

Adaptive and Coping Mechanisms of Pastoralists in Dry Land Ecosystem and Their Implications on Rift Valley Fever Control in Ijara Division, N.E. Kenya

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Abstract: This study sought to investigate the adaptive and coping mechanisms of the pastoralists and their implications on Rift Valley fever control in Ijara Division, North Eastern Kenya. It was cross sectional in design with a mix of quantitative and qualitative methods of data collection. The findings suggest that the characteristic instability of most rangeland environments inherently expose the pastoralists to vulnerabilities such as Rift Valley Fever outbreaks. The pastoralists interface this instability with a diversity of adaptive and coping mechanisms most of which have implications on Rift Valley fever control. Study findings show that the youthful herders who move with cattle in search of ephemeral resources are more vulnerable to Rift Valley Fever disease than women and men because of the gender role specifications traditionally ascribed to them. The home-processed sheep fat which is widely used as ethno-medicine for RVF cure in humans revealed a pluralistic perspective in health seeking behavior of the pastoralists but it also had the potential of delaying access to conventional medicine thereby worsening the condition of RVF victims. Furthermore, although most cattle keepers shelter sick animals in the same human dwelling unit during RVF outbreak for fear of losing them to wildlife attacks and adverse weather conditions, the study showed that this sleeping arrangement can accelerate Rift Valley Fever Virus infection from the animal to humans through contact with animal body fluids. Finally, study participants concurred that induced mobility and disease risk aversion strategies as practiced by the pastoralists would be more useful in Rift Valley Fever control if backed up with effective surveillance and early warning system to enable the pastoralists avoid areas most affected by the epidemic. Public health awareness on Rift Valley fever, improved surveillance and effective early warning system are therefore recommended to provide the pastoralists with the necessary information to adopt appropriate and safe adaptive and coping mechanisms for control of the zoonotic disease.

Keywords: Adaptive, coping, Dry land ecosystem, pastoralism, Rift Valley fever, zoonotic diseases.

1. INTRODUCTION

1.1. Emerging Infectious Diseases: Rift Valley fever:

Rift Valley fever (RVF) is an acute viral zoonosis that affects cattle, sheep, and goats but also, people and wildlife (Jost, et al. 2010). RVF is, primarily, transmitted by the Aedes mosquito and breaks out during unusually severe rainfall. According to the World Health Organization (WHO) (1998), RVF is one of the emerging infectious diseases that mainly affect the poor and marginalized populations that lack access to health services and are readily ignored. As a result, these populations are subjected to a cycle of ill health and poverty that aggravates their burden of infectious diseases. The majority of human infections take the form of mild fever, but a small percentage (< 1%) leads to more severe manifestations, including fatal hemorrhagic disease (Bird et al, 2007; LaBaeud et al., 2008). Humans usually get RVF

through bites from infected mosquitoes. RVF virus (RVFV) infection can also occur in humans if they are exposed to the blood, body fluids, or tissues of infected animals. Direct exposure to fluids of infected animals can occur during slaughter or through veterinary and obstetric procedures. Hence, the risk of infection is greatest when slaughtering in the context of traditional sacrificial practices, on which occasions aerosols of infected blood are likely to be generated (WHO, 1998; Bird et al., 2007). This is the major reason that outbreak of RVF is commonly associated with people whose livelihoods revolve around livestock rearing.

1.1.1. RVF hotspots:

After the discovery of RVF (RVFV) in 1930 among sheep on a Naivasha farm in the Rift Valley of Kenya, nineteen (19) extensive outbreaks were not reported until 1951, when an estimated 20,000 persons were infected during an epizootic of cattle and sheep in South Africa (Mundel & Gear, 1985). In 1950 and 1951, a main epizootic occurred in Kenya, resulting in 5,000,000 sheep abortions and 100,000 sheep deaths (Woods et al., 2002). RVF later occurred in epizootic form in northeastern Kenya in the years 1961 and 1962. Since then, outbreaks have occurred in a number of countries, notably Egypt in 1971–1978; Egypt and Senegal in 1993; Kenya, Somalia, and Tanzania in 1997 and 1998; and Saudi Arabia and Yemen in 2000 and 2001 (Lithicum et al., 1999; Woods et al., 2002; CDC, 2007). It is estimated that approximately 27,500 human infections occurred in Garissa, northeastern Kenya in 1997 and 1998, the largest ever recorded outbreak of RVF in east Africa (Woods et al., 2002). A multivariate analysis revealed that contact with sheep and body fluids and sheltering livestock in one's house were significantly associated with infection and suggested that public education during epizootics has the potential to reduce human illnesses and deaths associated with RVF outbreaks (Woods *et al.*, 2002). In east Africa, RVF has been reported in arid and semiarid areas in the form of sudden and dramatic epidemics at intervals of approximately 10 years associated with widespread flooding and the resultant swarms of mosquitoes (Lithicum et al., 1999). In 1997–1998 and 2006–2007, massive outbreaks of RVF occurred in east Africa, and both were associated with El Nino events (CDC, 2007; Woods et al., 2002). When the 2006–2007 outbreak subsided, more than 1,000 people had been diagnosed with RVF, and more than 300 people had been confirmed to have died of the disease (Breiman et al., 2008).

