



Food and Agriculture
Organization of the
United Nations

Real-time monitoring and forecasting of Rift Valley fever in Africa to drive preparedness and anticipatory actions

RVF Early Warning Decision Support Tool (DST)

Living Planet Symposium – Bonn, Germany - 24 May 2022

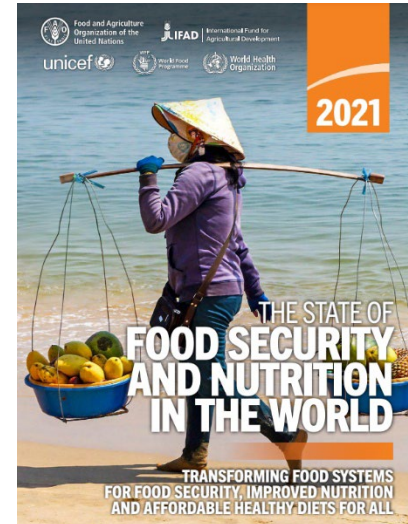
Claudia Pittiglio, Fredrick Kivaria, Karl Morteo, Charles Bebay, Jeffrey Gilbert, Baba Soumare and Madhur Dhingra

FAO Animal Health Service



Food security and nutrition in the world

- In 2020, **between 720 and 811 million people** affected by **hunger**
- **148 million more people impacted** since the outbreak of the COVID-19 pandemic
- **25%** of animal production is **lost because of disease**
- **FAO** believes that **Science, Technology and Innovation** can **accelerate** the transformation of **agrifood systems** towards the **Sustainable Development Goals**
- And contribute to **better production, better nutrition, a better environment and a better life**, leaving no one behind.

