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Prioritizing smallholder animal health needs in East Africa, West Africa, and South Asia using three approaches: Literature review, expert workshops, and practitioner surveys

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ABSTRACT

Managing the health needs of livestock contributes to reducing poverty and improving the livelihoods of smallholder and pastoralist livestock keepers globally. Animal health practitioners, producers, policymakers, and researchers all must prioritize how to mobilize limited resources. This study employed three approaches to prioritize animal health needs in East and West Africa and South Asia to identify diseases and syndromes that impact livestock keepers. The approaches were a) systematic literature review, b) a series of expert workshops, and c) a practitioner survey of veterinarians and para-veterinary professionals. The top constraints that emerged from all three approaches include endo/ ectoparasites, foot and mouth disease, brucellosis, peste des petits ruminants, Newcastle disease, and avian influenza. Expert workshops additionally identified contagious caprine pleuropneumonia, contagious bovine pleuropneumonia, mastitis, and reproductive disorders as constraints not emphasized in the literature review. Practitioner survey results additionally identified nutrition as a constraint for smallholder dairy and pastoralist small ruminant production. Experts attending the workshops agreed most constraints can be managed using existing veterinary technologies and best husbandry practices, which supports a shift away from focusing on individual diseases and new technologies towards addressing systemic challenges that limit access to veterinary services and inputs. Few research studies focused on incidence/ prevalence of disease *and* impact, suggesting better incorporation of socio-economic impact measures in future research would better represent the interests of livestock keepers.

1. Introduction

Healthy livestock support a growing human population, contribute to economic growth, and for the world's poor, can offer a pathway out of poverty. Disease is a threat to these benefits, and humans have been concerned with the control of animal disease for thousands of years. A collection of papyri from the ancient Egyptian town of Kahun dating back to 2nd millennium BC containing detailed descriptions of cattle diseases and their treatment showcases our long history managing animal disease (Steverding, 2008). In modern times, motivations to control animal disease range from public health concerns in the case of zoonoses (Sherikar and Waskar, 2005; Kahn, 2006; Katz et al., 2009), economic gain (Singh et al., 2015; Webb et al., 2018; Barratt et al., 2019), and improvement of livelihoods (Peacock, 2005; Randolph et al., 2007; Kryger et al., 2010), especially for people around the world who depend on livestock. Controlling disease is a worthy but costly investment. Motivations for control often dictate how research and control efforts are prioritized.

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1.1. Prioritization frameworks

This research contributes to an ongoing conversation about prioritization of animal health needs to maximize the impact of livestock on alleviating poverty. A seminal study described by Perry et al. (2002) was the first large-scale attempt to assess disease impacts with this goal in mind (Perry et al., 2002). The study considered all livestock species, all types of diseases (endemic, epidemic, zoonotic, and food-borne), and three major geographies where major concentrations of poverty exist: South-east Asia, South Asia, and Sub-Saharan Africa. The result was a ranking of priority diseases based on literature review and semi-quantitative input from groups of experts working in veterinary services, NGOs, and international organizations. Disease categorizations were overlaid on databases of livestock production systems and poverty.

Heffernan (2009) contributed a data-driven livestock disease prioritization framework that broadened the data inputs beyond a group of experts. The framework incorporates standard poverty measures, rankings of the importance of respective livestock species, income data, and mortality and morbidity rates of disease to yield a 'disease gap' or change in the poverty status of a household due to the impact of influence of a livestock disease. The study found large variations in the impact of the same disease across the wealth groups and within the same production system. East Coast fever had the greatest impact on poverty amongst pastoralists and smallholder farmers, while foot and mouth disease was more problematic for the better-off pastoralists (Heffernan, 2009). The framework was informed by data from livestock keeping households in Kenya. Data availability is a constraint to expanding this framework to new geographies. The Global Burden of Animal Diseases (GBAD) program, launched in 2018, is addressing this gap through the creation of a dataset used to estimate direct and indirect losses caused by animal diseases worldwide (Rushton et al., 2018). While the GBAD program will involve some data collection, it relies on exploiting existing public and private datasets.

This study contributes to the animal health needs prioritization conversation by identifying the most important animal health constraints affecting the livelihoods of commercially oriented smallholder farmers and pastoralists using three methods. By assessing the incidence/ prevalence and impact of smallholder animal health constraints using multiple methods across three geographic regions, we identify priorities and compare methods of prioritization.

2. Methods

The study contains three activities: a) a systematic literature review, b) a series of expert workshops, and c) a practitioner survey of veterinarians and para-veterinary professionals (Table 1). The geographic focus of the study was South Asia, West Africa, and East Africa. This study was designed as an initiative within the Global Alliance for Livestock Veterinary Medicines (GALVmed) 2030 strategy development process. GALVmed is a not-for-profit company operating as a livestock health product development and access partnership and a UK registered charity ("GALVmed", 2020).

2.1. Systematic literature review

A systematic literature review was conducted to understand the current state of published knowledge regarding smallholder animal health needs and the impact of diseases and syndromes (Fig. 1). We conducted searches in PubMed, CAB Abstracts, and Web of Science databases (Supplementary material 1). Document eligibility criteria included relevant location and livestock species, primary or secondary data, written in English, and published between 2002 and 2019. Each article was tagged with animal health constraint, location, and livestock category tags (Supplementary material 2 and 3). We were unable to consistently determine whether studies represented smallholder farmers, pastoralists, and/ or both so we did not disaggregate. The animal health tags were standardized based on health constraints that came up in the literature. All articles were given preliminary tags using keyword searches of the title and abstract. After the eligibility screening, a subset of articles with a focus on impact were selected and systematically tagged after reading the full text. These articles were purposively chosen for their consideration of incidence/ prevalence, impact, and smallholder perspective.

Summarized articles were given a ranking (green, yellow, red) to indicate the extent of the article's focus on incidence/ prevalence of animal health constraints and their impact (Fig. 1). Green-ranked articles are best, focusing on incidence/ prevalence and impact. Four researchers trained on a shared set of about 20 articles, discussed conflicts, then subsequent articles were ranked by a single researcher. A team of two researchers worked together on each geographic area with one member of each team professionally based in or responsible for the relevant geographic area. Incidence/ prevalence included disease seroprevalence, outbreak incidence, number of cases, or percentage of self-reported disease. Impact included mortality, morbidity, production losses, economic losses, monetary quantification of disease burden, or qualitative descriptions of impact by smallholder livestock keepers. The principal summary measure used in the results was whether a given animal health constraint was mentioned in the article regardless of the type of study conducted. We did not attempt to assess bias of individual studies that may have affected their study outcome although the quality of the impact articles is reflected in the ranking criteria.

Table 1
Summary of study methods with associated geographies, livestock categories, and production systems.

Method	Geography	Livestock categories	Production systems
1. Systematic literature review	**South Asia**: India, Nepal, *Bangladesh (only if paired with India/ Nepal)* **West Africa**: Senegal, Mali, Ghana, Burkina Faso, Ivory Coast, Togo, Benin, Nigeria **East Africa**: Tanzania, Kenya, Uganda, Ethiopia, South Sudan, Malawi, Mozambique, Zambia	**Bovids**: Cattle, dairy cows, buffalo, yaks **Small ruminants**: Sheep, goats **Poultry**: Chickens, ducks, guinea fowl	Smallholders, agro-pastoralists, pastoralists, small-scale commercial
2. Expert workshops	**South Asia**: Held in India, participants from India and Nepal **West Africa**: Held in Ghana, participants from Chad, Mali, Côte d'Ivoire, Nigeria, Ghana, Sierra Leone **East Africa**: Held in Ethiopia, participants from Kenya, Tanzania, Ethiopia, Uganda	Poultry, small ruminants, cattle, dairy (including buffalo)	Smallholder and pastoralists
3. Veterinary practitioner survey	**East Africa**: Practitioners from East Africa, Uganda best represented	Emergent commercial poultry farming Low input small ruminant farming Smallholder large ruminant (non-dairy) Small scale dairy farming Pastoralist large ruminant farming Pastoralist small ruminant farming	

2.2. Expert workshops

Three workshops were held with sector experts in Ethiopia, Ghana, and India in 2019.

Experts were selected based on having extensive, first-hand knowledge of smallholder livestock production systems in relevant settings

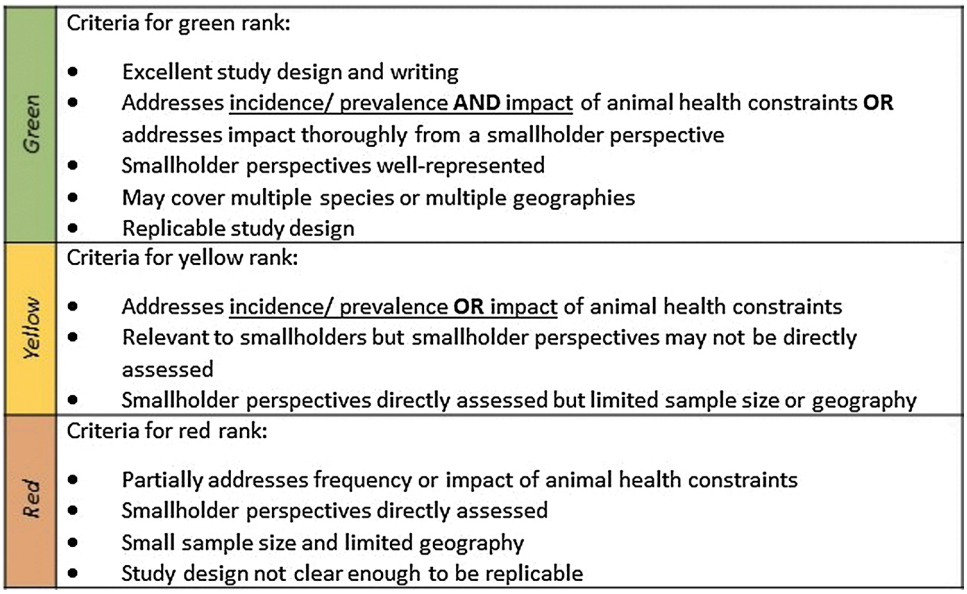

Fig. 1. Ranking criteria used for the subset of articles focusing on impact of animal health constraints on smallholders and pastoralists.

within the specific regions of interest (East Africa, West Africa, India & Nepal) and operational knowledge of veterinary provision to smallholder livestock keepers. The objective was to identify big picture priorities from the perspective of a commercially oriented smallholder livestock keeper across a large geographic area. By default, such an approach fails to capture finer scale variation and doesn't include first-hand testimonials from farmers, farmer groups, or value chain actors who interact with farmers. The workshop relied on experts to synthesize their experiences working with livestock keepers into succinct identification of constraints that are important on a large scale.

Workshop sessions were structured to achieve a consensus of animal health constraint ranking while attempting to address inherent biases brought by the experts (e.g. resulting from their research focus or those diseases prioritized by government veterinary services) and in the literature (e.g. focus on specific diseases without examining the broader impact to the smallholder). To assist the experts in developing independent opinions without being biased by the group during the workshop, each participant was asked to rank the top three animal health priorities before the meeting, using a standard form. Attention was drawn to the "animal health constraint" so the experts could prioritize syndromes and not be restricted to individual diseases. The literature review was shared with the attendees, after they had completed their survey, but before travelling to the workshop. The workshop itinerary is presented in Supplementary material 4.

2.3. Veterinary practitioner survey

An animal health priority questionnaire (Supplementary material 5) was administered to veterinarians and para-veterinary professionals working in East Africa. They were asked to rank animal health constraints in a series of categories of species/ production systems (Table 1). The survey administration was managed by two GALVmed regional veterinary consultants on contract for a larger survey project. The consultants reached out to the veterinary practitioners and requested they complete the 30- minute survey using an online link or by printing and scanning a paper form. A payment of $10 USD was set as an incentive to return the survey within one week. The target was to request a completed survey from 20 practitioners from each of the 3 countries (Kenya, Tanzania, and Uganda) for a total of 60 people contacted.

3. Results

3.1. Systematic literature review

The literature search resulted in 524 eligible documents for the overall literature review and a subset of 199 documents that focused on impact (see Fig. 2 and Supplementary materials 3, 6–8). Of the 199 impact articles, only 17 articles across all geographies met the criteria for the "best" green rank, "addressing incidence/ prevalence AND impact of animal health constraints OR addressed impact thoroughly from a smallholder perspective".

The top 15 animal health constraints for all geographies in order of number of overall literature review articles that mentioned them were foot and mouth disease (FMD), ectoparasites, brucellosis, endoparasites, helminths, peste des petits ruminants (PPR), animal African trypanosomiasis (AAT), tick-borne diseases, Newcastle disease (ND), mastitis, mange, tuberculosis, abortion, Rift Valley Fever (RVF), and diarrhea. The number of documents mentioning each health concern ranged from 60 for FMD to 19 for diarrhea (Fig. 3). A full list of all health constraints and annotated bibliographies by region and livestock type are presented in Supplementary material 6. Five green-ranked articles mentioned FMD and trypanosomiasis respectively (three articles discussing animal African trypanosomiasis plus two discussing trypanosomiasis in South Asia) and two mentioned lumpy skin disease (LSD) (Supplementary material 8). Health constraints mentioned by a single, green-ranked article included ectoparasites, abortion, East Coast fever, Newcastle disease, PPR, and black quarter.

When all impact articles are broken down by geography and production system, as shown in Table 2, important health concerns include FMD and brucellosis for bovids (which includes cattle and dairy), PPR for small ruminants, and Newcastle disease for poultry with the addition of avian influenza in West Africa and South Asia. Broad categories including endoparasites, exoparasites, and helminths are top concerns in all geographies, especially for bovids and small ruminants.

3.2. Expert workshops

A total of 23 participants attended the three expert workshops (12 in South Asia, 13 in West Africa, and 8 in East Africa). The experts included academic researchers, government veterinarians, and representatives from private sector companies and NGOs delivering veterinary products and services to smallholder livestock keepers. Only three participants

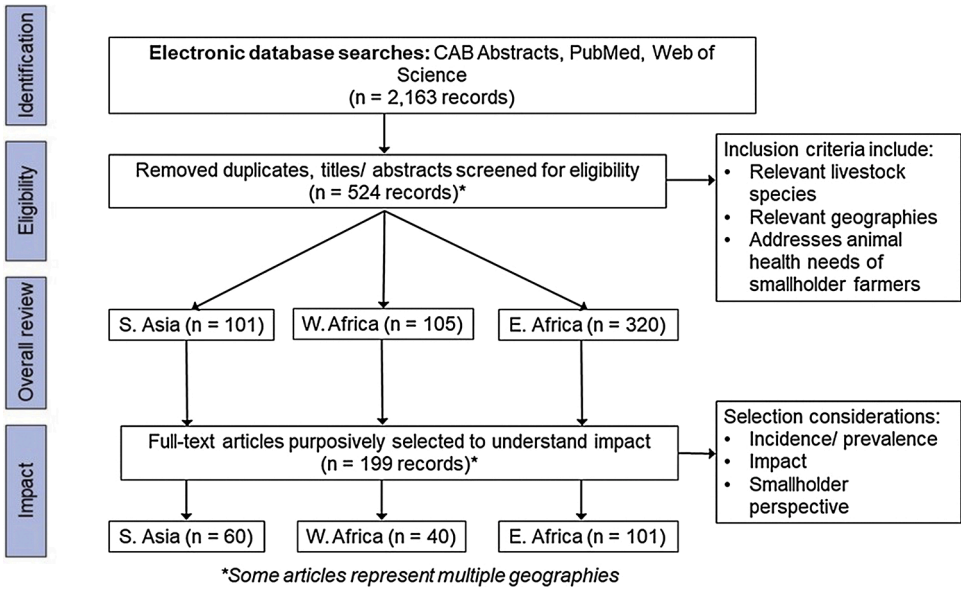

Fig. 2. PRISMA flow diagram showing the selection of articles for the overall literature review and more targeted impact study.

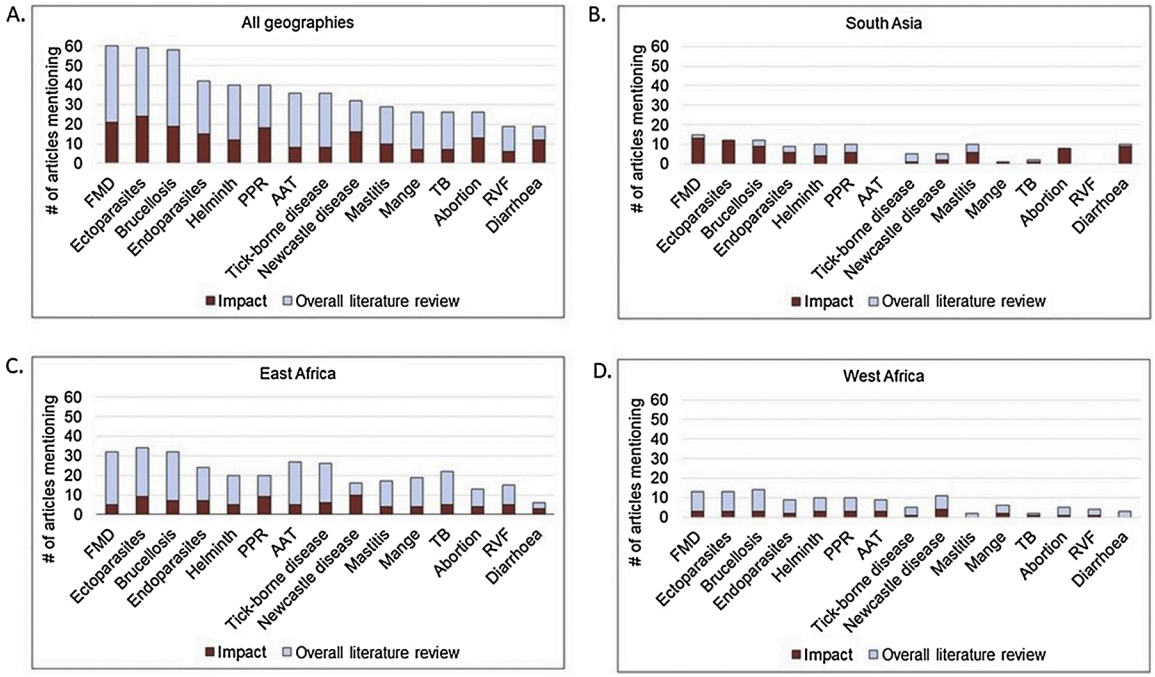

Fig. 3. Top 15 animal health constraints by geographic area ordered by number of articles mentioning the concern. (n = 524 articles) The height of the bar represents the total number of articles, the upper, light blue bar represents the number of articles in the overall literature review, and the lower, dark red bar represents the subset of articles focusing on impact. **Abbreviations:** Foot and mouth disease (FMD), peste des petits ruminants (PPR), animal African trypanosomiasis (AAT), tuberculosis (TB), Rift Valley Fever (RVF), lumpy skin disease (LSD). **Note:** Some constraints do not apply to all geographic areas, such as Rift Valley Fever in South Asia. Some articles mention multiple health constraints.

were women and there were no women participants in the South Asia workshop. The workshops, unlike the systematic literature review, differentiated between animal health constraints for smallholder farmers and pastoralists and divided dairy and cattle into two separate categories.

Top concerns included FMD, PPR, Newcastle disease, avian influenza, consistent with the top results of the systematic literature review, with the addition of Contagious Caprine Pleuropneumonia (CCPP), Contagious Bovine Pleuropneumonia (CBPP), mastitis, and reproductive disorders (Table 3). The workshop results contained additional health constraints not mentioned in the top 15 animal health constraints of the systematic literature review, including dermatophilosis, Gumboro disease (infectious bursal disease), sheep and goat pox, respiratory problems, abortion, coccidiosis, lameness, orf, and foot rot.

The increasing endemicity of avian influenza in West Africa and India was highlighted as a threat to smallholder poultry production, with broader veterinary public health implications. FMD was recognized as a constraint to large ruminant production in all three workshops. The availability of FMD vaccines, either through public immunization campaigns or private sector delivery, was identified as a major factor in

Table 2
Animal health constraints: Findings from overall literature review documents including subset of impact articles. Health constraints mentioned by only one article not listed.

Overall review	Region	n	1.	2.	3.	4.	5.
Poultry	East Africa	29	ND (16)	IBD (10)	*Fowl pox (4)	*Coccidiosis (4)	*Endo/exoparasites (4)
	West Africa	24	Avian influenza (9)	ND (8)	IBD (4)		
	South Asia	16	ND (5)	Avian influenza (3)	Coccidiosis (2)	Salmonellosis (2)	
Small ruminants	East Africa	100	PPR (20)	Ectoparasites (19)	Mange (16)	Helminths/ endoparasites (12)	RVF (12)
	West Africa	34	Ectoparasites (8)	Helminths (7)	Endoparasites (6)	Brucellosis (6)	
	South Asia	35	PPR (9)	Ectoparasites (8)	Helminths (7)	Endoparasites (6*)	Brucellosis (6*)
Cattle/dairy	East Africa	240	FMD (31)	Brucellosis (29)	AAT (27)	Ectoparasites (25)	TBDs (22)
	West Africa	67	FMD (13)	Brucellosis (12)	AAT (9*)	Ectoparasites (9*)	Helminths (9*)
(w. buffalo)	South Asia	61	Ectoparasites (12*)	FMD (12*)	Brucellosis (11)	Mastitis (10)	Theileriosis (8)
Impact	Region		1.	2.	3.	4.	5.
Poultry	East Africa	12	ND (10)	IBD (3)	Fowl pox (4)	Endo/exoparasites (3*)	Coccidiosis (3*)
	West Africa	10	Avian influenza (5)	ND (4)	CRD (2)		
	South Asia	9	Avian influenza (3)	ND (2)	Coccidiosis (2)		
Small ruminants	East Africa	35	PPR (10)	Ectoparasites (9)	Mange (9)	Endoparasites (6)	
	West Africa	24	Helminths (4)	Ectoparasites (3)	Endoparasites (3)	Haemonchosis (3)	
	South Asia	24	Helminths (4)	PPR (3*)	Endoparasites (3*)	Ectoparasites (3*)	Haemonchosis (3*)
Cattle/dairy	East Africa	67	Brucellosis (9)	FMD (8*)	AAT (8*)	Ectoparasites (8*)	TBDs/ LSD (8*)
	West Africa	25	Brucellosis (5*)	Helminths (5*)	FMD (4*)	Endoparasites (4*)	
(w. buffalo)	South Asia	37	FMD (10)	Ectoparasites (8*)	Brucellosis (8*)	Diarrhea (7)	

Abbreviations: Newcastle disease (ND), Infectious bursal disease (IBD), peste des petits ruminants (PPR), Rift Valley Fever (RVF), African trypanosomiasis (AAT), tick-borne diseases (TBDs), lumpy skin disease (LSD). **Notes:** TBDs include heartwater, ECF, anaplasmosis, babesiosis. Helminths is a subset of the endoparasite category.
* Indicates a tie.

Table 3
Animal health constraints: Consensus from East Africa, West Africa, and South Asia expert workshops.

Smallholders	Region	1.	2.	3.	4.	5.	6.
Poultry	East Africa	ND	Nutrition	Diarrhea	Gumboro	Fowl typhoid	Fowl pox
	West Africa	ND	Gumboro	Diarrhea	Avian influenza	Fowl pox	
	South Asia	Avian Influenza	ND	Fowl pox	Coccidiosis	Ecto/ Endoparasites	Gumboro
Small ruminants	East Africa	CCPP	PPR	SGP	Helminths	Abortion	Foot rot
	West Africa	PPR	Helminths	Mange	Abortion	Heartwater	Lameness
	South Asia	PPR	Endoparasites/ diarrhea	Respiratory problems	Vesicular disease	Zoonoses	Abortion
Cattle	East Africa	FMD	TBDs	LSD	Helminths	AAT	
	West Africa	CBPP	Dermatophilosis	Abortion	Ecto/Endo parasites	Lameness	
Dairy	East Africa	Mastitis	Abortion	Brucellosis	FMD	LSD	TBDs
	West Africa	Masititis	Abortion	FMD	Helminths	Dermatophilosis	
(w/ buffalo)	South Asia	Reproductive disorders	FMD	Mastitis	Ecto/Endo/ Haemo parasites	Metabolic diseases	Zoonoses
Pastoralists							
Small ruminants	East Africa	CCPP	Helminths	PPR	SGP	Orf	Abortion
	West Africa	PPR	Helminths	Abortion	Mange	Heartwater	
Cattle	East Africa	FMD	TBDs	AAT	LSD	Helminths	Anthrax
	West Africa	CBPP	Dermatophilosis	FMD	Bovine TB	Abortion	Ecto/ Endoparasites

Abbreviations: Newcastle disease (ND), contagious caprine pleuropneumonia (CCPP), peste des petits ruminants (PPR), sheep and goat pox (SGP), foot and mouth disease (FMD), tick-borne diseases (TBDs), lumpy skin disease (LSD), animal African trypanosomiasis (AAT), contagious bovine pleuropneumonia (CBPP), bovine tuberculosis (bovine TB). **Note:**Haemo parasites include theileria, trypanosomes, and babesia; metabolic diseases include milk fever and ketosis; vesicular diseases include Orf, contagious ecthyma, FMD, SGP; zoonoses include Johne's disease and brucellosis; reproductive disorders include symptoms resulting from brucellosis, Infectious bovine rhinotracheitis (IBR), bovine viral diarrhea (BVD), poor diet and infertility from unknown causes.

controlling disease for smallholder livestock keepers.

The constraints in Table 3 can be grouped into three classes: vaccine preventable (registered vaccines available in the region/country), treatable with pharmaceuticals (registered pharmaceuticals available within the region/country), and largely avoidable through best practice in husbandry (recognized methods in production which if followed will reduce the risk of certain conditions). The experts were challenged to reflect whether a smallholder livestock keeper with the knowledge and financial resources could address these constraints within their country, given the existing private and public sector set-ups as they currently

stand. For most of the constraints, the answer was "yes".

One exception to the constraints acknowledged to be avoidable through vaccination, treatment, or good husbandry, was reproductive disorders. In all workshops, it was recognized there was a poor understanding of the etiology underlying these disorders, particularly for abortions and neo-natal mortality. While *Brucella* species were commonly implicated, the evidence base was often poor, with those few studies conducting more rigorous diagnostic investigations suggesting a much more complicated and unclear picture as to the main reasons for abortions and neo-natal mortality.

3.3. Workshop discussion

In addition to the prioritization of animal health constraints, workshop participants brought up additional, cross-cutting concerns including improved vaccines, regulatory reform, product quality and correct application, and emerging trends.

3.3.1. Improved vaccines

A common theme from across all three workshops was the desire for combination vaccines. The idea was discussed particularly with reference to the global programme for the control and eradication of PPR, which will provide an important platform for controlling other diseases including CCPP and SGP. The profile of a combination eye-drop vaccine for poultry disease was also supported. Reduced vial size and simplification of administration (e.g. pre- diluted) were also common themes, widely recognized as helping to improve uptake by smallholder livestock keepers.

3.3.2. Regulatory reform

Reforms in specific legislation were identified as important in addressing several of the animal health constraints. In Kenya, the mismatch between the desire for smallholder livestock keepers to vaccinate against FMD privately, and the regulated role of the state in providing all FMD vaccinations (without enough resources to meet demand) was one such example. Across both Africa meetings, the role of community animal health workers was discussed. The need for improved standards for artificial insemination operatives, and the ability for them to increase income from the provision of other services, such as vaccination, was highlighted. Similar concerns were expressed for the standardization of para-veterinarians.

3.3.3. Product quality and correct application

Quality issues with vaccines, pharmaceuticals and supplements/feed were highlighted as a contributory factor for many of the constraints listed in Table 3. It was recognized that private animal health product and service providers should be able to address these issues through well managed supply chains. Developing a recognizable and enforceable mark for veterinary inputs, such as the Pan African Veterinary Centre of the African Union (PANVAC) stamp on vaccines, was proposed as a way for smallholder livestock keepers to assess quality. With intensification of smallholder livestock production, issues of feed quality and the need for supplementation of incomplete diets is increasingly necessary to capitalize on market opportunities.

