Food and Agriculture Organization of the United Nations

SUSTAINABLE DEVELOPMENT GOALS

Disease forecasting at FAO

Focus on Rift Valley Fever

FAO HQ Rome, 4 February 2020

Claudia Pittiglio

Disease ecology and risk modelling expert, FAO AGAH

FAO Animal Health Service (AGAH) mandate:

- Prevent, contain and control the world's most serious livestock diseases at their source, while also surveying for newly emerging pathogens in a changing environment

Core activities:

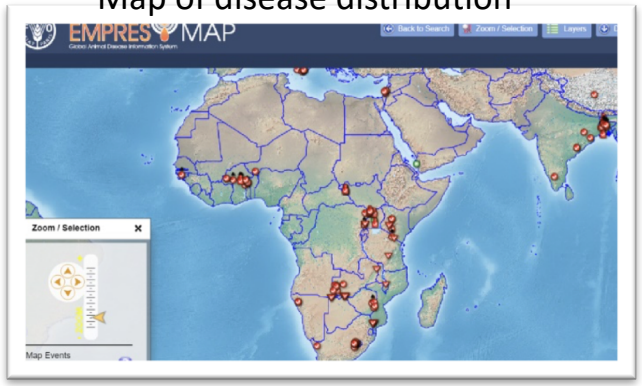
- *Early warning, forecasting* and *early detection* to enhance early action and response

Protecting livestock against diseases and preventing their spread is one of the keys to fighting hunger, malnutrition and poverty

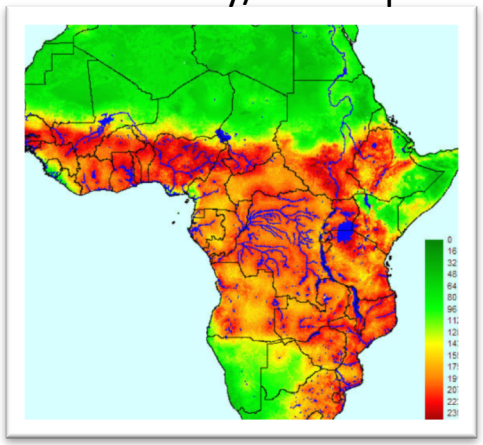
Risk modelling and mapping in Animal Health

- More than simply plotting the disease outbreaks on a map
- The process of **estimating**, **understanding**, **predicting** / **forecasting** and **displaying** the **risk** of emergence, spread and/or persistence of animal health threats with a map
- Risk maps can inform decision-making; support animal disease prevention, management and control
- E.g., risk-based **surveillance**; prioritization of **vaccination**; **vector** control; **biosecurity**; **control** measures; reduce **costs**; improve **interventions**; evaluate effect of **mitigations**
- FAO is active on Avian Influenza, Anthrax, Ebola, FMD
- … and on monitoring and forecasting **Rift Valley Fever**