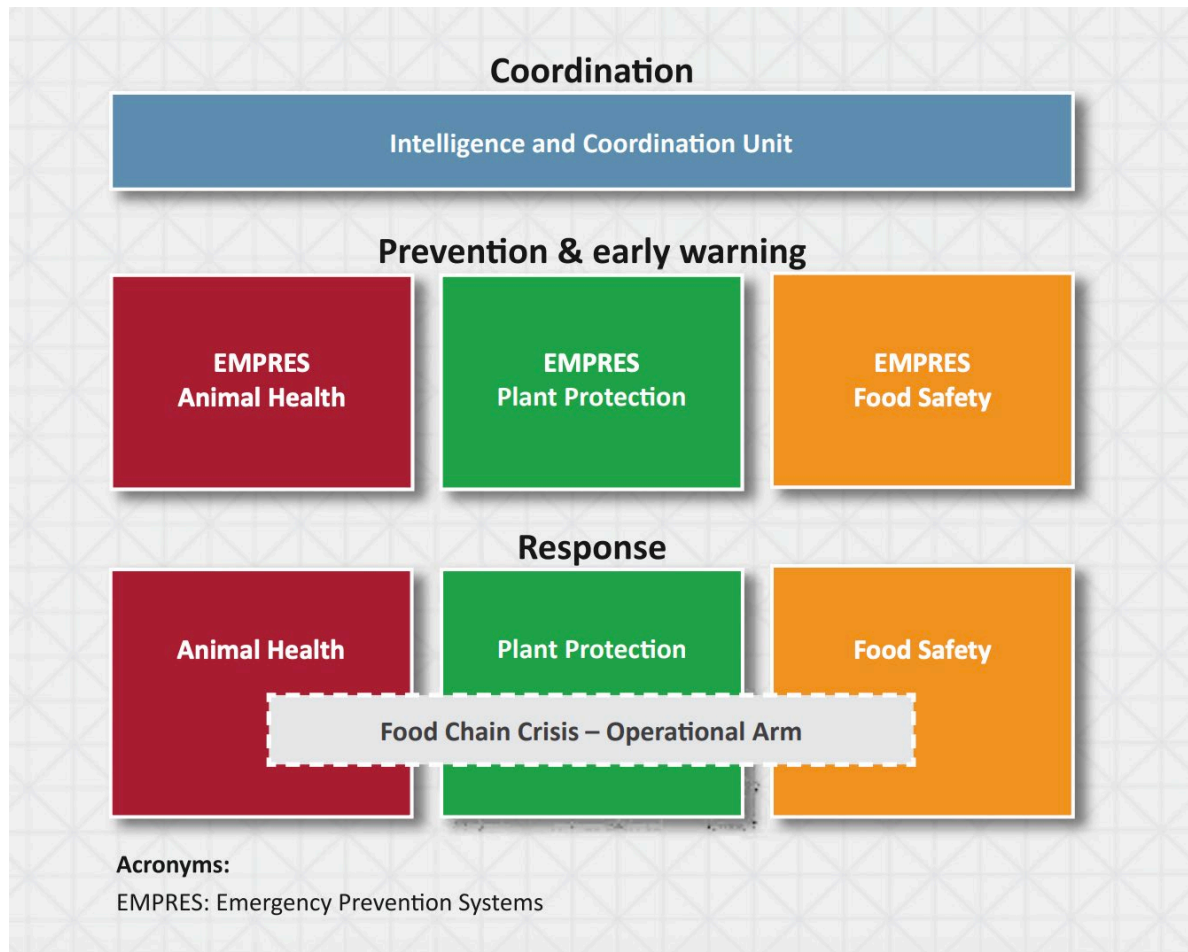


**Strategic
Framework
2022-31**





The Emergency Prevention System (EMPRES) for transboundary animal and plant pests



THE EMPRES MANDATE

Managing animal and plant health, natural resources, fisheries and forestry

State of Play: animal health, plant health, forest health, fisheries/aquaculture health

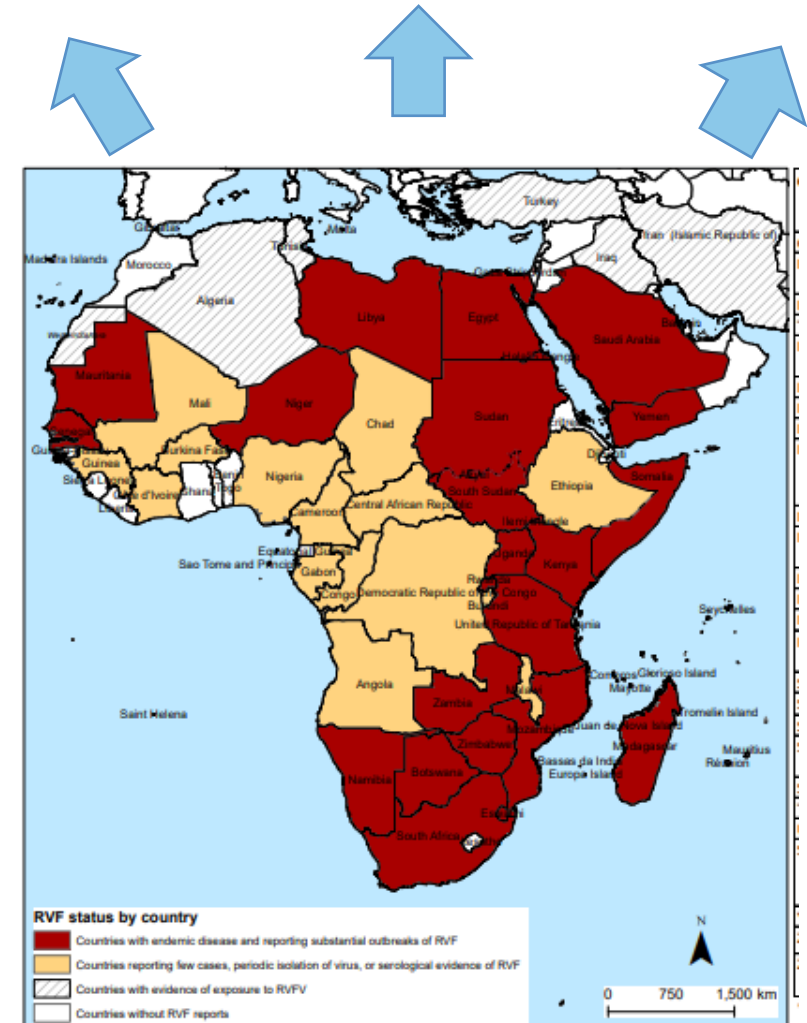
Mapping of areas

- Early warning
- Risk assessment
- Surveillance
- Capacity development
- APPDs prevention and resilience
- Emergency preparedness and response
- Coordination and governance



Rift Valley fever (RVF): background

- Major **zoonotic viral vector-borne disease**
- **Wild and domestic ruminants** (cattle, sheep, goats, camels) and **humans affected**
- **Transmitted** by many **mosquito's species** (9 genera); through contact with infected animals
- **Transovarial transmission** in mosquitoes
- **Spill-over** from **wild animals**
- **Driven by climate variability**
- **Significant economic losses**, closure of markets, trade disruption
- **Risk of RVF introduction into EU** and other regions of the world due to climate change