In Kenya, outbreaks have occurred in the northeast, where a nomadic way of life is the predominant social order and livestock rearing is pivotal to livelihoods. The last major outbreak of RVF experienced in Kenya occurred in 2006, with the last case being confirmed in June of 2007. This together with the 1996/1997 outbreak was the most notable in terms of public health and socioeconomic impact, thereby attracting unprecedented research interest (Murithi et al., 2010).

Although the Somali pastoralists of Ijara, North Eastern Kenya are directly dependent on livestock for daily nourishment and as income resource within a dry land ecosystem, the livelihood is constrained by the high prevalence of diseases such as RVF.

1.2. Pastoralism as an adaptive strategy in dry land ecosystem:

Pastoralism refers to both an economic activity and a cultural identity. As an economic activity based on animal production, pastoralism is defined by a specialization to take advantage of the characteristic instability of most rangeland environments, where key resources such as nutrients and water for livestock can be relied on in the form of unpredictable and short-lived concentrations more than in uniform and stable distributions (Kratli et al., 2013). In pastoral systems, the herders are mobile targeting the ephemeral concentration of resources while other household members might be sedentary for part or most of the year. Herders target areas of prime pasture with species combinations they know to be beneficial to their animals. The goal of this “strategic mobility” according to African Union (2010), is to enhance production by keeping the livestock on a diet that is higher in nutritional value than the average value of the range.

Ruminants respond to a poor diet by decreasing intake. For this reason, the most specialized groups of pastoralists try to breed animals particularly competent in feeding selectively, which are capable of avoiding the less nutritious opportunities and only feeding on the best bites (Kratli, 2008).

If not constrained, pastoralists target optimal animal nutrition by monitoring the range and leading their herds onto the best available pastures throughout the year (Wilson and Clarke, 1976). There is a great deal of knowledge management among other adaptive mechanisms involved in these processes (Kauffman 2007). This routine mobility for production is fundamentally different from the mobility as a coping strategy aimed at minimizing the negative effects of drought, epidemics, or conflict. Pulled by relative abundance rather than pushed by scarcity, this production-boosting mobility is much more intense during wet season, when returns are highest. In economic terms, the rangeland environment

experienced by the herds under this regime is significantly more favourable than the same environment described from the perspective of sedentary agriculture or mixed farming (Kratli, 2010). Through strategic mobility, pastoralism finds an asset in the existence of dynamic variability in range land environments where sedentary agriculture finds a problem in its lack of uniformity and stability.

Strategic mobility offers the highest returns but requires relatively large herds and extensive social networks or social capital. Livestock in impoverished households with shrunk social capital is moved much less, both in frequency and intensity. Dry land pastoralists might also balance mobility against perceived risks (for example insecurity and diseases) or advantages (e.g. the wish to or necessity to access services still only provided in settlements) or against land access constraints. In all cases, reducing mobility lowers the returns of dry land animal production and compromises both economic and ecological sustainability (IUCN, 2012). One of the most critical analyses of the environmental impact of the livestock sector, *The Livestock Long Shadow*, found that "If properly managed, nomadic pastoral livestock production is potentially the most environmentally compatible agricultural activity in this ecosystem (dry land)" (Steinfeld et al., 2006, p.260). Indeed, comparing nutritional status of children from nomadic and sedentary population groups in Mali, Pedersen and Benjamisen (2008) conclude that farming appears to be a poorer adaptation than nomadic pastoralism in arid environments such as the northern Sahel. Mobile pastoral systems in both West and East Africa were found to perform better than sedentary systems under the same conditions (Wilson and Clarke, 1976).

A degree of vulnerability is inherent to pastoralism as it is inherent to any system operating by harnessing risk and instability. When addressing vulnerability in pastoralism, it is therefore crucial to distinguish between this "baseline vulnerability," which is strategic and the managing of which is the business of the system, and dysfunctional vulnerability that arises from the sudden or cumulative incapacity to operate the system due to structural changes triggered by external forces or disease epidemics such as Rift Valley fever (Kratli 2013). For pastoralist households, this non-strategic vulnerability increases as their capacity to operate pastoral production strategies decreases (Little et al., 2001). A recent policy document produced by the Ministry for Development of Northern Kenya makes a clear link between food insecurity among pastoralists and the incapacity to operate the pastoral system: "Eighteen of the 20 poorest constituencies in Kenya, where 74 to 97% of the people living below poverty line, are in Northern Kenya. The greatest rates of poverty are observed among those who are no longer directly involved in pastoralism, particularly those without livestock who depend on casual labour or petty trade in towns". (MDNKAL, 2010, p. 5).