Outside of the quality of product, correct application was identified as another important contributory factor to the persistence of avoidable constraints. Well-recognized examples included under-application of acaricides and underdosing with antimicrobials leading to increased problems of resistance. Linked to this, on the off-take side, poor practices drive antimicrobial and acaricide/insecticide contamination of eggs, milk, meat, and hides.

The growth of both antimicrobial drug resistance and acaricide resistance were addressed in all three workshops. It was recognized that lack of knowledge on correct administration, as well as poor quality or even counterfeit products, were major contributors to the trend.

3.3.4. Emerging trends

Participants in all three workshops brought up two additional emerging trends: the growing importance of goats and climate change.

Although the drivers were different (e.g., export trade to the Middle East in East Africa, land pressures and migration pattern change in West Africa, rise of popularity of goat milk in India), goats were seen as an increasingly important source of income for smallholder livestock keepers. Traditionally, goats have been perceived as a livestock option that requires minimal investment, with smallholders not investing much in animal health inputs. The PPR vaccination programs, coupled with increased market demand for goat meat and milk, provide an opportunity to alter these perceptions.

Increased climatic variability and increased frequency of extreme weather events were considered important trends in all three settings. This is contributing to changes in land use which greater pressure on water and grazing land; this in turns drives driving intensification and changes in production systems, such as the switch from cattle to goats.

3.4. Veterinary practitioner survey

The results of the veterinary practitioner survey are shown in Table 4. Constraints match those mentioned in the workshop, with the addition of chronic respiratory disease for poultry, anaplasmosis in smallholder dairy operations, and the inclusion of nutrition as a constraint, mentioned in relation to smallholder dairy and pastoralist small ruminants. Out of 60 practitioners contacted, only 20 returned surveys (response rate of 33 %). The survey was sent soon after another extensive survey done by GALVmed which likely led to contact and practitioner fatigue and contributed to the low response rate. Most practitioners were from Uganda (13), followed by Tanzania and Kenya (3 each), and one from Ethiopia. The practitioners had an average of 15 years of field experience. The gender of the practitioners was not recorded.

4. Discussion

The objective of this study was to assess the incidence/ prevalence and impact of smallholder animal health needs using multiple methods across three geographic regions, identify priorities, and compare methods of prioritization.

4.1. Incidence, prevalence, and impact

Less than 10 % (17/199) of the impact articles met the criteria for green ranking, evidence that few studies were able to address impact thoroughly from a smallholder perspective or incorporate measures of incidence/ prevalence and impact of animal health constraints. In this section, we briefly discuss the types of articles found in the literature review, highlight two excellent, green-ranked studies, and identify opportunities for better incorporating impact measures in future research.

Many articles were characterizations of production systems with limited sample sizes in a single geographic area (Kamal et al., 2012; Seyoum et al., 2013; Olobatoke et al., 2015; Satisha et al., 2018). Others addressed incidence/ prevalence with a larger sample size in a broader geographic area (for example serosurveys for a specific disease) but failed to connect incidence or prevalence estimates to the impact on smallholder livestock keepers (Jagun and Onoja, 2011; Kabi et al., 2015; Abdela, 2017; Chengat Prakashbabu et al., 2017; Okumu et al., 2019). A few articles estimated economic impact of specific diseases or outbreak events at household level (Sitawa et al., 2016), farm level (Govindaraj et al., 2018), or herd level (Alhaji and Isola, 2018).

Examples of green-ranking articles include Jemberu et al. (2014) with an outbreak investigation of FMD in Ethiopia which reported on morbidity/ mortality rates and economic losses due to milk loss, draft power loss, and mortality (Jemberu et al., 2014). The study also disaggregated data based on production system, differentiating between

Table 4
Animal health constraints: Consensus from veterinary practitioner survey conducted in East Africa.

Smallholders	1.	2.	3.	4.	5.
Poultry	ND	Coccidiosis	Ecto/Endo parasites	Fowl pox	Chronic respiratory disease
Small ruminants	Helminths	TBDs	CCPP	PPR	Orf
Cattle	FMD	TBDs	LSD	Helminths	Trypanosomiasis
Dairy	Mastitis	Infertility & abortion	Nutrition	ECF	Anaplasmosis
Pastoralists					
Small ruminants	CCPP	PPR	Endoparasites	Nutrition	Orf & pasteurellosis
Cattle	FMD	CBPP	ECF	TBDs	Endoparasites

Abbreviations: Newcastle disease (ND), tick-borne diseases (TBDs), contagious caprine pleuropneumonia (CCPP), peste des petits ruminants (PPR), foot and mouth disease (FMD), lumpy skin disease (LSD), East Coast fever (ECF), contagious bovine pleuropneumonia (CBPP).

pastoralists and crop-livestock mixed system. A second example of a green ranking article is a study by Kumar et al. (2017), who conducted retrospective risk analyses to estimate economic losses in India due to trypanosomiasis. In addition to reporting an estimated total annual loss of US $ 671.1 million (US $ 344–US $ 1209 million at 95 % confidence interval), they included loss parameters relevant to smallholder livestock keepers including reduction in milk yield (36 % of total loss), reproductive losses (26 %), reduction in growth (10 %), reduction in draught power (8 %), and additional opportunity cost (3 %) (Kumar et al., 2017).

Opportunities for contributing to the current body of literature for smallholder animal health needs include studies from interdisciplinary teams that connect results from epidemiology studies with socio-economic impact assessments identify priorities and compare methods of prioritization and consideration and inclusion of impact indicators that are relevant for a smallholder context. All three prioritization methods identified constraints such as endo and ectoparasites, mange, mastitis, reproductive disorders, and even nutrition in the veterinary practitioner survey, that contribute to morbidity rather than mortality. Impact on smallholder livestock keepers may come in the form of production losses, less profitable sales, increased veterinary costs, or increased labor or time required to care for animals. Thoughtful identification of relevant indicator measurements of impact and measurement of these indicators will allow for more useful impact estimates. Interdisciplinary teams that include economists and social scientists are more likely to have a broader vocabulary and include a wider range of impact indicators that studies undertaken by veterinarians or epidemiologists only. The conspicuous absence of gender as a consideration in this and other studies is evidence of the limited capacity of many animal health research teams. The role of women in agriculture and livestock production is well-documented (FAO, 2010) and the different roles played by men and women in livestock keeping means they may be differentially impacted by disease (Kristjanson et al., 2010), prioritize livestock species differently (Wieland et al., 2016), and face different challenges in accessing information and veterinary services such as vaccines (Mutua et al., 2019). While this study does not provide a metric for the number of articles that incorporated a gender perspective, it is clearly an area for improvement in future research projects. Lastly, stratifying disease priorities by production system is useful in interpreting animal health priorities, however not all studies in the systematic literature review were specific enough to distinguish between pastoralists and smallholder farmers or even identify the level of intensification. Clearly indicating this type of information makes studies more useful for prioritizing smallholder animal health constraints.

4.2. Identifying priorities

Globally, ten constraints emerge from all three methods as having high impact on smallholder livestock keepers: endo/ ectoparasites, FMD, brucellosis, PPR, Newcastle disease, avian influenza, CCPP, CBPP, mastitis, and reproductive disorders. This list is in no way exhaustive and it may be more useful to look at the full list of disease constraints identified by region or production system.

As noted by the workshop participants, many of these constraints, except for reproductive disorders, can be prevented or treated using best practices with existing technologies available in the respective geographies. This supports the prioritization of addressing systemic limitations that make it challenging for smallholder livestock keepers to access veterinary services and inputs. The conclusions about regulatory reform and product quality/ correct application raised by workshop participants are examples of such challenges. Improved vaccines, especially combination vaccines that prevent multiple diseases, may be a valuable contribution for populations with limited access to veterinary services. Supporting infrastructural improvements to veterinary systems through support of paraprofessionals or strengthening public private partnerships may also be a valuable entry-point for addressing animal health constraints. Prioritizing the systems and infrastructure that delivery existing veterinary technologies is another direct invitation to incorporate gender analyses into future studies. While women livestock keepers may face more barriers to access, they can be powerful allies in disease control when given access to the appropriate tools, as evidenced by a study in Kenya linking the formation of women's groups with improved control of transboundary livestock diseases (Kristjanson et al., 2010).

4.3. Comparing methods

Lastly, we compare methods of prioritization within the study and across similar studies. While there is some consensus across the three methods of prioritizing animal health constraints within this study, the following constraints were not in the top 15 identified in the literature review overall or for any geographic region but were identified as important in the workshops and/ or practitioner survey: CBPP, CCPP, heartwater, and lumpy skin disease.

Published literature focused more on individual diseases rather than syndromes, such as reproductive disorders (although abortion was a top constraint), or production constraints, such as nutrition. Funding and research priorities are not necessarily driven by improving the welfare of smallholder livestock keepers and using published studies to inform priorities may lead to bias towards zoonoses such as zoonotic tuberculosis, biologically interesting diseases such as trypanosomiasis, or well-recognized diseases such as FMD at the expensive of chronic and low-mortality constraints such as mange or syndromes such as reproductive disorders. Workshop participants may also introduce biases stemming from their personal research interests. Veterinary practitioners may underestimate the danger of outbreaks of rare diseases or constraints that have economic and public health consequences beyond the impact on the clients they work with.

Conclusions of this study shared by Perry et al. (2002) and Heffernan (2009) , two other studies prioritizing animal health concerns as a function of their impact on the poor, are the need for improved impact measures and the promise of using existing technologies and best practices in conjunction with improving the delivery of animal health services. A key finding from Heffernan's study was that for diseases with a high morbidity but comparatively low mortality, poor households spent much less on treatment and prevention than the better off, and are therefore disproportionately affected (Heffernan, 2009). The delivery of

animal health services and the need to make existing technologies "more effective and appropriate for the poor" was addressed by Perry et al. (2002). Debates about how best to serve farmers in smaller scale production systems continue, as evidenced by the theme of the 2018 Tanzania Veterinary Association conference "Veterinary Profession as a Catalyst for Transformative Change of the Animal Industry", where veterinary practitioners discussed the changing landscape of veterinary governance and extension service delivery system (Tanzania Veterinary Association, 2018).

While some overarching challenges remain constant, the systematic literature review revealed some notable progress managing animal health constraints since publication of the first systematic prioritization study by Perry et al in 2002. Examples include the global eradication of rinderpest (Roeder and Rich, 2009), a disease that ranked within the top 20 conditions with impact on the poor, and commitment from the international community to begin working towards the eradication of peste des petits ruminants (OIE/FAO, 2015). There have also been beneficial technological advances, such as the development of a thermotolerant Newcastle disease vaccine (I-2), which is now produced and available in many developing countries (Fisher, 2014).

4.4. Limitations

Limitations to this study include lack of representation of grey literature published outside of peer-reviewed journals, potential exclusion of relevant articles from Francophone countries in West Africa by limiting the search to articles published in English, having only one reviewer assigning impact score for each article in the systematic literature review, the selection of a small number of experts for the workshops, lack of representation of livestock keepers themselves in the workshop, and the limited geography of the veterinary practitioner survey, which ideally would have also been administered in West Africa and South Asia. Despite literature documenting the gender gap in agriculture and the role of women in livestock production, the underrepresentation of women in the stakeholder workshops (only 3 of 23 experts were women) perpetuates the status quo where the priorities and interests of men dominate discussions about how resources should be prioritized. Pigs were not included in this study due to the organizational prioritizations of GALVmed and its funders, however they play an important role in smallholder livelihoods globally. Nutrition and feeding strategies and antimicrobial resistance were excluded in the systematic literature review, but nutrition was identified as an important constraint in the veterinary practitioner survey and antimicrobial resistance was brought up in the expert workshops. There were few representatives of broader animal management constraints such as nutritionists or welfare specialists in the expert workshops, which likely contributed to their underrepresentation in the findings. Lastly, there were some small differences in the disease constraint definitions across the three methods because a categorization system was independently created for each method. For example, the systematic literature review included ectoparasites and endoparasites separately while the stakeholder workshop combined them. This allowed the disease constraints to more closely match the priorities that emerged from each method, however, introduces minor challenges when comparing results across methods.

4.5. Conclusion

Managing animal health constraints is a pathway to improving the livelihoods of smallholder and pastoralist livestock keepers globally. By employing three methods of prioritization, we identify diseases and syndromes that have the greatest impact on livestock keepers. Most of the top priorities can be managed using existing technologies and best practices which supports a shift away from focusing on individual diseases and new technologies and towards addressing systemic challenges that limit access to veterinary services and inputs. Few research studies focused on incidence/ prevalence of disease and impact on smallholders suggesting opportunities for interdisciplinary studies that include gender analyses and define impact using socioeconomic indicators in addition to epidemiology indicators.

Declaration of Competing Interest

Paul Coleman, Andrea Guest, Brian Perry, and Zoë Campbell contributed as consultants for GALVmed to complete these research activities.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.prevetmed.2021.105279.

References[1]

Abdela, N., 2017. Sero-prevalence, risk factors and distribution of foot and mouth disease in Ethiopia. Acta Trop. 169, 125–132. https://doi.org/10.1016/j.actatropica.2017.02.017.

Alhaji, N.B., Isola, T.O., 2018. Pastoralists' knowledge and practices towards clinical bovine dermatophilosis in cattle herds of North-Central Nigeria: the associated factors, burden and economic impact. Trop. Anim. Health Prod. 50, 381–391. https://doi.org/10.1007/s11250-017-1445-y.

*Barratt, A.S., Rich, K.M., Eze, J.I., Porphyre, T., Gunn, G.J., Stott, A.W., 2019. Framework for estimating indirect costs in animal health using time series analysis. Front. Vet. Sci. 6 https://doi.org/10.3389/fvets.2019.00190.

Chengat Prakashbabu, B., Thenmozhi, V., Limon, G., Kundu, K., Kumar, S., Garg, R., Clark, E.L., Srinivasa Rao, A.S.R., Raj, D.G., Raman, M., Banerjee, P.S., Tomley, F.M., Guitian, J., Blake, D.P., 2017. Eimeria species occurrence varies between geographic regions and poultry production systems and may influence parasite genetic diversity. Vet. Parasitol. 233, 62–72. https://doi.org/10.1016/j.vetpar.2016.12.003.

*FAO, 2010. Documenting the gender gap in agriculture. Women in Agriculture: Closing the Gender Gap for Development. FAO, pp. 23–38.

*Fisher, H., 2014. Newcastle Disease Control in Africa, ACIAR Impact Assessment Series.

*GALVmed [WWW Document], 2020. GALVmed [WWW Document]. URL https://www.galvmed.org/ (Accessed 6.25.20).

Govindaraj, G., Sridevi, R., Nandakumar, S.N., Vineet, R., Rajeev, P., Binu, M.K., Balamurugan, V., Rahman, H., 2018. Economic impacts of avian influenza outbreaks in Kerala, India. Transbound. Emerg. Dis. 65, e361–e372. https://doi.org/10.1111/tbed.12766.

*Heffernan, C., 2009. Panzootics and the poor: devising a global livestock disease prioritisation framework for poverty alleviation. OIE Rev. Sci. Tech. 28, 897–907. https://doi.org/10.20506/rst.28.3.1934.

[1] Indicates article is referenced in the paper but not part of the systematic literature review

Jagun, A., Onoja, A.B., 2011. The current status of Peste des Petits Ruminant (PPR) in sheep in Ibadan southwestern Nigeria. J. Commonw. Vet. Assoc. 27, 133–138.
Kabi, F., Muwanika, V., Masembe, C., 2015. Spatial distribution of Brucella antibodies with reference to indigenous cattle populations among contrasting agro-ecological zones of Uganda. Prev. Vet. Med. 121, 56–63. https://doi.org/10.1016/j.prevetmed.2015.06.007.
*Kahn, L.H., 2006. Confronting zoonoses, linking human and veterinary medicine. Emerg. Infect. Dis. 12, 556–561. https://doi.org/10.3201/eid1204.050956.
Kamal, M., Mondal, S., Islam, S., Islam, M., 2012. Present status of goat rearing under rural conditions in south-west regions of Bangladesh. In: Rahmann, G., Godinho, D. (Eds.), Organic Animal Husbandry Challenges. Hamburg/ Trenthorst, Germany.
*Katz, J.M., Veguilla, V., Belser, J.A., Maines, T.R., van Hoeven, N., Pappas, C., Hancock, K., Tumpey, T.M., 2009. The public health impact of avian influenza viruses. Poult. Sci. 88, 872–879. https://doi.org/10.3382/ps.2008-00465.
*Kristjanson, P., Waters-Bayer, A., Johnson, N., Tipilda, A., Njuki, J., Baltenweck, I., Grace, D., Macmillan, S., 2010. Livestock and Women's Livelihoods: A Review of the Recent Evidence. Nairobi, Kenya.
*Kryger, K., Thomsen, K., Whyte, M., Dissing, M., 2010. Smallholder Poultry Production – Livelihoods, Food Security and Sociocultural Significance. Smallholder Poultry Production, Rome.
Kumar, R., Jain, S., Kumar, S.S., Sethi, K., Kumar, S.S., Tripathi, B.N., 2017. Impact estimation of animal trypanosomosis (surra) on livestock productivity in India using simulation model: current and future perspective. Vet. Parasitol. Reg. Stud. Rep. 10, 1–12. https://doi.org/10.1016/j.vprsr.2017.06.008.
*Mutua, E., De Haan, N., Tumusiime, D., Jost, C., Bett, B., 2019. A qualitative study on gendered barriers to livestock vaccine uptake in kenya and uganda and their implications on rift valley fever control. Vaccines 7, 1–22. https://doi.org/10.3390/vaccines7030086.
*OIE/FAO, 2015. Global Strategy for the Control and Eradication PPR.
Okumu, T.A., John, N.M., Wabacha, J.K., Tsuma, V., VanLeeuwen, J., 2019. Seroprevalence of antibodies for bovine viral diarrhoea virus, Brucella abortus and Neospora caninum, and their roles in the incidence of abortion/foetal loss in dairy cattle herds in Nakuru District, Kenya. BMC Vet. Res. 15, 95. https://doi.org/10.1186/s12917-019-1842-8.
Olobatoke, R., Mobayo, E., Mathuthu, M., 2015. Evaluation of local chicken production in Kogi State of Nigeria. Int. J. Agric. Policy Res. 3, 377–381.
*Peacock, C., 2005. Goats - A pathway out of poverty. Small Rumin. Res. 60, 179–186. https://doi.org/10.1016/j.smallrumres.2005.06.011.
*Perry, B.D., Randolph, T.F., McDermott, J.J., Sones, K.R., Thornton, P.K., 2002. Investing in Animal Health Research to Alleviate Poverty. Nairobi, Kenya.
*Roeder, P., Rich, K., 2009. Conquering the cattle plague: the global effort to eradicate rinderpest. In: Spielman, D.J., Pandya-Lorch, R. (Eds.), Millions Fed: Proven Successes in Agricultural Development. International Food Policy Research Institute (IFPRI), Washington, D.C, pp. 109–116.
*Rushton, J., Bruce, M., Bellet, C., Torgerson, P., Shaw, A., Marsh, T., Pigott, D., Stone, M., Pinto, J., Mesenhowski, S., Wood, P., 2018. Initiation of global burden of animal diseases programme. Lancet 392, 538–540. https://doi.org/10.1016/S0140-6736(18)31472- 7.
Satisha, M.C., Tiwari, R., Roy, R., 2018. Performance of dairy animals in commercial dairy farms in Karnataka. Indian J. Dairy Sci. 71, 620–624.
Seyoum, Z., Terefe, G., Ashenafi, H., 2013. Farmers' perception of impacts of bovine trypanosomosis and tsetse fly in selected districts in Baro-Akobo and Gojeb river basins, Southwestern Ethiopia. BMC Vet. Res. 9, 214. https://doi.org/10.1186/1746-6148-9-214.
Sherikar, A., Waskar, V., 2005. Emerging zoonoses and social-economic impact in India - A review. Indian J. Anim. Sci. 76, 700–705.
Singh, B.B.B., Dhand, N.K.K., Gill, J.P.S.P.S., 2015. Economic losses occurring due to brucellosis in Indian livestock populations. Prev. Vet. Med. 119, 211–215. https://doi.org/10.1016/j.prevetmed.2015.03.013.
Sitawa, R., Mbogoh, S.G., Gathuma, J.M., Kairu, S., 2016. An evaluation of economic returns from east coast fever control through infection and treatment method at household level in Nandi and Uasin-Gishu counties of Kenya. Int. J. Agric. Policy Res. 4, 149–156.
*Steverding, D., 2008. The history of African trypanosomiasis. Parasit. Vectors 1, 1–8. https://doi.org/10.1186/1756-3305-1-3.
*Tanzania Veterinary Association, 2018. Veterinary Profession as a Catalyst for Transformative Change of the Animal Industry. Arusha, Tanzania.
*Webb, M., Gibson, J., Strutt, A., 2018. The impact of diseases on international beef trade: market switching and persistent effects. Food Policy 75, 93–108. https://doi.org/10.1016/j.foodpol.2018.01.006.
*Wieland, B., Kinati, W., Mulema, A.A., 2016. Sheep Are Like Fast-growing Cabbage: Gender Dimensions of Small Ruminant Health in Ethiopia.

Further reading

Abbas, B., Yuusif, M.A., Nur, H.M., 2014. Animal health constraints to livestock exports from the Horn of Africa. Rev. Sci. Tech. l'OIE 33, 711–721. https://doi.org/10.20506/rst.33.3.2314.
Abdilatif, M.H., Onono, J.O., Mutua, F.K., 2018. Analysis of pastoralists' perception on challenges and opportunities for sheep and goat production in Northern Kenya. Trop. Anim. Health Prod. 50, 1701–1710. https://doi.org/10.1007/s11250-018-1613-8.
Abebe, R., Hatiya, H., Abera, M., Megersa, B., Asmare, K., 2016. Bovine mastitis: prevalence, risk factors and isolation of Staphylococcus aureus in dairy herds at Hawassa milk shed, South Ethiopia. BMC Vet. Res. 12, 1–11. https://doi.org/10.1186/s12917-016-0905-3.
Abera, Z., Degefu, H., Gari, G., Kidane, M., 2015. Sero-prevalence of lumpy skin disease in selected districts of West Wollega zone, Ethiopia. BMC Vet. Res. 11, 135. https://doi.org/10.1186/s12917-015-0432-7.
Abera, T., Bitew, M., Gebre, D., Mamo, Y., Deneke, Y., Nandi, S., 2018. Bluetongue disease in small ruminants in south western Ethiopia: cross- sectional sero-epidemiological study. BMC Res. Notes 11, 112. https://doi.org/10.1186/s13104-018-3222-z.
Abraham-Oyiguh, J., Adewumi, M.O., Onoja, A.B., Suleiman, I., Sulaiman, L.K., Ahmed, S.J., Jagboro, S.T., 2015. Seroprevalence of infectious bursal disease virus in local chickens in Udu Local Government Area of Delta state, South East Nigeria. J. Immunoass. Immunochem. 36, 398–404. https://doi.org/10.1080/15321819.2014.973116.
Abunna, F., Tilahun, G., Megersa, B., Regassa, A., Kumsa, B., 2008. Bovine cysticercosis in cattle slaughtered at Awassa municipal abattoir, Ethiopia: prevalence, cyst viability, distribution and its public health implication. Zoonoses Public Health 55, 82–88. https://doi.org/10.1111/j.1863-2378.2007.01091.x.
Adam, I.A., Abdalla, M.A., Mohamed, M.E., Aradaib, I.E., 2014. Prevalence of bluetongue virus infection and associated risk factors among cattle in North Kordufan State, Western Sudan. BMC Vet. Res. 10, 94. https://doi.org/10.1186/1746-6148-10-94.
Addy, F., Alakonya, A., Wamae, N., Magambo, J., Mbae, C., Mulinge, E., Zeyhle, E., Wassermann, M., Kern, P., Romig, T., 2012. Prevalence and diversity of cystic echinococcosis in livestock in Maasailand, Kenya. Parasitol. Res. 111, 2289–2294. https://doi.org/10.1007/s00436-012-3082-8.
Adedeji, A.J., Dashe, Y., Akanbi, O.B., Woma, T.Y., Jambol, A.R., Adole, J.A., Bolajoko, M.B., Chima, N., Asala, O., Tekki, I.S., Luka, P., Okewole, P., 2019. Co-infection of peste des petits ruminants and goatpox in a mixed flock of sheep and goats in Kanam, North Central Nigeria. Vet. Med. Sci. 170 https://doi.org/10.1002/vms3.170 vms3.
Adjou Moumouni, P.F., Aplogan, G.L., Katahira, H., Gao, Y., Guo, H., Efstratiou, A., Jirapattharasate, C., Wang, G., Liu, M., Ringo, A.E., Umemiya-Shirafuji, R., Suzuki, H., Xuan, X., 2018. Prevalence, risk factors, and genetic diversity of veterinary important tick-borne pathogens in cattle from Rhipicephalus microplus-invaded and non-invaded areas of Benin. Ticks Tick. Dis. 9, 450–464. https://doi.org/10.1016/j.ttbdis.2017.12.015.
Adombi, C.M., Waqas, A., Dundon, W.G., Li, S., Daojin, Y., Kakpo, L., Aplogan, G.L., Diop, M., Lo, M.M., Silber, R., Loitsch, A., Diallo, A., 2017. Peste des petits ruminants in Benin: persistence of a single virus genotype in the country for over 42 years. Transbound. Emerg. Dis. 64, 1037–1044. https://doi.org/10.1111/tbed.12471.
Agegnehu, A., Bogale, B., Tesfaye, S., Dagnachew, S., 2018. Status of mange infestation in indigenous sheep and goats and their control practices in Wag-Himra zone, Ethiopia. J. Vet. Med. Anim. Heal. 10, 128–134.
Ahir, V.B., Roy, A., Jhala, M.K., Bhanderi, B.B., Mathakiya, R.A., Bhatt, V.D., Padiya, K. B., Jakhesara, S.J., Koringa, P.G., Joshi, C.G., 2011. Genome sequence of Pasteurella multocida subsp. gallicida Anand1_poultry. J. Bacteriol. 193, 5604. https://doi.org/10.1128/JB.05706-11.
Ahmadu, B., Lovelace, C.E.A., Samui, K.L., Mahan, S., 2004. Some observations on the sero-prevalence of heartwater and tick infestation in Zambian goats. Onderstepoort J. Vet. Res. 71, 161–164.
Akidarju, M.S., Onyemaechi, E.G., Dauda, M.G., 2010. An assessment of some poultry management practices and disease recognition by poultry farmers in Maiduguri arid zone, Nigeria. Worlds Poult. Sci. J. 66, 285–296. https://doi.org/10.1017/S0043933910000334.
Akinseye, V.O., Adesokan, H.K., Ogugua, A.J., Adedoyin, F.J., Otu, P.I., Kwaghe, A.V., Kolawole, N.O., Okoro, O.J., Agada, C.A., Tade, A.O., Faleke, O.O., Okeke, A.L., Akanbi, I.M., Ibitoye, M.M., Dipeolu, M.O., Dale, E.J., Lorraine, P., Taylor, A.V., Awosanya, E.A., Cadmus, E.O., Stack, J.A., Cadmus, S.I., 2016. Sero-epidemiological survey and risk factors associated with bovine brucellosis among slaughtered cattle in Nigeria. Onderstepoort J. Vet. Res. 83 https://doi.org/10.4102/ojvr.v83i1.1002.
Akwuobu, C.A., Ayling, R.D., Chah, K.F., Oboegbulem, S.I., 2014. Studies into the prevalence of Mycoplasma species in small ruminants in Benue State, North-central Nigeria. Trop. Anim. Health Prod. 46, 1087–1092. https://doi.org/10.1007/s11250-014-0613-6.
Alemayehu, G., Leta, S., Hailu, B., 2015. Sero-prevalence of Contagious Bovine Pleuropneumonia (CBPP) in bulls originated from Borena pastoral area of Southern Ethiopia. Trop. Anim. Health Prod. 47, 983–987. https://doi.org/10.1007/s11250-015-0820-9.
Alemu, B., Gari, G., Libeau, G., Kwiatek, O., Kidane, M., Belayneh, R., Siraw, B., Wieland, B., Asfaw, W., Abdi, R.D., 2019. Molecular detection and phylogenetic analysis of Peste des petits ruminants virus circulating in small ruminants in eastern Amhara region, Ethiopia. BMC Vet. Res. 15, 84. https://doi.org/10.1186/s12917-019-1828-6.
Alhaji, N., Babalobi, O., 2015. Socio-cultural factors influencing transmission of Mycoplasma mycoides mycoides small colony in pastoral cattle herds of north-central Nigeria. Vom J. Vet. Sci. 10, 1–13.
Alhaji, N.B., Babalobi, O.O., 2016a. Qualitative and quantitative impacts assessment of contagious bovine pleuropneumonia in Fulani pastoral herds of North-central Nigeria: the associated socio-cultural factors. Prev. Vet. Med. 128, 124–134. https://doi.org/10.1016/j.prevetmed.2016.04.004.
Alhaji, Nma Bida, Babalobi, O.O., 2016b. Sero-positivity and associated risk factors for contagious bovine pleuropneumonia under two cattle production systems in North Central Nigeria. Trop. Anim. Health Prod. 48, 311–320. https://doi.org/10.1007/s11250-015-0952-y.
Alhaji, N.B., Wungak, Y.S., Bertu, W.J., 2016. Serological survey of bovine brucellosis in Fulani nomadic cattle breeds (Bos indicus) of North-central Nigeria: potential risk factors and zoonotic implications. Acta Trop. 153, 28–35. https://doi.org/10.1016/j.actatropica.2015.10.003.

