Social, Economic and Environmental Drivers of Zoonoses in Tanzania (SEEDZ)

Principal Investigators: Prof. Sarah Cleaveland, Prof. Jo Sharp (University of Glasgow)

Abstract

This project will examine and assess drivers, risks and impacts of zoonotic diseases - brucellosis, Q fever and Rift Valley Fever - that affect cattle, sheep and goats, and impact on human health, livelihoods and poverty in pastoral and peri-urban communities in Tanzania. The project will use inter-disciplinary methodologies from qualitative social sciences, epidemiology and economics to examine how these drivers influence human behaviour and livestock contact networks, and how these, in turn, affect transmission of zoonotic pathogens from livestock to people. Quantitative and qualitative data pertaining to all these elements will be collected coherently in one geographical system, explicitly integrating network patterns and infection dynamics with human economic incentives and behavioural responses. The research methodology includes: (a) qualitative social science and GIS studies to identify and assess drivers of change in livestock systems; (b) cross-sectional epidemiological studies to determine pathogen exposure patterns in linked human and livestock populations; (c) quantitative and qualitative analyses to identify risk factors for transmission in different communities; (d) analyses of household survey data to link serology with livestock reproductive disease and human disease syndromes (febrile illness, reproductive disease, joint pain) and analysis of confirmed human cases across pastoral and peri-urban sites; (e) development of compartmental network disease models and agent-based simulations that incorporate human behaviour and economics; (f) development of household-level economic models and qualitative social autopsies to determine disease impact on family income and livelihoods; (g) model simulations to evaluate the effectiveness of intervention strategies, and qualitative methods to understand factors affecting acceptability of interventions, with engagement of policy-makers throughout the project to support uptake of findings.

Summary

Livestock are critical for the food security and livelihoods of almost 600 million people worldwide, and represent an important resource that has the potential to support economic development of many countries in sub-Saharan Africa. However, livestock also act as a source of zoonoses, diseases that can be transmitted to people from animals. There is growing recognition that zoonotic diseases have a profound impact on the health and livelihoods of some of the world's poorest people. This is especially the case for endemic zoonoses that are widespread in low-income countries, including Tanzania. The zoonotic diseases that are the focus of this study, brucellosis, Q-fever and Rift Valley Fever (RVF), can all result in livestock production losses and cause severe fever-causing illnesses in people, with the potential for chronic disability (brucellosis and Q fever), as well as fatal haemorrhagic disease (RVF). Zoonoses that causing fevers are particularly problematic because they are difficult to diagnose on symptoms alone, and in sub-Saharan Africa are almost always misdiagnosed, often as malaria, with serious consequences for human health. Livestock systems in Africa are undergoing rapid transition. Changes in market dynamics, land-use and agricultural policy,

environmental factors, cultural practices and technology are all changing the way people keep and manage livestock, both for food and as sources of income. However, the consequences of these changes on zoonotic disease risk are almost unknown. This project will use the case of Tanzania to explore the nature of livestock systems, focusing on two systems undergoing rapid transition: (1) the pastoral-wildlife sector affected particularly by expansion of crop-based agriculture, and (2) the peri-urban livestock sector. Within these systems, we will compare communities that vary in relation to their connectivity with urban centres and wildlife areas to characterise drivers of change (environmental, social, economic, demographic and governance). We will examine how these relate to risks of diseases transmitted to people from animals and how these diseases affect household livelihoods and poverty. We will first develop models of disease risk using information on these three zoonotic diseases in northern Tanzania. From this, we will produce a model that can be applied to several other zoonotic diseases and which will allow us to anticipate how drivers may affect livestock systems and zoonotic disease risks in the future. Throughout the project, quantitative epidemiological approaches and disease modelling will be complemented by qualitative research (including interviews, focus group discussions and participatory methods) to enable researchers to understand patterns of risk of disease transmission but also the reasoning that lies behind people's decisions to respond (or not) to this risk. This will also help to ensure that policy interventions to mitigate disease risk are developed in a way that is appropriate to, and therefore more likely to be accepted by, the communities in question. This project is necessarily interdisciplinary and is jointly led by an epidemiologist and a social scientist, which will ensure that scientific and social scientific issues and mutual understanding between disciplines remain central to the project. The international team represents wide-ranging expertise in livestock systems, disease modelling, qualitative social sciences, economics, and development, and also includes policy-makers at national and international levels to inform study design and dissemination approaches that will maximise the uptake of research findings. Annual meetings and regular Skype calls will ensure the exchange of ideas between disciplinary and national backgrounds and will enhance interaction and mentoring between staff at different stages of their careers. The project provides a valuable platform for training opportunities and capacity-building.

Impact Summary

The outputs of this project will substantially advance our understanding of how social, environmental and economic drivers of change affect zoonotic disease risks in Tanzania through changing patterns of livestock ownership, management and human behaviour. The project will focus on three diseases - brucellosis, Q fever and Rift Valley Fever - for which existing interventions (eg livestock vaccination/husbandry, food preparation) have the potential for mitigating disease risks, but are not widely adopted. We will evaluate the epidemiological effectiveness of interventions, as well as the social, economic and behavioural factors that affect acceptability and uptake at community and policy levels. As a result, we will identify methodologies for promoting their uptake to provide practical and immediate ways of minimising disease risk. Through detailed evaluation of disease impact on household livelihoods and poverty, including impacts through human febrile illness and livestock production losses, we will raise awareness of these diseases for evidence-based policy decisions. These outputs and outcomes will generate benefits for a broad constituency of stakeholders: livestock-owners, other men and women who work with livestock, and consumers in

pastoral and peri-urban communities in Tanzania (with relevance for many other parts of Africa); scientists from a range of disciplines in human and animal health, social sciences and economics; and veterinary and medical practitioners. Direct beneficiaries will include communities within the study sites, who will benefit in the near-term as a result of improved awareness of zoonotic diseases and steps that can be taken to reduce disease risks. Enhanced clinical awareness and diagnostic capacity will also improve management of human febrile illness. In the medium-term, communities from across Tanzania, and the sub-Saharan African region will benefit from identification of appropriate intervention strategies in livestock, and the engagement of policy makers with livestock-keepers and researchers throughout the project will ensure that interventions are more likely to be implemented. Community-level benefits will include improved health of people and reduced productivity losses in livestock, which will enhance food security and livelihoods. The academic users of the research will include social scientists, epidemiologists, disease modellers and economists, who will be able to apply insights gained and frameworks established in this project to a range of zoonotic disease problems in other settings. It will also provide interdisciplinary skills for researchers and policy-makers at many different levels, particularly enhancing capacity for social sciences within Tanzanian institutions, which will generate capacity to tackle future interdisciplinary challenges. Policy-makers in Tanzania, as well as international organizations, will benefit from the evidence base generated by this research to support the development of appropriate and integrated policies that relate to livestock and wildlife systems, as well as human health. Engagement of policy-makers throughout the project, and the involvement of project members in regional and international networks, consortia and advisory groups, will facilitate dissemination and uptake of research findings. The project will generate a valuable set of quantitative and qualitative data, including human and livestock sera, with detailed contextual information that adds value to their use for research into other diseases. We will also establish and extend laboratory diagnostic capacity for these diseases in northern Tanzania to support research beyond the project. The project will provide an excellent opportunities training and networking, both within the ZELS programme and other One Health capacity-building and research initiatives. The project thus has great potential to enhance the visibility and competitiveness of UK and Tanzanian science.