Supporting Evidence Based Interventions: Causes and extent of reproductive loss and mortality of domestic ruminants in Tanzania

F. Lankester[1]

Email: felix.lankester@wsu.edu

[1] Paul G. Allen School for Global Animal Health, Washington State University, USA

SUMMARY

Improving productivity of livestock systems by reducing mortality, including reproductive losses, is a priority investment area. Data on the incidence and aetiology of livestock mortality, reproductive losses, and their impact on productivity in sub-Saharan Africa are required in order to prioritize interventions but are still very limited. The overarching objective of SEBI-Tz is to develop intervention strategies to control diseases causing mortality and reproductive loss in livestock in Tanzania. The project will do this by: a) collating and analysing Tanzanian mortality and reproductive loss data found in the literature and other data sources; b) screening existing livestock serum samples to determine the range of abortigenic pathogens that livestock are exposed to; c) analysing linked household survey data to determine the frequency of livestock reproductive losses and associations with pathogen exposure; d) establishing a livestock abortion surveillance platform to investigate cases of reproductive loss and to determine the prevalence of abortigenic agents in such cases; e) carrying out an economic assessment to determine the costs associated with reproductive loss and costs of the strategies used by farmers to mitigate these losses; f) designing and evaluating cost-effective and locally appropriate intervention strategies. SEBI-Tz was launched in March 2017 and the first phase will complete in August 2019. We will present preliminary mortality data, cross-sectional household survey data illustrating the impact of reproductive losses across a range of livestock keeping settings, and results emanating from the first year of the abortion surveillance platform.

Key words: livestock, mortality, abortion, reproductive loss, Tanzania

INTRODUCTION

Improving the productivity of livestock systems by reducing young and adult stock mortality, including reproductive losses, is a high priority investment area. However, data on the incidence and aetiology of livestock mortality, reproductive losses, and their impact on productivity in sub-Saharan Africa are inadequate. Such data are required in order to prioritize interventions in an objective way. The ***Supporting evidence-based interventions - Causes and extent of reproductive loss and mortality of domestic ruminants in Tanzania (SEBI-Tz)*** program has been designed to contribute directly to these goals.

There are four key objectives of SEBI-Tz. First is to collate and analyse existing data on mortality and reproductive losses in Tanzanian cattle and small ruminants at national level; second objective is to use information acquired from the first objective to generate data on patterns and prevalence of infection of abortigenic agents in cattle, sheep and goats in smallholder, agropastoral and pastoral farming systems in Tanzania. The third objective is to establish a surveillance platform by building on existing collaborations in Tanzania and to generate prospective data on aetiology, incidence and impact of cattle and small ruminant abortion in northern Tanzania. Lastly, in the fourth objective, the cumulative data will be used to develop a framework for identifying and evaluating potential interventions.

As the SEBI-Tz project is ongoing, this paper provides a report on the activities carried out and preliminary results generated thus far.

MATERIAL AND METHODS

To accomplish the first objective, data was sourced from the Living Standards Measurement Study – Integrated Survey on Agriculture (LSMS-ISA), published literature, grey literature and household survey. Household data were collected as part of a research programme on Zoonoses and Emerging Livestock Diseases through the Social, Economic and Environmental Drivers of Zoonoses in Tanzania (SEEDZ) project.

For the second objective, serum from over 7,000 livestock samples from northern Tanzania (Arusha, Manyara and Kilimanjaro regions), previously collected as part of the zoonoses research programme, are being tested for exposure to a range of pathogens that may cause reproductive losses in ruminants but are not captured by current disease surveillance in Tanzania. Data for the third objective was collected through the implementation of a real-time surveillance platform that was established covering 16 randomly selected sentinel wards in Arusha, Manyara and Kilimanjaro Regions of Tanzania. Sensitisation meetings were held with livestock keepers in each sentinel ward. During these meetings, livestock keepers were encouraged to report any abortion or peri-natal mortality event observed in cattle, sheep or goats to their local livestock field officer (LFO). These are veterinary technicians employed by the Tanzanian Ministry of Livestock and Fisheries who provide basic veterinary services and are involved in surveillance and veterinary public health measures in Tanzania. Livestock abortions were defined as the termination of pregnancy by the observed expulsion of foetus prior to the end of the known gestation period. Peri-natal mortality was defined as the birth of a calf, lamb or kid that died prior to, during or within 48 hours of parturition and for which the cause of death was unknown. Following training given in data and sample collection, LFOs were asked to report an abortion or still birth event to the project team and, in response to this event, LFOs or members of the study field team visited the dam/ewe/doe(s) in order to collect data and samples. The aim was to make visits within 72 hours of the abortion/still birth event.

