county and national governments which may find them useful in mounting interventions to prevent and control RVF in this region. This interview will take about 50 minutes and your time will be highly appreciated. If you consent to participating in the study, I will kindly ask you to append your signature on this form.

I ……agree to participate in the study.

Date…….Signature……

APPENDIX II: QUESTIONNAIRE FOR THE HERD OWNERS

Questionnaire Code: _____ DATE (dd/mm/yyyy): _____

INTERNATIONAL CENTRE FOR INSECT PHYSIOLOGY AND ECOLOGY (ICIPE)/UNIVERSITY OF NAIROBI

ECO-HEALTH PROJECT

ECOLOLGY, LIVELIHOODS AND RIFT VALLEY FEVER IN IJARA DIVISION N. E. KENYA

QUESTIONNAIRE FOR HERD OWNERS

This questionnaire should be administered to herd owners

Good morning/afternoon/evening. We are a team of researchers from ICIPE conducting a study to explore the interactions of ecology, livelihoods and Rift Valley Fever among the pastoralist communities of Ijara Division. We would appreciate if you could spare some of your valuable time to give us your views and opinions. We are aware that some questions are likely to be sensitive but we assure you that all the answers you give will be treated in confidence and your identity will not be revealed to anyone. This interview will take about 25 minutes and your time will be highly appreciated.

I certify to the best of my knowledge that I have conducted the interview according to the project brief I was given

Interviewer Code: _____ Supervisor's Signature: _____

N^{o}	QUESTIONS	ANSWERs/responses	
SECTION 1: DEMOGRAPHICS OF RESPONDENT			
1	Name		
2	Age of respondent **(INDICATE AGE COHORT)**	Exact age _____ (Years)	
		1) <18 2) 18 – 24 3) 25 – 34 4) 35 – 44 5) 45 – 54	6) 55 - 64 7) > 65 98) No answer 99) Don't know

N^{o}	QUESTIONS	ANSWERs/responses	
3	Gender	1 = Male 2 = Female	
4	What is the highest level of formal schooling you have completed?	0 = Never attended school 1 = Did not complete primary education 2 = Completed Primary 3 = Secondary	4 = College 5 = University 98 = No answer 99 = Don't know
5	What is your religion?	1 = Catholic 2 = Protestant 3 = Christian – Other 4 = Muslim	5 = Traditional 6 = Other 98 = No answer 99 = Don't know
6	What is your marital status?	1 = Single (Never married) 2 = Married 3 = Widow/ widower 4 = Divorced	5 = Separated 98 = No answer 99 = Don't know
7	Who is the head of this household?	1 = Myself 2 = Spouse (husband/wife) 3 = Other _____	98 = No answer 99 = Don't know
8	What is your household's main source of income?	1 = pastoralism/livestock rearing 2 = Business 3 = Farming 4 = Employment 5 = Pension	6 = Token from relatives 7 = Cash transfer programme 8 = Other _____ 98 = No answer

N^{o}	QUESTIONS	ANSWERs/responses	
9	Do you have any other source of income?	1 = Yes 2 = No 98 = No answer 99 = Don't know	**IF NO SKIP TO QN 11**
10	If yes above, what are the other sources of income?	1 = Subsistence farming 2 = Mining 3 = Business	4 = Others _____ 98 = No answer 99 = Don't know
SECTION 2: PASTORALIST PRODUCTION SYSTEM			
11	Do you consider livestock rearing/pastoralism to be sustainable?	1 = Yes 2 = No	98 = No answer 99 = Don't know
12	Which kinds of livestock do you rear?	1 = Cows 2 = Goats 3 = Sheep 4 = Camels	5 = Donkeys 6 = Others _____ 98 = No answer 99 = Don't know
13	What is the size of your herd?	1 = <20 2 = 20 – 50 3 = 51 = 100 4 = 101 – 200	5 = > 200 98 = No answer 99 = Don't know
14	What is your household average income per month (based on expenditure)	1 = 0 – 5,000 2 = 5,001 – 10,000 3 = 10,001 – 15,000 4 = 15,001 – 20,000 5 = 20,001 – 50,000	6 = 50,001 – 100,000 7 = 100,001 and above 98 = No answer 99 = Don't know