Map of disease distribution

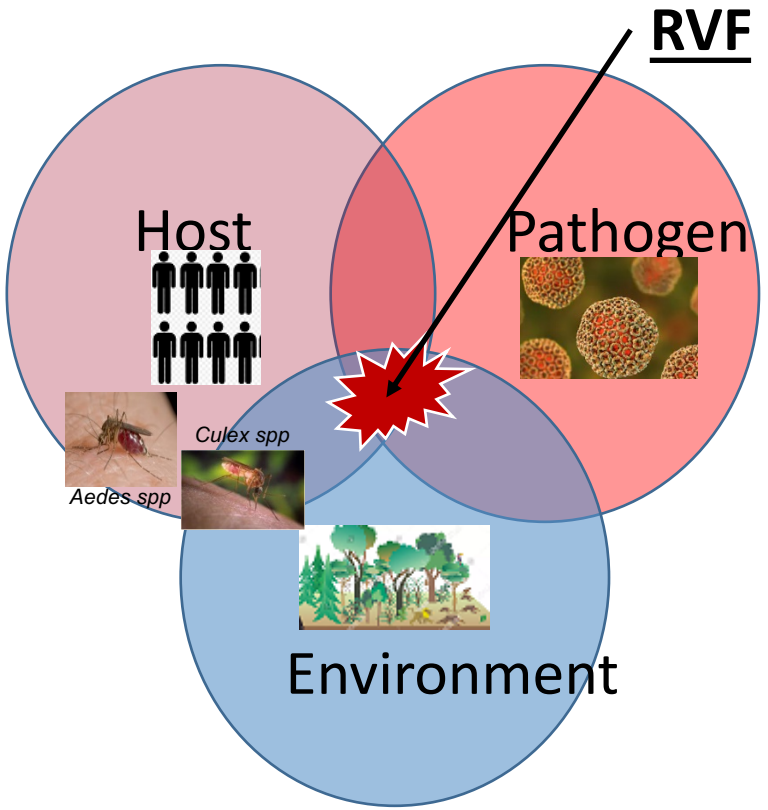


Suitability/risk map



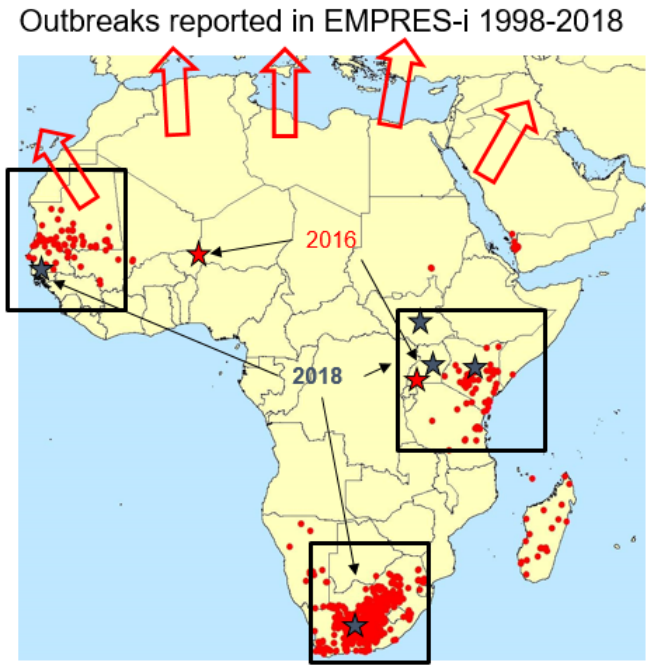
Rift Valley Fever (RVF): What we know

- Major zoonotic viral vector-borne disease (affecting cattle, sheep, goats, camels, wildlife and humans)
- Transmitted by mosquitoes species (e.g., *Aedes*, *Culex*), but also through the contact with infected animals
- Seasonal patterns are influenced by environmental and anthropogenic factors
- Any change in those factors (e.g., prolonged and heavy rains, floods, drought, agriculture expansion/irrigation schemes), have an impact on the host, vector, pathogen & environment (HPE) system
- And can **facilitate** the emergence, spread, transmission of RVF
- Strong *environmental and dynamic component (climate)*



