

## Agriculture-associated diseases research at ILRI: Emerging infectious diseases

*Bernard Bett*

*ILRI brings excellent science with a pro-poor perspective to the increasing global threat of emerging infectious disease.*

### Key points

- Diseases are emerging more rapidly – currently one every 4 months;
- 75% of emerging infectious diseases are zoonotic;
- Current surveillance measures aren't good at spotting emerging diseases or new variants of emerging pathogens;
- Interventions must be founded on one-health principles for greater impact.

Emerging infectious diseases (EIDs) are infections that newly appear, or have existed previously but are rapidly increasing in incidence or geographical or host range. These include diseases that have never been recognized before e.g. bird flu<sup>1</sup>, HIV/AIDS<sup>2</sup>, or SARS<sup>3</sup> as well as diseases that have been around for decades but have come back in different forms or in different places, e.g.

1. H5N1 highly pathogenic avian influenza
2. Human immunodeficiency virus / acquired immunodeficiency syndrome
3. Sudden acute respiratory syndrome



Rift Valley fever, West Nile virus, and dengue. Diseases that are intentionally introduced for bioterrorism (e.g. anthrax) can also be considered emerging diseases.

Over the past 5 years, the International Livestock Research Institute (ILRI) has carried out substantive research on two important emerging diseases: bird flu in Africa and Asia and Rift Valley fever in Africa as well as more general work on zoonotic emerging infectious disease in South East Asia.

## What we have learned

### *Drivers of EID emergence*

EIDs arise from the interaction between ecological, social and biological factors including:

- high densities and movements of human and animal populations,
- pathogen evolution,
- presence and mobility of vectors,
- human behaviour that promotes exposure,
- changes in farming systems,
- climate change and variability.

Risk mapping and risk factor analyses for bird flu conducted by ILRI in Asia and Africa indicated that high human and poultry population densities, dense road network and ports, and wet lands were associated with increased risk of outbreaks. A systematic literature review by ILRI and partners identified the pathogens of most likely to emerge (bat viruses being a big threat), the major drivers (essentially demographic) and risky practices (including lack of genetic diversity in livestock).

### *Cost of EIDs*

EIDs can have enormous socio-economic on among producers and downstream livestock value chain actors including traders, abattoir operators and actors from non-agricultural sectors such as tourism. A study conducted by ILRI in 2007 following a Rift Valley fever outbreak in Kenya estimated multiple impacts of the disease and demonstrated that the downstream impacts were much higher than those felt at the farm-level. That study utilized a value chain analytical framework, which is being integrated with epidemiology across a number of ILRI studies.

### *EID surveillance*

Risk predictions based on the standard surveillance systems often lack enough specificity to lead to effective response interventions. Therefore, outbreaks are frequently observed when humans get sick and die. Observations made from participatory studies implemented by ILRI and partners for bird flu and Rift Valley fever suggest that local communities often have reliable information and timelines on emerging disease outbreaks that could be valuable for developing innovative surveillance systems.

## *Control of EID*

Emergency response and management measures can be very effective in controlling outbreaks of EIDs. However, based on the observations made from the bird flu studies, poor detection, underreporting of cases, and challenges associated the implementation of control measures, particularly among small scale livestock producers allow such outbreaks to become endemic. With respect to Rift Valley fever, studies conducted by ILRI indicate that delays in response to outbreaks, particularly by the veterinary department in Kenya are associated with all-or-none decision making. In this case, interventions are implemented when tell-tale signs of an outbreak are observed.

### *EID and One Health*

Integrated control measures using a combination of measures best suited for EID control can be effectively used for managing outbreaks especially is used at the animal level. Studies conducted by ILRI on bird flu suggest that the effectiveness of the control measures depends, not only on the technical characteristics of the control measure, but also on livestock value chain actors' capacities and incentives to comply with the technical requirements for the implementation of each measure.

*One is the collaborative effort of multiple disciplines to attain optimal health for people, animals, and our environment. Ecohealth is systemic, participatory approaches to understanding and promoting health and well-being in the context of social and ecological interactions. They have much in common and are increasingly aligned; both emphasize multidisciplinary and the importance of agriculture and ecosystem-based interventions*

## *Challenges*

The challenges encountered in the course of implementing this work varied with the case studies but in general,

- there was lack of data or information for designing field studies and parameterization of epidemiological models developed,
- much time was need for backstopping local partners involved in these projects, and
- some countries or regions either attempted to conceal EID outbreaks or dictate areas where field studies had to be done. The selection of study areas based on political considerations weakens the design of a study. For at least two bird flu studies, the expectations of the donor or its lead partner kept evolving; this greatly affected the implementation of those projects.

