COMMUNITY ADAPTATION TO MALARIA AND RIFT VALLEY FEVER IN BARINGO COUNTY, KENYA

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N79/96907/2014

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

2017

DECLARATION

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

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Abbreviations and Acronyms

ACTs	Artemisinin-based Combination Therapies
AL	Artemether-Lumefantrine (AL)
CBPP	Contagious Bovine Pleuro-Pneumonia
CCPP	Contagious Caprine Pleuro-Pneumonia
CDF	Constituency Development Fund
CIDP	County Integrated Development Plan
ECF	East Coast fever
DDT	Dichloro-diphenyl-trichloroethane
DfID	Department for International Development
DOMC	Division of Malaria Control
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Group Discussion
FMD	Foot and Mouth Disease
GHG	Green House Gases
GoK	Government of Kenya
IFAD	International Fund for Agricultural Development
IPCC	Inter-governmental Panel on Climate Change
IPTi	Intermittent Preventive Therapy during Infancy
IPTp	Intermittent Preventive Therapy during Pregnancy
ITNs	Insecticide Treated Nets
KAP	Knowledge Attitudes and Practices
KII	Key Informant Interviews
KNBS	Kenya National Bureau of Statistics
LLIN	Long Lasting Insectidal Net
LSD	Lumpy Skin Disease
MoMS	Ministry of Medical Services

MPHS	Ministry of Public Health Services
NCPHSBS	National Commission for the Protection of Human Subjects of Biomedical and Behavioral Sciences
NMCP	National Malaria Control Program
NIB	National Irrigation Board
NHIF	National Health Insurance Fund
RVF	Rift Valley Fever
PPR	Peste des Petits Ruminants
SDG	Sustainable Development Goal
UNDP	United Nations Development Program
UNSDR	United Nations International Strategy for Disaster Reduction
WHO	World Health Organization

Acknowledgements

I am extremely grateful to the University of Nairobi and Jaramogi Oginga Odinga University of Science and Technology for collaboratively hosting the three year study titled "Early warning systems for improved human health and resilience to climate sensitive vector borne diseases in Kenya," in which this PhD research was nested. I thank the Project's Principal Investigator, Prof. Benson Estambale, in conjunction with the project steering committee, for awarding me with a three year scholarship which made the pursuit of this doctoral degree a reality.

My gratitude also extends to my Supervisors, Prof. Isaac Nyamongo and Dr. Salome Bukachi who were instrumental in guiding me through proposal development, data collection, data analyses and writing my thesis and peer reviewed papers. I thank Dr. Bernard Bett, for supervising me throughout my graduate fellowship at the International Livestock Research Institute. I also thank Prof. Daniel Olago for providing additional guidance. The Project staff in Baringo composed of the Project co-ordinator Douglas Anyona; research assistants Juliet Chepkoskei, Macrae Mbalanya and Vivian Yegon; data analyst Edwin Kiprutoh; and project drivers Eric Agure and Gilbert Obila made field work an enjoyable learning experience. I also thank the other students in the project: Alfred Oluoch, Isabella Moraa, Jacinta Amadi, Collins Omondi, Evans Juma, Calvin Loye, Duncan Kobia and Lavinca Achieng for the constant motivation and encouragement through the various phases of study. The support of the other project members, who have not been individually mentioned herein, is also acknowledged.

The study would not have been a success without the support of the people of Baringo and the County administration. I therefore extend my gratitude to the Baringo County Ministry of Health, the County Director of Health, the County Veterinary Department, the Public administration and community members for providing the project with all relevant non-monetary support. I also thank the WHO/TDR/IDRC for generously funding the larger project in which this study is nested through grant number B20278 and the Animal and Human Health group of the International Livestock Research Institute (ILRI) who supplemented my scholarship with funding from the CGIAR Research Program on Agriculture for Nutrition and Health, led by the International Food Policy Research Institute, Washington. Lastly, I thank Dr. Elizabeth Waithanji, Dr. Jemimah Njuki, Dr. Michael Kidoido, Luke Korir, Nicholas Ndiwa and Nancy Moss for their constant support and advice.

Dedication

This research is dedicated to my dad, Mr. Joseph Kyallo and mum, Mrs. Florence Kyallo for teaching me the value of hard work and discipline, without which this achievement would not be possible. It is also dedicated to my siblings Juliet Kavuu, Joyceline Mumbua, Faustin Mutua and Mandela Mutinda for their unwavering support. To my niece Janelle Ndanu and nephew Joe Kariuki, may this be an inspiration to you not to just dream, but make those dreams a reality. This work is also in memory of my grandmother, Esther Nduku, who called me a doctor long before I knew the meaning of the word.

Abstract

Community Adaptation to Malaria and Rift Valley Fever in Baringo County

Malaria and Rift Valley Fever (RVF) are climate sensitive mosquito borne diseases of great public health concern. Baringo County experiences seasonal transmission of malaria during the rainy season while RVF was reported for the first and only time in 2006-2007 during the El-Nino rains. This study sought to establish the extent of community adaptation to malaria and RVF among community members in Baringo County. A mixed methods approach was adopted. Key informant interviews (KII) with veterinary officers, nurses and community members; focus group discussions (FGDs) with community members and observations generated qualitative data while surveys with household members (n=560), livestock traders (n=203) and slaughter facility workers (n=10) produced quantitative data. Analyses for FGDs and KIIs were conducted through content analysis. Quantitative data was analyzed using summary and inferential statistics.

The results indicate that communities had bio-medical and local knowledge of malaria etiology and engaged in socio-cultural practices that influenced their vulnerability to the disease. Communities coped with malaria using both traditional and conventional methods of vector control. At the onset of suspected malaria, 28.9% of respondents sought care from a health facility, 37.2% used painkillers, 26.6% herbal remedies, 2.2% remnant malaria medicines, 2.2% over-the-counter anti-malaria drugs, 1% traditional healers and 1.8% other treatments. Subsequent treatment was sought in health facilities. Their ability to deal with malaria was compromised by lack of or limited bed nets, inconsistent use of bed nets and non-compliance to malaria medicine.

In contrast to malaria, the communities had little knowledge of RVF etiology and seasonality but reported that the main avenues through which an individual could be infected with any zoonotic disease were consumption of meat (79.2%) and milk (73.7%) or contact with blood from sick animals (40%). Ownership of susceptible livestock species, risky consumption patterns of livestock products, and poor handling of sick and dead animals increased community vulnerability to RVF. There were neither community led initiatives towards prevention of human/animal RVF cases nor sensitization campaigns.

In conclusion, communities in Baringo had a better adaptive capacity for malaria than RVF and more action is required to make them resilient to both diseases. The study therefore recommends that continuous health education regarding the importance of adopting prevention and management measures of malaria and RVF infections be provided to community members in appropriate formats. In addition, strengthening of veterinary services and inclusion of communities in participatory disease surveillance will enhance the County's ability to detect livestock disease outbreaks.

Chapter 1: Background to the Study

1.1 Introduction

The ability of human beings to adapt to an ever changing environment is a critical element of their survival. According to Brown (1998), adaptation is key to survival for any living organism. Human beings the world over are distinguished from other animals by their ability to adapt to changing environments through culture. Hence, human adaptation to challenges presented by the biotic and abiotic environments can be either biological or cultural (Brown, 1998). Long term biological adaptation involves modification of genes, which are then transmitted through reproduction and often happens over a long period of time (Brown, 1986). Cultural adaptation, on the other hand, involves making deliberate choices that can be transmitted through social learning which happens quicker and with greater flexibility (Brown, 1986). Both types of adaptation are useful and mutually reinforcing with the aim of enhancing human survival. This study focuses on the cultural aspect of adaptation to malaria and Rift Valley Fever (RVF), which are influenced greatly by climate change.

Naturally, climate change occurs gradually but it has been quickened by anthropogenic activities that increase quantities of greenhouse gases in the earth's atmosphere since 1970 (GOK, 2013; Houghton et al., 1996; UNISDR, 2008, 2009). Impacts of climate change, which include incremental frequency, magnitude and spatial coverage of extreme weather events such as drought, floods and erratic rainfall, have become more noticeable (GOK, 2013; Haines et al., 2006; McMichael et al., 2006). Changes in temperatures, rainfall quantities and humidity have resulted in multiple consequences such as illnesses, injuries and deaths from heat stress and floods; food, water and vector borne diseases; destruction of land and water ecosystems; and poor yields in agriculture (Haines et al., 2006; McMichael et al., 2006; WHO, 2010).

Malaria and RVF are examples of vector borne diseases associated with climate change (WHO, 2010, 2016a). The occurrence of these diseases is associated with the rainy season. Malaria is transmitted by infected female *Anopheline* mosquitoes (Asenso-Okyere et al., 2011), while RVF is transmitted by infected *Aedes* and *Culex* mosquitoes (Anyamba et al., 2010; Hightower et al., 2012). Vector and parasite growth, development, length of transmission periods and geographic spread is influenced by temperatures and rainfall (Haines et al., 2006). Other climate sensitive vector borne diseases that affect humans include dengue fever, yellow fever, leishmaniasis, chagas disease (American trypanosomiaisis), lyme disease, tick-borne encephalitis, African trypanosomiasis (sleeping sickness), schistosomiasis (bilharziasis), and onchoceraciasis (river blindness) (Allotey et al., 2005; Haines et al., 2006; McMichael et al., 2006).

Communities whose livelihoods depend on climate sensitive resources are most vulnerable to climate change effects (CARE, 2010; UNISDR, 2008). For instance, droughts in Vietnam and Ethiopia, have resulted in women having to fetch water further than usual thus increasing labour demands placed on them (Asheber, 2010; Shaw et al., 2008). In pastoral areas of Kenya, they have caused livestock deaths, catalyzed cattle raiding resulting in increased number of female headed households due to male deaths and decreased food security (Omolo, 2010). Erratic rainfall in Tanzania has been associated with a rise in the rates of periodic male out migration and HIV incidence (Nelson et al., 2009).

Recovery from adverse effects of climate change depends on the adaptive capacity that a community has. This capacity is influenced by the magnitude to which the community interacts with effects of climate variability in spatial and temporal terms (exposure); the extent to which a community is adversely affected by climate change (sensitivity); social stratification in terms of

gender, age, occupation; and access, control and ownership of natural, physical, human, financial, social and political capitals (Cutter et al., 2003; Wongbusarakum et al., 2011). In this study, malaria and RVF occurrence were the stimuli that communities were exposed to. Sensitivity referred to the ability of the individual and community by extension to respond to the effects of both diseases. The available resources and utilization strategies applied by community members to cope and adapt to malaria and RVF were also assessed. These resources comprised of the natural, human, physical, financial, social and political resources community members had access and control to in relation to their age and gender.

This study took place in Baringo County which was mainly inhabited by the Tugen, Pokot and Ilchamus who form part of the highland nilotes in Kenya. Agriculture was the County's main economic and livelihood activity. Mixed farming was practiced in the highland parts of the County while the lowland favoured pastoralism. In both agricultural systems, livestock played a critical role.

1.2 Problem Statement

Malaria and RVF are climate sensitive vector borne diseases that cause morbidity, mortality and economic losses. Malaria is a major public health problem in Baringo County (Government, 2016). Nationally, the disease is a proven inhibitor of growth, slowing advancement of countries by 2% (Asenso-Okyere et al., 2011) compared to those without malaria (Greenwood et al., 2005). Globally, malaria is estimated to have caused 429 thousand deaths and morbidity in 200 million people in 2015 (WHO, 2016c). In the same period, Sub-Saharan Africa bore 90% of all malaria cases and 92% of deaths (WHO, 2016c). The disease also costs the continent US$ 12billion annually through loss of or decreased labor, productivity, time and opportunities necessary for human development (Asenso-Okyere et al., 2011).

Previous RVF outbreaks have had negative impacts on people, livestock and economies. During the 2006-2007 outbreak in Kenya, in excess of 85% of 340 confirmed and possible cases were found to have been from Garissa (31%), Baringo (24%), Ijara (22%) and Kilifi (10%) districts (Nguku et al., 2010). Specifically, the outbreak resulted in 5 human deaths and 85 disease cases in Baringo (Nguku et al., 2010). Losses estimated at Kenya shillings 610 million from livestock mortality, over Kenya shillings 5 million in potential milk production, in addition to losses from closure of local slaughter houses in Mwingi, Garissa and upstream ones in Nairobi were also reported (Rich et al., 2010). In East and Horn of Africa and the Arabian Peninsula (Saudi Arabia and Yemen), RVF outbreaks in 1998 and 2000 respectively, gravely affected the livestock sector leading to losses of live and unborn flock, banning exportation of livestock and livestock products, collapse of live animal markets, restricted movement of livestock, decrease in stock prices and massive disruptions of livelihood strategies (Antoine-Moussiaux et al., 2012).

Despite availability of biomedical means of controlling and managing these diseases in Baringo County through human health and veterinary services, malaria is consistently reported as a dominant human disease while RVF remains a potential threat to cattle, sheep, goats and humans particularly in the lowland where flooding is common. In future, malaria and RVF incidences are likely to increase with negative effects on livelihoods due to frequent occurrence of adverse effects of climate change such as flooding and rising land temperatures which set conducive environment for disease vector and pathogen growth and development. This begs further investigation into community interactions with malaria and RVF by looking into their ways of life and how these increase or decrease risk of infections. A people's way of life has significant influence on morbidity and mortality rates (Winkelman, 2008).

The place of human behavior in disease control and management is often overlooked and communities are often viewed as passive recipients of health care services as opposed to active determinants of their own health outcomes. In Baringo County, community interactions with malaria and RVF have not been widely investigated from a cultural dimension and hence the dearth of information on how cultural adaptation or maladaptation influences community health outcomes. Unchecked, this gap in knowledge renders mainstream health services ineffective and unresponsive to community needs and makes communities more vulnerable to diseases. In addition, decreased county resilience to malaria and RVF contributes towards national and global non-achievement of the Sustainable Development Goals (SGDs) on good health and wellbeing (goal 3) and protection of life on land (goal 15).

For purposes of addressing this problem, this study therefore sought answers to the following questions:

1. To what extent do communities in Baringo understand the relationship between climate change, malaria and RVF?
2. How do socio-cultural practices pre-dispose communities in Baringo to malaria and RVF?
3. What resource factors predispose communities in Baringo to malaria and RVF?
4. What strategies do communities in Baringo have for coping with malaria and RVF?

1.3 Research Objectives

1.3.1 Overall Objective

To examine community adaptation to malaria and RVF in Baringo County.

1.3.2 Specific Objectives

1. To establish community knowledge of the relationship between climate change, malaria and RVF in Baringo.
2. To determine the link between socio-cultural practices and vulnerability to malaria and RVF among communities in Baringo.
3. To describe the effect of resource factors to community vulnerability to malaria and RVF in Baringo.
4. To establish community strategies for coping with malaria and RVF in Baringo.

1.4 Justification of the Study

The Kenya national government has shifted emphasis from curative to preventive care as outlined in Vision 2030 (GOK, 2007). Communities are now recognized as an important tier in Kenya's health system because they not only create demand for health services, but also have potential to control and manage diseases (Ministry of Health, 2014). For instance, in malaria and RVF control, communities are instrumental in applying preventive measures through the use of both conventional and indigenous methods. Effective community driven climate change adaptation strategies combine both indigenous and scientific knowledge for sustainability (UNDP, 2010). This study was conducted in Baringo County to examine community adaptation to malaria and RVF and documented both scientific and indigenous knowledge on community adaptation to these diseases.

The findings of this research provide insights into community knowledge and practices in control and management of malaria and RVF; institutional and infrastructural challenges in disease detection, control and management and recommends corrective measures that can be used by the County officials to increase the County's resilience. This information can also be used by policy

makers to inform design and implementation of adaptation strategies and policies on climate change and disease. This is especially useful to the local communities because most climate change interventions tend to address national concerns at the expense of those experienced directly by local communities (UNDP, 2010). Besides contributing to knowledge development, this study formed a basis for further research on climate change, gender and health by future academicians.

1.5 Scope and Limitation of the Study

This study only focused on exploring community awareness of the relationship between climate change, malaria and RVF; the practices and resource factors that predispose communities to these diseases; and the coping strategies that communities have developed in Baringo County. This descriptive study applied a cross-sectional design, interviewing local populations, health and veterinary officers using quantitative and qualitative methods.

Climate change, malaria and RVF are multi-faceted subjects but this study focused only on community adaptation to these vector borne diseases. This was not intended to understate the importance of epidemiology, parasitology and climatology components of the complex relationship between climate change and vector borne diseases. The RVF research was not conducted during an outbreak period and therefore the reported findings may have been affected by recall bias. The qualitative findings of this study were not generalized to populations outside the County as they only covered the Baringo cultural context. They can, however, be used in comparative studies of areas affected by malaria and RVF. The researcher, not a Kalenjin speaker, was faced with language barrier challenges with some study participant during data collection. To counter this challenge, the researcher engaged research assistants/enumerators that

had a good command of both English and the local languages to assist with data collection and transcription.

1.6 Study Assumptions

1. Communities in Baringo had an indigenous understanding of the relationship between climate change, malaria and RVF.
2. Communities in Baringo had socio-cultural practices that pre-disposed them to malaria and RVF.
3. Inadequate resources pre-disposed communities in Baringo to malaria and RVF.
4. Communities in Baringo had indigenous strategies for managing malaria and RVF.

1.7 Definition of Key Terms

Adaptation: The capacity of human and natural systems to respond to potential and actual risks and their consequences with an aim of minimizing harm and enhancing productivity

Climate change: Climate variability observed over a long period of time

Coping: This is a reactive short term response taken by persons or institutions to avert adverse effects of a shock using readily available resources and capacities.

Gender: Socially constructed expectations of men and women in terms of their roles, responsibilities and relations that vary across communities and change over time.

Malaria: A febrile disease transmitted by bites of female *Anopheline* mosquitoes infected with protozoan parasites.

Resources: Natural, human, physical, financial, social and political capitals/assets that people use to make a livelihood.

Rift Valley Fever: A viral zoonotic disease transmitted through bites of infected *Culex* and *Aedes* mosquitoes whose onset is marked with storm abortions in gestating cattle, goats and sheep. In humans, RVF may manifests as a mild febrile illness that may go undetected but in rare conditions, can escalate to hemorrhage, encephalitis, ocular disturbances in 0.5-2% and death in 1% of cases.

Sex: Biologically determined physiological characteristics that classify individuals as either male or female.

Vulnerability: Features of a human or non-human entity that make it susceptible to adverse effects of hazards

Chapter 2: Literature Review

2.1 Introduction

This section covers the relationship between climate change, malaria and RVF; practices; resource factors that pre-dispose communities to malaria and RVF and strategies for coping with malaria and RVF.

2.2 Climate Change, Malaria and RVF

2.2.1 Climate Change and Variability

Climate Change is defined as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UNISDR, 2009) page7. It is caused by anthropogenic activities that increase concentration of carbon dioxide, nitrous oxide, methane, ozone and water vapour, together commonly referred to as greenhouse gases (GHGs), in the earth's atmosphere (Houghton et al., 1996). Human activities that cause climate change include: deforestation, use of fossil and biomass fuels, overgrazing and land use conversion (GOK, 2013; UNISDR, 2008). Climate change also occurs naturally, with gradual changes over long periods of time and less damaging effects (Houghton et al., 1996).

In enhanced quantities, GHGs form a blanket in the atmosphere that absorbs solar energy radiated from the earth's surface and redirects it back making the earth warmer than it should be, a phenomena known as global warming (Houghton et al., 1996). This alteration causes changes in oceanic and atmospheric temperatures and hydrological cycles (Houghton et al., 1996). Subsequently, climate variability manifestations, which include increase in number and scale of extreme climatic events such as floods and droughts; changes in onset or end, intensity and

frequency of rains; increased land temperatures and elevated sea levels, have become more common (GOK, 2013). These climatic events affect food security, human and livestock health and human economic activities weaved around climate sensitive resources such as agriculture (UNISDR, 2008).

Above normal rainfall and increased temperatures are some of climate change effects that have been associated with vector borne diseases (Haines et al., 2006; Mabaso et al., 2012). These weather parameters affect rates of vector development, length of transmission periods and geographic coverage (Haines et al., 2006) and are likely to cause emergence, resurgence or decline of vector borne diseases (WHO, 2010, 2016a). While rainfall occurs in varying intensities, quantity becomes a determinant in the spread of vector borne diseases if water pools that last long enough to allow mosquito development form (Stresman, 2010). Water is the medium upon which the egg, larvae and pupa stages of mosquito development occur (Gerdes, 2004; Shaalan et al., 2009). Increased biting frequency and rates of mosquito and *Plasmodium* parasite development are associated with high temperatures (Alonso et al., 2011; Mabaso et al., 2012).

2.2.2 Malaria

Malaria, a communicable disease that affects humans, is caused by the *P falciparum, P vivax, P malariae* and *P ovale* protozoan parasites of the *Plasmodium* genus (Greenwood et al., 2005). The *P falciparum* parasite causes most infections in Kenya (DOMC et al., 2011) and Africa (Greenwood et al., 2005). Malaria is transmitted through bites of infected female *Anopheline* mosquitoes (Asenso-Okyere et al., 2011), which tend to bite in the dark (Walker et al., 2014). *Plasmodium falciparum* caused malaria presents with symptoms about 6 days from infective bite (Walker et al., 2014). These include fever, chills, headaches, tiredness, muscle/joint aches,

nausea, vomiting, anaemia, diarrhoea and jaundice. Mabaso & Ndlovu (2012), identify poor disease surveillance and control structures, movement of people to endemic areas, land use changes and drug and insecticide resistance as factors influencing the occurrence, severity and distribution of malaria infections. In the context of climate change, increase in temperatures and frequency of occurrence of extreme weather events such as flooding are likely to lead to the emergence of malaria vectors in areas where they did not exist previously, leading to a resurgence of cases and/or the spread of the disease into new geographic locations (Haines et al., 2006). A study in south east Iran has demonstrated that temperature increase is a significant determinant of malaria incidence, with an increase of 1° Celsius in maximum temperature resulting in 15%-19% increase in malaria incidence (Mohammadkhani et al., 2016).

Young children, pregnant women, people living with HIV/AIDS and persons traveling from non-endemic areas to endemic areas, whether or not they originally come from endemic areas, are most vulnerable to malaria (WHO, 2016a). Malaria not only endangers the life of an expectant mother but also that of the unborn child by increasing the risk of abortion, still birth, premature delivery and low birth weight in infants (Walker et al., 2014). These outcomes are more adverse for expectant women with HIV (WHO, 2007). A quarter of cases of severe anemia among expectant women, 10-20% of cases of low birth weight among infants (Greenwood et al., 2005) and 5-10% of deaths among neonates and infants with low birth weights are caused by malaria (Walker et al., 2014). Low birth weight and exposure to diseases in childhood is linked to poor mental development, performance in education and health outcomes in adulthood (World-Bank, 2009).

Malaria is treatable with combined artemesinin or non-artemesinin drugs. However, the former, commonly referred to as ACTs, are widely used in Africa and Asia where resistance to mono-

therapies has been established (Greenwood et al., 2005). Vector control, prophylaxis treatment for travelers and intermittent preventive therapies in pregnancy and infancy are effective methods of preventing the disease (DOMC et al., 2011; Greenwood et al., 2005).

2.2.3 RVF

In Kenya, RVF was first reported in 1912 (Murithi et al., 2011) and characterized in 1931 (Gerdes, 2004). Since then, the disease has occurred nine more times; 1936, 1947, 1951, 1957, 1961, 1968, 1977, 1998 and 2006 (Ahmed, 2010). Kenya's neighbours have experienced outbreaks of the disease about the same time. For example: Uganda in 1944, 1955, 1960 and 1968; Sudan in 1973, 1977, 2007; Tanzania in 1978 and 2006 and Somalia in 1998 and 2006 (Ahmed, 2010).

This viral zoonotic disease, to which humans and domestic ruminants such as cattle, sheep, goats and camels are susceptible, is caused by a *Phlebovirus* of the *Bunyaviridae* family (Anyangu et al., 2010; De Boer et al., 2010; Gerdes, 2004). The *Aedes* and *Culex* mosquitoes are the main vectors through which RVF is spread (Anyamba et al., 2010; Hightower et al., 2012). Bites from infected mosquitoes and contact with infected animal secretions and tissues are the primary avenues of human infection (Anyangu et al., 2010; De Boer et al., 2010). Blood, organ meats, placenta, aborted fetuses and fetal secretions from animals infected with the RVF virus are associated with high risks of infection through broken skin owing to the high viral loads found in them (Pfeiffer et al., 2005). At household level, persons involved in milking, care of sick animals, slaughtering and preparing meat during RVF epidemics are at risk of infection as this is done with bare hands (Pfeiffer et al., 2005). Rift Valley Fever is not transmissible from human to human except through contact with infected human excretions (Ahmed, 2010). Animals acquire RVF through bites from the same vectors as humans (Hightower et al., 2012). Movement

of infected vectors, persons and animals to unexposed areas can lead to emergence of the disease in non-endemic areas (Ikegami et al., 2009).

Outbreaks of RVF have been witnessed in Africa and the Arabian Peninsula (Anyamba et al., 2010; King et al., 2010). In East and South Africa, they are associated with wet seasons with higher than normal rainfall resulting in floods (Gerdes, 2004; Kortekaas et al., 2012), which provide ideal environment for multiplication of infected mosquitoes (Anyamba et al., 2010; Anyangu et al., 2010). Due to climate change, it is projected that extreme weather events such as heavy rains leading to flooding will become more frequent in future thus increasing the risk of RVF outbreaks (Haines et al., 2006). Flooding triggers hatching of infected *Aedes* mosquito eggs into infected female adults which transmit the disease to domestic animals (Anyamba et al., 2009). After a blood meal, infected female *Aedes* mosquitoes lay eggs in soil, which remain dormant until the next flooding (Anyamba et al., 2009), thereby perpetuating outbreak cycles (Pfeiffer et al., 2005). However, RVF can occur in the absence of rain as has been witnessed in North and West Africa where it is associated with large rivers and dams (Gerdes, 2004). It predominantly occurs in rural and peri-urban areas where livestock farming is practiced (El Vilaly et al., 2013).

The RVF virus incubates for 2-6 days before symptoms manifest (Ikegami et al., 2009). Livestock infections precede human infections (El Vilaly et al., 2013). Abortions of unborn fetuses occur in gestating livestock, (Anyamba et al., 2010), high mortalities in young animals (Anyangu et al., 2010) and the disease may be unapparent in other livestock (Gerdes, 2004). Human symptoms include bleeding from body openings, headaches, fevers, disrupted speech, muscular pains and inability to withstand light (Ikegami et al., 2009). The disease causes death in

livestock and mild to potentially fatal infections in humans (Anyamba et al., 2010; De Boer et al., 2010; Gerdes, 2004).

Prevention of RVF in livestock can be achieved by vaccinating with the Smithburn vaccine prior to disease occurrence to enable animals develop desired immunity levels (El Vilaly et al., 2013). Vaccinations done on uninfected animals in times of outbreaks do not offer required immunity as fast as needed. There is no human vaccine licensed for mass production and use for treatment (El Vilaly et al., 2013; Ikegami et al., 2009). Hence, human cases are managed symptomatically.

2.3 Practices Pre-disposing Communities to Malaria and RVF

This section covers gendered ownership, control and access to resources; gendered division of labor and exposure to disease; gendered perceptions of disease risk and bio-security practices influencing vulnerability to malaria and RVF.

2.3.1 Gendered Ownership, Access and Control of Capitals

Gender is a critical determinant of men's and women's health outcomes as it influences their social relations, power hierarchies, ownership, control and access to resources (Allotey et al., 2005). The concept of ownership is deeply nuanced and can be understood as a combination of management, withdrawal, alienation, access and exclusion rights to assets (Behrman et al., 2014). The kind of ownership rights that an individual has over assets determines their extent of utilization. Men's and women's assets differ in type, quality and quantity; can be owned individually or jointly and are used differently to cope with shocks (Meinzen-Dick et al., 2011).

Men and women have differential access to, control and ownership of resources, consumption patterns and bargaining power (UNDP, 2010). Comparatively, men tend to have more access to, control and ownership of assets (WHO, 2012a) and hence more bargaining power at household,

community and national levels (WHO, 2010). Limited bargaining power in women results in unequal distribution of resources, decision making capacities and participation in decision making processes in favour of men (WHO, 2010), even when the decisions to be made affect their lives (UNDP, 2010). For example, women have been shown to delay in seeking treatment when they are sick because they are dependent on men for financial support, have to get consent from primary males to leave their homes or may be culturally required to be accompanied by a man when seeking health services outside their community (Allotey et al., 2005; WHO, 2010).

2.3.2 Gendered Division of Labour and Exposure to Disease

Based on the gendered division of labour, caregiving activities for the young, elderly and sickly are carried out by women (WHO, 2010). Care giving roles determine and restrict the kind of work that one can partake, the duration of engagement per day and participation in other productive engagements such as education (Allotey et al., 2005). Disease outbreaks are likely to disrupt women's livelihood strategies as women may be forced to forfeit income earning activities to care for the sick, or stretch their labour too thin, resulting in low productivity. Baringo County has a population of 555,561 people; 279,081 males and 276,480 females spread in 110,649 households (KNBS, 2010). The County has an age dependency ratio[1] of 100:107 indicative of a high care burden even before occurrence of disease (KNBS, 2010).

In livestock production, men, women, boys and girls play different roles. Tangka et al. (2000), examined the gendered division of labour in nomadic pastoral systems as exemplified by the Maasai community. Maasai men are the main decision makers in livestock production. Together with older boys, they feed, water, market, treat sick animals, repair watering points, decide

[1] The dependency ratio relates the number of children (0-14 years old) and older persons (65 years or over) to the working-age population (15-64 years old).
http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/demographics/dependency_ratio.pdf

where, when and how to move their flock, source for feed and market information. Women's responsibility revolves around dairying (milking, milk processing and sale of surplus) and caring for animals that cannot leave the homestead such as gestating cows, newborn calves, sick and injured animals. Male and female children are engaged in herding of small stock but boys take on cows as they grow older. This example shows that roles in livestock production are gendered. It shows that men, women, boys and girls are exposed to zoonotic diseases in different ways and are custodians of varied indigenous knowledge associated with prevention and management of livestock diseases depending on their roles and responsibilities in livestock production (World-Bank, 2009). Although young children may not always play an active role in animal care, they remain vulnerable to zoonotic and bacterial diseases from animal products if adequate veterinary care and hygiene standards are not observed at household level (Tangka et al., 2000).

Outside the household, persons whose occupations revolve around livestock can be exposed to RVF. Veterinary doctors and lab workers, abattoir workers and traders in livestock and livestock products can be exposed through veterinary procedures, aerosol inhalation from infected specimens, slaughter and handling of livestock and livestock products respectively (Anyamba et al., 2010; Anyangu et al., 2010; Gerdes, 2004).

Exposure to malaria can also be different for men and women. For instance, women's and girls' activities with water or around water bodies, and carrying out domestic chores before dawn or at dusk, increase their vulnerability to malaria (WHO, 2007, 2010). Women, especially during their first and second pregnancies, become extremely vulnerable to malaria (Dorman et al., 2000; Shulman et al., 2003; WHO, 2007). Two studies carried out in Gambia to investigate the attractiveness of pregnant and non-pregnant women to *Anopheline* mosquitoes found that the former were more attractive (Ansell et al., 2002; Lindsay et al., 2000). Both studies attributed

this outcome to the physiological and behavioral changes that women exhibit in pregnancy. The changes include: increase in frequency of night time urination; increased in body size; increase in body temperature; exhalation of higher volumes of carbon-dioxide especially in advanced stages of pregnancy and production of volatiles produced by skin bacteria (Ansell et al., 2002; Lindsay et al., 2000). In combination, these changes enable mosquitoes to locate expectant women more readily than non-expectant ones. Leisure activities, such as resting and sleeping outdoors, can result in exposure to disease vectors (WHO, 2007). In areas with high malaria prevalence, working in forested areas and mines contributes to human vector contact and hence increased vulnerability to disease often among men (WHO, 2007).

2.3.3 Gendered Perceptions of Disease Risk

In disease control and management, gender influences risk of exposure, magnitude of infection, period of ailment, type of care, use of medical services, effect of ailment on household and secondary diseases emanating from the first ailment (Allotey et al., 2005). Increased understanding of the role that gender plays in disease control and management is therefore important. It carries potential for increasing efficiency of health programs by encouraging prompt uptake of health services, improving diagnosis and fostering compliance to treatment courses and preventive measures (WHO, 2010).

Men's and women's response to disease is determined by their perception of risk. Societies have culturally set ways of identifying disease, classifying severity and thresholds that determine the extent to which men and women are expected to withstand disease without disrupting their daily routines and the urgency with which they seek medical attention (Allotey et al., 2005). For example, a study on health seeking behavior in response to malaria among the Abagusii revealed

that most people first treated themselves with herbs and over-the-counter remedies and only sought treatment from health facilities if disease severity increased (Nyamongo, 2002).

A society's view of disease is important as it determines: how people relate with men and women who suffer from the disease; whether sick persons complete treatment courses and whether communities adopt preventive measures or not (Allotey et al., 2005). For instance, a study on socio-cultural practices around bed net usage in southern Tanzania cites an example where community members are culturally required to sleep outdoors without bed nets when mourning their dead (Dunn et al., 2011). The magnitude of discomfort experienced, particularly from mosquito bites and sleeping on the ground is considered as the measure to which one respects and values the dead (Dunn et al., 2011). Another study comparing knowledge, attitudes and practices among communities from malaria prone and non-prone areas in Tanzania found that some community members believed that use of bed nets was harmful especially to pregnant mothers (Kinung'hi et al., 2010). When diseases cause disfiguration of the body such as in the case of onchocercal skin disease, elephantiasis and leprosy or require frequent visits to health facilities for treatment such as the case for tuberculosis especially during the first two months, stigmatization and consequent non-compliance to treatment tends to be higher for women than men (Allotey et al., 2005; WHO, 2010). Socio-cultural, political and religious norms entrench attitudes, beliefs and practices that stigmatize women (UNDP, 2010).

Perceptions of masculinity and femininity also determine health seeking behavior. For example, where sickness and consequent dependency on others is seen as a sign of weakness, men might not admit to ill health thus delaying treatment (WHO, 2010). However, in some instances, men and women might be well aware of disease severity and the urgency with which they need to seek medical care but fail to get it due to their perceptions of care quality. These perceptions

include: the direct, indirect and opportunity costs of seeking treatment; sex of service providers and attitudes of service providers towards patients (Allotey et al., 2005; WHO, 2010).

2.3.4 Biosecurity Practices

Biosecurity, described as "a strategic and integrated approach that encompasses the policy and regulatory frameworks for analyzing and managing relevant risks to human, animal, plant life and health, and associated risks to the environment (FAO, 2007: 3)," is an important element of disease prevention and preparedness and by extension, sustainable agriculture (AHA, 2012). In livestock production, it is a strategy to minimize spread of transmissible diseases through aerosols; infected, sick or dead animals of similar or different species; inadequate waste management; and exposure to contaminated persons, husbandry equipment and means of transport (AHA, 2012). The responsibility of controlling and managing livestock diseases and resultant risks rests with both direct value chain actors such as farmers, traders, processors and consumers and indirect actors such as private veterinary service providers and government authorities specializing in livestock health.

Adherence to measures that can prevent RVF from occurring and minimizing exposure to infected or contaminated substances is key in managing and controlling RVF. During an outbreak, public education about RVF modes of transmission and preventive measures; use of protective clothing in handling animals suspected or confirmed of having RVF; banning slaughter of animals for domestic consumption during an epidemic and animal and meat inspection at abattoirs is recommended (Pfeiffer et al., 2005). Other measures include: developing farmers' ability to identify sickly animals in early stages of disease; prompt reporting of unusual disease and death to veterinary officers; continuous monitoring of livestock health status especially in times of intensive vector activities; appropriate disposal of dead animals;

vaccination; eased access to veterinary officers; and isolation of sick animals for treatment (AHA, 2012).

2.4 Resources Factors Pre-disposing Communities to Malaria and RVF

In examining the resource factors that predispose communities to malaria and RVF, this section discusses the various capitals that men and women own, control or have access to and their role in increasing or decreasing a community's vulnerability to disease.

2.4.1 Natural Capitals

Natural capitals comprise of assets such as land, water and genetic materials from which flows and services relevant for livelihoods are drawn (DfID, 1999; Meinzen-Dick et al., 2011). 80% of Kenya's land is either arid or semi-arid and is home to 60% of the country's livestock (GOK, 2013). Aridity is the most predominant characteristic of the drylands, which are categorized as hyper-arid, arid, semi-arid or dry sub-humid. Annually, hyper arid areas get <100mm of rain, arid areas get 100-300mm and semi-arid areas get 300- 800mm (Ffolliott et al., 2003; Wale et al., 2013). In terms of ecosystems, drylands are characterized by insufficient and variable rainfall, frequent droughts, thin soils with poor nutrient quality, limited fresh water resources and increased salinity in underground water in varying degrees (Ffolliott et al., 2003; Wale et al., 2013). In adapting to these challenges, depending on the level of aridity of an area, communities can adopt nomadic, semi-nomadic, transhumant or sedentary lifestyles. Baringo County receives an average annual rainfall of 650mm, making it semi-arid. The communities in Baringo predominantly practice agriculture as their main source of livelihood. Those living in the highland are sedentary and practice cash crop and subsistence farming while those in the lowland practice livestock keeping and tend towards nomadism.

Livestock serve multiple purposes in the lives of their keepers. They are; sources of rich proteins, draught power, raw materials (dung, skins, hides and bones), manure, social and cultural identity, stores of food and wealth, mediums of exchange and sources of cash (Mutua et al., 2017; Tangka et al., 2000). Communities express the cultural importance of livestock in how certain breeds contribute to preservation of local traditions and their day to day lives (Gandini et al., 2003). The importance is manifested in the duration they have kept certain breeds, the predominance of certain breeds in their traditional farming systems, diet, folklore, handicrafts, religious practices and other traditional customs (Gandini et al., 2003).

In most communities, men own large stock such as cattle, camels and buffaloes while women own small stock such as chickens, sheep and goats (FAO, 2011; Njuki & Sanginga, 2013; Smith et al., 2013). Although this is common, it is not true for all livestock ownership; men can also own small stock and women large stock too (Kristjanson et al., 2014). Men's and women's livestock ownership is influenced by production systems, culture (Njuki et al., 2013) and household headship (FAO, 2011). On average, female headed households own fewer livestock than male headed households (FAO, 2011).

Baringo County has a high population of livestock as shown in table 2.1. Cattle, sheep, goats and camels are susceptible to RVF (Gerdes, 2004). Livestock losses occasioned by disease have numerous consequences to communities. They may result in little or total non-consumption of animal source proteins (Smith et al., 2013), inter-community conflicts (Omolo, 2010), decreased household assets and diminished social and cultural identity.

Table 2.1: Livestock distribution by district

County	District	Cattle	Sheep	Goats	Camels
Baringo	Baringo Central	68,595	72,260	168,852	13
	Baringo North	38,143	30, 446	128,364	28
	East Pokot	787,209	380,125	1,474,617	67,036
	Koibatek	96,952	67,988	100,644	6
	Total	990, 899	550,819	1,872,477	67,083

Source: KNBS, 2010

Agriculture is the biggest economic enterprise in rural areas and is also the greatest producer of GHGs into the atmosphere in Kenya (GOK, 2013). It produces 30% of total national emissions, 90% of which come from the livestock sector (GOK, 2013). Farming practices such as clearing forested land for agriculture and overgrazing compound the impacts of climate change (GOK, 2013; UNISDR, 2008). Farmers, therefore, are not only affected by climate change but also affect it.

Baringo County is home to lakes Baringo, Bogoria and Kamnarok sized 130km², 34km² and 1km² respectively. Of the three lakes, only Lake Baringo has fresh water. Pekerra, Lororo and Losikem irrigation schemes are also found in the County. Permanent water bodies, whether natural or man-made, provide favourable breeding grounds for mosquitoes thus increasing the risk of malaria in adjacent areas year round (Stresman, 2010). This study explored the natural assets that communities in Baringo County owned or had access to and how this variation associated with increased or decreased vulnerability to malaria and RVF.

2.4.2 Physical Capitals

Physical capitals comprise of infrastructure and goods that increase human productivity (DfID, 1999). They include agriculture and business equipment, houses, consumer durables, vehicles, energy, communication, water and sanitation supply systems (DfID, 1999; Meinzen-Dick et al., 2011). In terms of healthcare, important physical capitals include heath facilities complete with

adequately skilled health service providers, medical equipment and supplies; reliable means of transport and all weather roads. Where transport systems are poor and/or people have to travel long distances to access health services, uptake of medical care is low (Mullner, 2009). Hence, proximity of health facilities and the state of roads linking people to the facilities determine utilization of health services and by extension health outcomes.

Mobile phones offer an opportunity for improving access to preventive medical care information and management of chronic diseases (Mullner, 2009). However, their use is limited by unavailability of health applications and platforms through which credible information can be accessed; lack of internet connectivity; low literacy levels, lack of phones and money to pay for the service (Mullner, 2009). Access to online medical information presents the risk of mis-diagnosis and self-treatment.

This study examined availability, accessibility and use of human and livestock health services. It assessed effects of poor road networks, mobile telephony and distances between health facilities on health care access and delivery. In terms of relevant supplies, the study assessed use of malaria medicines and technologies necessary for mosquito control and management such as bed nets, mosquito repellents and insecticides in Baringo County.

2.4.3 Human Capitals

Human capitals such as knowledge, skills, health and labour carry with them mutually reinforcing intrinsic and instrumental values (DfID, 1999; IFAD, 2001). Intrinsically, they increase a person's capabilities while instrumentally; they can be applied to increase productivity and other assets categories (DfID, 1999; IFAD, 2001). They are major determinants of individual and household opportunities, productivity and socio-economic outcomes (FAO,

2011). Strong correlations have been established between household agricultural, nutritional and economic outcomes and the level of human capital a household has (FAO, 2011).

Ill health results in multiple negative effects. On the sick person, there is loss of productivity which may result in loss of working and/or study days. Women, the primary care-givers, are faced with challenges of increased workload and disruption of their engagement in income earning activities when family members get unwell. They may stretch their labour too thin or forgo their livelihood strategies causing a decline in productivity (Allotey et al., 2005). The study investigated the consequences of ill health on the ailing individual, household and community at large.