N^{o}	QUESTIONS	ANSWERs/responses	
15	What is the estimated proportion of your monthly income earned from livestock rearing?	1 = 100% 2 = 75% 3 = 50% 4 = 25%	5 = < 25% 98 = No answer 99 = Don't know
16	What are the uses of livestock in your household?	1 = Food 2 = Income from sales of surplus animals 3 = Transport 4 = Skins 5 = Socio-cultural roles (bride price, social gatherings, rituals, e.t.c)	6 = Manure 7 = Other _____ 98 = No answer 99 = Don't know
17	Has there been improvement in your livelihoods security in the past three years?	1 = Yes 2 = No 98 = No answer 99 = Don't know	**IF NO SKIP TO QN 19**
18	If yes, what has made your livelihoods to improve in the last three years?	CIRCLE ALL MENTIONED 1 = Infrequent/lack of livestock diseases 2 = Improvement in climatic conditions 3 = Support from relatives 4 = Support for marketing livestock 5 = Improved veterinary services 6 = Support with loans/micro credit 7 = Diversified income sources 98 = No answer 99 = Don't know	

N^{o}	QUESTIONS	ANSWERs/responses	
19	Which species of your animals do you value most?	1 = Cattle 2 = Goats 3 = Sheep 4 = Camel	5 = Other _____ 98 = No answer 99 = Don't know
20	What reasons do you give for valuing the species in 19 above	CIRCLE ALL MENTIONED 1 = Provides high income returns 2 = Provides a source of food for family 3 = Withstands drought conditions 4 = Withstands many types of diseases 5 = Do not require plenty of pasture 6 = Other_____ 98 = No answer 99 = Don't know	
21	What are the different ways you use to get pasture for the herd?	CIRCLE ALL MENTIONED 1 = Grazing livestock on pastures found locality 2 = Moving livestock out of the locality for pasture 3 = Buying animal feeds from the veterinary retail shop 4 = Other _____ 98 = No answer 99 = Don't know	
22	What are the roles of men in livestock rearing?	CIRCLE ALL MENTIONED 1= Moving with animals in search of pastures 2 = Treating livestock when sick 3 = Milking	

N^{o}	QUESTIONS	ANSWERs/responses	
		4 = Providing security for the animals 5 = Other_____ 98 = No answer 99 = Don't know	
23	What are the roles of women in livestock rearing?	CIRCLE ALL MENTIONED 1= Moving with animals in search of pastures 2 = Treating livestock when sick 3 = Milking 4 = Providing security for the animals 5 = Other_____ 98 = No answer 99 = Don't know	
24	What are the roles of children in livestock rearing?	CIRCLE ALL MENTIONED 1= Moving with animals in search of pastures 2 = Treating livestock when sick 3 = Milking 4 = Providing security for the animals 5 = Other_____ 98 = No answer 99 = Don't know	
SECTION 3: INCIDENCE AND SOCIO-CULTURAL FACTORS OF RIFT VALLEY FEVER			
25	Do you know Rift Valley Fever disease?	1 = Yes 2 = No	**IF NO SKIP TO QN 27**

N^{o}	QUESTIONS	ANSWERs/responses	
		98 = No answer 99 = Don't know	
26	If yes above, please outline its signs and symptoms	CIRCLE ALL MENTIONED 1 = Abortion 2 = Froth from the nose 3 = Bloody diarrhea 4 = Coughing 5 = Fever 6 = Lachrymation	7 = Pruritus 8 = Salivation 9 = Other _____ 98 = No answer 99 = Don't know
27	Which are the **top four livestock diseases** that you consider fatal to livestock in this community?	1 = Rift Valley Fever 2 = Lumpy Skin Disease 3 = Tick-Borne Diseases 4 = Foot and Mouth Disease 5 = Contagious Caprine Pleuropneumonia 6 = Anthrax	7 = Trypanosomosis 8 = Sudden death 9 = Gastro intestinal parasitism 10 = Enterotoxaemia 98 = No answer 99 = Don't know
28	What are the causes of Rift Valley Fever disease	CIRCLE ALL MENTIONED 1 = Sudden torrential rainfall 2 = Mosquito swarms 3 = Change in vegetation cover	4 = Ticks 5 = Other…… 98 = No answer 99 = Don't know
29	How is Rift Valley Fever disease transmitted?	CIRCLE ALL MENTIONED	