The complex nature of pastoralists' relationship with their herds underpinned by the pivotal role livestock play in their livelihoods within the context of unstable ecosystem is the main reason why threats of epidemics such as Rift Valley fever (RVF) remain a major issue of concern among the pastoralists, public health experts and researchers. A part from the economic losses that result from RVF outbreak, human and animal morbidity and mortality that ensue is devastating at household, community and national levels further aggravating poverty levels. Appreciating that pastoralism remains the most viable economic activity in the district, few studies if any have attempted to investigate pastoralists' adaptive and coping mechanisms and their implications on RVF control.

The pastoralists invoke diverse adaptive strategies to guarantee their survival and optimize the benefits derived from livestock-the bedrock of their livelihoods. These adaptive strategies have both positive and negative implications on RVF control. Similarly, the cattle keepers adopt a myriad coping mechanisms aimed at minimizing the negative effects of RVF outbreaks. This article sought to show the adaptive and coping mechanisms employed by the pastoralists to sustain and optimize pastoralism within the context of unstable dryland ecosystem. The paper also attempts to underscore the practical implications and appropriateness of the mechanisms in RVF control.

2. METHODS AND PROCEDURES

2.1.1. Research Site:

This research project was carried out in Gedilun Sub-location, Ijara Division in North Eastern part of Kenya (See map 1 below). Ijara Division falls within Ijara District which is one of the seven districts that form N.E. Province and was carved out of Garissa in the year 2000. The district borders Fafi district to the North, Lamu district to the South, Tana Delta district to the South West, Tana River to the West and Republic of Somalia to the East. Ijara is also one of the four constituencies forming Garissa County. The others are Fafi, Dujis and Lagdera. Ijara district lies approximately 1° 7' S and 2° 3' S and longitude approximately 40° 4' E and 41° 32' E (MDNKAL, 2010). It covers an area of 10,000 km² and is made up of seven divisions namely Ijara, Masalani, Shangailu, Hulugho, Kotile, Ruqa and Bodhai. Out of the seven

divisions, the study was conducted in one division of Ijara. Ijara district was a major hotspot area during the last outbreak of RVF in 2006/07. The area is semi-arid located between Tana River and the boundary to Somalia.

2.1.2. Topography:

Ijara District neighbours Garissa and just as is characteristic of the entire County is a very flat floodplain stretching from Garissa in SSE direction towards the coast with little topography, perennial river valleys and gentle local elevations. The area is semi-arid with low undulating plains that have low-lying altitude ranging between 0 meters and 90 meters above sea level with vegetation cover of shrubs and acacia bushes. This typology of topography is a major factor contributing to massive floods during periodic heavy rains offering a good breeding medium for aedes mosquitoes-the vector of RVF virus.

2.1.3. Climate:

This is a semi-arid area, which has two rainy seasons a year; the long rains in March to April and the short rains in October to December. Typical annual rainfall averages between 300mm and 500mm (Jost *et al.*, 2010) although there is high inter-annual variability. The rainfall is unreliable with some short periodic torrential down pours. The temperatures are often high ranging from 20-38 degrees centigrade.

2.1.4. Population and livelihood:

Garissa County where Ijara falls covers 44,175 km sq. with a population of 623,060 out of which about 93,000 live in Ijara district. Approximately 11,474 live in Ijara Division alone-the focus of the study (KNBS, 2010). The inhabitants are predominantly Somali pastoralists practicing livestock keeping as the main economic activity. Although a number of settled towns are dispersed throughout the region, the rural population is principally composed of nomadic herdsmen. About 90 percent of the population is directly dependent on livestock for daily population nourishment and as income resource (Woods *et al.*, 2002). During the last outbreak (2006/7), a ban on livestock trade and imposition of quarantine resulted in severe economic losses that run to greater than US \$ 9.3 million in Garissa in North Eastern Kenya (Murithi *et al.* 2010).

2.2. Research design:

The study design was cross-sectional and descriptive combining quantitative and qualitative methods of data collection.

