Exploring Maasai Livestock Disease in Tanzania

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Research Summary

Northern Tanzanian Maasai pastoralists, are coping with the illnesses and deaths due to many diseases. This is impacting social and ecological factors. Pastoralists depend on the health of their livestock herds for a large percentage of their food, cultural activities, income, and trading. In 2003, the incidences of these diseases were not well known, and for diseases that have treatments available it has remained challenging for pastoralists to vaccinate and otherwise treat their herds due to the cost. Stacy Lynn and Isaya Rumas set out to survey residents of three predominantly Maasai villages in northern Tanzania, and here we focus on Sukuro Village, which is located in the Maasai Steppe. The research conducted in this village consisted of 61 interviews about diseases that were found to be common amongst cattle, goats, and sheep. Analysis will provide baseline data for disease incidence, illness, and mortality for Sukuro Village herds. This investigation will inform future studies of diseases in this region and allow study of livestock disease trends in this area. Data from interviews with household heads, *Boma* (the owner and lead decision-maker of the livestock) were digitized using Google Sheets, and data were analyzed in Microsoft Excel and transferred to Graphpad prism to create a visualization of the data. Data includes comprehensive information for each of the six diseases, and we take a deeper look at three major diseases that had catastrophic impacts to livestock herds. The results of this project will be readily available for village use, with products including a brochure to explain the impact of zoonotic infection in livestock herds which affect pastoral livelihoods.

Introduction

In northern Tanzania, the livelihoods of Maasai pastoralists depend on the health of their livestock for financial stability and food. Pastoralists throughout Tanzania are trying to cope with illnesses and deaths of their livestock herds due to the many diseases that have been on the rise due to "ecological and social factors, including pestilent insects, poor land-use planning and policies, climate change, and the decline of health services for public and private animals" **(Douglas, C., 2009).**

Source: Household members surrounding calves. Stacy Lynn, 2003

In 2003, Stacy Lynn and Isaya Rumas conducted semi-structured interviews with many pastoralists in three villages located in the Simanjiro plains of northern Tanzania ***(Figure 1).*** For this study we are focusing on Sukuro village and the six key diseases that were most commonly reported by heads of households, which locals refer to as *Boma*. In these areas, "cattle are a sign of wealth and are owned by the men of the household, while small stock (i.e., chickens, goats, and sheep) are looked after by the females of the household" **(Covarrubias, K. 2012).** Rural households in Tanzania rely heavily on their livestock for their source of income; this includes trading, gifts, meat products, and more. If any livestock gets ill or dies, that affects the pastoralists livelihoods and incomes.