In terms of knowledge, this study established the extent of men's and women's awareness on the relationship between climate variability, malaria and RVF; attitudes and practices around malaria and RVF control and management; and documented indigenous knowledge that the Baringo community had in detecting, controlling and managing malaria and RVF. Men's and women's knowledge are mutually reinforcing and essential for sustainable adoption of adaptation strategies (UNDP, 2010).

2.4.4 Financial Capitals

Financial assets – which include savings, credit and insurance – play an important role in enhancing household agricultural productivity and economic viability (FAO, 2011). Men's and women's consumption and investment patterns have been found to differ with women investing more on human capitals of their children (World-Bank, 2011). Women's control of income and ability to influence household economic decisions has been associated with improved education, nutrition and health outcomes for children (FAO, 2011). Women's access to financial services

improves their voice, economic status, capacity to make decisions and bargaining power within the household and community as well (UNCDF, 2005).

In seeking health care, financial resources play a key role. Combined, the cost of medical services; associated indirect costs such as transport and meals; and the loss of time for engaging in productive activity make the total cost of seeking health care (WHO, 2010). Lack of money to cater for these costs inhibits access to health care. For example, women have been shown to delay in seeking treatment when they are sick because they are dependent on men for financial support (Allotey et al., 2005; WHO, 2010). This study sought to investigate how availability or lack of financial capitals affected the community's ability to prevent, control and manage malaria and RVF.

2.4.5 Social Capitals

Social capital refers to "institutions, relationships, attitudes and values that govern interactions among people and contribute to economic and social development" (Grootaert & Van Bastelaer 2001:3). It manifests in cognitive and institutional forms (Grootaert et al., 2001). Cognitive forms comprise of intangible elements such as trust, reciprocal actions and conventional norms, attitudes and beliefs whereas networks, associations, institutions and the regulations that govern them form the tangible institutional element (Grootaert et al., 2001). Men tend to join market oriented groups composed of formal non-household relations while women join micro-savings and social welfare groups comprised of kin and informal relationships (Gotschi et al., 2009). Collective action, a by-product of social capital has been associated with increased self-esteem, assets, income, bargaining power among poor women (World-Bank, 2011) and ability to withstand shocks (DfID, 1999). Although beneficial, social capital has the potential of

segregating people into different categories and thus can end up reinforcing inequalities among gender groups (Gotschi et al., 2009; World-Bank, 2009, 2011).

Social capital has a role in determining health outcomes. A study in Mongolia showed that maternal deaths were higher among women with weak social support structures since they lacked assistance in substituting their labour as they sought healthcare and in enabling them to seek healthcare (WHO, 2010). This study investigated the types of associations that men and women in Baringo County had and how these contributed towards RVF and malaria control and management.

2.4.6 Political Capitals

Political capitals are essential because access to rights-claims and assets- are political in nature (Baumann, 2000). They include citizenship, enfranchisement and effective management in governance (DfID, 1999; Meinzen-Dick et al., 2011). These capitals enable individuals to establish their power status and position in relation to powerful policy and political institutions outside their locality (Baumann, 2000). The ability to influence policy and institutions is determined by a people's bargaining power, active participation, access to relevant information, legal and social standing (World-Bank, 2011). Political capital meets resistance from people and institutions that benefit from the status quo who may sabotage the push for change through non-cooperating in policy development or non-implementation of policy actions (World-Bank, 2011). This study examined how Baringo County constituents were able to interact with and influence policy and other actors engaged in control and management of malaria and RVF.

2.5 Strategies for Coping and Adapting to Malaria and RVF

Coping

Coping refers to the reactive short term measures taken by an individual or an institution to avert the adverse effects of a shock and enhance survival by using readily available resources (Daz'e et al., 2009). Men and women have different perceptions of shocks, their impacts and opinions over appropriate coping strategies (Quisumbing et al., 2011). Stinting, hoarding, protecting, depleting, diversifying, claiming and moving are some of the strategies applied by men and women to cope with shocks (Chambers et al., 1992). Sometimes the coping strategies applied are counter-productive, leading to unsustainable use of resources and increasing an individual's or communities' exposure to a shock (Daz'e et al., 2009). For instance, in times of crises, women's assets tend to be drawn down first before men's assets (FAO, 2011) despite women having fewer assets to cope with climate shocks compared to men (WHO, 2012a).

Among the coping strategies applied in RVF control is livestock vaccination. Although uninfected animals can be vaccinated with the Smithburn vaccine, during outbreaks, they may not benefit from it as full immunity is not achieved immediately upon vaccination (El Vilaly et al., 2013). For maximum efficacy to be achieved, the inactivated vaccine requires a booster and annual revaccination of affected livestock (Kortekaas et al., 2012). Since RVF is a fast spreading viral disease, the ideal vaccines for preventing livestock infections are those that can trigger quick immunity upon administration in a single vaccination (Kortekaas et al., 2012). Efforts to develop such vaccines are underway. None of the existing vaccines developed for human immunization are licensed for mass production and use (El Vilaly et al., 2013; Ikegami et al., 2009).

Vector control and barrier methods can be used in RFV control (Anyamba et al., 2010). Methods in vector control, which include spraying approved chemical insecticides on areas where adult mosquitoes rest and larval mosquitoes grow, work by interrupting the RVF epidemic cycle. Barrier methods include: use of mosquito repellents; insecticide treated nets; remaining indoors at peak biting times and avoiding risky handling of livestock and livestock products, slaughter, ingestion of animal tissue, raw milk and blood especially in times of outbreaks.

Multiple coping strategies have been applied in the control of malaria. The use of rapid diagnostic test kits to distinguish between true and false cases of malaria is one such strategy. It is especially important as the disease is often misdiagnosed in Africa (Greenwood et al., 2005) with most diagnosed fevers in Kenya treated as malaria (DOMC et al., 2011). Other control measures include use of insecticide treated nets (ITNs), intermittent preventive therapy during pregnancy (IPTp) and in infancy (IPTi), prophylaxis drugs given people travelling to endemic areas, residual household spraying, use of combined therapy drugs for treatment and concerted efforts in development of malaria vaccines (DOMC et al., 2011; Greenwood et al., 2005). Effective adoption of these measures heavily relies upon the existence of sound medical structures.

Adoption of preventive measures has not been without challenges. Misdiagnosis of most fevers as malaria even when they are not has led to misuse of malaria drugs, resulting in drug resistance (Greenwood et al., 2005). Rapid diagnostic test kits and combined therapy drugs are useful in control of malaria but costly in procurement and development (Greenwood et al., 2005). The efficacy of ITNs is only realized if they are used appropriately and consistently and if they are treated as required (Greenwood et al., 2005). Malaria vectors have also been found to develop resistance to pyrethroids used to treat ITNs (Greenwood et al., 2005). Residual household

spraying can only be effective if a house has sprayable walls, mosquitoes can be found in the house and they are not resistant to insecticide used (Mendis et al., 2009). Malaria vectors have been noted to develop resistance to insecticides like dichloro-diphenyl-trichloroethane (DDT) (Mendis et al., 2009). The efficacy of intermittent preventive therapy during pregnancy (IPTp) is compromised among women with HIV (Greenwood et al., 2005) while no country had adopted IPTi by 2015 (WHO, 2016c). Breakdown of medical structures as witnessed in war situations disrupts access to medical services and supplies reinforcing disease burdens (Greenwood et al., 2005).

When faced with disease, communities use a variety of treatment options, namely, self-treatment, allopathy and alternative treatment (WHO, 2012b). Self-treatment is associated with delayed access to proper medical care and non-compliance to set treatment guidelines resulting in drug resistance (Kinung'hi et al., 2010). Alternative treatments for malaria include consumption of herb portions made from boiled Neem plant (*Azadirachta indica)* leaves and bark (Nyamongo, 2002). Another strategy that communities use to control disease is repelling mosquitoes. Traditionally, communities in North West Tanzania have been burning eucalyptus and Neem leaves to repel mosquitoes (Kinung'hi et al., 2010). An ethnobotanical study on insect repelling plants used by Ethiopians shows that different plants can be used differently to repel mosquitoes. For example, juice extracted from seeds of black mustard *(Brassica nigra)*, leaves and barks of *Vernonia amygdalina del.* and garlic bulbs *(Allium sativum)*, are applied on the skin; leaves of *Eucalyptus*, barks/dermis of autumn crocus *(Colchicum autumnale)*, roots of *Buddleja polystachya fresen.* and peels of sweet orange *(Citrus sinensis (L.) Osb)* are smoldered while juice extracts from crushed seeds of garden cress (*Lepiduim sativum)* are consumed to repel mosquitoes (Karunamoorthi et al., 2014).

Communities play a critical role in determining the success of the identified control and management measures of malaria and RVF. Their willingness and ability to adopt malaria and RVF control technologies can be determined by the types of assets they have at individual, household and community level. For instance, human capital (limited or lack of knowledge or awareness of disease) can result in reduced access to preventive and curative care services (WHO, 2010). Examples from Uganda, Ghana and Guatemala show how communities attribute wrong causes to malaria (Obol et al., 2011). For instance, in Uganda, some communities believed that the disease was caused by consumption of untreated water, lung associated illnesses and improper diet; in Ghana, some believed it was caused by consumption of starchy and oily foods, while in Guatamala, they believed it was caused by contact with cold weather, poor diet and hygiene.

Adaptation

Adaptation refers to "the capacity of human and natural systems to respond to potential and actual risks and their consequences with an aim of minimizing harm and enhancing productivity" UNSIDR: 4, (2009). Consequently, cultural adaptation to climate change effects, which include emergence and resurgence of malaria and RVF, is a process that involves intentions, actors, and actions (Eisenack et al., 2012). The intention of adaption is to minimize vulnerability and enhance adaptive capacities of individuals, communities or institutions at local, national and international levels, who are in themselves actors (CARE, 2010). To minimize vulnerability, these actors can apply specific strategies and activities which could either be direct or indirect, purposeful or accidental, anticipatory or reactive, facilitative or reflexive, to achieve adaptation (Eisenack et al., 2012). These actions include: preventing a shock from happening or tolerating it; sharing or spreading loss; changing use or activity around a resource; migration and

restoration of damaged resource (Carter et al., 1994). For these actions to be executed, natural, human, financial, physical, social and political capitals are necessary (Eisenack et al., 2012). This makes adaptation a costly undertaking particularly for the resource poor (Stockholm Environment Institute, 2009).

An individual's or institution's adaptive capacity can vary over time depending on prevailing shocks (Daz'e et al., 2009). Adaptation can be hampered by inappropriate intentions, actor limitations, under or over utilization of resources and use of inappropriate strategies and actions (Eisenack et al., 2012). For example, actor limitations, such as having limited, distorted or wrong information on disease causes, control and management can result in mal-adaptation to disease. Obol et al. (2011), cite examples from Uganda, Ghana and Guatemala on how communities attribute wrong causes to malaria. For instance, in Uganda, some communities believed that the disease was caused by consumption of untreated water, lung associated illnesses and improper diet; in Ghana, some believed it was caused by consumption of starchy and oily foods, while in Guatamala, they believed it was caused by contact with cold weather, poor diet and hygiene. A study by Kinung'hi et al. (2010), comparing knowledge, attitudes and practices among communities from malaria prone and non-prone areas in Tanzania found that some community members believed that use of bed nets was harmful especially to pregnant mothers (Kinung'hi et al., 2010). These communities are likely to take inappropriate adaptive measures hence increasing their vulnerability to malaria.

In a study of the socio-economic impacts of RVF in Kenya during the 2007 outbreak, Rich & Wanyoike (2010), explain that northern Kenya faced most negative impact on persons engaged in cattle and goat value chains. For three months when a slaughter ban was in effect, men, who are the dominant actors in the trade of live animals and meat, lost their main source of livelihood

and were forced to live on their savings and alternative livelihood strategies (Rich et al., 2010). Ceasation of the outbreak did not usher immediate return to trade for all. In Mwingi, 50% of local cattle traders, 75% of local goat traders and 45% of traders that procure animals from Garissa had not resumed trade a month after the outbreak ceased due to financial constraints (Rich et al., 2010). This indicated that the coping strategies utilized by the traders were not contributing into the long-term resilience of the communities in Garissa. Adaptation strategies and activities are expected to continuously and deliberately focus on long-term strengthening of an individual or organization in managing exposure and reducing sensitivity to shocks while utilizing available resources sustainably (Daz'e et al., 2009).

Adaptation to disease can apply both biomedical and indigenous knowledge. This is exemplified in a study on the health seeking behavior of the Abagusii of Kenya who thought that they had malaria (Nyamongo, 2002). The study showed that people first applied self-treatment with herbs or over the counter medicines before seeking treatment in health facilities. The practice of self-treatment was driven by the awareness of the right herbs and medicine for malaria, knowledge of malaria signs and symptoms and the need to save money which would have been spent in seeking treatment. However, self-treatment can result in mismanagement of disease hence increasing its severity and outcomes and misuse of malaria medicines in case of misdiagnosis.

Some strategies used in coping can also be used for adaptation. For example, the use of conventional malaria medicines to manage the disease is a coping strategy. However, continuous compliance with conventional malaria treatment regime at community level can be considered an adaptation measure because it stems drug resistance and enhances wellness in the long term. Due to the continuous nature of adaptation, individuals and actors can utilize old and new adaptive strategies simultaneously to enhance their resilience to shocks such as diseases (Daz'e et al.,

2009). For instance, an individual that previously only cleared their compound of excess vegetation to reduce mosquito resting spaces can also add bed net use to strengthen their vector control strategy.

2.6 Theoretical Framework: The Bio-cultural Approach

The Bio-cultural approach to human health is propounded by Ann McElroy (McElroy, 1990). It views human health outcomes as products of biological, socio-cultural and environmental functions (Dufour, 2006; McElroy, 1990). It holds that holistic understanding of issues affecting human populations can only be achieved through a combination of these three dimensions. Bio-cultural health research finds expression in two dominant models; one which combines biological, environmental and cultural data and another in which biological data is dominant and is supplemented by cultural and environmental data (McElroy, 1990). This study applied the first model which gives prominence to biological, cultural and environmental data through the general adaptation model of the bio-cultural approach. This model is composed of four components, namely, the biotic environment, abiotic environment, cultural environment and human variation (Khongsdier, 2007). The biotic environment refers to living things such as disease causing organisms and predators while abiotic environment refers to non-living things that are not man-made such as rain, temperature and topography (Khongsdier, 2007). The cultural environment refers to behavioral, social and economic contexts (Khongsdier, 2007). Human variation includes demographic and physiological characteristics of human population (Khongsdier, 2007).

By nature, bio-cultural research is too broad to be covered by a single researcher. In addition, it requires a multi-disciplinary team to effectively research the biological, cultural and environmental dimensions. This necessitates the use of secondary data to enhance research

findings in dimensions that are inadequately covered by the research (McElroy, 1990). This study focused on the socio-cultural dimensions of adaptation to malaria and RVF and used relevant secondary data from the fields of medicine, epidemiology and climatology to explain research findings where necessary.

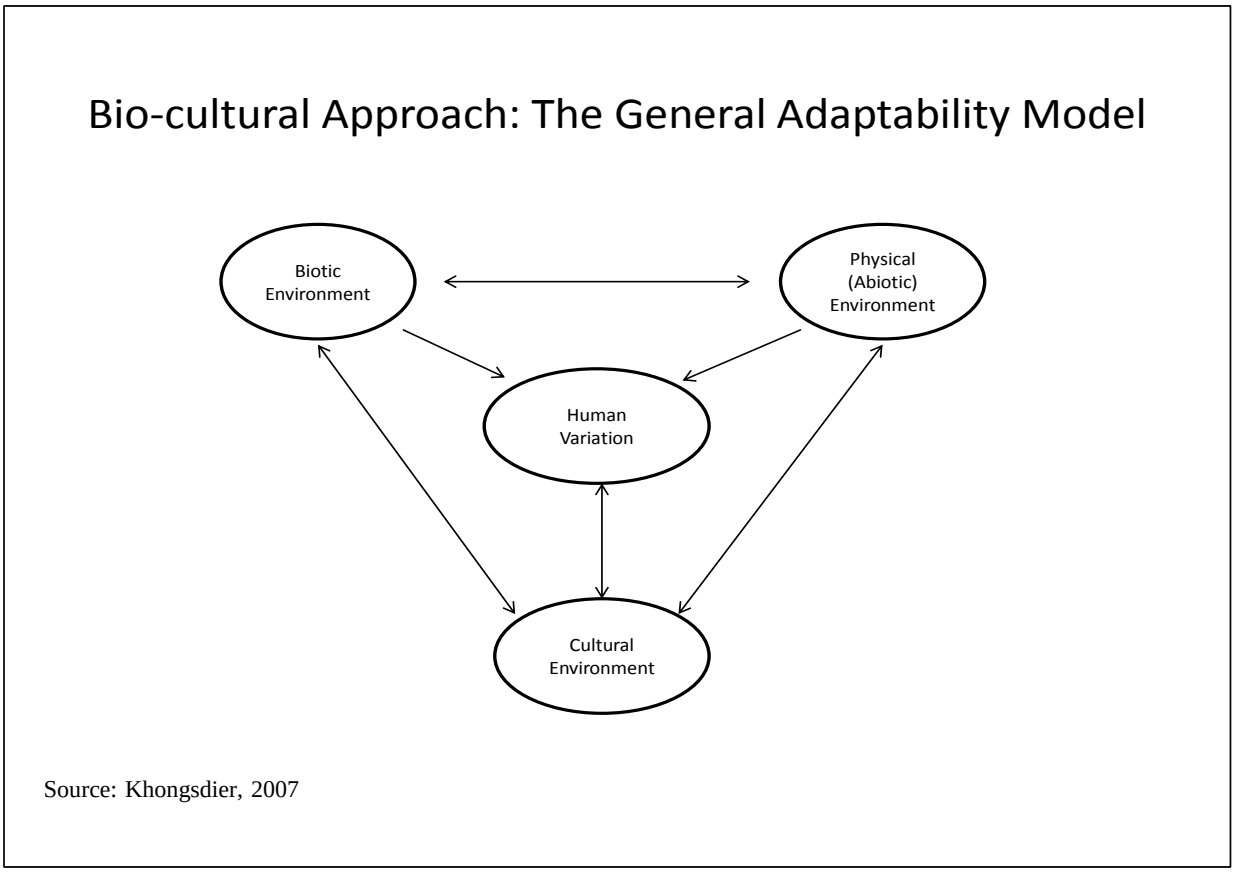


Figure 2. 1: Illustration of the bio-cultural approach-the general adaptability model

2.6.1 Relevance of the Bio-cultural Approach to the Study

The bio-cultural approach is relevant to this study because it links the biotic, abiotic and socio-cultural environments and human variations to demonstrate conditions that make it possible for malaria and RVF to occur and cause adverse effects on human beings while giving indications of potential solutions. In this study, the biotic environment referred to malaria and RVF vectors and the parasites and virus that cause the diseases, respectively. The abiotic environment referred to

rainfall, temperature and topography that favours vector and malaria parasite and RVF virus development and transmission. The socio-cultural environment refers to the human way of life in terms of interactions with disease causing vectors; practices that increase or decrease vulnerability to these diseases; ownership, control and access to human, natural, physical, financial, social and political capitals for use in disease control and management; and the strategies communities have for coping with these diseases. Human variation refers to differences in demographic characteristics such as age and sex.

Together, the four components of the conceptual framework influence the cycle of disease and determine human and livestock health outcomes resulting in differential vulnerability and resilience. Specifically, adequate amounts of rainfall and temperatures create conducive environment for breeding, growth and development of malaria and RVF vectors and associated disease causing organisms. Based on the community's way of life, transmission of disease causing organisms to humans in the case of malaria and both humans and livestock for RVF is possible. For instance, in communities where human-livestock interaction is high, and low levels of biosecurity measures are applied, probability of transmission of zoonotic diseases like RVF is high. Where women are engaged in fetching water for domestic use at dawn, their exposure to malaria vectors is increased.

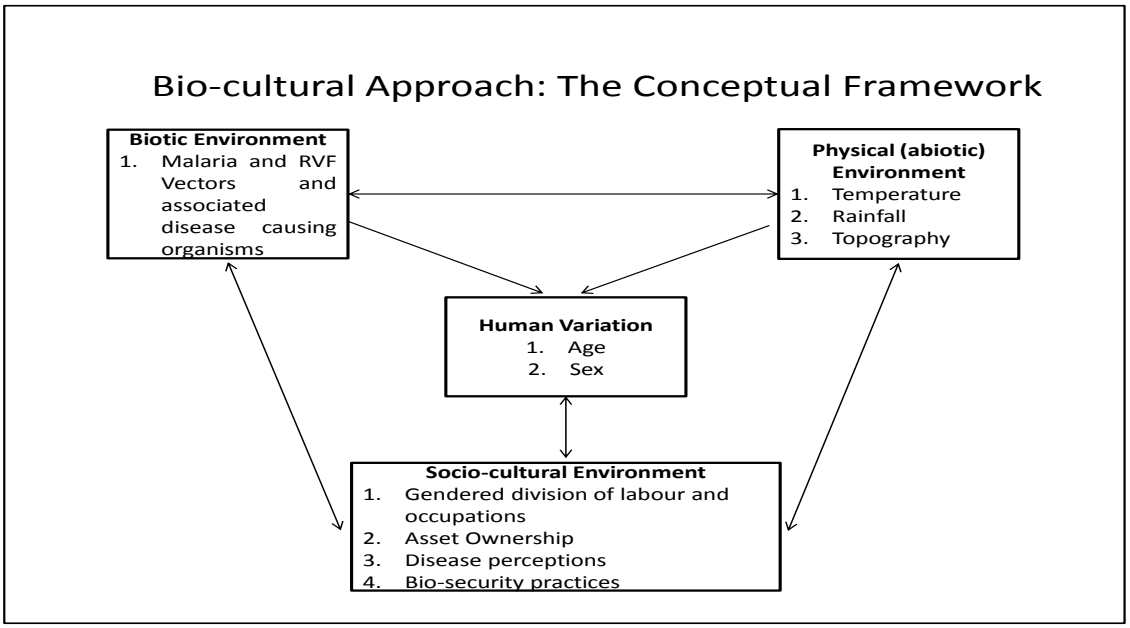


Figure 2. 2: The conceptual framework-Adapted from Khongsdier (2007)

Human variations like age and sex determine an individual's potential avenues of exposure to disease. In terms of sex for example, men working in livestock trade and abattoirs are at greater risk of infection during an RVF outbreak compared to those in other industries. Expectant women have been found to be more attractive to malaria vectors and hence more vulnerable to the disease than non-expectant ones. Age wise, children under five years are more vulnerable to malaria compared to older ones. In households that do not observe adequate veterinary care and sanitation standards, children are at great risk of contracting bacterial and zoonotic diseases like RVF from animal source proteins.

Through its way of life, a community can influence climatic outcomes. Anthropogenic activities such as land use practices, use of fossil and bio-mass fuels contribute to emission of GHGs into the atmosphere. Subsequently, global warming occurs and over time causes changes in oceanic and atmospheric temperatures and hydrological cycles. As a consequence, extreme weather

events such as flooding and increased in land temperatures, which create conducive environment for growth and development of malaria and RVF vectors and pathogens occur.

Chapter 3: Methodology

3.1 Introduction

This section is broadly made up of two parts; the site description and the research methodology. The site description covers the geographic, economic and health systems characteristics of Baringo County as described in the first County Integrated Development Plan 2013-2017. The research methodology section covers the research design; study and sample population; sampling procedures; data collection and analysis and ethical considerations.

3.2 Research Site

3.2.1 Administrative Boundaries and Population

The study took place in Baringo County, Kenya, shown in Map 1. Located at 04° 0′N 36° 00′E, Baringo County constitutes of Baringo Central, Baringo North, East Pokot, Koibatek, Mogotio and Marigat sub-counties (Figure 3.1). It borders Turkana and Samburu counties to the north, Laikipia County to the east, Nakuru and Kericho Counties to the south and West Pokot, Elgeyo Marakwet and Uasin Gishu Counties to the west. It had an area of 11,075.3 km² and a population of 555,561 (KNBS, 2010). Of these, 279,081 were males and 276,480 females (KNBS, 2010). The County had an age dependency ratio of 100:107 (KNBS, 2010).

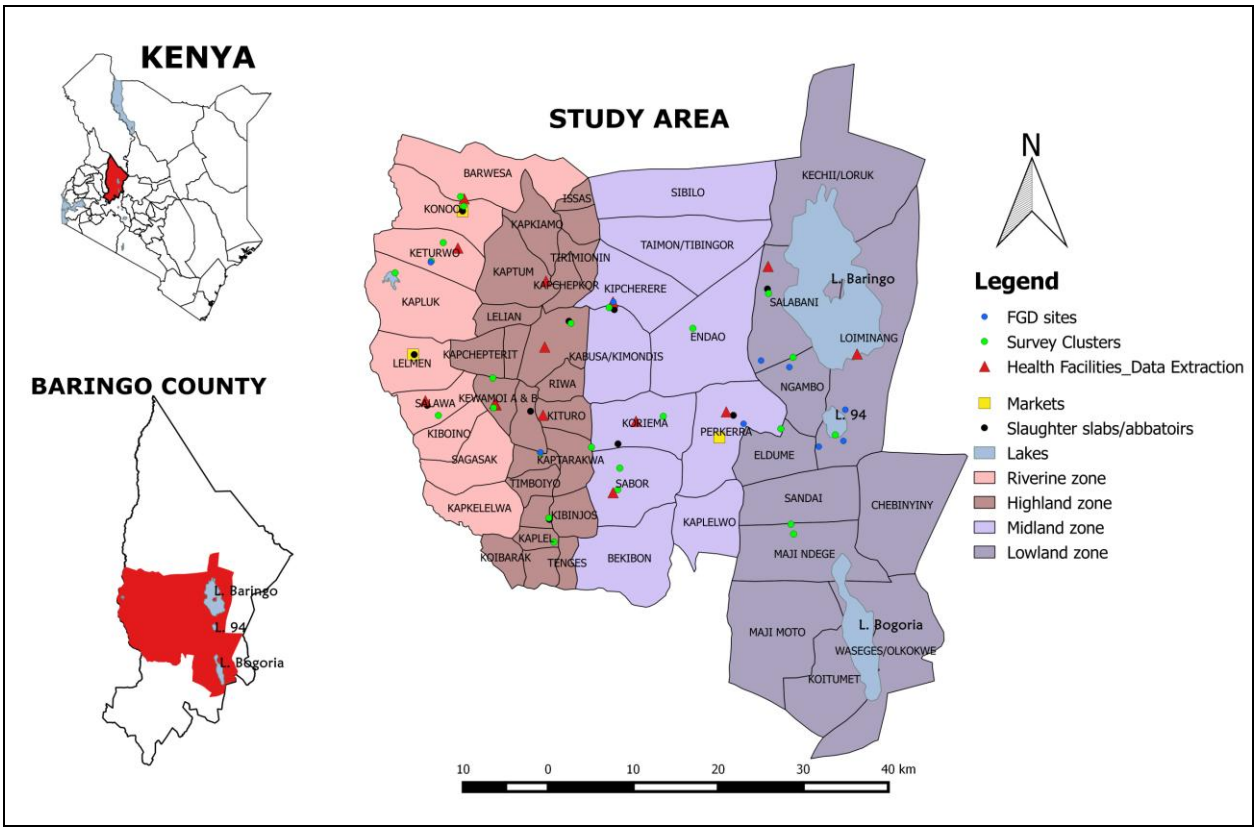


Figure 3. 1: Study site

3.2.2 Climate and Topography

The County's altitude varied from 700m-3000m between the lowest and the highest points above the sea level respectively. It received an average of 650mm of rainfall annually, ranging from 600mm in the lowland to 1500mm in the highland between March and August. In terms of sub-counties, Koibatek received the most rainfall while Mogotio, Baringo North and East Pokot which make the lowland got the least. Temperatures ranged from a minimum of 10° C to a maximum of 35°C on average. Lake Baringo and Lake Bogoria made the largest water bodies in the County.

The study was carried out in Baringo Central, Marigat and Baringo North sub-counties which lie in the central part of the larger Baringo County (Figure 3.1). The site was divided into four zones running parallel to one another in north-south direction. This categorization was based on

altitude, water bodies, rainfall quantities and vegetation. The zones, from east to west were: the lowland surrounding Lakes Baringo, Bogoria and 94; the mid altitude areas; the highland and the riverine area along the Kerio River.

3.2.3 Economic Activities

The County's main economic activities were agricultural in nature. The highland were fertile and communities practiced mixed farming while the lowland had poor soils and rainfall and thus limited crop production was practiced. The crops grown in the County included maize, beans, sorghum, finger millet, rice and cowpeas. Of these, maize was the main food and cash crop produced. Small scale irrigation was practiced in Marigat sub-county. In terms of livestock, cattle, goats, sheep and poultry were the most common. Trade in livestock and derived products was a key economic activity. Fishing was practiced around Lake Baringo. The County had potential for tourism but the sector was largely underdeveloped.

3.2.4 Health Systems

The County had 184 health facilities spread in its six sub-counties. These include: 2 medical clinics, 19 health centres, 156 dispensaries, 4 sub-county hospitals, 1 county hospital and 2 others. These health facilities had fewer staff and resources than the County required and were often difficult to access owing to poor road networks. The most prevalent diseases in Baringo County were malaria, pneumonia, respiratory tract infections and skin diseases.

3.3 Research Design

The descriptive cross-sectional study applied a mixed methods approach, collecting both qualitative and quantitative data in the highland, lowland, midland and riverine zones. Quantitative data comprised of a Knowledge, Attitudes and Practices (KAP) survey, and surveys

on biosecurity practices in markets, abattoirs and slaughter slabs. Qualitative data comprised of Focus Group Discussions (FGDs), Key Informant Interviews (KIIs) and observations.

3.4 Study Population

The study population primarily constituted of people in Baringo County. Other stakeholders in malaria and RVF control and management, who comprised of Nurses In-charge of health facilities and veterinary officers, were also included.

3.5 Sample Population

The sample population constituted of local men and women that had either been affected or infected by malaria and RVF, County and sub-County veterinary officers, and Nurses In-charge of select health facilities.

3.6 Sampling Procedure and Sample Size

Baringo County, the site of this study was chosen purposively as it falls in the seasonal transmission zone of malaria (DOMC et al., 2011) and cases of RVF were reported in the 2006-2007 outbreak (Anyamba et al., 2010). A study by Nguku et al. (2010), illustrating the scale of the 2006-2007 RVF outbreak through surveillance and sero-surveys found that out of 340 human incidents that met the possible or confirmed case threshold in Kenya, 84 cases were from Baringo.

Participants for the qualitative component of this study were selected purposively. This non-random sampling technique is flexible and allows a researcher to sample respondents that are not evenly distributed in a study population (Bailey et al., 2011). For FGDs, community members who had lived in the area for over two years and were knowledgeable of community characteristics, human and livestock diseases were identified with the help of village leaders and

invited for discussions. Key informants were selected for interviews based on their depth of knowledge and experience with livestock and human diseases and changes that have happened in the study site over time in terms of climate variability and disease. Markets, abattoirs and slaughter slabs were selected based on their location within the study site.

For the quantitative component of this study, the KAP survey, clustered sampling method was used to capture respondents from the four zones. The unit of analysis was the individual. The sample frame of the locations in the study site was approximately 117,300 (KNBS, 2010). The sample size for respondents of the KAP survey was determined by the use of proportionate to size sampling methodology for a finite population (Kothari, 2004), as follows:

Table 3.1: Sample size calculation

$n = \frac{z^2.p.q.N}{e^2(N-1)+z^2.p.q}$	N = the population size n = sample size z = 1.96 (the 95% confidence level) p =0.5 (using a proportion of 0.5 gives the largest sample possible) q = 0.5 or (1- p) (the proportion of community members that is knowledgeable of Malaria and RVF) e = 0.05 (the margin of error set at 95%)

The calculated sample size (n) for the KAP survey was 383 persons. To cover for any drop-outs and incomplete questionnaires, a further 5% of (n) were added to make the sample size 400. In this study, 400 persons were set as the minimum number of respondents acceptable with

possibility of proportionately enlarging the sample in each cluster if resources allowed. Therefore, a total of 560 individuals, 160 more than the set minimum were interviewed.

3.7 Data Collection Methods

The study collected both primary and secondary data. Primary data was collected through a KAP survey, biosecurity practices in markets survey, biosecurity practices in abattoirs/slaughter slabs survey, Focus Group Discussions (FGDs), Key Informant Interviews (KIIs) and observation. Data collection began in October 2014 ended in November 2015.

3.7.1 Primary Data Collection

Knowledge, Attitudes and Practices Survey: This is a closed ended questionnaire survey that examines what a sample population knows about a given subject, thinks and feels about it and behaves towards it (Hausmann-Muela et al., 2003). In this study, the KAP survey was categorized into 4 sections on household characteristics, malaria, RVF and perceptions of health care services (appendix 9.4). The household characteristics section captured demographic information of the respondents and their livelihood activities. The malaria section was used to collect data on perceptions of malaria, populations at risk of infection, treatment, bed net use, and use of other control measures. The RVF section covered knowledge of the disease and modes of transmission to humans, livestock ownership patterns, current use and value of livestock and livestock products, livestock disease management, and disposal of dead livestock. The final section looked into the perceived quality of health care and how it influenced use of medical services. The survey questionnaire was pretested with 40 respondents in three areas which shared similar characteristics with the sampled sites and all relevant amendments made before data collection. The pretest sites were excluded from the main survey. Data was collected by Tugen and Ilchamus speaking enumerators.

Biosecurity practices in markets and abattoirs/slaughter slab survey: A biosecurity practices survey targeting livestock traders was also conducted to assess livestock movements and disease control and/or management practices for animals on transit within and outside the County. In addition, four abattoirs and six slaughter slabs were also visited and 10 respondents interviewed on frequency of slaughter, disposal of condemned parts and other slaughter waste, and cleaning of the slaughter facilities. The checklists for both studies are provided in appendices 9.5 and 9.6 respectively.

Focus Group Discussions: These are interactive discussions between participants with characteristics or experiences that are useful in informing a pre-determined topic (Bailey et al., 2011). Used for broad exploration of a given topic under the guidance of a trained moderator, this method can be used in collecting and verifying multiple views simultaneously within duration of 1-1.5 hours (Bailey et al., 2011). In this study, for clarity in data collection, 3 focus group discussion schedules on community characteristics, malaria and RVF were used separately with different groups (appendix 9.2). Each guide was pretested in 2 FGDs comprising exclusively of men or women to assess appropriateness of questions, participatory activities and duration. All requisite amendments were made prior to actual data collection.

Sex disaggregated qualitative data were collected through 66 focus group discussions (20 FGDs on control and management of malaria, 26 on livestock production practices and RVF and 20 on community characteristics). Half of the FDGs (33) comprised of men only and the other half women only. Conducting single sex groups enabled the researcher to collect views from both men and women without cultural inhibitions often associated with mixed FGDs in conservative communities. Each FGD was recorded in audio and manual formats for use in data analyses.

Key Informant Interviews: These are in-depth face-to-face interviews designed to collect personal views on a pre-selected topic from knowledgeable persons (Bailey et al., 2011). In this study, 21 KIIs were conducted; 14 with elderly community members, 4 with veterinary officers and 3 with Nurses In-charge of different health centers. Half (7) of the interviews with community members comprised of male interviewees and the other half women. These interviews discussed traditional methods of predicting weather patterns, malaria and RVF control and management and perceived quality of health services. Interviews with health and veterinary officers covered malaria and livestock disease management, respectively. Each interview was recorded in audio and manual formats for use in data analyses. The KII schedules used for each these categories of informants are provided in appendix 9.3.

Observation: This is a data collection method that allows a researcher to observe and record peoples actions in a given context (Bailey et al., 2011). With the guidance of bio-security checklists (appendices 9.4 and 9.5), the researcher observed adherence of various biosecurity measures in the 3 main livestock markets, 3 abattoirs and 7 slaughter slabs in the study area. These measures included: inspection of animals for disease upon entry into markets, abattoirs and slaughter slabs; waste disposal; infrastructure; use of protective clothing by abattoirs/slaughter slabs workers; meat inspection and meat/livestock transportation. All observations were captured in pictures and the questionnaire.

3.7.2 Secondary Data Collection

Secondary data on climate change and variability, malaria and RVF aligned with the objectives of the study was collected through literature searches in relevant books and journal articles.

These data informed the researcher of what other scholars in the fields of climate change, malaria, RVF and community resilience had covered and the gaps that need further investigation.

3.8 Data Processing and Analyses

Upon collection, recorded audio qualitative data from KIIs and FGDs were transferred from recorders to a computer for storage under unique identifier codes. All audio files were transcribed verbatim into English by Tugen and Ilchamus speaking scribes. Each script was verified by reading through while listening to the audio file to ensure that the content matched. Further verification was achieved through comparing field notes and the scripts to capture any additional comments and observations regarding the topic of discussion. Verified data was coded into emergent themes and analyzed using the content analysis technique in NVivo version 10. Quantitative data from the KAP and biosecurity practices studies were entered into CSPro version 6.1 and cleaned through verifying that the data captured matched those recorded in the questionnaires. Cleaned data was exported to SPSS 23 for analyses through descriptive and inferential statistics. Back up files for all data were created and stored online and in an external hard disk to prevent data loss.

3.9 Ethical Considerations

The study applied the ethical principles of respect, justice, and beneficence as required when conducting behavioral research with human subjects (Resea et al., 1978). In accordance with the principle of respect of persons, all study participants were treated humanely and respectfully at all times. Prior to recruitment of participants for the study, the researcher explained to each individual the purpose of the study, the methods that would be used to collect data, the use and storage of raw data, dissemination of analyzed data, benefits and risks of participating in the study and the amount of time needed for the exercise. Each potential participant was allowed to

ask questions regarding the study and their willingness or unwillingness to participate. Participation was only on voluntary basis. Written consent was sought and obtained from willing participants, all of whom were of consenting age (between 18 and 89 years) before engaging in any research activity. Illiterate participants were allowed to substitute their signatures for thumb prints as evidence of consent.

Minimizing potential for harm and maximizing potential for good are the intentions of the principle of beneficence. In this study, to minimize potential for harm to participants, anonymity of all participants was maintained during and after data collection. All collected data remains confidential and was used by the research team only for purposes of research. No participant was coerced to participate in the study. Potential participants who were unwilling to participate in the study and those that dropped out in the course of the data collection period were not penalized in any way. In maximizing potential for good, each participant benefited directly from participating in this study by receiving information on prevention and control of malaria and RVF. The findings of this study were used to inform efforts in management and control of malaria and RVF in Baringo County. The principle of justice was applied through ensuring that each selected participant was given fair chance to participate in the study.

Prior to commencement, this research received ethical clearance through the Kenyatta National Hospital and University of Nairobi Ethics Review Committee reference P70/02/2013 (appendix 9.7) and WHO Ethics Protocol ID B20278. The researcher also acquired a research permit referenced NACOSTI/P/15/4591/4465 from the National Council of Science, Technology and Innovation as required by Kenya government. Additional authorization was also awarded by the Baringo County veterinary, health and education departments (appendix 9.7).

Chapter 4: Community Knowledge, Practices and Vulnerability to Malaria and RVF

4.1 Introduction

This chapter covers results on objective 1 on community knowledge of the relationship between malaria, RVF and climate variability and objective 2 which aims at determining the link between socio-cultural practices and vulnerability to the diseases. It is divided into three sections. These are: the demographic characteristics of focus group discussants, KAP survey respondents, livestock traders, slaughter facilities' workers and key informants; findings on community knowledge of the relationship between climate variability, malaria and RVF; and findings on socio-cultural practices influencing vulnerability to malaria and RVF.

4.2 Demographic Characteristics of Study Participants

4.2.1 Sex

In FGDs, 76 men and 88 women participated in 20 discussions on malaria (n=164), 97 men and 90 women in 20 discussions on community characteristics (n=187) and 112 men and 119 women in 26 discussions on RVF (n=231). A total of 560 respondents participated in the KAP survey of which 47.5% were male and 52.5% female (Table 4.1). All abattoir and slaughter slab workers interviewed were male (n=10). Among livestock traders, 96.1% were male and 3.9% female (n=203).

4.2.2 Age

Focus group discussants' and survey respondent ages ranged from 18-84 and 18-89, respectively, with a median of 40 years. Among livestock traders and abattoir/slaughter slab workers the median ages were 35 (range 18-68) and 47 years (range 23-62) respectively.

4.2.3 Education

In FGDs, discussants ranked education levels into five categories namely: none, primary, secondary, college and university. For both men and women, percentages in each category were estimated through proportion piling and the median percentages computed. More women (12%) than men (10.5%) lacked formal education while more women (32.5%) than men (29.5%) had primary education. More men had secondary (31.5%), college (12.5%) and university (7.5%) education than women (secondary 27%, college 7.8%, and university 7%). A similar pattern was observed with the KAP survey respondents. Combined, however, most focus group discussants estimated that majority of population (32%) and survey respondents (52%) had primary education. Among livestock traders, 5.4% had no formal education, 39.9% primary, 36% secondary, 6.4% college, 7.4% university and 4.9% declined to disclose. Of the 10 abattoir/ slaughter slab workers interviewed, 7 had primary, 2 had secondary and 1 had tertiary education.

Pursuit of education was faced with institutional, domestic and environmental challenges. At institutional level, there was consensus among FGD discussants that not all schools had enough teachers (20), desks (18), text and exercise books (18). Parents were often required to top up the deficit through making additional payments to schools and purchase of school materials such as desks and books. In terms of infrastructure, schools were continuously improving from semi-permanent to permanent structures with electricity and stable water supply. At the domestic level, inability to afford school fees (18), long distances to schools (9), food (18) and water (4) shortage, insecurity (3) and early pregnancies (3), were identified as the key challenges. Environmental challenges like flooding made movement difficult for day scholars while drought led to food and water shortage which subsequently encouraged absenteeism.