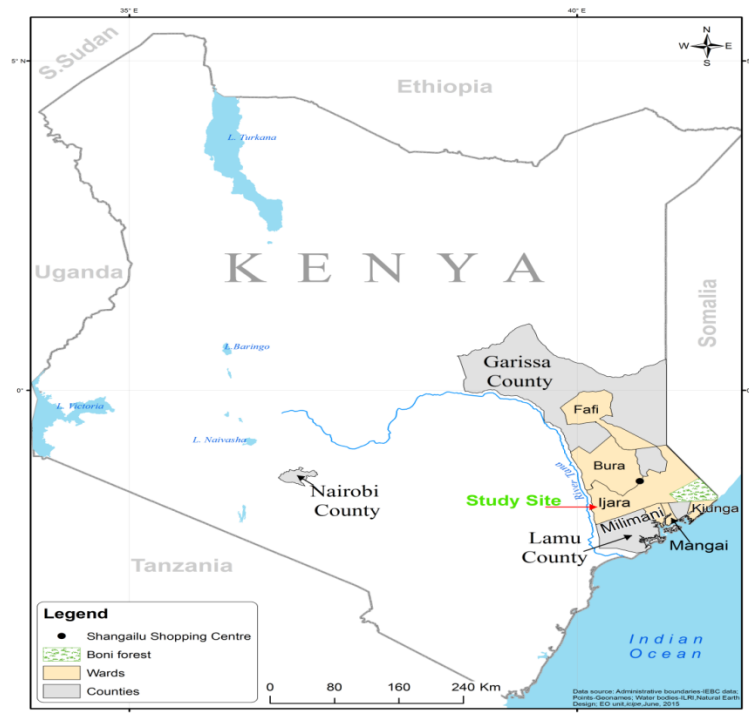


Fig 1: Map Showing Ijara Division Study Site

2.2.1. Sample population and sampling procedure:

The research team with the assistance of local administration identified a community central point within Gedilun sub-location in Ijara Division. The team then took the coordinates of the central point (S 01⁰ 22.832' E 040⁰ 42.201 E 117) and mapped out enumeration area within 2 KM radius from the central point. The geographic reference system ensured efficiency in getting respondents who are mobile pastoralists since the sample frame was unknown. It also gave each potential interviewee within the radius an equal chance of being interviewed. Convenience sampling strategy was then employed to identify 204 herd owners within the mapped radius. The sample size was derived using Yamane (1967:886) formula with $\pm 7\%$ precision level to get a sample size lower than 385 if precision level was the standard $\pm 5\%$. This was because of the difficulty in getting the mobile herd owners in the rangelands:

Sample calculation:

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

Where:

n = Sample size

N = Population size

e = Level of precision

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

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

2.3. Methods of data collection:

2.3.1. Survey technique:

A standard questionnaire was administered to 204 herd owners who were randomly sampled within a radius of 2 KM from a community central point within Gedilun sub-location. The researcher used local data collectors and community leaders to facilitate identification of the herd owners. The instrument was translated into Somali language for ease of interview and responses translated and recorded in English. To allow for probing, precision and efficiency, both open and closed ended questions were used.

2.3.2. Qualitative methods:

These comprised Key Informant Interviews (KIIs) with people who are knowledgeable in the livelihoods of pastoralists and Rift Valley fever, Focused Group Discussions (FGDs) with men and women, narratives and observation. Local interpreters versed with local language were used to facilitate the interviews.

2.4. Data management and analysis:

Data management was a continuous process in the study. Data from different sources was checked for clarity and completeness. They were reviewed, cleaned and stored in flash disks and compact disks. The hard copies were filed appropriately for continuous referencing during the study. In terms of data analysis, qualitative data were analyzed using thematic content analysis technique. Selected comments and direct quotes from Key Informants were also analyzed. Thematic content analysis was done to identify emerging themes in the study and relate the themes with the objectives to find out their answers to research questions. These were presented in prose. Direct quotes and comments from Key Informants were also captured and presented to help in understanding the world view of the pastoralists thereby bringing out their real life experiences and emic perspectives. On the other hand, Statistical Package for Social Science (SPSS) version 21 was used to analyze statistical data. Descriptive analysis method was used to produce descriptive statistics mainly percentages and frequencies of the measured variables.

