Decision Support Tools to inform Kyasanur Forest Disease Management

Background & Aims

- Kyasanur Forest Disease (KFD) disproportionately affects low-income rural communities that depend on forest for their livelihoods, for grazing, fuel, fodder and harvesting of non-forest products.
- By combining epidemiology, geographical information systems and remote sensing, spatial decision support tools for zoonotic diseases can identify “at-risk” communities in which human disease is most likely to occur.
- Such tools can help decision-makers across sectors to target interventions such as surveillance, vaccination or awareness raising.
- Past tools for zoonotic diseases do not integrate wide-ranging ecological, environmental and social risk factors and are not tailored to the needs of decision-makers or the often local scale of interventions.
- The MonkeyFeverRisk project is co-developing the first integrated Decision Support Tool for Kyasanur Forest Disease, with beneficiaries across the Public Health, Animal Health and Environmental Sectors.
- Here we explain how the tool has been developed and tailored to the needs of cross-sectoral beneficiaries.

Needs of One Health Stakeholders

- Through workshops and interviews, MonkeyFeverRisk has engaged with cross-sectoral stakeholders to identify and rank:
  - key risk factors for KFD (Table 1)
  - policies that interact with the KFD system
  - key needs to deal with KFD, including seasonal and geographical info.
- Stakeholders are also being consulted about the value, functionality, format and appearance of the Spatial Decision Support Tool.

Table 1. Top-ranked risk factors for KFD identified by stakeholders (below) in August 2018 and how they were addressed in subsequent field surveys and risk models

Rank	Risk factors	No. of votes	How risks addressed in project
1	Lack of awareness about KFD	10	SOCIAL SURVEYS
2	Under or late reporting of monkey deaths	9	RISK MODELS
2	Deforestation and/or forest degradation	9	RISK MODELS, STRATIFY SOCIAL & ECOLOGICAL SURVEYS
2	Lack of awareness of preventative measures (tick repellents, vaccination)	9	SOCIAL SURVEYS
3	Lack of awareness or understanding of alternative hosts	8	SOCIAL AND ECOLOGICAL SURVEYS
4	Human use of forests	7	SOCIAL SURVEYS AND RISK MODELS
4	Low vaccination coverage	7	SOCIAL SURVEYS AND RISK MODELS
4	Poor diagnostics and surveillance	7	IMPROVEMENTS COULD RESULT FROM STRONGER ONE HEALTH NETWORK
4	Lack of OneHealth policy	7	STRONGER ONE HEALTH NETWORK
5	Poor data management	6	INFORM BLUEPRINT FOR FUTURE DATA MANAGEMENT FOR KFD
5	Poor understanding of tick ecology	6	ECOLOGICAL SURVEYS
6	Side effects and concerns about vaccines	5	SOCIAL SURVEYS

Developing the Decision Support Tool

Developing risk models and mapping key risk factors for KFD

- With DHFWS Medical Officers, we compiled data on known KFD cases since 2014 from all affected states (e.g. Fig.1).
- KFD emergence has been linked to past deforestation. Forest and plantation types and forest change were mapped using Earth Observation (Fig.2).
- Other risk factors integrated were elevation, cattle densities and public health factors
- Human cases more likely to occur in diverse forests with high % moist evergreen and plantation and low % dry deciduous, high indigenous cattle densities, > 600 m.a.s.l. (Figs. 1& 2)
- Both regional and district level models were extended across unsampled areas to map locations “at-risk” of human disease (Fig. 3)

Fig. 1. Example mosaic forest-plantation-paddy landscapes that favour KFD cases

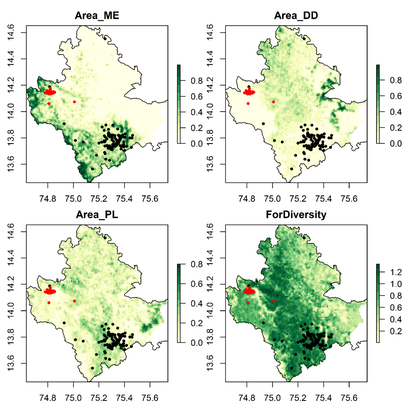

Fig. 2. Maps of forest risk factors for KFD cases. ME=moist evergreen, PL=plantation, DD= dry deciduous, ForDiversity = forest type diversity

- Initial risk maps for Shimoga (2014-2018 data) identified some 2019 outbreaks in Sagar
- Regional and district-level models being validated
- Integrating tick abundance and infection rates by habitat from field data into tool

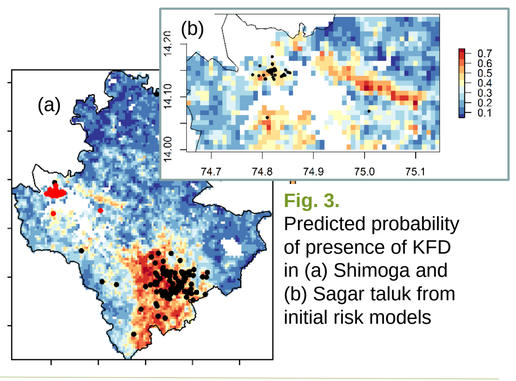

Fig. 3. Predicted probability of presence of KFD in (a) Shimoga and (b) Sagar taluk from initial risk models

Tailoring the tools to needs of beneficiaries

In the Shiny desk-based tool, we have implemented the following functionality requested by stakeholders:

- Visualise risk over contextual factors in the landscape that guide management e.g. hamlets, roads, health centres
- Allow risk areas to be viewed at different geographical scales
- Overlay key risk factors and public health constraints
- Automatic calculation of population at risk, vaccine doses and radius around outbreaks

Next steps: what will be achieved in this project and beyond

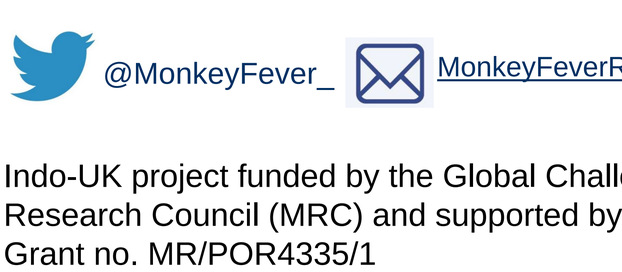

Fig. 4. Screenshot from Kyasanur Forest Disease Risk Explorer

- Integrate field data and refined risk models and risk factors into the Desk-based Tool.
- Understand how the MonkeyFeverRisk Tool complements other health information systems available in India.
- Tailor the Desk-based tool, and risk guidance to **your feedback** and disseminate it to cross-sectoral end-users.
- Pilot the development of a Phone App for decision-making and awareness raising by taluk level workers (2020)
- Ascertain with cross-sectoral stakeholders whether similar tools are required for other zoonotic diseases in India, particularly for those affecting forest-dependent communities.
- Scope out what would be needed in terms of data, partnerships and research to develop tools for other diseases.

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Indo-UK project funded by the Global Challenges Research Fund lead by the UK Medical Research Council (MRC) and supported by the AHRC, BBSRC, ESRC, and NERC.
Grant no. MR/POR4335/1

UKRI Medical Research Council; Biotechnology and Biological Sciences Research Council; Arts and Humanities Research Council; Economic and Social Research Council; Natural Environment Research Council