TDR-IDRC RESEARCH INITIATIVE ON VECTOR BORNE DISEASES IN THE CONTEXT OF CLIMATE CHANGE

FINDINGS FOR POLICY MAKERS

RIFT VALLEY FEVER IN KENYA

Enhancing responses and community resilience to RVF in Kenya

Executive summary

This policy brief provides recommendations based on evidence emanating from findings of a multidisciplinary collaborative research project titled "*Improving Human Health and Resilience to Climate-Sensitive Vector Borne Diseases in Kenya*", which was conducted in Baringo County between 2014-2016. The aim of the project was to assess factors predisposing local communities to Rift Valley fever and develop strategies to improve their resilience. The brief complements Kenya's *Rift Valley Fever Contingency Plan (2014)* and *RVF Decision Support Tools (2010)*. Successful adoption of the recommendations in this brief requires public education and awareness, effective vector control, enhancement of community early warning systems and strategic livestock vaccination, as well as coordinated response between the health and veterinary departments.

About the project

This policy brief forms part of the research project on *Early warning systems for improved human health and resilience to climate-sensitive vector borne diseases in Kenya.*

This programme is implemented by TDR-WHO, with funding support from the International Development Research Centre (IDRC) and in technical collaboration with WHO's Department of Public Health and Environment (WHO-PHE), WHO's Regional Office for Africa (WHO-AFRO), and the International Research Institute for Climate and Society (IRI), Columbia University, New York, USA.

The Principal Investigator of this project is Professor Benson Estambale, Jaramogi Oginga Odinga University of Science and Technology, Kenya, bestambale@jooust.ac.ke

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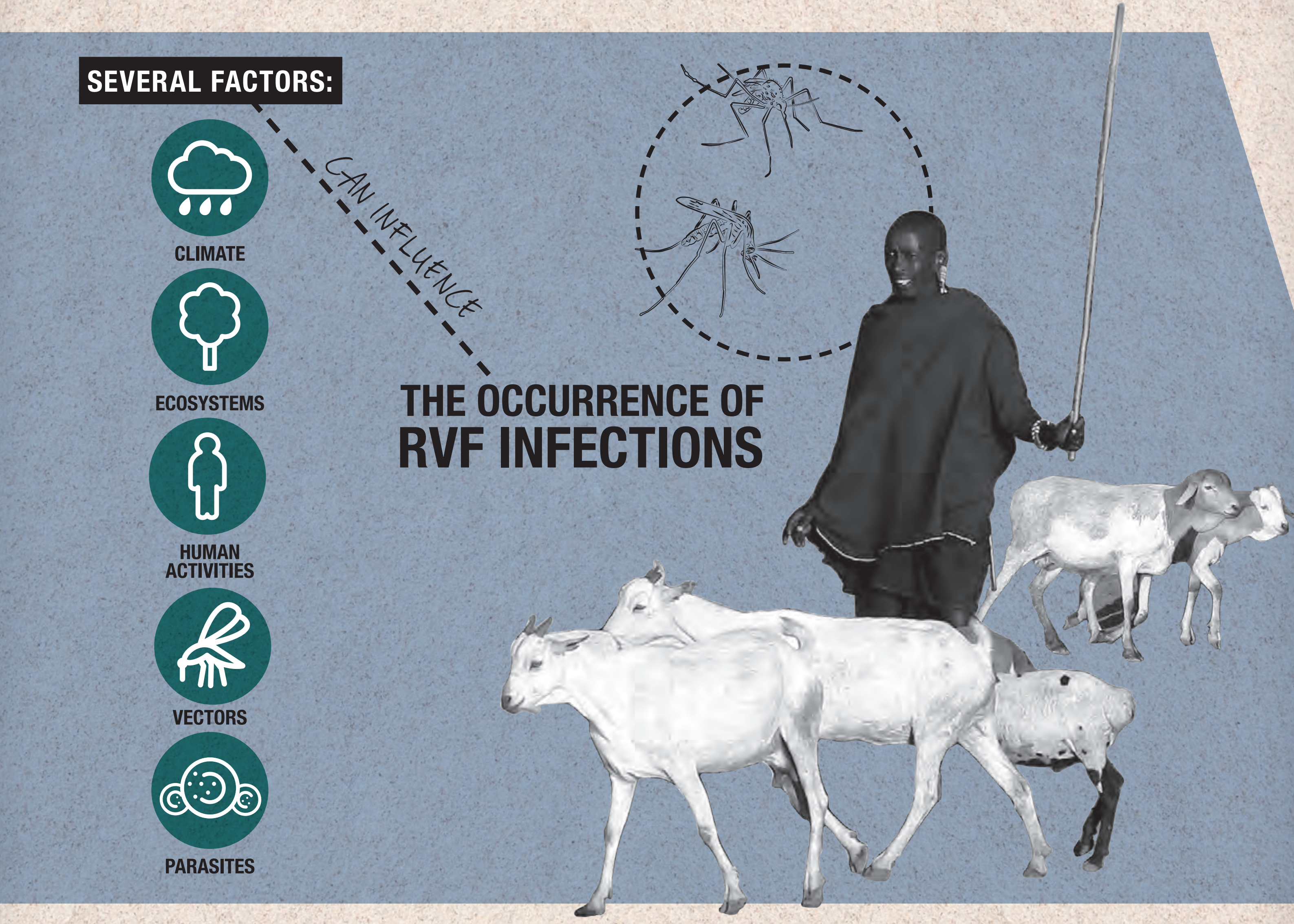
Background