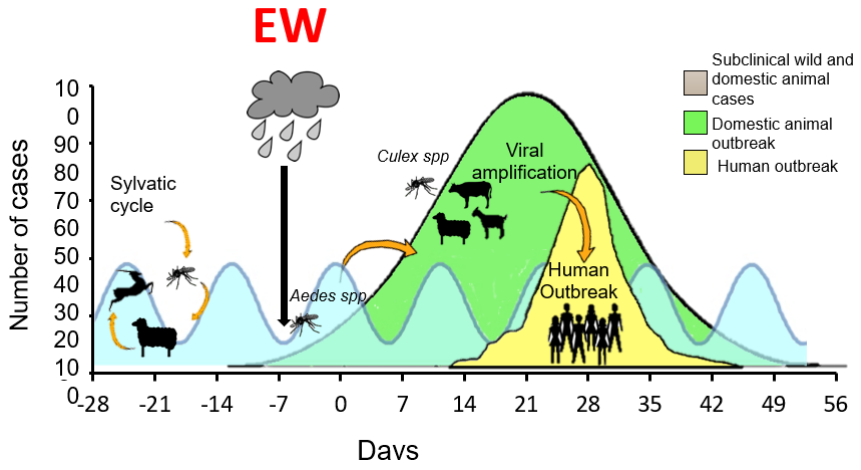
RVF: Changing environment and climate

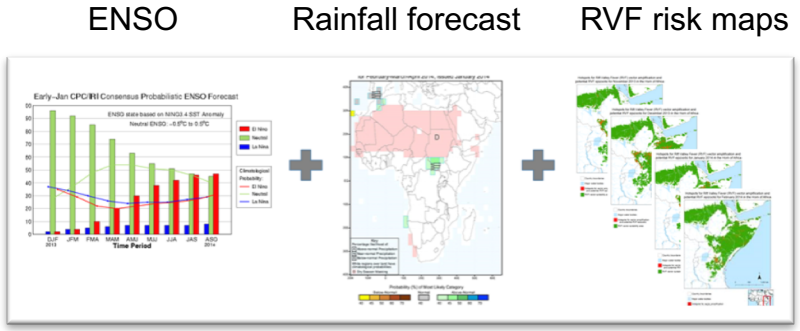
- Changes in the climate patterns and ecosystems affect:
  - Host: immunity, distribution, abundance and movements
  - Pathogen: resistance and selection of the host
  - Vector: distribution, abundance and vectorial capacity
  - Ecosystem/environment: availability and accessibility of water, food resources and shelter
- Such changes are expected to increase due to climate change, favoring the introduction, spread or persistence of RVF at the human-wildlife-livestock interface
- Growing concern of geographical spread (Middle East and Europe)



RVF monitoring, risk modelling, forecasting and mapping at FAO

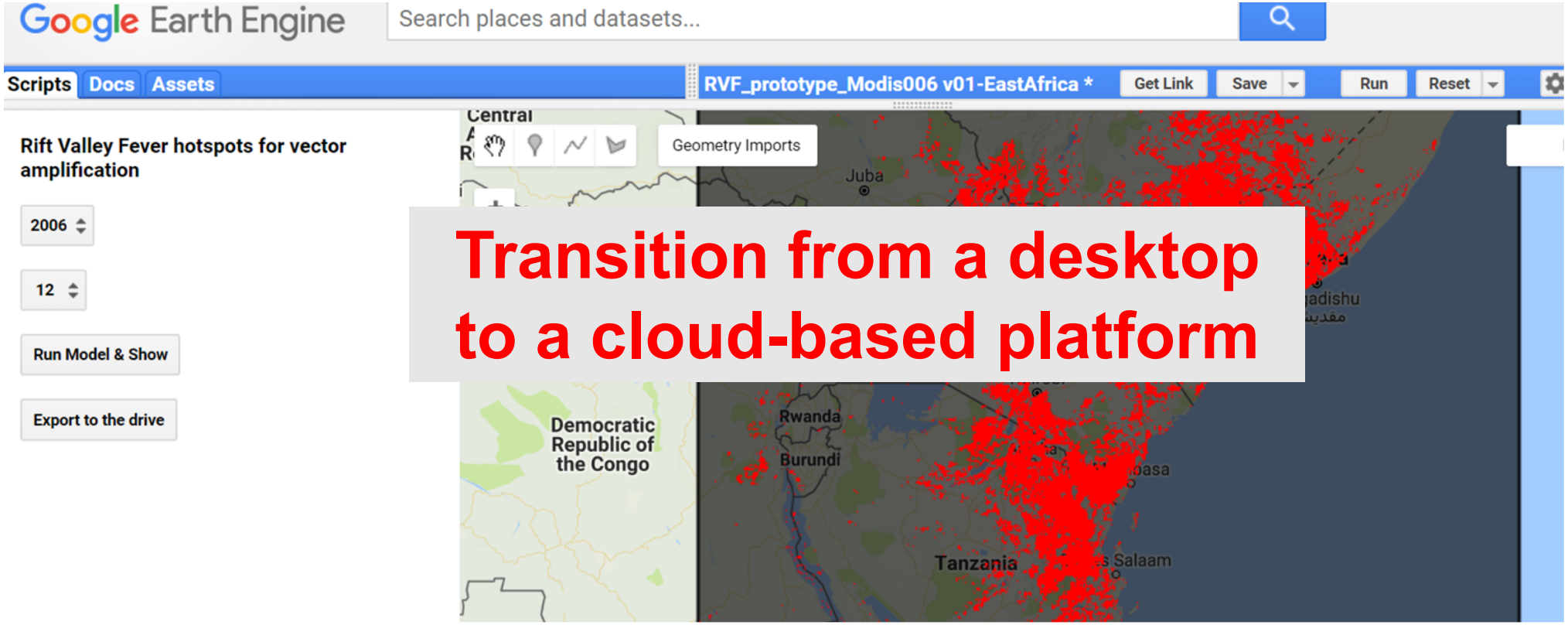
- Over the past 10 years FAO and partners (NASA, WHO, OIE) have successfully forecasted hotspots for RVF vector amplification providing recommendations and early warning messages for countries at risk of RVF outbreaks;
- **The dynamic model** used by FAO builds upon the work by NASA (Anyamba et al. 2009), who developed a monitoring and risk mapping system that utilizes **NDVI and rainfall anomalies** as a proxy for ecological dynamics to map areas at potential risk of RVF in East Africa;
- The model has been calibrated by FAO (2016 -2017): **maps are updated every month** at **250 m** spatial resolution using satellite images in a **cloud-based platform** (Google Earth Engine).





