Climate models predict persistent above-average rains and risk of flooding in East Africa: FAO, OIE and WHO warn countries to remain vigilant about Rift Valley fever

Introduction

Rift Valley fever (RVF) is an arthropod-borne arboviral disease that affects ruminants and humans. Most human cases develop a mild influenza-like illness while a small percentage of patients develop a much more severe form of the disease. In ruminants it may be associated with high mortality in neonates and young animals as well as high levels of abortion, resulting in significant socio-economic consequences. The disease is transmitted by mosquitoes of several different species (mainly Aedes and Culex) and through direct contact with tissue of infected animals (Linthicum *et al.*, 1999). Although currently confined to sub-Saharan Africa, and having spread to the Arab Republic of Egypt and the Arabian Peninsula, this disease poses a threat to non-endemic countries in temperate regions where both hosts and potential vectors co-occur (Tran *et al.*, 2013; Xue *et al.*, 2013).

Climatic factors, such as temperature, rainfall and humidity are important drivers of RVF viral activity as they drive vector abundance and population dynamics, thus influencing the risk of disease emergence, transmission and spread. The disease ecology of RVF in East Africa has been investigated. Epidemics occur periodically (from 5 to 15 year cycles) and are significantly associated with climate anomalies such as persistent, unusual, widespread, above-average rainfall and flooding, particularly during El Niño events (Anyamba *et al.*, 2009). Temporarily flooded areas and water pools in low-lying areas, also known as *dambos*, create the conditions for disease-carrying mosquitoes to breed, including the Aedes species, whose eggs can survive in soil for long dry periods. During persistent heavy rainfall, the *dambos* become flooded triggering transovarially infected eggs to hatch. This results in increased infected vector population abundance and a greater risk of the disease being transmitted to susceptible ruminant species. Subsequently, as vegetation grows in response to heavy rains, other Culex species of mosquito vectors multiply due to the increased availability of suitable environments and by feeding on infected livestock they transmit the virus to other animals and humans (Linthicum *et al.*, 1999; Turell *et al.*, 2008) (Figure 1).

Sero-surveillance efforts have found significant levels of RVF antibodies in domestic and/or wild ruminants in many African countries across different agro-climatic zones. However, many countries are not aware of the circulation of the virus in their territories because systematic surveillance for confirming the presence and distribution of RVF infection is lacking. Limited focal enzootic circulation of RVF has been documented among domestic and/or wild mammalian species.

Climate-based forecasting models and early warning systems

The availability of near-realtime satellite-based climate data, such as rainfall, temperature and vegetation indices, has provided an opportunity to monitor climatic conditions that are linked to vector abundance and population dynamics. This has facilitated the development of cost-effective Early Warning Systems (EWSs) for vector-borne diseases, including RVF. The aim of such EWSs is to monitor the first signals of a possible increase in vector abundance and RVF risk and provide information for prevention and risk mitigation. The Goddard Space Flight Center (GSFC) of the NASA, FAO and WHO have been monitoring climatic conditions to predict the risk of RVF vector amplification in East Africa for the past several years using a modelling approach developed by the NASA GSFC team (Anyamba et al., 2009).

With this approach, near-realtime satellite-derived climate data such as precipitation and the Normalized Difference Vegetation Index (NDVI) are used to identify and map areas with persistent, heavy, above-average rains and vegetation anomalies over the last three consecutive months. Results are then interpreted and assessed in relation to El Niño and Sea Surface Temperature (SST) indicators and precipitation forecasts and compared with historical data. Warm El Niño conditions and positive SST are significantly associated with persistent and abnormal rains in East Africa, which determine suitable environmental conditions for vector amplification. In 2006-2007 this climate-based model predicted the risk of RVF occurrence in the Horn of Africa several weeks before the first signs of the disease were recorded in livestock and humans. This facilitated strategic preparedness and significantly enhanced field response (Anyamba et al., 2010; FAO, 2006; WHO, 2006).

Recent warning message

During September, October and mid-November 2014 the observed conditions of the El Niño Southern Oscillation (ENSO) decreased from those of a borderline El Niño to a relatively warm ENSO-neutral state (Figure 2). However, most of the ENSO prediction models continue to indicate development of weak El Niño conditions from October to December 2014, reaching a low peak during winter 2014 - 2015 and lasting through most of northern spring 2015. Positive equatorial SST anomalies continue across most of the Pacific Ocean. Some impacts from the current SST anomaly patterns can be observed in the pattern of global convective activity illustrated by the Outgoing Longwave Radiation (OLR) anomaly patterns. From August through October 2014, large positive departures (>+35 watts per meter squared [W/m²]) in OLR across the Republic of Indonesia and coastal southeast Asia indicate drier than average conditions, while large negative departures (<-40 W/m²) across northern China, the western Indian Ocean, central Asia, north-central and northeast Africa, the United Mexican States/ Central America, the southwestern United States of America, and the northeastern and southwestern tropical Pacific suggest wetter than average conditions (Figure 3). There was increased rainfall from September through mid-November in East Africa (Figure 4) and above-average precipitation was predicted for the coming months.