Rift Valley fever (RVF) is a viral disease that is transmitted by mosquitoes to livestock and spreads to humans through contact with infected animal fluids or tissue. The disease was first reported in 1912 in Kenya's Rift Valley. Since then, cases have mainly been reported in the north-eastern region of the country with the first report in Baringo County in 2007. RVF outbreaks occur at irregular intervals of between 5-15 years. The outbreaks are associated with flooding caused by heavy prolonged rains and sudden upsurge of mosquito populations. In domestic animals, RVF causes severe disease characterized mainly by abortion, high fever and death in goats, sheep, cattle and camels. Humans experience a mild to severe form of the disease that is usually confused with malaria due to their similar symptoms. The symptoms include high fever, headaches and joint pains. RVF outbreaks thus cause adverse social, economic and public health impacts including deaths in humans and animals, loss of livelihoods and wellbeing. On management, RVF is effectively controlled in animals through strategic vaccinations which must be carried out prior to the onset of the rains. In contrast, vaccines for humans are still under development and only supportive treatment is provided in health facilities.

The Kenyan Government's commitment toward prevention and control of RVF is reflected in the Kenya National Livestock Policy of 2008. The policy advocates for effective control of animal diseases and safety of foods of animal origin. This brief supports the *National Contingency Plan for RVF (2014)* aimed at promoting quick response and emergency preparedness to forestall RVF outbreaks and mitigate its health and socio-economic impacts. The evidence produced from this research strengthens the framework for comprehensive management of RVF outbreaks in Kenya, specifically in the areas of RVF surveillance, laboratory diagnosis, prevention and infection control.



Approaches

1 The longitudinal study was conducted over 36 months during which data was collected from selected sites, villages, water bodies and animal herds.

2 The study area was classified into four ecological zones characterized by differences in vegetation cover, altitude and proximity to Kerio river. The zones included the lowland, midland, highland and riverine zones (Figure 1).