Table 4.1: Summary of demographic characteristics

	Demographic characteristics		Participant Category				
			FGD participants	KAP Survey respondents	Livestock Traders	Slaughter slab and abattoir workers	Key Informants
1	Sex	Male	49%	47.5%	96.1%	100%	53.3%
		Female	51%	52.5%	3.9%	0	46.7%
2	Age	Range	18-84 years	18-89 years	18-68 years	23-62 years	-
		Median	40 years	40 years	35 years	47 years	-
3	Education	None	-	20.2%	5.4%	0	-
		Primary	-	52%	39.9%	70%	-
		Secondary	-	21.1%	36%	20%	-
		Tertiary	-	6.8%	13.8%	10%	23.3%
		Not disclosed	-	0	4.9%	0	77.6%
4	Religion	Christian	-	98.9%	98.5%	100%	100%
		Other	-	1.1%	1.5%	0	0
5	Ethnicity	Tugen	-	84.1%	82.2%	100%	73.3%
		Ilchamus	-	12.5%	5%	0	16. 7%
		Other	-	3.4%	12.8%	0	10%

4.2.4 Marital Status

In FGDs, proportions of people in monogamous and polygynous unions were estimated through proportion piling and the medians generated. When the marital status were compared through household headship, 70.5% of households were estimated to comprise of married couples, 18.5% single mothers and 9% single fathers. Seven in ten of the marital unions were found to be monogamous while the remaining 3 were polygamous. In the KAP survey, most respondents (78.4%) were in monogamous unions while the others were either in polygamous unions (10.5%) or single (11.1%).

4.2.5 Religion

The study participants were predominantly Christian.

4.2.6 Ethnicity

The Tugen and the Ilchamus sub-tribes of the Kalenjin and Maa communities, respectively, were the main inhabitants of the study site.

4.2.7 Livelihood Activities

According to FGD discussants, in terms of employment, majority of the people depended on wage labour and self-employment than formal employment. Of the formally employed, most were men. They tended to serve as teachers, policemen, soldiers, doctors, nurses, other civil servants and political leaders. The self-employed mainly engaged in goods or service delivery. These included retailing household consumables, construction materials, offering transport services using motorbikes and livestock trading and were mainly men.

In wage employment, certain activities were designated for men or women only. For instance only men could repair fences, source cattle feed from trees, herd cattle, sheep and goats and clear bush for farming. Women on the other hand sourced grass for thatching houses, fetched water or firewood for hotels and domestic consumption, took care of children, washed clothes or served as house helps. However, both men and women engaged in tilling land, planting, weeding and harvesting. The availability of casual labour varied seasonally. In the dry season, there was more labour in fetching water and firewood, herding livestock, sourcing livestock feed from trees, tiling land and fencing. During the wet season, available labour needs comprised mainly of planting and weeding. There was more casual labour in the wet than in the dry seasons. Men

found it more difficult to get wage labour in the dry than wet season than women since they could not do household chores.

Regardless of employment status, people engaged in multiple income generating activities to meet their needs. This is reflected in the KAP survey respondents whose main livelihood activities included crop farming (47.5%), livestock farming (20.2%), service delivery (7%), goods delivery (9.6%), wage employment (7.9%) and formal employment (5.7%).

4.2.8 Wealth Status

For wealth status, discussants classified community members as rich, average or poor. Proportions for each category were estimated through proportion piling and the median percentages for each category computed. The rich were the least at 15.5%, followed by the average at 34.5% and the poor at 46%. The common indicators used in wealth status ranking were ownership of land, vehicles, housing and livestock; children's education status; parents' education status; access to food and healthcare; and the type of livelihood activity one engages in. Of these, livestock ownership, children's education status, access to food and type of livelihood activity were identified in all 20 wealth ranking discussions. Housing and livestock were identified in 18 groups, parent's level of education and land ownership in 17, access to health care services in 16 and vehicles in 8. Detailed categorization is provided in Table 4.2a, Table 4.2b, Table 4.2c. Other indicators that were not widely identified included household electronics like radios, televisions, refrigerators; having piped water to the household and ability to harvest and store large quantities of rain water for domestic use.

Table 4.2a: Wealth indicators

	Indicators	Rich	Middle/Average	Poor
1	Land ownership	• They own large tracks of land within and in arable areas outside their locality on which they do crop and livestock farming • They also rent land for farming	• They own land on which they can live and do crop farming • Few afford to rent additional pieces of land within their locality for crop farming purposes such as along the shores of lake Baringo where they do irrigation	• They only own a small piece of land on which they build their house but it is not sufficient for crop farming, few may be landless
2	Vehicles ownership	• They have family cars, lorries, and motorcycles	• Have no cars but have motorcycles and/or bicycles	• May have a bicycle
3	Housing	• Iron sheet roof, stone/brick /iron sheet wall, cemented/ earthen floor • Have latrines and may have a flash toilet in the house • Have multiple living quarters within and outside the locality • Compound is fenced	• Iron sheet/grass thatched roof, timber/iron sheet/earthen walls and floor that may be smeared with cow dung • Have latrines (made of sticks, sack, or iron sheet and earthen walls) • House may be rented • Have 2 rooms and a separate grass thatched kitchen	• They mainly have grass thatched/iron sheet roof, earthen walls and floor houses • Some have houses made of stick walls and grass thatch *(borroriet)* • May have a maximum of two rooms (2 grass thatched houses) • No latrines, they depend on the bush
4	Livestock ownership	• Cattle (dairy) 0-5 • Cattle (indigenous) 10-100 • Goats (dairy) 0-5 • Goats (indigenous) 20-200 • Sheep 2-100 • Chicken 5-50 • They have ability to buy feeds and water for their livestock in the dry season • They practice herd splitting within and outside the locality • Some may not have livestock but have heavy machinery instead	• Cattle (dairy) 0-5 • Cattle (indigenous) 2-60 • Goats 2-60 • Sheep 0-20 • Chicken 2-20 • They practice herd splitting within the locality	• Cattle 0-2 • Goats 0-10 • Sheep 0-6 • Chicken 0-2 • No herd splitting

Table 4.2b: Wealth indicators (continued)

	Indicators	Rich	Middle/Average	Poor
5	Children's education status	• Can afford to educate their children from nursery to university levels in private and public institutions locally and internationally without fee challenges • Their children are believed not to have the aptitude for education owing to the comforts availed to them • Those who pursue education diligently are highly skilled and employed	• Manage to educate their children but with difficulties with school fees in secondary and tertiary levels • Can successfully hold fundraisers to cover education cost or rely on the Constituency Development Fund (CDF) • Children may go to either public and private schools • Children only study within the country, not abroad	• Have difficulties in educating their children from nursery level onwards • Their children are smart and driven by the need to come out of poverty • They are dependent on bursaries, fundraisers by well-wishers, CDF, for primary education and beyond • Their children are lowly educated, unless supported externally. Most drop out at primary level
6	Parents' education status	• Some have tertiary education • Those who are employed have tertiary education-diplomas and degrees • Some lack formal education	• They are educated sometimes to tertiary level and may hold diplomas • Most have secondary education • Some may not be formally educated	• There are those with some education and those without • They do not have tertiary education. They mainly achieve primary education
7	Food access	• Have 3 or more meals per day at pleasure • The meals are balanced and have variety • Can afford "luxury foods" such as meat, rice, tomatoes, fruits, spaghetti, processed flour • Food is sourced from their farms sometimes	• Have 2-3 meals a day, mainly breakfast and supper • Meals are less varied but balanced • Can afford "luxury foods" occasionally but their common meals constitute of *"githeri" (maize and beans boiled together)*, tea, *"sukuma wiki" (kales)* and *"ugali"*	• 1-2 meals per day mainly breakfast and supper. Sometimes they rely on food donations • Meals lack variety, mainly *"githeri"*, porridge, black tea, wild vegetables and "*sukuma wiki"* • Children go to school for lunch • Their children may suffer from food deficiency diseases
8	Healthcare access	• They go to private and public health facilities where they get comprehensive care and are able to afford the services • Have medical insurance cover by the state (NHIF) in addition the employer's insurance if one is employed • Can afford treatment abroad • They can afford to transport a sick person with ease through their vehicles or taxis	• Can access medical care in public and private health facilities • Need assistance from others when faced with serious conditions (such as kidney problems) to fundraise • Some have state insurance cover (NHIF)	• They have difficulties in accessing quality healthcare • They depend on money borrowed from the middle class or other community members through fund raising • Can access services at the local dispensary where they are free of charge • They do not have state insurance cover (NHIF)

Table 4.2c: Wealth indicators (continued)

	Indicators	Rich	Middle/Average	Poor
9	Livelihood activities	• They are employed as nurses, doctors, police, soldiers, teachers, District commissioners, senators, Members of County assembly, civil servants or in multi-national companies and have regular monthly income • They have businesses like hardwares, *m-pesa (mobile money transfer services),* hotels, wholesale shops, crop (with or without irrigation) and livestock farming, charcoal, land brokering within and outside the locality • May have remittances from children • Are able to employ farm hands and domestic workers • They depend on more than one livelihood activity to make ends meet	• Some are employed as civil servants, teachers, nurses, policemen or other employment such as watchmen • They have businesses like selling traditional liqour, charcoal, vegetables, fruits, firewood, Napier grass, water, ballast, fish, meat, household consumables • They engage in wage employment like clearing farms, tilling land, weeding, irrigating farms, spraying pesticides, masonry, fencing, managing farming, fetching water, making beehives, cooking, herding livestock and serving as house helps • Sometimes can afford to employ farmhands and domestic workers • They engaged in more than one livelihood activity	• They rely on wage employment from the middle class like fetching water and firewood, grass cutting, tilling land, herding livestock, washing clothes, splitting firewood for hoteliers, burning charcoal, bulking grass thatches or serving as house helps • They have small businesses like shoe repair, tailoring, knitting sweaters • They engage in more than one livelihood activity to make ends meet
10	Relations with other wealth categories	• They provide wage employment for the average and poor • They have limited interaction with the poor	• They provide link between rich and poor by providing services to the rich and labour for the poor • Most poor people can depend on them as they help more readily than the rich • They help each other within their class	• They depend on the middle class more than the rich • They help each other within their class and with the middle class more than the rich

4.3 Malaria, RVF and Climate Variability

This section is categorized into two sections. They address the relationship between climate variability and both malaria and RVF.

4.3.1 Malaria and Climate Variability

This section covers the communities perceptions about malaria as well as its signs and symptoms. It further assesses local knowledge of severity of malaria signs and symptoms,

seasonality and how climate variability continues to manifest. It concludes by exploring the methods that the community uses in traditional weather forecasting.

Malaria

There was consensus in focus group discussions that malaria, locally referred to as *"esse"* in Tugen or *"ntikana"* in Ilchamus was the most common disease in the area, followed by diarrheal and respiratory tract diseases (RTIs). The RTIs comprised of pneumonia, tuberculosis, common cold and asthma. Diarrheal diseases included typhoid, amoebiasis, brucellosis and diarrhea. Malaria was reported to occur all year round but there were more cases in the wet than dry seasons.

Survey respondents reported varying combinations of malaria signs and symptoms which comprised of fever (80.2%), headache (65%), vomiting (60.5%), loss of appetite (53.4%), joint pains (51.4%), chills (48.8%), weakness (37.2%), diarrhea (14.3%) and drowsiness (5.9%) as summarized in Figure 4.1. However, 74.2% of respondents were aware that all fevers were not a sign of malaria. There was a positive statistical association between education and knowledge that all fevers were not a sign of malaria (χ^2 =19.820, df=3, p<0.001). Similarly, in all FGDs, fever, headache, vomiting, loss of appetite, joint pains, weakness, diarrhea and dizziness/drowsiness were identified as the main signs and symptoms of malaria.

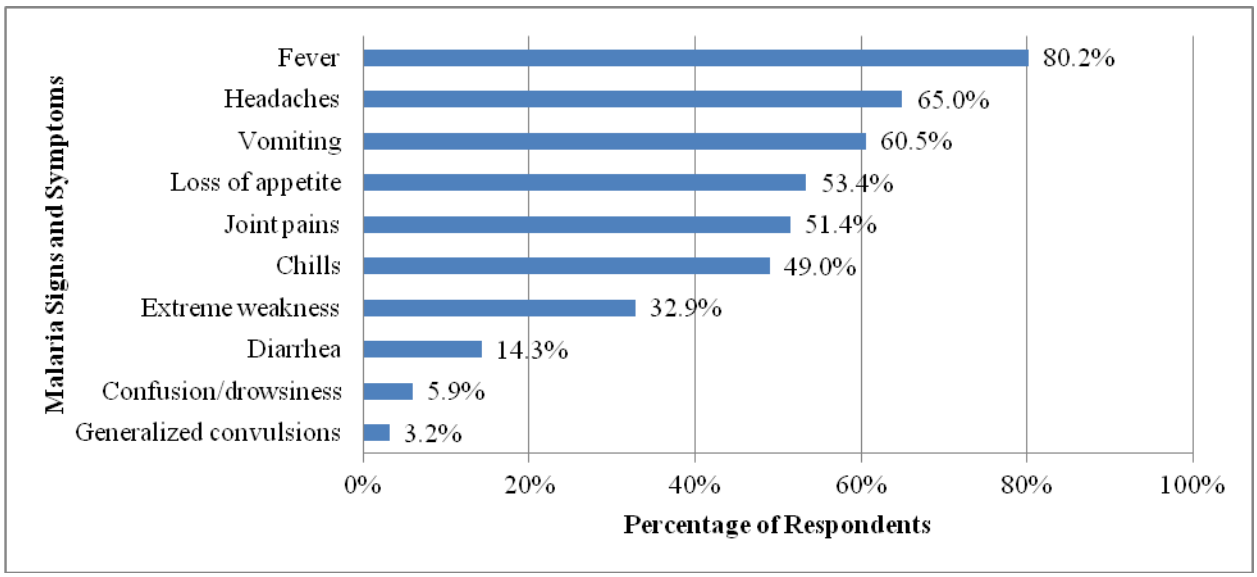


Figure 4. 1: Malaria signs and symptoms (multiple responses)

In every FGD, a pairwise ranking exercise was conducted to determine the relative severity of each malaria sign or symptom (Figure 4.2). Discussants ranked vomiting, diarrhea, fever, headache, body weakness, loss of appetite, joint pains, chills and dizziness/drowsiness in decreasing order of severity. In Figure 4.2, the signs and symptoms assumed to be most severe are situated towards the center of the figure and have a relative weight score closer to 1 while those that are less severe are located towards the periphery and have scores closer to 0. For example, in comparison to other signs and symptoms, dizziness had the lowest score (0) relative to diarrhea and vomiting while the latter (vomiting) had the highest relative weight at 0.95. There was no gender difference in the identification of malaria signs and symptoms and perceived severity.

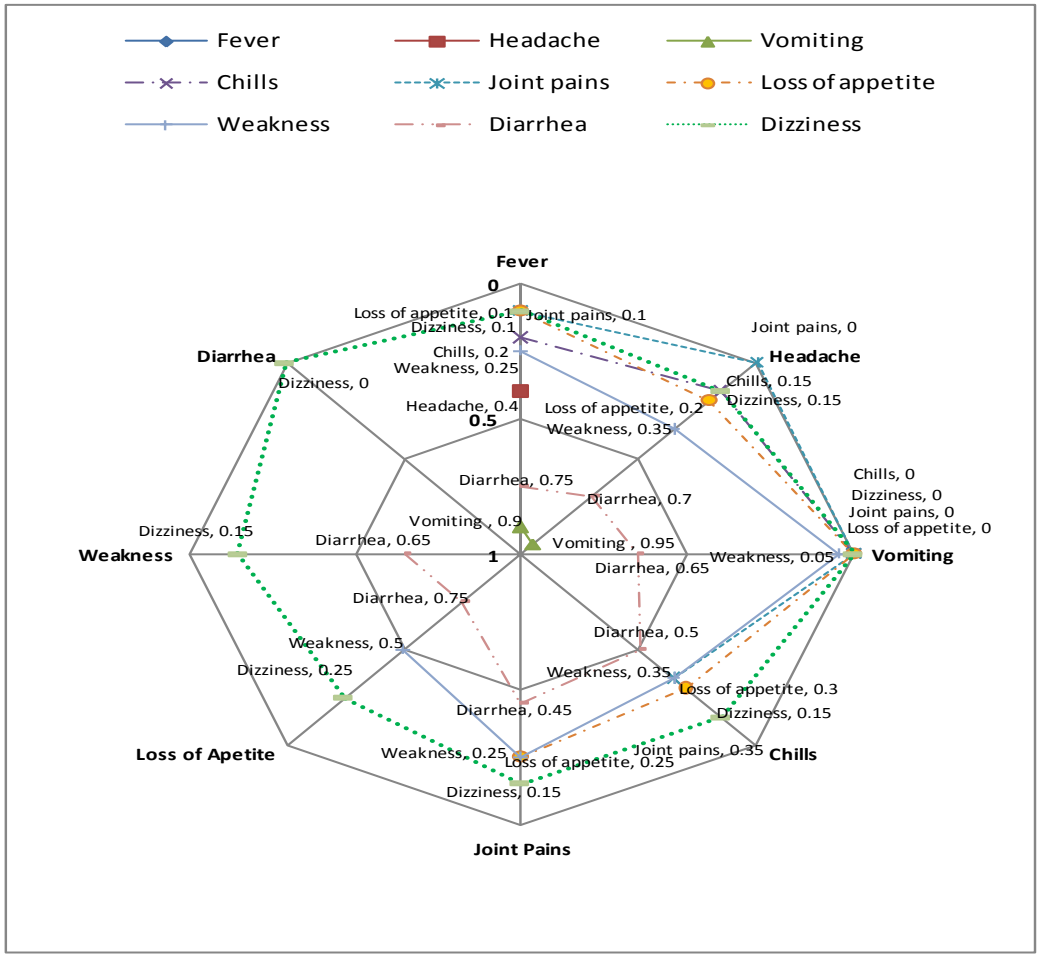


Figure 4. 2: Aggregate pairwise ranking of malaria signs and symptoms

Malaria seasonality

Through seasonality calendars, community members categorized January and February as dry months, March as mainly dry but sometimes wet towards the end, April to July as wet and August to December as mainly dry but with possibility of light rains. Most malaria cases were reported to occur between May and August when the rains facilitated formation of numerous pools of stagnant water which became mosquito breeding sites. The rains also led to an increase in vegetation cover which provided mosquitoes with ample resting places.

Years with high rainfall were reported to witness larger mosquito populations but not necessarily more malaria cases due to use of vector control methods. However, there was no consensus on

whether malaria cases had been increasing or decreasing over time. Discussants that believed malaria cases were on the increase attributed the it to consumption of fatty, sugary or fresh/"green" foods and the introduction of *Prosopis juliflora* plant which provided ample resting places for mosquitoes. Those that believed malaria cases were on the decline attributed the change to the use of vector control methods and effective medicines. Weather changes were in no way associated with the perceived increase or decrease in malaria cases.

Climate Variability

Discussants observed that increasingly, wet seasons now have unpredictable onsets, with rains often coming later and in lesser quantities than expected. Survey respondents affirmed this finding, with 46.6% reporting that changes in the onset of the rainy season resulting in changes in planting time were high in frequency while 45% rated the occurrence as moderate in the last five years. The shifts from old patterns where rain started promptly in March and was heavy to the current unpredictable form were attributed to cutting down trees to clear land for inhabitation by the ever growing population; sourcing timber for construction and carpentry; or wood for charcoal burning. The belief that the lengthier dry spells observed were punishments from God for the increased wickedness in the locality was also cited.

Traditional weather forecasting

Traditionally, rainy seasons were predicted using tree phenology, goat intestines, or the positioning of stars and planets. Forecasting using tree phenology was done by both men and women based on observation of the flowering season of certain tree species such as the *Acacia tortilis* (Picture 4.1). The trees identified and the interpretation of their phenological characteristics are presented in Table 4.3.

Picture 4. 1: A flowering *Acacia tortilis* tree

Table 4.3: Tree species used for weather prediction

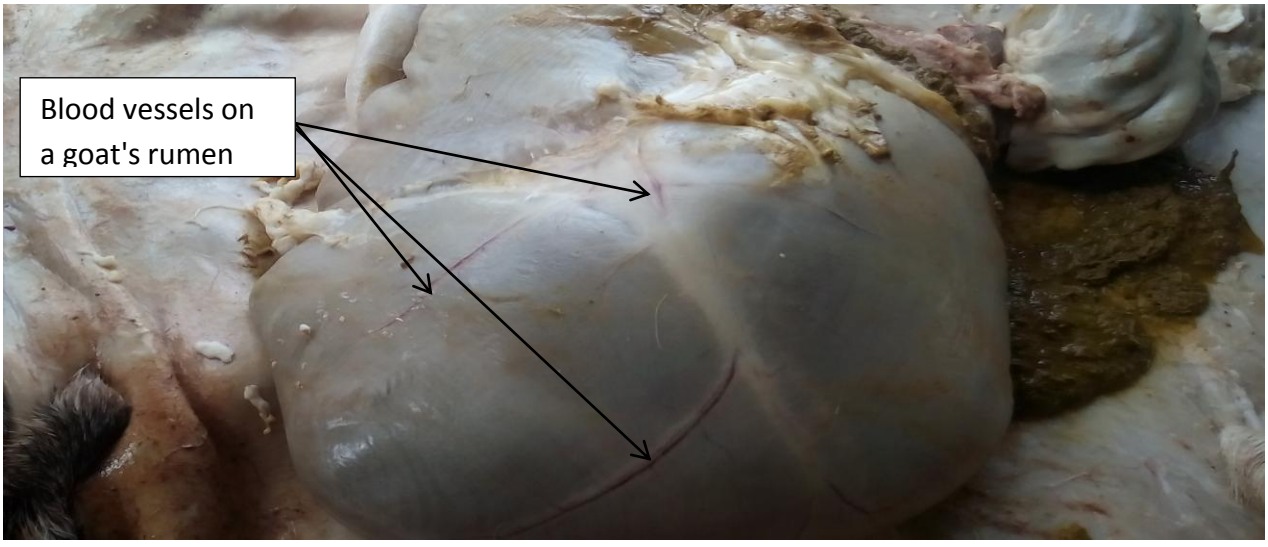
	Local tree name	**Scientific tree name**	**Indicator**
1	Komolwe	*Vangueria infausta*	It flowers at the onset of the wet season
2	Lomoiywe	*Syzygium guineese*	It flowers towards the end of the dry season and extends into the rainy season
3	Sessiat	*Acacia tortilis*	It flowers at the onset of the wet season
4	Tabilikwe	*Dodonoea viscosa*	If it has a lot of flowers/seeds the millet harvest be good (indicating moderate rainfall)
5	Logoiywe	*Ficus sycomorus*	It flowers at the onset of the wet season
6	Torlolokwo	*Sclerocarya birrea*	It flowers at the onset of the wet season
7	Tilingwo	*Meyna tetraphylla*	It flowers at the onset of the wet season

Forecasting using goat intestines was a reserve of a select group of male elders. Upon slaughter, a goat's abdomen was opened and the moisture content and intensity in the color of blood vessels was observed (Picture 4.2 and Picture 4.3). Moist intestines in texture and bright red blood

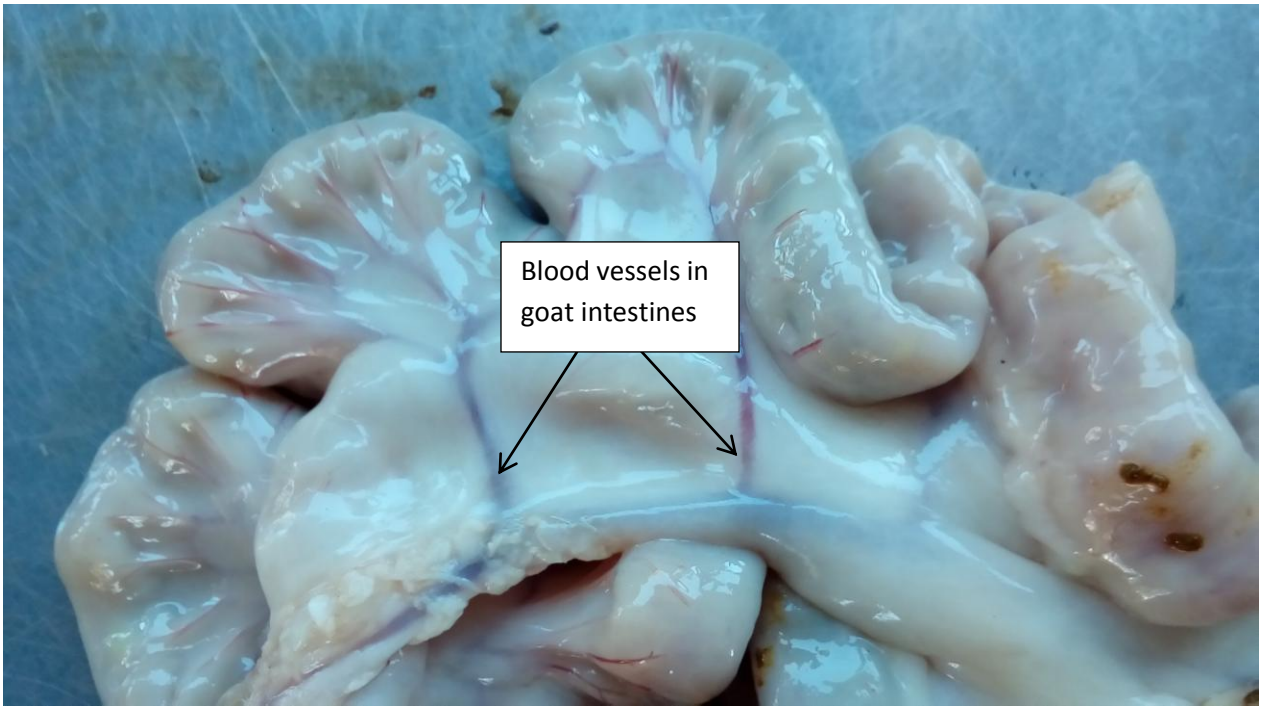
vessels indicated good rains in future. Further analysis was always conducted to determine rainfall quantities and the anticipated magnitude of losses in human life and property as exemplified by the following excerpt:

> The men said that before they separated the offals into different parts [after slaughter], they studied the blood vessels then predicted the rains and whether the rains would cause human deaths by sweeping people away. From the blood vessels, they could also determine the number of people who would be carried away by the swollen rivers and it occurred just as had been predicted. *Female discussant, Borowonin FGD1*

"Dry" intestines and pale red blood vessels indicated a lengthier dry spell. When drought persisted, the elders offered prayers and sacrificed sheep to appease the "gods" to restore rains. Select women were allowed to offer similar prayers in a separate area, where they offered milk and other food items as sacrifices prior to men's prayers.



Picture 4. 2: Blood vessel on a goat's rumen



Picture 4. 3: Blood vessel in the intestines

Weather forecasting using the positioning of planets and stars was done in the night and over a long period of time by a select group of men. The community members identified *"the male planet"* (Jupiter) as big and plain and *"the female planet"* (Venus) as small and bright. Elders observed the two planets' movements and alignment to each other. If the *"male planet"* moved towards the *"female planet"* quicker and she aligned with him, there would be rain. If the *"female"* moved quicker than the *"male"* or failed to align to him there would be no rains. When they aligned "perfectly", they would be close to *"three stars arranged in a straight line"* (the Orion's belt). Perfect alignment was interpreted as consummation of the union between the *"male"* and the *"female"* which resulted in rainfall. It was attained in July, which was reported to have the heaviest rainfall, but the movement of the planets towards each other was observed earlier.

Traditional weather specialists shared forecasts to community members by word of mouth. Similarly, community members reported that climate related information was currently relayed orally, with vernacular radio (58%), national radio (53.9%), village leaders (37.7%) and friends and family (30.9%) being the most common information sources (Figure 4.3).

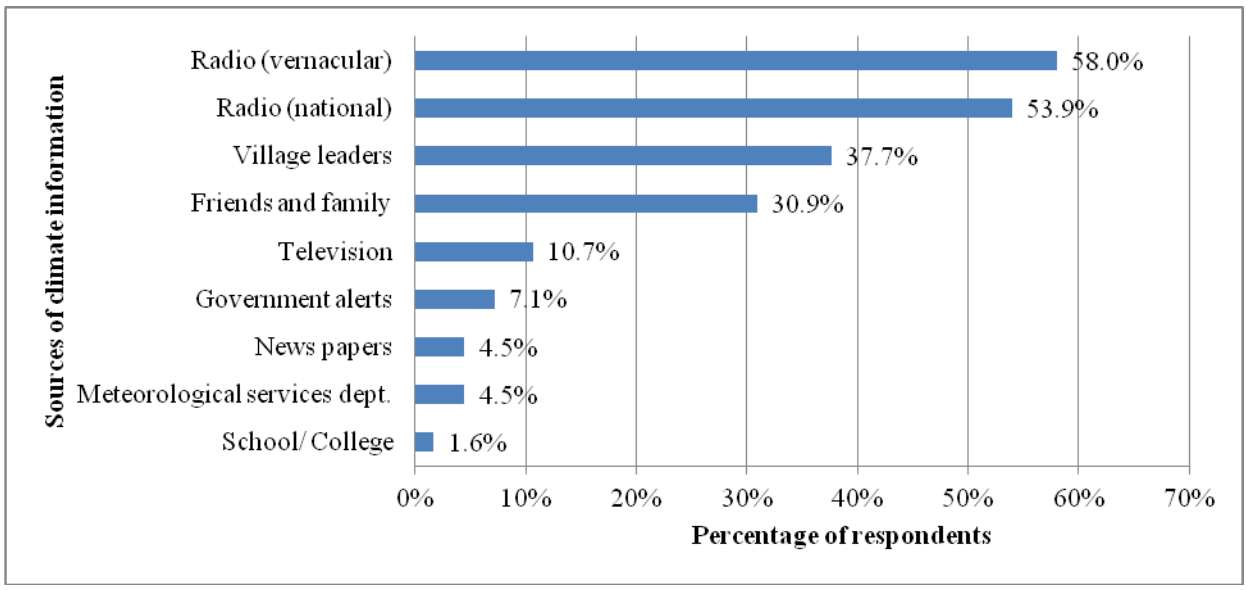


Figure 4. 3: Sources of climate related information

4.3.2 Community Knowledge of Climate Variability and RVF

The community had little knowledge of the relationship between RVF occurrence and climate variability. Focus group discussants best demonstrated the lack of knowledge in the following excerpts:

> We were confused [about the cause of RVF] because we always have mosquitoes in this area but had never been affected that much [like 2006-2007]. We are not sure if it [the cause of RVF] is mosquitoes or tsetse flies. *Male discussant, Lorok FGD2*

We really don't know what caused the disease. We thought it was just a bad air. *Male discussant, Lorok FGD2*

We heard that RVF is caused by monkeys. *Female discussant, Salabani FGD2*

When it [RVF] started we didn't know the cause. We even thought that the abortions in livestock were due to weather changes because it was rainy season. *Female discussant, Soruro FGD2*

Maybe ticks cause RVF. *Male discussant, Litein FGD3*

Among the Ilchamus community from the lowland, the names used to identify RVF were *"the El-Nino livestock disease"* coined from the last disease outbreak which occurred during the 2007 El-Nino rains. Another name, *"ngea na nyori",* which referred to the greenish/yellow pigmentation found in rotting meat was also identified. However, there was no consensus on the name to use. Among the Tugen, the term *"kipkoloswo",* which refers to jaundice in persons infected with yellow fever, was also used to describe RVF disease in humans.

In terms of frequency of occurrence, RVF was not ranked as a common livestock disease. The most common cattle diseases identified were: east coast fever (ECF), foot and mouth (FMD), contagious bovine pleuro-pneumonia (CBPP), lumpy skin disease (LSD), anthrax, trypanosomiasis, brucellosis, foot rot, red water, black quarter, mange and mastitis. Among sheep and goats, contagious caprine pleuro-pneumonia (CCPP), ECF, brucellosis, heart water, diarrhea, peste des petits ruminants (PPR), FMD, mastitis, mange, sheep and goat pox and foot rot were reported as most common. Of these diseases, brucellosis and anthrax are zoonotic. Community members reported that RVF occurred for the first time in 2007 and has since not recurred.

4.4 Community Socio-cultural Practices and Vulnerability to Malaria and RVF

This section is sub-divided into two sections on socio-cultural practices that influenced community vulnerability to malaria and RVF.

4.4.1 Community Socio-cultural Practices and Vulnerability to Malaria

This section covers the socio- cultural practices that were found to expose community members to malaria which included sitting out-doors after dark, working in the Perkerra irrigation scheme, water sourcing and inconsistent use of bed nets. The section further addressed gender differences in health seeking behavior and caregiving in the community.

Sitting Outdoors after Dark

Community members had practices that would render them vulnerable to malaria. For instance, sitting outdoors after dark was common practice despite 94.5% of respondents having the knowledge that it exposed them to mosquitoes. Normally, more men than women stayed outdoors in the evenings but during full moon both did as shown by the following excerpts:

> Definitely in the evening we [men] normally stay outdoors and we are bitten by mosquitoes. Women are not affected so much because they are in the kitchen and mosquitoes don't like places with fire/heat. *Male discussant, Salabani FGD1*

> We like staying outdoors as we unwind. When there are mosquitoes, you persevere and just stay outdoors and you get malaria instead of protecting yourself. *Female discussant, Litein FGD2*

> People here have a habit of staying outside during the night especially when there is moonlight. *Female discussant, Perkerra FGD2*

> Women stay outdoors during full moon. But if it is not full moon they stay indoors. *Male discussant, Litein FGD3*

Working in the Perkerra Irrigation Scheme

Working in the Perkerra Irrigation Scheme was also reported to amplify exposure to malaria. This is largely because work in the scheme was conducted in the day and sometimes, the night. In addition, the mosquito population in the farms was reported to be high due to presence of multiple breeding areas occasioned by the irrigation practice and availability of hiding places for mosquitoes provided by the crops. The following excerpt demonstrates the presence of mosquitoes in the farms and the work patterns in the irrigation scheme.

> Even during the day in the scheme, mosquitoes bite. And sometimes we work in the farms at night. *Female discussant, Perkerra FGD2*

Inconsistent Bed Net Use

Inconsistent use of bed nets was also cited as a cause for exposure to malaria particularly in the lowland area, where community members reported that high temperatures were experienced most of the time. Inconsistent use of bed nets was further reinforced by the belief that in the dry season there were no mosquitoes. These findings are exemplified by the following excerpts:

> Even me I don't sleep under net because it is hot here. *Female discussant, Perkerra FGD2*

> You know sometimes when you feel hot you leave out the bed net. Sometimes I roll it up before I sleep to see if there are mosquitoes during the dry season. If I can hear them I then return it later when I want to sleep. *Male discussant, Perkerra FGD3*

Water Sourcing

Communities in the study site relied on rivers and lakes as the primary sources of water for domestic utilization**.** For cooking, 51.1% of respondents used river water and 14.5% used lake water. For drinking, 48.8% of respondents used river water and 11.1% used lake water. Only <10% had access to water piped into their compounds. Sourcing water for domestic consumption was mainly a women's and girls' responsibility. They fetched water 2-3 times daily in 20 litre plastic containers which they carried on their backs. Drinking water was fetched in the morning, as early as 5 am, before the sources were contaminated with mud and livestock waste. Water for other uses could be fetched at any other time with 6pm-8pm being the latest. In the dry season, women were required to rise earlier, walk further and wait longer than usual in search of water as demonstrated by the following excerpts:

> When our local source dries we walk up to five kilometers to Katibel to a spring that has a hand pump. *Female discussant, Litein FGD3*

> If you were to be taken to the river you will wonder about the length of the queues, people can fetch for around one hour before you can get the chance to collect your own, people collect water day and night. *Female discussant, Borowonin FGD1*

Similarly, in dry seasons when cattle have to be moved to distant areas in search of water and pasture, it was the responsibility of men to move with them. The practice required them to be in the wild for long durations, often living in makeshift housing as echoed by the following quotes:

> There are times when they [people] take cattle far way for grazing. Long time ago young boys used to take them, but now because of education which requires them

to be in school, men take the cattle for grazing. *Female discussant, Kipcherere FGD2*

Men and boys take the livestock to Kerio Valley [for grazing]. They stay there until when the pasture and water condition gets better then the cattle are brought [back to the village]. *Male discussant, Litein FGD2*

Construction of Houses

Communities in Baringo lived in various types of houses. These included: grass thatched and earthen walls; corrugated iron roof and earthen walls; corrugated iron roof and wall; and stone/timber walls and corrugated iron roof. Of the survey respondents, 43.4% lived in houses made of earthen walls, 32.9% corrugated iron sheet, 16.8% timber, 6.1% stone/brick and 0.9% used other materials. Most respondents' houses had corrugated iron sheet roofing (79.8%) while the rest had grass thatch (20.2%). Respondents' houses mainly had earthen floors (69.1%) while 30.9% had either concrete or cement. The houses were observed to have varying eave sizes (Picture 4.4 and Picture 4.5). Focus group discussants reported that houses with wide eaves increased the inhabitants' vulnerability to malaria by increasing the surface area through which mosquitoes could access the house. The following excerpt demonstrates this:

Most people have houses that have openings that allow mosquitoes to come in. For those who don't have nets, they should ensure that eaves in their houses are not wide. They should fill any holes to prevent mosquitoes from coming in. *Male discussant, Kipcherere FGD4*

Picture 4. 4: Grass thatched, earthen wall house with wide eaves

Picture 4. 5: Corrugated iron roof and mud wall house with wide eaves

Homesteads were observed to have toilets which varied in construction design. Focus group discussants reported that wealthier homes mostly had corrugated iron roofed latrines whose walls were made of stone or corrugated iron sheets. The latrines also had doors made of wood or corrugated iron sheets. Some households of the middle and poor wealth categories had latrines without roofs and were made of sticks and tree foliage. Few of their latrines had wooden/corrugated iron sheet doors but others utilized sheets of cloth, plant foliage or had no door at all. In the wet season, community members reported that some pit latrines filled with rain water and drained slowly, thus providing ample mosquito breeding grounds. Most of the poor were reported to have no latrines and relied on the bush. Through observation, it was noted that latrines were located away from the main house regardless of the wealth category households fell in. Among survey respondents, 70.5% had access to pit latrines, 28.57% relied on the bush, 0.54% used flash toilets and 0.36% use other unspecified facilities.

Gender Differences in Health Seeking Behavior

Men and women who suspected that they had malaria exhibited differences in their health seeking behavior. Discussions in 14 of the 20 groups demonstrated that women sought medical treatment earlier than men to enable them meet their productive and reproductive roles as shown by the following excerpts:

> If you [the woman] are sick who will take responsibility? There are cows here, there is the child and there is the kitchen. So it is better to treat yourself early so that you can be able to do all that work. *Female discussant, Borowonin FGD1*

> Most work in the house is done by women and when a woman becomes sick, it is a huge loss if you waste a lot of time being sick. *Female discussant, Borowonin FGD2*

On the other hand men delayed in seeking treatment to show stoicism and associated women's early response as a sign of weakness as reflected by the following excerpts:

> A man might delay [in seeking treatment] till he dies while he is still saying he is being a man. Men go to the hospital when the malaria is too severe. *Male discussant, Borowonin FGD3*

> Stoicism is tradition; we say that if a man has a big problem he must bear it. He has to persevere with the thing no matter how hard it is. *Male discussant, Kipcherere FGD4*

> The way I see it, it is about strength. Women have less strength but men are strong and can persevere with all these diseases. *Male discussant, Kipcherere FGD3*

In half (10) of the focus group discussions, it was reported that more males than females were unwilling to have their blood sample drawn for malaria testing for fear that they would also be tested for HIV. This assumption was influenced by the lack of certainty over the range of tests that were conducted by the laboratory technicians once patients gave their blood samples. Patients never witnessed the malaria tests being conducted as they were asked to wait for the results elsewhere. The near similarity in the design and functionality of malaria and HIV test kits also added to the suspicion. The following excerpt demonstrates men's fear of malaria testing:

> There are some men who refuse to go to hospital because they fear to be tested for HIV. They think that when they go to hospital they are going to be tested for both malaria and HIV. *Male discussant, Borowonin FGD4*

Medical services in public health facilities were said to be slow, resulting in long waiting hours. Between men and women, men were less inclined to access the services due to delays in service delivery. Among survey respondents, there was a statistically significant relationship between sex and having failed to seek for medical services due to long waiting periods in health facilities (χ^2=11.442, df=1, p<0.001). More proportions of men than women failed to seek medical treatment if services were delayed. Discussants from 3 FGDs shared similar observations as exemplified in the following excerpt:

> Most men are not patient enough when they visit hospital. They cannot wait or queue to see the doctor. That is why they go to private facilities. You notice that only the old poor men queue in public hospitals. Most men seek treatment at private clinics because they have money and there is no time wastage in private clinics. *Female discussant, Perkerra FGD1*

Caregiving Practices

There was a gendered division of caregiving roles at household level. Men were mainly expected to provide the income required to meet the costs associated with seeking medical care. Women were expected to provide bedside care for the sick person which comprised of feeding, cleaning, administering medications and providing emotional support. If the sick person was the male head of household or a child, the wife, mother and older children were primarily tasked with caregiving. If it was the woman, bedside care was mainly provided by other women who were not necessarily family members. The assistance offered to sick women depended on the strength

of their social networks and comprised of substitution of their labour in childcare, cooking, cleaning, fetching water and farming activities in few occasions. Among survey respondents, there was a statistically significant relationship between sex and ability to get care from nuclear family members (χ^2=20.948, df=3, p<0.001) with higher proportions of men than women being able to get care from the nuclear family.

In case of critical illness or medical emergencies, the larger community normally assisted affected families through contributing money to take the sick person to hospital as well as meet the medical bills. Help could also be offered in-kind such as through provision of transport services to or from hospital, bringing the household food, caring for children left at home or the sick in hospital. There was a statistically significant relationship between sex and ability to rely on friends and neighbours assistance in meeting medical bills for an ailing family member (χ^2=25.149, df=3, p<0.001) with more men than women being more likely to get assistance among survey respondents. As demonstrated by the wealth ranking, only a minority had access to medical insurance covers to subsidize their medical expenses.

4.4.2 Communities' Socio-cultural Practices and Vulnerability to RVF

This section presents the socio-cultural practices that community members engaged in which had potential for exposing them to RVF in the event of an outbreak. It is sub-divided into five subsections covering: uses of livestock and derived products; consumption patterns of livestock products; control and management of livestock diseases at household, markets and slaughter facilities; and disposal of dead animals at household level.