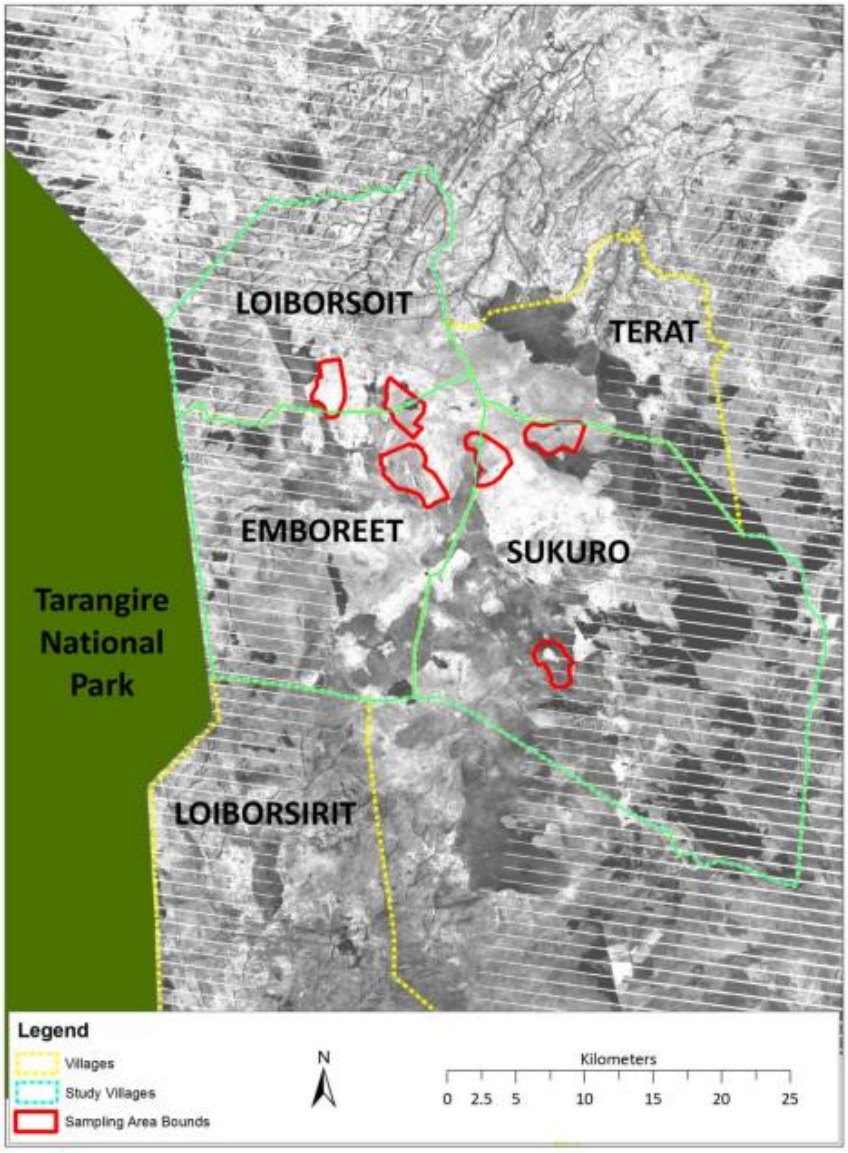

Figure 1 Study Villages near the TNP. (Lynn, S. 2010) Sukuro is the only village that is being analyzed. This map is just to show the location of where Sukuro is to the TNP.

Policy changes, land-use planning, and other environmental changes have an affect on the health of these animals due to the herd proximity to wildlife that may harbor diseases. For

example, villages that were located near the Tarangire National Park (TNP) had different ranking systems for their animals than villages that were further away from the park. When the park expanded, the village people had to find new land for their animals, bringing them closer to wild animals and living quarters **(Baird, T. D., 2009).**

Source: Baby sheep and member of household. Stacy Lynn, 2003

Another problem that pastoralists face, when it comes to the ecosystem, is the destabilization of land from increases in livestock overstocking and overgrazing. Overstocking is having more animals on a piece of land than the land is used to having. Overgrazing refers to a situation when soil and plants in an area are exposed to too much livestock for a long period of time without the land having a chance to recover properly. Both are a factor that has shown to decrease productivity of a village were the main source of income comes from livestock and small stock. This is due to the soil, plants, and grasses not being healthy enough to recover in times of natural disasters and erosion **(Ellis, J. E., 1988).**

Furthermore, zoonotic diseases (diseases that spillover between animal and human hosts) are of concern to this human-livestock-wildlife interface. In some cases, diseases are transferred to humans from milk or through animal protein. Understanding the impacts and

what signs to look out for should provide more context for household Boma and reduce the transfer of these types of diseases.

Source: Herding of cattle and calves. Stacy Lynn, 2003

Research Questions and Hypotheses

- Based on the data that was collected from 97 interviews (n = 61) in 2003 from the Tanzanian village of Sukuro, what can the pastoralists do to better protect their livestock from future fatal diseases?
- How can the government better support pastoralists when dealing with the many different types of diseases cited here, and how can these be prevented or better treated in the future?
- How might government funding improve local pastoralists' herd health, and how can this funding be mobilized to prevent future illnesses and deaths from zoonotic diseases?

Methods

In 2003, Lynn and Rumas set out to interview pastoralists throughout three villages in Tanzania. The data analyzed in this project focuses on one such village, and the local livestock diseases, including illnesses and deaths that were recorded throughout 97 Maasai pastoralists livestock herds. These data were systematically entered into a spreadsheet using Google Sheets software; this software was strategically chosen due to its confidentiality of personal information and the statistical processes it allows systematically. For increases analysis, the Google Sheet was transformed into a Microsoft Excel spreadsheet to account for missing pieces of the qualitative data from collected interviews. From this qualitative data, totals of all the animals comprising a herd were calculated, as were the number of livestock that became sick or died due to illness. Means and medians for these totals were calculated and compared across herds. Background information for these diseases of interest was collected.