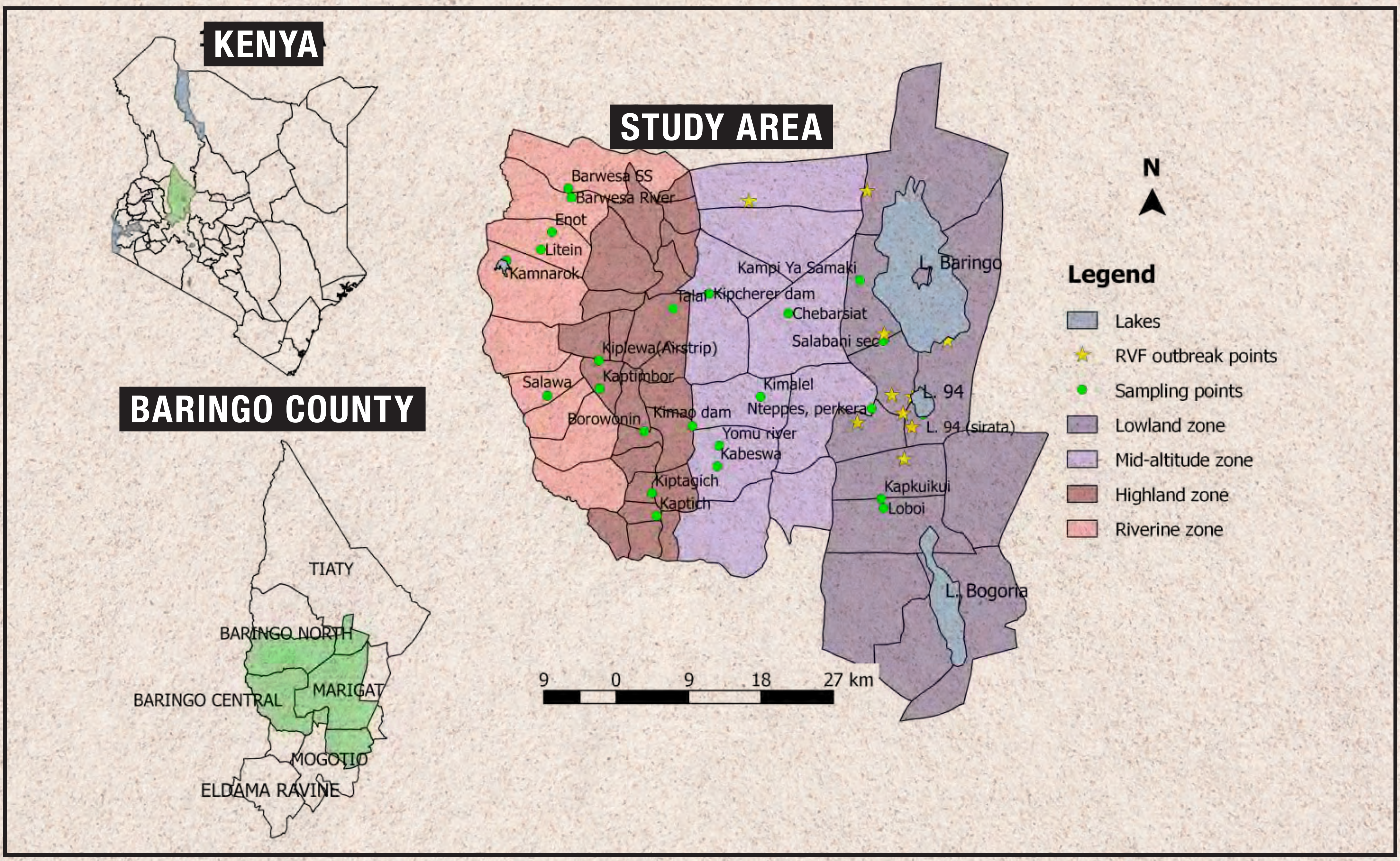
3 The study employed a participatory rural appraisal approach in collecting information from 560 individuals through a questionnaire survey, 20 focus group discussions (FGDs) and 18 key informant interviews (KIIs) with an aim of establishing knowledge, attitude and practices on RVF. An additional 203 livestock traders (195 males and 8 females) were interviewed to determine actual livestock movements, and disease control and management practices within and outside the county.

4 Mosquito breeding habitats were identified, mapped and later sampled. Sampled mosquito larvae were identified to species level. Outdoor and indoor adult mosquitoes were sampled every month during the 24 months of study using CDC light traps and pyrethrum spray catches (PSC) methods, respectively. Sampled mosquito larvae and adults were identified under a dissecting microscope using standard taxonomic keys.

5 To determine the level of previous exposure to RVF, 287 ruminants [cattle (n=98), goats (n=102) and sheep (n=87)] were sampled and blood collected for ELISA based serological analysis.

6 Temperature, rainfall and vegetation index data covering 2001-2015 was extracted from online repositories, processed and analyzed to determine and map their respective influence on the occurrence of RVF.