Alhaji, N.B., Babalobi, O.O., Wungak, Y., Ularamu, H.G., 2018. Participatory survey of Rift Valley fever in nomadic pastoral communities of North-central Nigeria: the associated risk pathways and factors. PLoS Negl. Trop. Dis. 12, e0006858 https://doi.org/10.1371/journal.pntd.0006858.

Alingu, R.A., Muhanguzi, D., MacLeod, E., Waiswa, C., Fyfe, J., 2014. Bovine trypanosome species prevalence and farmers' trypanosomiasis control methods in south-western Uganda. J. S. Afr. Vet. Assoc. 85 https://doi.org/10.4102/jsava.v85i1.1094.

Allan, K.J., Halliday, J.E.B., Moseley, M., Carter, R.W., Ahmed, A., Goris, M.G.A., Hartskeerl, R.A., Keyyu, J., Kibona, T., Maro, V.P., Maze, M.J., Mmbaga, B.T., Tarimo, R., Crump, J.A., Cleaveland, S., 2018. Assessment of animal hosts of pathogenic Leptospira in northern Tanzania. PLoS Negl. Trop. Dis. 12, e0006444 https://doi.org/10.1371/journal.pntd.0006444.

Allepuz, A., Stevenson, M., Kivaria, F., Berkvens, D., Casal, J., Picado, A., 2015. Risk factors for foot-and-mouth disease in Tanzania, 2001–2006. Transbound. Emerg. Dis. 62, 127–136. https://doi.org/10.1111/tbed.12087.

Almaw, G., Zerihun, A., Asfaw, Y., 2008. Bovine mastitis and its association with selected risk factors in smallholder dairy farms in and around Bahir Dar, Ethiopia. Trop. Anim. Health Prod. 40, 427–432. https://doi.org/10.1007/s11250-007-9115-0.

Almaw, G., Duguma, M., Wubetie, A., Tuli, G., Koran, T., 2016. A contagious bovine pleuropneumonia outbreak on a research farm in Ethiopia, and its dynamics over an eight-month period. Rev. Sci. Tech. l'OIE 35, 787–793. https://doi.org/10.20506/rst.35.3.2569.

Ameni, G., Erkihun, A., 2007. Bovine tuberculosis on small-scale dairy farms in Adama Town, central Ethiopia, and farmer awareness of the disease. Rev. Sci. Tech. 26, 711–719.

Ameni, G., Tadesse, K., Hailu, E., Deresse, Y., Medhin, G., Aseffa, A., Hewinson, G., Vordermeier, M., Berg, S., 2013. Transmission of Mycobacterium tuberculosis between farmers and cattle in Central Ethiopia. PLoS One 8, e76891. https://doi.org/10.1371/journal.pone.0076891.

Ameni, G., Tafess, K., Zewde, A., Eguale, T., Tilahun, M., Hailu, T., Sirak, A., Salguero, F. J., Berg, S., Aseffa, A., Hewinson, R.G., Vordermeier, H.M., 2018. Vaccination of calves with Mycobacterium bovis Bacillus calmette-guerin reduces the frequency and severity of lesions of bovine tuberculosis under a natural transmission setting in Ethiopia. Transbound. Emerg. Dis. 65, 96–104. https://doi.org/10.1111/tbed.12618.

Amenu, K., Szonyi, B., Grace, D., Wieland, B., 2017. Important knowledge gaps among pastoralists on causes and treatment of udder health problems in livestock in southern Ethiopia: results of qualitative investigation. BMC Vet. Res. 13, 303. https://doi.org/10.1186/s12917-017-1222-1.

Angwech, H., Nyeko, J.H.P., Opiyo, E.A., Okello-Onen, J., Opiro, R., Echodu, R., Malinga, G.M., Njahira, M.N., Skilton, R.A., 2015. Heterogeneity in the prevalence and intensity of bovine trypanosomiasis in the districts of Amuru and Nwoya, Northern Uganda. BMC Vet. Res. 11, 255. https://doi.org/10.1186/s12917-015-0567-6.

Anyango, G., Mutua, F., Kagera, I., Andang'O, P., Grace, D., Lindahl, J.F., 2018. A survey of aflatoxin M1 contamination in raw milk produced in urban and peri-urban areas of Kisumu County, Kenya. Infect. Ecol. Epidemiol. 8, 1547094.

Arowolo, O.O., Banmeke, T.O.A., Ajayi, M.T., 2012. Assessment of the training needs of poultry farmers in Ovia and oredo local government areas of edo state, Nigeria. Afr. J. Livest. Extension 10, 23–30.

Asakura, S., Makingi, G., Kazwala, R., Makita, K., 2018a. Brucellosis risk in urban and agro-pastoral areas in Tanzania. Ecohealth 15, 41–51. https://doi.org/10.1007/s10393-017-1308-z.

Asakura, S., Makingi, G., Kazwala, R., Makita, K., 2018b. Herd-level risk factors associated with Brucella sero-positivity in cattle, and perception and behaviours on the disease control among agro-pastoralists in Tanzania. Acta Trop. 187, 99–107. https://doi.org/10.1016/j.actatropica.2018.07.010.

Ashenafi, F., Teshale, S., Agga, G., Fikru, R., Laikemariam, Y., 2016. Distribution of brucellosis among small ruminants in the pastoral region of Afar, eastern Ethiopia. Rev. Sci. Tech. l'OIE 26, 731–739. https://doi.org/10.20506/rst.26.3.1781.

Asmare, K., Megersa, B., Denbarga, Y., Abebe, G., Taye, A., Bekele, J., Bekele, T., Gelaye, E., Zewdu, E., Agonafir, A., Ayelet, G., Skjerve, E., 2013. A study on seroprevalence of caprine brucellosis under three livestock production systems in southern and central Ethiopia. Trop. Anim. Health Prod. 45, 555–560. https://doi.org/10.1007/s11250-012-0258-2.

Asmare, K., Sibhat, B., Ayelet, G., Gebremedhin, E.Z., Lidete, K.A., Skjerve, E., 2018. Serological evidence of Bovine herpesvirus-1, Bovine Viral Diarrhea virus and Schmallenberg v irus infections in relation to reproductive disorders in dairy cattle in Ethiopia. Acta Trop. 178, 236–241. https://doi.org/10.1016/j.actatropica.2017.12.005.

Assefa, G.A., Kelkay, M.Z., 2018. Goat pasteurellosis: serological analysis of circulating Pasteurella serotypes in Tanqua aberegelle and Kola Tembien Districts, Northern Ethiopia. BMC Res. Notes 11, 485. https://doi.org/10.1186/s13104-018-3606-0.

Assefa, H., Mulate, B., Nazir, S., Alemayehu, A., 2015. Cystic echinococcosis amongst small ruminants and humans in central Ethiopia. Onderstepoort J. Vet. Res. 82, E1–7. https://doi.org/10.4102/ojvr.v82i1.949.

Assenga, J.A., Matemba, L.E., Muller, S.K., Mhamphi, G.G., Kazwala, R.R., 2015. Predominant leptospiral serogroups circulating among humans, livestock and wildlife in Katavi-Rukwa ecosystem, Tanzania. PLoS Negl. Trop. Dis. 9, e0003607 https://doi.org/10.1371/journal.pntd.0003607.

Awa, D.N., Adakal, H., Luogbou, N.D.D., Wachong, K.H., Leinyuy, I., Achukwi, M.D., 2015. Cattle ticks in Cameroon: is rhipicephalus (Boophilus) microplus absent in Cameroon and the Central African region? Ticks Tick Borne. Dis. 6, 117–122. https://doi.org/10.1016/j.ttbdis.2014.10.005.

Awad, H., Al-Hamidhi, S., El Hussein, A.-R.M., Yousif, Y.M.Z., Taha, K.M., Salih, D.A., Weir, W., Babiker, H.A., 2018. Theileria lestoquardi in Sudan is highly diverse and genetically distinct from that in Oman. Infect. Genet. Evol. 62, 46–52. https://doi.org/10.1016/j.meegid.2018.04.014.

Awah-Ndukum, J., Mouiche, M.M.M., Bayang, H.N., Ngwa, V.N., Assana, E., Feussom, K. J.M., Manchang, T.K., Zoli, P.A., 2018. Seroprevalence and associated risk factors of brucellosis among indigenous cattle in the Adamawa and north regions of Cameroon. Vet. Med. Int. 2018, 1–10. https://doi.org/10.1155/2018/3468596.

Ayebazibwe, C., Tjørnehøj, K., Mwiine, F.N., Muwanika, V.B., Okurut, A.R.A., Siegismund, H.R., Alexandersen, S., Ademun Okurut, A.R., Siegismund, H.R., Alexandersen, S., 2010. Patterns, risk factors and characteristics of reported and perceived foot-and-mouth disease (FMD) in Uganda. Trop. Anim. Health Prod. 42, 1547–1559. https://doi.org/10.1007/s11250-010-9605-3.

Ayelet, G., Mahapatra, M., Gelaye, E., Egziabher, B.G., Rufeal, T., Sahle, M., Ferris, N.P., Wadsworth, J., Hutchings, G.H., Knowles, N.J., 2009. Genetic characterization of foot-and-mouth disease viruses, Ethiopia, 1981–2007. Emerg. Infect. Dis. 15, 1409–1417. https://doi.org/10.3201/eid1509.090091.

Ayelet, G., Haftu, R., Jemberie, S., Belay, A., Gelaye, E., Sibhat, B., Skjerve, E., Asmare, K., 2014. Lumpy skin disease in cattle in central Ethiopia: outbreak investigation and isolation and molecular detection of the virus. Rev. Sci. Tech. 33, 877–887.

Baby, J., Mani, R.S., Abraham, S.S., Thankappan, A.T., Pillai, P.M., Anand, A.M., Madhusudana, S.N., Ramachandran, J., Sreekumar, S., 2015. Natural rabies infection in a domestic fowl (Gallus domesticus): a report from India. PLoS Negl. Trop. Dis. 9, e0003942 https://doi.org/10.1371/journal.pntd.0003942.

Balamurugan, V., Saravanan, P., Sen, A., Rajak, K.K., Bhanuprakash, V., Krishnamoorthy, P., Singh, R.K., 2011. Sero-epidemiological study of peste des petits ruminants in sheep and goats in India between 2003 and 2009. Rev. Sci. Tech. 30, 889–896.

Balamurugan, V., Das, S., Raju, D.S.N., Chakravarty, I., Nagalingam, M., Hemadri, D., Govindaraj, G., Ibotombi Singh, N., Ltu, K., Devi, M., Sharma, K., Gajendragad, M.R., Rahman, H., 2014. Prevalence of peste des petits ruminants in goats in North-East India. VirusDisease 25, 488–492. https://doi.org/10.1007/s13337-014-0237-5.

Baluka, S.A., 2016. Economic effects of foot and mouth disease outbreaks along the cattle marketing chain in Uganda. Vet. World 9, 544–553.

Bangar, Y.C., Dohare, A.K., Kolekar, D.V., Avhad, S.R., Khan, T.A., 2015a. Seasonal variation in morbidity pattern in cattle by log- linear model approach. J. Appl. Anim. Res. 43, 283–286. https://doi.org/10.1080/09712119.2014.963100.

Bangar, Yogesh Chandrakant, Singh, B., Dohare, A.K., Verma, M.R., 2015b. A systematic review and meta-analysis of prevalence of subclinical mastitis in dairy cows in India. Trop. Anim. Health Prod. 47, 291–297. https://doi.org/10.1007/s11250-014-0718-y.

Banumathi, B., Vaseeharan, B., Rajasekar, P., Prabhu, N.M., Ramasamy, P., Murugan, K., Canale, A., Benelli, G., 2017. Exploitation of chemical, herbal and nanoformulated acaricides to control the cattle tick, Rhipicephalus (Boophilus) microplus - A review. Vet. Parasitol. 244, 102–110. https://doi.org/10.1016/j.vetpar.2017.07.021.

Belgrad, J.P., Rahman, M.A., Abdullah, M.S., Rashid, M.H., Sayeed, M.A., Anwer, M.S., Hoque, M.A., 2018. Newcastle disease sero and viro-prevalence in rural poultry in Chittagong, Bangladesh. Prev. Vet. Med. 160, 18–25.

Bell-Sakyi, L., Koney, E.B.M., Dogbey, O., Walker, A.R., 2004. Ehrlichia ruminantium seroprevalence in domestic ruminants in Ghana; I. Longitudinal survey in the Greater Accra Region. Vet. Microbiol. 100, 175–188. https://doi.org/10.1016/j.vetmic.2004.02.010.

Bertram, M.R., Bravo de Rueda, C., Garabed, R., Dickmu Jumbo, S., Moritz, M., Pauszek, S., Abdoulkadiri, S., Rodriguez, L.L., Arzt, J., 2018. Molecular epidemiology of foot-and-Mouth disease virus in the context of transboundary animal movement in the far north region of Cameroon. Front. Vet. Sci. 5 https://doi.org/10.3389/fvets.2018.00320.

Bertu, W.J., Ducrotoy, M.J., Muñoz, P.M., Mick, V., Zúñiga- Ripa, A., Bryssinckx, W., Kwaga, J.K.P.P., Kabir, J., Welburn, S.C., Moriyón, I., Ocholi, R.A., 2015. Phenotypic and genotypic characterization of Brucella strains isolated from autochthonous livestock reveals the dominance of B. abortus biovar 3a in Nigeria. Vet. Microbiol. 180, 103–108. https://doi.org/10.1016/j.vetmic.2015.08.014.

Bessell, P., Kushwaha, P., Mosha, R., Woolley, R., Al-Riyami, L., Gammon, N., 2017. Assessing the impact of a novel strategy for delivering animal health interventions to smallholder farmers. Prev. Vet. Med. 147, 108–116. https://doi.org/10.1016/j.prevetmed.2017.08.022.

Bessell, P.R., Sargison, N.D., Mirende, K., Dash, R., Prasad, S., Al-Riyami, L., Gammon, N., Stuke, K., Woolley, R., Barbaruah, M., Wambura, P., 2018. The impact of anthelmintic drugs on weight gain of smallholder goats in subtropical regions. Prev. Vet. Med. 159, 72–81. https://doi.org/10.1016/j.prevetmed.2018.08.014.

Bett, B., Jost, C., Allport, R., Mariner, J., 2009. Using participatory epidemiological techniques to estimate the relative incidence and impact on livelihoods of livestock diseases amongst nomadic pastoralists in Turkana South District, Kenya. Prev. Vet. Med. 90, 194–203. https://doi.org/10.1016/j.prevetmed.2009.05.001.

Bett, B., Mariner, J.C., Kihu, S., Swai, E.S., Jost, C.C., Njogu, G., Nzietchueng, S., Kihu, S., Bett, B., Njogu, G., Swai, E.S., Mariner, J.C., 2010. Epidemiological assessment of the Rift Valley fever outbreak in Kenya and Tanzania in 2006 and 2007. Am. J. Trop. Med. Hyg. 83, 65–72. https://doi.org/10.4269/ajtmh.2010.09-0290.

Bettridge, J.M., Lynch, S.E., Brena, M.C., Melese, K., Dessie, T., Terfa, Z.G., Desta, T.T., Rushton, S., Hanotte, O., Kaiser, P., Wigley, P., Christley, R.M., 2014. Infection-interactions in Ethiopian village chickens. Prev. Vet. Med. 117, 358–366. https://doi.org/10.1016/j.prevetmed.2014.07.002.

Beyene, T.J., Eshetu, A., Abdu, A., Wondimu, E., Beyi, A.F., Tufa, T.B., Ibrahim, S., Revie, C.W., 2017. Assisting differential clinical diagnosis of cattle diseases using

smartphone-based technology in low resource settings: a pilot study. BMC Vet. Res. 13, 323. https://doi.org/10.1186/s12917-017-1249-3.
Bhanuprakash, V., Hosamani, M., Singh, R.K., 2011. Prospects of control and eradication of capripox from the Indian subcontinent: a perspective. Antiviral Res. 91, 225–232. https://doi.org/10.1016/j.antiviral.2011.06.004.
Bhatt, P.R., Pandya, K.B., Patel, U.D., Patel, H.B., Modi, C.M., 2019. Survey on ethnoveterinary practices around Junagadh, Gujarat, India. Indian J. Pharm. Sci. 81 https://doi.org/10.4172/pharmaceutical- sciences.1000493.
Biffa, D., Bogale, A., Godfroid, J., Skjerve, E., 2012. Factors associated with severity of bovine tuberculosis in Ethiopian cattle. Trop. Anim. Health Prod. 44, 991–998. https://doi.org/10.1007/s11250-011-0031-y.
Biswas, P., Christensen, J., Ahmed, S., Barua, H., Das, A., Rahman, M., Giasuddin, M., Habib, M., Hannan, A., Debnath, N., 2011. Mortality rate and clinical features of highly pathogenic avian influenza in naturally infected chickens in Bangladesh. Sci. Tech. Rev. Off. Int. des Epizoot. 30, 871–878.
Blomström, A.-L., Scharin, I., Stenberg, H., Figueiredo, J., Nhambirre, O., Abilio, A., Berg, M., Fafetine, J., 2016. Seroprevalence of Rift Valley fever virus in sheep and goats in Zambézia, Mozambique. Infect. Ecol. Epidemiol. 6, 31343. https://doi.org/10.3402/iee.v6.31343.
Bok, J., Hogerwerf, L., Germeraad, E.A., Roest, H.I.J., Faye- Joof, T., Jeng, M., Nwakanma, D., Secka, A., Stegeman, A., Goossens, B., Wegmüller, R., van der Sande, M.A.B., van der Hoek, W., Secka, O., 2017. Coxiella burnetii (Q fever) prevalence in associated populations of humans and small ruminants in the Gambia. Trop. Med. Int. Health 22, 323–331. https://doi.org/10.1111/tmi.12827.
Borah, B., Deka, P., Sharma, K., Baro, S., Hazarika, A.K., Das, C., Garam, G.B., Boro, P., Ltu, K., 2018. Isolation, identification and retrospective study of foot-and-mouth disease virus from affected Mithun (Bos frontalis) in north-eastern India. Transbound. Emerg. Dis. 65, e63–e69. https://doi.org/10.1111/tbed.12678.
Boukary, A.R., Saegerman, C., Abatih, E., Fretin, D., Alambédji Bada, R., De Deken, R., Harouna, H.A., Yenikoye, A., Thys, E., 2013. Seroprevalence and potential risk factors for Brucella spp. infection in traditional cattle, sheep and goats reared in urban, periurban and rural areas of Niger. PLoS One 8, e83175. https://doi.org/10.1371/journal.pone.0083175.
Boussini, H., Lamien, C.E., Nacoulma, O.G., Kaboré, A., Poda, G., Viljoen, G., 2014. Prevalence of Rift Valley fever in domestic ruminants in the central and northern regions of Burkina Faso. Rev. Sci. Tech. 33, 893–901.
Brar, P., Nanda, A., 2008. Postpartum ovarian activity in South Asian Zebu cattle. Reprod. Domest. Anim. 43, 207–212. https://doi.org/10.1111/j.1439-0531.2008.01163.x.
Brookes, V.J., Gill, G.S., Singh, B.B., Sandhu, B.S., Dhand, N.K., Aulakh, R.S., Ward, M.P., 2019. Challenges to human rabies elimination highlighted following a rabies outbreak in bovines and a human in Punjab, India. Zoonoses Public Health 66, 325–336. https://doi.org/10.1111/zph.12568.
Bugeza, J., Muwonge, A., Munyeme, M., Lasuba, P., Godfroid, J., Kankya, C., 2018. Seroprevalence of bovine brucellosis and associated risk factors in Nakasongola district, Uganda. Trop. Anim. Health Prod. https://doi.org/10.1007/s11250-018-1631- 6.
Byarugaba, D.K., Mugimba, K.K., Omony, J.B., Okitwi, M., Wanyana, A., Otim, M.O., Kirunda, H., Nakavuma, J.L., Teillaud, A., Paul, M.C., Ducatez, M.F., 2014. High pathogenicity and low genetic evolution of avian paramyxovirus type I (Newcastle disease virus) isolated from live bird markets in Uganda. Virol. J. 11, 173. https://doi.org/10.1186/1743-422X-11-173.
Byaruhanga, C., Oosthuizen, M.C., Collins, N.E., Knobel, D., 2015. Using participatory epidemiology to investigate management options and relative importance of tick-borne diseases amongst transhumant zebu cattle in Karamoja Region, Uganda. Prev. Vet. Med. 122, 287–297. https://doi.org/10.1016/j.prevetmed.2015.10.011.
Campbell, Z., Marsh, T., Mpolya, E., Thumbi, S., Palmer, G., 2018. Newcastle disease vaccine adoption by smallholder households in Tanzania: identifying determinants and barriers. PLoS One 13, e0206058. https://doi.org/10.1371/journal.pone.0206058.
Campbell, Z., Otieno, L., Shirima, G., Marsh, T., Palmer, G., 2019. Drivers of vaccination preferences to protect a low-value livestock resource: willingness to pay for Newcastle disease vaccines by smallholder households. Vaccine 37, 11–18. https://doi.org/10.1016/j.vaccine.2018.11.058.
Carlson, C.J., Kracalik, I.T., Ross, N., Alexander, K.A., Hugh- Jones, M.E., Fegan, M., Elkin, B.T., Epp, T., Shury, T.K., Zhang, W., Bagirova, M., Getz, W.M., Blackburn, J. K., 2019. The global distribution of Bacillus anthracis and associated anthrax risk to humans, livestock and wildlife. Nat. Microbiol. https://doi.org/10.1038/s41564-019-0435-4.
Catalano, D., Biasibetti, E., Lynen, G., Di Giulio, G., De Meneghi, D., Tomassone, L., Valenza, F., Capucchio, M.T., 2015. "Ormilo disease" a disorder of zebu cattle in Tanzania: bovine cerebral theileriosis or new protozoan disease? Trop. Anim. Health Prod. 47, 895–901. https://doi.org/10.1007/s11250-015-0805-8.
Catley, A., Irungu, P., Simiyu, K., Dadye, J., Mwakio, W., Kiragu, J., Nyamwaro, S.O., 2002. Participatory investigations of bovine trypanosomiasis in Tana river District, Kenya. Med. Vet. Entomol. 16, 55–66. https://doi.org/10.1046/j.0269-283x.2002.00346.x.
Catley, A., Chibunda, R.T.T., Ranga, E., Makungu, S., Magayane, F.T.T., Magoma, G., Madege, M.J.J., Vosloo, W., 2004. Participatory diagnosis of a heat-intolerance syndrome in cattle in Tanzania and association with foot-and-mouth disease. Prev. Vet. Med. 65, 17–30. https://doi.org/10.1016/j.prevetmed.2004.06.007.
Catley, A., Admassu, B., Bekele, G., Abebe, D., 2014. Livestock mortality in pastoralist herds in Ethiopia and implications for drought response. Disasters 38, 500–516. https://doi.org/10.1111/disa.12060.
Chah, J., M.Obi, U.P., Ndofor-Foleng, H.M., 2013. Management practices and perceived training needs of small ruminant farmers in Anambra State, Nigeria. African J. Agric. Res. 8, 2713–2721. https://doi.org/10.5897/AJAR2013.7209.
Chaka, H., Aboset, G., Garoma, A., Gumi, B., Thys, E., 2018. Cross-sectional survey of brucellosis and associated risk factors in the livestock–wildlife interface area of Nechisar National Park, Ethiopia. Trop. Anim. Health Prod. 50, 1041–1049. https://doi.org/10.1007/s11250-018-1528-4.
Chakraborty, S., Dhama, K., Tiwari, R., Iqbal Yatoo, M., Khurana, S.K., Khandia, R., Munjal, A., Munuswamy, P., Kumar, M.A., Singh, M., Singh, R., Gupta, V.K., Chaicumpa, W., 2019. Technological interventions and advances in the diagnosis of intramammary infections in animals with emphasis on bovine population -a review. Vet. Q. 1–30. https://doi.org/10.1080/01652176.2019.1642546.
Chang'A, J.S., Robertson, L.J., Mtambo, M.M.A., Mdegela, R.H., Løken, T., Reksen, O., Chang'a, J.S., Robertson, L.J., Mtambo, M.M.A., Mdegela, R.H., Løken, T., Reksen, O., 2011. Unexpected results from large-scale cryptosporidiosis screening study in calves in Tanzania. Ann. Trop. Med. Parasitol. 105, 513–519. https://doi.org/10.1179/2047773211Y.0000000007.
Chatikobo, P., Choga, T., Ncube, C., Mutambara, J., 2013. Participatory diagnosis and prioritization of constraints to cattle production in some smallholder farming areas of Zimbabwe. Prev. Vet. Med. 109, 327–333. https://doi.org/10.1016/j.prevetmed.2012.10.013.
Chauhan, H.C., Lambade, P.S., Sen, A., Dadawala, A.I., Ranaware, P.B., Chandel, B., Joshi, D.V., Patel, S.S., Pankaj, K., Shah, N.M., Kher, H.N., 2011. The use of pathological and histopathological techniques in the diagnosis of peste des petits ruminants in India. Vet. Italy 47, 41–47.
Chauhan, H.C., Patel, B.K., Bhagat, A.G., Patel, M.V., Patel, S.I., Raval, S.H., Panchasara, H.H., Shrimali, M.D., Patel, A.C., Chandel, B.S., 2015. Comparison of molecular and microscopic technique for detection of Theileria annulata from the field cases of cattle. Vet. World 8, 1370–1374. https://doi.org/10.14202/vetworld.2015.1370- 1374.
Chazya, R., Muma, J.B., Mwacalimba, K.K., Karimuribo, E., Mkandawire, E., Simuunza, M., 2014. A qualitative assessment of the risk of introducing peste des petits ruminants into Northern Zambia from Tanzania. Vet. Med. Int. 2014, 1–10. https://doi.org/10.1155/2014/202618.
Chhetri, B.K., Perez, A.M., Thurmond, M.C., 2010. Factors associated with spatial clustering of foot-and-mouth disease in Nepal. Trop. Anim. Health Prod. 42 https://doi.org/10.1007/s11250-010-9573-7.
Chikerema, S.M., Pfukenyi, D.M., Matope, G., Bhebhe, E., 2012. Temporal and spatial distribution of cattle anthrax outbreaks in Zimbabwe between 1967 and 2006. Trop. Anim. Health Prod. 44, 63–70. https://doi.org/10.1007/s11250-011-9888-z.
Chikerema, S.M., Matope, G., Pfukenyi, D.M., 2013. Awareness and attitude toward zoonoses with particular reference to Anthrax Among cattle owners in selected rural communities of Zimbabwe. Vector-Borne Zoonotic Dis. 13, 243–249. https://doi.org/10.1089/vbz.2011.0916.
Chimana, H.M., Muma, J.B., Samui, K.L., Hangombe, B.M., Munyeme, M., Matope, G., Phiri, A.M., Godfroid, J., Skjerve, E., Tryland, M., 2010. A comparative study of the seroprevalence of brucellosis in commercial and small-scale mixed dairy-beef cattle enterprises of Lusaka province and Chibombo district, Zambia. Trop. Anim. Health Prod. 42, 1541–1545. https://doi.org/10.1007/s11250-010-9604-4.
Choudhary, V., Garg, S., Chourasia, R., Hasnani, J.J., Patel, P.V., Shah, T.M., Bhatt, V.D., Mohapatra, A., Blake, D.P., Joshi, C.G., 2015. Transcriptome analysis of the adult rumen fluke Paramphistomum cervi following next generation sequencing. Gene 570, 64–70. https://doi.org/10.1016/j.gene.2015.06.002.
Cleaveland, S., Shaw, D.J., Mfinanga, S.G., Shirima, G., Kazwala, R.R., Eblate, E., Sharp, M., 2007. Mycobacterium bovis in rural Tanzania: risk factors for infection in human and cattle populations. Tuberculosis (Edinb) 87, 30–43. https://doi.org/10.1016/j.tube.2006.03.001.
Clifford, D.L., Kazwala, R.R., Sadiki, H., Roug, A., Muse, E.A., Coppolillo, P.C., Mazet, J. A.K., 2013. Tuberculosis infection in wildlife from the Ruaha ecosystem Tanzania: implications for wildlife, domestic animals, and human health. Epidemiol. Infect. 141, 1371–1381. https://doi.org/10.1017/S0950268813000836.
Coffin, J.L., Monje, F., Asiimwe-Karimu, G., Amuguni, H.J., Odoch, T., 2015. A one Health, participatory epidemiology assessment of anthrax (Bacillus anthracis) management in Western Uganda. Soc. Sci. Med. 129, 44–50. https://doi.org/10.1016/j.socscimed.2014.07.037.
Craighead, L., Meyer, A., Chengat, B., Musallam, I., Akakpo, J., Kone, P., Guitian, J., Häsler, B., 2018. Brucellosis in West and Central Africa: a review of the current situation in a changing landscape of dairy cattle systems. Acta Trop. 179, 96–108. https://doi.org/10.1016/j.actatropica.2017.12.026.
Dahmani, M., Sambou, M., Scandola, P., Raoult, D., Fenollar, F., Mediannikov, O., 2017. Bartonella bovis and Candidatus Bartonella davousti in cattle from Senegal. Comp. Immunol. Microbiol. Infect. Dis. 50, 63–69. https://doi.org/10.1016/j.cimid.2016.11.010.
Dalis, J.S., Kazeem, H.M., Kwaga, J.K.P., Kwanashie, C.N., Yakubu, B., Owolodun, O.A., Jambol, A.R., 2018. Molecular characterization of dermatophytes isolated from cattle in Plateau State, Nigeria. Vet. Microbiol. 219, 212–218. https://doi.org/10.1016/j.vetmic.2018.04.022.
Dar, P.A., Hajam, I.A., Suryanarayana, V.S., Kishore, S., Kondabattula, G., 2015. Kinetics of cytokine expression in bovine PBMCs and whole blood after in vitro stimulation with foot-and-mouth disease virus (FMDV) antigen. Cytokine 72, 58–62. https://doi.org/10.1016/j.cyto.2014.12.011.
Dar, M.A., Ahmed, R., Urwat, U., Ahmad, S.M., Dar, P.A., Kushoo, Z.A., Dar, T.A., Mumtaz, P.T., Bhat, S.A., Amin, U., Shabir, N., Bhat, H.F., Shah, R.A., Ganai, N.A., Heidari, M., 2018. Expression kinetics of natural resistance associated macrophage protein (NRAMP) genes in Salmonella typhimurium-infected chicken. BMC Vet. Res. 14, 180. https://doi.org/10.1186/s12917-018-1510-4.