3. FINDINGS AND DISCUSSION

3.1. Adaptive mechanisms of pastoralists in dry land ecosystem and their implications on Rift Valley Fever control:

3.1.1. Division of labour among Somali pastoralists:

Labour division among different groups in a society is a reflection of the group's adaptive strategy to harness resources and guarantee survival in their environment. Among the Somali pastoralists, gender roles and responsibilities were found to be closely associated with vulnerability to RVF. Herders who are mainly young men tasked with the responsibility of moving with cattle in search of pasture and water were found to be more vulnerable to RVF as reported by 84.3% of the respondents. This was opposed to 11.8% for herd owners and 1% for women. 84.7% of respondents concurred on four main reasons for the vulnerability of the youthful herders to RVF; the herders interact closely and regularly with animals as they look for pasture and water, they get exposed when slaughtering animals, they handle lactating animals and they together with their herds interact with wild animals in the forest during their cyclical movement. While these findings confirm those of other studies by Linthicum et al (1999); Labeaud et al., (2005); Aagaard-Hansen et al., (2010) and Muga, et al., (2015), they also contradict others. For example, one study by Linthicum et al., (1999) revealed that male participants were nearly three times more likely to be seropositive than female participants, a picture that was equally noted in the 1997 RVF outbreak investigations in North Eastern Kenya (Linthicum et al.,1999). According to Muga et al (2015), this is particularly so because men, particularly the herders interact closely and for longer periods in isolation with animals during their seasonal movements in search of pasture. During this time, they are confronted with many risk factors which increase their vulnerability to RVF. For instance, the reality of having to solely rely on raw cattle milk and blood and uninspected meat during their seasonal movements confronts them with higher risk factors than women and herd owners. This finding is also consistent with that of Aagaard-Hansen et al., (2010) who also found out that gender roles have differential exposure to diseases particularly the Neglected Tropical Diseases (NTDs) such as trachoma and schistosomiasis.

Joeke and Pointing (1991) found out that in sub-Saharan Africa, women frequently spend more time than their husbands in animal care. This led Dahl (1987) to conclude that pastoralism is a form of production in which the contributions of males and females are neatly interwoven. In analogous terminologies of Joeke and Pointing (1991), whereas women are associated with livestock as the means of subsistence, as "milk managers," men are associated with animals as wealth, as "managers of herds." This social disposition may set women to risks of contracting the RVF as they get into contact with these animals on a day-to-day basis. Women do all the work concerning animal products like milking, slaughtering the small animals (goats and sheep), processing the milk and caring for the hides and skins of slaughtered animals.

Among pastoral nomads and other herders in the arid regions of Africa, men and women are likely to be differentially exposed to RVF infection depending on the role specifications traditionally ascribed to them. For example, Bird et al., (2007) revealed that males were nearly three times more likely to be seropositive than females, a picture that was equally noted in the 1997 RVF outbreak investigations in North Eastern Kenya (Woods et al., 2002). This is particularly so because men, particularly the herders interact closely and for longer periods in isolation with animals during their seasonal movements in search of pasture. During this time, they are confronted with many risk factors which increase their vulnerability to RVF. For instance, the reality of having to solely rely on raw cattle milk and blood and uninspected meat during their seasonal movements confronts them with higher risk factors than women and herd owners. This finding is also consistent with that of Aagaard-Hansen et al., (2010) who also found out that gender roles have differential exposure to diseases particularly the Neglected Tropical Diseases (NTDs) such as trachoma and schistosomiasis.

However, in the study by LaBeaud et al., (2008), the difference in the seropositivity among males and females was not explained on the basis of reported animal or non-animal exposures which were comparable and not statistically different between genders. Instead, increased seropositivity among males, they concluded, was attributable to biological factors on the ground that the outcome of infection and resultant immune response to other viruses has been linked to gender differences.

The finding on how gender roles differentially expose the youthful herders to RVF has important implications for RVF control. Public health education and RVF prevention campaigns which have disproportionately focused on adult men and women in the settlements have missed the most vulnerable group which is usually out of the settlements in the rangelands. Hence for the health education campaigns and medical responses to succeed, deliberate efforts must be made to target the most vulnerable youthful herders who are often out in the remote and difficult-to-reach rangelands.

3.1.2. Strategic and induced cyclical mobility and knowledge management:

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

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

The cyclical mobility is represented a flow chart in Figure 2 below.

It can be deduced from the above data that the pastoralists not only make strategic decisions on mobility based on shared knowledge management on availability of pasture and water but also disease and vector prevalence such as tsetse. This finding has implications for RVF control in the dry land ecosystem. With continuous surveillance for early detection of RVF, effective early warning system and robust information dissemination, the pastoralists will be better able to plan to avoid areas that have RVF outbreak and only visit them for pasture and land when their network of knowledge management and that of the health authorities have declared the areas safe. However, the fact that the mobility pattern may take the youthful herders into different ecosystems may result in transmission of RVF through the vectors. As the human population continues to grow accompanied by increased livestock ownership, there is more pressure on available pasture for domestic animals and human settlement with consequent invasion of wildlife territory in search of pasture and food. This may bring livestock and herders in contact with cycles of transmission of disease between wildlife and mosquitoes.

