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
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.

*FAO Animal Health Service (AGAH) mandate:*

- 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
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

Transition from a desktop to a cloud-based platform
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)

<table>
<thead>
<tr>
<th>Forecasted RVF events</th>
<th>Date of RA/Alert</th>
<th>Date of reporting</th>
<th>Date of observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Gambia</td>
<td>15 Sept 2017</td>
<td>19 Jan 2018</td>
<td>10 Dec 2017</td>
</tr>
<tr>
<td>Senegal</td>
<td>15 Sept 2017</td>
<td>March/Apr 2018</td>
<td>Feb/Mar 2018</td>
</tr>
<tr>
<td>South Africa</td>
<td>5 Feb 2018</td>
<td>16 May 2018</td>
<td>28 Apr 2018</td>
</tr>
<tr>
<td>Kenya</td>
<td>March 2018</td>
<td>8 June 2018</td>
<td>3 June 2018</td>
</tr>
<tr>
<td>Rwanda</td>
<td>March 2018</td>
<td>June 2018</td>
<td>May 2018</td>
</tr>
<tr>
<td>Kenya</td>
<td>10 Oct 2018</td>
<td>14 Feb 2019</td>
<td>31 Dec 2018</td>
</tr>
<tr>
<td>Sudan</td>
<td>10 Oct 2018</td>
<td>21 Nov 2018</td>
<td>Oct/Nov 2018</td>
</tr>
<tr>
<td>Mauritania</td>
<td>10 Oct 2018</td>
<td>30 Jan 2019</td>
<td>NA</td>
</tr>
<tr>
<td>Horn of Africa</td>
<td>16 Oct 2019</td>
<td>January 2020 (Uganda)</td>
<td>December 2019</td>
</tr>
</tbody>
</table>
May 2018: RVF reported in South Africa

June 2018: RVF reported in Kenya

Is this sufficient to trigger early action?
<table>
<thead>
<tr>
<th>STRENGTHS</th>
<th>CHALLENGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near real-time environmental monitoring system</td>
<td>Real-time validation of RVF at risk areas (mosquito surveillance, sentinel herds; expert knowledge, etc.)</td>
</tr>
<tr>
<td>Cost-effective</td>
<td>Calibration for countries with no RVF outbreak data</td>
</tr>
<tr>
<td>Availability of RVF risk maps on monthly basis</td>
<td>Establish a network of experts to discuss the RVF risk maps and update the RVF situation</td>
</tr>
<tr>
<td>Accurate predictions for endemic countries with RVF historical data</td>
<td>Data sharing to assess the occurrence and spread based on effective exposure (n animals, vaccinations, animal movement, trade)</td>
</tr>
<tr>
<td></td>
<td>Quantitative RA: Integration of other risk factors to assess and quantify animals and humans at risk</td>
</tr>
<tr>
<td></td>
<td>Risk maps are difficult to interpret</td>
</tr>
<tr>
<td></td>
<td>Key messages for risk areas to facilitate early action</td>
</tr>
</tbody>
</table>
Decision-support tool for prevention and control of Rift Valley fever epizootics in the Greater Horn of Africa

Version 1

ILRI DISCUSSION PAPER

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