RVF Early Warning Tool (FAO prototype)

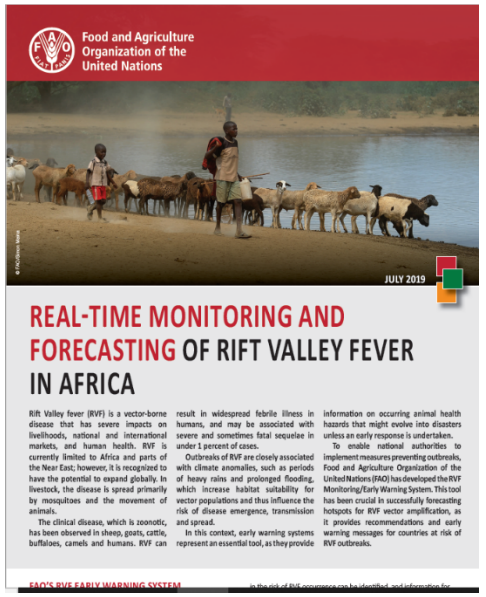
Near-real time monitoring and risk mapping of RVF vector amplification with GEE



Achievements over the past 24 months:

- > 600 RVF risk maps for Africa (since 2002--)
- Numerous risk assessments (jointly with NASA, WHO, OIE and field) and 5 alerts for West (1), East (3) and Southern Africa (1)
- RVF forecasts in quarterly FAO bulletins (FCC and EWEA)

Forecasted RVF events	Date of RA/Alert	Date of reporting	Date of observation
The Gambia	15 Sept 2017	19 Jan 2018	10 Dec 2017
Senegal	15 Sept 2017	March/Apr 2018	Feb/Mar 2018
South Africa	5 Feb 2018	16 May2018	28 Apr 2018
Kenya	March 2018	8 June 2018	3 June 2018
Rwanda	March 2018	June 2018	May 2018
Kenya	10 Oct 2018	14 Feb 2019	31 Dec 2018
Sudan	10 Oct 2018	21 Nov 2018	Oct/Nov 2018
Mauritania	10 Oct 2018	30 Jan 2019	NA
Sudan	9 Sept 2019	13 Oct 2019	25 Sept 2019
Horn of Africa	16 Oct 2019	January 2020 (Uganda)	December 2019



Joint FAO-NASA RA **(Feb 2018)**

Food and Agriculture Organization of the United Nations

Animal Production and Health Division

Southern African countries at risk of Rift Valley fever (RVF)

According to a climate monitoring system available at the National Aeronautics and Space Administration (NASA) and FAO, southern Africa has experienced heavy rains during the last weeks that may result in suitable environmental conditions for the emergence of the Rift Valley fever (RVF).