FIGURE 1: Map of the study area showing the four zones and sampling sites

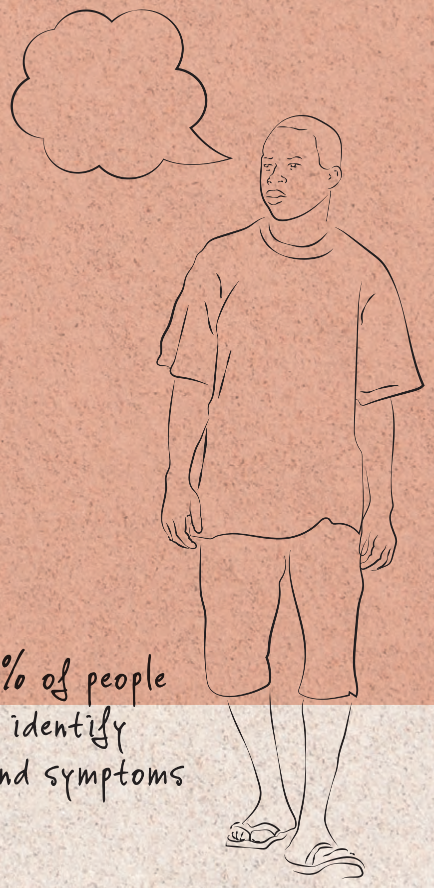


Results

KNOWLEDGE, ATTITUDES AND PRACTICE

Community knowledge on causes, transmission and clinical signs and symptoms of RVF in both humans and livestock was generally low with less than 18% of people being able to identify RVF signs and symptoms in humans. They were aware of some RVF transmission routes from animals to humans, such as consumption of infected livestock products, e.g. meat (79%), and contact with infected blood (40%).

Community practices which were likely to increase exposure to RVF infections included consuming animal products from sick and dead animals; poor disposal of dead animals and aborted foetal materials; managing livestock diseases without the guidance of veterinary officers and poor ante-mortem and waste disposal practices in some slaughter facilities. Uncertified indigenous methods of determining the safety of meat for consumption, such as observing the behavior of certain species of ants when exposed to animal products; observing whether the spleen of a dead animal appears to swell when sprinkled/covered with soil; and observing the health status of people who consume suspect meat for any adverse effect were used by the local population to inform their decision as to whether to consume meat from sick/dead animals or not. Livestock products were used as part of the treatment regimen either as a source of traditional medicine or in the administration of both conventional and herbal medicine thus potentially exposing sick people and their caregivers to infections during an RVF outbreak. Male community members were more at risk of infection than females because of their traditional roles in slaughtering, herding and treating sick livestock.



Less than 18% of people were able to identify RVF signs and symptoms in humans.

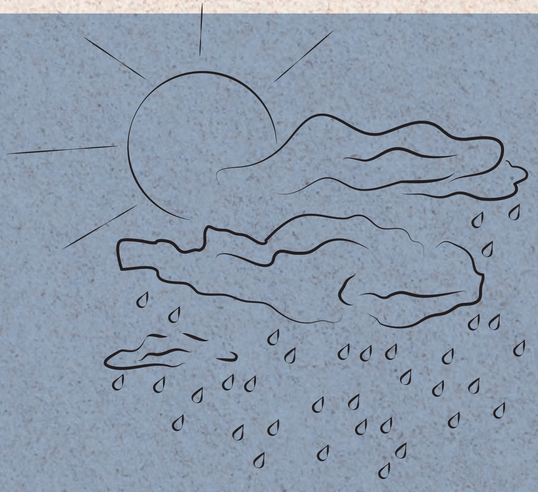
PRESENCE OF RVF ANTIBODIES IN LIVESTOCK

Of the 287 animals tested, 16 were positive for RVF antibodies. This prevalence of 5.6% gives an indication of previous exposure to the RVF virus. A significantly high proportion of sero-positivity was recorded in animals sampled from the lowland zone.

5.6% of sampled animals tested positive for RVF antibodies

EFFECT OF CLIMATE AND ENVIRONMENTAL FACTORS ON RVF VECTORS

Four secondary RVF vectors *Mansonia uniformis*, *M. africana*, *Culex univittatus* and *Cx. pipiens* s.l. were identified. These vectors varied in their distribution with the highest proportion, 82.5%, found in the lowland zone where RVF had earlier been reported and only 14.6% of the proportion in the riverine zone. Analysis of the long-term trend of climatic conditions indicated a decrease in temperature ranges in Baringo County. Changes in climatic conditions, particularly the decrease in temperature, favoured larval survival and female reproductive output.



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TOOLS FOR DETECTING THE LIKELY OCCURRENCE OF RVF

This study contributed to the growing success of using spatial distribution maps to predict disease risk. These could assist in prioritization of vector and disease control. The most influential predictors for *M. africana* were rainfall derivatives, i.e. precipitation in the driest quarter and in the wettest quarter. Temperature range and lake water levels were significant factors that contributed to RVF outbreak 2006-2007.