Communities' Uses of Livestock and Derived Products

In Baringo County, livestock served multiple purposes which included being sources of food, medicine, manure, skins/hides, social status/prestige, draft power, bride price and income; stores of wealth, means of predicting rainfall patterns and conducting rituals. Food items comprised of meat, milk, blood, eggs and animal fat. Utilization of meat and milk was more widespread than blood, eggs and animal fat. In management of human diseases, liquid extracts from a goat's rumen and intestines were considered to be medicinal by community members whereas meat stock and milk were utilized in administration of conventional and herbal medicines in adults and children respectively. The following excerpts exemplified the stated uses:

> *"Eyande*" [green liquid extracted from the rumen of a goat] treats malaria that is chronic. The goat is slaughtered and many herbs are added when boiling the meat. You squeeze "*eyande*" out [and take] and you take the soup [mixed with herbs], you get healed completely. *Male discussant, Perkerra FGD3*

> Why a goat is [a source of] medicine is that it eats bitter leaves, bitter herbs. So when one is sick and eats intestines from a goat, it is medicine. You don't wash the intestines because it will remove the medicine inside. You get them that way [uncleaned], then you cut into pieces, you mix with herbs and boil. When it is cooked in its fat you take it and you become well. *Male discussant, Borowonin FGD3*

Animal fat, particularly from sheep's tail was used as treatment for skin conditions, snake bites and ingestion of poisonous substances as shown in the following excerpts:

> We use fat from sheep as medicine to cure measles, chicken pox, chest problems, and in case of snake bite or bee stings. *Female discussant, Soruro FGD2*

> Also when you get a sheep's fat you keep it and if there is someone sick and has consumed expired medicine, you get the fat and give him/her first. It [the bad medicine] will come out. If children consume something poisonous, fat from sheep is medicine. *Male discussant, Borowonin FGD3*

Consumption Patterns of Livestock Products at Community Level

Milk

Nine in every ten respondents (91.5%) always consumed boiled milk. A further 2.3% of respondents only boiled milk sometimes while 2.3% never did. Milking was mainly done on healthy animals, with 62.4% of respondents reporting that they never consumed milk from sick animals and 58.7% never milked sick animals. There was a statistically significant relationship between sex and milking (χ^2=22.146, df=4, p<0.001) and consumption of milk from sick animals (χ^2 = 53.875, df=4, p<0.001). A higher proportion of men were inclined to consume milk from sick animals compared to women. This may be attributed to consumption of raw milk when grazing livestock away from home. On the other hand, women, who were culturally tasked with milking and preparing milk for consumption, were less inclined to milk sick animals.

Blood

Traditionally, blood played a significant nutritional role. It was consumed whole while still warm or allowed to cool and coagulate enabling separation of serum from the cellular component after which the former was mixed with milk. The cellular part was eaten raw or cooked. Among survey respondents, 62.7% of respondents had ever consumed raw blood and 76.3% had ever

consumed cooked blood. There was a statistical relationship between sex and consumption of raw (χ^2=23.970, df=4, p<0.001) and cooked blood (χ^2=23.556, df=4, p<0.001). More men than women consumed raw or cooked blood. The following excerpts exemplified current blood consumption patterns:

> When we have removed what we call *"nyaiketik"*, [coagulated blood], the serum is mixed with milk. *Male discussant, Borowonin FGD3*

> The part [of blood] that coagulates is not mixed with milk, it is eaten raw without cooking. But if you want to cook or eat it raw it is still acceptable. *Male discussant, Borowonin FGD3*

Collection could be done through extraction from the jugular vein of a living animal or collected during slaughter. To maximize on blood collection, animals were either killed through asphyxiation before slitting the throat or containers were placed beneath the neck of the slaughtered animal. These findings are reflected by the following excerpts:

> When slaughtering, we put the blood in a bucket then we drink as it is part of food. Also in ceremonies like initiation of boys, we extract blood and mix it with milk and drink it. We don't kill the animal we just pierce the neck. *Male discussant, Soruro FGD1*

> There is another way to slaughter without pouring out blood. We strangle the animal then slit the neck before blood cools down. Blood will pour out at a very high speed [into a container]. *Male discussant, Soruro FGD1*

When a community member wanted blood but could not get it at home, it was observed in two slaughter facilities that they collected during slaughter. Picture 4.6 shows a woman who had just

collected blood in two plastic containers. She was sited outside an abattoir scrapping meat from cattle hides to add to her food collection.

Picture 4. 6: Blood collected for consumption

According to focus group discussants, consumption of blood was on a decline, an outcome influence by religion and fear of contracting livestock diseases.

> Everyone used to consume blood but now when people turned to Christianity, many stopped. *Male discussant, Litein FGD3*

> People fear that if they drink the blood they may get infected with disease so they have stopped. *Male discussant, Kipcherere FGD1*

Meat

Meat was mainly sourced from healthy animals and cooked before consumption. However, in some instances, men ate raw kidneys, liver, the omasum and abomasum during slaughter.

Further, six in every ten respondents (59.7%) had ever eaten meat from a sick animal that had been slaughtered whereas one in every five (50.8%) had consumed meat from an animal that had died of illness. There was a statistically significant relationship between sex and slaughtering sick (χ^2 =50.909, df=4, p<0.001) or dead (χ^2 =50.358, df=4, p<0.001) animals for consumption. Men were more inclined to engage in the practice than women. A quarter of survey respondents (23.6%) always had animals slaughtered for domestic consumption inspected by a veterinary officer while 11.7% relied on a local animal health expert. Other indigenous methods of inspecting meat for safety of consumption that were used by community members included observation of the meat's effect on other humans, use of ants, herbs or the spleen.

Observation

The first method of checking meat for safety of consumption entailed observing the health of people who consumed uninspected meat for any undesirable effects. If none were observed, others who had not consumed the meat earlier gained courage as shown by the following excerpts:

> There was a cow that was struck by lightning. When the animal was slaughtered, some people took the meat but did not eat immediately. They waited for other people first to eat so that if they [those who ate first] were affected the others [those who had not eaten] would not eat. *Female discussant, Borowonin FGD1*

> When the old men have eaten the meat from the sick livestock, other people go ahead and eat. *Male discussant, Litein FGD1*

Use of Ants

Two ant species, *"kilik" (Messor angularis)* and *"butbutie", (Crematogaster sp)* were used by the Tugen community to test meat for safety of consumption. A piece of meat from the slaughtered animal would be placed near the ants' nests and people would observe whether they would attempt to eat it or not. If the ants avoided the meat it was considered unsafe for consumption but if they did not, the meat was assumed to be safe and was therefore consumed.

> *"Kilik"* are ants that are used to test the safety of meat from dead animals…. When they eat the meat and die, the meat is not safe and when they eat and they survive then the meat is safe for consumption. *Female discussant, Kipcherere FGD1*

> You know there are methods the old men used traditionally. They cut a small piece of the meat and take it to the *"butbutie"*. If they eat there is no problem. People eat. If they don't eat people leave [the meat alone]. *Male discussant, Litein FGD1*

Use of Herbs

Meat from sick/dead animals was also boiled in herbs and considered safe for consumption. The mixture of herbs used was a closely guarded secret held by male community members. Meat prepared in this way was mainly consumed by men, often away from their homes to avoid putting the rest of the community at risk of infection. The herbs were considered effective for treating any other meat because of previous use in meat from animals that had died of anthrax without casualties. Some examples of the herbal plants are shown in the following excerpts:

> "Soget*" (Warbugia ugandensis)*, "Sessiat" *(Acacia tortilis)*, "Puryokwe" and "Subeiwet/Ntepes" *(Acacia gerrardii)* are used to cure the meat. They [men] mix [the herbs] and put in meat from an animal sick with anthrax. *Male discussant, Kipcherere FGD1*

> The herbs [used to treat the meat] come from the "Seketeiywo" and "Chepkurak" trees found along the river. *Male discussant, Kipcherere FGD1*

Use of the Spleen

The spleen, harvested from a slaughtered animal was also used to test meat for safety of consumption by burying it under soil and observing for any increases in size and eventual bursting. If it appeared to retain its normal size, meat was considered safe for consumption but if it appeared to be swelling, it was considered unsafe as exemplified in the following excerpts:

> When an animal has been slaughtered, you remove the spleen and put some soil on it. When it swells you know it is bad. It is dangerous. *Male discussant, Kipcherere FGD1*

> If an animal dies, the old men put the spleen on the ground [covered in soil]. In a short while it bursts and they know it is anthrax. *Male discussant, Sirata FGD1*

Management of Livestock Diseases in Households, Markets, and Slaughter Facilities

Producers

At producer level, livestock diseases could be managed using conventional or traditional medicines with or without the guidance of a veterinary officer. From various focus group discussions, it was established that the choice of treatment pathways was influenced by past experiences with managing the perceived disease, perceived severity of disease, ability of disease

to be transmitted to other livestock, perceived cost of seeking treatment, anticipated magnitude of losses incurred from the perceived disease and directives issued by the veterinary department regarding mass vaccination of livestock. Response to diseases assumed to have high impact on animals and producers were quicker than those assumed to have low impact.

Among survey respondents, 40.4% reported that veterinary services were often easy to access with a near equal proportion (44%) frequently relying on a veterinary officer to treat their livestock. A further 61.6% reported buying and administering veterinary medicines to livestock without the guidance of a veterinary officer. A similar proportion (63.9%), thought that veterinary services were often expensive. A third of respondents reported that veterinary medicines were often difficult to access whereas 28.4% experienced difficulties in administering them. Only 14% of respondent often used herbal treatments for their sick livestock. When animals aborted, 65.8% of respondents often treated them with conventional veterinary medicines while 22.6% used herbal treatments. Sick, delivering or aborting animals were handled with bare hands in 84% of cases.

The findings on farmers treating their livestock without assistance from veterinary officers and services being expensive were further confirmed by key informants from the veterinary department in the following excerpts:

Veterinary Department Key Informant1

Interviewer: So why do they [farmers] prefer to do livestock treatment for themselves before calling the vets?

Interviewee1: I may not know them, or know the real reason but one of the speculated reasons could be that we also have very few staff available in the field, because of the low number of staff who are in our department.

Veterinary Department, Key Informant2

Interviewer: How do communities handle sick animals in terms of disease reporting and treatment in this region?

Interviewee2: Initially we had field staff everywhere but after the privatization of most of the veterinary services, it became difficult because no staff was employed after 1988 and those who are in the field now are private [self-employed]. They don't work like a county government employee should. They have to meet their expenses so in some cases they fleece the farmers.

Interviewer: Okay, so you said farmers report [diseases cases] to the veterinary offices. So like what proportion/ percentage would you say reports and what percentage would you say does not report?

Interviewee2 Around 45% reports depending on the distance and then you see the services are also paid for and it also depends on whether they have the money or not. A lot of factors affect the reporting and treatment of the same animal. Because you may want to report may be…okay initially the government had a lot of motorbikes and had fuel and a case could be reported and then you [the veterinary officer] just jump onto your motorbike and go [to the farmer] but this time actually before the introduction of the County government the farmer has to foot all the costs. If it is hiring a vehicle or fueling a motor bike and also that there are no drugs in the government stores the farmer has to buy the drugs. So may be the work of the veterinary officer is just to diagnose and may be advice the farmer on the type of drugs to buy as per the diagnosis.

There was a statistical association between sex (Table 4.4) and handling sick livestock with bare hands; perception that veterinary services were expensive; perception that accessing veterinary medicines was difficult; seeking veterinary services; perception that veterinary services were easy to access and that veterinary medicines were difficult to administer. However, more men than women were prone to handling sick livestock with bare hands, feeling that veterinary services were expensive and thinking that accessing veterinary medicines was difficult. On the other hand, higher proportions of women were inclined to seek a veterinary officer's services for

livestock treatment, think that veterinary services were easy to access but find it difficult to administer veterinary medicines. The role of treating sick animals was culturally prescribed for men. Only 6% of respondents thought that they had the capacity to influence decisions on the quality of veterinary services offered in their locality. Most felt that they were passive recipients of veterinary services and could not influence the quality of service they received.

Table 4.4: Statistical associations between practices/perceptions and sex

	Practice or Perception	**Statistical association with sex**
1	Handling sick livestock with bare hands	(χ^2 =11.185, df=4, p=0.025)
2	Perception that veterinary services were expensive	(χ^2 =13.210, df=4, p=0.010)
3	Perception that accessing veterinary medicines was difficult	(χ^2 =32.627, df=4, p<0.001)
4	Seeking veterinary services	(χ^2 =17.539, df=4, p=0.002)
5	Perception that veterinary services were easy to access	(χ^2 =33.915, df=4, p<0.001)
6	Perception that veterinary medicines were difficult to administer	(χ^2 = 26.884, df=4, p<0.001)

Markets

Before and during movement of livestock to the markets, traders assessed each animal for diseases through a criteria comprising of 22 signs and symptoms. The most commonly reported signs and symptoms were: poor gait/ulcerated hooves (29.6%), rough skin/hide (24.6%), and presence of nasal discharge (19.7%), lacrimation (19.7%), mouth ulcers (8.9%) and skin disease (7.4%) (Figure 4.4). Other signs and symptoms included low weight, injuries, levels of alertness and appetite, coughing, weakness, infestation with visible parasites, labored breathing, diarrohea, bloody stool, hard dung, infected udder, frequency of and colour of urination, animal smell, swollen lymph nodes and profuse salivation.

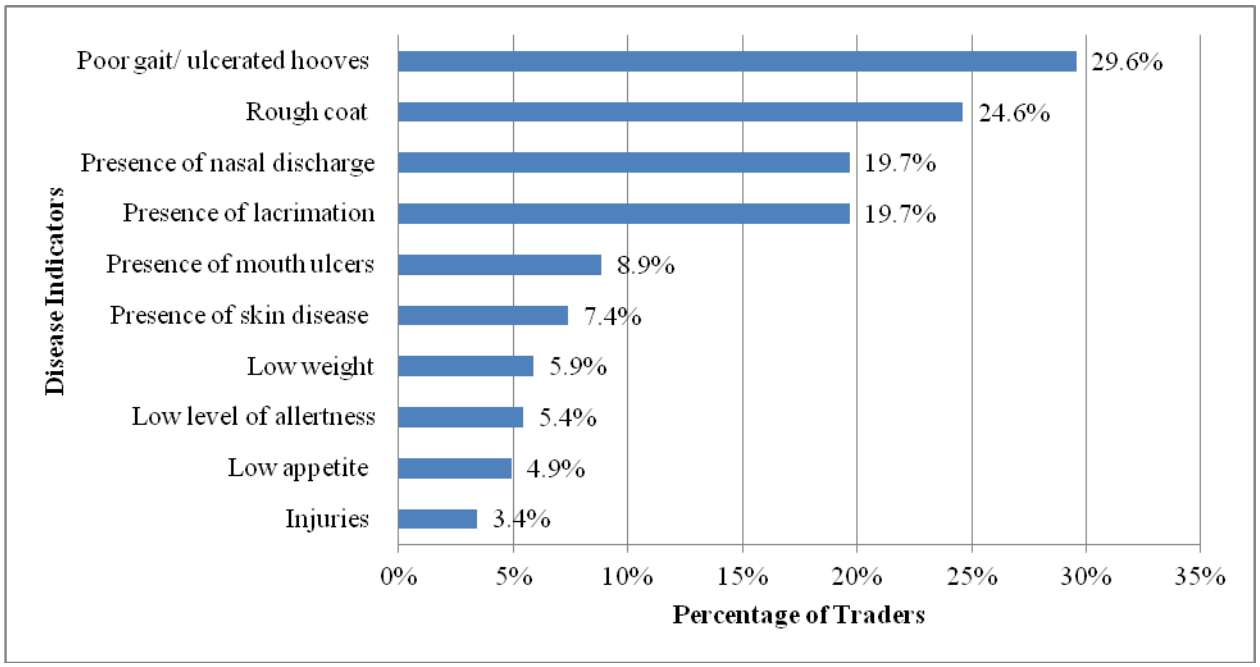


Figure 4. 4: Common disease indicators

Upon arrival at the market, livestock were further examined by veterinary officers, traders or both in the "before auction holding pens" (Figure 4.5). Slightly more than half of the traders relied on a veterinary officer to inspect the animals, 39.6% inspected for themselves, and 4.4% relied on inspection by both the veterinary officer and themselves. Sickly animals were isolated from healthy ones and excluded from sale to allow for treatment. Animals were mainly sold openly in the auction arena. Besides enabling a trader to get a fair price for their livestock, sale through auction facilitated issuance of movement permits and tax collection by the County veterinary office. However, some traders preferred to negotiate directly with sellers before animals were auctioned. Such animals were retained in the "before auction holding pens" until all requisite taxes were paid and permits issued.

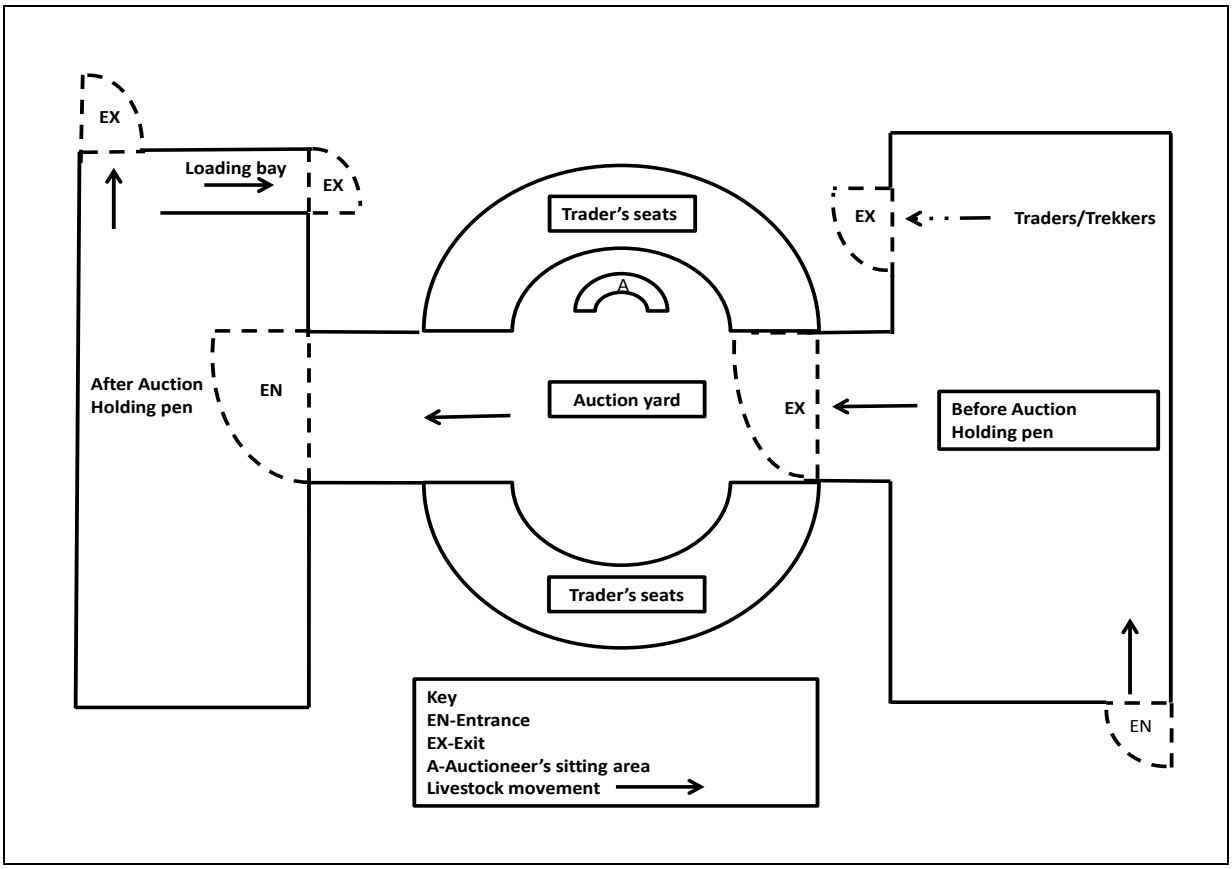


Figure 4. 5: Market layout

Livestock traders mainly moved their livestock to (96.2%) and from (60.1%) markets on foot. Only 37.9% used vehicles to transport animals from the market to their next point of use. Movement through motorcycles or partial coverage of the journey on foot and vehicles were used by 1.5% of traders. Prior to transporting animals, 26.3% of traders (n=76) did not clean the vehicle, 22% swept it clean, 18.4% laid it with sawdust and 18.4% washed it with plain water (Figure 4.6). After ferrying livestock, 19.7% of traders cleaned the vehicle with soap, water and disinfectant, 27.6% with water and soap, 34.2% with plain water, 7.9% swept the vehicle and 10.5% took no action.

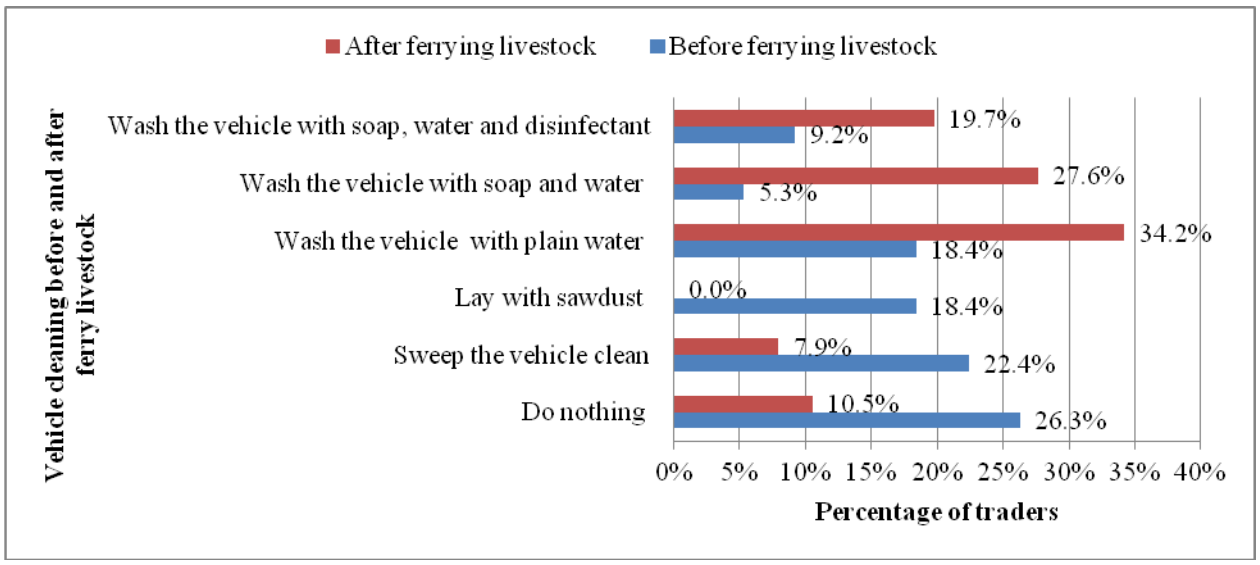


Figure 4. 6: Vehicle cleaning before and after ferrying livestock

In the event of foot and mouth (FMD), lumpy skin disease (LSD), anthrax or RVF outbreaks, Marigat, Barwessa and Kaptara market committees reported that the veterinary department, through the County Livestock Auctioneer, effected market closures and trade bans until the diseases were contained. During such periods, livestock traders either ceased operations, moved to other markets that were not affected by the diseases or traded in stock that were not affected by any of the diseases. When there were disease outbreaks necessitating market closures, 60.9% of the interviewed traders ceased operations completely while 33.7% ceased operations in the affected areas and continued trading in areas where the disease had not occurred.

Abattoirs and Slaughter Slabs

At the abattoirs and slaughter slab level, disease control was achieved in six ways namely; workers use of protective clothing; conducting ante-mortem inspection on animals awaiting slaughter; meat inspection, disposal of condemned animals or parts; cleaning and waste disposal; and closures during outbreaks of notifiable diseases. When on duty, all workers from the three abattoirs wore white coats/overalls and gumboots as protective gear. However, only a few had

caps on, some of which were not white in colour as required. Observed slaughter slab workers did not have all the requisite protective clothing. For instance, in 3 slaughter slabs, few workers had coats, gumboots or caps but none wore the three. In the remaining four slaughter slabs, none of workers wore any protective clothing (Picture 4.7). Outsiders were allowed within the slaughter areas, sometimes engaging in slaughter activities, without protective clothing.

Picture 4. 7: Slaughter slab worker without protective clothing

Animals intended for slaughter in the abattoirs were subjected to ante-mortem assessments and the meat inspected before release to the market. However, this was not always the case in some slaughter slabs. Animals could be slaughtered as soon as they arrived and the carcasses taken to butcheries for sale before inspection. A key contributor to laxity in the slaughter slabs was that slaughter activities tended to take place early in the morning making it difficult for meat inspectors to arrive at each slaughter facility in time for inspection. In addition, slaughter slabs processed few animals and were sometimes located in far flung areas that were not always easily accessible.

Condemned carcasses or parts were required to be disposed in condemnation pits. However, of the sampled slaughter facilities, 3 did not have any condemnation pits. In some instances, condemned parts and waste pieces of meat were fed to dogs which had easy access to the facilities' compounds (Picture 4.8). Only 2 facilities had access to piped water. None of the facilities had a continuous supply of running water, thus making cleaning challenging in some facilities (Picture 4.9). Cleaning was done with soap and water only; disinfectant was rarely used. Five slaughter slabs drained their waste water on open ground while the other slaughter facilities used cess pits. In all slaughter houses, manure was mainly discarded in open pits (Picture 4.10). In response to major disease outbreaks, slaughter facilities reported closure whenever slaughter bans were imposed by the veterinary department notably during RVF, FMD, LSD and anthrax outbreaks.

Picture 4. 8: Dogs accessing a slaughter slab

Picture 4. 9: Poor hygiene at a slaughter slab

Picture 4. 10: Manure disposal

Disposal of Dead Animals at Household Level

Besides consumption, focus group discussants reported that at household level, animal cadavers were disposed off through burying, burning, feeding to dogs or throwing in the open before or after skinning. Some community members believed that "when a sick animal is buried with the skin/hide, it causes harm to the remaining stock, they might die" hence the emphasis of skinning cadavers before disposal. It was possible for an individual to utilize more than one of the methods. For instance, only 27.5% and 9% of respondents always buried animal cadavers and always burned, respectively. Nearly 3 in every ten aborted fetuses were always buried (28.4%). Up to 40% and 73.2% of respondents had ever left fetuses out in the open to rot or fed them to dogs, respectively. There was a statistically significant relationship between sex and feeding

fetuses to dogs (χ^2 =18.114, df=4, p<0.001) with higher proportions of men than women inclined to engage in the practice.

The practice of burying livestock went against Ilchamus culture which dictated that animal cadavers could not be buried in the same manner as human beings. Failure to observe this taboo was believed to cause harm to the remaining livestock as shown below:

> We do not bury livestock like human beings. You just slaughter the animal because it is also taboo not to cut open the abdomen even if it will be fed to dogs. *Female discussant, Salabani FGD2*

> You cannot bury human beings and bury livestock. If you do, all the livestock will die. *Female discussant, Sirata FGD2*

Similar disposal methods to those identified at household level were also reported by livestock traders (Figure 4.7). If an animal died enroute to or from a market, traders preferred burying (32%) or slaughtering the animal for consumption (29.6%). Other methods applied included burning, feeding to dogs or throwing in the open before or after skinning.

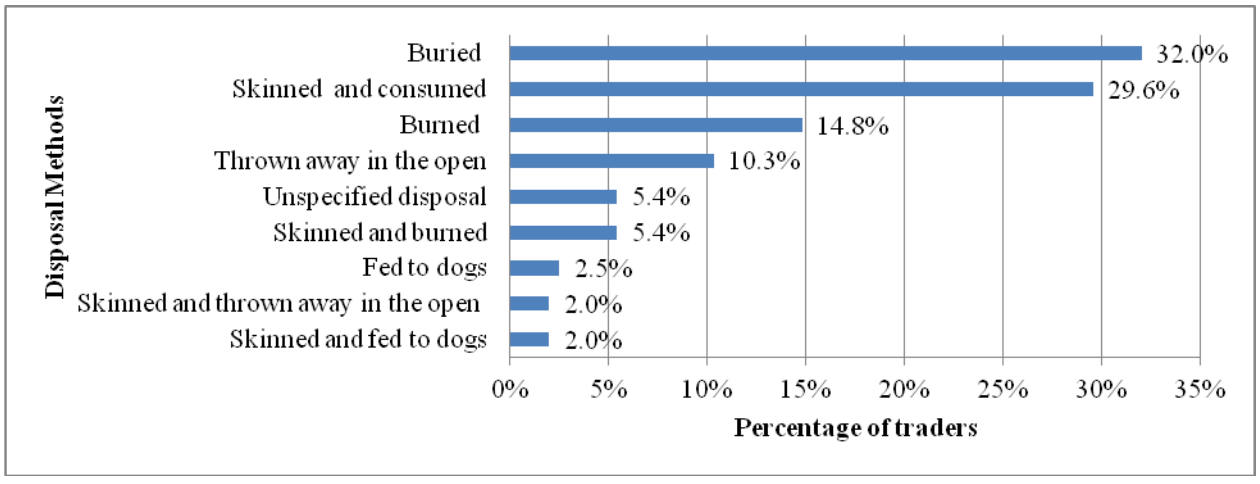


Figure 4. 7: Disposal methods of dead animals

Chapter 5: Community Resources and Coping Strategies for Malaria and RVF

5.1 Introduction

This chapter covers results from study objective 3 addressing linkages between resources and vulnerability to malaria and RVF and objective 4 on coping strategies utilized for both diseases. It is broadly divided into two sections based on the objectives.

5.2 Relationship between Community Resources, Malaria and RVF

This section reports on the relationships between the resources communities were endowed with and risk to malaria and RVF.

5.2.1 Relationship between Community Resources and Malaria

This section covers communities' knowledge of cause of malaria; populations at risk; impact on communities, and sources of malaria information.

Knowledge of Malaria Cause

Mosquitoes

Nearly all (96%) surveyed respondents identified mosquitoes as a "cause" of malaria but only 40% believed that all mosquitoes had the ability to "cause" the disease (Figure 5.1). The knowledge that not all mosquitoes could transmit malaria was statistically significant and had a positive association with education among demographic characteristics (χ^2 =44.01, df=3, p<0.001). Similarly, there was agreement that mosquitoes transmitted malaria in all FGDs. Discussants in 8 FGDs (out of the 20) identified the female *Anopheles* as the disease "causing" mosquito, 3 groups stated that the malaria "causing" mosquito is female but could not isolate the species, 2 groups identified the species but could not tell whether it was the male or female and 7 groups identified the mosquito but could neither specify the species nor the sex. Only in 8 FGDs

did discussants state that not all mosquitoes had the capacity to transmit malaria. These views are captured in the following excerpts:

> You know our problem is that we assume all types of mosquitoes are the same. But I heard a certain type called *Anopheles* a long time ago in school…. When I'm bitten at night by a mosquito, how do I know that this is *Anopheles* or not? *Male discussant, Kipcherere FGD4*

> The female *Anopheles* mosquito causes malaria. It is drawn this way, [demonstrates a 45 degrees angle]. Its legs look like this [as she draws] 45 degrees. It stays like this, even when it wants to bite, its legs just draw back that way. If it wants to bite, its legs are raised to a 45 degrees angle. They appear to be standing at an angle of 45 degrees. *Female discussant, Borowonin FGD1*

> [Malaria is caused by] that female one which doesn't make noise. It just bites and sucks blood and the following day you feel a bitter taste in your mouth. *Female discussant, Salabani FGD3*

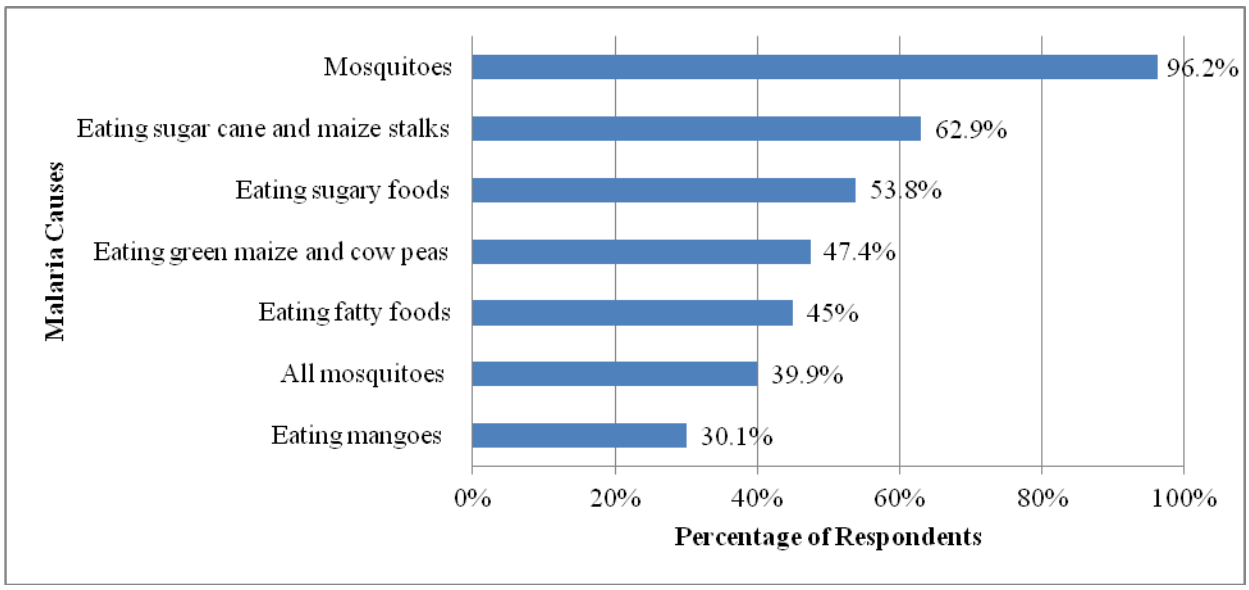


Figure 5. 1: Causes of malaria (multiple responses)

Foods

In addition to mosquitoes, beliefs that malaria is caused by consumption of mangoes, fatty foods, sugary foods, green maize and cow peas, sugar cane and maize stalks were widespread. These beliefs were negatively associated with education: consumption of fatty foods (χ^2 =14.87, df=3, p=0.002); sugary foods (χ^2 =17.17, df=3, p=0.001); sugar cane and maize stalks (χ^2 =13.26, df=3, p=0.004); and green maize and cow peas (χ^2 =13.78, df=3, p=0.003). Consumption of fatty and sugary foods were the main food related causes identified in 8 and 7 FGDs, respectively. Local communities believed that consumption of such foods caused an increase in the amount of bile "*ngw'one*"(Tugen)/*"lodua"*(Ilchamus) in the body thus triggering the occurrence of malaria as exemplified in the following excerpts:

> Malaria has become common nowadays because people take a lot of foods rich in sugar which increase bile in the body, after a few days it becomes too much and causes malaria. *Male discussant, Borowonin FGD4*

> If you eat a lot of fats, it becomes bile and then it becomes malaria. *Male discussant, Kipcherere FGD3*

Water

In addition to foods and mosquitoes, water was identified as another key cause of malaria in 15 FGDs. Consuming water from the lowland of Baringo (6 groups), water contaminated with mosquito eggs (5) or other dirt (5) and stagnant water (4) were the main myths identified as shown in the excerpts below. In some groups, more than one myth was identified.

> There used to be a belief, especially for us who live here [in the highland], that if we go to lowland areas like Marigat and Lodwar, or if someone goes there and comes back they immediately will have malaria. I don't know why. I used to think that in that place the sun is very hot and when you are hit by that sun and you drink their water, when you come back here, you get malaria directly. *Female discussant, Borowonin FGD1*

> Also, people in the past never knew malaria was caused by mosquitoes. They thought it was caused by water. So when somebody was going somewhere, they took some soil [with them] and when they reached [where they were going], they asked for water from the new area, mixed a little with the soil and consumed. They did that thinking it prevents malaria because water from other places can affect a visitor. They used to believe that but still they got malaria. *Male discussant, Kipcherere FGD4.*

Knowledge of Populations at Risk of Malaria

Malaria was perceived as a dangerous disease by nearly all respondents (96.4%). Children <5 years (88.2%) and pregnant women (62.5%) comprised of the main population segments deemed to be most at risk of malaria infection (Figure 5.2). Elderly women (28.9%) and men (25.3%) were also identified as vulnerable compared to other adult categories.

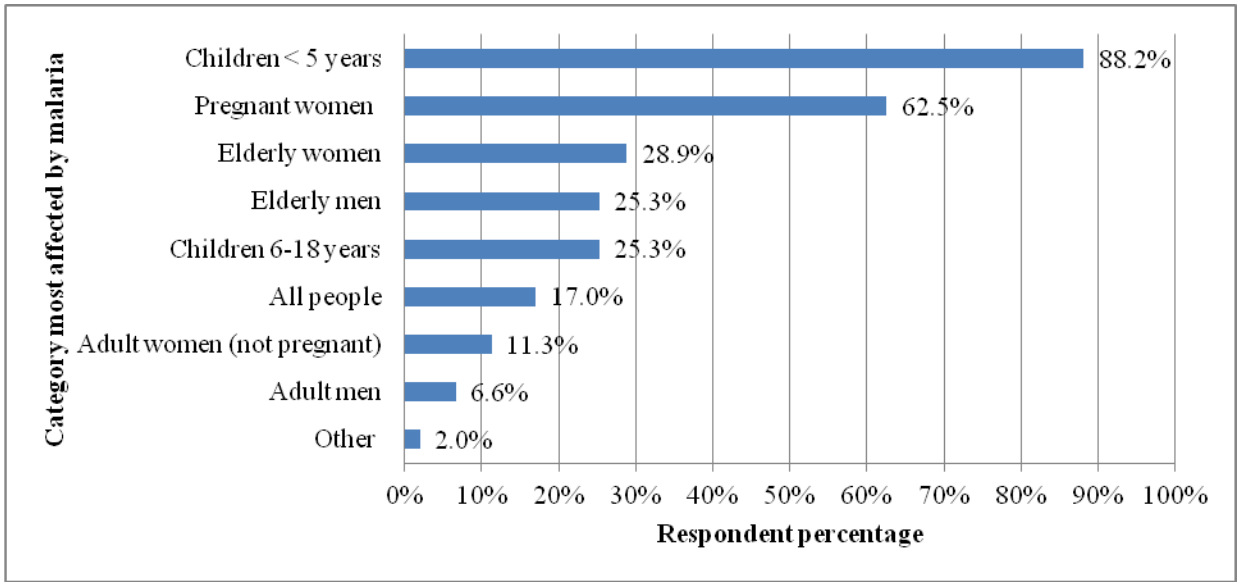


Figure 5. 2: Populations at risk of malaria

Perception of Malaria Impact to the Communities

Malaria occurrence led to loss of incomes through treatment expenses; inability of the sick person and the caregiver to engage in income generating activities; loss of lives, particularly among children and psychological stress. At household level, discussants reported that if a mother/wife was sick there was greater negative impact on the household than if the father/husband was sick because her roles were not easily substitutable. If malaria occurred in pregnancy, 61.4% of respondents stated that it could cause unspecified harm to the unborn, 83.9% stated it could result in delivery of a child with low birth weight, 54.4% stated that it could lead to abortions and 51.1% stated in could lead to still births (Figure 5.3).

There was a statistically significant relationship between sex and knowledge that malaria in pregnancy could lead to abortion of an unborn child (χ^2 =9.559, df=2, p=0.008) and still births (χ^2 =8.294, df=2, p=0.016). More men than women were more knowledgeable of the fact that malaria in pregnancy could result in abortions and still births. However, there was no statistically significant relationship between sex and the knowledge that malaria in pregnancy could result in birth of children with low birth weight (χ^2 =1.222, df=2, p=0.543). In relation to education levels, there was a positive statistically significant relationship between education level and knowledge that malaria could cause abortions (χ^2 =19.208, df=6, p=0.004) and still births (χ^2 =15.474, df=6, p=0.017). None existed between education and knowledge that malaria in pregnancy could lead to the birth of a child with low birth weight (χ^2 =10.609, df=6, p=0.101).

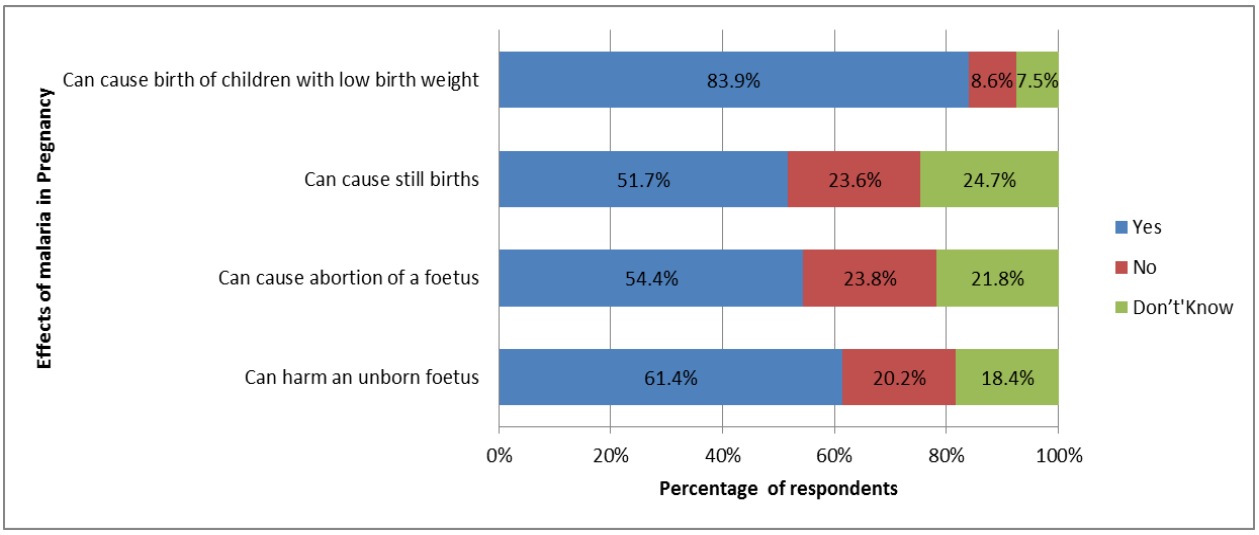


Figure 5. 3: Effects of malaria in pregnancy

Sources of Malaria Information

The key sources of malaria information were radio (71.4%), health facilities (62.9%), friends and family 35.7% and community/public health workers (Figure 5.4) all of whom disseminated information to community members orally.

