

Multispecies livestock rearing in developing countries – a challenge to collect, present and interpret surveillance data

TT ZAW WIN¹, A CAMPBELL⁴, RJS MAGALHAES^{1,2,3}, KN OO⁵, J HENNING¹

¹The School of Veterinary Science, The University of Queensland, Gatton, Australia; ²UQ Spatial Epidemiology Laboratory, The School of Veterinary Science, The University of Queensland, Gatton, Australia; ³Children's Health and Environment Program, The University of Queensland, The University of Queensland, South Brisbane ⁴QLD, Australia; ⁴Faculty of Veterinary & Agricultural Sciences, The University of Melbourne, Melbourne, Australia;

⁵Livestock Breeding and Veterinary Department, The Ministry of Agriculture, Livestock and Irrigation, The Republic of the Union of Myanmar

*t.zawwin@uq.edu.au

Abstract

The Central Dry Zone (CDZ) is one of the most important livestock production areas of Myanmar. This region supports 10 million people whose livelihoods depend on small-scale, dry-land agriculture, but it is also one of the poorest regions of Myanmar. Livestock production is a major income source for farmers in the CDZ. Multi-species rearing of livestock is common under the challenging climatic conditions of the CDZ. There is a need to understand the limitations and opportunities for livestock production, health and marketing in the multispecies environment of CDZ in order to develop methods to improve livestock production outputs and to establish a disease surveillance system that addresses the challenges of multispecies rearing. In this research project, quantitative survey techniques were used to compile data on livestock production, health and trading from cattle, sheep and goat and village chicken farmers in 40 villages of the CDZ. Survey-design based regression modelling was used to quantify factors affecting livestock production, biosecurity and health in the CDZ. Our results highlight that livestock management, disease prevention methods, biosecurity practices and even farmer's awareness towards disease control differ between livestock species ownership groups. The characteristics, constraints and opportunities of species-specific production and marketing have to be considered in order to develop efficient, reliable and relevant strategies to improve production and to establish a holistic disease surveillance system for multispecies livestock rearing households.

Keywords: *Livestock production; central dry zone; small scale farmers; health; livelihood; smallholder*

Introduction

Myanmar's economy is dominated by agricultural production with livestock production playing an important role. According to a 2009 World Animal Health Organization (OIE) report, approximately 13 million cattle, three million sheep and goats and 135 million poultry are kept in Myanmar (1). The centre of Myanmar is occupied by the Central Dry Zone (CDZ), a major hub for crop and livestock production, containing almost 50% of Myanmar's livestock population and the majority of the country's 47 official cattle markets. The area comprises alluvial lowlands in a semi-arid tropical

environment and is characterised by variable, low annual rainfall of approximately 600–1,000mm (2). Small ruminants (goats and sheep) are frequently reared in the CDZ, reflecting these species' adaptability and suitability to the area's climate (3), although cattle and village chicken production dominate livestock rearing in the region.

Some reports describing individual livestock sectors exist (4), however comprehensive research of livestock husbandry and health and, in particular, the ways comparable households raise different livestock species has not been conducted. Approaches that focus on all livestock species within a household, rather than different livestock species in isolation, are particularly important for providing holistic information about how livestock ownership and management may be used to improve the livelihoods of small-scale producers. This is particularly important as infectious diseases, such as Foot and Mouth Disease, can be transmitted between different species within the same household, and trade of multiple species from households can result in a wide range of transmission pathways for infectious pathogens along the market chain.

This study describes multi-species livestock rearing and its contribution to the livelihoods of farmers in the Central Dry Zone (CDZ) of Myanmar. It identifies limitations and opportunities for animal production, health and marketing in the CDZ, which could be further researched or addressed with the aim of improving livestock productivity. This study also identified characteristics of multispecies rearing that have to be considered when conducting disease surveillance in resource-poor households in developing countries.