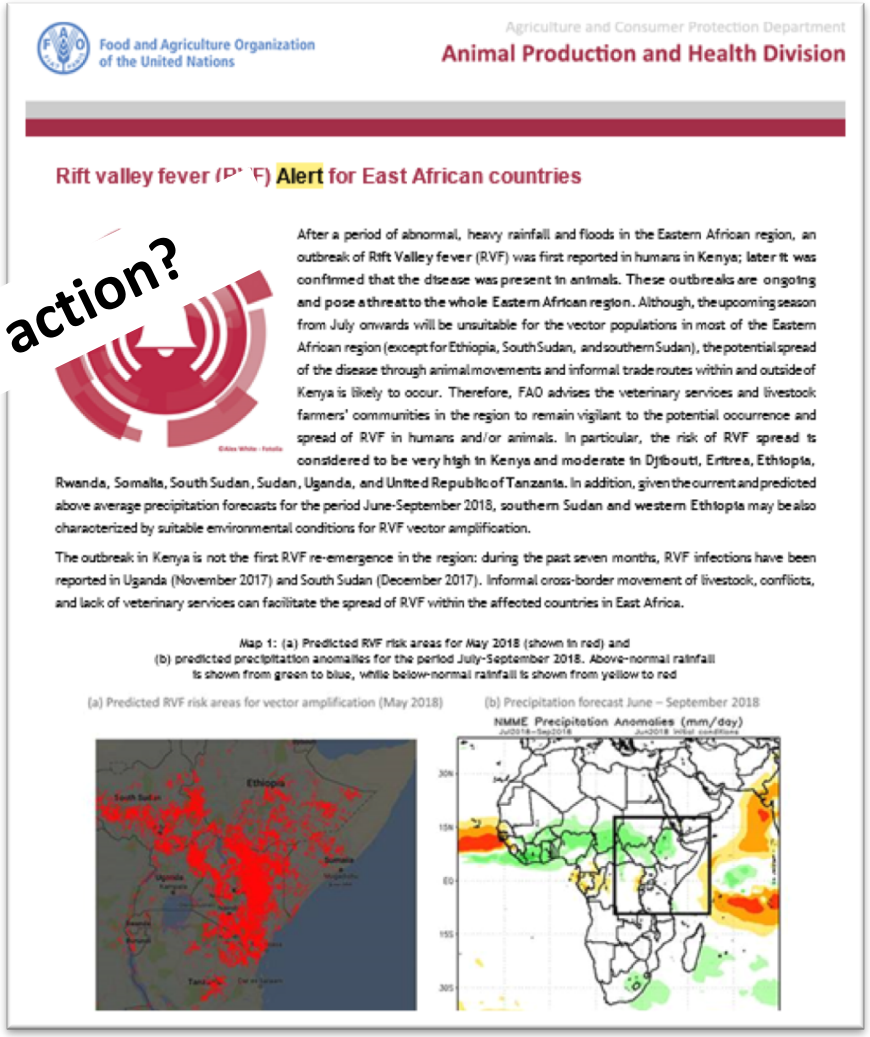
Based on the risk maps prepared by FAO in consultation with NASA for the period October-December 2017, **major potential hotspots of RVF vector amplification are located in north-western Namibia, south-eastern Botswana, south-western and northern Zimbabwe and wide areas in Mozambique.** The enclosed risk maps are generated from remotely-sensed data on precipitation and vegetation anomalies relevant for the RVF vector amplification.

Considering that precipitation forecasts for February and March 2018 predict above-normal rainfall in the region, FAO advises that the veterinary services and livestock farmers' communities remain vigilant on the potent… occurrence of RVF outbreaks in human and/or animal populations.

Map 1: (a) Predicted RVF risk areas are shown in red and highlighted by grey circles. Past RVF occurrence… 1969-2014 overlaid on (b) the vector suitability areas (green); (c) the human population counts and … (in tropical livestock unit). (e) Predicted precipitation anomalies for February 2018. Above-no… to blue, while below-normal rainfall is shown from yellow to red.

Is this sufficient to trigger early action?