Under the current study, RVF vector species prediction maps and models (Figure 2) were developed and showed that the lowland areas between L. Baringo and L. 94 were the most suitable habitats for these vectors based on the soil types and the climatic conditions. The results with some model mosquito species indicated that variations in climatic conditions can affect the spatial extent of the vector ranges. One such species was *M. africana*. This species exhibited a northward shift within the highland and the mid-altitude zones; a shift that can be attributed to climate change. Based on this background, the expected climate change is likely to alter ecological suitability of other areas which may eventually result in the spread of RVF vectors to other areas.

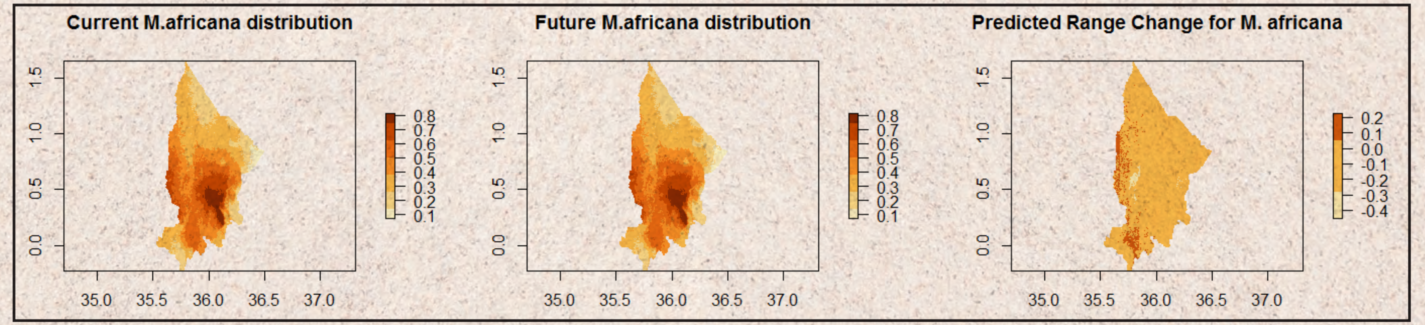

Figure 2: Predicted change in the ecological range of Mansonia africana. A) Distribution map based on current climatic conditions; B) Forecast climatic conditions for the year 2050. Habitat suitability ranges from poor (0.1) to good (0.8); C) Expected change in the range of this vector species; positive values indicate range expansion or increase in habitat suitability while negative values indicate range reduction or decrease in habitat suitability.

Implications

Even though all community members are vulnerable to RVF, men and women are affected to different extents due to their varied roles in livestock production. This may be complicated further as there are no community driven RVF control strategies save for the intervention by the veterinary department. Effectiveness of some of the government control strategies encounter challenges during implementation. Measures such as bans on slaughter of livestock and consumption of derived products may be difficult to enforce when there is food scarcity. The study shows that animals younger than three years had low RVF sero-prevalence compared to older animals. This suggests that older animals were exposed to the RVF virus at least three years before. Despite low level circulation of antibodies in livestock in the County, there has not been another outbreak since 2007. This is probably because there has not been a suitable interplay between climatic and environmental factors that can potentially lead to mass emergence of vectors.

The 2006-2007 RVF outbreak was mainly driven by flooding of Lake Baringo; which would have increased the number of suitable breeding habitats. Understanding local vector species distribution and seasonal abundance would improve vector control strategies, and therefore help prevent vector borne diseases. However, climatic conditions that favour their breeding is not static. The Study shows that climate change can have an impact on the spatial distribution of RVF vectors by expanding their realized niche, thus putting more populations at risk. These findings can be used by policy makers, government agencies, medical and veterinary personnel in planning the targeted prevention and management of RVF.

Recommendations

1. Continuous education of communities to improve their knowledge on RVF causes, symptoms, risk factors and prevention should be carried out by the public health and veterinary departments in collaboration with relevant stakeholders.

2. Establishment of sentinel herds by the county veterinary department in the hotspot areas for surveillance and monitoring of vector and virus activity for timely and effective responses to RVF outbreaks in line with RVF contingency and control programs.

3. Continuous monitoring of Lake Baringo water levels to determine when its shorelines flood and create possible breeding grounds for mosquitoes that transmit RVF.

4. Maintenance of adequate stockpiles of RVF vaccines by the county veterinary department to facilitate strategic prevention and control programs.

5. Incorporation of area-specific vector predictive maps of Baringo in the existing national RVF contingency plan by the veterinary department as part of an improved local preparedness and early response to RVF outbreaks.

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