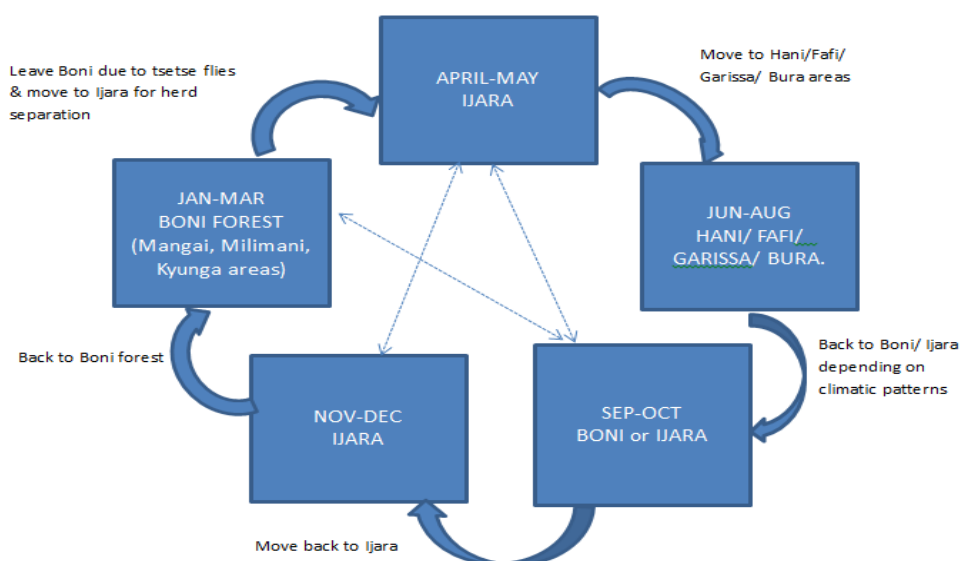


Fig 2: Cyclical mobility pattern of the Somali pastoralists

The findings above confirm those of other scholars. For example, Aagaard-Hansen et al., (2010) observed that nomads have differential exposure to diseases compared to settled populations primarily because of their mobility although Sheikh-Mohammed and Velema (1999) affirmed that they may also avoid some health risks because of their movements.

This study argues that RVF can therefore be effectively controlled if information on the areas affected by an outbreak is availed to the pastoralists in good time so as to avoid such spots to enable the herders to move their livestock to safer regions. Jost et al., (2010) pointed out that late detection of the disease during 2006/7 outbreak in both animals and humans meant that the disease was well established in livestock population before veterinary and public health interventions were initiated.

3.1.3. Disease-related risks aversion strategies and RVF epidemiology: Herd division, herd dispersion and diversification strategies:

Over time, nomadic pastoralists have evolved a diversity of mechanisms to reduce the risk of losing their livestock to drought and diseases. Survey showed the main risk mitigation mechanisms used against RVF as follows: vaccination of animals (87.3%), herds' dispersion (39.7%), herds division (39.2%) and herds' diversification (30.4%).

These risk aversion strategies also have important bearings on their exposure to RVFV infection and RVF control. Scholars such as Evers (1994) and Keya (2002) have similarly asserted that in the same way agricultural communities adopt practices such as multi-cropping and maintenance of reserve granaries in areas of risky agricultural production, pastoral risk aversion strategies focus on herd modification actions like diversification of species, dispersion, herds division and expansion and migration. These mechanisms are likely to either prevent or expose pastoralists to the risk of infection with RVFV.

3.1.3.1. Herds' division/separation:

A common drought and disease-related livestock management strategy adopted by pastoralists is herds division. Survey data indicated that 39.2% of respondents adopt herds division as a risk mitigation mechanism against RVF. Here, pastoralists split their herds into smaller groups in order to visit different grazing areas simultaneously. This has great potentials for evading spread of RVF in the event of an outbreak from animal to animal should information on impending outbreak be passed to the pastoralists in good time. It is not clear from the body of existing literature whether this aspect has been integrated during public education on RVF control. On the other hand, when sheep which has the highest mortality and incidence rate during RVF outbreak are grazed separately together (Jost et al., 2010), the proximity of high density of sheep herd may escalate the transmission and spread of RVF to both the sheep and their herds men.

3.1.3.2. Herd dispersion among pastoralists' social networks:

Close to 40% of respondents said they practice herd dispersion to minimize risks associated with RVF. In this practice, herds are regularly exchanged between herders within ones social networks to avoid the danger of losing the entire herd to disease. This finding supports that of Gulliver (1972) who similarly reported that herd dispersion is an effective strategy of spreading the risks of epidemics. Using recipients who live far away from each other facilitates this process because regions are mostly affected differently by diseases such as RVF. Gulliver's finding is affirmed by this study as captured in the quotation below from a key informant who stated that Shangailu was the most affected area in the entire Ijara district.