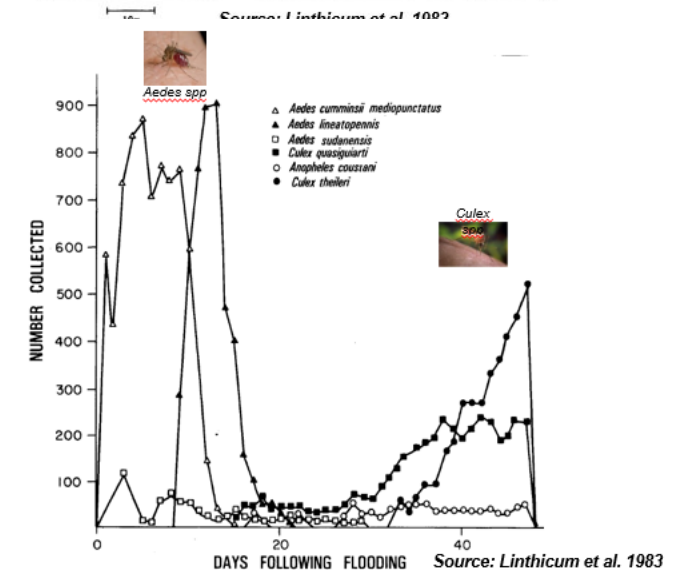
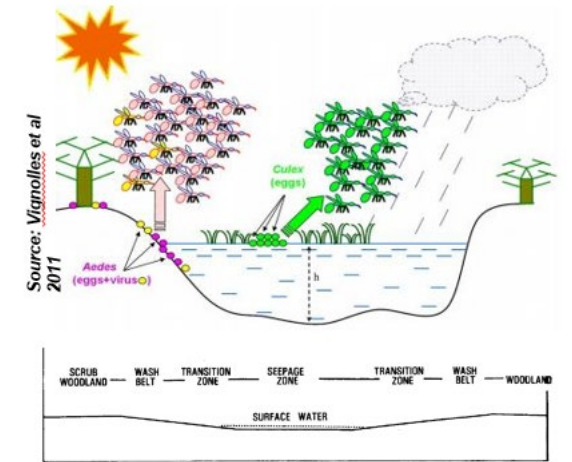
Source: RVF Action Framework (FAO 2022)

<https://www.fao.org/3/cb8653en/cb8653en.pdf>



Climate variability, vector dynamics and RVF outbreaks

- RVF **outbreaks** are triggered by **climate anomalies** (e.g., heavy rains and prolonged flooding) that **increase** habitat suitability for **vector amplification**
- A **dynamic prediction model** by NASA captures and monitors **RVF vector dynamic** under flooding conditions using precipitation and NDVI anomalies over the past 3 consecutive months, precipitation forecasts, SST and ENSO (Anyamba et al. 2009)
- The **innovative** part of FAO's work consists in its calibration and implementation in an **early warning tool for near-real-time monitoring and forecasting** of RVF at-risk areas in Africa.