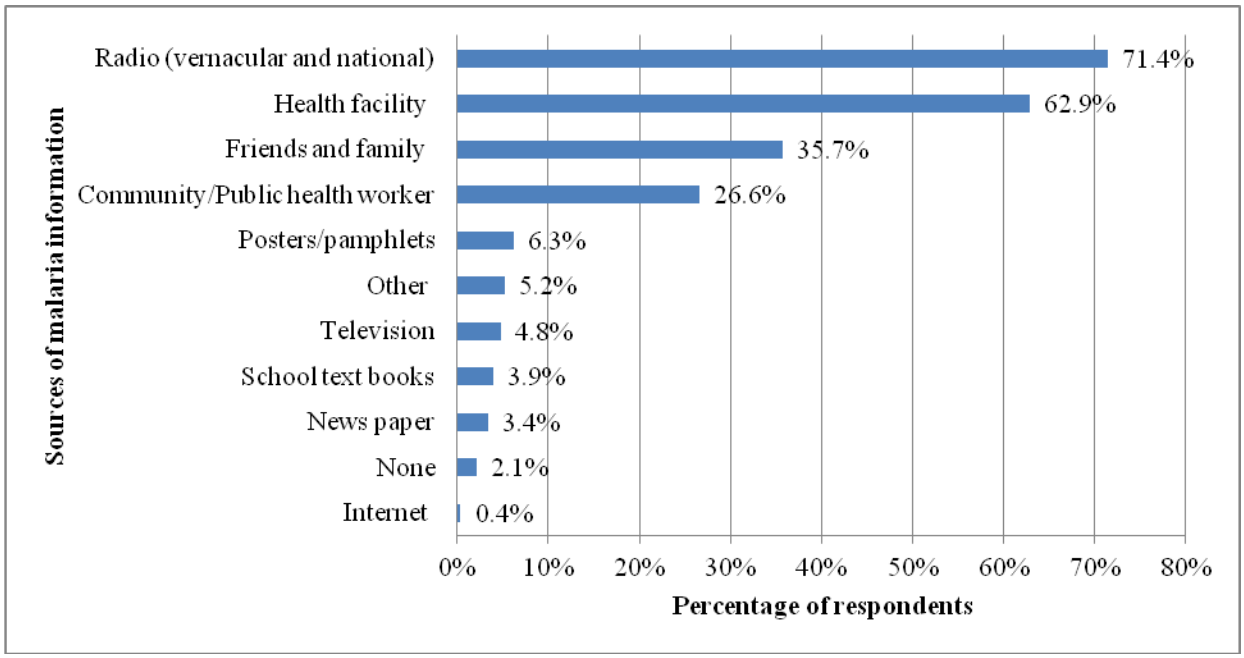


Figure 5. 4: Sources of malaria information

5.2.2 Community Resources and Vulnerability to RVF

This section is further sub-divided into two sections. The first covers the livestock keeping patterns practiced in the County. The second section covers the communities' and medical practitioners' knowledge of RVF, its signs and symptoms in humans and transmission routes.

Livestock

Livestock farming was the second most important livelihood activity after crop farming among survey respondents. Farmers mainly kept cattle, goats, sheep, chicken but rabbits, pigs and donkeys were found in small numbers. According to focus group discussants, indigenous species were more favoured to cross and exotic breeds due to their ability to resist disease, survive on scarce feed resources, walk long distances in search of feed and water, and survive the high temperatures experienced in most of the region. Cross breed animals were more common in the highland area which received more rains as compared to the lowland, midland and riverine zones. Through proportion piling, discussants estimated livestock populations at a median

percentage of 34% (range 5%, 44%) goats, 22.5% (13%, 55%) cattle, 20.5% (10%, 30%) sheep, 18% (7%, 39%) chicken, 3.5% (0, 10%) donkeys, 0 (0, 9%) rabbits and 0 (0, 8%) pigs in decreasing order.

Community and Medical Practitioners Level of Knowledge of RVF

Level of Knowledge at Community Level

Despite having been reported to occur once in the region, nearly 9 in 10 respondents had heard of RVF. The main sources of information on RVF (n=481) were national and vernacular radio (68.9%), friends and family (40.7%), veterinary officer (34.7%), community/public health officials (19.8%), heath facilities (19.4%) and local animal experts (18%) as shown in Figure 5.5. The least utilized sources were internet (0.4%), text books (1.9%), posters/pamphlets (2.3%) and television (2.7%).

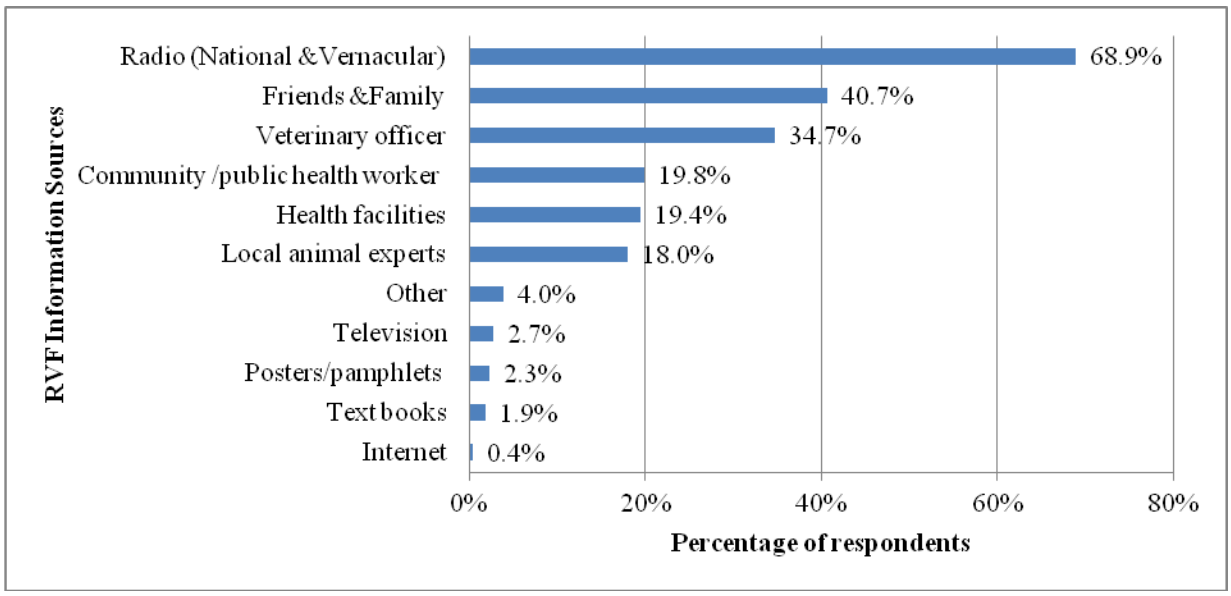


Figure 5. 5: Sources of RVF information

The widespread knowledge of RVF was influenced by the blanket ban imposed on consumption and trade in livestock and derived products despite RVF cases being reported in the lowland

only. The following excerpts exemplify the different ways in which discussants got to know of RVF:

> There was a time we had an RVF problem. People were told not to eat meat, not to drink milk or anything from cattle. We stayed almost 5 months [before resuming consumption]. *Male discussant, Litein FGD1*

> There was a car moving around announcing that people should not drink milk and eat meat because the livestock were sick. *Female discussant, Perkerra FGD1*

> Even meat was not there because butcheries closed [during the RVF outbreak]. *Female discussant, Perkerra FGD4*

> People were told [by the veterinary officers] that they should not sell their cattle. *Female discussant, Borowonin FGD1*

> They [the veterinary department] restricted the movements of livestock. *Female discussant, Borowonin FGD1*

> During that time we were told to wait for the outbreak to end before paying any dowry. No exchange of livestock occurred. *Male discussant, Litein FGD1*

> Even those who were wedding were not allowed to slaughter cattle, sheep or goats. They only slaughtered chicken. *Male discussant, Salabani FGD1*

Community Knowledge of RVF Signs and Symptoms in Humans

Few respondents were knowledgeable of RVF signs and symptoms in humans. Identified signs and symptoms included: fever (17.7%), headache (16.2%), jaundice (14.3%), vomiting (13.7%), diarrhea (12.7%), bleeding from body openings (11.6%), joint pains (11.2%) and impaired vision

(8.3%) (Figure 5.6). The following excerpts also reflect the level of awareness of RVF signs and symptoms:

> People infected with RVF also showed some signs which resembled those of malaria; that is having very high fever, weak joints and a headache. *Male discussant, Lorok FGD2*

> Those who died [of RVF] had diarrhea and their eyes were yellow when we saw them in the hospital, *Male discussant, Perkerra FGD1*

> Others started going blind. I even saw an old man who became blind within a very short time and eventually he died. *Male discussant, Soruro FGD1*

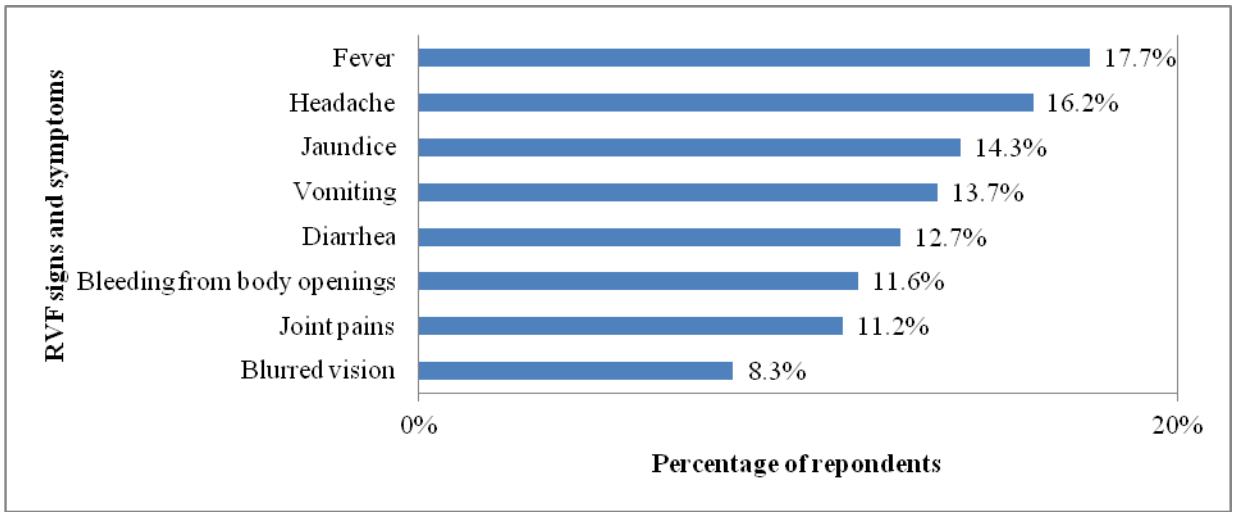


Figure 5. 6: RVF signs and symptoms

Community Knowledge of RFV Transmission Routes

The overall knowledge of RVF transmission routes was determined through eight questions on contact with sick animals, animal tissue, secretions and consumption of products from sick animals (Figure 5.7). Slightly more than half of the respondents (54.6%) scored higher than the

mean of 5 (s.e. = ± 0.94). The main means through which respondents believed they could be infected with a livestock zoonotic disease were through consumption of meat (79.2%) and milk (73.7%) or contact with blood (40%) from sick animals. Only a third (33.5%) of respondents knew that mosquitoes had capacity to transmit a livestock disease to humans.

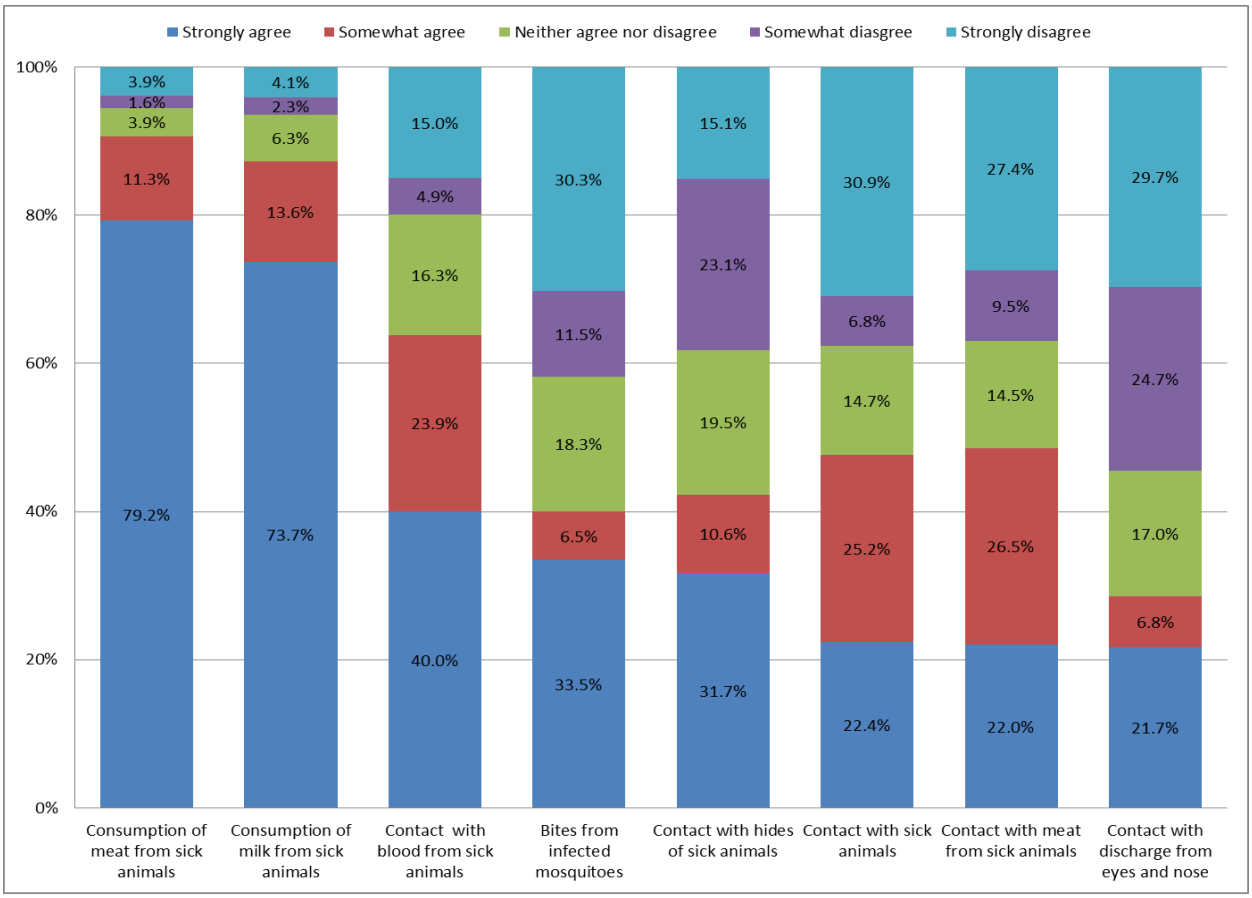


Figure 5. 7: Communities' knowledge of RVF transmission routes

Medical Practitioners Awareness Level of RVF

In this study, three Nurses In-charge of health facilities in the three sub-counties were interviewed. The nurses displayed different levels of knowledge of RVF causes and transmission mechanisms depending on their experiences and the area in Baringo in which they were practicing at the time of the last RVF outbreak. The following interview excerpts demonstrate these varying levels of knowledge:

Interview 1: Nurse In-Charge, Baringo North Sub-County

Interviewer:	Have you heard of a disease called Rift Valley Fever?
Interviewee:	Yes.
Interviewer:	The last time there was an outbreak in 2006-2007 were you practicing?
Interviewee:	Yes, I was practicing because I was employed in 2002. In 2006 I was in East Pokot.
Interviewer:	Did you at that time get comprehensive training on what RVF was? What caused it?
Interviewee:	I never went for any training.
Interviewer:	And as practitioners that time, did you received any training on Rift Valley Fever?
Interviewee:	No, we were just given a pamphlet.
Interviewer:	Beyond that?
Interviewee:	Nothing else.
Interviewer:	In your view, do you think that disease can occur again in future?
Interviewee:	It can occur.
Interviewer:	As practitioner, do you feel adequately equipped to handle RVF if it occurred?
Interviewee:	No. I am not ready. I am not prepared.

Interview 2 Nurse In-charge Baringo Central Sub-County

Interviewee:	Were you in service during the last Rift Valley Fever outbreak?
Interviewee:	Yes.
Interviewer:	Here or somewhere else?
Interviewee:	At the district hospital.
Interviewer:	At the district hospital. What was the experience?

Interviewee: It was terrible. That thing is not good. But I remember we did isolation. When a patient came we isolated them straight away.

Interviewer: Before then, did you have any experience in dealing with Rift Valley Fever?

Interviewee: No.

Interviewer: What do you know about RVF? Causes, how it is caused, how people end up with it in the first place.

Interviewee: I don't know but the little I heard was when it rains a lot the bacteria…[long silence]

Interviewer: Since then, have you received any training on RVF management?

Interviewee: No.

Interview 3: Nurse In-Charge, Marigat Sub-County

Interviewer: When you had the last RVF outbreak, how was it in that area?

Interviewee: It occurred in 2009 and it just happened after two things. There were some rains. Then after that there were some cattle dying. Then people started eating the cattle. So whoever ate the meat would obviously die. That is how RVF started……

Interviewer: And RVF symptoms in humans?

Interviewee: Of course there is high body temperatures. You find a person is very sick. They cannot help themselves.

Interviewer: They became weak?

Interviewee: Yes.

Interviewer: Other symptoms?

Interviewee: Others got diarrhea. And like we said general weakness.

Interviewer: Are there those who showed signs of vomiting?

Interviewee: Yes. When they had diarrhea, they also vomited.

Interviewer: Where there those who complained of joint pains?

Interviewee: People thought it was malaria. So those symptoms of malaria were observed.

Interviewer: Observed?

Interviewee: Yes.

Interviewer: Were there those who were sick to a point of oozing blood through body openings?

Interviewee: Yes. They were there. We lost around 10 or so. They showed those signs.

5.3 Community strategies for Coping with Malaria and RVF

This section is divided into two subsections on community strategies for coping with malaria and RVF.

5.3.1 Community Strategies for Vector Control and Coping with Malaria

This section addresses the traditional and conventional strategies used in mosquito control and management of malaria.

Vector Control Strategies

Traditional Vector Control Strategies

Traditional methods of vector control included use of plant materials and animal dung. However, only a small proportion of respondents, 7.7% and 7.3%, used plant materials and animal dung respectively. Discussants explained that dry cattle, sheep or goat dung could be used to repel mosquitoes but cattle dung was most preferred. The following excerpt exemplifies the use of animal dung as mosquito repellent:

You see, when children are studying and there are a lot of mosquitoes it is disruptive. So you burn the cow dung so that the smoke goes into the house to repel mosquitoes then the children can study. *Female discussant, Salabani4*

Discussants identified several plant species that could be used in repelling mosquitoes (Table 5.1).

Table 5.1: Plant species used as mosquito repellents

	Local name	**Scientific name**	**Community that identified the plant**	**Number of FGDs that identified the plant**
1	Mwarubaini	*Azadirachta indica*	Tugen and Ilchamus	3
2	Lekuru	*Acalypha fruticosa*	Ilchamus	2
3	Ng'oswe	*Balanites aegyptiaca*	Tugen	1
4	Kelelwa	*Croton dichogamus*	Tugen	1
5	White/Purple flower	*Catharanthus roseus*	Tugen	1
6	Kapito	*Sphaeranthus ukambanensis*	Tugen	1

The common characteristic in the usage of plant materials as repellents was burning of leafy twigs to produce dense smoke which repelled mosquitoes as exemplified below:

"Kelelwa" gets rid of all the mosquitoes. It produces a very strong smell. You use its leaves when they are fresh. Then you put them on the fire and they produce very thick smoke. *Male discussant, Litein FGD3*

Even, *"ng'oswe"*, if you burn its' leaves it can repel mosquitoes. *"Ng'oswe"* produces smoke for a long time because it burns slowly. It can burn till morning. If *"ng'oswe"* is burnt, the smoke chases the mosquitoes completely. *Male discussant, Litein FGD3*

You burn the *"mwarubaini"* leaves within the compound and it repels mosquitoes. *Female discussant, Perkerra FGD1*

> Sometimes you burn this shrub called "*lekuru*" to chase away mosquitoes. When it burns you put off the fire so that it releases smoke. You burn it when it is green. *Female discussant, Salabani FGD4*

Conventional Vector Control Strategies

Among the communities in Baringo, conventional vector control measures included use of bed nets, insecticide sprays, repellent jellies/lotions and coils (Figure 5.8). Of all the control measures, bed net use was the most widely practiced by the respondents. Among survey respondents, 98.9% (n=560) had ever seen a bed net and 94.6% had ever used one. However, those that had at least one bed net in their home at the time of the survey were 74.1%. Slightly less (68.7%) reported sleeping under a bed net the day before the interview. On use, 10.4% believed that bed nets should be used by expectant women only; 10.5% believed that bed nets were to be used by children <5years of age only; but 96.6% reported that everyone should sleep under a bed net regardless of age and physiological disposition. A similar percentage (96.6%) reported that using a bed net reduces the risk of malaria infection.

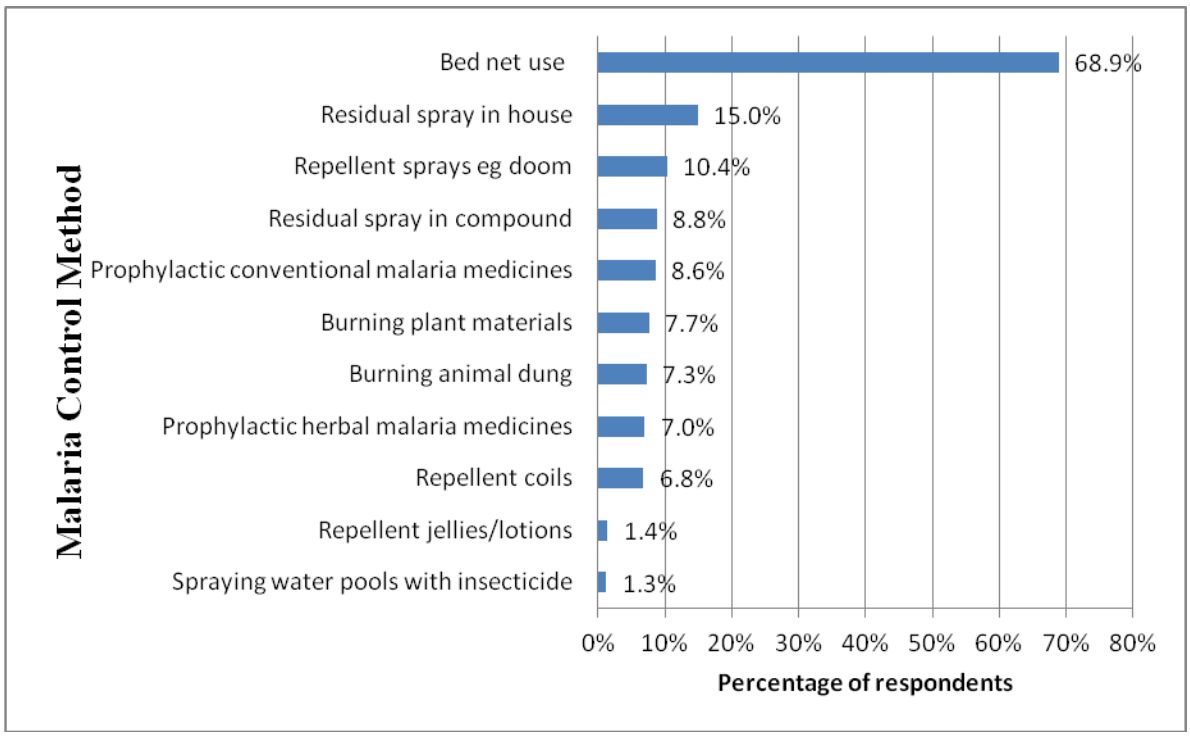


Figure 5. 8: Malaria control methods

In the study site, seven in ten respondents (70.8%) sourced bed nets from government health facilities while two in ten (21%) purchased from retail shops (Figure 5.9). Expectant women and newborns were supplied with free bed nets in government facilities through an initiative that targeted to control malaria in pregnancy and infants. All respondent (99.3%), reported that women in the County attended ante-natal clinics, the primary source of bed nets as demonstrated by the following excerpts:

> I asked [health workers] if I can get a bed net for free from the health facility and they told me unless you are pregnant or you come with a clinic card for a baby who is below five years you cannot be given. If you were once given a mosquito net they will not give you again because they stamp the card to show that you have already been given. So we were given the option of getting

pregnant so that we can be given a mosquito net. *Female discussant, Salabani FGD4*

Old men have problems with getting bed nets. If it was not for the women who get the nets from the hospital, we would keep scratching ourselves because of mosquitoes. *Male discussant, Kipcherere FGD3*

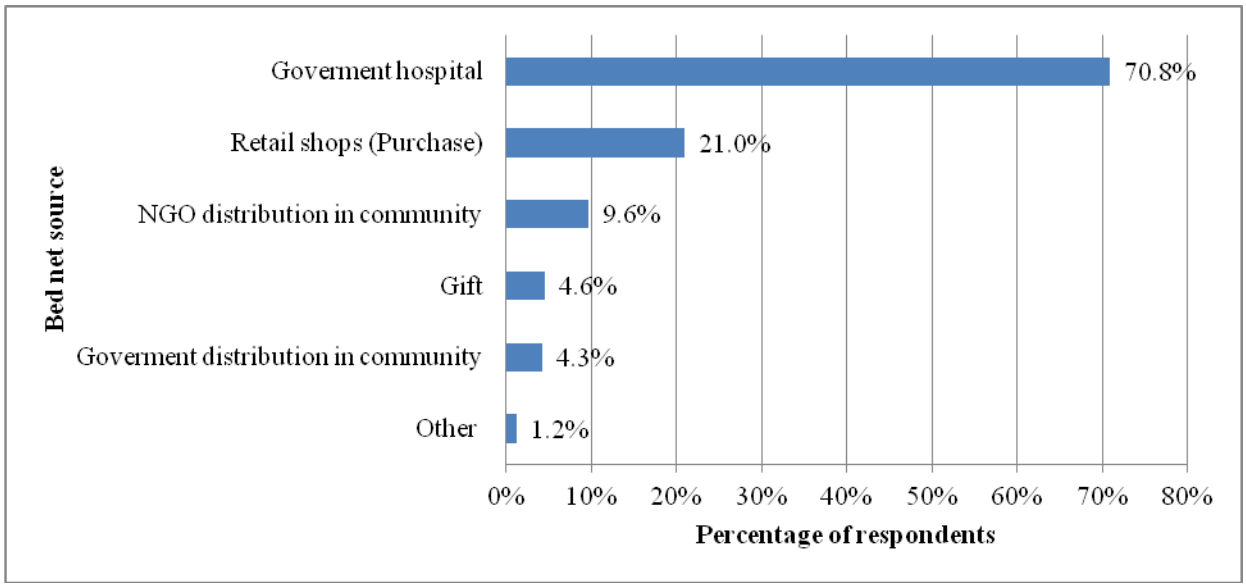


Figure 5. 2: Sources of bednets

Additional bed net sources included retail shops, community level distribution by non-governmental organizations during floods or to households whose children they sponsored. Persons working in the Perkerra Irrigation scheme occasionally benefited from free bed nets distributed by the National Irrigation Board (NIB).

When faced with bed net shortages, preference was given to the younger children as exemplified by the following excerpts:

> It's better for me [the parent] to sleep outside the bed net but my child to sleep under one. I can chase away mosquitoes or cover myself up when I hear them coming. *Female discussant, Borowonin FGD4*

> The youngest children will get priority [of use] if you have one mosquito net. *Female discussant, Salabani FGD3*

Treatment of bed nets was not common. Of those with bed nets, 87.7% had not treated them in the last six months. Discussants reported that bed nets were assumed not to require additional treating in their entire duration of use. The use of bed nets was also said to have limitations in that they could only be protective when someone slept under them and not before. One female discussant from Litein FGD2 highlighted this challenge saying "you can protect yourself during the night when you are asleep but during the day what can you do? You cannot be under a bed net by 6 pm."

Repellent jellies/lotions had only been used by 1.4% of respondents and coils by 6.8%. Discussants pointed out that these methods were largely unknown and the products were not readily available in their localities. Use of a domestic range of repellent sprays like "doom" were reported by 10.4% of respondents. Discussants attributed the low level of usage to inhibitive costs of the product. Residual spraying was mainly done in Perkerra Irrigation Scheme by the National Irrigation Board (NIB). Community members cleared excess vegetation from their compounds primarily for aesthetic purposes but received the additional benefit of vector, pest and snake control as shown by the following excerpts.

> When you have a lot of trees and grasses in the compound, mosquitoes will hide themselves inside. *Female discussant, Kipcherere FGD1*

> In my case, during the rainy season the grass or the bushes will grow and the compound becomes very bushy. So sometimes I clear excess vegetation to make the compound look good and keep away snakes but indirectly I am chasing away the mosquitoes. In my mind I am not targeting the mosquitoes, so that comes as a coincidence. *Male discussant, Salabani FGD2*

Discussants also identified presence of stagnant water pools as amplifying vector presence hence increasing exposure to mosquitoes at household level. They suggested that people should "destroy mosquito breeding places by draining stagnant water," and "if there are broken pots and idle containers that can hold some water, they should be removed".

Discussants who believed that malaria was caused by consumption of dirty water proposed water treatment as a means of control.

> You can boil water to prevent malaria because water may contain mosquito eggs or you treat water using chemicals such as water guard. *Male discussant, Borowonin FGD2*

> We can prevent malaria by drinking boiled water. *Female discussant, Litein FGD2*

Malaria Management

Malaria Management Using Conventional Medicines

Majority of respondents (96.4%) believed that malaria was treatable and non-contagious (87.1%). Up to 9 in10 respondents (87.9%) had ever suffered from malaria in their lifetime (n=492). At the onset of suspected malaria cases (Time 1), 37.2% of respondents took various analgesics such as paracetamol and aspirin, 28.9% went to hospital, 26.6% used herbal

medicines, 2.2% took remnant malaria medicines, 2.2% used over the counter malaria medicines, 1% visited traditional healers and 1.8% used other treatments (Figure 5.10). If the disease persisted (Time 2) almost all (97.8%) respondents sought care at a medical facility. Focus group discussants stated that analgesics were primarily used in relieving pain associated with malaria prior to seeking further treatment. The choice of treatments used at Time 1 was influenced by the perceived severity of disease, rate of disease progression, availability of treatment option, cost of seeking treatment, timing of illness onset and distance to preferred health facility. If an individual recovered from the perceived malaria after treatment at Time 1 no further treatment was sought. If the disease persisted, treatment at Time 2 was sought in a health facility where management with Artemether-Lumefantrine (AL) was initiated.

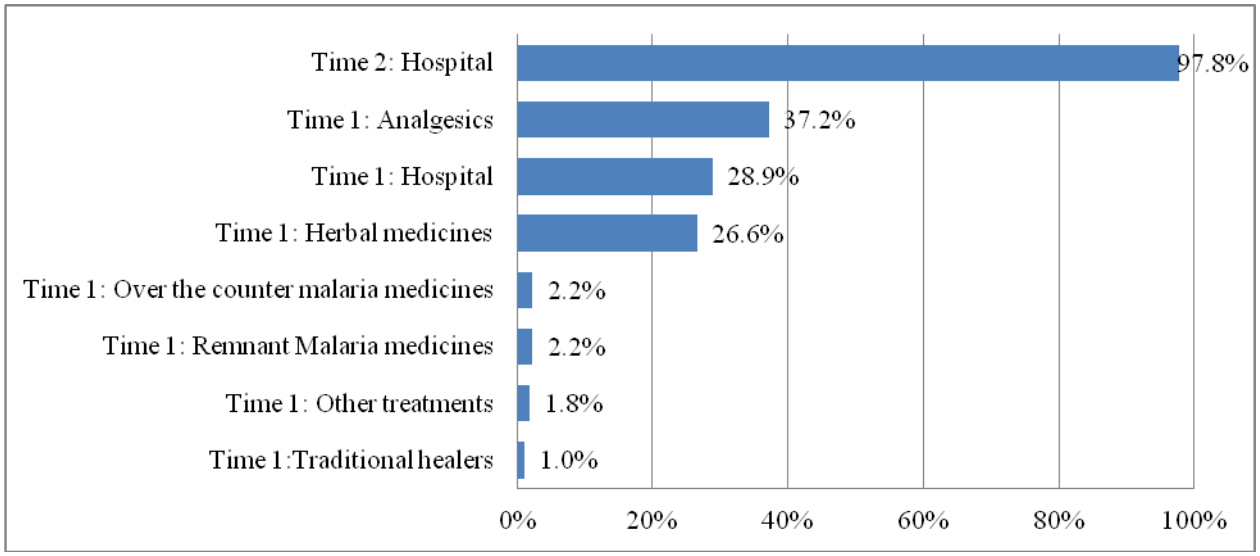


Figure 5. 30: Community treatment options at time 1 (T1) and time 2 (T2)

At the health facility, 81.9% of respondents were tested for malaria prior to treatment. Upon confirmation of infection, discussants reported that treatment with AL was initiated. The medicines' most desirable quality was its efficiency in treatment as stated by 96.5% (n=490) of respondents. However, bitterness (31.3%), bad smell (30.5%), nausea (27.2%) and long regime

of treatment (5.1%) were identified as the undesirable qualities associated with the use of AL. Only a tenth (10.2%) of respondents reported that these undesirable qualities had ever stopped them from complying the with malaria treatment regimen.

Contrary to survey findings that only 10.2% of respondents had ever failed to complete their malaria medication due to the undesirable qualities, discussants reported that non-compliance to malaria treatment regimen was widespread with the leading cause being quick relief from signs and symptoms, a quality linked to the efficiency of AL, in 18 of the FGDs. Undesirable qualities of malaria medicines such as bitterness (13 FGDs), causing vomiting (12 FGDs), nausea (10 FGDs), bad smell (8 FGDs) and many tablets to swallow (3 FGDs) also contributed to non-compliance as shown in the excerpts below:

> In this area, if you take the tablets in the morning, because of the hot sun you will do nothing the whole day. You will feel bad when you go outdoors. You smell of that medicine. Your whole body and sweat is like that medicine so some people prefer taking the medicine in the night and skip taking them in the morning. I take the malaria medicines in the evening only. I take [the medicine] for six days though it is not correct to skip other times. *Female discussant, Salabani FGD4*

> When I was sick I took eight tablets from the first day's dose, then my daughter who's in university got ill and we could not get more medicine. I gave her the rest, we shared. *Male discussant, Litein FGD1*

Among survey respondents, there was a statistically significant relationship between sex and not completing malaria medicines due to their undesirable qualities (Fischer's exact test p=0.02). Higher proportions of women than men had ever failed to comply with malaria treatment

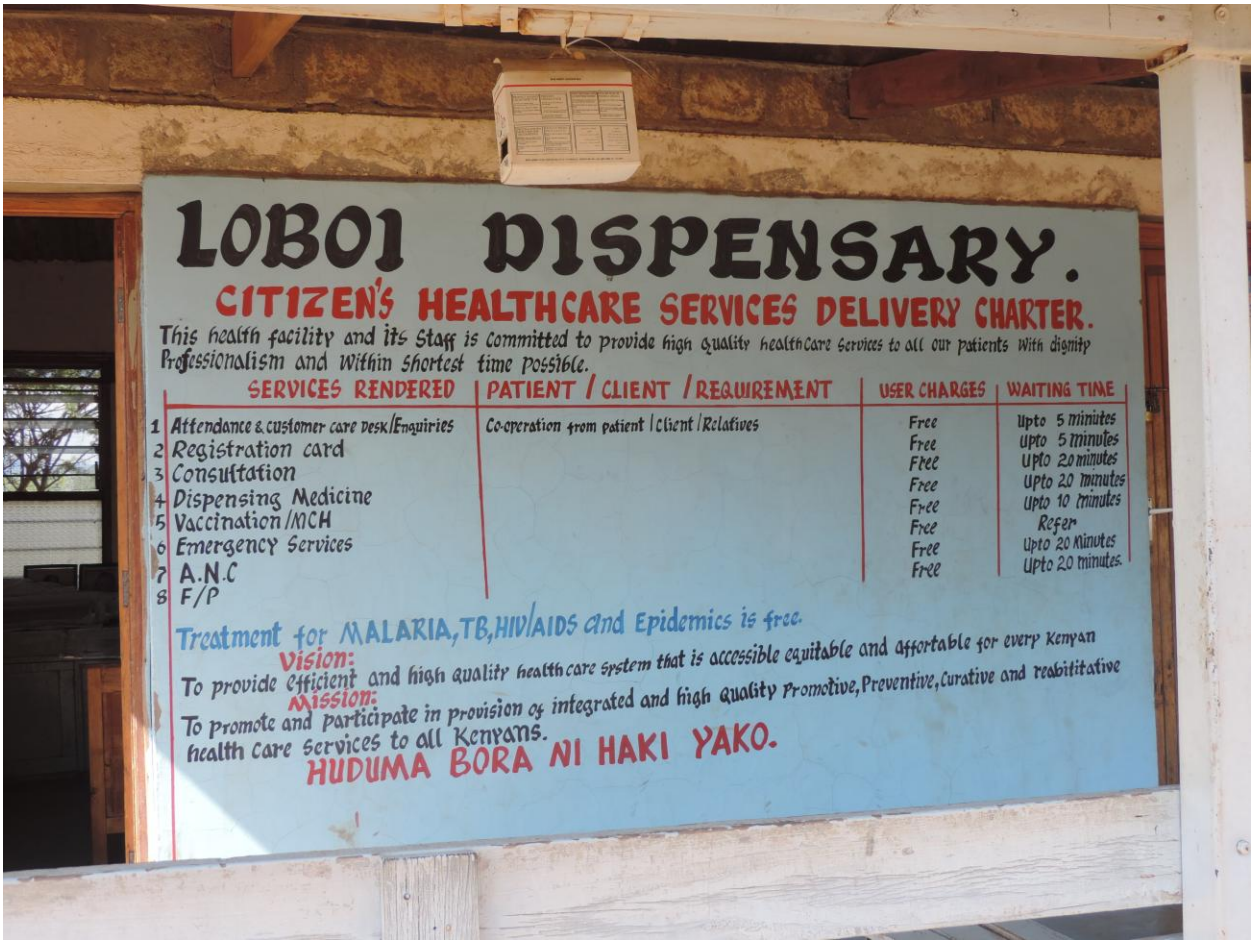
regimen because of the undesirable qualities. Remnant malaria medication was kept and used at the onset of another case of perceived malaria with or without confirmation of expiry.

> They [people] check the expiry date [of the remnant malaria medication], if it is past, it's not supposed to be taken. They then visit the hospital. But if it is not yet expired they use it. If they feel well they will not go to the hospital but if they don't they will [go to the hospital]. *Male discussant, Borowonin FGD3*

> Some people don't check for the expiry date of remnant malaria medicines. You [referring to another discussant] have said that [one should check for the expiry date of remnant malaria medicines] because you know that one should check but what of those that do not check the expiry date? *Male discussant, Perkerra FGD1*

Study participants reported that persons seeking treatment in health facilities were faced with a myriad of challenges. These included walking for long distances to access care. According to survey respondents 72.6% of them accessed the nearest health facility by foot, 24.7% by motorcycles and 2.7% by vehicles. People who were too ill to walk were carried in makeshift stretchers or blankets to the nearest point where a vehicle or motor cycle could be accessed. According to focus group discussants, movement was especially difficult in the rainy season when most malaria cases occurred because most roads were not well graded. In government health facilities, malaria testing and treatment was offered at no cost (Picture 5.1). However, patients and their care givers had to meet costs associated with transport as well as any other medical services they received. In times of drug shortage, patients were reportedly given prescriptions and asked to buy what they could not get in the health facilities' pharmacies from other outlets. All dispensaries and health centres were mainly open from 8am-5pm Monday to

Friday. After working hours, patients had to look for alternative means of managing illness. The county and sub-county hospitals were always open but not easy to access for persons living in distant areas.



Picture 5. 1: Citizen's charter indicating malaria treatment is offered at no cost

Malaria Treatment Using Herbal Medicines

In all FGDs, there was agreement that people applied varying approaches in malaria management. These included taking analgesics, herbal medicines, remnant malaria medicines or visiting a health facility. Discussants stated that herbal remedies were mainly used to delay disease progression before seeking medical treatment (Table 5.2). However, in some instances, they were used as full treatment courses after which no additional treatment was sought. In both

instances, infusions or decoctions made from leaves, roots or barks of various medicinal plants with emetic or purgative qualities were consumed. These medicines were often consumed 1-3 times a day for 1-3 days. As reported by focus group discussants, herbal treatments were mainly preferred because of ease of access (8 FGDs), lack of money to access medical care at the onset of illness (8 FGDs), belief that one will get well (8 FGDs), distance from health facility (7 FGDs), they have been used for many generations (7 FGDs), are cheap (6 FGDs), fear of hospitals (6 FGDs) and ability to slow down disease progression (5 FGDs).