FAO Risk Assessment **(April 2018)**



Food and Agriculture Organization of the United Nations

Agriculture and Consumer Protection Department

Animal Production and Health Division

Rift valley fever (R… F) Alert for East African countries

After a period of abnormal, heavy rainfall and floods in the Eastern African region, an outbreak of Rift Valley fever (RVF) was first reported in humans in Kenya; later it was confirmed that the disease was present in animals. These outbreaks are ongoing and pose a threat to the whole Eastern African region. Although, the upcoming season from July onwards will be unsuitable for the vector populations in most of the Eastern African region (except for Ethiopia, South Sudan, and southern Sudan), the potential spread of the disease through animal movements and informal trade routes within and outside of Kenya is likely to occur. Therefore, FAO advises the veterinary services and livestock farmers' communities in the region to remain vigilant to the potential occurrence and spread of RVF in humans and/or animals. In particular, the risk of RVF spread is considered to be very high in Kenya and moderate in Djibouti, Eritrea, Ethiopia, Rwanda, Somalia, South Sudan, Sudan, Uganda, and United Republic of Tanzania. In addition, given the current and predicted above average precipitation forecasts for the period June-September 2018, southern Sudan and western Ethiopia may be also characterized by suitable environmental conditions for RVF vector amplification.

The outbreak in Kenya is not the first RVF re-emergence in the region: during the past seven months, RVF infections have been reported in Uganda (November 2017) and South Sudan (December 2017). Informal cross-border movement of livestock, conflicts, and lack of veterinary services can facilitate the spread of RVF within the affected countries in East Africa.

Map 1: (a) Predicted RVF risk areas for May 2018 (shown in red) and (b) predicted precipitation anomalies for the period July-September 2018. Above-normal rainfall is shown from green to blue, while below-normal rainfall is shown from yellow to red

(a) Predicted RVF risk areas for vector amplification (May 2018)

(b) Precipitation forecast June – September 2018

NMME Precipitation Anomalies (mm/day)

May 2018: RVF reported in South Africa

June 2018: RVF reported in Kenya

STRENGHTS	CHALLENGES
Near real-time environmental monitoring system	Real-time validation of RVF at risk areas (mosquito surveillance, sentinel herds; expert knowledge, etc.)
Cost-effective	Calibration for countries with no RVF outbreak data
Availability of RVF risk maps on monthly basis	Establish a network of experts to discuss the RVF risk maps and update the RVF situation
Accurate predictions for endemic countries with RVF historical data	Data sharing to assess the occurrence and spread based on effective exposure (n animals, vaccinations, animal movement, trade)
	Quantitative RA: Integration of other risk factors to assess and quantify animals and humans at risk
	Risk maps are difficult to interpret
	Key messages for risk areas to facilitate early action

Food and Agriculture Organization of the United Nations

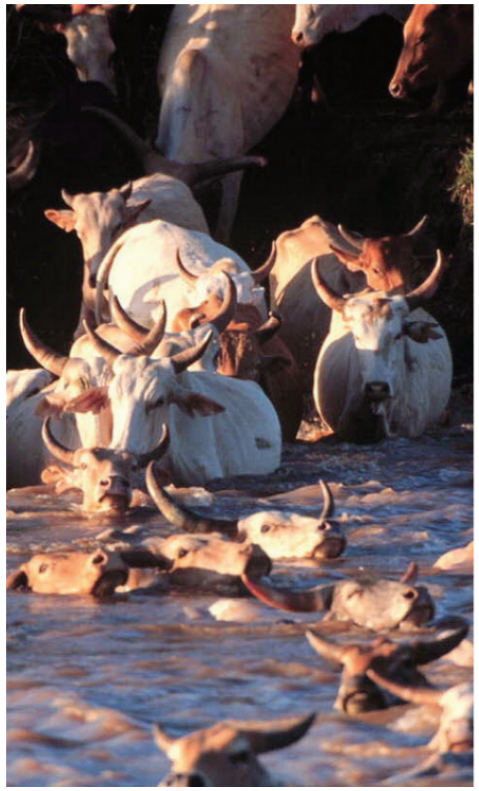
SUSTAINABLE DEVELOPMENT GOALS

Manuals and Guides No. 7

Decision-support tool for prevention and control of Rift Valley fever epizootics in the Greater Horn of Africa