N^{o}	QUESTIONS	ANSWERs/responses	
		1 = Transmitted from human to livestock 2 = Transmitted from infected livestock 3 = Transmitted through mosquito bites 4 = Transmitted through drinking raw animal milk 5 = Transmitted through drinking raw animal blood 6 = Transmitted from infected livestock meat 7 = Transmitted from wild animals 8 = Transmitted from infected human to human 9 = Other _____ 98 = No answer 99 = Don't know	
30	Have you or any of your family member ever suffered from Rift Valley Fever?	1 = Yes 2 = No 98 = No answer 99 = Don't know	**IF NO SKIP TO QN 32**
31	If yes above when were you affected?	1 = 1 year ago 2 = 3 years ago 3 = 5 years ago 4 = 10 years ago	5 = 15 years ago 6 = Other _____ 98 = No answer 99 = Don't know
32	What symptoms were manifested when you/ your family member suffered from Rift Valley Fever?	CIRCLE ALL MENTIONED 1 = Fever 2 = Hemorrhage 3 = Body pains 4 = Diarrhoea	5 = Other_____ 98 = No answer 99 = Don't know

N^{o}	QUESTIONS	ANSWERs/responses	
33	When did the last Rift Valley Fever outbreak happen in this community?	1 = 1-3 years ago 2 = 4-10 years ago 3 = 11-15 years ago 4 = 16-20 years ago	5 = Other_____ 98 = No answer 99 = Don't know
34	Which of the livestock species is **Most** affected by Rift Valley Fever?	1 = Cattle 2 = Goats 3 = Sheep 4 = Camels	5 = Other _____ 98 = No answer 99 = Don't know
35	Do you think some socio-cultural practices of your community expose animals and people to RVF?	1 = Yes 2 = No 98 = No answer 99 = Don't know	**IF NO SKIP TO QN 37**
36	If yes above please, which are the cultural practices?	1 = Drinking raw blood 2 = Drinking raw milk 3 = Consuming meat during sacrificial occasions 4 = Gender roles assigned to family members 5 = Beliefs and perceptions about Rift Valley Fever 6 = Other _____ 98 = No answer 99 = Don't know	
37	Which factors do you consider when moving from place to place in search of pasture	CIRCLE ALL MENTIONED 1= Animal disease outbreak 2= Availability of social networks 3 = Availability of veterinary services 4 = Security of herds	

N°	QUESTIONS	ANSWERs/responses	
		5 = Other_____ 98 = No answer 99 = Don't know	
38	What are some of the risk factors associated with RVF?	CIRCLE ALL MENTIONED 1 = Abnormal heavy rainfall 2 = Emergence of mosquito swarms 3 = Wet grass 4 = Stagnant water 5 = Ticks 6 = Wind	7 = Soil and dust 8 = Biting flies 9 = Contact with wild animals 10 = Other _____ 98 = No Answer 99 = Don't Know
39	Which risk mitigation mechanisms do you practice to safe guard your livestock against Rift Valley Fever?	CIRCLE ALL MENTIONED 1 = Vaccination of animals 2 = Herds' dispersion 3 = Herds division 4 = Herds diversification	5 = Other _____ 98 = No answer 99 = Don't know
40	Of the people attending to your herd, who are the most vulnerable to RVF disease?	1 = Herd owners 2 = Herders 3 = Women 4 = Children	6 = Others_____ 98 = No answer 99 = Don't know
41	What are the reasons for making your choice above?	CIRCLE ALL MENTIONED 1 = They handle lactating livestock 2 = They get exposed when slaughtering the	

N^{o}	QUESTIONS	ANSWERs/responses	
		animals 3 = They interact with the animals regularly as they look for pasture 4 = They handle smaller animals 5 = They take the animals to the forest where they interact with wild animals 6 = Other_____ 98 = No answer 99 = Don't know	
SECTION 4: RIFT VALLEY FEVER PREVENTION AND CONTROL MEASURES			
42	How is Rift Valley Fever treated in humans in this community?	CIRCLE ALL MENTIONED 1 = Use of herbs for human treatment 2 = Buy medicine from local chemists 3 = Visit health facility	4 = Other _____ 98 = No answer 99 = Don't know
43	How is Rift Valley Fever treated in animals in this community?	CIRCLE ALL MENTIONED 1 = Use of herbs for animal treatment 2 = Buy animal drugs from the local shops 3 = Call veterinary officials to treat the animals 4 = Take the animals for vaccination 5 = Wait for treatment by veterinary officials at community centres 6 = Other _____ 98 = No answer 99 = Don't know	