Table 5.2: Medicinal plants used in malaria management

	Local Name	**Scientific name**	**Part used**	**Preparation method**
1	Chepnyalile bei	*Chasmanthera dependens*	Rhizomes	Macerated and steeped in cold or hot water
2	Chepkingung	-	Roots	Ground root or root powder steeped in hot water
3	Kimnaget	*Cynanchum viminale*	Stem	Chewed, cut into pieces and steeped in cold water, boiled
4	Mwarubaini	*Azadirachta indica*	Leaves, bark, roots	Leaves, bark, roots boiled, bark may be steeped in cold water
5	Ngwantere	*Ajuga integrifolia*	Leaves	Macerated and steeped in cold water, can be powdered, can be chewed
6	Poroch	*Brassica ssp*	Roots	Macerated and steeped in cold water
7	Soget/Sok	*Warbugia ugandensis*	Leaves, bark	Steeped in cold water
8	Sogotei	*Salvadora persica*	Roots, bark	Boiled or macerated and steeped in cold water
9	Tabarar	*Cissampelos pareira*	Roots	Macerated and steeped in cold water
10	Tengeretwet	*Aloe secundiflora*	Leaf sap	Mixed with cold water
11	Yellow flower	*Tithonia diversifolia*	Leaves	Macerated and steeped in cold water
12	Ngoswe/Lowei	*Balanites aegyptiaca*	Bark	Boiled
13	Ilkokoyei	-	Roots	Boiled, mixed with hot soup
14	Subeiwa/Eldepe	*Acacia gerrardii*	Roots	Boiled, mixed with hot soup, milk
15	Yemit/Yemdit	*Olea europeaea L.*	Bark	Steeped in cold water

In the study area, it was widely believed that recovery from malaria only occurred if the body was cleansed of excess bile through the use of purgatives and emetics derived from plants assumed to have medicinal qualities. Locally, this process of cleansing the body was referred to as *"kecheru ngw'one"*(Tugen) or *"aitei lodua"*(Ilchamus). Excess bile was believed to be

caused by consumption of fatty or sugary foods. Utilization of herbal remedies appeared more common with older community members compared to the younger ones as shown in the following excerpts:

> … nowadays people have gone to school. You will find that the digital [young people] don't like herbal medicines so much but the analogue [old people] continue using them. *Male discussant, Salabani FGD1*

> You see these medicinal plants, not everyone knows them. Not everyone knows that they are medicinal. You know we stay in town, near the hospital. They [people] are close to the hospital and maybe they do not know those herbs so they just have to go to the hospital. *Male discussant, Perkerra FGD1*

5.3.2 Extent of Community Adaptation to Malaria

Beyond coping, the study sought to assess the level of community adaptation to malaria by identifying the assets and strategies the community had and how they were utilized in the control and management of malaria. A summary of the influence of resources and practices on the communities' adaptive capacity to malaria is presented in Table 5.3a and Table 5.3b.

Table 5.3a: Influence of resources and practices/current status on adaptation to malaria

	Asset Category	Specific asset	Practices/status	Influence on Adaptive capacity
1	Natural	Health	Ill health was not considered the norm and attempts were made to preserve good health	This perception strengthened the adaptive capacity of the people
		Climate variability and Geographic location	The County falls under the seasonal transmission of malaria zone	The County is provided with malaria testing kits, medicines and bed nets for malaria treatment and control increasing its adaptive capacity
2	Human	Knowledge	Communities were knowledgeable of malaria signs, symptoms and seasonality	Ability to identify when malaria cases are probable and how they manifest is important in initiating access to medical care and hence strengthens the communities' adaptive capacity
			Communities held myths on malaria causes in addition to biomedical knowledge	Belief in myths had potential for compromising access to appropriate medical care thus compromising an individual's adaptive capacity
3	Physical	Hospital access	Sub-county and county hospitals operated on a daily basis while dispensaries and some health centers operated for 8 hours a day, 5 days a week	When patients cannot be able to access medical care from health facilities due to restricted operating hours, distance or limited supply of medicines it compromises the County's adaptive capacity. It also encourages self-management of disease delaying access to appropriate care.
		Medicine	Mainly provided in health facilities	The malaria medicine is able to cure but it compromised by non-compliance lowering the patients' adaptive capacity. Further upon suspicion of malaria cases community members attempt to treat the disease and visit health facilities when its persists, delaying onset of appropriate treatment and risking severe cases with may lead to death
		Bed nets	Mainly sourced from hospitals by expectant mothers and those with children under 1 year	Bed net use strengthens the adaptive capacity of newborns and expectant mothers against malaria. However, among other populations bed net uptake is low increasing risk of malaria infection therefore weakening the communities' adaptive capacity
		Roads	Mostly made of earth	Movement becomes difficult in the rainy season lengthening response time thus weakening the communities adaptive capacity
		Mobile telephony	Majority of people from all zones had mobile phones but some places lacked reliable network coverage	Ownership of phones strengthened the adaptive capacity through easing communication and reducing the time and effort it takes to mobilize help
		Transport	Most people accessed health facilities mainly on foot, followed by motorcycles	Accessing county and sub county hospitals is challenging due to limited number of vehicles and difficult terrain

Table 5.3b: Influence of resources and practices/current status on adaptation malaria (continued)

	Asset Category	Specific asset	Practices/status	Influence on Adaptive capacity
4	Financial	Money	Malaria testing and medicine were provided for free but patients covered all other costs associated with seeking treatment	This strengthens the communities' adaptive capacity by lowering the direct costs of malaria treatment
		Health insurance	Only the rich and few people with permanent employment had access to health insurance	This compromises ability to cover medical bills particularly if one is admitted hence lowering a family's adaptive capacity
		Livelihood activities	Majority of people relied on wage employment whose returns were low and unreliable; sale of livestock to raise money was often done as last resort	This provides a level of financial security which may not be able to meet medical bills hence lowering a family's adaptive capacity
5	Social	Care giving for sick person	Men mainly met financial costs while women provided bedside care	This enhances the adaptive capacity of the sick individual but has potential for compromising the caregivers ability to engage in productive work
		Community participation in caregiving	Community members contributed in caring for sick persons	This enables sick persons to meet their reproductive roles and financial obligations hence strengthening the affected family's adaptive capacity
6	Political	Ability to influence quality of health care in the locality	Community members were not organized into groups that could influence quality of health care in their locality Individual members felt unable to meaningfully influence quality of healthcare in their locality	Lack of public involvement in decision making processes on local health matters compromises the County's adaptive capacity

5.3.3 Community Strategies for Coping with RVF

This section addresses various strategies utilized by communities in coping with RVF. These included: treatment of RVF human and livestock cases; dietary diversification; livelihoods diversification; restocking lost livestock and livestock vaccination.

Treating Human RVF Cases Using Herbs and Hospital Care

During the RVF outbreak, affected community members attempted to treat the sick persons using both traditional and conventional medicines as exemplified in the following interview excerpt:

Interviewer: Were there those who tried to treat RVF infected patients at home?

Interviewee: Before it was completely known [that the disease was RVF], we used herbs. So you would find a person, when they are sick, they go to the bush and collect some herbs but when it became worse they stopped.

Interviewer: For those who came to the hospital after they had tried to manage the case at home and it worsen, did they say what they did at home, or the kind of medicine they tried?

Interviewee: They didn't. When they came for treatment, they stopped consuming herbal medicines but didn't give an account of what they did.

Interviewer: Might you be aware of the herbs that they were using?

Interviewee: Unfortunately, I don't know their scientific names.

Interviewer: Just local names.

Interviewee: So, we have herbs called "lemunyi" (*Harrisonia abyssinica),* "mwarubaini" *(Azadirachta indica),* we also have an herb called "logotim" (*Berchemia discolour).* I don't know whether you are getting?

Interviewer: Yes. Am getting.

Interviewee: We also have tree called "lowei" *(Balanites aegyptiaca)* for inducing vomiting.

Interviewer: This is for vomiting?

Interviewee: Yes. It induces vomiting. When someone starts to show signs of nausea, it encourages bile removal.

Treating Sick Livestock

During the 2006-2007 outbreak, community members unsuccessfully attempted to treat infected livestock with both conventional and herbal medicines without guidance from a veterinary officer as exemplified below:

> We really tried to treat the livestock. We used "mwarubaini" *(Azadirachta indica)* but it never helped. *Male discussant, Lorok FGD2*

> We treated animals with RVF using "sokonyi" *(Warbugia ugandensis sprague)* and "sukuroi" *(Aloe secundiflora). Male discussant, Soruro FGD1*
>
> We also used "ilbukoyei" *(Terminalia kilimandscharica). Male discussant, Soruro FGD1*
>
> We tried to treat them [livestock] because we realized it was RVF when it was too late. *Female discussant, Soruro FGD2*

Dietary Diversification

During the last RVF outbreak, community members adjusted to the bans placed on consumption of animal products in two ways; by adherence or non-adherence. Community members adhered to the bans on cattle, sheep and goat products by substituting them with vegetables, pasteurized milk and white meat as exemplified in the following excerpts:

> For those who refused to consume [cattle, sheep and goat products], they just took sukumawiki (kales) and other greens. They also took fish because we have a lot here in the lake [Baringo]. Others just avoided consuming anything meaty because the disease persisted for about a month. *Female discussant, Lorok FGD1*
>
> People bought packed milk. It was expensive. *Female discussant, Perkerra FGD1*
>
> People ate chicken during the RVF outbreak. We also ate fish and vegetables. *Female discussant, Salabani FGD2*
>
> Those who were wedding were not allowed to slaughter cattle, sheep or goats. They only slaughtered chicken. *Male discussant, Salabani FGD1*

Community members who preferred not to change their diet still ate the banned livestock products. To ensure safety in consumption, community members boiled the animal products for

longer than usual, sometimes in herbs, and discarding all stock/soup as shown in the following excerpts:

> My goat died and my husband told me to go and bury it. I waited until he went to work then slaughtered it, boiled the meat for long and consumed. I wasn't affected. On the last day my husband discovered [what I had done] and he consumed it too, *Female discussant, Lorok FGD1*

> We were told [by the veterinary officers] not to eat meat but some people said that if you boiled it well, it would be safe so long as it was not roasted. *Male discussant, Litein FGD1*

> When meat was boiled we did not drink the soup. The [RVF] virus was in the soup. *Male discussant, Litein FGD3*

> We also boiled milk four times before drinking. *Male discussant, Soruro FGD1*

> We added herbs to the meat, *Male discussant, Litein FGD3*

Discussants attempted to use plastic bags as protective gear to control infection when handling livestock products. A female discussant from Lorok FGD1 reported that "we were told to wear plastic bags on our hands when milking cows and people followed and were not affected but for those who didn't follow the advice, they were affected."

Diversification of Livelihood Activities

During the last RVF outbreak, the veterinary department banned trade of cattle, sheep and goats and derived products to control disease spread. Consequently, livestock markets, abattoirs/

slaughter slabs and butcheries remained dormant resulting in livelihood disruptions until the ban was raised as shown below:

> Even meat was not there because butcheries closed [during the RVF outbreak]. *Female discussant, Perkerra FGD4*

> People were told [by the veterinary officers] that they should not sell their cattle. *Female discussant, Borowonin FGD1*

> They [the veterinary department] restricted the movements of livestock. *Female discussant, Borowonin FGD1*

Restocking Lost Stock

Besides purchase, inheritance and gifting, community members restock lost livestock through loaning each other animals for milk and offspring. Lack of livestock in communities in Baringo is considered an indicator of poverty and therefore shameful. Among the Tugen, it is equated to being naked, requiring quick response through a traditional practice referred to as *"som no nguer"* which translates to "borrowing clothes." In institutionalizing this culture of sharing among the Ilchamus, if someone gave another a bull, they called each other *"pakiteng"* and if it was a cow *"ntawo"*. The following excerpts show how this traditional form of loaning and sharing was conducted:

> Culturally, when you have no livestock at all, you borrow from someone then you come to take care of them. But the livestock is not yours, you will just be taking care of it for the owner. If he's a good person, he will give you one or two then retain the others. *Female discussant, Litein FGD4*

> You may be called by a neighbor and be given say, four heads of cattle to take care of. He [the owner] tells you to take care of them and when they give birth, the calves will be yours. After sometime, he will ask you how the cattle are doing. When you get a problem, the owner can just allow you to sell one of the cattle. As time goes by, you will own all the cattle or if he [the owner] comes and asks for them, at least he will not take all of them. *Male discussant, Lorok FGD2*

Livestock Vaccination

While livestock were vaccinated during the last RVF outbreak, the intervention was led by the veterinary department and not community members. An interview with a key informant demonstrated that the intervention came too late, after animals were already infected.

> We [veterinary department] had problems with vaccination. There were issues of abortion in animals so we had to ask them [farmers] to choose whether to let the animals die from RVF or vaccinate. The animal aborts or it dies, so we had to agree [with the farmer] to save the animal even if it aborts. Because you could hardly tell if sheep, goats and cows were pregnant, we could get the owner to tell us which one was pregnant then we told him the animal may abort or not. We advised him of the possibilities. The animals which were actually aborting already had the disease so when you vaccinate, it just made it worse. *Veterinary Department Key Informant3*

5.3.4 Extent of Community Adaptation to RVF

Beyond coping, the study sought to assess the level of community adaptation to malaria by identifying the assets the community had and how they were utilized in the control and

management of RVF. A summary of the influence of resources and practices on the communities' adaptive capacity to RVF is presented in Table 5.4a and Table 5.4b

Table 5.4a: Influence of resources and practices/current status on adaptation to RVF

	Asset Category	**Specific asset**	**Practices/status**	**Influence on Adaptive capacity**
1	Natural	Geographic location and climate variability	There had been one reported RVF outbreak in 2006	This weakened the County's adaptive capacity to livestock diseases since there were no preventive measures in place before the outbreak
		Livestock	Farmers mainly kept cattle, sheep and goats	The animals are susceptible to RVF if adequate prevention measures are not taken hence weakening both farmers' and livestock's adaptive capacity
			Animal source foods consumed by local communities include meat, milk, blood and animal fat	During an RVF outbreak, these practices may inhibit adherence to bans on consumption of livestock products lowering the communities' adaptive capacity
			Local communities used livestock products as treatment or means through which medicines could be administered	During an RVF outbreak, these practices may inhibit adherence to bans on consumption of livestock products lowering the communities' adaptive capacity
			Disposal of dead animals was mainly through consumption or burying	Consumption of dead animals increases possibility of infection with disease hence compromising an individuals' adaptive capacity
2	Human	Knowledge	Limited knowledge of RVF signs and symptoms in humans	Since both RVF and malaria share symptomatology and occur in the wet season, it is possible for RVF to be assumed and managed as malaria, compromising the infected person's adaptive capacity
			Fair knowledge of RVF transmission routes	Community members are likely to be infected through routes that are not assumed to be life threatening hence reducing their adaptive capacity
3	Physical	Hospital access	Sub-county and county hospitals operated on a daily basis while dispensaries and some health centers operated for 8 hours a day, 5 days a week	When patients cannot be able to access medical care from health facilities due to restricted operating hours, distance or limited supply of medicines it compromises the County's adaptive capacity. It also encourages self-management of disease delaying access to appropriate care
		Veterinary services	The County veterinary department had inadequate staff, medicines and unreliable means of transport. Suspect samples had to be transported outside the county for investigation.	These can lead to delays in response time giving the disease ample lead time to spread before any measures are taken

Table 5.4b: Influence of resources and practices/current status on adaptation to RVF (continued)

	Asset Category	**Specific asset**	**Practices/status**	**Influence on Adaptive capacity**
		Roads	Mostly made of earth	Movement becomes difficult in the rainy season lengthening response time thus weakening the communities' adaptive capacity
		Mobile telephony	Majority of people from all zones had mobile phones but some places lacked reliable network coverage	Ownership of phones strengthened the adaptive capacity through easing communication and reducing the time and effort it takes to mobilize help
4	Financial	Money	Inability to afford veterinary services due to cost	RVF vaccines are provided by the Kenya government at no cost to farmers but during the last RVF outbreak they arrived after animals were already infected thus lowering the adaptive capacity
5	Social	Friendship/ brotherhood	To rebuild stocks of animals lost to disease, community members loaned animals to each other to "cover nakedness" and provide milk	This enhances adaptive capacity as families without animals can build assets by providing labour in exchange
		Care giving for sick person	Men mainly met financial costs while women provided bedside care	It enhances the adaptive capacity of the sick individual but has potential for compromising the caregivers ability to engage in productive work
		Community participation in caregiving	Community members contributed in caring for sick persons	This enables sick persons to meet their reproductive roles and financial obligations hence strengthening the affected family's adaptive capacity
6	Political		Community members were not organized into groups that could influence the quality of veterinary services Individually, community members felt unable to meaningfully influence quality of veterinary care in their locality	Lack of public involvement in decision making processes on local animal health matters compromises the County's adaptive capacity

Chapter 6: Discussion

6.1 Introduction

Chapter six discusses the results reported in chapters four and five. It is divided into four main sections covering the four research objectives namely, community knowledge of the relationship between malaria and RVF and climate variability; linkages between socio-cultural practices and vulnerability; effect of resource factors to vulnerability; and assessment of community coping and adaptation mechanisms in relation to malaria and Rift Valley Fever.

6.2 Community Knowledge of the Relationship between Climate Variability, Malaria and RVF

6.2.1 Community Knowledge of the Relationship between Climate Variability and Malaria

The study established that communities had local names for malaria which indicated that they had interacted with the disease long enough to begin to characterize it. Indeed, this was further established by more than half of household survey respondents who knew at least five malaria signs and symptoms. These included fever, headache, vomiting, loss of appetite and joint pains. Fever was the most commonly identified symptom (80.2%) in the survey whereas convulsions were the least (3.2%). These findings are in agreement with other studies assessing community knowledge of malaria signs and symptoms in Tanzania (Kinung'hi et al., 2010), Uganda (Batega, 2004), Ethiopia (Abate et al., 2013) and Ghana (Adongo et al., 2005) where fever was reportedly the most identified symptom. However, this is not the case in all countries in Africa. In South Africa for instance, a study reported that most people were knowledgeable of headache as a symptom of malaria while fever was less known (MRLP, 2008). Another study conducted in Ethiopia reported chills as the most known malaria symptom followed by fever (Aderaw et al., 2013).

The knowledge of convulsions, a sign of severe malaria, was found to be similarly poor in studies in Tanzania (Kinung'hi et al., 2010) and Uganda (Batega, 2004). Consequently, the occurrence of convulsions has been attributed to attacks by spiritual beings, moths, birds and caterpillars in Tanzania (Dillip et al., 2009; Makundi et al., 2006; O'Neill et al., 2015). Therefore, the first choice of treatment for convulsions has been the traditional healers who treat the condition by exorcising the "evil spirits" or conducting cleansing ceremonies to forestall future incidences (Dillip et al., 2009; Makundi et al., 2006; O'Neill et al., 2015). These findings indicate that there is limited knowledge on signs and symptoms of severe malaria at community level.

Malaria shares symptomatology with other illnesses such as typhoid (WHO, 2004) and brucellosis (Dean et al., 2012). Therefore, patients who experience fever, vomiting, diarrhea and body weakness, which are some of the symptoms experienced by persons suffering from malaria, must not always assume they have the disease. Without testing, it is difficult for the lay person to differentiate between malaria and other infections. Consequently, the infection that is often assumed to be malaria at community level may turn out to be different upon biomedical testing. In health facilities where malaria testing is not conducted, there lies possibilities of over diagnosis and misuse of malaria medicines due to the propensity to associate these signs and symptoms with malaria rather than a group of diseases (Ukaegbu et al., 2014).

According to study participants, malaria could occur all year round in Baringo County, but majority of cases were reported in the rainy season. This was attributed to an increase in mosquito breeding grounds generated by water pooling. This linkage between malaria and the wet season was in agreement with the national classification of malaria zones. The County falls within the seasonal malaria transmission zone characterized by acute transmission of malaria in

the rainy season (DOMC et al., 2011). This zone, geographically located towards the north and south eastern part of the country, comprises of the arid and semi-arid areas of Kenya which normally experience high temperatures (GOK, 2016). Malaria vector and parasite growth, development, length of transmission periods and geographic spread is influenced by temperatures and rainfall (Haines et al., 2006).

Indigenous methods of weather forecasting have been used for a long time before the advent of modern techniques. To determine weather patterns, particularly the rainy season, the communities in Baringo used tree phenology, goat intestines and astronomical bodies in forecasting. The use of tree phenology has also been reported in other regions in Kenya (Speranza et al., 2010), Tanzania (Chang'a et al., 2010), Zimbabwe (Enock, 2013; Muguti et al., 2012; Risiro et al., 2012), the Sahel belt (Nyong et al., 2007) and India (Acharya, 2011). In Tanzania for instance, early and heavy flowering of *Erythrina abyssinica* and the *Brachystegia speciformis* indicate that there will be good rains (Chang'a et al., 2010; Chengula et al., 2016). Similar to what was reported in Baringo, intense flowering of the *Acacia sp* in the Makueni region of Kenya indicated that there would soon be rain (Speranza et al., 2010). Among the Shona community of Zimbabwe, withering and peeling of the leaves of *Brachystegia boehmii* indicated lack of rains but withering of leaves without peeling implied coming of heavy rains (Muguti et al., 2012). Further, both in Tanzania and Zimbabwe, heavy fruiting of the mango tree was associated with lengthier dry spells while the reverse implied occurrence of heavy rains (Chengula et al., 2016; Muguti et al., 2012).

Besides trees, astronomical bodies have also been used in traditional weather forecasting. In Baringo, the positioning of Jupiter, Venus and select constellations were used to predict whether rains would fall as expected. In the Makueni region in Kenya, a central positioning of “a

constellation of seven stars" implied that rains were forthcoming but if they were located to the east there would be none (Speranza et al., 2010). In Zimbabwe, rural communities were reported to use the positioning of the sun, moon, certain constellations and lightning for weather forecasting (Enock, 2013; Muguti et al., 2012; Risiro et al., 2012). While there is agreement across areas that astronomical bodies can be used in weather forecasting, the choice of the specific features varied from place to place.

The behavior of insects such as ants, spiders, bees and butterflies has also been used in traditional weather forecasting. For example, in Zimbabwe, rural communities associated the disappearance of ants that were previously seen gathering food as an indicator that rains would fall in 24 hours (Enock, 2013). In addition, spiders weaving short and stout webs above the ground implied that rains were forthcoming (Enock, 2013). In Kenya (Speranza et al., 2010) and Zimbabwe (Enock, 2013), an increase in the number of crickets points to poor rains or a persistent dry spell. When bees are seen moving from one area to another, usually in an east-west or north-south pattern, the place they previously inhabited is assumed to be faced with drought (Speranza et al., 2010). The sudden appearance of rare insects such as red ants and black butterflies between September and November has been associated with imminent rains in India (Acharya, 2011).

Observation of bird behavior has also been identified as another method of weather forecasting. For example, in Zimbabwe, when migratory birds are seen from one area to another, the area they previously inhabited is assumed to be faced with protracted drought (Muguti et al., 2012). However, when storks emerge and engage in singing it signals forthcoming rain (Enock, 2013; Muguti et al., 2012). In Kenya, the emergence of many swallows points to imminent rainfall. In India, when birds that ordinarily fly and catch insects in the skies are seen feeding near the

ground, it is an indication that rains are forthcoming (Acharya, 2011). In Tanzania, the singing of the white browed coucal, *("dudumizi")*, early in the morning signaled the onset of rainfall (Chang'a et al., 2010; Chengula et al., 2016).

Observation of plants, astronomical bodies, insects and birds are not the only methods used in traditional weather forecasting. Others include observation of wild animals such as gazelles and zebras (Speranza et al., 2010) and frogs (Muguti et al., 2012). In the reviewed articles on traditional weather forecasting, the use of goat intestines was not reported. This implied that the method was unique to the communities in Baringo. It also indicated that there are probably more methods of traditional weather forecasting that are not yet documented and therefore are only known in the local contexts within which they are applied.

While the use of traditional methods of weather forecasting can help strengthen a communities' early warning systems, the use of traditional weather forecasting methods faces a lot of challenges. At the fore is lack of documentation as has been noted with the use of goat intestines. Since this indigenous knowledge is held by a minute proportion of the elderly population (Risiro et al., 2012), often of one gender, it is mainly lost to natural attrition by way of death of custodians or memory loss (Enock, 2013). Lack of documentation makes authentication of traditional forecasts difficult thus lowering their reliability (Enock, 2013). That the knowledge is not systematically passed to the younger generations further dilutes its utilization and credibility leading to preference for conventional forecasts (Risiro et al., 2012; Speranza et al., 2010). The declined use of indigenous methods of weather forecasting has been credited to colonization and consequent branding of local knowledge as inferior to western knowledge (Muguti et al., 2012).

Traditional weather forecasting has not been integrated with conventional methods despite the two bodies of knowledge co-existing together. This has been attributed to the perception that indigenous knowledge is not necessary, coupled with lack of knowledge on how to marry the two especially when traditional and conventional forecasts for an area differ (Nyong et al., 2007). Preference of conventional over traditional methods is driven by the need for robust and generalizable climate information, covering large geographic spaces (Speranza et al., 2010). These qualities are not possessed by traditional forecasts as they tend to be context specific (Speranza et al., 2010). Moreover, traditional forecasting is not static and neither are some of the mediums used in the practice. For instance, as ecosystems change, there is possibility that plants will adapt to the new changes or become extinct, making their use problematic (Speranza et al., 2010). It is also not automatic that community members will be knowledgeable of the changes occurring on the mediums.

Despite the challenges, indigenous forecasting has been utilized by communities for many generations and still proven useful. Its use is gainful because it recognizes communities as important contributors to their own adaptation to climate variability challenges and creates opportunities for knowledge transfer between the two schools of practice (Nyong et al., 2007). Indigenous and scientific forecasting should not be seen to be in competition but rather as complementary.

6.2.2 Community Knowledge of the Relationship between Climate Variability and RVF

The El-Nino Southern Oscillation (ENSO) phenomenon has been isolated as the primary determinant of inter-annual weather variability and occurrence of extreme weather events such as anomalous rainfall and drought (Kovats et al., 2003). In sub-Saharan Africa and the Arabian Peninsula, it has been linked with RVF outbreaks precipitated by above normal rainfall

(Anyamba et al., 2009; Linthicum et al., 1999). In Kenya, this relationship has been demonstrated during the 1997-98 (Anyamba et al., 2009) and 2006-2007 outbreaks (LaBeaud et al., 2008). Voluminous rainfall occurring during the El-Nino period creates ambient environment for hatching of infected *Aedes* eggs previously deposited in soil (Breiman et al., 2008; Sang et al., 2010). This results in rapid multiplication of infected *Aedes* mosquitoes, which are the main RVF vectors (Breiman et al., 2008). During an active outbreak, the *Culex* and *Anopheles* mosquitoes intensify transmission of the RVF virus to susceptible livestock hosts, eventually infecting human beings through contact with animal tissues and secretions (Himeidan, 2016).

The communities in Baringo had little knowledge of the relationship between climate variability and RVF. While few focus group discussants could rightly situate the occurrence of the 2006-07 outbreak within the El-Nino rains period, the link between consequent flooding and RVF vectors was not identified. This was suggested by the uncertainty on whether mosquitoes had a role to play in RVF occurrence and subsequent attribution of the disease to monkeys, bad air, ticks, tsetse flies and rain. While rain played a key role in creating suitable breeding grounds for RVF vectors, it was not the cause of the disease. Ticks (Gerdes, 2004) and tse-tse flies (WHO, 2016b), have been isolated as having the potential to mechanically transmit RVF. An entomological survey conducted in Kenya to identify the infection status of RVF vectors from areas where the 2006-07 outbreak occurred collected mosquitoes and other hematophagous arthropods for screening (Sang et al., 2010). However, only a small number of ticks were collected and screened but none were found to be infected (Sang et al., 2010). No comprehensive study has been done to verifying the role of tsetse flies in spreading RVF.

That the communities were largely aware of RVF but not its association with climate variability is not surprising considering that the disease was first reported in Baringo County in 2007 and

has not recurred since (Nguku et al., 2010). This may explain why the disease has been speculatively attributed to air, rain, ticks and tsetse flies and monkeys. Moreover, there was no consensus on the local name for RVF. This differs from the Somali community in Northern Kenya, where the disease has occurred severally, is locally referred to as "*sandik"* which translates bloody nose (Abdi et al., 2015) and is associated with above normal rains causing floods and increase in mosquito populations (Jost et al., 2010; Ng'ang'a et al., 2016).

6.3 Socio-cultural Practices and Vulnerability to Malaria and RVF

6.3.1 Socio-cultural Practices and Vulnerability to Malaria

The communities in Baringo practiced socio-cultural practices that would increase their risk to malaria. These included: sitting outdoors in the dark; working in an irrigation scheme; inconsistent use of bed nets; water sourcing practices; gender differences in health seeking behavior and caregiving practices. In many rural communities, it is common for people to sit outdoors in the evening as a means of resting from the day's activity. Besides Kenya, the practice has also been documented in Tanzania (Maia et al., 2016), Uganda (Braack et al., 2015) and South Africa where it was related to increased exposure to malaria vectors (Braack et al., 2015). In Ghana, a study on irrigated agriculture and malaria found that malaria episodes in children were statistically associated ($p<0.01$) with household members sitting outdoors in the evenings (Afrane et al., 2004). Besides sitting outdoors, sleeping outdoors has also been reported in northern Kenya due to the high temperatures experienced in the area (Kimani et al., 2006). Malaria vectors in Africa, namely, *Anopheles gambie s.s., Anopheles funestus,* and *Anopheles arabiensis* have been found to feed both indoors and outdoors thus making sitting outdoors a risk factor of malaria (Braack et al., 2015). A study on the feeding behavior of malaria vectors in

Tanzania has also shown that as the use of Long Lasting Insectidal Net (LLIN) increases, malaria vectors are adapting by increasing outdoors feeding (Russell et al., 2011).

As a means of livelihood, community members from the lowland zone reported working in the Perkerra irrigation scheme often in the day but sometimes in the night hence increasing exposure to malaria vectors. The irrigation scheme provided suitable mosquito breeding grounds in and around the canals when water flow was minimal resulting in numerous pools of water. The plants grown in the farm also provide ample resting place for adult mosquitoes. A different study conducted in the same irrigated area (Perkerra) reported that lightly clothed farmers often stayed outdoors in the evenings to water their crops hence exposing themselves to mosquitoes (Mala et al., 2011). A study comparing malaria prevalence in irrigated (Bura) and non-irrigated (Ijara) areas of northern Kenya found that persons living in the Bura irrigation scheme were more likely to be infected with malaria than those living in the none irrigated area of Ijara (Muriuki et al., 2016). Another study on irrigated agriculture in Ghana reported that irrigated areas had more mosquitoes and malaria cases compared to non-irrigated areas in Kumasi (Afrane et al., 2004). The difference was attributed to the increase in surface area for mosquito breeding space (Afrane et al., 2004).

Bed nets were the primary method of vector control utilized by community members. However, their use was reported not to be consistent based on the proportion of respondents (68.7%) that had used a bed net the day before the household survey. Similar finding has been recorded in western Kenya where even after mass distribution of bed nets in Asembo, only 77% of recipients used them (Bayoh et al., 2010). In Baringo, part of the reasons presented for inconsistent use of bed nets are high temperatures experienced in the lowland and there being no visible mosquitoes indoors. In Ghana, Afrane et al. (2004), reported that some community members only used bed

nets in the rainy season when they felt most at risk of malaria. In the south-west Pacific, community members from Vantua reported that they often used bed nets when they thought there were mosquitoes and temperatures were cool (Atkinson et al., 2010). Nationally, 25% of respondents to the 2015 Kenya Malaria Indicator Survey believed that people were at risk of getting malaria only in the rainy season (NMCP et al., 2016). These findings demonstrate that ownership of a bed net is necessary but not sufficient to ensure protection from malaria vectors if not consistently used. The practice of using bed nets only when an exposure was perceived was influenced by an individual's perception of risk. This behavior is explained by the health belief model which holds that an individual's perception of risk to a given disease and the perceived benefits of taking preventive actions impacts on their ability to take action against the disease (Hausmann-Muela et al., 2003).

Malaria vectors have been reported to change their feeding patterns from indoor to outdoors, targeting to feed from people who are unprotected by bed nets (Russell et al., 2011). The practice of fetching water at dawn and/or dusk when malaria vectors are active therefore carries potential for exposing women and children to malaria vectors during fetching and on the walk to and from water sources. That the communities rely on unprotected water bodies comprising of rivers and lakes, which also increase mosquito breeding surface area and populations, further increases their risk. A study on the effect of environmental resources on malaria transmission in Tanzania, Burundi, Malawi and Liberia found that households that sourced their water from unprotected wells increased their risk of malaria infection by 22%-56% (Semakula et al., 2015). On the contrary, houses that used piped water decreased their risk to malaria by between 30%-87% in Tanzania, 48%-95% in Burundi, 67%-77% in Malawi and 58%-73% in Liberia (Semakula et al., 2015).

Traditionally, communities in Baringo have constructed houses made of grass thatch and earthen walls which may be smoothened using cow-dung. The houses have tended not to have windows but instead had sizable eaves to improve ventilation and lighting. However, eaves without screens have been implicated in increasing mosquito access into houses and thereby increasing the inhabitants' risk to malaria (Knols et al., 2016; Mala et al., 2011; Okumu et al., 2012). As communities embrace new building techniques and materials, houses have tended to have smaller or closed eaves thereby decreasing ventilation, a factor related with declined indoor comfort and probability of none use of bed nets due to high indoor temperatures (Knols et al., 2016). Despite houses made of grass thatch roofs and having open eaves being cooler, they have been found to host *Anopheles arabiensis,* the main malaria vector in Baringo, more readily compared to houses roofed with corrugated iron sheets (Mala et al., 2011). The design and location of latrines has also been identified as a potential risk factor. Latrine pits exposed to rain water and flooding are likely to become mosquito breeding sites (Semakula et al., 2015). The distance covered from the house to the facility increases probability of exposure to malaria vectors (Semakula et al., 2015).

Gender differences in health seeking behavior were to some extent steeped in cultural expectations of masculinity and femininity. For example, in this study, women sought medical care sooner than men or failed to comply with malaria treatment due to the cultural demand to meet their reproductive roles. Men on the other hand delayed in seeking medical care as a means of demonstrating high thresholds of endurance compared to women, a quality culturally expected of them. This practice increased the risk of delaying men's access to medical care and consequently presenting with severe cases. Indeed, the culturally permissible threshold of withstanding disease before interruption of normalcy set for men and women influences their

access to medical services (Allotey et al., 2005). Further, gender differences in ownership and control of assets afforded men more choice over where to seek care compared to women (Mutua et al., 2016). As shown in this study, men were more likely to seek care in private health facilities or buy over the counter malaria medicine compared to women. In fact, men were found not to seek services in public health facilities where services delayed unlike women. Culturally, men are also expected to be more sexually active compared to women as a means of proving their masculinity, hence increasing their risk to HIV/AIDS (Eriksson, 2011). This may explain why in the current study, men were more likely to avoid taking malaria tests for the fear that they would be simultaneously tested for HIV. This concern has also been reported in western Kenya in a study on mass testing and treatment of malaria (Shuford et al., 2016).

When a person was taken ill with malaria among the study communities, care was sourced through networks within the family and the community. Social capital, both at family and community level, was found to have a positive influence on health outcomes by improving the patient's access to medical care, meeting medical expenses, offering emotional support and substituting a sick person's labour. This was especially useful since only a minority were found to have medical insurance covers. The help extended by community members to affected families was considered a means of self-insurance due to expected reciprocity in case of an occurrence of similar misfortune. Mobilization of such aid is anchored on community norms and enforced through a system of sanctions and rewards (Eriksson, 2011). The quality and quantity of social capital an individual can access is based on their reputation; on whether the person can be trusted to reciprocate when they are called upon (Fujiwara et al., 2008). In Europe, a study on the role of social capital in healthcare found that in countries with high levels of social capital: patients had more access to health information through their social networks; had access to

informal and material support from their friends and neighbours; and could easily mobilize themselves to participate in political action on health matters (Rocco et al., 2012). However, it is not always the case that social capital influences positive health behavior. For example, men delayed in seeking care because they were expected to act stoically by fellow men and community by extension. Hence, the desire to adhere to this norm, avoid the "sanctions" of being branded a weakling and enhance the "benefit" of being perceived as more manly led to men presenting for medical care with more severe cases of malaria. Such outcomes are not limited to the African setting alone. In Sweden, men with high social capital and low level of trust for those they engaged with were more likely to engage in risky drinking practices (Scheffler et al., 2010).

6.3.2 Socio-cultural Practices and Vulnerability to RVF

The study showed that communities in Baringo did engage in socio-cultural practices that would expose them to risk of RVF in case of an outbreak. These included their patterns in handling and consumption of livestock products; managing livestock diseases and disposal of dead animals. Among the food items, milk was an important part of the diets of people from Baringo. It was mainly consumed boiled by 91.5% of respondents. The remaining 8.5% had ever consumed raw milk. A relatively high proportion has also been observed in Sudan where 70.3% boiled their milk, 17% took it raw, 10.6% fermented and 2% cooked/processed into cheese (El Rehima et al., 2011). Lower proportions have been reported among Ghanaian herders where 35.5% only consumed boiled milk, 22.8% took it either raw or boiled and 40.5% took raw milk (Addo et al., 2011). In pastoral communities in Ijara, only 17% consumed boiled milk (LaBeaud et al., 2008). From this study, the proportion at risk was low compared to those from the studies in Ijara, Sudan and Ghana. However, it shows that the practice of consuming raw milk still exists albeit in a small proportion of people. The greater risk to RVF comes from milking and consuming milk

from sick animals as reported in 41.3% and 37.6% of respondents, respectively. Milking (Pfeiffer et al., 2005) and consuming raw milk from infected animals have been identified as possible transmission routes in RVF outbreaks (LaBeaud et al., 2008). In these communities, the role of milking belonged to women. Men only milked when they were away from home with livestock. This shows that women were more at risk of infection with RVF through milking and milk handling.

Home slaughters were found to present opportunity for consumption of blood both raw and cooked in 62.7% and 76.3% of cases respectively. As a food type, blood is assumed to be highly nutritious among pastoral communities (Muga et al., 2015). For instance, in Ijara northern Kenya, women who recently delivered consume raw sheep blood so as to replace that which was lost during childbirth (Ng'ang'a et al., 2016). With the role of slaughtering large stock culturally ascribed to men and blood being among the highly viraemic secretions, men would be at high risk of RVF infection through contact with blood. During the 2006-2007 (Anyangu et al., 2010) and 1997-1998 (Woods et al., 2002) RVF outbreaks in Kenya, blood was implicated as a source of infection. Similar finding has also been established in South Africa (Archer et al., 2013).

The use of livestock products for treatment of human disease reflects potential risk to RVF. For example, the use of *"eyande"* to treat febrile illnesses assumed to be malaria, which can only be extracted after slaughtering an animal, would put the sick, their care givers and those slaughtering at risk during an RVF outbreak. Milk and stock used to administer medicine can only be acquired through interaction with an animal through milking and slaughter or preparation of derived foods, respectively. This would also increase vulnerability to infection with RVF during an outbreak. The practice of using animal products as medicine or in fostering recovery is not unique to the Baringo community. Raw blood, unpasteurized milk and fat derived from sheep

have also been used in treatment of persons infected with RVF in Ijara (Ng'ang'a et al., 2016). Fat extracted from mutton (which is derived from the most susceptible animal to RVF), has been used to treat RVF like symptoms like fever and hematochezia in pastoral communities (Muga et al., 2015).

Home slaughters and skinning of dead animals were often accompanied by consumption of meat before inspection by trained veterinary personnel and local animal experts. Occasionally, other traditional methods such as observation, ants, herbs, and the spleen have been used. Whereas these uncertified traditional methods may have been used successfully for many years, further research is needed to establish their suitability in preventing infection. For example, investigations may be conducted on the herbs used to cure meat from sick or dead animals to establish their potency against specific disease causing pathogens. This is especially important since during the 2006-2007 outbreak in the County, slaughtering, skinning and consumption of meat were identified as some of the ways through which people got infected (Munyua et al., 2010).

In abattoirs, there were concerted efforts in ensuring that all animals presented for slaughter were disease free and all meat was certified safe for consumption by veterinary personnel before sale. However, this was not always the case in slaughter slabs indicating the risk of slaughtering and selling a sick animal's meat to an unsuspecting public. This was contrary to the Meat Act (GOK, 2012), which dictates that animals should only be slaughtered after they have gone through an ante-mortem and carcasses cleared for sale by an inspecting veterinary officer. The workers, who were predominantly male, rarely had full protective clothing while on duty indicating the possibility of exposure to disease causing pathogens. This was also in contravention of the

requirement of the Meat Act which states that slaughter facility workers should wear clean protective clothing while on duty.

Cleanliness levels in slaughter facilities are partially determined by water availability. Sampled facilities were plagued with water shortage since none had a continuous supply. The little water available used for cleaning was also utilized when cold; not when heated to 82°Celcius to denature disease causing micro-organisms that may be in slaughter equipment, surfaces and floors as required by the Meat Act. After cleaning, disinfectants were also not used for routine sterilization of the premises and equipment. Appropriate disposal of condemned parts and carcass debris in condemnation pits was found to be a challenge in slaughter slabs without the facilities. This encouraged disposal in open spaces for dogs to consume which was in contravention of the Meat Act (GOK, 2012). This showed that slaughter facilities' workers were at risk of infection either through contact with sick livestock or working in unsanitary conditions. Indeed, they have been isolated as part of the populations at risk during RVF outbreaks (Gerdes, 2004).

Handling abortus has been identified as a major risk factor in transmission of RVF since birthing fluids from infected animals are rich in virus and highly infectious (Pfeiffer et al., 2005). In Baringo, animals that encountered difficulties with delivery were assisted with bare hands. Aborted foetal materials were also handled with bare hands and sometimes left out in the open to rot or fed to dogs. Among persons surveyed for RVF infection in northern Kenya after the 1997-1998 outbreak, there was a statistical association between sero-positivity and arbotus disposal (LaBeaud et al., 2008). Similar finding has been recorded in Mayotte, where RVF sero-positivity was statistically associated with assisting animals with delivery and coming in contact with or engaging in disposal of aborted foetal materials (Lernout et al., 2013).