"2006/7 response was late. I came with the equipment one month late. We distributed 3 nets per household in the whole district. Hospital staff initially were not prepared but later the positive tested patients were isolated. MSF erected tents in the hospital. The worst hit division was Shangailu".

Pastoralists sustain the strategy of herd dispersion by maintaining individual networks, where livestock transactions occur among people who are well known to each other and share common vested interest in particular type of herds (Gulliver 1972; Reckers 1997). In this respect, herd dispersion that is practiced among pastoralists has implications on RVF control. Herd owners with a wide social capital can help prevent the spread of RVF within the herd and hence massive loss of livestock during epizootic by invoking this strategy.

3.1.3.3. Large livestock production/herd diversification:

Thirty percent (30%) of the respondents in the study expressed that they adopt herd diversification to mitigate the risks of RVF. Herd diversification is a practice by pastoralists where different types of livestock are kept basically to avert risks associated with disease and drought. This is because different species of livestock have different survival capacity in the face of calamities hence a farmer is able to spread the risk of losing the whole herd. To further affirm this fact, the study has shown that the Somali pastoralists practice large livestock production as 64.1% of the herd owners had herd sizes of 50< comprising different species of livestock. On herd diversification continuum, livestock owners' affinity with their livestock is quite a rational decision. The more arid an area is, the bigger the herd size in order to avoid the risk of human starvation (Reckers 1997). Herd diversification makes more efficient land use possible, offers a broader spectrum of animal products and secures a steadier supply of food. The different animals do not compete for pastures because of their different feeding requirements. Herds also vary in their susceptibility to disease, dry conditions and theft (Reckers 1997).

Since herds differ in their susceptibility to RVF with sheep being the most affected followed by the goats (Jost et al., 2010), herd diversification may guarantee the security of stock by ensuring that the herd owner does not lose all the livestock to RVF. Including this finding in public health education on RVF can help in the control and management of the zoonotic disease.

3.1.4. Animal treatment and vaccination:

"From mid-December to early January, they come to Ijara and Hulugho to separate the herd. They leave the calves and lactating animals in the Manyattas so as to provide milk to the family members. They also come for treatment and vaccination against tsetse". Source: A male key informant who is also a herd owner.

The above quotation by a key informant indicates the pastoralists' reliance on regular vaccination as an adaptive mechanism in dry land ecosystem. Eighty seven percent (87.3%) of herd owners surveyed said they take their animals for vaccination to mitigate the risks of RVF among other diseases within their ecosystem. As seen above, mobility of the herd is carefully planned such that after visiting disease prone areas, the herders must bring back the animals to the bases where veterinary services are available primarily for treatment and vaccination before they continue with the cyclical movement pattern. Therefore, it cannot be over-emphasized that this practice has a positive bearing on RVF control.

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

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

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

3.2.1. Use of mosquito nets:

Study findings showed that the Government of Kenya and other development agencies mainly Medicines Sans Frontiers (MSF) supplied mosquito nets to the communities affected by RVF during the 2006/7 outbreak. There were also door to door campaigns on RVF during which time three mosquito nets were distributed to each household to protect its members from mosquito bites- a major risk factor for RVF. There is however, no evidence available to show the utilization level of the nets within the households during the outbreak and also whether this resulted in sustainable behavioural transformation to safeguard the community from mosquitoes through use of the nets at all times. The use of mosquito nets is also reported by Jost et al., (2010) who found out that in 2006/7, the medical teams vaccinated livestock, treated sick animals that had other infections and provided nets and insecticides (pour-ons for the control of mosquitoes). Collaboration between public health officials, village criers, village elders, local administration and Community Health Workers (CHWs) in sensitizing the community on the use of nets across all seasons could prove successful against RVF.

3.2.2. Use of fire and smoke to drive away mosquitoes:

Due to poor terrain, impassable roads, dispersed settlements and expansive rangeland, the Government officials and other stakeholders that mounted responses to the last RVF outbreak of 2006/7 could not distribute mosquito nets to all households in the wider Ijara district. Those who could not access the nets devised a local coping mechanism of lighting fire and using smoke to drive away mosquitoes from their manyattas.

“During heavy rainfall and floods, water flows right into our huts which then become so wet that we cannot sleep. Then the other menace during this time is the mosquitoes. Households that do not have nets lit fires in the homesteads and in the huts so as to drive away the mosquitoes. The heat and smoke from the fires are believed to keep the mosquitoes away”. (Source: A female key informant).

Even though the efficacy of this mechanism may need to be subjected to further investigation, from the community indigenous knowledge perspective, it helped to ward off mosquitoes and protected them from mosquito bites that transmit RVF Virus. This coping mechanism was mentioned by the community as cost effective and locally appropriate and could be integrated into public health campaigns.