Since September 2014, NASA GSFC intensified their monitoring activity to produce biweekly maps of precipitation anomalies and monthly RVF risk maps in response to the predicted and current development of the El Niño event in East Africa. NASA GSFC has recently delivered a warning message to remain vigilant about the risk of RVF occurrence in East Africa in the coming weeks. Although precipitation patterns are currently less persistent and widespread than expected, in some locations the rainfall estimates and anomalies for October and mid-November 2014 are similar to, or above, values observed in 1997/1998 and/or in 2006/2007, when major outbreaks occurred in the Republic of Kenya, the Federal Republic of Somalia and the United Republic of Tanzania (Figure 5). Comparisons between the current cumulative rainfall estimates, historical RVF outbreak reference periods and long-term average estimates have highlighted areas at increased risk of flooding. These include reference meteorological stations Sukari Farm and Marigat in the Republic of Kenya; Belet Wayne in the Federal Republic of Somalia; Manyara Ranch and Magara in the United Republic of Tanzania.

Figure 5 shows the cumulative rainfall anomaly maps for September to mid-November 2014 that reference meteorological stations with rainfall anomalies (pink closed circles). In the Federal Republic of Somalia, a first flood occurred during the
last week of October in one of the predicted locations, Belet Weyne, forcing 2 500 people to seek safety on higher ground away from the riverbanks. This area was affected by RVF in January 2007. However, except for a few small areas in Southern Sudan, the RVF risk map for October 2014, which is based on NDVI anomalies over August, September and October 2014, does not yet show widespread RVF at-risk areas in East Africa or near the reference sites (Figure 6).

Erratic and less persistent rainfall occurred during the first weeks of November suggesting the development of less extreme rainfall patterns than those observed in 1997/1998 and 2006/2007 (Figure 4). Nevertheless, because the anomalies increase in positive Western Indian Ocean (WIO) SSTs (Figure 2) and persistent rainfall conditions are still forecast for the coming months, these areas remain at-risk of vector amplification, RVF disease emergence and spread. Such areas may require early targeted surveillance. In addition areas of the southwestern part of the Kingdom of Saudi Arabia and the western part of the Republic of Yemen bordering the Red Sea are advised to enhance targeted surveillance in areas that have received anomalous high rainfall and an increase in NDVI (Figure 3, 5, 6) which can result in an increase in RVF vector mosquito populations.
Surveillance systems should be strengthened, applying a One Health integrated approach, with an active collaboration and partnership of the national ministries responsible for public health, agriculture and livestock.

**Vaccination**

The use of vaccination as a control option for RVF is aimed at limiting virus circulation in enzootic areas and preventing epidemics in free areas and is most effective when used in conjunction with other control strategies including surveillance, quarantine and movement controls. Vaccination against RVF in East Africa (mainly in the Republic of Kenya and the United Republic of Tanzania) is undertaken normally in response to the occurrence of RVF outbreaks using a live vaccine prepared from an attenuated strain of the RVF virus (Smithburn strain). Given the side effects associated with the use of live vaccines, uptake has been limited in areas of East Africa where RVF is enzootic.

A new generation of vaccine, Clone 13, currently in use in South Africa, offers high level of protection with less virulence. Recognizing that the Clone 13 vaccine is safe and efficacious against RVF, countries at risk of an incursion of RVF are therefore strongly encouraged to register it.

Mass vaccination is one of the tools for preventing RVF epidemics in animals. However, vaccination is not recommended in the event of known RVF circulation, as inappropriate vaccination can promote the spread of virus transmission.


**Vector control**

Efforts to prevent the transmission of the virus through contact with mosquitoes should be part of the overall One Health approach. The use of insecticides, repellents on animals and humans, mosquito netting and strategic larvicidal treatment for mosquito breeding habitats, can decrease the risk of virus transmission in at-risk areas.