Materials and methods

Study design and selection of sampling units

A cross-sectional study was conducted among small-scale farming households owning different livestock species in two administrative areas ('townships'), Myingyan and Meikhtila, in the CDZ of Myanmar. These two CDZ townships were the sites for a broader livestock production and health research project (the 'DAHAT PAN' project), and had been identified as being representative for CDZ livestock production (5). Two-stage (villages and households) sampling was used to identify households to be included in the survey. The survey's

sample size was calculated to estimate the proportion of households deriving at least half their income from livestock assuming an *a priori* prevalence of $\geq 70\%$, precision of $\pm 5\%$, 95% confidence, and within- and between-cluster variances of $\pm 10\%$ and $\pm 2.5\%$, respectively, based on a preliminary survey. The software Survey Toolbox was used to estimate the number of villages and households to be sampled (6) – the required sample size was 20 households per village from 38 villages. Probability proportion-to-size sampling (7) was used to select the villages to be sampled from a total of 400 villages across the two townships.

Questionnaire

A questionnaire was developed to collect information on herd/flock structure, husbandry practices, biosecurity measures, household size and demographics, householders' education level, and size and source of household income and assets. Owners were asked to specify the health problems observed in their animals over the preceding two years, which were then grouped according to common clinical syndromes for different body systems. The questionnaire was developed in English and translated into Myanmar/Burmese, and piloted in several villages. The questionnaire survey was conducted by seven trained enumerators.

Statistical analysis

Data were entered in Microsoft Excel 2013, and checked for data entry errors, validation and reliability. Survey analysis was conducted in Stata 14.0 (Stata Statistical Software, College Station, Stata Corporation, 2015), accounting for sampling weights, sampling strata (townships) and clustering (villages). Hypothesized causal diagrams between different outcome variables and predictors were created using acyclic graph theory (8) and visualized with DAGitty software (9) by adjusting for direct and indirect effects (10). Risk factors significant at $P < 0.05$ in the univariate analyses were tested in multivariable models using a backward stepwise model building procedure. Multivariable models were compared using the likelihood ratio test (LR), Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). Results of the final models were presented as adjusted odds ratios.

Results

Data were collected from a total of 613 households. Multispecies livestock production within a household was very common. Of the 613 households, 19.6% of household had cattle only, 18.9% of households kept cattle and village chickens, 16.8% of households raised small ruminants only, 15.5% of households had cattle, small ruminants and village chickens, 12.2% of households had village chickens only, 9.2% of households kept cattle and small ruminants, and 7.8% of households small ruminants and village chickens. The median herd or flock sizes were four cattle, 30 small ruminants and 10 village chickens. Households owning larger cattle herds (small herd size = 1-3; medium herd size = 4-6; large herd size = >6) were more likely to hire labour (OR: 2.4, 95%CI: 1.3-4.4), and provide supplementary feed in the form of sesame cake in summer (OR: 2.1, 95%CI: 1.1-4.0)

and maize in winter (OR: 2.1, 95%CI: 1.2-3.7). However, these management practices were less common for goat and sheep holdings, where the odds ratios for labour hiring, and sesame and maize feeding in large herds/flocks compared to smaller ones were 0.5 (95%CI: 0.3-0.99), 0.3 (95%CI: 0.1-0.8) and 0.2 (0.1-0.7), respectively.

Natural mating was the most common livestock breeding method in the CDZ. About half (57%, 95%CI: 50.0-63.2) of all cattle farms sourced bulls from the same village, although 27% (95%CI: 22.1-34.0) used bulls from other villages. 13.4% (95%CI: 9.4-18.6) of households used their own bull; only 0.5% (95%CI: 0.1-3.3) of households used artificial insemination. In contrast, the large majority (86% (95%CI: 81-89%)) of small ruminant-owning households used males from within their own household herds/flocks, with only 14% (95%CI: 10-18%) and 1% (95%CI: 0.3-3%) of households sourcing males from elsewhere in the same village or another village, respectively.

