



Rift Valley Fever (RVF) decision support tool: Upgrades in 2024

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Date 15/01/2025

Work package Enabling digital platforms and services

Partners International Livestock Research Institute (ILRI)



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Context

Rift Valley fever (RVF) is a zoonotic disease caused by a virus that is transmitted by a wide range of mosquitoes. The disease mainly affects livestock and people. It has been listed by the World Health Organization as one of the nine diseases that has the potential to cause pandemics. RVF outbreaks are often sudden and intense, typically occurring after prolonged periods of heavy rainfall. These events are challenging to predict with sufficient lead time due to their rapid onset and progression. For instance, during the 2006-2007 RVF outbreak in East Africa, an early warning was issued in mid-September 2006, but a comprehensive warning only came in November 2006, by which time initial cases had already been reported. These delays in forecasting, combined with inadequate surveillance systems, have hindered the ability of public and animal health authorities to implement effective response measures.

Post-outbreak assessments conducted in Kenya revealed that the epidemic's severity was aggravated by delays in recognizing the risks and taking preventive and control actions. The evaluations further highlighted the absence of a documented contingency or emergency plan for RVF, as well as the lack of pre-allocated emergency funds, especially in the livestock sector. These challenges underscored the need to refine contingency plans and led to the development of the RVF Decision Support Tool (DST) to enhance preparedness and guide responses to future epidemics. (Mbotha, D. and Bett, B. 2015)

Overview

The tool is jointly developed by the One Health Initiative and the Digital Innovation Initiative. It is designed to provide comprehensive analytics on climate-epidemic interactions and offers decision support for the prevention and control of RVF outbreaks in the Greater Horn of Africa. It features a decision-support system tailored to manage RVF epizootics, aiding in timely and effective responses. Additionally, it incorporates a disease information management system to ensure efficient compilation and dissemination of critical data at various levels. The tool also facilitates routine disease surveillance in high-risk areas by integrating trapping systems with community reports and supports cost-efficacy studies of RVF prevention and control strategies, feeding these insights into contingency planning.

The tool offers meteorological data, providing detailed information on current rainfall and precipitation at county and sub-county levels. Its RVF modeling capabilities include mapping both positive and negative cases to enhance risk assessment. For decision support, it serves as a critical resource in guiding prevention and control efforts for RVF in the region. Furthermore, it includes an online news bulletin feature that allows users to customize scientific advisories with geospatial visualizations, producing professional reports tailored to specific needs.

On 4th September 2024, ILRI organized a collaborative workshop in Naivasha, Kenya, to enhance the RVF decision support tool. The workshop focused on defining the tool's geographic coverage, identifying target users, assessing demand for scaling, and engaging key experts for the process. Participants highlighted challenges such as the tool's complexity, limited awareness among users, and dependence on internet connectivity. They proposed solutions including simplifying the interface, implementing training and awareness programs, and incorporating offline functionalities to improve accessibility.

These discussions generated valuable recommendations, which the project team will integrate to align the tool with practical needs and support informed, timely responses to RVF outbreaks.

Major enhancements in 2024

The RVF tool is evolving, with periodic upgrades and the addition of new features to enhance user experience and utility. Below are some of the recent enhancements:

RVF Analytics Web Dashboard (Version 1)

- **Branding and Homepage Design:** Developed a branding strategy and designed a homepage to align with One Health Africa's mission, enhancing visibility and communication of the organization's goals.
- **Climate Epidemic Interactions Dashboard:** Initiated the development of a dashboard to illustrate the interactions between climate variables and epidemic patterns.
- **Past Rainfall Anomalies Visualization:** Created visualizations to illustrate rainfall anomalies at the sub-county level in Kenya, providing a clear understanding of historical trends.
- **Rainfall Data Integration:** Integrated historical rainfall data from GPM with monthly rainfall forecasts sourced from AICCRA, ensuring comprehensive data coverage.
- **Rainfall Forecast Graph:** Developed a forecast graph using data from GFS NOAA, enabling better planning and risk assessment.
- **RVF Risk Maps:** Prepared monthly RVF risk maps by analyzing rainfall anomalies and displayed them alongside rainfall maps with a comparative feature for better insights.
- **Digitization of RVF DSS Content:** Digitized the RVF Decision Support System (DSS) content and uploaded it into a centralized database.

- Filterable DSS System: Designed and built a filterable DSS system, allowing users to access and analyze digitized content more efficiently.

News Bulletin System

- Compilation of Data Visualizations: Consolidated past rainfall maps, forecasted rainfall graphs, and anomalies graphs into a single document for streamlined reporting.
- Web Page Development: Designed a user-friendly web page to host maps and graphs, allowing users to edit content before generating final reports.
- Report Customization Features: Added an "edit content" feature to enable customization of reports directly within the system.
- Report Generation and Sharing: Enabled functionalities for generating reports and downloading or sharing them with stakeholders.

RVF Analytics Web Dashboard - Machine Learning Model (Version 2)

- Analysis of RVF Positive Cases: Conducted a detailed analysis of RVF-positive cases to evaluate their relevance for predictive modeling.
- Data Engineering for Negative Cases: Processed and engineered datasets for negative RVF cases to enhance the reliability of the machine-learning model.
- Exploratory Data Analysis (EDA): Performed EDA to uncover patterns and insights from the data, laying the foundation for model development.
- Explanatory Data Collection: Collected explanatory variables, including rainfall, temperature, clay content, elevation, and land use/land cover (LULC), to improve prediction accuracy.
- Data Transformation: Transformed data at a granular level, including 5x5 km pixels and sub-county resolution, for precise modeling.

- Automated Data Fetching: Built APIs and Lambda functions to automate data fetching for explanatory variables, streamlining data preparation.
- Model Implementation: Implemented machine learning models, including Random Forest Regression, Random Forest Classification, and Multi regression, to predict RVF occurrences. Accuracy testing is ongoing.
- Sub-County Classification Maps: Created sub-county-level classification maps to support localized decision-making and interventions.

Way forward

Significant progress has been made across all components of the project, from dashboard development to machine learning model implementation. Future efforts will focus on testing and refining functionalities, ensuring user-friendliness, and improving predictive accuracy for RVF risk assessment. With these refinements, the tool will be ready for government use, enabling it to reach a wider audience and play a crucial role in enhancing preparedness and response to RVF outbreaks.

References

Mbotha, D. and Bett, B. 2015. Utilization of the Rift Valley fever decision support tool in Kenya: Successes and challenges. ILRI Discussion Paper 28. Nairobi, Kenya: International Livestock Research Institute (ILRI).