Besides consumption, carcass disposal within the study area was mainly by burying. However, the practice of burying livestock carcasses was in conflict with Ilchamus culture where interment was only a preserve of human bodies. Therefore, this left consumption as the other acceptable means of disposal. Consumption of meat from sick or dead animals is perceived as a means to minimize loses incurred from sickness (Munyua et al., 2010). The culture of consuming meat from dead animals was further reinforced by the beliefs that boiling meat with or without certain herbs had capacity to denature disease causing pathogens in meat making it safe for consumption. An RVF study among pastoral communities in Ijara, Kenya, found that they believed that boiled meat carried no disease and was therefore safe for consumption (Ng'ang'a et al., 2016). In contrast, a study in Tanzania found that majority 44% of respondents buried dead animals, 15.5% skinned while 10.8% left them out in the open to rot (Shabani et al., 2015). These findings draw attention to the need to provide communities with alternatives that are culturally sensitive and able to meet the goals of disease prevention to prevent resistance.

Livestock diseases were mainly managed by men using conventional and traditional medicine, often without the guidance of a veterinary officer. The study demonstrates that while it is preferred to seek veterinary services when faced with livestock diseases, this can only occur in contexts where facilitative structures exist. For example, adequate quantities of government employed veterinary officers should be available. They should also be provided with adequate resources such as vehicles/motor cycles, fuel, medicines and other requisite consumables such as gloves and syringes. Without efficient veterinary services, farmers are forced to manage livestock diseases on their own, even when they are not aware of which disease animals are suffering from. Handling of sick animals with bare hands further amplifies the risk of infection.

In Kenya, RVF outbreaks are often confirmed scientifically long after the disease has spread in humans and livestock (Breiman et al., 2008; Munyua et al., 2010). Prior to the 2006-2007 RVF outbreak in Tanzania and Kenya, alerts were issued 11 and 18 weeks, respectively, before the first human cases were confirmed, pointing to weaknesses in uptake of surveillance information (Himeidan, 2016). Therefore, attempts to treat infected animals before the disease is confirmed could lead to human infections.

Disease control measures were found to be more stringent in livestock trade. Quarantines were imposed when there were FMD, LSD and RVF outbreaks. By design, quarantines are intended to prevent disease spread by restricting movement of infected or exposed animals from an affected area to another (Geering et al., 2002). In Baringo, community members reported that during the RVF outbreak bans were placed on trade of livestock and derived products. This resulted in closure of livestock markets, abattoirs/slaughter slabs and butcheries. As part of routine disease surveillance, veterinary officers inspected livestock in the markets, barring sale of sick animals. However, this was only the case for the main livestock markets where the veterinary department was involved in auctioning of livestock and issuance of movement permits. In smaller markets, there was the risk of trading in sick animals, hence spreading disease from one household/region to another or increasing probability of slaughter of sick livestock for sale to the public. Movement of infected animals has been isolated as a key factor in the spread of RVF in new areas such as the Arabian Peninsula (Himeidan, 2016; Nanyingi et al., 2015). Among livestock traders who ferried their animals by vehicles, cleaning was mainly done using cold water with or without soap. This demonstrated that disinfectants were rarely used as part of regular sanitization of vehicles. As such traders frequented different markets in varying geographic locations, they run the risk of spreading disease causing pathogens from one area to another.

Overall, if an RVF outbreak occurred, this study suggests that infection is likely to follow a gendered pattern. Women are more likely to be infected through milking and handling or processing meat and milk. Men, on the other hand, are likely to be infected through contact and consumption of blood; slaughtering or skinning dead animals; contact with sick animals; treating sick animals and livestock marketing.

6.4 Effects of Resource Factors to Community Vulnerability to Malaria and RVF

6.4.1 Effects of Resource Factors to Community Vulnerability to Malaria

Knowledge of malaria, its causes, populations at risk, effects in pregnancy and to the community at large is important for malaria control and management. Communities in Baringo were aware that mosquitoes transmitted malaria as reflected by 96% of survey respondents. However only four in ten respondents knew that not all mosquitoes had capacity to transmit the disease. The knowledge that not all mosquitoes could transmit malaria was associated statistically with education. This finding demonstrates that having formal education increases the possibility of accessing, acquiring and understanding health information due to the possession of ability to read and understand information packaged in other languages besides mother tongue. In other studies, a mother's level of education has been found to impact on her child's health outcomes with children of educated mothers faring better (FAO, 2011). A study in India found that after dissemination of information on malaria vector control to a rural community, infections declined significantly due to adoption of preventive measures and change in attitudes towards vector control (Ghosh et al., 2006). A study on the impact of a health education program in Nigeria showed that providing information on malaria prevention to nursing mothers led to increased bed net usage but the attitudes and perceptions towards malaria did not change as much (Amoran,

2013). This therefore cautions against assuming that provision of health information results in quick change in attitudes and perceptions towards malaria.

In Baringo, despite the high level of awareness that mosquitoes transmitted malaria, the assumption that the disease was also caused by foods and water was widespread. This finding is not unique to Baringo since across Africa, other causes have been identified depending on a community's context. They have included insects, foods, change in weather patterns, supernatural causes, and poor hygiene (Abate et al., 2013; Bussmann, 2006; Fratkin, 1996). Among insects, ticks and bedbugs have been identified as possible malaria vectors (Kinung'hi et al., 2010). This assumption may be coming from the fact that these insects share similarity with mosquitoes in that they are hematophagous and through feeding can be infected with disease causing agents (Delaunay et al., 2011). However, among the three, only bed bugs have been proven not to carry potential for transmitting diseases (Delaunay 2011). Association of malaria with foods vary from consuming certain items such as green maize, maize stalks and mangoes to the temperature at which the food is served and the freshness level (Kinung'hi et al., 2010; Obol et al., 2011). In Baringo consumption of green maize, maize stalks and mangoes was associated with malaria infections. While consumption of these food items does not lead to malaria infection, the foods are produced during the rainy season and the farms where they grow provide ample resting grounds for mosquitoes. The process of harvesting the foods for consumption may expose individuals to mosquitoes leading to infections. Dirty, contaminated, or untreated water has also been cited as a possible cause of malaria. While the water does not have the capacity to transmit malaria, the environment from which it is fetched such as rivers and streams surrounded by dense vegetation can host mosquitoes. In China for example, living close to water bodies has been associated with high malaria infection rates (Zhou et al., 2012). These findings demonstrate

that whereas some of the malaria causes provided by communities may appear irrational, further analysis into the contexts within which the causes are birthed in relation to biomedical malaria etiology may give clarity on the existing knowledge gaps at community level.

Local perceptions of the cause of malaria can increase the risk of negatively influencing malaria treatment choices among community members. In Baringo for instance, use of emetics and purgatives derived from locally available plants for malaria treatment was perpetuated by the local perception that consumption of fatty or sugary foods triggered an increase of bile levels in the human body, thus resulting in malaria. This perception has also been reported among the Marakwet (Jeruto et al., 2008) and Nandi (Kipkore et al., 2014), sub-tribes of the Kalenjin and the Maasai (Fratkin, 1996) and Samburu (Bussmann, 2006) sub-tribes of the Maa communities. The Tugen and Ilchamus are sub-tribes of the Kalenjin and the Maa communities, respectively. The fact that these local perceptions are common among members of fairly related communities of whom the Tugen and Ilchamus are members suggests that these perceptions are not random or irrational. Instead, they could be anchored on local cosmologies.

Community members reported that every individual in the County was at risk of malaria. Of all population categories, expectant women and children under five years of age were identified as the most vulnerable. Higher levels of malaria related mortality were reported among children below five years of age compared to adults. Nationally, seven in ten Kenyans, who include pregnant women and children, are at risk of malaria because they live in malaria prone areas (NMCP et al., 2016). Similarly, these findings match the facts provided by WHO on populations at risk of malaria which include: expectant women, children under 5 years of age, HIV/AIDS patients and persons from areas with high malaria incidence (WHO, 2016a). Globally, sub-Saharan Africa, of which Kenya is part, bears the greatest malaria burden (WHO, 2016a).

The effects of malaria in pregnancy were known to some community members. Six in every ten survey respondents reported that malaria could cause unspecified harm to the unborn baby while 8 in 10 reported it could result in birth of children with low weight. This thinking may have been fueled by communities' association of sickness with weight loss. Only half of respondents, 54.4% and 51.7% knew that malaria in pregnancy could result in abortion or still births, respectively. This reflects a knowledge gap among community members. However, education was found to play a positive role in increasing awareness of the effects of malaria in pregnancy. At the national level, education has also been positively associated with a woman's knowledge of ACTs as malaria medicine (NMCP et al., 2016).

Besides experience, the main sources of malaria information were radio, health facilities, friends and family and community/public health workers in decreasing order. All these information sources relied on oral transmission as the main dissemination medium. With radio ranked as the primary source of malaria information, it would be a useful tool in the dissemination of malaria health information due to its wide coverage. Sourcing of malaria information from health facilities would likely reach more women than men. This study has established that men compared to women, do not frequent health facilities. More women than men visit health facilities in search of care services for themselves, their children, and other community members. Transfer of malaria health information from friends and family may be useful but plagued with risk of distortion depending on the source's knowledge levels.

In Baringo County, malaria was reported to cause physical and economic loses to both the sick person, the immediate family and community by extension. Malaria burden in Kenya is high, as it is the leading cause of morbidity in the country (GOK, 2016). In addition, the disease has been ranked as the sixth major cause of mortality in Kenya; accounting for 5.8% of deaths. The

burden of malaria has also been quantified in terms of disability adjusted life years (DALYS), a measure used to quantify the years lost to sickness, disability or death. Currently, malaria accounts for 7.2% of Kenya's DALYS (MOH, 2014). Besides the loss in human life and productivity, there are other loses in income spent on medical care. A study conducted in Kenya on the cost of treating malaria episodes in children estimated that a single case cost the health system US$ 2.77-US$57 depending on severity (Sicuri et al., 2013). When direct, indirect and health systems costs were added, the cost ranged from US$ 11.24 to US$287.81 per episode (Sicuri et al., 2013). In terms of labour, a study on impact of malaria on wage earnings reported that the disease led to a significant loss of earnings when one was ill (Kioko et al., 2013).

6.4.2 Effects of Resource Factors to Community Vulnerability to RVF

The study focused on the livestock species kept by the communities and their awareness levels of RVF, its signs and symptoms and modes of transmission as key resources in determining vulnerability to the disease. It was established that communities in Baringo mainly kept cattle, sheep, goats and chickens whose populations as at 2015 were estimated at 140,219, 124,713, 376,122 and 337,342 respectively by the veterinary department. A smaller proportion of community members also kept rabbits (3260) and pigs (7) and dogs (not counted). Cattle, sheep and goats are the most susceptible species to RVF whereas rabbits, pigs and dogs are dead end hosts. This implied that in the event of an RVF outbreak, both livestock and persons within the study site would be at high risk of infection owing to the huge populations of susceptible animals within their locality.

In human beings, RFV has been found to manifest within a broad spectrum of symptomatology ranging from self-limiting asymptomatic episodes (Anyangu et al., 2010) to a febrile influenza-like ailment that may be accompanied by encephalitis, visual disturbances or hemorrhage

(Gerdes, 2004) in <8% of cases (Mohamed et al., 2010). Nearly a fifth (18%) of respondents in Baringo identified in descending order, fever, headaches, jaundice, vomiting, diarrhea, hemorrhage, joint pains and visual disturbances, as RVF symptoms. In contrast to the current study, research from Tanzania found that hemorrhage was the most known sign (15.5%) while joint pains/jaundice (0.7%) were the least known (Shabani et al., 2015). This finding implies that there is a low level of awareness of RVF symptomatology not just among communities in Baringo but also in other areas.

Community members also reported that RVF shared some symptoms with malaria, implying that at community level, it is possible for RVF cases to be assumed to be and diagnosed as malaria. This thinking can be further influenced by the weather conditions under which both diseases occur. Specifically, RVF and malaria mainly occur in a wet season, a period in which there is an increase in mosquito populations. The need for caution against the possibility of misdiagnosis of RVF as malaria has also been highlighted in Tanzania, where RVF outbreaks have been reported in malaria endemic areas (Shabani et al., 2015).

Contact with infected animal tissues, secretions, aerosols and bites from infected mosquitoes are the main methods through which human beings are infected with RVF (Gerdes, 2004). In this study, the main avenues through which community members reported they could get infected with a zoonotic livestock disease would be through consumption of meat and milk or contact with blood from sick animals. The capacity of mosquitoes to transmit the zoonotic disease was only identified by a third. Slightly less identified contact with other animal tissues such as meat, skins/hides and eye/nasal secretions. Further uncertainty in the cause of RVF is reflected in some of the responses offered by focus group discussants who implicated ticks, tsetse flies, monkeys,

rains and bad air. This reflects limited knowledge of RVF transmission routes and the spectrum of diseases that can be transmitted by mosquitoes.

Information on RVF was mainly shared through oral means: radio, friends/family and veterinary officers whereas television and internet were least utilized. This finding implies that in the event of an RVF outbreak, audio formats of information sharing would be most appropriate and would have the widest coverage compared to written mediums. As the information is taken in by community members and relayed from one person to another, there lies risk of distortion and miscommunication. Therefore, the health messages would need to be easy to comprehend and may require to be relayed repeatedly to avoid confusion and distortion. At zone level, the lowland, where the disease occurred in 2007, community members generally had more knowledge than other zones due to concerted efforts by the veterinary department in teaching them how to prevent the spread of RVF. This was achieved through community talks and audio announcements made from vehicles traversing the affected areas.

6.5 Community Strategies for Coping with Malaria and RVF

6.5.1 Community Strategies for Coping with Malaria

Community members used both traditional and conventional methods of vector control and treatment in coping with malaria. Coping, refers to the reactive short-term measures taken to enhance survival through shocks by drawing from readily available resources in the absence of capacity to withstand the shock (Daz'e et al., 2009). In vector control, traditional methods comprised of burning dry cow dung and fresh twigs from plants assumed to possess mosquito repellent qualities. Of the six plants species that were identified, extracts from leaves, fruits, barks or roots of *Azadiractcha indica* (Wannang et al., 2015); *Balanites eagyptiaca* (Nganjiwa et al., 2015) and *Catharanthus roseus* (Subarani et al., 2013) were found to have abilities to

eliminate mosquito larva or repel adult mosquitoes. The potency of *Acalypha frutocosa* and *Croton dichogamus* could not be clearly established due to paucity of data on these species. However, other plant species from the same families; *Acalypha indica* (Kumar et al., 2012) and *Croton roxburghii* (Vongsombath et al., 2012) have been found to possess mosquito repellent qualities. No published literature on the uses of *Sphaeranthus ukambanensis* and cow dung were found. These findings demonstrate that indigenous knowledge is not irrational. Therefore, community members' inability to explain from a scientific perspective why certain plant species have repellent qualities should not be used as a basis to negate the usefulness of their indigenous knowledge.

The practice of burning plant materials to repel mosquitoes has also been reported in other countries. For example, fresh *Eucalyptus* and Neem leaves are burnt to repel mosquitoes in Tanzania (Kinung'hi et al., 2010). In Ethiopia, *Eucalyptus* leaves, autumn crocus barks *(Colchicum autumnale), Buddleja polystachya fresen.* roots and peels of sweet orange *(Citrus sinensis (L.) Osb)* are also burnt to repel mosquitoes (Karunamoorthi et al., 2014). Burning is not the only method through plant repellents are generated. For example; extracts from black mustard seeds *(Brassica nigra),* leaves and barks of *Vernonia amygdalina del.* and garlic bulbs *(Allium sativum),* are applied on the skin; while juice extracts from crushed seeds of garden cress (*Lepiduim sativum)* are consumed to repel mosquitoes (Karunamoorthi et al., 2014).

Bed net use was the main vector control method utilized in Baringo. The bed nets were mainly sourced from health facilities through a government driven distribution program targeting expectant women seeking ante-natal care and children below the age of five. The Kenya Malaria Indicator Survey 2015 reports that in Kenya, 69% of bed nets were accessed for free through government led initiatives and only 21% were purchased from retail outlets (NMCP et al., 2016).

These proportions are near similar with those recorded in this study where 70.8% of respondents used a bed net that had been sourced from a government health facility while 21% had purchased them from retail outlets. The government distributed Long lasting Insectidal Nets (LLINs) which could be used for up to three years without the need for treatment even after several washes (NMCP et al., 2016). This may explain why a high number of respondents (87.7%) had not treated their bed nets in the last six months. Nationally, 65% of the population had at least one bed net and 48% of the population slept under a bed net the night before the malaria survey was conducted (NMCP et al., 2016). In the current study, 74% of respondents had at least one bed net and 68.7% slept under it the night before the survey was conducted. This difference may have occurred as a result of the Baringo study capturing a small portion of the national population and hence not being able to account for use variation across the country. The pattern observed in Baringo of giving preference to younger children when bed nets were few was also echoed nationally. The national survey showed that 62%-64% of children under the two years of age slept under a bed net the night before compared to 50%-53% of those aged two to five years (NMCP et al., 2016). Not all people that had access to bed nets utilized them consistently as earlier discussed.

In malaria management, medical pluralism was found to be common. It included the use of both traditional and conventional methods of treatment in managing a single suspected case of malaria. Initial attempts of disease management were done at home but if there was no recovery, further care was sought in health facilities. The choice of treatment utilized by sick individuals' in both instances was influenced by the perceived seriousness of infection, available treatment choices, likely costs of seeking health care, distance to preferred health facilities and timing of disease occurrence. An earlier study on health seeking behavior in Marigat area of Baringo

County showed that community members first accessed free medical care in public health facilities then if the disease persisted they proceeded to private hospitals or reverted to herbal medicines (Munguti, 1995). A different study conducted among the Abagusii of Kenya reported that in an effort to save on medical costs, persons suspecting that they had malaria first attempted to manage the infection at home and only sought medical care when the disease persisted (Nyamongo, 2002). These findings show that the choice of treatment pathways that individuals use are influenced by a multiplicity of factors that may either speed up or delay recovery.

Herbal medicines have been used for diseases management across many communities and generations. Despite the advent of conventional medicines, the use of herbal medicines still persists. These medicines are preferred for their accessibility, affordability, and cultural acceptability and present a much needed alternative in the drylands of Kenya (Owuor et al., 2006) which have weak medical infrastructure (GOK, 2004). That notwithstanding, the use of herbal remedies is plagued with a myriad of challenges. For example, homemade portions tend to vary in levels of potency which increase the risk of non-consumption of optimal doses (Owuor et al., 2006) rendering them ineffective (Glynn et al., 2013) or harmful to human health (WHO, 2004). The efficacy of some of the herbal remedies used by communities has not been scientifically validated due to paucity of pharmacological research and their interactions with conventional medicines remains largely unknown (Owuor et al., 2006). Due to the lack of documentation of practices in utilization of medicinal plants, the quality of knowledge declines over time through distortion and memory loss (Owuor et al., 2006). Mixed use of both traditional and conventional medicines may also cause non-adherence to biomedical treatment and compromise treatment and recovery from malaria (Yakasai et al., 2015).

Through government subsidy, malaria testing and treatment in Kenya public health facilities is offered at no cost. However, provision of accurate diagnosis is not possible when patients decline to take malaria tests. Many cases of clinically diagnosed malaria are not true cases (Ghai et al., 2016; Whitty et al., 2008). Provision of appropriate medication does not also guarantee compliance to treatment. Beyond prescription of medicine, the responsibility of ensuring compliance to treatment lies with the patient or care giver. In the current study, the rate of compliance reported varied with the method of data collection used. Focus group discussions rated it low while individual questionnaire surveys rated it high. This outcome could be due to the need for survey respondents to avoid embarrassment and appearing careless (Bruxvoort et al., 2014). In addition, cross-sectional household surveys such as the current study are likely to report high proportions of adherence due to recall bias (Banek et al., 2014).

The challenge of non-compliance to malaria treatment is widespread and has been related with a myriad of reasons. In Nigeria for instance, bad pill taste, tablet size, treatment duration, administration frequency and cost of medicine have contributed to non-compliance (Shorinwa et al., 2012). In a study conducted in the Tigray region of Ethiopia, non-compliance was attributed to pill bitterness, pills being too big to swallow, quantity, recovery before completing the requisite medication course, forgetfulness, saving medicines for future infections and declining to take the medicines (Lemma et al., 2011). Separate studies in western Kenya associated non-compliance with: getting well before completing the treatment course, sharing medicines with someone else and saving the medicine for future use (Watsierah et al., 2011); and being older, having low education level, low monthly household income and low literacy were contributors (Onyango et al., 2012). Therefore, there is need for consistent advocacy on appropriate use of

malaria medicine at community level to prevent drug resistance and protect the efficacy of first line malaria medicines.

6.5.2 The Extent of Community Adaptation to Malaria

Unlike coping, adaptation focuses on long term ability of an entity to withstand and recover from shocks through continuous anticipatory planning utilizing old and new strategies, sourcing of new solutions and ensuring efficient and sustainable use of resources (Daz'e et al., 2009). The purpose of adaptation is to enhance the capacities of individuals, communities and institutions to withstand climate related shocks (CARE, 2010). Adaptation can be hampered by inappropriate intentions; actor limitations; under or over utilization of resources; and use of inappropriate strategies or actions (Eisenack et al., 2012). In this study, the communities' adaptive capacity was assessed based on how they utilized the resources and strategies they had to prevent future malaria infections.

As a means of utilization of natural capitals in adaptation to malaria, community members had various plant species for vector control and treatment of suspected cases. While some of the species identified have been scientifically proven to possess repellent and/or medicinal qualities, pharmacological research on them is still minimal. It is still not known how communities can use them for maximum benefit. Currently, the use of these medicinal plants is sub-optimal and risks becoming obsolete thereby having no impact on the communities adaptation to malaria.

In terms of human capitals, community members were found to be knowledgeable of malaria, its signs and symptoms, cause, seasonality and treatment options. However, the knowledge on malaria causes coexisted with other local perceptions which influenced the communities' health seeking behavior. The knowledge on medicinal trees and their uses is neither systematically

transferred to the younger generations nor documented. Consequently, as the elders who possess the information die, the knowledge is lost too. The level of knowledge of malaria was also found not to have any statistical relationship with the actions that persons took when they were ill. This implied that knowledge is necessary but not sufficient in ensuring positive health outcomes.

The main physical capitals the community had for enhancing adaptation to malaria were bed nets, malaria testing kits, malaria medicines and medical infrastructure. Provision of these items was largely government driven and were offered at no cost to the consumer. The Kenya government has been steadfast in the provision of these requirements, setting apart a health department to specifically oversee national activities on malaria control and management and set/monitor goals on how to ensure reduction of malaria caused morbidity and mortality (MOH, 2014). From the demand side, the uptake of bed net use has been on the rise indicating that more people now sleep under a mosquito net (NMCP et al., 2016). However, consistent use among those that have bed nets has not been achieved. In addition, the number of people purchasing bed nets for themselves still remains low implying that a section of the population does not use bed nets. Another challenge is that bed nets do not offer protection from malaria vectors when someone is not covered. Thus, there is still need for further research into other methods that would efficiently offer protection against malaria vectors beyond sleeping hours (Ferguson et al., 2010; Russell et al., 2011). Non-compliance to malaria medicines has been reported to increase the risk of drug resistance. In terms of response, community members reported that malaria cases occurred mainly in the rainy season when roads were in poor shape making movement difficult and expensive. Increased penetration of mobile phones and motor cycles has however made it easier to mobilize help unlike before when they had to rely on word of mouth to pass

information and to access health facilities by foot. These challenges notwithstanding, the country has continued to report a decline in malaria cases and deaths pointing to strengthened adaptation.

Towards reducing the cost of access of medical care, the Kenya government has fully subsidized malaria testing in all government health facilities, a factor that enhances the County's adaptive capacity. This has subsequently increased access. Consumers of health services still have to bear the indirect costs of seeking medical care such as transport and food. The study shows that only a minority of community members have medical covers to help meet other direct costs of treatment such as admission charges and medicine purchase when local facilities run out of supply.

Community members were found to utilize social capital to access and give out support within the family and the community, making it an important resource in adaptation to malaria. Through these networks, community members assisted each other in minimizing impact of shocks occasioned by the disease such as medical expenses, loss of labour and in some instances loss of life. Community members increased their social currency by individually offering support to others or collectively adhering to appeals made to the community to offer assistance. An individual's perceived trustworthiness and ability to reciprocate was a key determinant of the quality of help the person could receive.

Politically, community members felt they had limited capacity to effectively involve themselves in local health issues. They were rarely involved in making decisions on local health issues. This may be attributed to the lack of community based organized groups to lobby the local government on health matters. It may also be because there is a tendency to view communities as passive recipients of health services and not active determinants of their own health outcomes.

Overall, the findings of this study show that the communities are adapting to malaria. However, they would need to effectively utilize each adaptation strategy as required to improve their adaptive capacity. This will include consistent use of bed nets, compliance with requirement to test for malaria and treatment. More will also have to be done to build communities' capacities to utilize their natural and political capitals.

6.5.3 Community Strategies for Coping with RVF

After the occurrence of RFV, communities in Baringo effected several strategies for coping with the outbreak. In this study, the community responded by attempting to treat sick animals; complying or not complying with bans on slaughter and consumption of livestock products; observing bans on movement and trade in livestock and derived products; and vaccination.

Communities in Baringo have been treating their animals using both traditional and conventional medicine. The use of traditional medicines in control and management of livestock diseases is not a new practice; it has been in use long before the availability of conventional veterinary medicines (Muga et al., 2015). However, a challenge is posed by emergence of livestock diseases in new areas where the community has little indigenous knowledge on how to predict occurrence, identify signs and symptoms and determine how best to address the diseases. In a study on the RVF outbreak of 2006-2007 comparing community knowledge of RVF in Kenya and Tanzania established that in Kenya, where the livelihoods of Somali pastoralists depended mainly on livestock, the level of awareness was higher (Jost et al., 2010). The pastoralists were aware of the possibility of an RVF outbreak after observing heavy rains and mosquitoes with white legs despite not being able to initiate any preventive activities (Jost et al., 2010).

Among the key lessons learnt from the 2006-2007 outbreak, bans on food products cause serious problems among communities whose mainstay is livestock (Breiman et al., 2008). In Baringo, food variation during the RVF outbreak was found to be a challenging affair; making it difficult for communities to observe bans on slaughter and consumption of animal products. Here, livestock were sold to generate money for purchasing non meat foods such as grains and vegetables. Thus, placing bans on livestock trade during the RVF outbreak reduced the communities' ability to purchase alternative food. Coupled with sharp price increases occasioned by limited supply of "safe proteins" such as pasteurized milk, fish and chicken, the bans despite being a protective measure, caused food shortage at household level. It has been reported that during the last RVF outbreak, cases of human infection in Baringo were associated with contact with or consumption of meat from sick or dead animals (Munyua et al., 2010; Nguku et al., 2010) and milk (Anyangu et al., 2010), implying that some community members defied the bans.

Observation of slaughter and consumption bans is also complicated by the belief that livestock products have medicinal qualities and their use in religious ceremonies. In northern Kenya for instance, animals were slaughtered in prayer ceremonies of persons infected with RVF contributing to further the spread of the disease (Muga et al., 2015). Among the Somali pastoralists in Ijara, raw blood, unpasteurized milk and fat derived from sheep have also been used in treatment of persons infected with RVF (Ng'ang'a et al., 2016). Fat extracted from mutton (which is derived from the most susceptible animal to RVF), has been used to treat RVF like symptoms like fever and hematochezia (Muga et al., 2015). In Baringo both conventional and herbal medicines are administered in or through milk for children and stock for adults since consumption of animal proteins is associated with quick recovery.

During RVF outbreaks, bans were imposed on movement and trade of livestock and derived products (Jost et al., 2010; Shabani et al., 2015). This forced a diversification of livelihood activities among those whose primary livelihood activities revolved around livestock. Butchers, abattoirs and slaughter slab workers, stock trader and trekkers were most affected. Similar observation was made in Garissa where livestock traders attempted to sell chicken and vegetables just to keep their business afloat (Rich et al., 2010). However, some lacked alternative livelihood activities thus were forced to utilize their savings to survive, making it difficult to revamp their businesses when the ban was lifted (Rich et al., 2010). The ability to withstand shocks is influenced by the amount of assets an individual has at their disposal. Persons with more assets were more resilient and were able to go back to business while those who had depleted their resources did not have means to restart. This indicates that diversification of livelihoods in crises is challenging and is not always possible.

Livestock vaccination against RVF is the most effective preventive measure in high risk areas (Kahn et al., 2016). When using the Smithburn vaccine whose efficacy is realized 6-7 days post immunization, livestock should be vaccinated before an RVF outbreak (Kahn et al., 2016). However, this was not the case during the 2007 outbreak. In Baringo, farmers reported that vaccinations were done long after the disease was reported. Similar observations were made in Northern Kenya and Tanzania where vaccinations were conducted late (Jost et al., 2010). Alerts for the same outbreak were issued in September 2006 and the index human cases in Kenya and Tanzania reported 18 and 11weeks later, respectively (Himeidan, 2016). According to Jost et al. (2010), livestock vaccinations in Kenya began in January, nearly the same time with the index human case. The process of vaccinating livestock in northern Kenya was also hampered by delayed procurement of vaccines, under staffing, lack of requisite equipment and movement

difficulties occasioned by flooding (Jost et al., 2010). In RVF hotspots, it is therefore advisable that vaccinations are conducted before the outbreak, probably 2-3 months before vector emergence if alerts come from credible surveillance (Davies, 2010).

6.5.4 Community Adaptation to RVF

In this study, the communities' adaptive capacity was assessed based on how they utilized the resources and strategies they had to prevent future human and livestock infections with RVF. In terms of livestock production, community members have continued to rebuild their cattle, sheep and goat quantities. The stock is built through reproduction, inheritance, bride price, gifting, loaning and purchase. However, during the predicted El-Nino rains of 2015, there were no community led measures in place to protect their livestock from the possible RVF outbreak. This is partly influenced by the limited knowledge on the seasonality of RVF. In Kenya, the disease has been associated with the El-Nino rains (Anyamba et al., 2009).

Beyond the 2006-2007 outbreak, the communities had not benefited from sensitization to increase knowledge levels of RVF seasonality, causes, transmission modes and human signs and symptoms as demonstrated by the low awareness levels noted in the study. Further, community members reverted to milking and consuming milk from sick animals and consuming meat from sick and dead animals. This implied that training programs initiated in 2007 were not sustained beyond the outbreak. Since RVF occurs in irregular intervals of 5-10 years, if awareness levels are allowed to decline, the risk of individual, community and institutional memory loss increases hence rendering the community vulnerable.

Prior to the predicted El-Nino rains of 2015, the veterinary department in Baringo initiated livestock vaccination against RVF at no cost to the farmer. This implied that unlike in 2006-2007

El-Nino period, the national government and the County veterinary department by extension responded to RVF alerts issued based on surveillance information from global and local institutions. However, compared with the 2006-2007 outbreak, when it was reported that there were severe logistical and staffing challenges (Jost et al., 2010), the veterinary department in Baringo still faced similar challenges in being under resourced with transport facilities, staffing and veterinary medicines. This indicated that efforts to improve the capacity of the veterinary department to function optimally were limited. Nonetheless, the Baringo veterinary department had capacity to issue and enforce bans on livestock trade and consumption of derived products which enhances the County's adaptive capacity by controlling disease spread.

Widespread ownership of mobile phones had eased ability to communicate compared to 2006-2007. Their ability to increase speed of information sharing and lowering response time has enhanced the communities' adaptive capacity in times of crises. However, the technology is not safe from misuse through sending of unverified and alarmist news. It thereby presents new challenges in constituting reliable communication channels that can be used in relaying credible information on livestock disease outbreaks, control and management practices.

In terms of social capitals, the community in Baringo was found to provide a safety net for individuals who needed medical care by sourcing transport, fund raising to cover medical bills for community members who could not afford and sometimes substituting the sick person's labour to relieve them of some of their reproductive roles. However, the assistance was dependent on the affected person's ability to reciprocate thereby implying that certain community members would lack or receive minimal support due to their perceived inability to reciprocate.

Politically, community members felt they had limited capacity to effectively influence local livestock initiatives aimed at enhancing quality of veterinary services. This shows the gap that exists between the veterinary department and the people it is meant to serve. The gap may be caused by the limited resources in the department, which force farmers to find solutions to their livestock health problems without involving veterinary personnel hence reducing the County's adaptive capacity.

Overall, the community is not well adapted to RVF. Save for the livestock vaccination against RVF initiated by the veterinary department, the community would have poor adaptive capacity. This is due to limited knowledge of RVF etiology and lack of community driven adaptation measures in Baringo.

Chapter 7: Conclusion and Recommendations

7.1 Conclusion

Malaria and RVF are climate sensitive vector borne diseases of major public health concern. Both nationally and in Baringo County, malaria is ranked as a major cause of morbidity and mortality among pregnant women and children under five years of age. Community members were found to be knowledgeable of malaria symptomatology, seasonality and cause. Biomedical and local knowledge of malaria etiology co-existed and to some extent influenced malaria management. Among the non-biomedical causes identified were consumption of sugary and fatty foods, green maize and cow peas, mangoes, sugarcane and maize stalks. Consumption of sugary and fatty foods was believed to cause an increase in bile quantities in the body resulting in malaria.

When someone was sick with suspected malaria, attempts were made to manage the disease at home and patients only sought medical care if the disease persisted. Both traditional and conventional medicines were used in malaria management. Conventional medicines comprised of analgesics, remnant malaria medicines, over the counter malaria medicines or malaria medicines prescribed in a public health facilities. In public health facilities, malaria testing and treatment was provided at no cost to the consumer. The main challenge associated with their use was non-compliance to treatment regimen. The practice was blamed on early recovery before completion of the treatment regime and the medicine's undesirable qualities. Traditional medicine comprised of infusions and decoctions made from leaves, barks or roots of plants assumed to have emetic and purgative qualities. These plants were preferred because of ease of access particularly for persons living in distant places from health facilities, belief that one will get well, they have been used for many generations, are cheap and have the ability to slow down

disease progression. Among community members who believed that malaria was caused by accumulation of bile in the body, herbal remedies were most preferred for the ability to induce vomiting or diarrhea which was locally perceived as cleansing the body of excess bile.

For vector control community members also utilized both conventional and herbal repellents. The main conventional vector control method used was the LLIN which was mainly sourced by expectant women and mothers with children under one year from public health facilities at no cost. Only a small proportion of community members bought bed nets for themselves. The bed nets were not always consistently used. Only a limited number of community members utilized traditional methods of vector control which comprised of burning green twigs from plants assumed to have mosquito repellent qualities and dry cow dung.

Overall, the fight against malaria in the County was found to be continuous. From the supply side, the national government had fully subsidized malaria treatment, medicines, testing kits and bed nets for expectant women and children under five years of age. From the demand side, patients primarily sought medical treatment from public health facilities. Despite cases on non-compliance to treatment and inconsistent use of bed nets being reported, the County's adaptive capacity to malaria was still high.

On RVF, community members were found to have limited knowledge of the disease's symptomatology in humans, cause and transmission routes probably because they had only experienced it once. Practices such as: milking and consuming milk from sick animals; consumption of blood; slaughtering sick and dead animals for consumption; consuming meat that has not been certified as safe by a veterinary officer or local animal health expert; and attempting

to treat sick animals without the guidance of a veterinary officer, would expose the communities to RVF in case of an outbreak.

In coping with the last RVF outbreak, the veterinary department responded by banning livestock movements, trade and consumption of meat and milk from cattle, sheep and goats. Preventive vaccination was conducted long after the disease had already spread and thereby making it difficult to realize its full benefits. In 2015 when the next cycle of El-Nino rains were expected, the national government procured vaccines on behalf of the County and the veterinary department conducted vaccination of susceptible species in risk areas. However, the rains were not adequate to lead to an outbreak. Beyond responding to calls to present their animals for vaccination, community members did not have any community led initiatives for RVF prevention or adequate knowledge on how to detect RVF. This lowered the County's adaptive capacity to RVF.

7.2 Recommendations

In response to the challenges highlighted in malaria and RVF control, the study recommends that:

1. Due to the existing misconceptions about malaria etiology and low knowledge of RVF, its transmission and prevention mechanisms, community members should be provided with malaria and RVF prevention and control information by the department of medical and veterinary services, respectively. The information should be provided through mediums that disseminate orally, using local languages, such as *barazas* (public meetings), health talks and radio health programs or advertisements. The information should be provided continuously to reach as many people as possible, improve the level

of awareness, and influence wide adoption of preventive measures and compliance to malaria treatment regime.

2. Since community members had practices that increased their risk to malaria and RVF, the health and veterinary department should also provide them with control and prevention information that demonstrates how the local practices are linked to community vulnerability to the diseases as a means of influencing behaviour change.
3. To increase Baringo County's ability to cope with malaria and RVF, the County department of health should provide communities the option of purchasing bed nets from government health facilities at a subsidized price to increase coverage and ensure more people are protected from mosquitoes. The department can also partner with humanitarian and relief institutions with capacity to provide bed nets to communities to increase supply while minimizing cost.
4. Towards increasing Baringo County's ability to cope with RVF and other livestock diseases, the County and national governments should strengthen the veterinary department's capacity to offer services to community members through adequate staffing, provision of veterinary medicines and transport services. The veterinary department should also actively seek opportunities to partner with livestock research and development projects/institutions working in the County to strengthen diseases surveillance and service provision to community members. The County veterinary department should encourage participatory disease surveillance by strengthening the communities' abilities to detect and report livestock disease outbreaks.

5. For effective management of RVF outbreaks in future, the County's veterinary department should establish linkages with the department of health to identify appropriate strategies for coordinating prevention and control initiatives.
6. The County rangelands and forestry departments should also document the medicinal uses of the local plant species to conserve the indigenous knowledge at risk of distortion and loss when knowledgeable persons age or die.
7. The County's Drought Management Authority and Meteorology offices engage community weather experts to draw from synergies between scientific and indigenous methods of weather prediction. The relations established can be used as means to share climate related information with community members and enhance credibility of indigenous methods.

7.3 Areas for Further Research

The following areas for research are proposed:

1. Pharmacological studies on the medicinal plants identified by the communities in Baringo to determine their efficacy in managing the identified diseases
2. Studies on community uptake and willingness to pay for the RVF vaccine in Baringo
3. Studies on the complementarities between tradition and conventional methods of weather forecasting
4. Studies mapping livestock movement and trade in the entire Baringo County

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9. Appendices

9.1: Informed Consent Forms

KII/FGD/KAP Survey Consent Form

I am…….working with a project whose aim is to develop an early warning system for human population health and resilience to climate sensitive vector borne diseases managed by the University of Nairobi and the Jaramogi Oginga Odinga University of Science and Technology. As a researcher in this project, I am tasked to study community adaptation to malaria and Rift Valley Fever (RVF). This study will be looking at community awareness of the relationship between climate change, Malaria and RVF, the economic and socio-cultural factors that pre-dispose men, women, boys and girls to these diseases and the coping strategies that they have in place. The questions asked in this KII/FGD/KAP survey will be in line with these three objectives. The data will be recorded both in manual and audio formats. KIIs are expected to take about 45 minutes and 1.5 hours for FGDs and KAP survey.

The names of all respondents will be withheld and replaced with numerical codes and pseudo-names for purposes of protecting their identities. The data collected will be used purely for research purposes by the project team only. It will be kept confidential at all times. The findings of this study will be presented in the form of a cumulative report and not individual interview reports. Upon completion of the study, the raw data will be destroyed to ensure confidentiality and anonymity of respondents is maintained.

Participating in this study has both direct and indirect benefits to the community. All respondents will directly benefit by receiving information on how to control and manage malaria and RVF. Indirectly, you will be contributing to the development of an early warning system for malaria and RVF for Baringo County and building its resilience to these diseases. Respondents are required to participate voluntarily. You are allowed not to respond to questions that make you uncomfortable. Refusal to participate in the study or to respond to some sections of the interview that make you uncomfortable will not result in negative consequences to you or your family. However, we request that you answer all the questions and enable us to use the information to achieve the aim of developing early warning systems for Malaria and RVF. The outcomes of this study will be fed back to the local community through stakeholder forums and to the larger scientific community through scientific papers and a thesis.

For more information on this research contact the Principal Investigator, Prof. Benson Estambale, Jaramogo Oginga Odinga University of Science and Technology. P. O. Box 210-40601, Bondo, Kenya. Tel. +254-57-250-1804

Do you have any questions? Yes (respond to the questions) No (continue)

Would you like to participate: Yes No

Name of Respondent Signature Date

Name of Interviewer/Moderator Signature Date

Market Survey Consent Form

I am…….working with a project whose aim is to develop an early warning system for human population health and resilience to climate sensitive vector borne diseases managed by the University of Nairobi and the Jaramogi Oginga Odinga University of Science and Technology. I am tasked to study community adaptation to malaria and Rift Valley Fever (RVF) in Baringo County. The study includes a market survey which will focus on livestock movements and trade within the County. The questions asked in this questionnaire will be in line with this objective. The data will be recorded manually. The questionnaire is expected to take about 15 minutes to complete.

The names of all respondents will be withheld and replaced with numerical codes and pseudo-names for purposes of protecting their identities. The data collected will be used purely for research purposes by the project team only. It will be kept confidential at all times. The findings of this study will be presented in the form of a cumulative report and not individual interview reports. Upon completion of the study, the raw data will be destroyed to ensure confidentiality and anonymity of respondents is maintained.

Participating in this study has benefits to the community. You will be contributing to the development of an early warning system for RVF for Baringo County and building its resilience to this disease. Respondents are required to participate voluntarily. You are allowed not to respond to questions that make you uncomfortable. Refusal to participate in the study or to respond to some sections of the interview that make you uncomfortable will not result in negative consequences to you or your family. However, we request that you answer all the questions and enable us to use the information to achieve the aim of developing early warning system for RVF. The outcomes of this study will be fed back to the local community through stakeholder forums and to the larger scientific community through scientific papers and a thesis.

