Climate and trade sensitive animal diseases: the case of Rift Valley fever in East Africa

Modeling and Risk Prediction

Assaf Anyamba
NASA Goddard Space Flight Center
Biospheric Sciences Laboratory
Greenbelt, MD.
ENSO Climate Teleconnections

- Interannual Variability - ~6/7 year cycle
- Global scale consequences
- Consequence – agriculture production and disease outbreak patterns

Glantz et al, 1991
Variability: 1. Trigger 2. Amplifier

Teleconnection impacts – affecting densely populated areas

Human behavior – amplifies outbreaks

Teleconnections and Rift Valley fever

- 2 Major epicenters
- El Niño – Eastern Africa
- La Niña – Southern Africa
- Human Factors (Trade and Animal Movement)
PEAM - Restricts areas of Risk Mapping

Livestock population density: cattle, sheep, goats

Human population density

BASELINE INPUTS

Rainfall

Vegetation

Land Surface Temperature

DYNAMIC INPUTS

RVF Risk Mapping Model
Summary Risk Map, Outbreaks, Early Warning Timelines

E. Africa: 70%
Sudan: 50%
S. Africa: 30% (2008)
S. Africa: 0% (2009)
S. Africa: 85% (2010-1)

Climate Change & Extremes Impacts

Anyamba et al, In progress
Contributors

NASA/GSFC
Jennifer Small
Heidi Tubbs
Dr. Richard Damoah
Dr. Compton J. Tucker

USDA/CMAVE
Dr. Kenneth J. Linthicum
Dr. Seth C. Britch

NOAA/CPC
Dr. Wassila Thiaw

- NASA Applied Sciences Program – Health and Air Quality (17-HAQ17-0065)
- NASA, Soil Moisture Active-Passive (SMAP) Mission Science Team (80NSSC21K0777)
- Armed Forces Health Surveillance Division (AFHSD) Global Emerging Infections Surveillance (GEIS) Branch 2009-2018
Extra / Backup Slides
Shifts Matter to Disease Outbreaks
• Estimate annual rate of change/degradation in immunity - if at all
• Needs a lot data – at farm level: # number of livestock, type, immunization status, age etc.
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RVF Early Warning Decision Support Tool (DST)

Climate Change and Animal Health – STDF webinar - 3 May 2022

FAO Animal Health Service
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
- APPPs prevention and resilience
- Emergency preparedness and response
- Coordination and governance

Acronyms:
EMPRES: Emergency Prevention Systems
RVF Early Warning Decision Support Tool (DST) – Anticipate and mitigate the risk of RVF
Real-time monitoring, risk forecasting, mapping & assessment to guide informed early actions for prevention and control

- 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

![Diagram showing the process of tracking climate variability and changing environments, forecasting, and alerting.]

**Tracking climate variability and changing environments**

- RVF DST Forecasting
- Early Warning Alerts!

**Number of cases**

- Improved state of vigilance and preparedness
- Without preventive measures
- With preventive measures
- First case in Is

**Time since first case**

- Shift to the left
- Early Warning, Detection, Response
- Tackling disease emergence at source
Web-based RVF Early Warning Decision Support Tool (DST)

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

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

RVF Risk Modelling and DST: major milestones and way forward

1. Increased FAO expertise in RVF risk modelling, prevention, and control
2. Transition from a desktop to cloud-based platform (Google Earth Engine)
3. Integration with expert knowledge (e.g., FAO-ILRI DSF) on RVF eco-epidemiology
4. Calibration of a dynamic model developed by NASA (Anyamba 2009)
5. Increased spatial and temporal resolution of the RVF risk maps (available every month at 250 m)
   - Dar es Salaam RVF Meeting recommendations
6. Increased interoperability (FAO Hand-in-Hand)
7. Building One Health Early Warning capacity at regional and national level - Rift Valley Fever Action Framework
8. Scalable to other countries/diseases
9. Scenario analysis (What if?)

Modelling: Risk categorization/Animal movement/Risk of Spread

Risk Of RVF Introduction + Risk Of RVF Spread = Risk of RVF Occurrence

Risk Of RVF

- East and West Africa
- West Africa

Multi-Criteria Decision Analysis (MCDA)
The overall effect is improved state of vigilance and preparedness
• Challenge
✓ Maintaining vigilance during the IEP
✓ Getting unified alert across the region, and averting unnecessary rumours and consequences
✓ Inadequate political support for unified action/s

• Solution

❑ 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 ≈ 700 animals
❑ RCCE
Thank you

claudia.pittiglio@fao.org

fredrick.kivaria@fao.org