3.2.3. Animal sleeping arrangements:

Observation showed that almost all homesteads had cattle sheds/Kraals within the homesteads which were fenced off using thorny poles and sticks to guard against wild animal invasion. However, sick animals particularly goats and sheep were observed sleeping in the same houses used by humans. Interviewees said that they sheltered sick animals in the same dwelling unit they used with family members because the sick animals are weak and therefore easily fall prey to wild animals' attacks. The fear of losing the animals makes the owners to give them shelter in their houses. However, as Muga et al., (2015) also observed, this sleeping arrangement where sick animals and humans share the same shelter poses a severe threat of disease transmission and spread. When the animal is infected with RVF, contact with animal fluids is enhanced and this could lead to human infection.

Use of indigenous knowledge in ethno-medicine for RVF cure

Survey data indicated that the Somali community uses pluralistic ways to treat RVF in humans. These are: ethno-medicine (7.4%); buying conventional medicine from local shops (8.3%); treatment at health facility (93.6%) and other (24%). The results for animal treatment were the same. It is instructive to note that “other” had a higher percentage (24%) compared to the other mechanisms safe for treatment at health facility. Qualitative data revealed that reciting the Quran to those who suffered from the 2006/7 outbreak was widespread as was the use of sheep fat to treat those suffering from RVF. These belonged to the “other” category. Focus Group Discussions helped to contextualize and bring out the processes used to prepare fat from sheep for medicinal use. The FGD participants explained that the fat in mutton is drained by boiling the meat and the resultant fatty liquid prepared for use in treating common ailments such as ulcers and diarrhea. As a first line of treatment within the confines of home care, evidence collected suggested that the fat was also used to treat patients manifesting RVF symptoms such as fever and bloody diarrhea during the 2006/7 outbreak. These findings reveal plurality in medicare and confirm those of Janzen (1978, p. xviii) who defined medical pluralism as the existence in a single society of differently designed and conceived medical systems. Such systems exist together and may compete with one another (Fabrega 1982, pp. 241–242) while Leslie (1976, p. 9) sees “medical systems as pluralistic structures of different kinds of practitioners and institutional norms”.

Furthermore, the health seeking behavior of the Somali pastoralists fits within the structural model of health care systems that was developed by Arthur Kleinman (1980). He distinguished the three overlapping sectors within which people seek health care in different societies as: the professional, folk, and popular sectors (Kleinman 1980, p. 50). The professional sector consists of the organized, healing professions. In most societies, this sector refers to the modern scientific medicine (Kleinman 1980, p. 53) also known as allopathic medicine or biomedicine. The folk sector, on the other hand, is the “non-professional, non-bureaucratic, specialist sector which shades into the other two sectors of the local health care system” (Kleinman 1980, p. 59) and which is either sacred or secular or a mixture of both. The popular sector is the lay, non-professional, non-specialist domain of society where illness is first detected and the first line of treatment offered, mainly at the household level. The popular sector “can be thought of as a matrix containing several levels: individual, family, social network, and community beliefs and activities” (Kleinman 1980, p. 50).

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The vulnerabilities inherent in dry land ecosystems especially when hit by RVF outbreak reveals the implications which the complex ethno-veterinary and ethno-medical pluralism has on RVF control. Since this medical pluralism is real in community under study, integration of a pluralistic perspective into the planning and implementation of human and animal health care interventions is apparent.

4. CONCLUSION AND RECOMMENDATIONS

This study has shown that the characteristic instability of most dry land ecosystems inherently expose the pastoralists to vulnerabilities such as Rift Valley fever outbreak. To make a living and continue maximizing the pastoralist production system in such contexts, the pastoralists adopt a diversity of adaptive and coping mechanisms which have implications on RVF control. But most of these mechanisms have not been incorporated into public health planning and response. The study has shown that the youthful herders are more vulnerable to RVF than women and men (old herd owners). This has implications on RVF control as public health interventions need to target the youthful herders who are usually out of the homestead in the rangelands. The use of ethno-medicine in the form of sheep fat used for cure of RVF alongside treatment at health facilities reveals a pluralistic perspective that needs public health attention so as not to delay seeking treatment at health facilities. Public health education is also required to change animal sleeping arrangement and avoid possibility of animal-human infection. Moreover, as most of the adaptive and coping mechanisms are cost effective and contextually appropriate, there is paucity of evidence to show that public health interventions have deliberately incorporated them. It is therefore recommended that a part from incorporating the adaptive and coping mechanisms into public health planning and response, collaboration between the authorities and the community is needed to develop an effective surveillance and early warning system that gives adequate lead time not only for mobilization for RVF control but also for the pastoralists to invoke the adaptive and coping mechanisms to cushion them from RVF risks.

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