Dar, M.A., Urwat, U., Ahmad, S.M., Ahmad, R., Kashoo, Z.A., Dar, T.A., Bhat, S.A., Mumtaz, P.T., Shabir, N., Shah, R.A., Heidari, M., 2019. Gene expression and antibody response in chicken against Salmonella typhimurium challenge. Poult. Sci. 98, 2008–2013. https://doi.org/10.3382/ps/pey560.

Dean, A.S., Fournié, G., Kulo, A.E., Boukaya, G.A., Schelling, E., Bonfoh, B., 2013. Potential risk of regional disease spread in West Africa through cross-border cattle trade. PLoS One 8, e75570. https://doi.org/10.1371/journal.pone.0075570.

Deb, R., Kumar, A., Chakraborty, S., Verma, A., Tiwari, R., Dhama, K., Singh, U., Kumar, S., 2013. Trends in diagnosis and treatment of bovine mastitis: a review. Pak. J. Biol. Sci. 16, 1653–1661.

Debele, G., Guru, M., Hundessa, F., Duguma, M., 2013. Assessment of farmers' management practices and factors affecting goats' production system in Adami Tulu Jido Kombolcha district of East Shawa Zone, Ethiopia. Agric. Biol. J. North Am. 4, 520–526.

de Bronsvoort, B.M.C., Thumbi, S.M., Poole, E.J., Kiara, H., Tosas Auguet, O., Handel, I. G., Jennings, A., Conradie, I., Mbole-Kariuki, M.N., Toye, P.G., Hanotte, O., Coetzer, J., Woolhouse, M.E., 2013. Design and descriptive epidemiology of the Infectious Diseases of East African Livestock (IDEAL) project, a longitudinal calf cohort study in western Kenya. BMC Vet. Res. 9, 171. https://doi.org/10.1186/1746-6148-9-171.

Demeke, B., Jenberie, S., Tesfaye, B., Ayelet, G., Yami, M., Lamien, C.E., Gelaye, E., 2017. Investigation of Marek's disease virus from chickens in central Ethiopia. Trop. Anim. Health Prod. 49, 403–408. https://doi.org/10.1007/s11250-016-1208-1.

Dhikusooka, M.T., Ayebazibwe, C., Namatovu, A., Belsham, G.J., Siegismund, H.R., Wekesa, S.N., Balinda, S.N., Muwanika, V.B., Tjørnehøj, K., 2016. Unrecognized circulation of SAT 1 foot-and-mouth disease virus in cattle herds around Queen Elizabeth National Park in Uganda. BMC Vet. Res. 12, 5. https://doi.org/10.1186/s12917-015-0616-1.

Dossa, L.H., Wollny, C., Gauly, M., 2007. Smallholders' perceptions of goat farming in southern Benin and opportunities for improvement. Trop. Anim. Health Prod. 39, 49–57.

Duguma, A., Abera, S., Zewdie, W., Belina, D., Haro, G., 2017. Status of bovine tuberculosis and its zoonotic implications in Borana zone, Southern Ethiopia. Trop. Anim. Health Prod. 49, 445–450. https://doi.org/10.1007/s11250-016-1213-4.

Dutta, T.K., Roychoudhury, P., Bandyopadhyay, S., Wani, S.A., Hussain, I., 2011. Detection and characterization of Shiga toxin producing Escherichia coli (STEC) and enteropathogenic Escherichia coli (EPEC) in poultry birds with diarrhoea. Indian J. Med. Res. 133, 541–545.

Edao, B.M., Hailegebreal, G., Berg, S., Zewude, A., Zeleke, Y., Sori, T., Almaw, G., Whatmore, A.M., Ameni, G., Wood, J.L.N., 2018. Brucellosis in the Addis Ababa dairy cattle: the myths and the realities. BMC Vet. Res. 14, 396. https://doi.org/10.1186/s12917-018-1709-4.

Ehizibolo, D.O., Haegeman, A., De Vleeschauwer, A.R., Umoh, J.U., Kazeem, H.M., Okolocha, E.C., Van Borm, S., De Clercq, K., 2017. Detection and molecular characterization of foot and mouth disease viruses from outbreaks in some states of Northern Nigeria 2013–2015. Transbound. Emerg. Dis. 64, 1979–1990. https://doi.org/10.1111/tbed.12602.

Ehizibolo, D.O., De Vleeschauwer, A.R., Haegeman, A., Lefebvre, D., Nwosuh, C.I., Umoh, J.U., Okolocha, E.C., Kazeem, H.M., Van Borm, S., De Clercq, K., 2019. Serological and molecular epidemiology of foot-and-mouth disease viruses in agro-pastoralist livestock herds in the kachia grazing reserve, Nigeria. Transbound. Emerg. Dis. https://doi.org/10.1111/tbed.13182 tbed.13182.

Elbrissi, A., Sabeil, Y.A., Khalifa, K.A., Enan, K., Khair, O.M., El Hussein, A.M., 2017. Isolation, identification and differentiation of Campylobacter spp. using multiplex PCR assay from goats in Khartoum State, Sudan. Trop. Anim. Health Prod. 49, 575–581. https://doi.org/10.1007/s11250-017-1231-x.

Elelu, N., 2017. Epidemiological risk factors of knowledge and preventive practice regarding avian influenza among poultry farmers and live bird traders in Ikorodu, Lagos State, Nigeria. Int. J. Vet. Sci. Med. 5, 47–52. https://doi.org/10.1016/j.ijvsm.2017.03.002.

Elelu, N., Ambali, A., Coles, G.C., Eisler, M.C., 2016. Cross-sectional study of Fasciola gigantica and other trematode infections of cattle in Edu Local Government Area, Kwara State, north-central Nigeria. Parasit. Vectors 9, 470. https://doi.org/10.1186/s13071-016-1737-5.

Enwelu, I.A., Ezeuko, E.L., Machebe, N.S., 2015. Challenges of smallholder sheep and goat keeping in rural communities of Aguata Agricultural Zone of Anambra State, Nigeria. Indian J. Anim. Res. 49, 373. https://doi.org/10.5958/0976-0555.2015.00131.4.

Esemu, S.N., Besong, W.O., Ndip, R.N., Ndip, L.M., 2013. Prevalence of Ehrlichia ruminantium in adult Amblyomma variegatum collected from cattle in Cameroon. Exp. Appl. Acarol. 59, 377–387. https://doi.org/10.1007/s10493-012-9599-9.

Eshetu, L., Yigezu, L., Asfaw, Y., 2007. A study on contagious caprine pleuropneumonia (CCPP) in goats at an export oriented abattoir, Debrezeit, Ethiopia. Trop. Anim. Health Prod. 39, 427–432.

Ezama, A., Gonzalez, J.-P., Majalija, S., Bajunirwe, F., 2018. Assessing short evolution brucellosis in a highly brucella endemic cattle keeping population of Western Uganda: a complementary use of Rose Bengal test and IgM rapid diagnostic test. BMC Public Health 18, 315. https://doi.org/10.1186/s12889-018-5228-9.

Fafetine, J., Neves, L., Thompson, P.N., Paweska, J.T., Rutten, V.P.M.G., Coetzer, J.A.W., 2013. Serological evidence of rift valley fever virus circulation in sheep and goats in Zambézia Province, Mozambique. PLoS Negl. Trop. Dis. 7, e2065. https://doi.org/10.1371/journal.pntd.0002065.

Fafetine, J.M., Coetzee, P., Mubemba, B., Nhambirre, O., Neves, L., Coetzer, J.A.W., Venter, E.H., 2016. Rift valley fever outbreak in livestock, Mozambique, 2014. Emerg. Infect. Dis. 22, 2165–2167. https://doi.org/10.3201/eid2212.160310.

Fandamu, P., Thys, E., Duchateau, L., Berkvens, D., 2006. Perception of cattle farmers of the efficacy of east coast fever immunization in Southern Zambia. Trop. Anim. Health Prod. 38, 9–16. https://doi.org/10.1007/s11250-006-4341-4.

Faris, D., Yilkal, A., Berhe, G., Kelay, B., 2012. Seroprevalence and sero-conversion after vaccination against Peste des Petits Ruminants in sheep and goats from Awash Fentale District, Afar, Ethiopia. Prev. Vet. Med. 103, 157–162.

Farougou, S., Gagara, M., Mensah, G.A., 2013. Prevalence of peste des petits ruminants in the arid zone in the Republic of Niger. Onderstepoort J. Vet. Res. 80 https://doi.org/10.4102/ojvr.v80i1.544.

Fasina, F.O., Sirdar, M.M., Bisschop, S.P.R., 2008. The financial cost implications of the highly pathogenic notifiable avian influenza H5N1 in Nigeria. Onderstepoort J. Vet. Res. 75, 39–46.

Fenteng, D.E., Ampofo, W., Afari, E., Wurapa, F., Aryee, M., Koney, E., Yebuah, N., Chima, J., Awumbila, B., 2011. Avian influenza surveillance in domestic poultry and wild bird-Tema Metropolis, Ghana, 2010. J. Commonw. Vet. Assoc. 27, 158–167.

Fentie, T., Abebe, B., Kassa, T., 2013. Small-scale family poultry production in north Gondar: characteristics, productivity and constraints. Livest. Res. Rural Dev. 25.

Fentie, T., Fenta, N., Leta, S., Molla, W., Ayele, B., Teshome, Y., Nigatu, S., Assefa, A., 2017. Sero-prevalence, risk factors and distribution of sheep and goat pox in Amhara Region, Ethiopia. BMC Vet. Res. 13, 385. https://doi.org/10.1186/s12917-017-1312-0.

Fetene, T., Kebede, N., 2009. Bovine tuberculosis of cattle in three districts of northwestern Ethiopia. Trop. Anim. Health Prod. 41, 273–277. https://doi.org/10.1007/s11250-008-9186-6.

Fuller, T.L., Ducatez, M.F., Njabo, K.Y., Couacy-Hymann, E., Chasar, A., Aplogan, G.L., Lao, S., Awoume, F., Téhou, A., Langeois, Q., Krauss, S., Smith, T.B., 2015. Avian influenza surveillance in Central and West Africa, 2010-2014. Epidemiol. Infect. 143, 2205–2212.

Gachohi, J.M.M., Ngumi, P.N.N., Kitala, P.M.M., Skilton, R.A.A., 2010. Estimating seroprevalence and variation to four tick-borne infections and determination of associated risk factors in cattle under traditional mixed farming system in Mbeere District, Kenya. Prev. Vet. Med. 95, 208–223. https://doi.org/10.1016/j.prevetmed.2010.03.015.

Gachohi, J.M., Njenga, M.K., Kitala, P., Bett, B., 2016. Modelling vaccination strategies against rift valley fever in livestock in Kenya. PLoS Negl. Trop. Dis. 10, e0005049 https://doi.org/10.1371/journal.pntd.0005049.

Gakuya, D.W., Mulei, C.M., Wekesa, S.B., 2011. Use of ethnoveterinary remedies in the management of foot and mouth disease lesions in a dairy herd. Afr. J. Tradit. Complement. Altern. Med. AJTCAM 8, 165–169. https://doi.org/10.4314/ajtcam.v8i2.63204.

Gakuya, F., Ombui, J., Heukelbach, J., Maingi, N., Muchemi, G., Ogara, W., Mijele, D., Alasaad, S., 2012. Knowledge of mange among Masai pastoralists in Kenya. PLoS One 7, e43342. https://doi.org/10.1371/journal.pone.0043342.

Gari, G., Warer-Szkuta, A., Grosbois, V., Jacquiet, P., Roger, F., 2010. Risk factors associated with observed clinical lumpy skin disease in Ethiopia. Epidemiol. Infect. 138, 1657–1666. https://doi.org/10.1017/S0950268810000506.

Gari, G., Bonnet, P., Roger, F., Waret-Szkuta, A., 2011. Epidemiological aspects and financial impact of lumpy skin disease in Ethiopia. Prev. Vet. Med. 102, 274–283. https://doi.org/10.1016/j.prevetmed.2011.07.003.

Gari, G., Grosbois, V., Waret-Szkuta, A., Babiuk, S., Jacquiet, P., Roger, F., 2012. Lumpy skin disease in Ethiopia: seroprevalence study across different agro-climate zones. Acta Trop. 123, 101–106. https://doi.org/10.1016/j.actatropica.2012.04.009.

Gari, G., Abie, G., Gizaw, D., Wubete, A., Kidane, M., Asgedom, H., Bayissa, B., Ayelet, G., Oura, C.A.L., Roger, F., Tuppurainen, E.S.M., 2015. Evaluation of the safety, immunogenicity and efficacy of three capripoxvirus vaccine strains against lumpy skin disease virus. Vaccine 33, 3256–3261. https://doi.org/10.1016/j.vaccine.2015.01.035.

Gebremedhin, E., Agonafir, A., Tessema, T., Tilahun, G., Medhin, G., Vitale, M., Marco, V., Cox, E., Vercruysse, J., Dorny, P., 2013. Seroepidemiological study of ovine toxoplasmosis in east and west shewa zones of oromia regional state, Central Ethiopia. BMC Vet. Res. 9, 117. https://doi.org/10.1186/1746-6148-9-117.

Gebremedhin, E., Tesfamaryam, G., Yunus, H., Duguma, R., Tilahun, G., Di Marco, V., Vitale, M., 2015. Seroepidemiology of Toxoplasma gondii infection in free-range chickens (Gallus domesticus) of Central Ethiopia. Epidemiol. Infect. 143, 608–617. https://doi.org/10.1017/S0950268814000971.

Geidam, Y.A., Ayi, V.K., Umar, I.I., Sunday, J., Musa, D., Goni, B., Mwapu, D.N., 2013. Participatory disease surveillance in the detection of trans-boundary animal diseases (TADS) in Borno State of arid north-eastern Nigeria. Bull. Anim. Health Prod. Afr. 61, 231–239.

Gelaye, E., Mekonnen, G., Jenberie, S., Ayelet, G., 2013. Detection of sheep-associated malignant catarrhal fever from clinical cases in Ethiopian cattle. Rev. Sci. Tech. l'OIE 32, 851–856. https://doi.org/10.20506/rst.32.2.2211.

Gelaye, E., Belay, A., Ayelet, G., Jenberie, S., Yami, M., Loitsch, A., Tuppurainen, E., Grabherr, R., Diallo, A., Lamien, C.E., 2015. Capripox disease in Ethiopia: genetic differences between field isolates and vaccine strain, and implications for vaccination failure. Antiviral Res. 119, 28–35. https://doi.org/10.1016/j.antiviral.2015.04.008.

Germeraad, E.A., Hogerwerf, L., Faye-Joof, T., Goossens, B., van der Hoek, W., Jeng, M., Lamin, M., Manneh, I.L., Nwakanma, D., Roest, H.I.J., Secka, A., Stegeman, A., Wegmüller, R., van der Sande, M.A.B., Secka, O., 2016. Low seroprevalence of brucellosis in humans and small ruminants in the Gambia. PLoS One 11, e0166035. https://doi.org/10.1371/journal.pone.0166035.

Getaneh, A.M., Gebremedhin, E.Z., 2017. Meta-analysis of the prevalence of mastitis and associated risk factors in dairy cattle in Ethiopia. Trop. Anim. Health Prod. 49, 697–705. https://doi.org/10.1007/s11250-017-1246-3.

Getaw, A., Beyene, D., Ayana, D., Megersa, B., Abunna, F., 2010. Hydatidosis: prevalence and its economic importance in ruminants slaughtered at Adama municipal abattoir, Central Oromia, Ethiopia. Acta Trop. 113, 221–225. https://doi.org/10.1016/j.actatropica.2009.10.019.

Giday, M., Teklehaymanot, T., 2013. Ethnobotanical study of plants used in management of livestock health problems by Afar people of Ada'ar District, Afar Regional State, Ethiopia. J. Ethnobiol. Ethnomed. 9, 8. https://doi.org/10.1186/1746-4269-9-8.

Girmay, G., Arega, B., Berkvens, D., Altaye, S.Z., Muleta, G., 2018. Community-based tsetse fly control minimizes the effect of trypanosomosis on livestock in Metekel zone, Ethiopia. Trop. Anim. Health Prod. 50, 621–627. https://doi.org/10.1007/s11250-017-1478-2.

Gitonga, P.N., Gachene, C.K., Njoroge, E., Thumbi, S.M., 2016. Small ruminant husbandry practices amongst Kajiado and Marsabit pastoralists and their effects on Peste des petits ruminants control strategies. Livest. Res. Rural Dev. 28.

Gomo, C., Kanonhuwa, K., Godobo, F., Tada, O., Makuza, S.M., 2017. Temporal and spatial distribution of lumpy skin disease (LSD) outbreaks in Mashonaland West Province of Zimbabwe from 2000 to 2013. Trop. Anim. Health Prod. 49, 509–514. https://doi.org/10.1007/s11250-017-1222-y.

Gorna, K., Houndjè, E., Romey, A., Relmy, A., Blaise-Boisseau, S., Kpodékon, M., Saegerman, C., Moutou, F., Zientara, S., Bakkali Kassimi, L., 2014. First isolation and molecular characterization of foot-and- mouth disease virus in Benin. Vet. Microbiol. 171, 175–181. https://doi.org/10.1016/j.vetmic.2014.03.003.

Govindaraj, G.N., Roy, G., Mohanty, B.S., Balamurugan, V., Pandey, A.K., Sharma, V., Patel, A., Mehra, M., Pandey, S.K., Roy, P., 2019. Evaluation of effectiveness of Mass Vaccination Campaign against Peste des petits ruminants in Chhattisgarh state. India. Transbound. Emerg. Dis. 66, 1349–1359. https://doi.org/10.1111/tbed.13163.

Gowda, R.N.S., 2005. An epidemiological study of sheep pox infection in Karnataka state, India. OIE Rev. Sci. Tech. 24, 909–920. https://doi.org/10.20506/rst.24.3.1621.

Gururaj, K., Pawaiya, R.S., Gangwar, N.K., Mishra, A.K., Singh, D.D., Andani, D., Paul, S., Sharma, N., Shivasharanappa, N., Rahal, A., Chaturvedi, V.K., Kumar, A., Sharma, D. K., 2019. Comparative molecular characterization and phylogenetic analysis of cerebral and non-cerebral coenurosis in Indian goats. Vet. Parasitol. Reg. Stud. Rep. 15, 100266 https://doi.org/10.1016/j.vprsr.2019.100266.

Gutiérrez- Expósito, D., Ferre, I., Ortega-Mora, L.M., Álvarez-García, G., 2017. Advances in the diagnosis of bovine besnoitiosis: current options and applications for control. Int. J. Parasitol. 47, 737–751. https://doi.org/10.1016/j.ijpara.2017.08.003.

Habitu, T., Areda, D., Muwonge, A., Tessema, G.T., Skjerve, E., Gebrehiwot, T., 2019. Prevalence and risk factors analysis of bovine tuberculosis in cattle raised in mixed crop-livestock farming system in Tigray region, Ethiopia. Transbound. Emerg. Dis. 66, 488–496. https://doi.org/10.1111/tbed.13050.

Habte, A., Ibrahim, N., 2018. Prevalence of Haemonchus contortus infection in sheep slaughtered at Jimma town municipal abattoir, Ethiopia. Trop. Anim. Health Prod. 50, 1865–1870. https://doi.org/10.1007/s11250-018-1637-0.

Habte, T., Amare, A., Bettridge, J., Collins, M., Robert, C., Wigley, P., 2017. Guide to Chicken Health and Management in Ethiopia.

Hailu, B., Tolosa, T., Gari, G., Teklue, T., Beyene, B., 2014. Estimated prevalence and risk factors associated with clinical Lumpy skin disease in north-eastern Ethiopia. Prev. Vet. Med. 115, 64–68. https://doi.org/10.1016/j.prevetmed.2014.03.013.

Hailu, B., Alemayehu, G., Sied, N., 2015. Participatory epidemiological studies of major trade constraint diseases of goats in selected districts of Afar region. J. Biol. Agric. Healthc. 5, 140–148.

Hamill, L., Picozzi, K., Fyfe, J., von Wissmann, B., Wastling, S., Wardrop, N., Selby, R., Acup, C.A., Bardosh, K.L., Muhanguzi, D., Kabasa, J.D., Waiswa, C., Welburn, S.C., 2017. Evaluating the impact of targeting livestock for the prevention of human and animal trypanosomiasis, at village level, in districts newly affected with T. b. rhodesiense in Uganda. Infect. Dis. Poverty 6, 16. https://doi.org/10.1186/s40249-016-0224-8.

Hammami, P., Lancelot, R., Lesnoff, M., 2016. Modelling the dynamics of post-vaccination immunity rate in a population of Sahelian sheep after a vaccination campaign against peste des petits ruminants virus. PLoS One 11, e0161769.

Hassan, O.A., Ahlm, C., Sang, R., Evander, M., 2011. The 2007 rift valley fever outbreak in Sudan. PLoS Negl. Trop. Dis. 5, e1229. https://doi.org/10.1371/journal.pntd.0001229.

Healy Profitós, J.M., Moritz, M., Garabed, R.B., 2013. What to do with chronically sick animals? Pastoralists' management strategies in the far north region of Cameroon. Pastoralism 3, 1–11. https://doi.org/10.1186/2041-7136-3-8.

Hector, E., Elelu, N., Ferrolho, J., Couto, J., Sanches, G., Antunes, S., Domingos, A., Eisler, M., 2019. PCR detection of Ehrlichia ruminantium and Babesia bigemina in cattle from Kwara State, Nigeria: unexpected absence of infection. Parasitol. Res. 118, 1025–1029. https://doi.org/10.1007/s00436-019-06204-1.

Hegde, R., Gomes, A.R., Muniyellappa, H.K., Byregowda, S.M., Giridhar, P., Renukaprasad, C., 2009. A short note on peste des petits ruminants in Karnataka, India. Rev. Sci. Tech. 28, 1031–1035.

Henning, J., Bett, B., Okike, I., Abdu, P., Perry, B., 2013. Incidence of highly pathogenic avian influenza H5N1 in Nigeria, 2005–2008. Transbound. Emerg. Dis. 60, 222–230. https://doi.org/10.1111/j.1865-1682.2012.01331.x.

Hiko, A., Agga, G.E., 2011. First-time detection of mycobacterium species from goats in Ethiopia. Trop. Anim. Health Prod. 43, 133–139. https://doi.org/10.1007/s11250-010-9665-4.

Hinsu, A.T., Thakkar, J.R., Koringa, P.G., Vrba, V., Jakhesara, S.J., Psifidi, A., Guitian, J., Tomley, F.M., Rank, D.N., Raman, M., Joshi, C.G., Blake, D.P., 2018. Illumina next generation sequencing for the analysis of eimeria populations in commercial broilers and indigenous chickens. Front. Vet. Sci. 5, 176. https://doi.org/10.3389/fvets.2018.00176.

Hørning, G., Rasmussen, S., Permin, A., Bisgaard, M., 2003. Investigations on the influence of helminth parasites on vaccination of chickens against Newcastle disease virus under village conditions. Trop. Anim. Health Prod. 35, 415–424.

Hota, A., Biswal, S., Sahoo, N., Venkatesan, G., Arya, S., Kumar, A., Ramakrishnan, M.A., Pandey, A.B., Rout, M., 2018. Seroprevalence of Capripoxvirus infection in sheep and goats among different agro-climatic zones of Odisha, India. Vet. World 11, 66–70. https://doi.org/10.14202/vetworld.2018.66-70.

Hove, T., Lind, P., Mukaratirwa, S., 2005. Seroprevalence of Toxoplasma gondii infection in goats and sheep in Zimbabwe. Onderstepoort J. Vet. Res. 72, 267–272.