Fewer efforts were made to improve the health of village chickens compared to large or small ruminants. More than half (52%, 95%CI: 46-61%) of village chicken owners would not conduct any treatment of sick chickens, while only 6.6% (95%CI: 4.3-10.0) and 3.9% (95%CI: 2.1-7.2) of cattle and small ruminant owners would not treat their sick animals, respectively. If treatment was conducted, the majority of small ruminant (64.1%) and village chicken (91.1%) owners relied on traditional medicine. Conversely, the majority of cattle farmers used a veterinary healthcare provider alone or in combination with traditional medicine. Interestingly biosecurity practices differed between livestock ownership groups ($p < 0.0001$), with cattle owners (28.7%, 95%CI: 23.0-35.3), small ruminant owners (63.3%, 95%CI: 55.7-70.4) and poultry farmers (69.7%, 95%CI: 62.6-75.9) conducting any of the followings: reducing contact with sick animal, reducing the entry of people, quarantine the sick animal, disinfection and regular cleaning the farm. Segregation of sick animals was more common for cattle owners (43.9%, 95%CI: 38.1-49.9) and small ruminant owners (34.0%, 95%CI: 25.9-43.1) than village chicken owners (24.6%, 95%CI: 18.0-32.6).

Respiratory problems (coughing, sneezing, discharge from the nose or other disorders of breathing) were most commonly reported for cows and calves, with 26% (95%CI: 21-32%) and 12% (95%CI: 8-18%) of animals showing signs in the last two years, respectively. Digestive system problems (including drooling, sores in mouth, anorexia, constipation, painful abdomen and diarrhoea) were most commonly reported in bulls (33%, 95%CI: 42-71%). Conversely, digestive system problems were most frequently reported in young small ruminants, affecting nearly half of all animals (46%, 95%CI: 37-55%). Respiratory problems were more common in adult small ruminants, affecting 49% (95%CI: 42-56%) of does/ewes and 37% (95%CI: 29-45%) bucks/rams. In village chickens, 'physical' abnormalities (twisted head or neck, slow growth, weakness, frequent lying down, mechanical injuries)

affected about one quarter of birds from different age/sex groups: 26% (95%CI: 19-33%) in chicks; 28% (95%CI: 21-37%) in hens; and 26% (95%CI: 19-35%) in cocks. There were differences in likelihood of health problems occurring depending on the size of the livestock holding. The majority of cattle farmers (81.2%, 95%CI: 76.4-85.3), 74.4% (95%CI: 66.8-80.7), small ruminant farmers and poultry farmers 67.8% (95%CI: 61.2-73.8) were aware of the effectiveness of vaccinations (FMD and ND). However, the major constraint for conducting vaccinations in cattle (17.4%, 95%CI: 12.7-23.3) and poultry (14.9% 95%CI: 10.3-21.1) were limited financial resources while small ruminant farmers highlighted their limited knowledge about vaccinations (21.4%, 95%CI: 15.9-28.2). Nevertheless, the majority of cattle farmers (87.0%, 95%CI: 80.8-91.4) small ruminant farmers (75.9%, 95%CI: 65.8-83.7) and poultry farmers (68.9%, 95%CI: 61.5-75.5 of) were willing to have their livestock vaccinated.

Discussion

The main goal of the current study was to provide more detailed descriptions of livestock ownership, husbandry and health in the CDZ of Myanmar. Despite the country's rapid recent social change and improved connection with the outside world, livestock production still mainly follows traditional methods. No single species dominated household ownership, and multiple species, even of different kinds of ruminants, were frequently owned by households. This suggests that livelihood development strategies should address the potential for multiple income sources within a household. Such strategies may also have wider benefit if they can exploit synergies between production practices and knowledge for different species—for example, ensuring that training to improve livestock nutrition identifies concepts that apply to both goats and cattle. Likewise, differences in seasonal patterns of grazing for large and small ruminants deserve further investigation to understand whether constraints or opportunities in one species' grazing management could be addressed for another's. Similarly, approaches to improve biosecurity and enhance disease control have to address all pathways for disease introduction and spread that come with rearing different livestock species within one household. The differences in farmer attitudes to investing extra in labour or feed for cattle compared to small ruminants are very interesting. The willingness of owners of larger cattle herds to spend more in these areas may reflect their greater wealth or financial insight. On the other hand, larger small ruminant herds/flocks may present an increasing financial challenge to farmers, making them reluctant to spend money to support productivity as their livestock holdings increase. This is a critical issue that must be addressed, as development strategies often seek to increase holdings of small ruminants by households. Our results suggest that farmers may be unwilling to invest in extra resources to support increased productivity as their holdings grow.