N^{o}	QUESTIONS	ANSWERs/responses	
44	What role does the veterinary department play to prevent and control Rift Valley Fever outbreak in this community?	CIRCLE ALL MENTIONED 1 = Vaccination of animals 2 = Education of the public on Rift Valley Fever Disease 3 = They do regular disease surveillance 4 = Imposition of movement controls and quarantine 5 = Closure of markets and butcheries 6 = Other _____ 98 = No answer 99 = Don't know	
45	What education messages do the Veterinary officials pass to community members during Rift Valley Fever outbreak?	CIRCLE ALL MENTIONED 1 = It is a disease that affects both livestock and humans 2 = Do not drink raw milk 3 = Do not slaughter animals 4 = Do not eat uninspected meat 5 = Other _____ 98 = No answer 99 = Don't know	
46	Do you think the preventive and control measures taken by the Veterinary department are effective in responding to RVF?	1 = Yes 2 = No 98 = No answer 99 = Don't know	**IF YES SKIP TO QN 48**
47	If NO above please explain	CIRCLE ALL MENTIONED 1 = The officials respond late when many livestock	

N^{o}	QUESTIONS	ANSWERs/responses
		have died of the disease 2 = They lack drugs to treat the sick animals 3 = They do not have vehicles to move in the community 4 = They lack adequate personnel 5 = They do not give clear education messages on how to prevent Rift Valley Fever 6 = Other _____ 98 = No answer 99 = Don't know
SECTION 5: FACTORS AFFECTING ACCESS TO HUMAN AND ANIMAL HEALTHCARE SERVICES		
48	What factors affect people in this area from accessing veterinary services for their livestock?	CIRCLE ALL MENTIONED 1 = They lack money to pay for veterinary services 2 = They do not know what to do during Rift Valley Fever outbreak 3 = Beliefs and perceptions about Rift Valley Fever affect their choices for veterinary services 4 = Veterinary officials are very few and do not respond on time. 5 = There are no veterinary extension workers. 6 = The veterinary office is far away from the community making it difficult to report the cases and receive services on time. 7 = The roads are impassable 8 = Other _____ 98 = No answer 99 = Don't know
49	What factors affect people in this community from accessing	CIRCLE ALL MENTIONED 1 = The health facilities are far away from the

N^{o}	QUESTIONS	ANSWERs/responses	
	healthcare from health facilities?	community and this discourages people from visiting the facilities 2 = Health staff are not receptive and friendly to the sick 3 = Medical facilities lack drugs for treatment 4 = People prefer using herbs at home to going to hospital 5 = Poor transport system 6 = Poor roads 7 = Other _____ 98 = No answer 99 = Don't know	
50	How long do you take to reach the nearest health facility?	1 = < 2 hours 2 = 2-5 hours 3 = 6-10 hours	4 = > 10 hours 98 = No answer 99 = Don't know
51	What are the impacts of Rift Valley Fever in this community?	CIRCLE ALL MENTIONED 1 = Market closure 2 = Loss of income 3 = Loss of human and animal lives 4 = Loss of family assets 5 = Lack of food supply	6 = Imposition of quarantine 7 = Other _____ 98 = No answer 99 = Don't know
52	How do you cope with Rift Valley Fever disease outbreak?	CIRCLE ALL MENTIONED 1 = Keeping different types of livestock 2 = Initiating micro-businesses to generate income 3 = Eating non-cultural foods	

N^{o}	QUESTIONS	ANSWERs/responses
		4 = Asset disposal 5 = Taking loans from banks and micro-credit institutions/groups 6 = Other _____ 98 = No answer 99 = Don't know
53	What can the government do to prevent and control Rift Valley Fever disease in this community?	CIRCLE ALL MENTIONED 1 = Educate the public on Rift Valley Fever 2 = Work closely with communities to detect early warning and take pro-active measures 3 = Employ more Veterinary and health officials 4 = Stock adequate vaccines against Rift Valley Fever 5 = Enhance coordination with NGOs and other partners 6 = Other_____ 98 = No answer 99 = Don't know

THAT IS THE END OF THE INTERVIEW. THANK YOU FOR TAKING THE TIMETO ANSWER OUR QUESTIONS

APPENDIX III: INTERVIEW GUIDE FOR KEY INFORMANTS

Pastoralist production system

- How is pastoralist production system as a livelihood activity organized in this community? (Probe for types and size of cattle kept, use, division of labour, e.t.c).
- How do pastoralists make use of grazing land in this area? (Probe for patterns of annual cyclical movements in relation to pastures, use of different ecological zones, other causes of movements, which species of cattle are moved, who moves with the cattle, responsibilities of the person moving with the cattle, responsibility of herd owner, size of cattle moved, e.t.c).
- What is your view of pastoralism in the context of climate change? (probe for resilience, adaptability to the ecological changes, vulnerabilities experienced within the production system).