For more information on this research contact:

Prof. Benson Estambale the Principal Investigator,

Jaramogo Oginga Odinga University of Science and Technology,

P. O. Box 210-40601, Bondo, Kenya.

Tel. +254-57-250-1804

Do you have any questions? Yes (respond to the questions) No (continue)

Would you like to participate: Yes No

Name of Respondent Signature Date

Name of Interviewer/Moderator Signature Date

9.2: Focus Group Discussion Schedules

A) Focus Group Discussion Schedule for Community Characterization

1. What are the types of households in this community? (Probe for proportions of Male Headed households, *De jure* female headed households, *De facto* female headed households)
2. Explain the marital status of households in this region. (Probe for proportions of monogamous and polygynous households)
3. Explain the education status of households in this region. (Probe for proportion of men/boys and women/girls in community with primary, secondary and tertiary education, proportion that can read and write)
4. What are the types of houses that people in this community live in? (Probe for roof, walls and floor building materials, number of rooms and their uses)
5. What are the sources of water available in this community? (Probe for drinking, cooking, washing, watering livestock, irrigation, proximity to households, harvesting and storage practices outside the house eg pools, earth dams and storage inside the house eg buckets, pots, frequency of emptying and refill)
6. What is the cultural definition of wealth in this community? (Probe who is considered wealthy or poor and why, what assets men and women in this community have, the most valuable assets for men and women and why are they considered valuable especially land and livestock, sources of wealth for men and women, if the ownership, control and uses of these assets have changed over time)
7. How are roles distributed between men and women in this community? (Probe for intra-household distribution of domestic chores, livestock care, crop farming, care for the sick)
8. What livelihood activities are undertaken by this community? (Probe for economic activities within and outside the home, seasonality changes, the age, gender and social status of people participating in these activities eg the educated/non educated, the poor/rich, if there have been changes over time with respect to the livelihood activities and roles that men and women play)
9. Describe the infrastructure in this community. (Probe for schools, hospitals, roads, modes of transport, access to mobile telephony network, proximity to nearest major town/urban centre, access to government offices)
10. What are the types of groups, both formal and informal that men, women, boys and girls join, reasons for joining, their roles and quality of participation in the groups, the functions of the groups, ability of groups to influence decision making at village, sub-location, location, district and county levels and if they addresses malaria or RVF? (Probe for farmer groups, trade and business associations, water users groups, religious groups, credit or micro-finance groups, civic groups, charitable groups, forest users groups, mutual help or insurance groups eg burial societies, local government)
11. Describe the interactions of the community with institutions eg CBO, NGOs, Government institutions working in this area especially on malaria and RVF or health in general. (Probe for nature of relationship, who is most powerful and influential in making decisions about Malaria and RVF, if the communities are active or passive recipients or participants of the institution's interventions)

B) Focus Group Discussion Schedule for Malaria

1. What are the most common human diseases in this community? (Probe for the disease local/popular/scientific names, rank the diseases in order of importance, probe for malaria if it is not mentioned)
2. What are the signs and symptoms, cause and seasonality of occurrence for malaria?
3. Compared to the past, has malaria's frequency of occurrence changed? If yes, in what ways? What could be causing this?
4. When people are infected with malaria, how do they handle the illness? (Probe for the treatment options used eg self-treatment with herbs, self-treatment with over the counter medication, self-treatment with remnant medication, treatment in private and public health facilities, traditional healers)
5. For each identified treatment option, what reasons influence the choice (Probe for distance, accessibility in wet and dry seasons, cost, time, availability of drugs in hospitals/shops/chemists, efficiency of treatment, health facility staff attitudes towards patients, perceived quality of care)
6. How does the community determine disease severity for men, women, boys and girls? Do treatment options change with severity of disease?
7. Is malaria preventable, how? How effective are the methods of prevention and management? (Probe for use of bed nets and sleeping patterns, residual household spraying, repellents, prevention in pregnancy, draining of water pools around the home, clearing bushes around the homes, use of new artemesinin based drugs, adherence to anti-malarial drugs)
8. Describe the care giving practices for persons with malaria. Who takes care of the sick person and why? Can one rely on others other than family for caregiving assistance? If there, who are the others? Under what circumstances can one get help?
9. What is the impact of malaria on the sick person, the caregiver, the family and the community? Is there a difference to a household if a primary male, primary female, male child or female child is sick?
10. Are there internal or external bodies with interventions on malaria control and management eg informal groups, CBOs, NGOs, government institutions, county government? What are they doing? How effective has it been? Has the community been actively involved? In what ways, if any? What more needs to be done?

C) Focus Group Discussion Schedule for RVF

1. What are the types of livestock assets owned in this community? (Probe for type, proportions and factors that determine the kind and quantity of livestock a household and community can own)
2. As per category, identify the various uses of livestock in this community (Probe for food sources- meat, milk and blood, drought power, raw materials (dung, skins, hides and bones), manure, social and cultural identity, stores of food and wealth, mediums of exchange and sources of cash)
3. Explain the distribution of livestock production roles among men, women, boys and girls in this community as per livestock category (Probe for grazing of mature and young livestock, watering, taking care of sick, injured and gestating animals, sourcing for treatment, construction of livestock sheds, livestock protection from predators and theft)
4. Kindly rank the livestock in order of importance and ownership trends-access, management, withdrawal, alienation and exclusion rights- among men, women, boys and girls, give reasons for this. Probe for sources of livestock such as gifts, purchases, inheritance for men and women
5. As per livestock category, identify important livestock diseases especially RVF (Probe for local/popular/scientific names, rank diseases in order of importance, seasons of occurrence, how farmers identify disease symptoms, actions taken for each disease whether preventive or curative, disposal of sick and dead animals, meat inspection -using veterinary care or alternative treatments such as herbs at household level, interventions by the government and NGOs and their reasons for these actions, whether the interventions have been effective and what needs to be done to enable the community to control and manage these diseases, impacts of diseases in this community and on livestock production)
6. Explain the herd migration patterns in search of water and pasture in this community (Probe for dry and wet season grazing areas, tenure systems of grazing lands, watering points, proximity of watering points and pasture lands, types of water points-man-made or natural, temporary or permanent and challenges/risks associated with herd movements especially diseases like malaria and security)
7. What are the livestock and livestock products marketing practices in this community? (Probe for each identified livestock category and product, marketing strategies, key markets and trade routes, seasonality of sale)
8. What changes over time have you observed with respect to livestock care, pastures and watering, quantities and qualities, proportions of households keeping livestock, diseases, markets)

9.3: Key Informant Interview Schedules

A) KEY INFORMANT INTERVIEW SCHEDULE FOR MALARIA

1. What are the most common human diseases in this region?
2. Explain the causes and seasonality of malaria in this region
3. Are there any changes in the prevalence of malaria in the past 5 years, 10 years? If there are any, what are they?
4. How do men and women identify the disease and what responses do they take? Are there differences in their responses? If yes, explain. How effective are these responses?
5. How do men and women in this region perceive malaria, in terms of severity and susceptibility, benefits and barriers to adoption of new behaviours to prevent disease? What other factors influence their vulnerability to malaria?
6. What have been the impacts of malaria to the region?
7. Are there any interventions by the county government, health systems and non-governmental organizations working in this region to control and manage malaria? If yes, describe. How effective have they been? What more needs to be done to make them effective?

B) KEY INFORMANT INTERVIEW SCHEDULE FOR RVF

1. What types of livestock assets are owned in this region? Kindly rank the livestock in order of importance to men, women, boys and girls and give the reasons why.
2. Describe livestock migration patterns in dry and wet seasons
3. Discuss livestock and livestock products trade in this region. What are the key markets? Is there seasonality of sale?
4. What are the most common livestock diseases in this region?
5. How do communities handle sick animals in terms of treatment and disposal in this region?
6. In the past when major livestock diseases have struck, what have communities done to recover from the disease impacts?
7. What are the causes of human and livestock RVF infections in this region?
8. Explain the frequency and signs and symptoms of RVF in livestock and human in this region.
9. How do men and women identify the RVF in livestock and in humans? What responses do they take? Are there differences in their responses? If yes, explain. How effective are these responses?
10. If you were still in this region during the 2006-2007 outbreak, what impacts did the disease have? If not, what are the potential impacts should the disease strike?
11. How do men and women in this region perceive RVF, in terms of severity and susceptibility, benefits and barriers to adoption of new behaviours to prevent disease in humans and animals? What other factors influence their vulnerability to RVF?
12. What measures have been put in place by the county government, health systems, non-governmental organization and community to control and manage the disease should it occur? How effective are these measures? What more needs to be done to achieve desired level of efficiency?

9.4: KAP Survey Tool

1. KNOWLEDGE, ATTITUDES AND PRACTICES SURVEY ON MALARIA AND RVF CONTROL AND MANAGEMENT IN BARINGO COUNTY

Exclusion Criteria: Respondent must have stayed in the locality for 2 years prior to the interview

A. Household Identification

Sub-county	1. Baringo North 2. Baringo Central 3. Marigat	Household Code	
		GPS coordinates	
Sub-location		Date of Interview	DD/MM/YYYY
Village		Start time in 24 hrs	HH/MM
Code of enumerator		End time in 24 hrs	HH/MM
Name of respondent		Tel. number	
Type of respondent	1=HH 2. Spouse 3. FHH	If FHH, which type?	1=De facto 2. De jure

Instruction to the interviewer: Introduce the next section to respondent before proceeding

B. Respondent Background Information

1	Sex	1. Male 2. Female	5	Highest level of education	1. None 2. Primary 3. Secondary 4. Middle level college 5. University
2	Marital Status	1. Single, never married 2. Married monogamous 3. Married polygamous 4. Separated 5. Divorced 6. Widowed	6	Number of children	Write the number ≤5years 6-18years >19years Male _____ _____ _____ Female_____ _____ _____
	Type of Household	1. Male and female adult 2. Male only, no female adult 3. Female only, no male adult 4. Child headed home	7	Religion	1. Christian protestant 2. Christian catholic 3. Muslim 4. Traditionalist 5. Atheist 6. Other
4	Age of respondent in complete years	Write number	8	Tribe	1. Tugen 2. Ilchamus 3. Turkana 4. Other

Instruction to the interviewer: Introduce the next section to respondent before proceeding

C. Household Characteristics

1	Wall type (Observe, do not ask)	1. Mud/cow-dung 2. Tin/corrugated iron 3. Stone/ Brick 4. Timber 5. Plastic matter 6. Other	7	What is the household's main source of cooking fuel?	1. Liquid propane gas LPG, Biogas 2. Paraffin 3. Charcoal 4. Firewood 5. Animal dung 6. Crop residue
2	Floor type (Observe, do not ask)	1. Mud/Cow dung 2. Concrete/cement 3. Other	8	What type of toilet does the family use?	1. Pit latrine 2. Flash toilet 3. Bush 4. Other
3	Roof type (Observe, do not ask)	1. Tin/Corrugated iron 2. Grass thatched 3. Plastic matter 4. Other	9	What is the household's main waste disposal method?	1. Garbage pit 2. Burned or buried 3. Public garbage bin 4. Heap 5. Dumped in vacant land/property 6. Dumped in pond/river/lake 7. Other
4	How many rooms are there in your house?	Write number			
5	How many rooms are exclusively used for sleeping?	Write number	10	What is the main livelihood activity you do?	1. Crop farming 2. Livestock farming 3. Bee keeping 4. Self-employed service delivery 5. Self-employed goods delivery 6. Wage employment 7. Salaried employment 8. Unemployed 9. Other
6	What is the household's main source of cooking water?	1. Public tap 2. Piped into compound but outside the house 3. Borehole with a pump 4. Rain water collection 5. Dam/ pond 6. Dug well/spring 7. River/ stream 8. Lakes 9. Other			
7	What is the household's main source of drinking water?	1. Public tap 2. Piped into compound but outside the house 3. Borehole with a pump 4. Rain water collection 5. Dam/ pond 6. Dug well/spring 7. River/ stream 8. Lakes 9. Other	11	What are the supplementary livelihood activities that you do?	**Circle all that apply** 1. Crop farming 2. Livestock farming 3. Bee keeping 4. Self-employed service delivery 5. Self-employed goods delivery 6. Wage employment 7. Salaried employment 8. Unemployed 9. Other

D. Climate variability

Instruction to the interviewer: Inform the respondent that you will be asking them questions about the areas climate variability

1	Climate Hazards and Impacts	In the last 5 years have you experienced the following climate events (check all that apply)	How would you rate the frequency of this occurrence? 3=High 2=Medium 1=Low	How would you rate the severity of this hazard? 3=High 2=Medium 1=Low	How would you rate the degree of negative impact on your household by this hazard? 3=High 2=Medium 1=Low	How would you rate the difficulty of coping with the hazard in your household? 3=High 2=Medium 1=Low	Total vulnerability
a	Changes in rainy season leading to changes in planting seasons						
b	Droughts						
c	Floods						
d	Heavier rains than usual						
f	Hotter climate						
g	Cooler climate						
h	Other						

Sources of climate-related knowledge

2	What are your sources of climate related knowledge? (Circle all that apply and rank them)	Source Meteorological services Newspapers Radio (vernacular) Radio (national) School/College Village leaders Friends and Family Government alerts Other	Rank ___ ___ ___ ___ ___ ___ ___ ___ ___

E. Perceptions of Malaria

Instruction to the interviewer: Inform the respondent that you will be reading some statements for them about malaria and you would like them to respond either yes or no

	Statements	Yes	No
1	Being rained on causes malaria		
2	Eating mangoes causes malaria		
3	Eating fatty food causes malaria		
4	Staying out in the cold causes malaria		
5	Eating green maize and cow peas (kunde) causes malaria		
6	Eating sugary foods causes malaria		
7	Sitting outdoors after dark exposes someone to mosquito bites		
8	There are more mosquitoes at night than day		
9	Sand harvested from riverbeds for construction purposes introduces mosquitoes where there were none		
10	Men cannot get Malaria		
11	Malaria is not a dangerous disease		
12	Malaria is treatable		
13	Malaria can be spread from one sick person to another		
14	Mosquito bites cause malaria		
15	Bites from all mosquitoes cause malaria		
16	In this area, who are mostly affected by malaria? Circle all that apply and rank 1) Children <5 _____ 2) Pregnant women _____ 3) Adult men _____ 4) Adult women (not pregnant)_____ 5) Elderly men _____ **6)** Elderly women _____		

	Statements	Yes	No
17	Expectant women are at high risk of malaria		
18	Children under five years are at low risk of malaria		
19	What signs of Malaria do you know of?	Circle all that apply 1. Fever 2. Headaches 3. Diarrhea 4. Vomiting 5. Extreme weakness 6. Joint Pains 7. Generalized convulsions 8. Confusion/drowsiness 9. Loss of appetite 10. Chills 11. None 12. Other	
20	All fevers are a sign of malaria	Yes	No
21	In the last 1 year, have you ever received any teaching about malaria from community health workers or public health officials?	Yes	No
22	What are the sources from which you get information on malaria? Circle all that apply	1. Family 2. Friends 3. Radio 4. Television 5. Posters/ Pamphlets 6. School text books 7. Health facility 8. Community health worker/public health official 9. Internet 10. None 11. Other _____	

Instruction to the interviewer: Introduce the next section to respondent before proceeding

F. Bed Net Use

	Question	Yes	No		Question	Yes	No	
1	Have you ever seen a bed net? If no skip to 16			12	Do you like the way bed nets look? Square Round			
2	Have you ever used a bed net?			13	Where did you get the bed nets you are currently using from?	**Circle all that apply** 1. Gift 2. Purchase 3. Government hospital 4. Government distribution of nets in community 5. NGO distribution of nets in community 6. Other		
3	Do you have any bed nets currently? **If yes, go to 4;** if no skip to 16							
4	How many bed nets do you have? Square _____ Round _____							
5	Do you know how to hang a square bed net?			14	Did any of the bed nets come with treatment tablets?			**DK**
6	Do you know how to hang a round bed net?			15	Did you treat the bed nets using the tablets after 6 months?			**DK**
7	Of the bed nets that you have, how many are in usable condition? Square _____ Round _____			16	Do you know where to get a mosquito net if you want one?			**DK**
				17	Are bed nets cheap to buy?			**DK**
8	Do you sleep under a bed net currently?			18	Are bed nets to be used by expectant mothers only?			**DK**
				19	Are bed nets to be used by children under 5 years of age only?			**DK**
9	Last night did you sleep under a bed net?			20	Are bed nets to be used by everyone?			**DK**
10	How many of the children living in your house slept under a bed net last night? ≤5years 6-18years Male _____ _____ Female_____ _____			21	Can using a bed net reduce your risk of getting malaria?			**DK**
				22	Can using a bed net reduce your risk of getting other diseases besides malaria?			**DK**
11	Are bed nets comfortable to use?			23	Besides malaria, do mosquitoes transmit any other diseases?			**DK**

Instruction to the interviewer: Introduce the next section to respondent before proceeding

G. Malaria treatment and other control measures

1	Have you ever suffered from malaria? If NO skip to 10	Yes	No
2	When you suspect that you are sick with malaria you **FIRST**:	1. Treat myself with herbs 2. Take painkillers as I observe how the disease will progress 3. Treat myself with remnant Malaria medication 4. Seek treatment at a health facility 5. Seek treatment from traditional healers 6. Buy malaria medicines from a chemist 7. Other _____	
3	If the disease becomes severe you often? **If the respondent does not go to a health facility in questions 2 and 3 skip to 9**	1. Treat myself with herbs 2. Self-medicate with over the counter Malaria medication 3. Treat myself with remnant Malaria medication 4. Seek treatment at a health facility 5. Seek treatment from traditional healers 6. Other	
4	When you last visited a health facility for malaria treatment, did the nurse/doctor draw a blood sample from your finger for testing?	Yes	No
5	The last time you were given medication in a health facility, did you finish the dose?	Yes	No
6	What qualities do you find desirable about malaria medication?	1. I get well 2. The dose lasts a few days 3. It is cheap to access 4. None 5. Other	
8	Have the undesirable qualities caused you to never finish a dose of malaria medicines? Go to 10	Yes	No
9	(If the respondent self-medicates with herbs, over the counter medicine or remnant medication) Why do you prefer to treat yourself?	1. Availability of medicines/herbs 2. Fear of conventional medicine 3. To save money 4. To save time 5. Health facilities are too far 6. Other	
10	When you need to visit a health facility for services, who decides **when** you go?	1. Myself 2. Spouse 3. Son 4. Daughter 5. Mother-in-law 6. Other	
11	When you need to visit a health facility for services, who decides **where** you go?	1. Myself 2. Spouse 3. Son 4. Daughter 5. Mother-in-law 6. Other	
12	In the last one month, has any person in your household been sick with malaria? Circle all that apply	1. Male <5 years 2. Female <5 years 3. Male 6 to 18 years 4. Female 6 to 18 years 5. Female >19 years 6. Male>19 years 7. None	
13	Which of the sick person(s) failed to do their productive activities i.e. work or school due to the illness? **Circle all that apply**	1. Male <5 years 2. Female <5 years 3. Male 6 to 18 years 4. Female 6 to 18 years 5. Female >19 years 6. Male>19 years 7. None	

7	What qualities do you find undesirable about malaria medications?	1. Have bitter taste 2. Bad smell 3. Causes nausea 4. Many tablets to swallow at the same time 5. They take too long to finish 6. They are expensive to buy 7. Other Negative side effects 8. Other			
			14	How many days of productive work or school did they lose?	1. Male <5 years ___ 2. Female <5 years___ 3. Male 6 to 18 years____ 4. Female 6 to 18 years____ 5. Female >19 years ___ 6. Male>19 years ___

Instruction to the interviewer: Introduce the next section to respondent before proceeding

H. Other Malaria Control Measures

	Question	Yes	No		Question	Yes	No
1	Has your **compound** been sprayed with chemical insecticides to repel mosquitoes in the last 6 months?			**6**	Have you used mosquito repellent coils in your house in the last 6 months?		
2	Has your **house** been sprayed with chemical insecticides to repel mosquitoes in the last 6 months?			**7**	Have you applied repellent lotion or jelly on yourself to protect yourself from mosquitoes in the last 6 months?		
3	When travelling to a place known to have a lot of malaria cases, do you take **conventional** malaria medication before the journey?			**8**	When it rains heavily, do you spray all pools of water with chemical insecticides to control mosquitoes?		
4	When travelling to a place known to have a lot of malaria cases, do you take **traditional** malaria medication before the journey?			**9**	Have you used animal (cow) dung to repel mosquitoes from your house in the last 6 months?		
5	Have you used mosquito repellent spray eg doom in your house in the last 6 months?			**10**	Have you used plant materials to repel mosquitoes in the last 6 months?		

Instruction to the interviewer: Introduce the next section to respondent before proceeding

I. Malaria in Pregnancy

	Malaria in Pregnancy	Yes	No	Don't know
1	Expectant mothers in this area attend ante-natal clinics			
2	Malaria in pregnancy harms the unborn foetus			
3	Malaria in pregnancy can cause abortion of a foetus			
4	Malaria in pregnancy can cause delivery of a dead foetus			
5	Infants born of mothers who had Malaria while pregnant may have low birth weights			

Instruction to the interviewer: End of malaria oriented questions. Introduce the section to the respondent

Rift Valley Fever

J. Livestock ownership

1. Do you keep any livestock?	2. What types of livestock do you keep in your home?
1. Yes 2. No - **go to the next section (N)**	**Instruction: Circle all that apply and indicate the numbers** **Type** — **Quantity** 1. Indigenous cattle _____ 2. Cross breed cattle _____ 3. Exotic cattle _____ 4. Goats _____ 5. Sheep _____ 6. Poultry _____ 7. Rabbits _____ 8. Other _____

Instruction to the interviewer: Introduce the next section to respondent before proceeding.

K. Livestock Prices

	Type of animal	**No. of Cattle**	**Average cost of animal**	**No. of Goats**	**Average cost of animal**	**No. of Sheep**	**Average cost of animal**
1	Calves (0-8 weeks), Kids and Lambs (0-3 months)						
2	Weaners (2 months – 1 year), Kids and Lambs (4-7 months)						
3	Yearlings (1-2 years), Growers (8-12 months)						
4	Adults cattle > 2 years, sheep and goats > 1 year						

Instruction to the interviewer: Introduce the next section to respondent before proceeding.

L. Milk Prices

	Type of Animal	Duration of lactation period in months	Milk yield at calving/kidding	Milk yield in middle of lactating period	Milk yield when drying	Average cost of milk per litre at farm gate
1	Cows					
2	Does					
3	Ewes					

Instruction to the interviewer: Introduce the next section to respondent before proceeding.

M. Milk Use

	Type of Animal	Average amounts consumed in household in the last 1 week	Average amounts sold in the last 1 week	Amounts given away (To neighbours/ labourers/extended family) in the last one week	**Milk units of measurement to be used by the enumerator in estimating quantities**
1	Cows				1. Litre 2. Bottle 750 ml 3. Bottle 500 ml 4. Small cup/ small soda bottle 350ml 5. Other _____
2	Goats				
3	Sheep				

Instruction to the interviewer: Introduce the next section to respondent before proceeding.

N. Knowledge of RVF symptoms

1	In this region, have you witnessed a livestock disease that occurred after heavy rains and caused: **(Read out all the options)** a) mass abortions in gestating cattle, goats and sheep b) mass deaths of lambs, kids and calves c) animals to have bloody diarrhea d) animals to have discharge from the eyes and nose e) many cattle, sheep and goats deaths f) cattle, goats and sheep to have high fever g) humans infections of the same disease	Yes	No	**4**	What was the source of information? (circle all that apply)	1. Family 2. Friends 3. Radio (national) 4. Radio (vernacular) 5. Television 6. Posters/ Pamphlets 7. School text books 8. Health facility 9. Community health worker/public health official 10. Local animal health experts 11. Veterinary officer 12. Internet 13. None 14. Other _____
2	Prior to this interview, have you ever heard of a disease called Rift Valley fever?	Yes	No			
3	What are the signs and symptoms of RVF in humans? (Circle all that apply) a) Blurred or decreased vision b) Jaundice c) Fever d) Headache e) Joint pains f) Diarrhea g) Vomiting h) Bleeding from body openings i) Other					

Instruction to the interviewer: Introduce the next section to respondent before proceeding.

O. Knowledge of risk factors of exposure to disease in humans

	Human beings can be infected with some livestock diseases through	**Strongly disagree**	**Somewhat disagree**	**Neither agree or disagree**	**Somewhat agree**	**Strongly agree**
1	contact with sick animals					
2	consumption of meat from sick animals					
3	consumption of milk from sick animals					
4	contact with blood from sick animals					
5	contact with animal discharge from eyes and nose					
6	contact with meat					
7	contact with skins and hides					
8	bites from infected mosquitoes					

Instruction to the interviewer: Introduce the next section to respondent before proceeding. Inform the respondent that you will be reading some statements for them about animal health and you would like them to respond as per the given Likert scale

P. Vulnerability to zoonotic diseases

	Statements on vulnerability to zoonotic diseases	**Never**	**Very few times**	**Sometimes**	**Most of the times**	**Always**
1	When cattle, goats or sheep are sick, we still milk them					
2	We consume milk from sick animals					
3	We boil our milk before consumption					
4	When a sick animal is about to die, we slaughter it and consume					
5	When a sick animal dies, we immediately slaughter it and consume it					
6	When a sick animal dies we immediately bury it					
7	When a sick animal dies we immediately burn it					
8	When we slaughter an animal, we call veterinary personnel to inspect the meat before consumption					
9	When we slaughter an animal, we call a local meat expert to inspect the meat before consumption					
10	When we slaughter an animal, some people consume the raw blood					
11	When we slaughter an animal, some people cook the blood and consume it					
12	When animals are delivering, we assist them with bare hands					
13	When animals are sick, we handle them with bare hands					
14	When an animal aborts we bury the foetus					
15	When an animal aborts we throw the foetus in the open to rot					
16	When an animal aborts we give the foetus to dogs to consume					
17	When an animal aborts we treat it with herbal medicines					
18	When an animal aborts we treat it with conventional medicine					
19	When your mature animals are sick, they spend the night near the household					
20	When your calves, kids or lambs are sick they spend the night in a room where humans sleep					
21	When your cattle, sheep and goats are sick you treat then with herbal medicines					
22	When your cattle, sheep and goats are sick buy veterinary medicines and treat them yourself					
23	When your cattle, sheep and goats are sick you call a veterinarian to treat them					

24	Veterinary services are expensive					
25	Veterinary officers are easy to access					
26	Veterinary officers are friendly to the farmers					
27	Veterinary medicines are difficult to find					
28	Veterinary medicines are difficult to administer					
29	Animals that are treated by veterinary officers always die					
30	When your animals are grazing, they come into contact with other animals in the locality					
31	Your animals graze outside the locality					
32	Your animals are watered in the same watering point as other animals in the locality					
33	If the government puts a ban on consumption of livestock products due to livestock disease outbreak, you will consume them anyway					

Instruction to the interviewer: Introduce the next section to respondent before proceeding. Inform the respondent that you will be reading some statements for them about access to health services and you would like them to respond yes or no.

Q. Access to health services

	Statements on access to health services	**Yes**	**No**	**Don't know**
1	The nearest health facility is located far from your home			
2	The cost of transport to the nearest health facility is too high			
3	You often go to nearest health facility by	Foot	Motor cycle	Vehicle
4	Roads to the nearest health facility are in good condition in the wet season			
5	The nearest health facility does not have enough medical personnel			
6	In the nearest health facility, it takes too long to get services			
7	You have failed to seek medical services in the nearest health facility because it takes too long to get services			
8	The nearest health facility does not always have the medication prescribed			
9	Treatment in the nearest health facility is costly			
10	You have failed to seek medical services in the nearest health facility because they are costly			
11	Medical staff in the nearest health facility are not friendly			
12	You have failed to seek medical services in the nearest health facility because medical staff are not friendly			
13	To what extent are you able to rely on your nuclear family for **care when sick**?		1. No extent 2. Low extent 3. Medium extent 4. High extent	
14	To what extent are you able to rely on other people besides your nuclear family for **care when sick**?			
15	To what extent can you rely on friends or neighbours for **labour substitution** when you are sick?			
16	To what extent are you able to rely on friends or neighbours to assist with **catering for medical expenses** of an ailing family member?			
17	To what extent are you able to influence decisions on **construction of health** facilities in your locality?			
18	To what extent are you able to influence decisions on the **quality of health service** offered to people in your locality?			
19	To what extent are you able to protest against poor health services in your locality?			

20	To what extent are you able to influence decisions on the quality of veterinary services offered in your locality?		
21	To what extent are you able to protest against poor veterinary services in your locality?		

9.5: Biosecurity Checklist in Markets

Respondent Background Information Code: _____

Market:_____ GPS Coordinates _____

Name: _____ Date: _____

Designation:_____ Phone number: _____

Age:_____ Sex: _____

Education level: _____ Religion: _____

Questions

1. Trader type: a. Buyer b. Seller c. Buyer/Seller
2. Product traded in a. Cattle b. Goats c. Sheep
3. Average quantities traded per market day
   a. Cattle _____ b. Goats _____ c. Sheep _____
4. What is your frequency of trading in this market?
   a. Weekly b. Twice a month c. Three times a month d. Monthly
   e. Every quarter f. Every half year g. Annually Other_____
5. Source of livestock for trade (if selling)

	Livestock	Source	Area	Source options
a	Cattle			a. Own farm b. Purchase from farmers at farm gate c. Purchase in the market for sale to other trader(s) d. Other _____ _____ __
b	Goats			
c	Sheep			

6. Use of bought livestock (if buying)

	Livestock	Uses	Area	Use options
a	Cattle			a. Farming b. Domestic consumption c. Slaughter for sale (abattoirs) d. Trading in meat (butcheries) e. Trading in stock
b	Goats			
c	Sheep			

7. **For stock traders**. My buyers in _____ buy the stock for?

	Livestock	Uses	Area	Use options
a	Cattle			a. Farming b. Domestic consumption c. Slaughter for sale (abattoirs) d. Trading in meat (butcheries) e. Trading in stock
b	Goats			
c	Sheep			

8. Mode of livestock movement to the market
   a. Foot b. Bicycle c. Motorcycle d. Vehicle

9. Mode of livestock movement from the market
   a. Foot b. Bicycle c. Motorcycle d. Vehicle

10. Are animals monitored for ill health while in-transit? 1: Yes 2. No

11. If yes, explain how
    _____
    _____
    _____

12. Are animals monitored for ill health while in the market? 1: Yes 2. No

13. If yes, explain how
    _____
    _____
    _____

14. How are animals that die in-transit disposed of?
    _____
    _____
    _____

15. Cleaning vehicles (only for those who use vehicles to transport their livestock

	Vehicle cleanliness	Answers	Options
a	Before carrying livestock you		a. Do nothing b. Sweep the vehicle clean c. Wash the vehicle with plain water d. Wash the vehicle with soap and water e. Wash with, soap, water and disinfectant
b	After carrying livestock you		

16. How do you respond to disease outbreaks in this area?

a. Operations cease

_____
_____
_____

b. Operations decline

_____
_____
_____

c. Operations continue as usual

_____
_____
_____

d. Move operations to another market

_____
_____
_____

9.6: Biosecurity Checklist in Abattoirs and Slaughter slabs

Respondent Background Information **Code** _____

Abb/SS : _____ GPS Co-ordinates _____

Name: _____ Date: _____

Designation: _____ Phone number: _____

Age: _____ Sex: _____

Education level: _____ Religion: _____

Observe or ask as appropriate for the question

1. Frequency of operations per week _____
2. Average number of livestock slaughtered per week: Goats_____

   Sheep _____ Cattle _____
3. Total number of workers in abattoir/ slaughter slab _____
4. Total number of workers with protective clothing

	Protective gear	**Total**	**Percentage**
a	White coat		
b	White cap		
c	Gum boots		
d	Googles		
e	Nose masks		

5. Cleaning

	Item	Water	Soap	Disinfectant (name)
a	Floors			
b	Tables			
c	Aprons			
d	Slaughtering equipment			
e	Other			

6. How are the following disposed

	Item	Disposal method
a	Condemned parts	
b	Carcasses	
c	Manure	
d	Blood	
e	Waste water	

7. Can birds, rodents, dogs and other pests access the slaughter slab, including rooms where carcasses are kept?
   a. Yes b. No

8. Are the dumping pits/sites accessible by dogs, birds, rodents and other pests?
   a. Yes b. No

9. How do markets respond to disease outbreaks?

a) Cease operations

_____
_____
_____

b) Reduced operations

_____
_____
_____

c) Continue as usual

_____
_____
_____

10. Is there routine awareness creation campaigns involving workers and users of the facility on biosecurity measures?
    a. Yes b. No

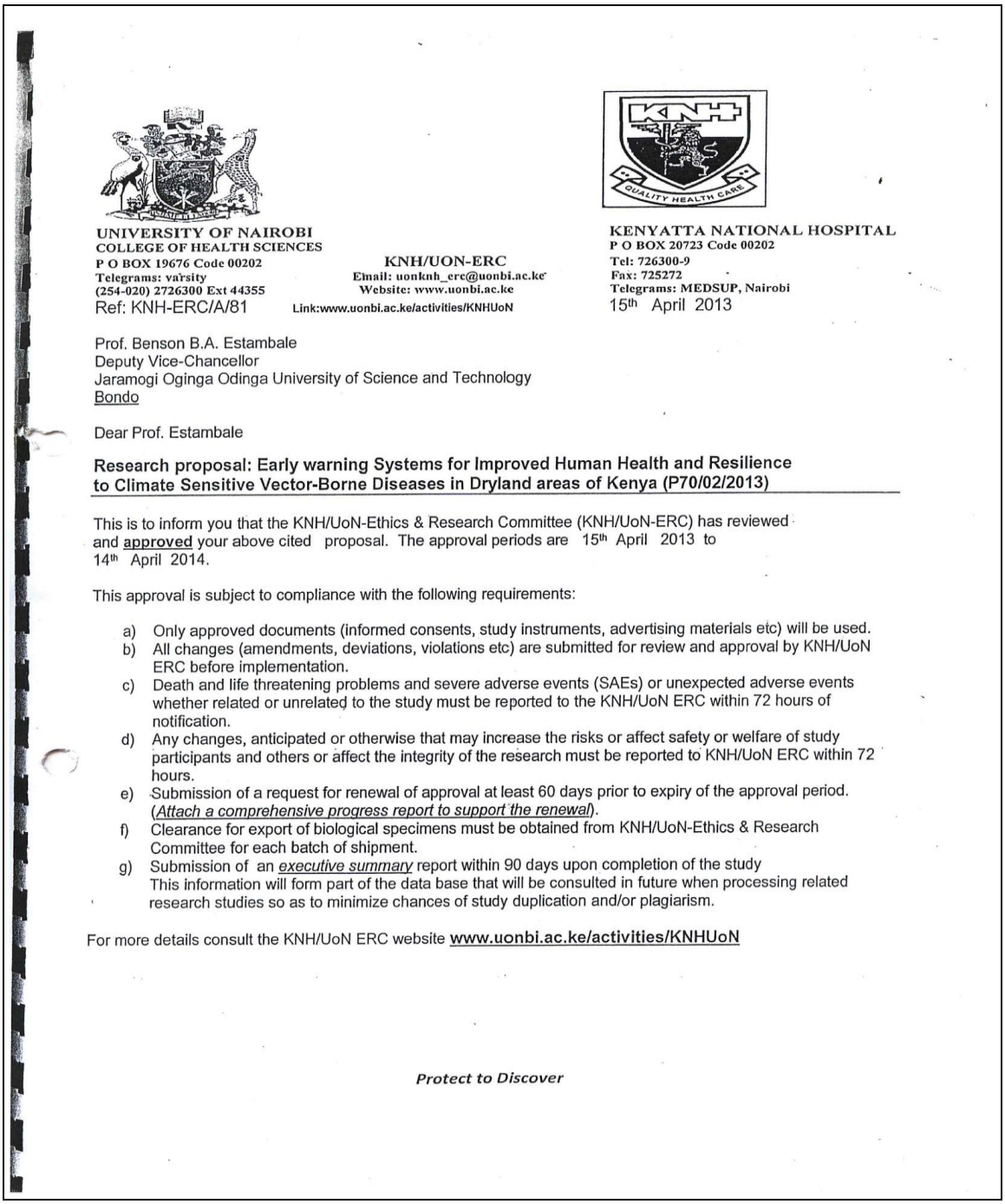
11. In the last six months what topics have the workers and users covered

_____
_____
_____

12. Are there empty containers/plastics and bushed that can act as mosquito breeding sites?
    a. Yes b. No

13. Description of location of abattoir/slaughter slab

9.7: Ethical Clearance Documents



UNIVERSITY OF NAIROBI
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KNH/UON-ERC
Email: uonknh_erc@uonbi.ac.ke
Website: www.uonbi.ac.ke
Link:www.uonbi.ac.ke/activities/KNHUoN

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/81

15th April 2013

Prof. Benson B.A. Estambale
Deputy Vice-Chancellor
Jaramogi Oginga Odinga University of Science and Technology
Bondo

Dear Prof. Estambale

Research proposal: Early warning Systems for Improved Human Health and Resilience to Climate Sensitive Vector-Borne Diseases in Dryland areas of Kenya (P70/02/2013)

This is to inform you that the KNH/UoN-Ethics & Research Committee (KNH/UoN-ERC) has reviewed and **approved** your above cited proposal. The approval periods are 15th April 2013 to 14th April 2014.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
c) Death and life threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
g) Submission of an *executive summary* report within 90 days upon completion of the study
This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

For more details consult the KNH/UoN ERC website **www.uonbi.ac.ke/activities/KNHUoN**

Protect to Discover

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Ref. No.KNH/ERC/R/68

21st May 2014

Prof. Benson Estamblae
Principal Investigator
Research, Innovation and Outreach
Jaramogi Oginga Odinga University of Science and Technology

Dear Prof.Estambale

Re: Approval of annual renewal – Early warning systems for improved Human Health and Resilience to climate sensitive Vector-Borne Disease in Dryland Areas of Kenya (P70/02/2013)

Refer your communication of May 4, 2014.

This is to acknowledge receipt of the study progress report and hereby grant you annual extension of approval for ethical research Protocol **P70/02/2013.**

The approval dates are 15th April 2014 to 14th April 2015.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
c) Death and life threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN- ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.

g) Submission of an *executive summary* report within 90 days upon completion of the study
This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

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Ref: KNH-ERC/ R/75

4th May, 2015

Prof. Benson B.A. Estambale
Deputy Vice-Chancellor
Principal Investigator
Jaramogi Oginga Odinga University of Science and Technology
Bondo

Dear Prof. Benson

Re: Approval of annual study renewal - Early Warming Systems for Improved Human Health and Resilience to Climate Change Sensitive Vector-Borne Diseases in Dryland Areas of Kenya (P70/02/2013)

Your communication of 10th April 2015 refers.

This is to acknowledge receipt of the study progress report and hereby grant you annual extension of approval for ethical research protocol.

The study renewal dates are 15th April, 2015 to 14th April 2016.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
c) Death and life threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN- ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.

g) Submission of an *executive summary* report within 90 days upon completion of the study
This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

REPUBLIC OF KENYA

MINISTRY OF EDUCATION, SCIENCE & TECHNOLOGY
STATE DEPARTMENT OF EDUCATION

OFFICE OF THE COUNTY DIRECTOR
(**BARINGO COUNTY**).

Our Email:countyedubaringo@gmail.com
Tel / Fax: 053/21282

P.O. BOX 664
KABARNET

REF: BAR/CDE/RESEARCH GEN/VOL.1/NO. 27/54

10/04/2014

Prof. Benson B.A Estambale
Deputy Vice – Chancellor
Jaramogi Oginga Odinga University of Science & Technology
Bondo.

RE: RESEARCH AUTHORIZATION

This office has received a letter Ref: KNH-ERC/A/81 dated 15th April, 2014 requesting for authority to allow you carry out research on ***"Early warning Systems for Improved Human Health and Resilience to Climate Sensitive Vector – Borne Diseases in Dryland areas of Kenya "*** in Baringo County.

We wish to inform you that the request has been granted, the authorities concerned are therefore requested to give you maximum support.

We take this opportunity to wish you well during this research.

BARINGO
APR 2014

DANIEL K. K. MOSBEI
COUNTY DIRECTOR OF EDUCATION
BARINGO.

BARINGO COUNTY GOVERNMENT

MINISTRY OF AGRICULTURE, LIVESTOCK AND FISHERIES

Telegrams .....KABARNET.....
Telephone:
Fax No.: (053) 22108
Email: countydvsbaringo@gmail.com
REF:BCG/VET/GEN/VOL1/62

DIRECTOR OF VETERINARY
BARINGO COUNTY
KABARNET
30/01/2015

Prof. Benson B.A Estambale
Deputy Vice-Chancellor
Jaramogi Oginga Odinga University of Science &Technology
Bondo

RE:RESEARCH AUTHORIZATION

Reference is hereby made to your letter dated **22nd January 2015** requesting for authority to allow you carry out research on ***"Early warning systems for improved Human Health and resilience to climate Sensitive Vector-Borne Diseases in Dry land areas of Kenya"*** in Baringo County.

The research may lead to access of sensitive government documentation and you are therefore asked to use them for intended purpose/research only and give the utmost confidentiality where necessary.

We wish to inform you that request has been granted, the concerned officers are therefore requested to give you maximum support.

We take this opportunity to wish you well as you interact with various stakeholders in your research.

COUNTY DIRECTOR
OF VETERINARY SERVICES
BARINGO COUNTY
P.O. Box 410-30400

DR B.K.R KANDIE
Director of Veterinary Services
BARINGO COUNTY

C.C :
C.E.C MOAL&F Baringo County
C.O MOAL&F Baringo County
DIRECTOR Administration Baringo County

MINISTRY OF HEALTH

Telephone: 053 Telephone: 053 21709,
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E-mail: baringochealth@gmail.com
When replying please quote

Ref. /: CNTY/ GEN/Vol.1/83

COUNTY DIRECTOR BARINGO
P.O. Box 21 – 30400,
KABARNET

28th April 2014

The Deputy Vice Chancellor
Research Innovation and Outreach
Jaramogi Oginga Odinga University
BONDO

Dear Sir

RE: AUTHORIZATION LETTER

I acknowledge receipt of your Research request Ref: JOOUST/DVC-R10/FP/F2/001 – WHO dated 16/4/2014 to access some non-clinical information from records.

You are therefore granted permission to collect the relevant data from records in the various health facilities in the County.

I hope your researchers and project personnel will handle all the information with the confidentiality it deserves and only use for the stated purpose.

I therefore request the staff in the various health facilities to assist your staff with the information required.

Yours faithfully

District Medical Officer of Health
P. O. Box 21-30400, Kabarnet
Baringo District

Dr Charles Kurgat
COUNTY DIRECTOR OF HEALTH
BARINGO COUNTY