Howell, A., Mugisha, L., Davies, J., LaCourse, E., Claridge, J., Williams, D.J., Kelly-Hope, L., Betson, M., Kabatereine, N.B., Stothard, J., 2012. Bovine fasciolosis at increasing altitudes: parasitological and malacological sampling on the slopes of Mount Elgon, Uganda. Parasit. Vectors 5, 196. https://doi.org/10.1186/1756-3305-5-196.

Howson, E.L.A., Armson, B., Lyons, N.A., Chepkwony, E., Kasanga, C.J., Kandusi, S., Ndusilo, N., Yamazaki, W., Gizaw, D., Cleaveland, S., Lembo, T., Rauh, R., Nelson, W.M., Wood, B.A., Mioulet, V., King, D.P., Fowler, V.L., 2018. Direct detection and characterization of foot-and-mouth disease virus in East Africa using a field-ready real-time PCR platform. Transbound. Emerg. Dis. 65, 221–231. https://doi.org/10.1111/tbed.12684.

Hutton, S., Bettridge, J., Christley, R., Habte, T., Ganapathy, K., 2017. Detection of infectious bronchitis virus 793B, avian metapneumovirus, Mycoplasma gallisepticum and Mycoplasma synoviae in poultry in Ethiopia. Trop. Anim. Health Prod. 49, 317–322. https://doi.org/10.1007/s11250-016-1195-2.

Ibrahim, A.M.E., Elfahal, A.M., El Hussein, A.R.M., 2012. First report of Neospora caninum infection in cattle in Sudan. Trop. Anim. Health Prod. 44, 769–772. https://doi.org/10.1007/s11250-011-9963-5.

Iqbal Yatoo, M., Raffiq Parray, O., Tauseef Bashir, S., Ahmed Bhat, R., Gopalakrishnan, A., Karthik, K., Dhama, K., Vir Singh, S., 2019. Contagious caprine pleuropneumonia - a comprehensive review. Vet. Q. 39, 1–25. https://doi.org/10.1080/01652176.2019.1580826.

Iraguha, B., Hamudikuwanda, H., Mushonga, B., 2015. Bovine mastitis prevalence and associated risk factors in dairy cows in Nyagatare District, Rwanda. J. S. Afr. Vet. Assoc. 86, 1228. https://doi.org/10.4102/jsava.v86i1.1228.

Isaac, C., Ohiolei, J.A.A., Ebhodaghe, F., Igbinosa, I.B., Eze, A.A.A., 2017. Animal African Trypanosomiasis in Nigeria: a long way from elimination/eradication. Acta Trop. 176, 323–331. https://doi.org/10.1016/j.actatropica.2017.08.032.

Ishag, O.M., Saeed, I.K., Ali, Y.H., 2015. Peste des petits ruminants outbreaks in White Nile State, Sudan. Onderstepoort J. Vet. Res. 82, E1–4. https://doi.org/10.4102/ojvr.v82i1.897.

Islam, M.A., Khatun, M.M., Werre, S.R., Sriranganathan, N., Boyle, S.M., 2013. A review of Brucella seroprevalence among humans and animals in Bangladesh with special emphasis on epidemiology, risk factors and control opportunities. Vet. Microbiol. 166, 317–326. https://doi.org/10.1016/j.vetmic.2013.06.014.

Jackson, D.S., Nydam, D.V., Altier, C., 2014. Prevalence and risk factors for brucellosis in domestic yak Bos grunniens and their herders in a transhumant pastoralist system of Dolpo, Nepal. Prev. Vet. Med. 113, 47–58.

Jagadeeswary, V., Reddy, M.S., Satyanarayan, K., 2014. Ethno-veterinary practices used by tribals of Chittoor district, Andhra Pradesh, India. Indian J. Anim. Res. 48, 251. https://doi.org/10.5958/j.0976-0555.48.3.054.

Jaiswal, A.K., Sudan, V., Kumar, P., Srivastava, A., Shanker, D., 2016. Bovine hypodermosis in indigenous cattle herd and its successful therapeutic management. J. Parasit. Dis. 40, 166–168. https://doi.org/10.1007/s12639-014-0470-2.

Jakhesara, S.J., Prasad, V.V.S.P., Pal, J.K., Jhala, M.K., Prajapati, K.S., Joshi, C.G., 2016. Pathotypic and sequence characterization of newcastle disease viruses from vaccinated chickens reveals circulation of genotype II, IV and XIII and in India. Transbound. Emerg. Dis. 63, 523–539. https://doi.org/10.1111/tbed.12294.

Jemberu, W.T., Mourits, M.C.M., Woldehanna, T., Hogeveen, H., 2014. Economic impact of foot and mouth disease outbreaks on smallholder farmers in Ethiopia. Prev. Vet. Med. 116, 26–36. https://doi.org/10.1016/j.prevetmed.2014.06.004.

Jemberu, W., Mourits, M., Hogeveen, H., 2015. Farmers' intentions to implement foot and mouth disease control measures in Ethiopia. PLoS One 10, e0138363. https://doi.org/10.1371/journal.pone.0138363.

Jemberu, W.T., Mourits, M.C.M., Sahle, M., Siraw, B., Vernooij, J.C.M., Hogeveen, H., 2016a. Epidemiology of foot and mouth disease in Ethiopia: a retrospective analysis of district level outbreaks, 2007–2012. Transbound. Emerg. Dis. 63, e246–e259. https://doi.org/10.1111/tbed.12338.

Jemberu, Wudu T., Mourits, M., Rushton, J., Hogeveen, H., 2016b. Cost-benefit analysis of foot and mouth disease control in Ethiopia. Prev. Vet. Med. 132, 67–82. https://doi.org/10.1016/j.prevetmed.2016.08.008.

Jenberie, S., Lynch, S.E., Kebede, F., Christley, R.M., Gelaye, E., Negussie, H., Asmare, K., Ayelet, G., 2014. Genetic characterisation of infectious bursal disease virus isolates in Ethiopia. Acta Trop. 130, 39–43. https://doi.org/10.1016/j.actatropica.2013.09.025.

Jenbreie, S., Ayelet, G., Gelaye, E., Kebede, F., Lynch, S.E., Negussie, H., 2012. Infectious bursal disease: seroprevalence and associated risk factors in major poultry rearing areas of Ethiopia. Trop. Anim. Health Prod. 45, 75–79. https://doi.org/10.1007/s11250-012-0176-3.

Jibril, A.H., Umoh, J.U., Kabir, J., Gashua, M.M., Bello, M.B., 2015. Application of participatory epidemiology techniques to investigate Newcastle disease among rural farmers in Zamfara state, Nigeria. J. Appl. Poult. Res. 24, 233–239. https://doi.org/10.3382/japr/pfv012.

Kabi, F., Masembe, C., Muwanika, V., Kirunda, H., Negrini, R., 2014. Geographic distribution of non-clinical Theileria parva infection among indigenous cattle populations in contrasting agro-ecological zones of Uganda: implications for control strategies. Parasit. Vectors 7, 414. https://doi.org/10.1186/1756-3305-7-414.

Kagira, J.M., Kanyari, P.W.N., 2012. Questionnaire survey on urban and peri-urban livestock farming practices and disease control in Kisumu municipality, Kenya. J. S. Afr. Vet. Assoc. 81, 82–86. https://doi.org/10.4102/jsava.v81i2.110.

Kairu-Wanyoike, S.W., Kaitibie, S., Heffernan, C., Taylor, N.M., Gitau, G.K., Kiara, H., McKeever, D., 2014. Willingness to pay for contagious bovine pleuropneumonia vaccination in Narok South District of Kenya. Prev. Vet. Med. 115, 130–142. https://doi.org/10.1016/j.prevetmed.2014.03.028.

Kakandelwa, C., Siwila, J., Nalubamba, K.S., Muma, J.B., Phiri, I.G.K., 2016. Prevalence of Giardia in dairy cattle in Lusaka and Chilanga districts, Zambia. Vet. Parasitol. 215, 114–116. https://doi.org/10.1016/j.vetpar.2015.11.004.

Kalleshamurthy, T., Shekar, R., Niranjanamurthy, H.H., Natesan, K., Shome, B.R., Bambal, R.G., Sairiwal, L., Barbuddhe, S.B., Sahare, A., Kilari, S., Rahman, H., Shome, R., 2018. Assessment of fluorescence polarization assay: a candid diagnostic tool in Brucella abortus strain 19 vaccinated areas. Microbiol. Immunol. 62, 694–701. https://doi.org/10.1111/1348-0421.12654.

Kamani, J., Apanaskevich, D.A., Gutiérrez, R., Nachum- Biala, Y., Baneth, G., Harrus, S., 2017. Morphological and molecular identification of Rhipicephalus (Boophilus) microplus in Nigeria, West Africa: a threat to livestock health. Exp. Appl. Acarol. 73, 283–296. https://doi.org/10.1007/s10493-017-0177-z.

Kamboyi, H.K., Garine-Wichatitsky, M., Hang'ombe, M.B., Munyeme, M., 2019. Risk mapping and eco-anthropogenic assessment of anthrax in the upper Zambezi basin. Vet. Med. Sci. 168. https://doi.org/10.1002/vms3.168 vms3.

Kanani, A., Dabhi, S., Patel, Y., Chandra, V., Kumar, O.R.V., Shome, R., 2018. Seroprevalence of brucellosis in small ruminants in organized and unorganized sectors of Gujarat state, India. Vet. World 11, 1030–1036. https://doi.org/10.14202/vetworld.2018.1030-1036.

Kang'ethe, E.K., Lang'a, K.A., 2009. Aflatoxin B1 and M1 contamination of animal feeds and milk from urban centers in Kenya. Afr. Health Sci. 9, 218–226.

Kanouté, Y.B., Gragnon, B.G., Schindler, C., Bonfoh, B., Schelling, E., 2017. Epidemiology of brucellosis, Q Fever and Rift Valley Fever at the human and livestock interface in northern Côte d'Ivoire. Acta Trop. 165, 66–75.

Kant, N., Kulshreshtha, P., Singh, R., Mal, A., Dwivedi, A., Ahuja, R., Mehra, R., Tehlan, M., Ahmed, P., Kaushik, S., Shipra, Kumar S., Mohammad, A., Shukla, S., Singh, D., Bhatnagar, R., 2018. A study to identify the practices of the buffalo keepers which inadvertently lead to the spread of brucellosis in Delhi. BMC Vet. Res. 14, 329. https://doi.org/10.1186/s12917-018-1670-2.

Karimuribo, E.D., Fitzpatrick, J.L., Bell, C.E., Swai, E.S., Kambarage, D.M., Ogden, N.H., Bryant, M.J., French, N.P., 2006. Clinical and subclinical mastitis in smallholder dairy farms in Tanzania: risk, intervention and knowledge transfer. Prev. Vet. Med. 74, 84–98. https://doi.org/10.1016/j.prevetmed.2006.01.009.

Kasanga, C.J., Sallu, R., Kivaria, F., Mkama, M., Masambu, J., Yongolo, M., Das, S., Mpelumbe-Ngeleja, C., Wambura, P.N., King, D.P., Rweyemamu, M.M., 2012. Foot-and-mouth disease virus serotypes detected in Tanzania from 2003 to 2010: conjectured status and future prospects. Onderstepoort J. Vet. Res. 79 https://doi.org/10.4102/ojvr.v79i2.462.

Kasanga, C.J., Yamaguchi, T., Munang'andu, H.M., Ohya, K., Fukushi, H., 2013. Molecular epidemiology of infectious bursal disease virus in Zambia. J. S. Afr. Vet. Assoc. 84 https://doi.org/10.4102/jsava.v84i1.908.

Kasanga, C.J., Wadsworth, J., Mpelumbe- Ngeleja, C.A.R., Sallu, R., Kivaria, F., Wambura, P.N., Yongolo, M.G.S., Rweyemamu, M.M., Knowles, N.J., King, D.P., 2015. Molecular characterization of foot-and-Mouth disease viruses collected in Tanzania Between 1967 and 2009. Transbound. Emerg. Dis. 62, e19–e29. https://doi.org/10.1111/tbed.12200.

Kassaye, E., Moser, I., Woldemeskel, M., 2003. Epidemiological study on clinical bovine dermatophilosis in northern Ethiopia. Tierarztl. Wochenschr. 110, 422–425.

Kassian, E.N., Simuunza, M.C., Silayo, R.S., Moonga, L., Ndebe, J., Sugimoto, C., Namangala, B., 2017. Prevalence and risk factors of bovine trypanosomosis in Kilwa district, Lindi region of southern Tanzania. Vet. Parasitol. Reg. Stud. Rep. 9, 1–5. https://doi.org/10.1016/j.vprsr.2017.03.004.

Katale, B.Z., Mbugi, E.V., Karimuribo, E.D., Keyyu, J.D., Kendall, S., Kibiki, G.S., Godfrey- Faussett, P., Michel, A.L., Kazwala, R.R., van Helden, P., Matee, M.I., 2013. Prevalence and risk factors for infection of bovine tuberculosis in indigenous cattle in the Serengeti ecosystem, Tanzania. BMC Vet. Res. 9, 267. https://doi.org/10.1186/1746-6148-9-267.

Kathiravan, G., Thirunavukkarasu, Michaelraj, P., 2007. Willingness to pay for annual health care services in small ruminants: the case of South India. J. Appl. Sci. 7, 2361–2365.

Kazoora, H.B., Majalija, S., Kiwanuka, N., Kaneene, J.B., 2014. Prevalence of Mycobacterium bovis skin positivity and associated risk factors in cattle from Western Uganda. Trop. Anim. Health Prod. 46, 1383–1390. https://doi.org/10.1007/s11250-014-0650-1.

Kelly, R.F., Hamman, S.M., Morgan, K.L., Nkongho, E.F., Ngwa, V.N., Tanya, V., Andu, W.N., Sander, M., Ndip, L., Handel, I.G., Mazeri, S., Muwonge, A., de Bronsvoort, B.M.C., 2016. Knowledge of bovine tuberculosis, cattle husbandry and dairy practices amongst pastoralists and small-scale dairy farmers in Cameroon. PLoS One 11, e0146538. https://doi.org/10.1371/journal.pone.0146538.

Kelly, T.R., Bunn, D.A., Joshi, N.P., Grooms, D., Devkota, D., Devkota, N.R., Paudel, L.N., Roug, A., Wolking, D.J., Mazet, J.A.K., 2018. Awareness and practices relating to zoonotic diseases among smallholder farmers in Nepal. Ecohealth 15, 656–669. https://doi.org/10.1007/s10393-018-1343-4.

Kelly, R.F., Mazeri, S., Hartley, C., Hamman, S.M., Ngu Ngwa, V., Nkongho, E.F., Tanya, V., Sander, M., Ndip, L., Morgan, K.L., Muwonge, A., Handel, I., de Bronsvoort, B.M.C., Williams, D.J.L., 2019. Assessing the performance of a Fasciola gigantica serum antibody ELISA to estimate prevalence in cattle in Cameroon. BMC Vet. Res. 15, 8. https://doi.org/10.1186/s12917-018-1762-z.

Kemal, J., Sibhat, B., Abraham, A., Terefe, Y., Tulu, K.T., Welay, K., Getahun, N., 2019. Bovine tuberculosis in eastern Ethiopia: prevalence, risk factors and its public health importance. BMC Infect. Dis. 19, 39. https://doi.org/10.1186/s12879-018-3628-1.

Kerario, I.I., Simuunza, M.C., Chenyambuga, S.W., Koski, M., Hwang, S.-G., Muleya, W., 2017. Prevalence and risk factors associated with Theileria parva infection in cattle in three regions of Tanzania. Trop. Anim. Health Prod. 49, 1613–1621. https://doi.org/10.1007/s11250-017-1367-8.

Kerfua, S.D., Shirima, G., Kusiluka, L., Ayebazibwe, C., Martin, E., Arinaitwe, E., Cleaveland, S., Haydon, D.T., 2019. Low topotype diversity of recent foot-and-mouth disease virus serotypes O and A from districts located along the Uganda and Tanzania border. J. Vet. Sci. 20, e4. https://doi.org/10.4142/jvs.2019.20.e4.

Kerur, N., Jhala, M.K., Joshi, C.G., 2008. Genetic characterization of Indian peste des petits ruminants virus (PPRV) by sequencing and phylogenetic analysis of fusion protein and nucleoprotein gene segments. Res. Vet. Sci. 85, 176–183. https://doi.org/10.1016/j.rvsc.2007.07.007.

Keyyu, J., Kyvsgaard, N., Kassuku, A., Willingham, A., 2003. Worm control practices and anthelmintic usage in traditional and dairy cattle farms in the southern highlands of Tanzania. Vet. Parasitol. 114, 51–61. https://doi.org/10.1016/S0304-4017(03)00111-0.

Khan, M.H., Manoj, K., Pramod, S., 2008. Reproductive disorders in dairy cattle under semi-intensive system of rearing in North-Eastern India. Vet. World 9, 512–518.

Kihu, S.M., Gachohi, J.M., Ndungu, E.K., Gitao, G.C., Bebora, L.C., John, N.M., Wairire, G.G., Maingi, N., Wahome, R.G., Ireri, R., 2015. Sero-epidemiology of Peste des petits ruminants virus infection in Turkana County, Kenya. BMC Vet. Res. 11, 87. https://doi.org/10.1186/s12917-015-0401-1.

Kim, T.Y., Kwak, Y.S., Kim, J.Y., Nam, S.-H., Lee, I.-Y., Mduma, S., Keyyu, J., Fyumagwa, R., Yong, T.-S., 2018. Prevalence of tick-borne pathogens from ticks collected from cattle and wild animals in Tanzania in 2012. Korean J. Parasitol. 56, 305–308. https://doi.org/10.3347/kjp.2018.56.3.305.

Kimaro, E.G., Mor, S.M., Gwakisa, P., Toribio, J.-A., 2017a. Seasonal occurrence of Theileria parva infection and management practices amongst Maasai pastoralist communities in Monduli District, Northern Tanzania. Vet. Parasitol. 246, 43–52. https://doi.org/10.1016/j.vetpar.2017.08.023.

Kimaro, E.G., Toribio, J.-A.L.M.L., Mor, S.M., 2017b. Climate change and cattle vector-borne diseases: use of participatory epidemiology to investigate experiences in pastoral communities in Northern Tanzania. Prev. Vet. Med. 147, 79–89. https://doi.org/10.1016/j.prevetmed.2017.08.010.

Kimaro, E.G., Toribio, J.-A.L.M.L., Gwakisa, P., Mor, S.M., 2018. Occurrence of trypanosome infections in cattle in relation to season, livestock movement and management practices of Maasai pastoralists in Northern Tanzania. Vet. Parasitol. Reg. Stud. Rep. 12, 91–98. https://doi.org/10.1016/j.vprsr.2018.02.007.

Kipronoh, A.K., Ombui, J.N., Kiara, H.K., Binepal, Y.S., Gitonga, E., Wesonga, H.O., 2016a. Prevalence of contagious caprine pleuro-pneumonia in pastoral flocks of goats in the Rift Valley region of Kenya. Trop. Anim. Health Prod. 48, 151–155. https://doi.org/10.1007/s11250-015-0934-0.

Kipronoh, K.A., Ombui, J.N., Binepal, Y.S., Wesonga, H.O., Gitonga, E.K., Thuranira, E., Kiara, H.K., 2016b. Risk factors associated with contagious caprine pleuro-pneumonia in goats in pastoral areas in the Rift Valley region of Kenya. Prev. Vet. Med. 132, 107–112. https://doi.org/10.1016/j.prevetmed.2016.08.011.

Kivaria, F.M., 2006. Estimated direct economic costs associated with tick-borne diseases on cattle in Tanzania. Trop. Anim. Health Prod. 38, 291–299. https://doi.org/10.1007/s11250-006-4181-2.

Kivaria, F.M., Noordhuizen, J.P.T.M., Kapaga, A.M., 2004. Risk indicators associated with subclinical mastitis in smallholder dairy cows in Tanzania. Trop. Anim. Health Prod. 36, 581–592.

Kivaria, F.M., Noordhuizen, J.P.T.M., Msami, H.M., 2007. Risk factors associated with the incidence rate of clinical mastitis in smallholder dairy cows in the Dar es Salaam region of Tanzania. Vet. J. 173, 623–629. https://doi.org/10.1016/j.tvjl.2006.01.009.

Koka, H., Sang, R., Kutima, H.L., Musila, L., 2018. Coxiella burnetii detected in tick samples from pastoral communities in Kenya. Biomed. Res. Int. 2018, 1–5. https://doi.org/10.1155/2018/8158102.

Komba, E.V.G., Mkupasi, E.M., Mwesiga, G.K., Mbyuzi, A.O., Busagwe, Z., Mzula, A., Lupindu, A.M., Nzalawahe, J., 2013. Occurrence of helminths and coccidia in apparently healthy free range local chickens slaughtered at Morogoro live bird market. Tanzania Vet. J. 28, 55–61.

Kouakou, A.V., Kouakou, V., Kouakou, C., Godji, P., Kouassi, A.L., Krou, H.A., Langeois, Q., Webby, R.J., Ducatez, M.F., Couacy-Hymann, E., 2015. Prevalence of Newcastle disease virus and infectious bronchitis virus in avian influenza negative birds from live bird markets and backyard and commercial farms in Ivory-Coast. Res. Vet. Sci. 102, 83–88. https://doi.org/10.1016/j.rvsc.2015.07.015.

Kouam, M.K., Tchouankui, H.N., Ngapagna, A.N., 2019. Epidemiological features of highly pathogenic avian influenza in Cameroon. Vet. Med. Int. 2019, 1–5. https://doi.org/10.1155/2019/3796369.

Kracalik, I.T., Kenu, E., Ayamdooh, E.N., Allegye-Cudjoe, E., Polkuu, P.N., Frimpong, J. A., Nyarko, K.M., Bower, W.A., Traxler, R., Blackburn, J.K., 2017. Modeling the environmental suitability of anthrax in Ghana and estimating populations at risk: implications for vaccination and control. PLoS Negl. Trop. Dis. 11, e0005885 https://doi.org/10.1371/journal.pntd.0005885.

Kulangara, V., Joseph, A., Thrithamarassery, N., Sivasailam, A., Kalappurackal, L., Mattappillil, S., Syam, R., Mapranath, S., 2015. Epidemiology of bovine viral diarrhoea among tropical small holder dairy units in Kerala, India. Trop. Anim. Health Prod. 47, 575–579. https://doi.org/10.1007/s11250-015-0766-y.

Kumaresan, A., Bujarbaruah, K.M., Pathak, K.A., Chhetri, B., Ahmed, S.K., Haunshi, S., 2008. Analysis of a village chicken production system and performance of improved