Basic farm level data, including number of animals kept, number of affected animals and recent history of reproductive losses were collected. Depending on the availability of material, the following samples were collected (Figure 2): 1. Blood samples from the cow/ewe/doe; 2. Milk samples; 3. Vaginal swabs from the cow/ewe/doe; 4. Tissue from the placental inter-cotyledonary space; 5. Placental cotyledon; 6. Fetal organs (liver, lung and kidney, thymus); and 7. Fetal stomach contents. All LFOs were trained in safe sample collection on both a group and one to one basis and provided with biosafety equipment including gloves, disposable overalls, a disposable apron, goggles, and N95 respirators. Samples were double packed according to UN3373 protocols and transported to the project laboratory at the Kilimanjaro Clinical Research Institute (KCRI) in the town of Moshi via a project vehicle or by courier. Within four to six weeks, the household in which the abortion or still birth occurred was re-visited by the project team and convalescent blood sample(s) collected from the aborting cow/ewe/doe. Where diagnostic results were available, these were fed back to livestock keepers and potential management strategies to minimise disease losses or transmission to people in the case of zoonoses discussed. A detailed household questionnaire, including questions on livestock management, disease losses and economic impacts was also conducted during this visit. Geographic co-ordinates from a central point within the household were collected with a handheld GPS (Garmin eTrex). Samples were tested for evidence of exposure or infection with a wide range of abortigenic pathogens.

RESULTS AND CONCLUSION

For the first objective, we aimed to use LSMS-ISA data to understand the importance of environment, land use, livestock management and veterinary inputs on disease distribution in order to identify targets for control. Average reported rate of disease loss was **5%** in cattle and **9%** in small ruminants**.** Reported mortality rates show important variation by region **(**Figure 1). Farmer reported East Coast fever and CBPP disease events are significant predictors of overall disease-associated mortality in cattle; farmer reports of CCPP strongly predict disease-associated mortality in small ruminants.

The results suggest a growing importance of small stock in response to changing climate with evidence of a shift in livestock keeping from cattle to small ruminants, particularly in rangeland areas. For the second objective, we identified the availability of very common abortigenic pathogens, including zoonotic *Coxiella* (Q fever) and *Leptospira* (Leptospirosis), bovine virus diarrhea virus (BVDV), bovine herpesvirus-1 (the cause of infectious bovine rhinotracheitis) and *Neospora caninum*. Only very low levels of exposure to *Chlamydia abortus* were detected, suggesting that the small ruminant population would be highly susceptible to introduction of the pathogen. In addition, the trend towards higher seropositivity in pastoral settings was identified