**Trade issues**

A revised Chapter on RVF (8.13) has been adopted at the General Session in May 2014. The 2014 edition of the Terrestrial Animal Health Code now clearly separates “Country or zone free from RVF virus (RVFV) infection” from “Country or zone infected with RVFV during the inter-epizootic period”. A country or zone may be considered free of RVFV...
Communications regarding disease risks and awareness campaigns on risk mitigation are essential to protect livestock and humans from RVF infections by limiting their exposure in particular for livestock farmers and communities, veterinarians and workers involved in slaughterhouse activities.

FAO, OIE and WHO encourage at-risk countries to prepare themselves in cases of an epidemic and specifically encourage veterinary and public health authorities to develop a joint comprehensive health education programme with the aim of informing the public but also targeting at-risk professions (farmers, veterinarians, slaughter house personnel, etc.).

In addition FAO and the International Livestock Research Institute (ILRI), along with relevant technical partners in Eastern Africa, have recently updated the 2010 (Risk-based) Decision-support framework for prevention and control of Rift Valley fever epizootics in the Greater Horn of Africa, providing guidance on how to plan and monitor activities in the different RVF alert stages. The document can be downloaded from the ILRI website: http://hdl.handle.net/10568/21783

**One Health communication and public awareness**

Communications regarding disease risks and awareness campaigns on risk mitigation are essential to protect livestock and humans from RVF infections by limiting their exposure in particular for livestock farmers and communities, veterinarians and workers involved in slaughterhouse activities.

FAO, OIE and WHO encourage at-risk countries to prepare themselves in cases of an epidemic and specifically encourage veterinary and public health authorities to develop a joint comprehensive health education programme with the aim of informing the public but also targeting at-risk professions (farmers, veterinarians, slaughter house personnel, etc.).

**Source:** AFHSC/Div GEIS Operations and NASA/GSFC GIMMS (Map) - NOAA/CPC-RFE (Graphics)
Public health messages for risk reduction should focus on:
- Reducing the risk of animal-to-human transmission as a result of unsafe animal husbandry and slaughtering practices. Gloves and other appropriate protective clothing should be worn and care be taken when handling sick animals or their tissues or when slaughtering animals;
- Reducing the risk of animal-to-human transmission arising from the unsafe consumption of fresh blood, raw milk or animal tissue. In the epizootic regions, all animal products (blood, meat and milk) should be thoroughly cooked before eating;
- Protecting the individual and the community against the risk of mosquito bites by using impregnated mosquito nets, personal insect repellent if available, light coloured clothing (long-sleeved shirts and trousers) and by avoiding outdoor activity at peak biting times of the vector species;

References


## Technical support

<table>
<thead>
<tr>
<th>Organization</th>
<th>Headquarters (GLEWS coordinator)</th>
<th>Nairobi office (ECTAD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAO</td>
<td>Dr. Julio Pinto <a href="mailto:julio.pinto@fao.org">julio.pinto@fao.org</a></td>
<td>Dr. B. A. Diop <a href="mailto:bouna.diop@fao.org">bouna.diop@fao.org</a></td>
</tr>
<tr>
<td>OIE</td>
<td>Dr. S. Münstermann <a href="mailto:s.munstermann@oie.int">s.munstermann@oie.int</a></td>
<td>Dr. P. Bastiaensen <a href="mailto:p.bastiaensen@oie.int">p.bastiaensen@oie.int</a></td>
</tr>
<tr>
<td>WHO</td>
<td>Dr. P. Formenty <a href="mailto:formentyp@who.int">formentyp@who.int</a></td>
<td>Dr. N. Ndayimirije <a href="mailto:ndayimirjen@who.int">ndayimirjen@who.int</a></td>
</tr>
</tbody>
</table>

## NOTES
Climate models predict persistent above-average rains and risk of flooding in East Africa: FAO, OIE and WHO warn countries to remain vigilant about Rift Valley fever.


Photo cover: ©FAO/Eran Raizman
Photos back cover: ©FAO/Simon Maina

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views or policies of FAO.

© FAO, 2014

FAO encourages the use, reproduction and dissemination of material in this information product. Except where otherwise indicated, material may be copied, downloaded and printed for private study, research and teaching purposes, or for use in non-commercial products or services, provided that appropriate acknowledgement of FAO as the source and copyright holder is given and that FAO’s endorsement of users’ views, products or services is not implied in any way.

All requests for translation and adaptation rights, and for resale and other commercial use rights should be made via www.fao.org/contact-us/licence-request or addressed to copyright@fao.org.

FAO information products are available on the FAO website (www.fao.org/publications) and can be purchased through publications-sales@fao.org