dual purpose chickens under a subtropical hill agro-ecosystem in India. Trop. Anim. Health Prod. 40, 395–402. https://doi.org/10.1007/s11250-007-9097-y.
Kumbhakar, N.K., Sanyal, P.K., Rawte, D., Kumar, D., Kerketta, A.E., Pal, S., 2016. Efficacy of pharmacokinetic interactions between piperonyl butoxide and albendazole against gastrointestinal nematodiasis in goats. J. Helminthol. 90, 624–629. https://doi.org/10.1017/S0022149X15000930.
Kundave, V.R., Patel, A.K., Patel, P.V., Hasnani, J.J., Joshi, C.G., 2014. Qualitative and quantitative assessment of Theileria annulata in cattle and buffaloes Polymerase Chain Reaction. Trop. Biomed. 31, 728–735.
Kundave, V.R., Patel, A.K., Patel, P.V., Hasnani, J.J., Joshi, C.G., 2015. Detection of theileriosis in cattle and buffaloes by polymerase chain reaction. J. Parasit. Dis. 39, 508–513. https://doi.org/10.1007/s12639-013-0386-2.
Laing, G., Aragrande, M., Canali, M., Savic, S., De Meneghi, D., 2018. Control of cattle ticks and tick-borne diseases by acaricide in southern province of Zambia: a retrospective evaluation of animal health measures according to current one health concepts. Front. Public Health 6, 45. https://doi.org/10.3389/fpubh.2018.00045.
Laisser, E.L.K., Kipanyula, M.J., Msalya, G., Mdegela, R.H., Karimuribo, E.D., Mwilawa, A.J., Mwega, E.D., Kusiluka, L., Chenyambuga, S.W., 2014. Tick burden and prevalence of Theileria parva infection in Tarime zebu cattle in the lake zone of Tanzania. Trop. Anim. Health Prod. 46, 1391–1396. https://doi.org/10.1007/s11250-014-0651-0.
Laisser, E.L.K., Chenyambuga, S.W., Karimuribo, E.D., Msalya, G., Kipanyula, M.J., Mwilawa, A.J., Mdegela, R.H., Kusiluka, L.J.M., 2017. A review on prevalence, control measure, and tolerance of Tanzania shorthorn Zebu cattle to East Coast fever in Tanzania. Trop. Anim. Health Prod. 49, 813–822. https://doi.org/10.1007/s11250-017-1266-z.
Lankester, F., Russell, G.C., Lugelo, A., Ndabigaye, A., Mnyambwa, N., Keyyu, J., Kazwala, R., Grant, D., Percival, A., Deane, D., Haig, D.M., Cleaveland, S., 2016. A field vaccine trial in Tanzania demonstrates partial protection against malignant catarrhal fever in cattle. Vaccine 34, 831–838. https://doi.org/10.1016/j.vaccine.2015.12.009.
Larson, P.S., Espira, L., Grabow, C., Wang, C.A., Muloi, D., Browne, A.S., Deem, S.L., Fèvre, E.M., Foufopoulos, J., Hardin, R., Eisenberg, J.N.S., 2019. The sero-epidemiology of Coxiella burnetii (Q fever) across livestock species and herding contexts in Laikipia County, Kenya. Zoonoses Public Health 66, 316–324. https://doi.org/10.1111/zph.12567.
Lasecka-Dykes, L., Wright, C., Di Nardo, A., Logan, G., Mioulet, V., Jackson, T., Tuthill, T., Knowles, N., King, D., 2018. Full genome sequencing reveals new southern African territories genotypes bringing us closer to understanding true variability of foot-and-mouth disease virus in Africa. Viruses 10, 192. https://doi.org/10.3390/v10040192.
Lee, S.-H., Mossaad, E., Ibrahim, A.M., Ismail, A.A., Adjou Moumouni, P.F., Liu, M., Ringo, A.E., Gao, Y., Guo, H., Li, J., Efstratiou, A., Musinguzi, P., Angara, T.E.E., Suganuma, K., Inoue, N., Xuan, X., 2018. Detection and molecular characterization of tick-borne pathogens infecting sheep and goats in Blue Nile and West Kordofan states in Sudan. Ticks Tick. Dis. 9, 598–604. https://doi.org/10.1016/j.ttbdis.2018.01.014.
Legesse, Y., Asfaw, Y., Sahle, M., Ayelet, G., Jenberie, S., Negussie, H., 2013. First confirmation of foot and mouth disease virus serotype SAT-1 in cattle and small ruminants in Ethiopia in 2007/08. Trop. Anim. Health Prod. 45, 1265–1267. https://doi.org/10.1007/s11250-012-0339-2.
Legesse, M., Medhin, G., Bayissa, M., Mamo, G., 2018. Knowledge and perception of pastoral community members about brucellosis as a cause of abortion in animals and its zoonotic importance in Amibara district, Afar Region, Ethiopia. PLoS One 13, e0206457. https://doi.org/10.1371/journal.pone.0206457.
Lesnoff, M., Laval, G., Bonnet, P., Abdicho, S., Workalemahu, A., Kifle, D., Peyraud, A., Lancelot, R., Thiaucourt, F., 2004. Within-herd spread of contagious bovine pleuropneumonia in Ethiopian highlands. Prev. Vet. Med. 64, 27–40. https://doi.org/10.1016/j.prevetmed.2004.03.005.
Lindahl, J.F., Young, J., Wyatt, A., Young, M., Alders, R., Bagnol, B., Kibaya, A., Grace, D., 2019. Do vaccination interventions have effects? A study on how poultry vaccination interventions change smallholder farmer knowledge, attitudes, and practice in villages in Kenya and Tanzania. Trop. Anim. Health Prod. 51, 213–220.
Lobago, F., Woldemeskel, M., 2004. An outbreak of Marek's disease in chickens in central Ethiopia. Trop. Anim. Health Prod. 36, 397–406.
Lopes, P.H., Akweongo, P., Wurapa, F., Afari, E., Sackey, S., Ocansey, D., Nyarko, K.M., 2016. Bovine tuberculosis surveillance system evaluation, Greater-Accra region, Ghana, 2006–2011. Pan. Afr. Med. J. 25 https://doi.org/10.11604/pamj.supp.2016.25.1.6181.
Ludi, A., Ahmed, Z., Pomeroy, L.W., Pauszek, S.J., Smoliga, G.R., Moritz, M., Dickmu, S., Abdoulkadiri, S., Arzt, J., Garabed, R., Rodriguez, L.L., 2016. Serotype diversity of foot-and-mouth-disease virus in livestock without history of vaccination in the far north region of Cameroon. Transbound. Emerg. Dis. 63, e27–e38. https://doi.org/10.1111/tbed.12227.
Luu, L., Bettridge, J., Christley, R.M., Melese, K., Blake, D., Dessie, T., Wigley, P., Desta, T.T., Hanotte, O., Kaiser, P., Terfa, Z.G., Collins, M., Lynch, S.E., 2013. Prevalence and molecular characterisation of Eimeria species in Ethiopian village chickens. BMC Vet. Res. 9, 208. https://doi.org/10.1186/1746-6148-9-208.
Lyons, N.A., Alexander, N., Stärk, K.D.C., Dulu, T.D., Rushton, J., Fine, P.E.M., 2015. Impact of foot-and-mouth disease on mastitis and culling on a large-scale dairy farm in Kenya. Vet. Res. 46, 41. https://doi.org/10.1186/s13567-015-0173-4.
Lyons, N.A., Jemberu, W.T., Chaka, H., Salt, J.S., Rushton, J., 2019. Field-derived estimates of costs for Peste des Petits Ruminants vaccination in Ethiopia. Prev. Vet. Med. 163, 37–43. https://doi.org/10.1016/j.prevetmed.2018.12.007.
Maan, S., Mor, S.K., Jindal, N., Joshi, V.G., Ravishankar, C., Singh, V.K., Ravindran, R., Sahoo, N., Radzio-Basu, J., Schilling, M.A., McVey, W.R., Mahajan, N.K., Kapur, V., Goyal, S.M., 2019. Complete genome sequences of Newcastle disease virus isolates from backyard chickens in Northern India. Microbiol. Resour. Announc. 8 https://doi.org/10.1128/MRA.00467-19.
Machila, N., Wanyangu, S.W., McDermott, J., Welburn, S.C., Maudlin, I., Eisler, M.C., 2003. Cattle owners' perceptions of African bovine trypanosomiasis and its control in Busia and Kwale Districts of Kenya. Acta Trop. 86, 25–34. https://doi.org/10.1016/S0001-706X(02)00288-7.
Madut, N.A., Muwonge, A., Nasinyama, G.W., Muma, J.B., Godfroid, J., Jubara, A.S., Muleme, J., Kankya, C., 2018. The sero-prevalence of brucellosis in cattle and their herders in Bahr el Ghazal region, South Sudan. PLoS Negl. Trop. Dis. 12, e0006456 https://doi.org/10.1371/journal.pntd.0006456.
Mafimisebi, T.E., Oguntade, A.E., Fajemisin, A.N., Aiyelari, O.P., 2012. Local knowledge and socio- economic determinants of traditional medicines' utilization in livestock health management in Southwest Nigeria. J. Ethnobiol. Ethnomed. 8, 2. https://doi.org/10.1186/1746-4269-8-2.
Mafirakureva, P., Saidi, B., Mbanga, J., 2017. Incidence and molecular characterisation of lumpy skin disease virus in Zimbabwe using the P32 gene. Trop. Anim. Health Prod. 49, 47–54. https://doi.org/10.1007/s11250-016-1156-9.
Magona, J.S.P., Olaho-Mukani, W., Coleman, P.G., Jonsson, N.N., Welburn, S.C., Eisler, M.C., J.W. M, 2003. A comparative study on the clinical, parasitological and molecular diagnosis of bovine trypanosomosis in Uganda. Onderstepoort J. Vet. Res. 70, 213–218.
Magona, J.W., Walubengo, J., Odimin, J.T., 2008. Acute haemorrhagic syndrome of bovine trypanosomosis in Uganda. Acta Trop. 107, 186–191. https://doi.org/10.1016/j.actatropica.2008.05.019.
Maitho, T., Kinyua, J.W., 2015. Factors and diseases influencing dairy goats production among small scale farmers in Laikipia East District, Kenya. Int. J. Livest. Res. 5, 43–48.
Majekodunmi, A., Fajinmi, A., Dongkum, C., Picozzi, K., Thrusfield, M., Welburn, S., 2013a. A longitudinal survey of African animal trypanosomiasis in domestic cattle on the Jos Plateau, Nigeria: prevalence, distribution and risk factors. Parasit. Vectors 6, 239. https://doi.org/10.1186/1756-3305-6-239.
Majekodunmi, A.O., Fajinmi, A., Dongkum, C., Picozzi, K., MacLeod, E., Thrusfield, M.V., M Shaw, A.P., Welburn, S.C., 2013b. Social factors affecting seasonal variation in bovine trypanosomiasis on the Jos Plateau, Nigeria. Parasit. Vectors 6, 293. https://doi.org/10.1186/1756-3305-6-293.
Makita, K., Fèvre, E.M., Waiswa, C., Eisler, M.C., Thrusfield, M., Welburn, S.C., 2011. Herd prevalence of bovine brucellosis and analysis of risk factors in cattle in urban and peri-urban areas of the Kampala economic zone, Uganda. BMC Vet. Res. 7, 60. https://doi.org/10.1186/1746-6148-7-60.
Malak, A.K., Mpoke, L., Banak, J., Muriuki, S., Skilton, R.A., Odongo, D., Sunter, J., Kiara, H., 2012. Prevalence of livestock diseases and their impact on livelihoods in Central Equatoria State, southern Sudan. Prev. Vet. Med. 104, 216–223. https://doi.org/10.1016/j.prevetmed.2011.12.001.
Malik, M., Verma, H., 2018. Epidemiological aspect and major constraints in controlling haemorrhagic septicemia in dairy animals of Punjab. Indian J. Anim. Sci. 88, 1112–1117.
Mamoudou, A., Njanloga, A., Hayatou, A., Suh, P.F., Achukwi, M.D., 2016. Animal trypanosomosis in clinically healthy cattle of north Cameroon: epidemiological implications. Parasit. Vectors 9, 206. https://doi.org/10.1186/s13071-016-1498-1.
Manjeet, Pander, B.L., Sharma, R., Dhaka, S.S., Magotra, A., Dev, K., 2017. Evaluation of genetic and non-genetic factors on foot and mouth disease (FMD) virus vaccine-elicited immune response in Hardhenu (Bos taurus x Bos indicus) cattle. Trop. Anim. Health Prod. 49, 1689–1695. https://doi.org/10.1007/s11250-017-1379-4.
Matiko, M.K., Salekwa, L.P., Kasanga, C.J., Kimera, S.I., Evander, M., Nyangi, W.P., 2018. Serological evidence of inter-epizootic/inter-epidemic circulation of Rift Valley fever virus in domestic cattle in Kyela and Morogoro, Tanzania. PLoS Negl. Trop. Dis. 12, e0006931 https://doi.org/10.1371/journal.pntd.0006931.
Matope, G., Bhebhe, E., Muma, J.B., Oloya, J., Madekurozwa, R.L., Lund, A., Skjerve, E., 2011. Seroprevalence of brucellosis and its associated risk factors in cattle from smallholder dairy farms in Zimbabwe. Trop. Anim. Health Prod. 43, 975–982. https://doi.org/10.1007/s11250-011-9794-4.
Matos, C.A., Gonçalves, L.R., de Souza Ramos, I.A., Mendes, N.S., Zanatto, D.C.S., André, M.R., Machado, R.Z., 2019. Molecular detection and characterization of Ehrlichia ruminantium from cattle in Mozambique. Acta Trop. 191, 198–203. https://doi.org/10.1016/j.actatropica.2019.01.007.
Mazeri, S., Scolamacchia, F., Handel, I.G., Morgan, K.L., Tanya, V.N., de Bronsvoort, B.M. C., 2013. Risk factor analysis for antibodies to Brucella, Leptospira and C. Burnetii among cattle in the Adamawa Region of Cameroon: a cross- sectional study. Trop. Anim. Health Prod. 45, 617–623. https://doi.org/10.1007/s11250-012-0268-0.
Mbengue, M., Diallo, A.A., Lo, F.T., Lo, M.M., Diop, M., Seck, P.S., Samb, Y., Diouf, M., Thiongane, Y., 2013. Réémergence de la péripneumonie contagieuse bovine au Sénégal. Bull. la Société Pathol. Exot. 106, 212–215. https://doi.org/10.1007/s13149-013-0298-5.
Mbuh, J.V.V., Ndamukong, K.J.N.J.N., Ntonifor, N., Nforlem, G.F.F., 2008. Parasites of sheep and goats and their prevalence in Bokova, a rural area of Buea Sub Division, Cameroon. Vet. Parasitol. 156, 350–352. https://doi.org/10.1016/j.vetpar.2008.06.021.
Mbyuzi, A.O., Komba, E.V.G., Kimera, S.I., Kambarage, D.M., 2014. Sero-prevalence and associated risk factors of peste des petits ruminants and contagious caprine pleuro-pneumonia in goats and sheep in the Southern Zone of Tanzania. Prev. Vet. Med. 116, 138–144. https://doi.org/10.1016/j.prevetmed.2014.06.013.
Meas, S., Nakayama, M., Usui, T., Nakazato, Y., Yasuda, J., Ohashi, K., Onuma, M., 2004. Evidence for bovine immunodeficiency virus infection in cattle in Zambia. Jpn. J. Vet. Res. 52, 3–8.

Mebrahtu, K., Teshale, S., Esatu, W., Habte, T., Gelaye, E., 2018. Evaluation of spray and oral delivery of Newcastle disease I2 vaccine in chicken reared by smallholder farmers in central Ethiopia. BMC Vet. Res. 14, 48. https://doi.org/10.1186/s12917-018-1355-x.

Meena, H., Ram, H., Sahoo, A., Rasool, T., 2008. Livestock husbandry scenario at high altitude Kumaon Himalaya. Indian J. Anim. Sci. 78, 882–886.

Mekonnen, S.A., Koop, G., Lam, T.J.G.M., Hogeveen, H., 2017a. The intention of North-Western Ethiopian dairy farmers to control mastitis. PLoS One 12, e0182727.

Mekonnen, S.A.A., Koop, G., Melkie, S.T.T., Getahun, C.D.D., Hogeveen, H., Lam, T.J.G.M., 2017b. Prevalence of subclinical mastitis and associated risk factors at cow and herd level in dairy farms in North-West Ethiopia. Prev. Vet. Med. 145, 23–31. https://doi.org/10.1016/j.prevetmed.2017.06.009.

Mekuriaw, A., Bitew, M., Gelaye, E., Mamo, B., Ayelet, G., 2017. Infectious bursal disease: outbreak investigation, molecular characterization, and vaccine immunogenicity trial in Ethiopia. Trop. Anim. Health Prod. 49, 1295–1302. https://doi.org/10.1007/s11250-017-1328-2.

Meskerem, A., 2017. Major health constraints and ethno-veterinary practices of small scale and backyard chicken production in some selected regions of Ethiopia. Rev. Med. Vet. (Toulouse) 168, 63–71.

Meunier, N.V., Sebulime, P., White, R.G., Kock, R., 2017. Wildlife-livestock interactions and risk areas for cross-species spread of bovine tuberculosis. Onderstepoort J. Vet. Res. 84 https://doi.org/10.4102/ojvr.v84i1.1221.

Miller, R., Nakavuma, J.L., Ssajjakambwe, P., Vudriko, P., Musisi, N., Kaneene, J.B., 2016. The prevalence of brucellosis in cattle, goats and humans in rural Uganda: a comparative study. Transbound. Emerg. Dis. 63, e197–e210. https://doi.org/10.1111/tbed.12332.

Mishra, D., Sahu, R., Mishra, N., Behera, A., 2015. Herbal treatment for common diseases in ruminants: an overview. J. Livest. Sci. 6, 36–43.

Mkama, M., Kasanga, C.J., Sallu, R., Ranga, E., Yongolo, M., Mulumba, M., Rweyemamu, M., Wambura, P., 2014. Serosurveillance of foot-and-mouth disease virus in selected livestock-wildlife interface areas of Tanzania. Onderstepoort J. Vet. Res. 81 https://doi.org/10.4102/ojvr.v81i2.718.

Mlilo, D., Mhlanga, M., Mwembe, R., Sisito, G., Moyo, B., Sibanda, B., 2015. The epidemiology of malignant catarrhal fever (MCF) and contribution to cattle losses in farms around Rhodes Matopos National Park, Zimbabwe. Trop. Anim. Health Prod. 47, 989–994. https://doi.org/10.1007/s11250-015-0821-8.

Mohamed, S.B., Alagib, A., AbdElkareim, T.B., Hassan, M.M., Johnson, W.C., Hussein, H. E., Taus, N.S., Ueti, M.W., 2018. Molecular detection and characterization of Theileria spp. infecting cattle in Sennar State, Sudan. Parasitol. Res. 117, 1271–1276. https://doi.org/10.1007/s00436-018-5775-0.

Mohammed, S., Munissi, J.J.E., Nyandoro, S.S., 2016. Aflatoxin M1 in raw milk and aflatoxin B1 in feed from household cows in Singida, Tanzania. Food Addit. Contam. Part B Surveill. 9, 85–90. https://doi.org/10.1080/19393210.2015.1137361.

Moiane, I., Machado, A., Santos, N., Nhambir, A., Inlamea, O., Hattendorf, J., Källenius, G., Zinsstag, J., Correia-Neves, M., 2014. Prevalence of bovine tuberculosis and risk factor assessment in cattle in Rural Livestock Areas of Govuro District in the southeast of Mozambique. PLoS One 9, e91527. https://doi.org/10.1371/journal.pone.0091527.

Molla, B., Delil, F., 2015. Mapping of major diseases and devising prevention and control regimen to common diseases in cattle and shoats in Dassenech district of South Omo Zone, South-Western Ethiopia. Trop. Anim. Health Prod. 47, 45–51. https://doi.org/10.1007/s11250-014-0681- 7.

Molla, W., de Jong, M.C.M., Frankena, K., 2017a. Temporal and spatial distribution of lumpy skin disease outbreaks in Ethiopia in the period 2000 to 2015. BMC Vet. Res. 13, 310. https://doi.org/10.1186/s12917-017-1247-5.

Molla, W., Frankena, K., De Jong, M.C.M., 2017b. Transmission dynamics of lumpy skin disease in Ethiopia. Epidemiol. Infect. 145, 2856–2863. https://doi.org/10.1017/S0950268817001637.

Molla, Wassie, de Jong, M.C.M.M., Gari, G., Frankena, K., 2017c. Economic impact of lumpy skin disease and cost effectiveness of vaccination for the control of outbreaks in Ethiopia. Prev. Vet. Med. 147, 100–107. https://doi.org/10.1016/j.prevetmed.2017.09.003.

Molla, Wassie, Frankena, K., Gari, G., de Jong, M.C.M., 2017d. Field study on the use of vaccination to control the occurrence of lumpy skin disease in Ethiopian cattle. Prev. Vet. Med. 147, 34–41. https://doi.org/10.1016/j.prevetmed.2017.08.019.

Molla, W., Frankena, K., Gari, G., Kidane, M., Shegu, D., de Jong, M.C.M., 2018. Seroprevalence and risk factors of lumpy skin disease in Ethiopia. Prev. Vet. Med. 160, 99–104. https://doi.org/10.1016/j.prevetmed.2018.09.029.

Mondal, D.B., Sarma, K., Saravanan, M., 2013. Upcoming of the integrated tick control program of ruminants with special emphasis on livestock farming system in India. Ticks Tick. Dis. 4, 1–10. https://doi.org/10.1016/j.ttbdis.2012.05.006.

Morakinyo, O.A., Babalobi, O.O., 2013. Participatory appraisal of Peste des Petite Ruminants (PPR) outbreaks in Iseyin local government area of Oyo State, Nigeria. Southern African Society for Veterinary Epidemiology and Preventive Medicine. KZN Dolphin Coast, South Africa, pp. 28–33.

Morgan, K.L., Handel, I.G., Tanya, V.N., Hamman, S.M., Nfon, C., Bergman, I.E., Malirat, V., Sorensen, K.J., de Bronsvoort, B.M.C., de Bronsvoort, B.M.C., 2014. Accuracy of herdsmen reporting versus serologic testing for estimating foot-and-mouth disease prevalence. Emerg. Infect. Dis. 20, 2048–2054. https://doi.org/10.3201/eid2012.140931.

Moti, Y., de Deken, R., Thys, E., van den Abbeele, J., Duchateau, L., Delespaux, V., 2015. PCR and microsatellite analysis of diminazene aceturate resistance of bovine trypanosomes correlated to knowledge, attitude and practice of livestock keepers in South-Western Ethiopia. Acta Trop. 146, 45–52.

Motta, P., Handel, I.G., Rydevik, G., Hamman, S.M., Ngwa, V.N., Tanya, V.N., Morgan, K. L., de Bronsvoort, B.M.C., Porphyre, T., 2018. Drivers of live cattle price in the livestock trading system of Central Cameroon. Front. Vet. Sci. 4 https://doi.org/10.3389/fvets.2017.00244.

Motta, P., Porphyre, T., Handel, I.G., Hamman, S.M., Ngu Ngwa, V., Tanya, V.N., Morgan, K.L., de Bronsvoort, B.M.C., 2019. Characterizing livestock markets, primary diseases, and key management practices along the livestock supply chain in Cameroon. Front. Vet. Sci. 6, 101. https://doi.org/10.3389/fvets.2019.00101.

Msami, H., 2007. Poultry Sector Country Review: Tanzania.

Msoffe, P.L.M.M., Bunn, D., Muhairwa, A.P., Mtambo, M.M.A.A., Mwamhehe, H., Msago, A., Mlozi, M.R.S.S., Cardona, C.J., 2010. Implementing poultry vaccination and biosecurity at the village level in Tanzania: a social strategy to promote health in free-range poultry populations. Trop. Anim. Health Prod. 42, 253–263. https://doi.org/10.1007/s11250-009-9414-8.

Mubamba, C., Ramsay, G., Abolnik, C., Dautu, G., Gummow, B., 2016. A retrospective study and predictive modelling of Newcastle Disease trends among rural poultry of eastern Zambia. Prev. Vet. Med. 133, 97–107. https://doi.org/10.1016/j.prevetmed.2016.09.017.

Muema, J., Thumbi, S.M., Obonyo, M., Wanyoike, S., Nanyingi, M., Osoro, E., Bitek, A., Karanja, S., 2017. Seroprevalence and factors associated with *Coxiella burnetii* infection in small ruminants in Baringo County, Kenya. Zoonoses Public Health 64, e31–e43. https://doi.org/10.1111/zph.12342.

Mugabi, K.N., Mugisha, A., Ocaido, M., 2010. Socio-economic factors influencing the use of acaricides on livestock: a case study of the pastoralist communities of Nakasongola District, Central Uganda. Trop. Anim. Health Prod. 42, 131–136. https://doi.org/10.1007/s11250-009-9396-6.

Mugisha, A., McLeod, A., Percy, R., Kyewalabye, E., 2005. Strategies, effectiveness and rationale of vector-borne disease control in the pastoralist system of south-western Uganda. Trop. Anim. Health Prod. 37, 479–489. https://doi.org/10.1007/s11250-005-2174-1.

Mugisha, A., McLeod, A., Percy, R., Kyewalabye, E., 2008. Socio-economic factors influencing control of vector-borne diseases in the pastoralist system of south western Uganda. Trop. Anim. Health Prod. 40, 287–297. https://doi.org/10.1007/s11250-007-9093-2.

Mugizi, D.R., Boqvist, S., Nasinyama, G.W., Waiswa, C., Ikwap, K., Rock, K., Lindahl, E., Magnusson, U., Erume, J., 2015. Prevalence of and factors associated with Brucella sero- positivity in cattle in urban and peri-urban Gulu and Soroti towns of Uganda. J. Vet. Med. Sci. 77, 557–564. https://doi.org/10.1292/jvms.14-0452.

Muhanguzi, D., Okello, W.O., Kabasa, J.D., Waiswa, C., Welburn, S.C., Shaw, A.P.M., 2015. Cost analysis of options for management of African Animal Trypanosomiasis using interventions targeted at cattle in Tororo District; south-eastern Uganda. Parasit. Vectors 8, 387. https://doi.org/10.1186/s13071-015-0998-8.

Muhanguzi, D., Mugenyi, A., Bigirwa, G., Kamusiime, M., Kitibwa, A., Akurut, G.G., Ochwo, S., Amanyire, W., Okech, S.G., Hattendorf, J., Tweyongyere, R., 2017. African animal trypanosomiasis as a constraint to livestock health and production in Karamoja region: a detailed qualitative and quantitative assessment. BMC Vet. Res. 13, 355. https://doi.org/10.1186/s12917-017-1285-z.

Muleme, M., Barigye, R., Khaitsa, M.L., Berry, E., Wamono, A.W., Ayebazibwe, C., 2012. Effectiveness of vaccines and vaccination programs for the control of foot-and-mouth disease in Uganda, 2001–2010. Trop. Anim. Health Prod. 45, 35–43. https://doi.org/10.1007/s11250-012-0254-6.

Mulugeta, Y., Yacob, H.T., Ashenafi, H., 2010. Ectoparasites of small ruminants in three selected agro-ecological sites of Tigray Region, Ethiopia. Trop. Anim. Health Prod. 42, 1219–1224. https://doi.org/10.1007/s11250-010-9551-0.

Muma, J.B., Godfroid, J., Samui, K.L., Skjerve, E., 2007. The role of Brucella infection in abortions among traditional cattle reared in proximity to wildlife on the Kafue flats of Zambia. Rev. Sci. Tech. 26, 721–730.

Muma, J.B., Syakalima, M., Munyeme, M., Zulu, V.C., Simuunza, M., Kurata, M., 2013. Bovine tuberculosis and brucellosis in traditionally managed livestock in selected districts of southern province of Zambia. Vet. Med. Int. 2013, 1–7. https://doi.org/10.1155/2013/730367.

Munang'andu, H.M., Banda, F., Chikampa, W., Mutoloki, S., Syakalima, M., Munyeme, M., 2012. Risk analysis of an anthrax outbreak in cattle and humans of Sesheke district of Western Zambia. Acta Trop. 124, 162–165. https://doi.org/10.1016/j.actatropica.2012.07.008.

Mungube, E.O., Tenhagen, B.A., Kassa, T., Regassa, F., Kyule, M.N., Greiner, M., Baumann, M.P.O., 2004. Risk factors for dairy cow mastitis in the central highlands of Ethiopia. Trop. Anim. Health Prod. 36, 463–472.

Munyeme, M., Munang'andu, H.M., Nambota, A., Muma, J.B., Phiri, A.M., Nalubamba, K.S., 2012. The Nexus between bovine tuberculosis and fasciolosis infections in cattle of the Kafue Basin Ecosystem in Zambia: implications on abattoir surveillance. Vet. Med. Int. 2012, 1–6. https://doi.org/10.1155/2012/921869.

Muraguri, G.R., McLeod, A., McDermott, J.J., Taylor, N., 2005. The incidence of calf morbidity and mortality due to vector-borne infections in smallholder dairy farms in Kwale District, Kenya. Vet. Parasitol. 130, 305–315. https://doi.org/10.1016/j.vetpar.2004.11.026.

Murugeswari, R., Valli, C., Karunakaran, R., Leela, V., Pandian, A.S.S., 2018. Prevalence and magnitude of acidosis sequelae to rice-based feeding regimen followed in Tamil Nadu, India. Vet. World 11, 464–468. https://doi.org/10.14202/vetworld.2018.464-468.

Musa, I., Ndahi, M., Pam, E., Okike, A., Cyrile, P., Saskia, H., Jost, C., 2013. Using participatory epidemiological techniques to establish rural based poultry disease profiles: practical field experience in the Jos Plateau, Nigeria. Worlds Poult. Sci. J. 69, 387–400. https://doi.org/10.1017/S0043933913000378.