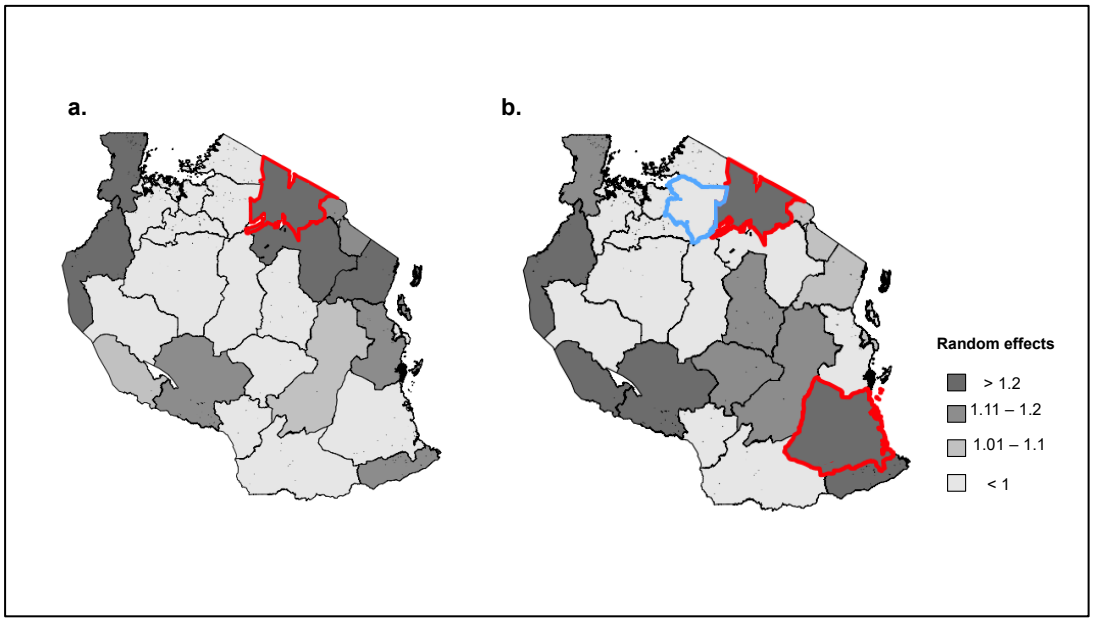

Figure 1. Regional-level random effects for **a. cattle** and **b. small ruminant** disease-associated mortality with account for differences in herd size, livestock production system and socioeconomic status. Regions with a red and blue border have a significantly elevated or reduced rate, respectively (Data source: Tanzania LSMS 2013 and 2015)

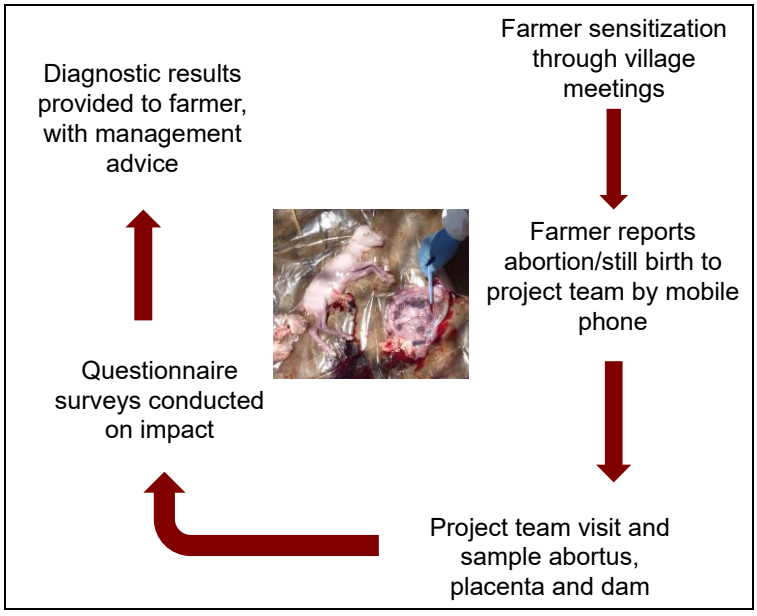

Figure 2. Active surveillance for ruminant abortion and still-birth

Active surveillance aimed at accomplishing the third objective began in December 2017 (Figure 2). A the time this paper was prepared (December 2018), *Coxiellaburnetii, Brucella* sp and *Neospora caninum* infections have been detected in abortion investigations in cattle whereas *C. burnettii* and N*eospora caninum* infection have been detected in goat investigations. Furthermore, *C. burnettii* and *Toxoplasma gondii* infection have been detected in sheep investigations while *Chlamydia abortus* has not been detected in all completed abortion investigations.