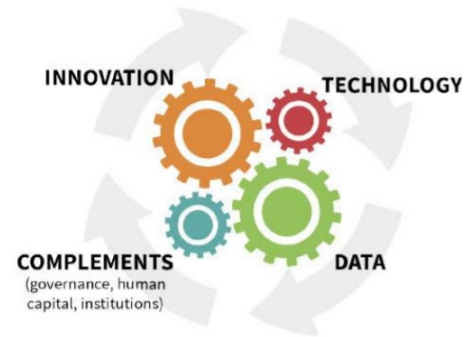




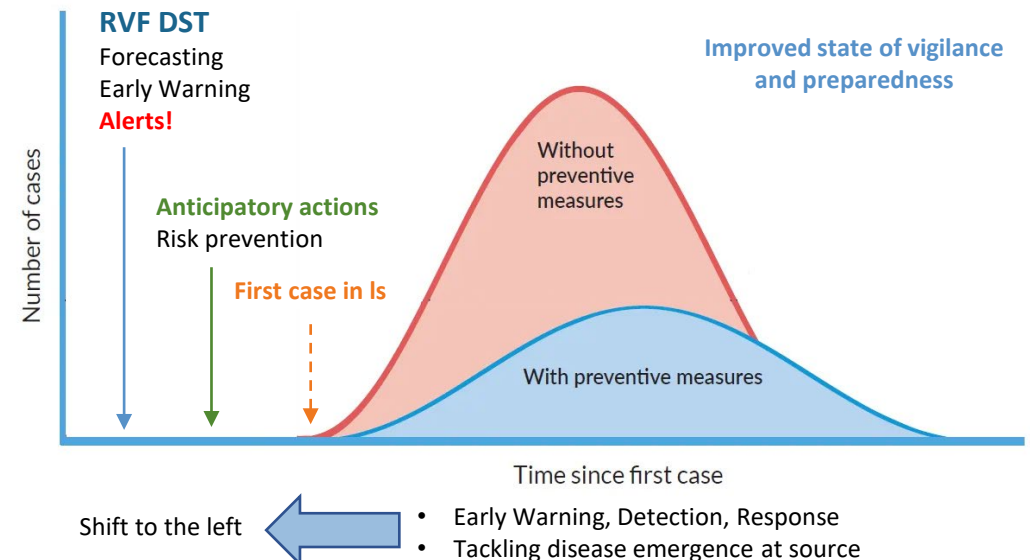
RVF Early Warning Decision Support Tool (DST) – Anticipate and mitigate the risk of RVF

- DST identifies **climatic anomalies** to **forecast areas at risk of RVF vector amplification**
- **Prediction capacity:** 1-2 months before the first case is observed
- **Integrated** in **FAO Hand-in-Hand** geospatial platform / RVF events from **EMPRES-i**
- **Facilitate real-time data sharing, consultation among experts, risk interpretation**
- **Scalable to other regions and diseases**

- Cost effective
- Disease-specific
- Easy to monitor
- Available on near real-time



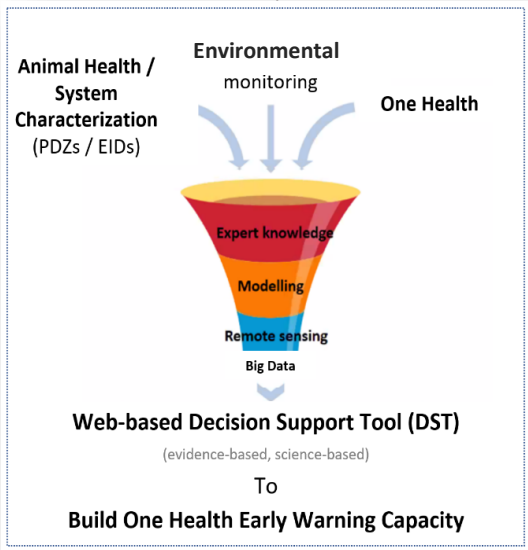
Tracking climate variability and changing environments



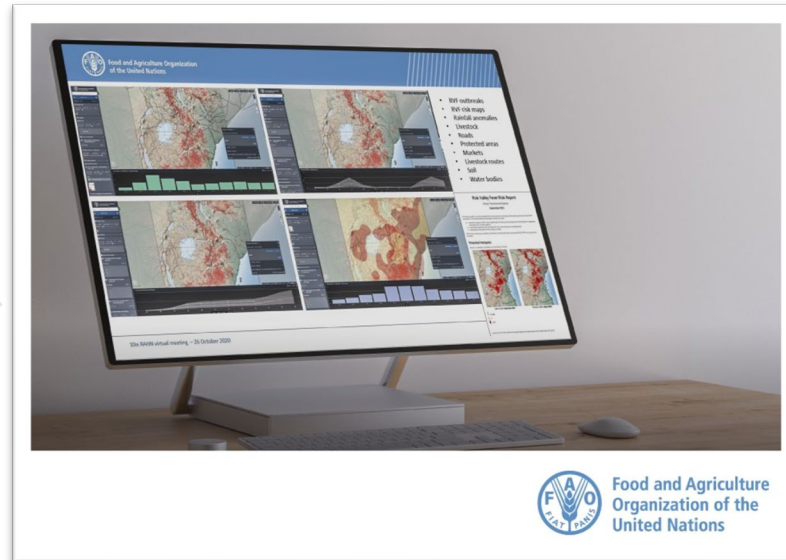


Web-based RVF Early Warning Decision Support Tool (DST)

Innovative Approach
Evidence-based, science-based



RVF Decision Support Tool



<https://www.fao.org/documents/card/en/c/cb5875en>

Monitoring, prevention and control



Alerts and RVF Monthly Updates



Capacity building



EXPERT KNOWLEDGE

Suitability for RVF vector amplification

- Risk maps/forecast (based on NASA model)
- Precipitation
- Temperature
- Vegetation
- Soil type
- Humidity
- Land cover
- Elevation
- Irrigation areas
- Flooding/dambos
- Seasonality (ENSO)