Musinguzi, S., Suganuma, K., Asada, M., Laohasinnarong, D., Sivakumar, T., Yokoyama, N., Namangala, B., Sugimoto, C., Suzuki, Y., Xuan, X., Inoue, N., 2016. A PCR-based survey of animal African trypanosomosis and selected piroplasm

parasites of cattle and goats in Zambia. J. Vet. Med. Sci. 78, 1819–1824. https://doi.org/10.1292/jvms.16-0240.
Mutebi, F., Krücken, J., Mencke, N., Feldmeier, H., von Samson- Himmelstjerna, G., Waiswa, C., 2016. Two severe cases of Tungiasis in goat kids in Uganda. J. Insect Sci. 16, 34. https://doi.org/10.1093/jisesa/iew016.
Mutinda, W.U., Nyaga, P.N., Mbuthia, P.G., Bebora, L.C., Muchemi, G., 2014. Risk factors associated with infectious bursal disease vaccination failures in broiler farms in Kenya. Trop. Anim. Health Prod. 46, 603–608. https://doi.org/10.1007/s11250-013-0533-x.
Mutua, E.N., Bukachi, S.A., Bett, B.K., Estambale, B.A., Nyamongo, I.K., 2017. "We do not bury dead livestock like human beings": community behaviors and risk of Rift Valley Fever virus infection in Baringo County, Kenya. PLoS Negl. Trop. Dis. 11, e0005582 https://doi.org/10.1371/journal.pntd.0005582.
Muyobela, J., Nkunika, P.O.Y., Mwase, E.T., 2015. Resistance status of ticks (Acari; Ixodidae) to amitraz and cypermethrin acaricides in Isoka District, Zambia. Trop. Anim. Health Prod. 47, 1599–1605. https://doi.org/10.1007/s11250-015-0906-4.
Mwakapuja, R.S., Makondo, Z.E., Malakalinga, J., Moser, I., Kazwala, R.R., Tanner, M., 2013. Molecular characterization of Mycobacterium bovis isolates from pastoral livestock at Mikumi-Selous ecosystem in the eastern Tanzania. Tuberculosis 93, 668–674. https://doi.org/10.1016/j.tube.2013.08.002.
Mwebe, R., Nakavuma, J., Moriyón, I., 2011. Brucellosis seroprevalence in livestock in Uganda from 1998 to 2008: a retrospective study. Trop. Anim. Health Prod. 43, 603–608. https://doi.org/10.1007/s11250-010-9739-3.
Mwenda, R., Changula, K., Hang'ombe, B.M., Chidumayo, N., Mangani, A.S., Kaira, T., Takada, A., Mweene, A.S., Simulundu, E., Hang'ombe, B.M., Chidumayo, N., Mangani, A.S., Kaira, T., Takada, A., Mweene, A.S., Simulundu, E., Hang'ombe, B. M., Chidumayo, N., Mangani, A.S., Kaira, T., Takada, A., Mweene, A.S., Simulundu, E., 2018. Characterization of field infectious bursal disease viruses in Zambia: evidence of co-circulation of multiple genotypes with predominance of very virulent strains. Avian Pathol. 47, 300–313. https://doi.org/10.1080/03079457.2018.1449941.
Nabukenya, I., Rubaire-Akiiki, C., Olila, D., Ikwap, K., Höglund, J., 2014. Ethnopharmacological practices by livestock farmers in Uganda: survey experiences from Mpigi and Gulu districts. J. Ethnobiol. Ethnomed. 10, 9. https://doi.org/10.1186/1746-4269-10-9.
Namatovu, A., Belsham, G.J., Ayebazibwe, C., Dhikusooka, M.T., Wekesa, S.N., Siegismund, H.R., Muwanika, V.B., Tjørnehøj, K., 2015a. Challenges for serology-based characterization of foot-and-Mouth disease outbreaks in endemic areas; identification of two separate lineages of serotype O FMDV in Uganda in 2011. Transbound. Emerg. Dis. 62, 522–534. https://doi.org/10.1111/tbed.12170.
Namatovu, Alice, Tjørnehøj, K., Belsham, G.J., Dhikusooka, M.T., Wekesa, S.N., Muwanika, V.B., Siegismund, H.R., Ayebazibwe, C., 2015b. Characterization of foot-and-mouth disease viruses (FMDVs) from Ugandan cattle outbreaks during 2012-2013: evidence for circulation of multiple serotypes. PLoS One 10, e0114811. https://doi.org/10.1371/journal.pone.0114811.
Nanyingi, M.O., Muchemi, G.M., Thumbi, S.M., Ade, F., Onyango, C.O., Kiama, S.G., Bett, B., 2017. Seroepidemiological survey of rift valley fever virus in ruminants in Garissa, Kenya. Vector- Borne Zoonotic Dis. 17, 141–146. https://doi.org/10.1089/vbz.2016.1988.
Nazki, S., Wani, S.A., Parveen, R., Ahangar, S.A., Kashoo, Z.A., Hamid, S., Dar, Z.A., Dar, T.A., Dar, P.A., 2017. Isolation, molecular characterization and prevalence of Clostridium perfringens in sheep and goats of Kashmir Himalayas, India. Vet. World 10, 1501–1507. https://doi.org/10.14202/vetworld.2017.1501-1507.
Ndengu, M., de Garine-Wichatitsky, M., Pfukenyi, D., Tivapasi, M., Mukamuri, B., Matope, G., 2017. Assessment of community awareness and risk perceptions of zoonotic causes of abortion in cattle at three selected livestock–wildlife interface areas of Zimbabwe. Epidemiol. Infect. 145, 1304–1319. https://doi.org/10.1017/S0950268817000097.
Ndhlovu, D.N., Masika, P.J., 2015. Risk factors associated with clinical dermatophilosis in smallholder sector cattle herds of Zimbabwe at the Amblyomma variegatum and Amblyomma hebraeum interface. Trop. Anim. Health Prod. 47, 353–360. https://doi.org/10.1007/s11250-014-0727-x.
Ndhlovu, F., Ndhlovu, D.N., Chikerema, S.M., Masocha, M., Nyagura, M., Pfukenyi, D.M., 2017. Spatiotemporal patterns of clinical bovine dermatophilosis in Zimbabwe 1995–2014. Onderstepoort J. Vet. Res. 84 https://doi.org/10.4102/ojvr.v84i1.1386.
Negusssie, H., Kyule, M.N., Yami, M., Ayelet, G., Jenberie, T.S., 2011. Outbreak investigations and genetic characterization of foot-and-mouth disease virus in Ethiopia in 2008/2009. Trop. Anim. Health Prod. 43, 235–243. https://doi.org/10.1007/s11250-010-9683-2.
Ngomtcho, S.C.H., Weber, J.S., Ngo Bum, E., Gbem, T.T., Kelm, S., Achukwi, M.D., 2017. Molecular screening of tsetse flies and cattle reveal different Trypanosoma species including T. grayi and T. theileri in northern Cameroon. Parasit. Vectors 10, 631. https://doi.org/10.1186/s13071-017-2540-7.
Ngonyoka, A., Gwakisa, P.S., Estes, A.B., Salekwa, L.P., Nnko, H.J., Hudson, P.J., Cattadori, I.M., 2017. Patterns of tsetse abundance and trypanosome infection rates among habitats of surveyed villages in Maasai steppe of northern Tanzania. Infect. Dis. Poverty 6, 126. https://doi.org/10.1186/s40249-017-0340-0.
Nguhiu-Mwangi, J., Mbithi, P., Wabacha, J., Mbuthia, P., 2008. Retrospective study of foot conditions in dairy cows in urban and periurban areas of Kenya. Isr. J. Vet. Med. 63, 40–45.
Nigussie, Z., Mesfin, T., Sertse, T., Fulasa, T.T., Regassa, F., Tolosa Fulasa, T., Regassa, F., 2010. Seroepidemiological study of bovine viral diarrhea (BVD) in three agroecological zones in Ethiopia. Trop. Anim. Health Prod. 42, 319–321. https://doi.org/10.1007/s11250-009-9445-1.
Njeru, J., Wareth, G., Melzer, F., Henning, K., Pletz, M.W., Heller, R., Neubauer, H., 2016. Systematic review of brucellosis in Kenya: disease frequency in humans and animals and risk factors for human infection. BMC Public Health 16, 853. https://doi.org/10.1186/s12889-016-3532-9.
Njuguna, J.N., Gicheru, M.M., Kamau, L.M., Mbatha, P.M., 2017. Incidence and knowledge of bovine brucellosis in Kahuro district, Murang'a County, Kenya. Trop. Anim. Health Prod. 49, 1035–1040. https://doi.org/10.1007/s11250-017-1296-6.
Nkegbe, E., Munkaila, L., Odoom-Sam, K., 2013. Regulatory compliance of small holder livestock farmers and herdsmen in the use of acaricides and gastrointestinal anthelmintics in sub-urban Accra, Ghana. Int. J. Dis. Disord. 1, 39–44.
Nnko, H.J., Gwakisa, P.S., Ngonyoka, A., Saigilu, M., Ole-Neselle, M., Kisoka, W., Sindato, C., Estes, A., 2017. Pastoralists' vulnerability to trypanosomiasis in Maasai Steppe. Ecohealth 14, 718–731. https://doi.org/10.1007/s10393-017-1275-4.
Noah, E.Y., Kimera, S.I., Kusiluka, L.J.M., Wambura, P., 2015. Abattoir surveillance demonstrates contagious bovine pleuropneumonia is widespread in Tanzania. Trop. Anim. Health Prod. 47, 1607–1613. https://doi.org/10.1007/s11250-015-0907-3.
Nonga, H.E., Karimuribo, E.D., 2009. A retrospective survey of hydatidosis in livestock in Arusha, Tanzania, based on abattoir data during 2005–2007. Trop. Anim. Health Prod. 41, 1253–1257. https://doi.org/10.1007/s11250-009-9308-9.
Ntirandekura, J.-B., Matemba, L.E., Kimera, S.I., Muma, J.B., Karimuribo, E.D., 2018. Association of brucellosis with abortion prevalence in humans and animals in Africa: a review. Afr. J. Reprod. Health 22, 120–136. https://doi.org/10.29063/ajrh2018/v22i3.13.
Nuru, A., Mamo, G., Zewude, A., Mulat, Y., Yitayew, G., Admasu, A., Medhin, G., Pieper, R., Ameni, G., 2017. Preliminary investigation of the transmission of tuberculosis between farmers and their cattle in smallholder farms in northwestern Ethiopia: a cross-sectional study. BMC Res. Notes 10, 31. https://doi.org/10.1186/s13104-016-2349-z.
Nwankiti, O.O., Ikeh, E.I., Asala, O., Seuberlich, T., 2013. A pilot study for targeted surveillance of bovine spongiform encephalopathy in Nigeria. Transbound. Emerg. Dis. 60, 279–283. https://doi.org/10.1111/j.1865-1682.2012.01340.x.
Nyaguthii, D.M., Armson, B., Kitala, P.M., Sanz-Bernardo, B., Di Nardo, A., Lyons, N.A., 2019. Knowledge and risk factors for foot-and-mouth disease among small-scale dairy farmers in an endemic setting. Vet. Res. 50, 33. https://doi.org/10.1186/s13567-019-0652-0.
Nyakarahuka, L., de St. Maurice, A., Purpura, L., Ervin, E., Balinandi, S., Tumusiime, A., Kyondo, J., Mulei, S., Tusiime, P., Lutwama, J., Klena, J.D., Brown, S., Knust, B., Rollin, P.E., Nichol, S.T., Shoemaker, T.R., de St Maurice, A., Purpura, L., Ervin, E., Balinandi, S., Tumusiime, A., Kyondo, J., Mulei, S., Tusiime, P., Lutwama, J., Klena, J.D., Brown, S., Knust, B., Rollin, P.E., Nichol, S.T., Shoemaker, T.R., 2018. Prevalence and risk factors of Rift Valley fever in humans and animals from Kabale district in Southwestern Uganda, 2016. PLoS Negl. Trop. Dis. 12, e0006412 https://doi.org/10.1371/journal.pntd.0006412.
Nyirenda, S.S., Sakala, M., Moonde, L., Kayesa, E., Fandamu, P., Banda, F., Sinkala, Y., 2019. Prevalence of bovine fascioliasis and economic impact associated with liver condemnation in abattoirs in Mongu district of Zambia. BMC Vet. Res. 15 (21 January 2019) https://doi.org/10.1186/s12917-019-1777- 0.
Nzalawahe, J., Kassuku, A.A., Stothard, J., Coles, G.C., Eisler, M.C., 2014. Trematode infections in cattle in Arumeru District, Tanzania are associated with irrigation. Parasit. Vectors 7, 107. https://doi.org/10.1186/1756-3305-7-107.
Nzalawahe, J., Kassuku, A.A., Stothard, J.R., Coles, G.C., Eisler, M.C., 2015. Associations between trematode infections in cattle and freshwater snails in highland and lowland areas of Iringa Rural District, Tanzania. Parasitology 142, 1430–1439. https://doi.org/10.1017/S0031182015000827.
Ocholi, R.A., Kwaga, J.K.P., Ajogi, I., Bale, J.O.O., 2005. Abortion due to Brucella abortus in sheep in Nigeria. Rev. Sci. Tech. 24, 973–979.
Ochwo, S., VanderWaal, K., Munsey, A., Ndekezi, C., Mwebe, R., Okurut, A.R.A., Nantima, N., Mwiine, F.N., 2018. Spatial and temporal distribution of lumpy skin disease outbreaks in Uganda (2002–2016). BMC Vet. Res. 14, 174. https://doi.org/10.1186/s12917-018-1503-3.
Odoi, A., Gathuma, J.M., Gachuiri, C.K., Omore, A., 2007. Risk factors of gastrointestinal nematode parasite infections in small ruminants kept in smallholder mixed farms in Kenya. BMC Vet. Res. 3, 6. https://doi.org/10.1186/1746-6148-3-6.
Odongo, D.O., Tiampati, C.M., Mulinge, E., Mbae, C.K., Bishop, R.P., Zeyhle, E., Magambo, J., Wasserman, M., Kern, P., Romig, T., 2018. Prevalence and genotyping of Echinococcus granulosus in sheep in Narok County, Kenya. Parasitol. Res. 117, 2065–2073. https://doi.org/10.1007/s00436-018-5889-4.
Odugbo, M.O., Ogunjumo, S.O., Chukwukere, S.C., Kumbish, P.R., Musa, A., Ekundayo, S.O., Okewole, P.A., Nwankpa, N.D., Itodo, A.E., Haruna, G., 2009. The first report of Histophilus somni pneumonia in Nigerian dairy cattle. Vet. J. 181, 340–342. https://doi.org/10.1016/j.tvjl.2008.03.007.
Ogendo, A., Obonyo, M., Wasswa, P., Bitek, A., Mbugua, A., Thumbi, S.M., 2017. Cryptosporidium infection in calves and the environment in Asembo, Western Kenya: 2015. Pan. Afr. Med. J. 28 https://doi.org/10.11604/pamj.supp.2017.28.1.9313.
Ogugua, A.J., Akinseye, V.O., Cadmus, E.O., Jolaoluwa Awosanya, E.A., Alabi, P.I., Idowu, O.S., Akinade, S.A., Dale, E.J., Perrett, L., Taylor, A., Ignocio, M., Cadmus, S. I.B., 2018. Prevalence and risk factors associated with bovine brucellosis in herds under extensive production system in southwestern Nigeria. Trop. Anim. Health Prod. 50, 1573–1582. https://doi.org/10.1007/s11250-018-1597-4.
Ogundiyi, A.I., Bemji, M.N., Adebambo, O.A., Dipeolu, M.A., Onagbesan, O.M., James, I. J., Osinowo, O.A., 2012. Prevalence of mange among West African Dwarf sheep and goats and associated haematological and biochemical parameters. Trop. Anim. Health Prod. 44, 1263–1269. https://doi.org/10.1007/s11250-011-0067-z.
Ohaga, S.O., Kokwaro, E.D., Ndiege, I.O., Hassanali, A., Saini, R.K., 2007. Livestock farmers' perception and epidemiology of bovine trypanosomosis in Kwale District, Kenya. Prev. Vet. Med. 80, 24–33. https://doi.org/10.1016/j.prevetmed.2007.01.007.

Okuni, J.B., Reinacher, M., Loukopoulos, P., Ojok, L., 2013. Prevalence and spectrum of Johne's disease lesions in cattle slaughtered at two abattoirs in Kampala, Uganda. Trop. Anim. Health Prod. 45, 1197–1202. https://doi.org/10.1007/s11250-012-0346-3.

Oluwayelu, D.O., Todd, D., Ball, N.W., Scott, A.N.J., Oladele, O.A., Emikpe, B.O., Fagbohun, O.A., Owoade, A.A., Olaleye, O.D., 2005. Isolation and preliminary characterization of chicken anemia virus from chickens in Nigeria. Avian Dis. 49, 446–450. https://doi.org/10.1637/7339-020705R.1.

Oluwayelu, D., Adebiyi, A., Tomori, O., 2018. Endemic and emerging arboviral diseases of livestock in Nigeria: a review. Parasit. Vectors 11, 337. https://doi.org/10.1186/s13071-018-2911-8.

Omony, J.B., Wanyana, A., Mugimba, K.K., Kirunda, H., Nakavuma, J.L., Otim-Onapa, M., Byarugaba, D.K., 2016. Disparate thermostability profiles and HN gene domains of field isolates of Newcastle disease virus from live bird markets and waterfowl in Uganda. Virol. J. 13, 103. https://doi.org/10.1186/s12985-016-0560-0.

Onono, J.O., Wieland, B., Rushton, J., 2014. Estimation of impact of contagious bovine pleuropneumonia on pastoralists in Kenya. Prev. Vet. Med. 115, 122–129. https://doi.org/10.1016/j.prevetmed.2014.03.022.

Onzima, R.B., Mukiibi, R., Ampaire, A., Benda, K.K., Kanis, E., 2017. Between-breed variations in resistance/resilience to gastrointestinal nematodes among indigenous goat breeds in Uganda. Trop. Anim. Health Prod. 49, 1763–1769. https://doi.org/10.1007/s11250-017-1390-9.

Opara, M.N., Ukpong, U.M., Okoli, I.C., Anosike, J.C., 2006. Cysticercosis of slaughter cattle in southeastern Nigeria. Ann. N. Y. Acad. Sci. 1081, 339–346. https://doi.org/10.1196/annals.1373.048.

Orono, S.A., Gitao, G.C., Mpatswenumugabo, J.P., Chepkwony, M., Mutisya, C., Okoth, E., de Bronsvoort, B.M.C., Russell, G.C., Nene, V., Cook, E.A.J., 2019. Field validation of clinical and laboratory diagnosis of wildebeest associated malignant catarrhal fever in cattle. BMC Vet. Res. 15, 69. https://doi.org/10.1186/s12917-019-1818-8.

Ortiz-Pelaez, A., Pfeiffer, D.U., Tempia, S., Otieno, F.T., Aden, H.H., Costagli, R., 2010. Risk mapping of Rinderpest sero-prevalence in Central and Southern Somalia based on spatial and network risk factors. BMC Vet. Res. 6, 22. https://doi.org/10.1186/1746-6148-6-22.

Osmani, M.G., Ward, M.P., Giasuddin, M., Islam, M.R., Kalam, A., 2014. The spread of highly pathogenic avian influenza (subtype H5N1) clades in Bangladesh, 2010 and 2011. Prev. Vet. Med. 114, 21–27. https://doi.org/10.1016/j.prevetmed.2014.01.010.

Owolodun, O.A., Yakubu, B., Jambol, A.R., Audu, B.J., Dogonyaro, B.B., Luka, P.D., 2015. Further evidence for very virulent infectious bursal disease virus in vaccinated chickens in Nigeria. Trop. Anim. Health Prod. 47, 1437–1441. https://doi.org/10.1007/s11250-015-0880-x.

Panda, T., Mishra, N., 2016. Indigenous knowledge on animal health care practices in Kendrapara District of Odisha, India. Int. Lett. Nat. Sci. 53, 10–27. https://doi.org/10.18052/www.scipress.com/ILNS.53.10.

Pandey, V., Nigam, R., Jaiswal, A.K., Sudan, V., Singh, R.K., Yadav, P.K., 2015. Haemato-biochemical and oxidative status of buffaloes naturally infected with Trypanosoma evansi. Vet. Parasitol. 212, 118–122. https://doi.org/10.1016/j.vetpar.2015.07.025.

Pandey, G.S., Simulundu, E., Mwiinga, D., Samui, K.L., Mweene, A.S., Kajihara, M., Mangani, A., Mwenda, R., Ndebe, J., Konnai, S., Takada, A., 2017. Clinical and subclinical bovine leukemia virus infection in a dairy cattle herd in Zambia. Arch. Virol. 162, 1051–1056. https://doi.org/10.1007/s00705-016-3205-0.

Patil, M.P., Nagvekar, A.S., Ingole, S.D., Bharucha, S.V., Palve, V.T., 2015. Somatic cell count and alkaline phosphatase activity in milk for evaluation of mastitis in buffalo. Vet. World 8, 363–366. https://doi.org/10.14202/vetworld.2015.363- 366.

Picado, A., Speybroeck, N., Kivaria, F., Mosha, R.M., Sumaye, R.D., Casal, J., Berkvens, D., 2011. Foot-and-Mouth Disease in Tanzania from 2001 to 2006. Transbound. Emerg. Dis. 58, 44–52. https://doi.org/10.1111/j.1865-1682.2010.01180.x.

Pomeroy, L.W., Bjørnstad, O.N., Kim, H., Jumbo, S.D., Abdoulkadiri, S., Garabed, R., 2015. Serotype-specific transmission and waning immunity of endemic foot-and-mouth disease virus in Cameroon. PLoS One 10, e0136642. https://doi.org/10.1371/journal.pone.0136642.

Prasad, S., Ramachandran, N., Raju, S., 2004. Mortality patterns in dairy animals under organized herd management conditions at Karnal India. Trop. Anim. Health Prod. 36, 645–654. https://doi.org/10.1023/B:TROP.0000042855.58026.bd.

Priyadarshini, A., Sarangi, L., Palai, T., Panda, H., Mishra, R., Behera, P., 2013. Brucellosis in cattle and occupationally exposed human beings: a serosurvey in Odisha, India. J. Pure Appl. Microbiol. 7, 3255–3260.

Rajeev, M., Mutinda, M., Ezenwa, V.O., 2017. Pathogen exposure in cattle at the livestock-wildlife interface. Ecohealth 14, 542–551. https://doi.org/10.1007/s10393-017-1242-0.

Rajkhowa, S., Rajkhowa, C., Hazarika, G.C., 2006. Prevalence of Cryptosporidium parvum in mithuns (Bos frontalis) from India. Vet. Parasitol. 142, 146–149. https://doi.org/10.1016/j.vetpar.2006.06.026.

Rajkumar, K., Bhattacharya, A., David, S., Balaji, S.H., Hariharan, R., Jayakumar, M., Balaji, N., 2016. Socio-demographic study on extent of knowledge, awareness, attitude, and risks of zoonotic diseases among livestock owners in Puducherry region. Vet. World 9, 1018–1024.

Ranabijuli, S., Mohapatra, J.K., Pandey, L.K., Rout, M., Sanyal, A., Dash, B.B., Sarangi, L. N., Panda, H.K., Pattnaik, B., 2010. Serological evidence of foot-and-mouth disease virus infection in randomly surveyed goat population of Orissa, India. Transbound. Emerg. Dis. https://doi.org/10.1111/j.1865- 1682.2010.01161.x.

*Randolph, T., Schelling, E., Grace, D., Nicholson, C., Leroy, J., Cole, D., Demment, M., Omore, A., Zinsstag, J., Ruel, M., 2007. Invited Review: role of livestock in human nutrition and health for poverty reduction in developing countries. J. Anim. Sci. 85, 2788–2800. https://doi.org/10.2527/jas.2007-0467.

Rao, K.A., Rao, K.S., Rao, S., Ravi, A., Anitha, A., 2011. Ethnoveterinary practices in sheep of North coastal zone of Andhra Pradesh. Indian J. Small Rumin. 17, 252–253.

Regassa, F., Araya, M., 2012. In vitro antimicrobial activity of Combretum molle (Combretaceae) against Staphylococcus aureus and Streptococcus agalactiae isolated from crossbred dairy cows with clinical mastitis. Trop. Anim. Health Prod. 44, 1169–1173. https://doi.org/10.1007/s11250-011-0054-4.

Romha, G., Gebru, G., Asefa, A., Mamo, G., 2018. Epidemiology of Mycobacterium bovis and Mycobacterium tuberculosis in animals: transmission dynamics and control challenges of zoonotic TB in Ethiopia. Prev. Vet. Med. 158, 1–17. https://doi.org/10.1016/j.prevetmed.2018.06.012.

Saka, J.O., Adesehinwa, A.O.K., Oyegbami, A., Omole, A.J., Gyoung Rae, C., Young Joo, S., ChongDae, K., SungWoo, K., IkSoo, J., 2017. The effects of health management system on the growth of chicken small farm in southwest states of Nigeria. Korean J. Poult. Sci. 44, 225–233.

Salih, D.A., El Hussein, A.M., Kyule, M.N., Zessin, K.-H., Ahmed, J.S., Seitzer, U., 2007. Determination of potential risk factors associated with Theileria annulata and Theileria parva infections of cattle in the Sudan. Parasitol. Res. 101, 1285–1288. https://doi.org/10.1007/s00436-007-0634-4.

Sambo, E., Bettridge, J., Dessie, T., Amare, A., Habte, T., Wigley, P., Christley, R.M., 2015. Participatory evaluation of chicken health and production constraints in Ethiopia. Prev. Vet. Med. 118, 117–127. https://doi.org/10.1016/j.prevetmed.2014.10.014.

Samuel, A., Nayak, B., Paldurai, A., Xiao, S., Aplogan, G.L., Awoume, K.A., Webby, R.J., Ducatez, M.F., Collins, P.L., Samal, S.K., 2013. Phylogenetic and pathotypic characterization of Newcastle disease viruses circulating in West Africa and efficacy of a current vaccine. J. Clin. Microbiol. 51, 771–781. https://doi.org/10.1128/JCM.02750-12.

Sangma, D.B., Manohara, T., 2018. The role of Garo tribes of Meghalaya (India) in the conservation and management of medicinal plants diversity used in treating livestock diseases. Plant Sci. Today 5, 155. https://doi.org/10.14719/pst.2018.5.4.416.

Sanogo, M., Abatih, E., Thys, E., Fretin, D., Berkvens, D., Saegerman, C., 2013. Importance of identification and typing of Brucellae from West African cattle: a review. Vet. Microbiol. 164, 202–211. https://doi.org/10.1016/j.vetmic.2013.02.009.

Sarma, K., Prasad, H., Das, G., Behera, P., Behera, S.K., Rajesh, J.B., Borthakur, S.K., 2016. Theileriasis in crossbred cows and its therapeutic management: first report from Lushai hill district of Mizoram. J. Parasit. Dis. 40, 605–610. https://doi.org/10.1007/s12639-014-0545-0.

Sathiyabarathi, M., Jeyakumar, S., Manimaran, A., Jayaprakash, G., Pushpadass, H.A., Sivaram, M., Ramesha, K.P., Das, D.N., Kataktalware, M.A., Prakash, M.A., Kumar, R.D., 2016. Infrared thermography: a potential noninvasive tool to monitor udder health status in dairy cows. Vet. World 9, 1075–1081. https://doi.org/10.14202/vetworld.2016.1075- 1081.

Schoonman, L., Swai, E.S., 2010. Herd- and animal-level risk factors for bovine leptospirosis in Tanga region of Tanzania. Trop. Anim. Health Prod. 42, 1565–1572. https://doi.org/10.1007/s11250-010-9607-1.

Schoonman, L.B., Wilsmore, T., Swai, E.S., 2010. Sero-epidemiological investigation of bovine toxoplasmosis in traditional and smallholder cattle production systems of Tanga Region, Tanzania. Trop. Anim. Health Prod. 42, 579–587. https://doi.org/10.1007/s11250-009-9460-2.

Seck, M.T., Bouyer, J., Sall, B., Bengaly, Z., Vreysen, M.J.B., 2010. The prevalence of African animal trypanosomoses and tsetse presence in Western Senegal. Parasite 17, 257–265. https://doi.org/10.1051/parasite/2010173257.

Shabani, S.S., Ezekiel, M.J., Mohamed, M., Moshiro, C.S., 2015. Knowledge, attitudes and practices on Rift Valley fever among agro pastoral communities in Kongwa and Kilombero districts, Tanzania. BMC Infect. Dis. 15, 363. https://doi.org/10.1186/s12879-015-1099-1.

Sharma, K.K., Kshirsagar, D.P., Kalyani, I.H., Patel, D.R., Vihol, P.D., Patel, J.M., 2015. Diagnosis of peste des petits ruminants infection in small ruminants through in-house developed Indirect ELISA: practical considerations. Vet. World 8, 443–448. https://doi.org/10.14202/vetworld.2015.443-448.

Sharma, G.K., Mahajan, S., Matura, R., Biswal, J.K., Ranjan, R., Subramaniam, S., Misri, J., Bambal, R.G., Pattnaik, B., 2017. Herd immunity against foot- and-Mouth disease under different vaccination practices in India. Transbound. Emerg. Dis. 64, 1133–1147. https://doi.org/10.1111/tbed.12478.

Shiferaw, T.J., Moses, K., Manyahilishal, K.E., 2010. Participatory appraisal of foot and mouth disease in the Afar pastoral area, northeast Ethiopia: implications for understanding disease ecology and control strategy. Trop. Anim. Health Prod. 42, 193–201. https://doi.org/10.1007/s11250-009-9405-9.

Shirima, G.M., Masola, S.N., Malangu, O.N., Schumaker, B.A., 2014. Outbreak investigation and control case report of brucellosis: experience from livestock research centre, Mpwapwa, Tanzania. Onderstepoort J. Vet. Res. 81 https://doi.org/10.4102/ojvr.v81i1.818.

Shittu, A., Abdullahi, J., Jibril, A., Mohammed, A.A., Fasina, F.O., 2012. Sub-clinical mastitis and associated risk factors on lactating cows in the Savannah Region of Nigeria. BMC Vet. Res. 8, 134. https://doi.org/10.1186/1746-6148-8-134.

Shrimali, R.G., Patel, M.D., Patel, R.M., 2016. Comparative efficacy of anthelmintics and their effects on hemato-biochemical changes in fasciolosis of goats of South Gujarat. Vet. World 9, 524–529. https://doi.org/10.14202/vetworld.2016.524-529.

Shyma, K.P., Gupta, J.P., Singh, V., 2015. Breeding strategies for tick resistance in tropical cattle: a sustainable approach for tick control. J. Parasit. Dis. 39, 1–6. https://doi.org/10.1007/s12639-013-0294- 5.

Sibhat, B., Asmare, K., Demissie, K., Ayelet, G., Mamo, G., Ameni, G., 2017. Bovine tuberculosis in Ethiopia: a systematic review and meta-analysis. Prev. Vet. Med. 147, 149–157. https://doi.org/10.1016/j.prevetmed.2017.09.006.

Sijapenda, J.E., Komba, E.V.G., Nonga, H.E., 2017. Studies on seroprevalence and risk factors for occurrence of bovine brucellosis in cattle in Lindi District, Tanzania. Tanzania Vet. J. 35, 82–89.