Data generated by the abortion surveillance platform, together with the collection of historical data, will provide key information for the design of potential livestock interventions,

which will be developed in the third year of the study as the fourth objective of the project. Community-based participatory approaches will be used to explore strategies based on behaviour change and livestock management strategies, focusing in pastoral communities. As livestock vaccines already exist for many of the expected abortigenic agents (*Brucella* spp*, Coxiellaburnetii, Leptospira serovarHardjo, C. abortus, T. gondii*, Rift Valley Fever virus, BVD, bovine herpesvirus-1), the next phase of the project will also explore options for strategies linked to livestock vaccination. Based on the early acquisition and analysis of data collected by the project, options for potential early interventions will be proposed in order to accelerate the benefits to the control strategies to the target population. The framework will involve a systems approach that will inform the design, implementation and evaluation of interventions, by developing an interdisciplinary 'toolkit' for interventions, including livestock vaccination as well as potential integrated interventions targeting multiple disease problems, including parasitic (e.g. neosporosis, toxoplasmosis), bacterial (e.g. brucellosis, leptospirosis) and viral (e.g. Rift Valley Fever and bovine viral diarrhoea) infections.

CONCLUSION

In conclusion this preliminary SEBI-Tz report has described efforts to understand the importance of environment, land use, livestock management and veterinary inputs on disease distribution in order to identify targets for control**.** In addition, patterns and prevalence of infection of abortigenic agents in cattle, sheep and goats across a range of farming systems in Tanzania have been described. We have reported that exposure is common for several pathogens, including zoonotic *Coxiella* (Q fever) and *Leptospira* (Leptospirosis), that there is a trend towards higher seropositivity of certain pathogens in pastoral settings and that awareness of zoonoses are negatively correlated with infection prevalence, suggesting the communities most at risk have the least knowledge and capacity to cope. Finally, the abortion surveillance platform has identified a number of abortigenic agents circulating and causing losses in Tanzania. We are beginning to develop intervention strategies and the output from this last objective, together with a complete set of results from the data generating objectives, will be presented at subsequent Tanzanian Veterinary Association meetings.

ACKNOWLEDGEMENTS

Team members who include Kathryn Allan[1], Joram Buza[2], Ryan Carter[1], John Claxton[1], Sarah Cleaveland[1], John Crump[3], Will de Glanville[1], Jo Halliday[1], Clare Hamilton[4], Hussein Hassan[2], Lee Innes[4], Frank Katzer[4], Tito Kibona[2], Felix Lankester[5], Matayo Lazaro[2], Morag Livingston[4], David Longbottom[4], Obed Nyasebwa[6], Blandina Mmbaga[7], Furaha Mramba[8], Fadhili Mshana[2], Dassa Nkini[2], Sarah Mollel[5], George Semango[2], Gabriel Shirima[2], Emanuel Swai[9], Rigobert Tarimo[2], Kate Thomas[3], Nick Wheelhouse[10], Ruth Zadoks[1]. Additional assistance to Erin Hodgkinson[1], Karen Main[1], Ellen Hughes[1], James Nyarobi[1] and Brian Willett[11].

[1]Institute of Biodiversity, Animal Health and Comparative Medicine, University of Glasgow, U.K
[2]Nelson Mandela African Institution for Science and Technology, Tanzania
3Centre for International Health, University of Otago, New Zealand
[4]Moredun Research Institute, Penicuik, U.K.; [5]Paul G. Allen School for Global Animal Health, Washington State University, USA; [6]Zonal Veterinary Centre, Ministry of Livestock and Fisheries, Arusha, Tanzania
[7]Kilimanjaro Clinical Research Institute, Moshi, Tanzania; [8]Tanzanian Veterinary Laboratories Agency, Dar es Salaam, Tanzania; [9]Ministry of Livestock and Fisheries, Dodoma, Tanzania
[10]Edinburgh Napier University, Edinburgh, U.K & [11]MRC-University of Glasgow Centre for Virus Research, U.K.

This project is funded by the Supporting Evidence Based Interventions project, University of Edinburgh (grant number R83537)