RVF endemic areas

- RVF core areas
- RVF events

Risk of exposure

- Livestock species
- Human population

Risk of spread (infrastructure)

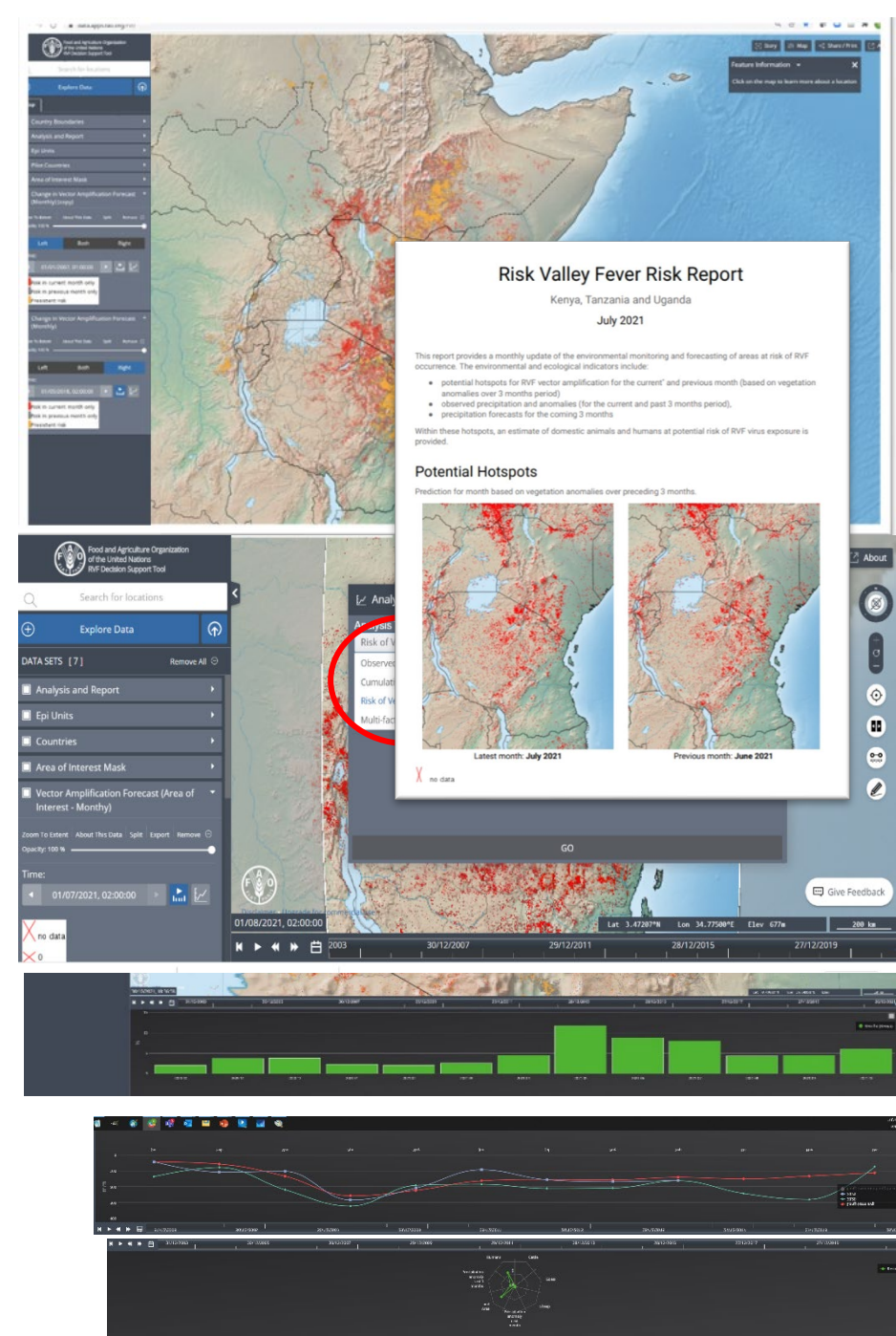
- Markets
- Villages
- Roads
- Livestock routes ...