Simukoko, H., Marcotty, T., Vercruysse, J., Van den Bossche, P., 2011. Bovine trypanosomiasis risk in an endemic area on the eastern plateau of Zambia. Res. Vet. Sci. 90, 51–54. https://doi.org/10.1016/j.rvsc.2010.04.021.

Simulundu, E., Mtine, N., Kapalamula, T.F., Kajihara, M., Qiu, Y., Ngoma, J., Zulu, V., Kwenda, G., Chisanga, C., Phiri, I.K., Takada, A., Mweene, A.S., 2017. Genetic characterization of orf virus associated with an outbreak of severe orf in goats at a farm in Lusaka, Zambia (2015). Arch. Virol. 162, 2363–2367. https://doi.org/10.1007/s00705-017-3352-y.

Simwango, M., Ngonyoka, A., Nnko, H.J., Salekwa, L.P., Ole- Neselle, M., Kimera, S.I., Gwakisa, P.S., 2017. Molecular prevalence of trypanosome infections in cattle and tsetse flies in the Maasai Steppe, northern Tanzania. Parasit. Vectors 10, 507. https://doi.org/10.1186/s13071-017-2411-2.

Singh, S.V., Singh, A.V., Singh, R., Sharma, S., Shukla, N., Misra, S., Singh, P.K., Sohal, J. S., Kumar, H., Patil, P.K., Misra, P., Sandhu, K.S., 2008. Sero-prevalence of Bovine Johne's disease in buffaloes and cattle population of North India using indigenous ELISA kit based on native Mycobacterium avium subspecies paratuberculosis 'Bison type' genotype of goat origin. Comp. Immunol. Microbiol. Infect. Dis. 31, 419–433. https://doi.org/10.1016/j.cimid.2007.06.002.

Singh, K., Chandel, B.S., Chauhan, H.C., Dadawala, A., Singh, S.V., Singh, P.K., 2013. Efficacy of "indigenous vaccine" using native "Indian bison type" genotype of Mycobacterium avium subspecies paratuberculosis for the control of clinical Johne's disease in an organized goat herd. Vet. Res. Commun. 37, 109–114. https://doi.org/10.1007/s11259-013-9551-4.

Singh, M., Dixit, A., Roy, A., Singh, S., 2014. Analysis of prospects and problems of goat production in Bundelkhand region. Range Manag. Agrofor. 35, 163–168.

Singh, B.B., Kaur, R., Gill, G.S., Gill, J.P.S., Soni, R.K., Aulakh, R.S., 2019. Knowledge, attitude and practices relating to zoonotic diseases among livestock farmers in Punjab, India. Acta Trop. 189, 15–21. https://doi.org/10.1016/j.actatropica.2018.09.021.

Sitali, D.C., Twambo, M.C., Chisoni, M., Bwalya, M.J., Munyeme, M., 2018. Lay perceptions, beliefs and practices linked to the persistence of anthrax outbreaks in cattle in the Western Province of Zambia. Onderstepoort J. Vet. Res. 85 https://doi.org/10.4102/ojvr.v85i1.1615.

Snoeck, C.J., Adeyanju, A.T., Owoade, A.A., Couacy- Hymann, E., Alkali, B.R., Ottosson, U., Muller, C.P., 2013. Genetic diversity of newcastle disease virus in wild birds and pigeons in West Africa. Appl. Environ. Microbiol. 79, 7867–7874. https://doi.org/10.1128/AEM.02716-13.

Sodjinou, E., Henningsen, A., Koudande, O.D., 2012. Improving village poultry's survival rate through community-based poultry health management: evidence from Benin. Trop. Anim. Health Prod. 45, 59–66. https://doi.org/10.1007/s11250-012-0174-5.

Souley Kouato, B., Thys, E., Renault, V., Abatih, E., Marichatou, H., Issa, S., Saegerman, C., 2018. Spatio-temporal patterns of foot-and-mouth disease transmission in cattle between 2007 and 2015 and quantitative assessment of the economic impact of the disease in Niger. Transbound. Emerg. Dis. 65, 1049–1066. https://doi.org/10.1111/tbed.12845.

Specht, E., 2008. Prevalence of bovine trypanosomosis in Central Mozambique from 2002 to 2005. Onderstepoort J. Vet. Res. 75, 73–81. https://doi.org/10.1520/D0850-11.1.

Spiegel, K.A., Havas, K.A., 2019. The socioeconomic factors surrounding the initial emergence of peste des petits ruminants in Kenya, Uganda, and Tanzania from 2006 through 2008. Transbound. Emerg. Dis. 66, 627–633. https://doi.org/10.1111/tbed.13116.

Squire, S.A., Yang, R., Robertson, I., Ayi, I., Squire, D.S., Ryan, U., 2018. Gastrointestinal helminths in farmers and their ruminant livestock from the Coastal Savannah zone of Ghana. Parasitol. Res. 117, 3183–3194. https://doi.org/10.1007/s00436-018-6017-1.

Stothard, J.R., Lockyer, A.E., Kabatereine, N.B., Tukahebwa, E.M., Kazibwe, F., Rollinson, D., Fenwick, A., 2004. Schistosoma bovis in western Uganda. J. Helminthol. 78, 281–284.

Sudan, V., Jaiswal, A.K., Shanker, D., 2014. Infection rates of Linguatula serrata nymphs in mesenteric lymph nodes from water buffaloes in North India. Vet. Parasitol. 205, 408–411. https://doi.org/10.1016/j.vetpar.2014.07.025.

Sudan, V., Jaiswal, A.K., Parashar, R., Shanker, D., 2015a. A duplex PCR-based assay for simultaneous detection of Trypanosoma evansi and Theileria annulata infections in water buffaloes. Trop. Anim. Health Prod. 47, 915–919. https://doi.org/10.1007/s11250-015-0808-5.

Sudan, V., Singh, S.K., Jaiswal, A.K., Parashar, R., Shanker, D., 2015b. First molecular evidence of the transplacental transmission of Theileria annulata. Trop. Anim. Health Prod. 47, 1213–1215. https://doi.org/10.1007/s11250-015-0835-2.

Sudan, V., Shanker, D., Jaiswal, A., Singh, A., Pandey, V., 2017. Standardization and validation of simple PCR, duplex PCR and RAPD in comparison to blood smear examination for diagnosing bovine tropical theileriosis. Biologicals 46, 88–91. https://doi.org/10.1016/j.biologicals.2017.01.003.

Sulayeman, M., Dawo, F., Mammo, B., Gizaw, D., Shegu, D., 2018. Isolation, molecular characterization and sero-prevalence study of foot-and- mouth disease virus circulating in central Ethiopia. BMC Vet. Res. 14, 110. https://doi.org/10.1186/s12917-018-1429-9.

Suleiman, A., Bello, M., Dzikwi, A.A., Talba, A.M., Grema, H.A., Geidam, Y.A., 2015a. Serological prevalence of contagious bovine pleuropneumonia in agro-pastoral areas of Nigeria. Trop. Anim. Health Prod. 47, 1033–1042. https://doi.org/10.1007/s11250-015-0824-5.

Suleiman, A., Jackson, E.L., Rushton, J., 2015b. Challenges of pastoral cattle production in a sub-humid zone of Nigeria. Trop. Anim. Health Prod. 47, 1177–1185. https://doi.org/10.1007/s11250-015-0845-0.

Suleiman, A., Jackson, E., Rushton, J., 2018. Perceptions, circumstances and motivators affecting the implementation of contagious bovine pleuropneumonia control programmes in Nigerian Fulani pastoral herds. Prev. Vet. Med. 149, 67–74. https://doi.org/10.1016/j.prevetmed.2017.10.011.

Sumaye, R.D., Geubbels, E., Mbeyela, E., Berkvens, D., 2013. Inter-epidemic transmission of rift valley fever in livestock in the Kilombero River Valley, Tanzania: a cross-sectional survey. PLoS Negl. Trop. Dis. 7, e2356. https://doi.org/10.1371/journal.pntd.0002356.

Sundufu, A.J., Ansumana, R., Bockarie, A.S., Bangura, U., Lamin, J.M., Jacobsen, K.H., Stenger, D.A., 2015. Syndromic surveillance of peste des petits ruminants and other animal diseases in Koinadugu district, Sierra Leone, 2011- 2012. Trop. Anim. Health Prod. 47, 473–477. https://doi.org/10.1007/s11250-014-0736-9.

Swai, E.S., Karimuribo, E.D., Ogden, N.H., French, N.P., Fitzpatrick, J.L., Bryant, M.J., Kambarage, D.M., 2005. Seroprevalence estimation and risk factors for A. Marginale on smallholder dairy farms in Tanzania. Trop. Anim. Health Prod. 37, 599–610.

Swai, E.S., Kessy, M.J., Sanka, P.N., Mtui, P.F., 2011. A serological survey for infectious bursal disease virus antibodies in free-range village chickens in northern Tanzania. J. S. Afr. Vet. Assoc. 82, 32–35. https://doi.org/10.4102/jsava.v82i1.30.

Swai, E.S., Karimuribo, E.D., Kambarage, D.M., 2012. Risk factors for smallholder dairy cattle mortality in Tanzania. J. S. Afr. Vet. Assoc. 81, 241–246. https://doi.org/10.4102/jsava.v81i4.155.

Swai, E.S., Hayghaimo, A.A., Hassan, A.A., Mhina, B.S., 2015. The slaughter of increased numbers of pregnant cows in Tanga abattoir, Tanzania: a cause for concern? Onderstepoort J. Vet. Res. 82, E1–5. https://doi.org/10.4102/ojvr.v82i1.947.

Swiswa, S., Masocha, M., Pfukenyi, D.M., Dhliwayo, S., Chikerema, S.M., 2017. Long-term changes in the spatial distribution of lumpy skin disease hotspots in Zimbabwe. Trop. Anim. Health Prod. 49, 195–199. https://doi.org/10.1007/s11250-016-1180-9.

Syakalima, M., Simuunza, M., Zulu, V.C., 2018. Ethnoveterinary treatments for common cattle diseases in four districts of the Southern Province, Zambia. Vet. World 11, 141–145. https://doi.org/10.14202/vetworld.2018.141-145.

Sylla, S., Sidimé, Y., Sun, Y., Doumbouya, S., Cong, Y., 2014. Seroprevalence investigation of bovine brucellosis in Macenta and Yomou, Guinea. Trop. Anim. Health Prod. 46, 1185–1191. https://doi.org/10.1007/s11250-014-0625-2.

Taha, K.M., Salih, D.A., Ahmed, B.M., Enan, K.A., Ali, A.M., Elhussein, A.M., 2011. First confirmed report of outbreak of malignant ovine theileriosis among goats in Sudan. Parasitol. Res. 109, 1525–1527. https://doi.org/10.1007/s00436-011-2428-y.

Taku, A., Chhabra, R., War, B.A., 2010. Footrot on a sheep breeding farm in the Himalayan state of Jammu and Kashmir. Rev. Sci. Tech. 29, 671–675.

Tarnagda, Z., Yougbare, I., Kam, A., Tahita, M.C., Ouedraogo, J.B., 2011. Prevalence of infectious bronchitis and Newcastle disease virus among domestic and wild birds in H5N1 outbreaks areas. J. Infect. Dev. 5, 565–570.

Tebug, S.F., Njunga, G.R., Chagunda, M.G.G., Mapemba, J.P., Awah- Ndukum, J., Wiedemann, S., 2014. Risk, knowledge and preventive measures of smallholder dairy farmers in northern Malawi with regard to zoonotic brucellosis and bovine tuberculosis. Onderstepoort J. Vet. Res. 81 https://doi.org/10.4102/ojvr.v81i1.594.

Tedla, M., Degefa, K., 2017. Bacteriological study of calf colisepticemia in alage dairy farm, Southern Ethiopia. BMC Res. Notes 10, 710. https://doi.org/10.1186/s13104-017-3038-2.

Tedla, M., Mehari, F., Kebede, H., 2018. A cross-sectional survey and follow up study on major dairy health problems in large and small scale urban farms in Mekelle, Tigray, Ethiopia. BMC Res. Notes 11, 236. https://doi.org/10.1186/s13104-018-3347-0.

Tekle, T., Terefe, G., Cherenet, T., Ashenafi, H., Akoda, K.G., Teko-Agbo, A., Van Den Abbeele, J., Gari, G., Clausen, P.-H., Hoppenheit, A., Mattioli, R.C., Peter, R., Marcotty, T., Cecchi, G., Delespaux, V., 2018. Aberrant use and poor quality of trypanocides: a risk for drug resistance in south western Ethiopia. BMC Vet. Res. 14, 4. https://doi.org/10.1186/s12917-017-1327-6.

Terefe, Y., Girma, S., Mekonnen, N., Asrade, B., 2017. Brucellosis and associated risk factors in dairy cattle of eastern Ethiopia. Trop. Anim. Health Prod. 49, 599–606. https://doi.org/10.1007/s11250-017-1242-7.

Terfa, Z.G.G., Garikipati, S., Kassie, G., Bettridge, J.M.M., Christley, R.M.M., 2018. Eliciting preferences for attributes of Newcastle disease vaccination programmes for village poultry in Ethiopia. Prev. Vet. Med. 158, 146–151. https://doi.org/10.1016/j.prevetmed.2018.08.004.

Tesfaye, G., Tsegaye, W., Chanie, M., Abinet, F., 2011. Seroprevalence and associated risk factors of bovine brucellosis in Addis Ababa dairy farms. Trop. Anim. Health Prod. 43, 1001–1005. https://doi.org/10.1007/s11250-011-9798-0.

Teshome, D., Sori, T., Sacchini, F., Wieland, B., 2019. Epidemiological investigations of contagious caprine pleuropneumonia in selected districts of Borana zone, Southern Oromia, Ethiopia. Trop. Anim. Health Prod. 51, 703–711. https://doi.org/10.1007/s11250-018-1744-y.

Thakur, R., Thakur, D., Dogra, P., 2018. Indigenous feeding practices for better reproductive performance in buffaloes in Himachal Pradesh, India. Buffalo Bull. 37, 361–368.

Tibbo, M., Mukasa-Mugerwa, E., Woldemeskel, M., Rege, J.E.O., 2003. Risk factors for mortality associated with respiratory disease among Menz and Horro sheep in Ethiopia. Vet. J. 165, 276–287.

Tolosa, T., Verbeke, J., Piepers, S., Supré, K., De Vliegher, S., 2013. Risk factors associated with subclinical mastitis as detected by California mastitis Test in smallholder dairy farms in Jimma, Ethiopia using multilevel modelling. Prev. Vet. Med. 112, 68–75. https://doi.org/10.1016/j.prevetmed.2013.06.009.

Toye, P.G., Batten, C.A., Kiara, H., Henstock, M.R., Edwards, L., Thumbi, S., Poole, E.J., Handel, I.G., Bronsvoort, B.Mde C., Hanotte, O., Coetzer, J.A.W., Woolhouse, M.E.J., Oura, C.A.L., 2013. Bluetongue and Epizootic Haemorrhagic Disease virus in local breeds of cattle in Kenya. Res. Vet. Sci. 94, 769–773. https://doi.org/10.1016/j.rvsc.2012.11.001.

Tripathi, S.M., Thaker, A.M., Joshi, C.G., Sankhala, L.N., 2012. Acephate immunotoxicity in White Leghorn cockerel chicks upon experimental exposure. Environ. Toxicol. Pharmacol. 34, 192–199. https://doi.org/10.1016/j.etap.2012.04.002.

Tschopp, R., Hattendorf, J., Roth, F., Choudhoury, A., Shaw, A., Aseffa, A., Zinsstag, J., 2012. Cost Estimate of Bovine Tuberculosis to Ethiopia, pp. 249–268. https://doi.org/10.1007/82_2012_245.

Tsegay, A., Tuli, G., Kassa, T., Kebede, N., 2015. Seroprevalence and risk factors of Brucellosis in small ruminants slaughtered at Debre Ziet and Modjo export abattoirs, Ethiopia. J. Infect. Dev. 9, 373–380. https://doi.org/10.3855/jidc.4993.

Ularamu, H.G., Ibu, J.O., Wood, B.A., Abenga, J.N., Lazarus, D.D., Wungak, Y.S., Knowles, N.J., Wadsworth, J., Mioulet, V., King, D.P., Shamaki, D., Adah, M.I., 2017. Characterization of foot-and-Mouth disease viruses collected in Nigeria between 2007 and 2014: evidence for epidemiological links between west and East Africa. Transbound. Emerg. Dis. 64, 1867–1876. https://doi.org/10.1111/tbed.12584.

Umeta, Gurmesa, 2011. Participatory analysis of problems limiting goat production at selected districts of East Showa zone, Ethiopia. African J. Agric. Res. 6 https://doi.org/10.5897/AJAR11.314.

Usman, I.S., Bzugu, P.M., Pur, J.T., Abdullahi, A., 2017. Indigenous control methods for parasites among pastoralists communities in Adamawa state, Nigeria. J. Agric. Ext. 21, 109. https://doi.org/10.4314/jae.v21i1.9.

VanderWaal, K., Omondi, G.P., Obanda, V., 2014. Mixed-host aggregations and helminth parasite sharing in an East African wildlife–livestock system. Vet. Parasitol. 205, 224–232. https://doi.org/10.1016/j.vetpar.2014.07.015.

Vhoko, K., Iannetti, S., Burumu, J., Ippoliti, C., Bhebhe, B., De Massis, F., 2018. Estimating the prevalence of brucellosis in cattle in Zimbabwe from samples submitted to the central veterinary laboratory between 2010 and 2014. Vet. Ital. 54, 21–27. https://doi.org/10.12834/VetIt.1111.6191.2.

Vijayasarathi, M.K., Sreekumar, C., Venkataramanan, R., Raman, M., 2016. Influence of sustained deworming pressure on the anthelmintic resistance status in strongyles of sheep under field conditions. Trop. Anim. Health Prod. 48, 1455–1462. https://doi.org/10.1007/s11250-016-1117-3.

Vordermeier, M., Ameni, G., Berg, S., Bishop, R., Robertson, B.D., Aseffa, A., Hewinson, R.G., Young, D.B., 2012. The influence of cattle breed on susceptibility to bovine tuberculosis in Ethiopia. Comp. Immunol. Microbiol. Infect. Dis. 35, 227–232. https://doi.org/10.1016/j.cimid.2012.01.003.

Vudriko, P., Okwee-Acai, J., Tayebwa, D.S., Byaruhanga, J., Kakooza, S., Wampande, E., Omara, R., Muhindo, J.B., Tweyongyere, R., Owiny, D.O., Hatta, T., Tsuji, N., Umemiya-Shirafuji, R., Xuan, X., Kanameda, M., Fujisaki, K., Suzuki, H., 2016. Emergence of multi-acaricide resistant Rhipicephalus ticks and its implication on chemical tick control in Uganda. Parasit. Vectors 9, 4. https://doi.org/10.1186/s13071-015-1278-3.

Vudriko, P., Okwee-Acai, J., Byaruhanga, J., Tayebwa, D.S., Omara, R., Muhindo, J.B., Lagu, C., Umemiya-Shirafuji, R., Xuan, X., Suzuki, H., 2018. Evidence-based tick acaricide resistance intervention strategy in Uganda: concept and feedback of farmers and stakeholders. Ticks Tick. Dis. 9, 254–265. https://doi.org/10.1016/j.ttbdis.2017.09.011.

Wambua, L., Wambua, P.N., Ramogo, A.M., Mijele, D., Otiende, M.Y., 2016. Wildebeest-associated malignant catarrhal fever: perspectives for integrated control of a lymphoproliferative disease of cattle in sub-Saharan Africa. Arch. Virol. 161, 1–10. https://doi.org/10.1007/s00705-015-2617-6.

Wanyoike, F., Rich, K.M., 2010. An assessment of the regional and national socio-economic impacts of the 2007 rift valley fever outbreak in Kenya. Am. J. Trop. Med. Hyg. 83, 52–57. https://doi.org/10.4269/ajtmh.2010.09-0291.

Wardrop, N.A., Thomas, L.F., Cook, E.A.J., de Glanville, W.A., Atkinson, P.M., Wamae, C. N., Fèvre, E.M., 2016. The sero-epidemiology of Coxiella burnetii in humans and cattle, Western Kenya: evidence from a cross-sectional study. PLoS Negl. Trop. Dis. 10, e0005032 https://doi.org/10.1371/journal.pntd.0005032.

Webster, B.L., Diaw, O.T., Seye, M.M., Webster, J.P., Rollinson, D., 2013. Introgressive hybridization of Schistosoma haematobium group species in Senegal: species barrier break down between ruminant and human schistosomes. PLoS Negl. Trop. Dis. 7, e2110. https://doi.org/10.1371/journal.pntd.0002110.

Wekesa, S.N., Muwanika, V.B., Siegismund, H.R., Sangula, A.K., Namatovu, A., Dhikusooka, M.T., Tjørnehøj, K., Balinda, S.N., Wadsworth, J., Knowles, N.J., Belsham, G.J., 2015. Analysis of recent serotype O foot-and-mouth disease viruses from livestock in Kenya: evidence of four independently evolving lineages. Transbound. Emerg. Dis. 62, 305–314. https://doi.org/10.1111/tbed.12152.

Welay, G.M., Tedla, D.G., Teklu, G.G., Weldearegay, S.K., Shibeshi, M.B., Kidane, H.H., Gebrezgiabher, B.B., Abraha, T.H., 2018. A preliminary survey of major diseases of ruminants and management practices in Western Tigray province, northern Ethiopia. BMC Vet. Res. 14, 293. https://doi.org/10.1186/s12917-018-1621-y.

Weny, G., Okwee-Acai, J., Okech, S.G., Tumwine, G., Ndyanabo, S., Abigaba, S., Goldberg, T.L., 2017. Prevalence and risk factors associated with hemoparasites in cattle and goats at the edge of Kibale National Park, Western Uganda. J. Parasitol. 103, 69–74. https://doi.org/10.1645/16-33.

Wesonga, F.D., Wesongah, J.O., Chemuliti, J., Wanjala, K., Munga, L., Gitau, P., 2006. Seroprevalence of Ehrlichia ruminantium (Heartwater) in small ruminants in a pastoral production system in Narok District, Kenya. Bull. Anim. Heal. Prod. Africa 54, 23–33.

Wesonga, F.D., Gachohi, J.M., Kitala, P.M., Gathuma, J.M., Njenga, M.J., 2017. Seroprevalence of Anaplasma marginale and Babesia bigemina infections and associated risk factors in Machakos County, Kenya. Trop. Anim. Health Prod. 49, 265–272. https://doi.org/10.1007/s11250-016-1187-2.

Whittington, R., Donat, K., Weber, M.F., Kelton, D., Nielsen, S.S., Eisenberg, S., Arrigoni, N., Juste, R., Sáez, J.L., Dhand, N., Santi, A., Michel, A., Barkema, H., Kralik, P., Kostoulas, P., Citer, L., Griffin, F., Barwell, R., Moreira, M.A.S., Slana, I., Koehler, H., Singh, S.V., Yoo, H.S., Chávez-Gris, G., Goodridge, A., Ocepek, M., Garrido, J., Stevenson, K., Collins, M., Alonso, B., Cirone, K., Paolicchi, F., Gavey, L., Rahman, M.T., de Marchin, E., Van Praet, W., Bauman, C., Fecteau, G., McKenna, S., Salgado, M., Fernández-Silva, J., Dziedzinska, R., Echeverría, G., Seppänen, J., Thibault, V., Fridriksdottir, V., Derakhshandeh, A., Haghkhah, M., Ruocco, L., Kawaji, S., Momotani, E., Heuer, C., Norton, S., Cadmus, S., Agdestein, A., Kampen, A., Szteyn, J., Frössling, J., Schwan, E., Caldow, G., Strain, S., Carter, M., Wells, S., Munyeme, M., Wolf, R., Gurung, R., Verdugo, C., Fourichon, C., Yamamoto, T., Thapaliya, S., Di Labio, E., Ekgatat, M., Gil, A., Alesandre, A.N., Piaggio, J., Suanes, A., de Waard, J.H., 2019. Control of paratuberculosis: who, why and how. A review of 48 countries. BMC Vet. Res. 15, 198. https://doi.org/10.1186/s12917-019-1943-4.

Woldemeskel, M., Mersha, G., 2010. Study on caprine and ovine dermatophilosis in Wollo, Northeast Ethiopia. Trop. Anim. Health Prod. 42, 41–44. https://doi.org/10.1007/s11250-009-9383- y.

Wolff, C., Boqvist, S., Ståhl, K., Masembe, C., Sternberg-Lewerin, S., Ståhl, K., Masembe, C., Sternberg-Lewerin, S., 2017. Biosecurity aspects of cattle production in Western Uganda, and associations with seroprevalence of brucellosis, salmonellosis and bovine viral diarrhoea. BMC Vet. Res. 13 (6 December 2017) https://doi.org/10.1186/s12917-017-1306- y.

Wright, A., Thrusfield, M., 2016. Perceptions of zoonotic and animal diseases in the Van Gujjar community of North India. Prev. Vet. Med. 123, 143–153. https://doi.org/10.1016/j.prevetmed.2015.11.012.

Wu, T., Perrings, C., 2018. The live poultry trade and the spread of highly pathogenic avian influenza: regional differences between Europe, West Africa, and Southeast Asia. PLoS One 13, e0208197. https://doi.org/10.1371/journal.pone.0208197.

Yadav, A., Panadero, R., Katoch, R., Godara, R., Cabanelas, E., 2017. Myiasis of domestic and wild ruminants caused by Hypodermatinae in the Mediterranean and Indian subcontinent. Vet. Parasitol. 243, 208–218. https://doi.org/10.1016/j.vetpar.2017.07.007.

Yamada, S., Konnai, S., Imamura, S., Simuunza, M., Chembensofu, M., Chota, A., Nambota, A., Onuma, M., Ohashi, K., 2009. PCR-based detection of blood parasites in cattle and adult Rhipicephalus appendiculatus ticks. Vet. J. 182, 352–355. https://doi.org/10.1016/j.tvjl.2008.06.007.

Yang, Z., Xu, G., Reboud, J., Ali, S.A., Kaur, G., McGiven, J., Boby, N., Gupta, P.K., Chaudhuri, P., Cooper, J.M., 2018. Rapid veterinary diagnosis of bovine reproductive infectious diseases from semen using paper-origami DNA microfluidics. ACS Sens. 3, 403–409. https://doi.org/10.1021/acssensors.7b00825.

Yasine, A., Kumsa, B., Hailu, Y., Ayana, D., 2015. Mites of sheep and goats in Oromia Zone of Amhara Region, North Eastern Ethiopia: species, prevalence and farmers awareness. BMC Vet. Res. 11, 122. https://doi.org/10.1186/s12917-015-0433-6.

Yihunie, A., Urga, B., Alebie, G., 2019. Prevalence and risk factors of bovine schistosomiasis in Northwestern Ethiopia. BMC Vet. Res. 15, 12. https://doi.org/10.1186/s12917-018-1757-9.

Zahid, U.N., Randhawa, Swaran Singh, Hussain, S.A., Randhawa, Sarnarinder Singh, Mahajan, V., Dua, K., 2014. Claw lesions causing clinical lameness in lactating holstein frisian crossbred cows. Vet. Med. Int. 2014, 764689 https://doi.org/10.1155/2014/764689.

Zúquete, S.T., Coelho, J., Rosa, F., Vaz, Y., Cassamá, B., Padre, L., Santos, D., Basto, A.P., Leitão, A., 2017. Tick (Acari: ixodidae) infestations in cattle along Geba River basin in Guinea-Bissau. Ticks Tick. Dis. 8, 161–169. https://doi.org/10.1016/j.ttbdis.2016.10.013.

Zvinorova, P.I., Halimani, T.E., Muchadeyi, F.C., Katsande, S., Gusha, J., Dzama, K., 2017. Management and control of gastrointestinal nematodes in communal goat farms in Zimbabwe. Trop. Anim. Health Prod. 49, 361–367.