Socio-cultural, economic and political drivers of RVF

- What is RVF and has it been experienced in this district? (Probe for history of RVF in the district, number of humans and livestock affected, symptoms in both human and livestock).
- What are some of the risk factors associated with RVF? (Probe for changes in climatic, entomological and vegetation conditions)
- Do you think the way of life of the Somali people predispose them to RVF? (Probe for dietary habits, cultural practices such as rituals and slaughter of animals, handling of sick animals (abortion cases), division of labour).
- What were the impacts of RVF in this district?
- Describe the GoK and stakeholder response to the last RVF outbreak (probe for preparedness and mobilization, detection, control and management approaches)

- How do GoK and stakeholders use the Early Warning System to predict, prepare and respond to RVF outbreak (Probe for efficiency of the system, who declares an area an epidemic zone, quarantines and movement controls?
- Have there been any challenges faced when enforcing control measures among the community members?

Indigenous knowledge of RVF

- Does the community know the risk factors associated with RVF? (Name them)
- What does the community consider to be symptoms of RVF in human and cattle?
- What is the community's attitude towards the disease? (Probe whether they view is as serious or not and beliefs around the zoonotic)
- How does community's attitude towards the disease influence their control and management approaches?
- How can the knowledge level of the community be used to improve human and animal health delivery approaches?

Access to animal and human health care services and facilities

- How many human health care centres are available in this division/area? (Probe their adequacy).
- What factors influence access to these health care centers?(Probe for distance, perception about service delivery).
- How do the health centres deal with RVF cases during the outbreak?
- What community-based livestock services are provided by GoK during RVF outbreaks?
- What are some of challenges with animal health care services provided?

APPENDIX IV: NARRATIVE GUIDE

- Can you tell a story of your experience with RVF starting with how you first recognized RVF in your herd to the time that the disease was controlled? (Probe for symptoms, home care, public veterinary services accessed, and their effectiveness).

- Can you tell a story of your experience with RVF starting with how you first recognized RVF in yourself or relative to the time that the disease was controlled? (Probe for symptoms, home care, public human health services accessed, and their effectiveness).

APPENDIX V: INTERVIEW GUIDE FOR FOCUS GROUP DISCUSSIONS

Pastoralist production system

- Which types of animals are kept and their roles/benefits (Use matrix scoring to obtain order of preference of different species).
- What is the average number of animals kept by a household?
- Where do the animals sleep at night and with whom?
- How is labour divided among household members?
- Describe the causes of movement of herds into new ecological zones (probe who moves in the household, the role of the herd owner and the person in charge of animals during movement, socio-cultural and economic causes of movement)
- Briefly describe your migratory patterns during rainy season.
- Briefly describe your migratory patterns during dry season.
- Which risk aversion strategies do you employ to guarantee sustainability in pastoralist production?

Socio-cultural, economic and political drivers of RVF

- Are there some ways of life of the Somali people which you think may cause RVF to both human and livestock?
- What impacts have RVF outbreak had in this community?
- How did the GoK respond to the outbreak? Probe for detection, control and management approaches.
- Do you think the response from GoK was adequate and effective?

Indigenous knowledge base of RVF

- What causes RVF?
- Which are some of the signs and symptoms associated with RVF in animals and humans in your locality?
- How different are they from other animal diseases?
- Which events occurred before, during and after the RVF outbreak which can be associated with RVF? (Probe for heavy rainfall, mosquito swarms, floods e.t.c and also for the duration each event lasted and the timing of any disease control intervention by various actors).
- How can the community support GoK in prevention, control and management of RVF?

Access to human and animal health care services and facilities

- Name the health facilities available in this division.
- What factors influence access to these health facilities?
- Describe their level of service provision in these health facilities
- How do they deal with RVF patients?
- Which veterinary services are provided by GoK in your locality?
- Comment on the effectiveness of veterinary services in addressing livestock diseases and RVF in particular.

APPENDIX VI: TURNITIN REPORT FOR THE THESIS

Turnitin Originality Report

ECOLOGY, LIVELIHOODS AND RIFT VALLEY FEVER DISEASE IN IJARA DIVISION, GARISSA COUNTY, KENYA by Geoffrey Muga

From ECOLOGY, LIVELIHOODS AND RIFT VALLEY FEVER DISEASE IN IJARA DIVISION, GARISSA COUNTY, KENYA (Information science)

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