Supportive documents

- RVF FAO Manuals
- FAO/ILRI Decision Support Framework
- RVF dynamic model for VA
- FAO RVF Action Framework

RVF DST functionalities

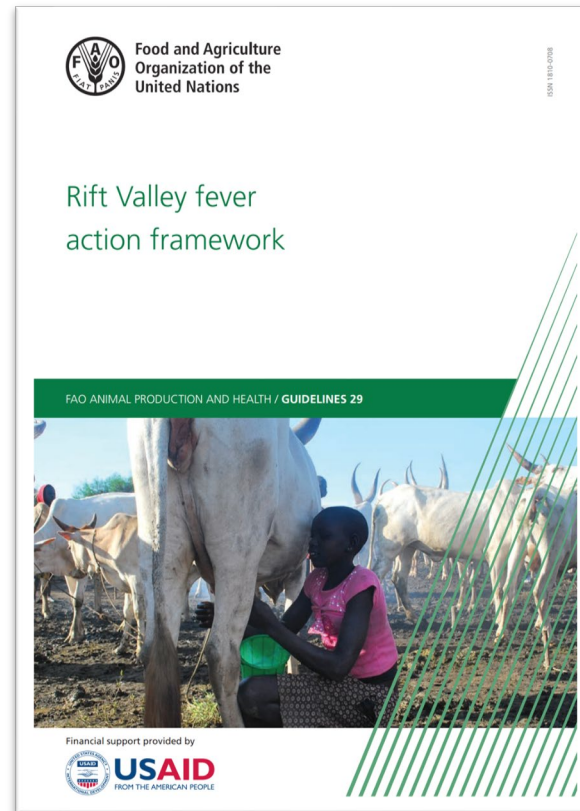
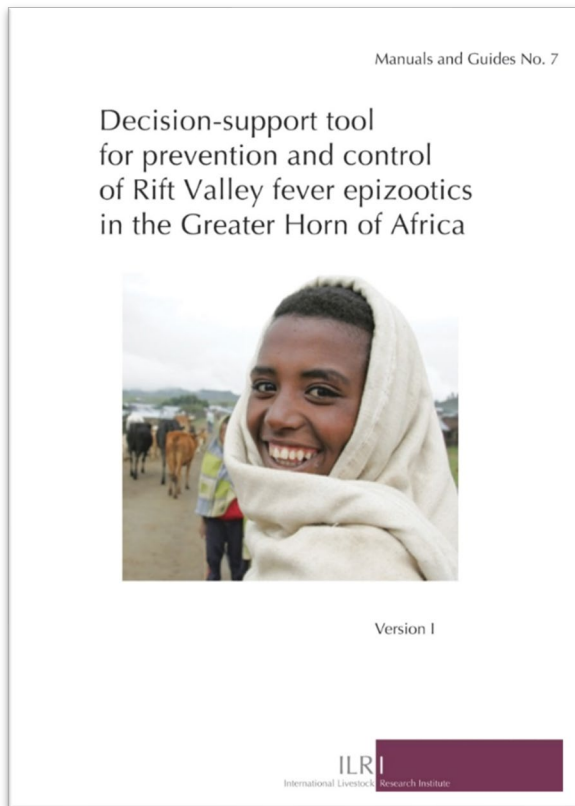
- **Password protected, online interactive maps for**
 - Near **real-time RVF VA Hotspots** and **historical archive (> 2002)**(monthly)
 - **RVF Outbreaks** (sourced from EMPRES-i) and heat map
 - Historical, real time and forecasted **rainfall** and **anomalies** (CHIRPS)
 - **Climatic** and **environmental factors** (e.g., soil, NDVI, EVI, T, water bodies, ...)
 - **Infrastructure** (e.g., roads, markets, main livestock routes)
 - **ENSO** forecast (updated on a monthly basis)
 - **Animals** (FAO GLW 2010) and **humans at Risk**
- **Upload** and visualization of **own data**
- **Analysis per polygon** (e.g., epi-unit, and drawn on map or uploaded shp):
 - trend/evolution of RVF risk over the past 12 months
 - observed and cumulative rainfall in average, current and previous year
 - Multi-radar chart of the risk factors
- **Easy comparison of risk factors and RVF hotspots** (with the split screen function)
- **Printfriendly report** for selected items and risk factors at national level
- **Link to metadata record** (Catalogue), **download of maps** (in GeoTiff format)
- **Real-time data sharing** (maps, project, story) with users
- **Storymap** of main outputs of the analysis for real-time sharing and early warning
- **Links to the main RVF documents** for ease of reference