The observations reported by farmers of their animals' health help identify body systems and a smaller set of potential diseases that could be targeted for investigation. This allows limited resources to be used more efficiently to better understand disease constraints on productivity. Similarly, this insight could be used to direct training or limited health surveillance resources to where it is likely most needed. On the hand, training workshops for farmers could cover various livestock species at the same time, thereby comparing appropriate approaches for different livestock species to improve their productivity and health. Smallholders appear to generally have poor access to veterinary services for small ruminants and village poultry, or are unwilling to spend money on these treatments compared to traditional ones. Furthermore, owners of all species appear to have poor access to knowledge and resources to manage the health of their animals. In addition income generated from more valuable livestock species, such as cattle, might also result in higher disease reporting efforts by farmers compared to less valuable livestock, such as chickens (which are also 'traded' as dead animals). Developing a disease surveillance system for multispecies rearing households has to synergistically address these challenges.

Whilst identifying important limitations to animal production in Myanmar's CDZ, this study also highlighted issues that have to be considered when conducting surveillance of production and health parameters in multispecies households.

References

1. **OIE.** Animal health situation in Asia, the Far East and Oceania in 2008 and the first half of 2009. In: *26th Conference of the OIE Regional Commission for Asia, the Far East and Oceania 2009*. Shanghai, PR China OIE.
2. **Raitzer DA et al.** Myanmar's Agriculture Sector: Unlocking the Potential for Inclusive Growth. In: *ADB Economics Working Paper Series*. Asian Development Bank: Manila, Philippines. p38, 2015
3. **JICA.** The development study on sustainable agriculture and rural development for poverty reduction programme in the Central Dry Zone of the Union of Myanmar. 2010. Cited 7 August 2015. http://www.lift-fund.org/sites/lift-fund.org/files/uploads/Dry_Zone/JICA_Central_DZ_Report.pdf.
4. **Maclean MF.** *Myanmar Livestock Sector Study*. FAO - Emergency Centre for Transboundary Animal Disease: Myanmar. p109, 2011
5. **ACIAR.** Improving livelihoods of small-scale livestock producers in the central dry zone through research on animal production and health in Burma. 2014. Cited 2 June 2016. <http://aciar.gov.au/project/ah/2011/054>.
6. **Sergeant E.** Sample sizes for 2-stage prevalence surveys. 2014 <http://epitools.ausvet.com.au/content.php?page=2StagePrevalence1>.
7. **Sergeant E.** Random sampling from sampling frame. 2014. <http://epitools.ausvet.com.au/content.php?page=RandomSampling1>.

8. **Wang L.** Directed acyclic graph, in Encyclopedia of Systems Biology. Springer. p574-574, 2013
9. **Textor J, Hardt J, Knüppel S.** DAGitty: a graphical tool for analyzing causal diagrams. *Epidemiology* 22(5), 745, 2011
10. **Textor J.** Drawing and Analyzing Causal DAGs with DAGitty. arXiv preprint arXiv:1508.04633, 2015.

Acknowledgements

I would like to express my gratitude and appreciation to the farmers, villagers, middlemen and traders for their answers, patience, assistance and friendliness. This work was supported by the Australian Government through the Australian Center for International Agriculture Research (ACIAR) and a John Allwright Fellowship.