Version I

ILRI
International Livestock Research Institute



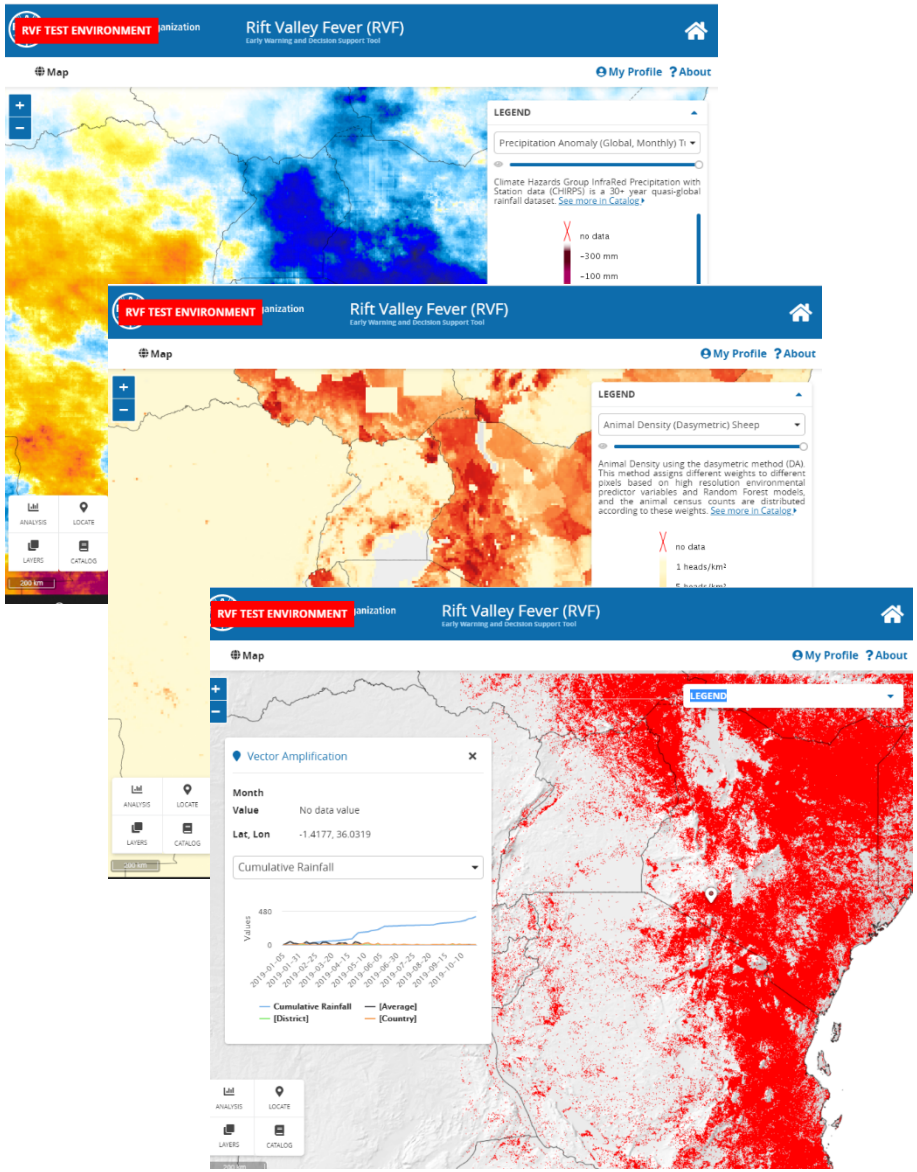
ILRI DISCUSSION PAPER 28

Utilization of the Rift Valley fever decision support tool in Kenya: Successes and challenges

CGIAR RESEARCH PROGRAM ON Agriculture for Nutrition and Health

Rift Valley fever (RVF) - Early Warning/Decision Support Tool

- Decision Support Tool (DST) **integrates** the near real-time RVF risk maps with relevant **geospatial products, classification, expert knowledge, assessment of the risk** and **recommended actions** to guide appropriate **response** to RVF at country level (Kenya, Uganda, Tanzania).
    - Rwanda recently vaccinated 67% of livestock following the FAO alert
    - Emergency Management Centre (EMC)-AGAH Incident Coordination Group (ICG) activated
    - EMC-AGAH Response Mission in Uganda



Acknowledgements

- Julio Pinto
- Juan Lubroth
- Eran Raizman
- Ludovic Plee
- Ahmed El Idrissi
- Daniel Beltran
- Erik van Ingen
- Kiran Viparthi
- Mario Bloise
- Assaf Anyamba (NASA)
- OIE and WHO colleagues
- Karl Morteo and IT team

Food and Agriculture Organization of the United Nations

SUSTAINABLE DEVELOPMENT GOALS

Thank you