Integrated approach to guide informed early actions for prevention and control

- Real-time consultation among experts for risk interpretation, assessment, monitoring
- Data-sharing of geospatial data, risk maps, supporting documents for capacity building



<https://www.fao.org/3/cb8653en/cb8653en.pdf>

Overall risk of occurrence (likelihood + impact)		
Low	Moderate	High
Passive surveillance system (e.g., Syndromic surveillance)	Active surveillance (particularly those bordering high risk areas) Continue passive surveillance	Sentinel herds monitoring (during alert periods) Continue passive surveillance (enhance syndromic surveillance during the alert period)
Awareness creation + Target communication messages	Awareness creation ++ Target communication messages Alert of possible outbreaks	Awareness creation+++ Target communication messages Alert of possible outbreaks
Vector surveillance +	Vector surveillance ++	Vector surveillance +++ Vaccination
Risk assessment/monitoring	Risk assessment/monitoring	Risk assessment/monitoring
Training personnel on sampling, disease reporting, Personal protection / biosafety	Vector control Training personnel on sampling, disease recognition, disease reporting, Personal protection / biosafety	Vector control Training personnel on sampling, disease recognition, disease reporting, Personal protection / biosafety

- **Challenge**
 - ✓ Getting unified alert across the region, and averting unnecessary rumours and consequences
 - ✓ Inadequate political support for unified action/s
- **Solution**
 - ✓ FAO-IGAD quarterly RVF alerts (July 2020) - <https://www.fao.org/3/cb8651en/cb8651en.pdf>
 - ❑ **Primary objective**
 - Political buy-in
 - Safeguard trade and livelihoods
- **Expected results**
 - ✓ Countries remain vigilant
 - ✓ Preemptive action taken
 - ✓ Improved cooperation
- **Specific examples of actions taken following the alert**
 - ✓ Oct'19/Apr'20 – preventative vaccination – Kenya
 - ✓ Jan' 22 – preemptive sero-surveillance – Kenya
 - ✓ Apr'22 – Rwanda
 - ❑ Proactive sero-surveillance
 - ❑ Vaccination ≈ 600 animals
 - ❑ RCCE



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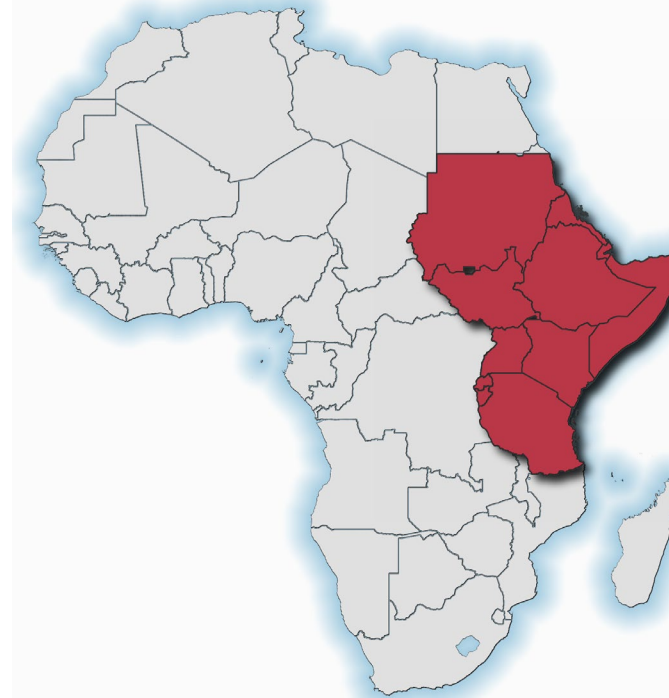


alert

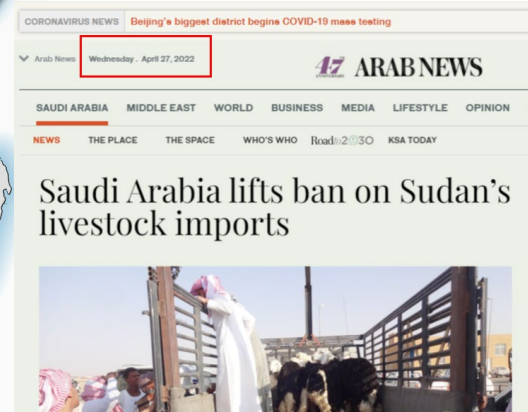


FAO AND IGAD ALERT COUNTRIES IN EASTERN AFRICA TO REMAIN VIGILANT FOR RIFT VALLEY FEVER

15 February 2022



an endemic vector-borne zoonotic disease that human health, animal health and livestock in the Eastern Africa region. The epidemiology of RVF is complex and challenging. To increase knowledge on RVF and disease management policies, the Food and Agriculture Organization of the United Nations (FAO) has developed and validated the RVF Early Warning Decision Support Tool (RVF DST) for forecasting based on precipitation and vegetation indices and other environmental factors. To this end, FAO, in partnership with the Intergovernmental Authority on Development (IGAD),