## ILRI and emerging infectious diseases

The rate of occurrence (one in every four months and spread of EIDs is increasing with time due to agricultural intensification, global climate change, alteration of biological, socio-economic and political environments and globalization (including expansion in travel and international trade). Under the CGIAR Research Program 4 on Agriculture for enhanced nutrition and health, ILRI will continue working on EIDs with Rift Valley fever being a flagship disease. Current research efforts focus on:

### *Understanding the disease system*

A dynamic systems model for simulating Rift Valley fever transmission dynamics is being developed. The model integrates vector-livestock-wildlife-human interactions and it is therefore suitable for evaluating the disease system and for identifying dynamic drivers for the disease under varied settings. The model will also be used to develop hypotheses and identify relevant field activities. The model will also be linked to climate forecasting models to enhance its predictive ability. Other related activities include using molecular techniques to identify viral infection dynamics in vectors and hosts during inter-epidemic periods.

### *Risk and socio-economic assessment*

RVF risk maps are being developed to guide assessment of the livelihood impacts of the disease as well as those of its control measures. The livelihood impacts will be differentiated by gender and other socio-cultural factors. The disease risk maps will also be integrated with poverty and demographic maps to rank areas by risk and vulnerability. Outputs from the dynamics systems models mentioned above will also be used for economic analyses to identify cost-effective RVF control strategies. This includes developing and determining costs, benefits and other institutional requirements for designing and implementing one-health interventions.

### *One-health interventions*

Seventy five percent of EIDs are zoonotic; EID interventions should therefore be founded on one-health principles to increase their sensitivity to EID risks at the animal-human interface. In most developing countries, surveillance measures have not been integrated

between animal and human health departments. Public resources are often disproportionately allocated to human health departments, leaving veterinary departments with limited capacity to implement routine surveillance. ILRI is currently implementing a project to assess cost-effectiveness of one-health interventions for RVF in Kenya. The project involves all the relevant government departments.

### *Innovation, information systems and risk-based disease management*

ILRI and partners have developed a risk-based RVF Decision Support Tool to help in the implementation of RVF-interventions. Integrated information systems are also being developed at the same time to help governments identify and rank areas based on the disease risk.

## Future plans and way forward

The CGIAR Research Programme on Agriculture for Enhanced Nutrition and Health impact pathway has four overlapping sets of activities based on a 'risk analysis' conceptual framework. Under each of these, priority research on emerging infectious disease might include:

### *Prioritization and systems understanding*

Prioritization of EIDS CRP 4.3 has already identified RVF as its flagship EID. Future EIDs will be identified and ranked based of their zoonotic potential and impacts to assess their suitability for inclusion in the research program.

Multi-sectoral studies Studies on RVF often focus on hosts, vectors or pathogen without paying much attention to ecological shifts that promote emergence of these diseases. Future studies will also identify ecological drivers of the disease. This will be require multi-sectoral studies.

### *Risk and socioeconomic assessment*

Metrics and multiple burdens of EID Appropriate metrics for RVF, which integrate human and animal health impacts, including socio-economic losses associated with reduced production, have not been developed. These metrics also need to capture the effects of RVF on the ecosystem. Such metrics would allow for the assessment of RVF health risks and economic, social (disaggregated

by gender), and ecological impacts as well as the effectiveness of intervention measures. These metrics and tools for calculating them can be applied to other EIDs

### *Innovation and risk-based management*

This focuses on developing technological, organizational and social innovations that can improve the detection and management of the multiple burdens of RVF. New surveillance and diagnostic tools that allow for a better understanding of RVF will be developed. These measures will integrate participatory approaches with technological innovations such as mobile phone technology, social networks, etc. Integrated methods of controlling the disease (without reducing production and productivity) e.g. targeted use of vaccines will be developed and assessed. These studies will also assess institutional and socio-economic factors that influence the implementation of intervention measures. This should also be useful for the management of other EIDs.

### *Cross-cutting activities*

Communication, capacity-building and gender, will be essential elements of the three preceding activities. Gender will be integrated through disaggregation of data, understanding differential risk and differential roles in risk management, and promoting gender equity. Capacity-building will be an explicit focus for all partners including farmers, NGOs, public services, private sector, students and ILRI scientists. Communication will include advocacy meetings, briefs, website, and reports disseminating research findings.

*On 9 and 10 November 2011, the ILRI Board of Trustees hosted a 2-day 'liveSTOCK Exchange' to discuss and reflect on livestock research for development.*

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