RVF Risk Modelling and DST: major milestones and way forward

Increased FAO expertise in RVF risk modelling, prevention, control

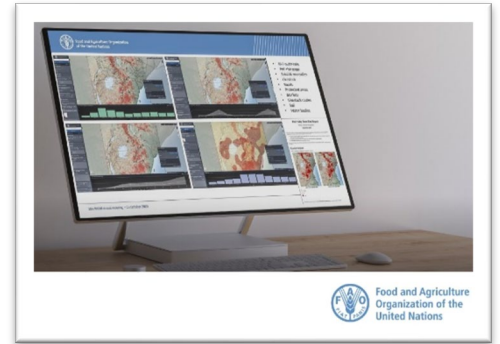
Transition from a desktop to cloud-based platform (Google Earth Engine)

Integration with expert knowledge (e.g., FAO-ILRI DSF) on RVF eco-epidemiology

Building One Health Early Warning capacity at regional and national level

Rift Valley Fever Action Framework

FAO web-based RVF Early Warning Decision Support Tool (DST)



1

Year: 2007-2011

2

2012-2016

3

2017

4

2018

5

2019

6

2020

7

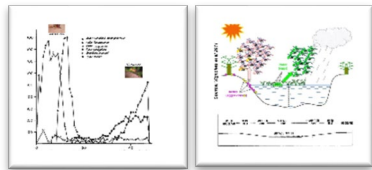
2021

8

2022

9

Calibration of a dynamic model developed by NASA (Anyamba 2009)



Increased spatial and temporal resolution of the RVF risk maps (available every month at 250 m)

Dar es Salaam RVF Meeting recommendations



Increased interoperability (FAO Hand-in-Hand)

Scalable to other countries/diseases
Scenario analysis (What if?)

Modelling: Risk categorization/ Animal movement / Risk of Spread



East and West Africa



West Africa

Multi-Criteria Decision Analysis (MCDA)

Thank you

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Prediction capacity

Tracking climate variability and changing patterns

- **Near real-time RVF monitoring and forecasting tool** (observed cumulative vegetation anomalies over the past 3 consecutive months; builds upon the dynamic environmental model by NASA)
- **Observed precipitation anomalies** (over the past 3 consecutive months)
- **Forecasted precipitation** (over the coming 3 months)
- **ENSO forecasts** (up to six months)
- Past and current **RVF outbreaks** (linked to FAO EMPRES-i)
- **Comparison with risk maps of reference years**
- Livestock distribution/density (linked to **FAO GLW**)
- **Expert knowledge**

FAO Forecasted RVF events	Date of FAO Risk Assessment / Alert	Reporting date (EMPRES-i)	Observation date (EMPRES-i)
The Gambia	15 Sept 2017	19 Jan 2018	10 Dec 2017
Senegal	15 Sept 2017	01 Mar 2018	28 Feb 2018
South Africa	5 Feb 2018	16 May 2018	28 Apr 2018
Kenya	Mar 2018	06 Jun 2018	11 May 2018
Rwanda	Mar 2018	18 May 2018	06 May 2018
Kenya	10 Oct 2018	14 Feb 2019	31 Dec 2018
Sudan	10 Oct 2018	21 Nov 2018	04 Oct 2018
Mauritania	10 Oct 2018	26 Nov 2018	04 Nov 2018
Sudan	9 Sept 2019	06 Oct 2019	19 Sep 2019
Horn of Africa	16 Oct 2019	02 Dec 2019 (in Uganda)	15 Nov 2019
Mauritania/ Senegal	24 June 2020	16 Sept 2020	04 Sep 2020
Kenya	15 Jan 2020 2 Apr 2020 15 May 2020 10 July 2020 7 Oct 2020	22 Dec 2020	15 Mar 2020 19 Aug 2020 19 Nov 2020



Comparison with risk maps of reference years

Similar patterns between:

- Oct 2006 – Jan 2007
- Feb – May 2018

From October 2006 to January 2007



From February 2018 to May 2018