After initial analysis, factors correlating with numerous animal deaths were identified, with the purpose of developing measurements to keep those animals healthy. Once these questions are answered, visual representation tools will be created for distribution to the locals who were interviewed, to show what major factors are contributing to herd illness and what preventative measures can be taken to decrease herd deaths.

Analysis of this data will be used to suggest changes to help protect these herds and to promote a growth in financial stability for the pastoralists.

Diagram 1: Research Methods Diagram. These are the steps that were taken throughout the course of this project.

Results

Disease Code	Maasai	Common Name	Common Code
D1	Orkipei	Contagious bovine pleuropneumonia	CBPP
D2	Ndigana/Oltikana	East Coast Fever	ECF
D3	Emonywa	Heartwater	HW
D4	Ormillo	Rinderpest	RP
D5	Ndorobo	Animal African Trypanosomiasis	AAT
D6	Olodokolak	Redwater	RW

Table 1 Six common diseases affecting livestock herds in 2003 and the translations from Maasai to common name.

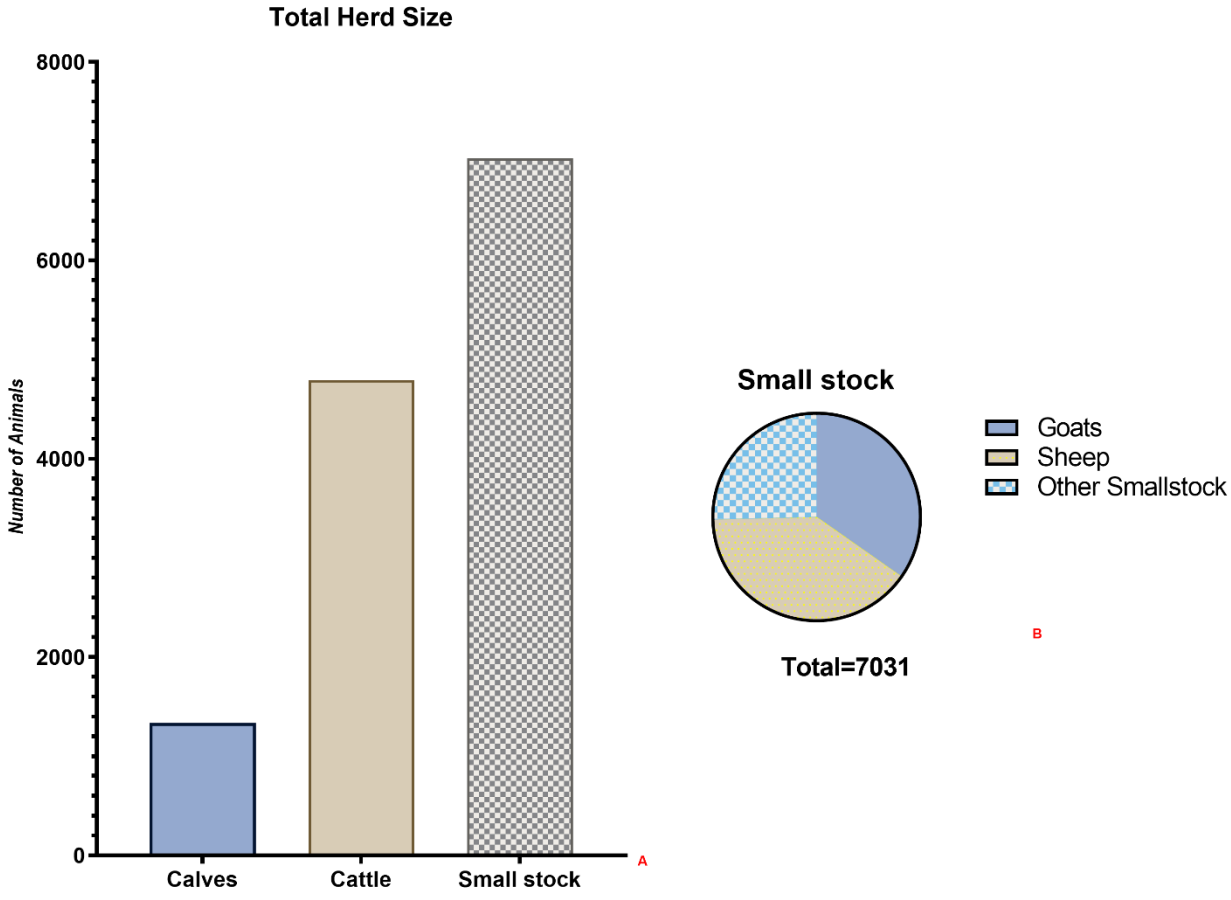

Figure 2 Total herd structure recorded from Boma in Sukuro Village in 2003. A) Total herd structure with small stock being the total of goats, sheep, and other small stock. B) Total animal species that are considered small stock.

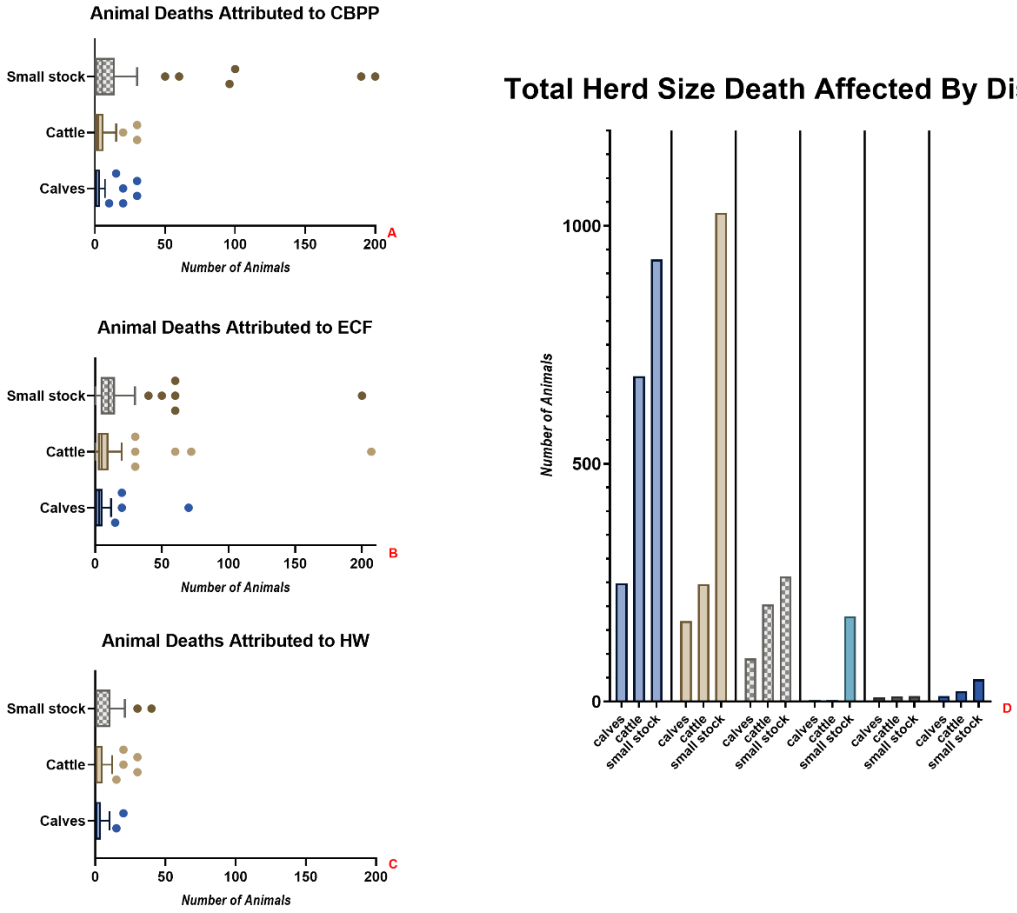

Figure 3 Totals of livestock deaths per disease. A) The median count of animal species deaths due to CBPP. CBPP was the number one cause of death of animal species throughout the village. B) The median count of animal species deaths due to ECF. ECF was the number two cause of death in animal species the village. C) The median count of animal species deaths due to HW. HW was the third most contributing death to the animal species in the village. D) Total herd size count of animal species involving the six common diseases reported from Boma, showing a simplified visual of what diseases were most impactful to the village for animal species loss.

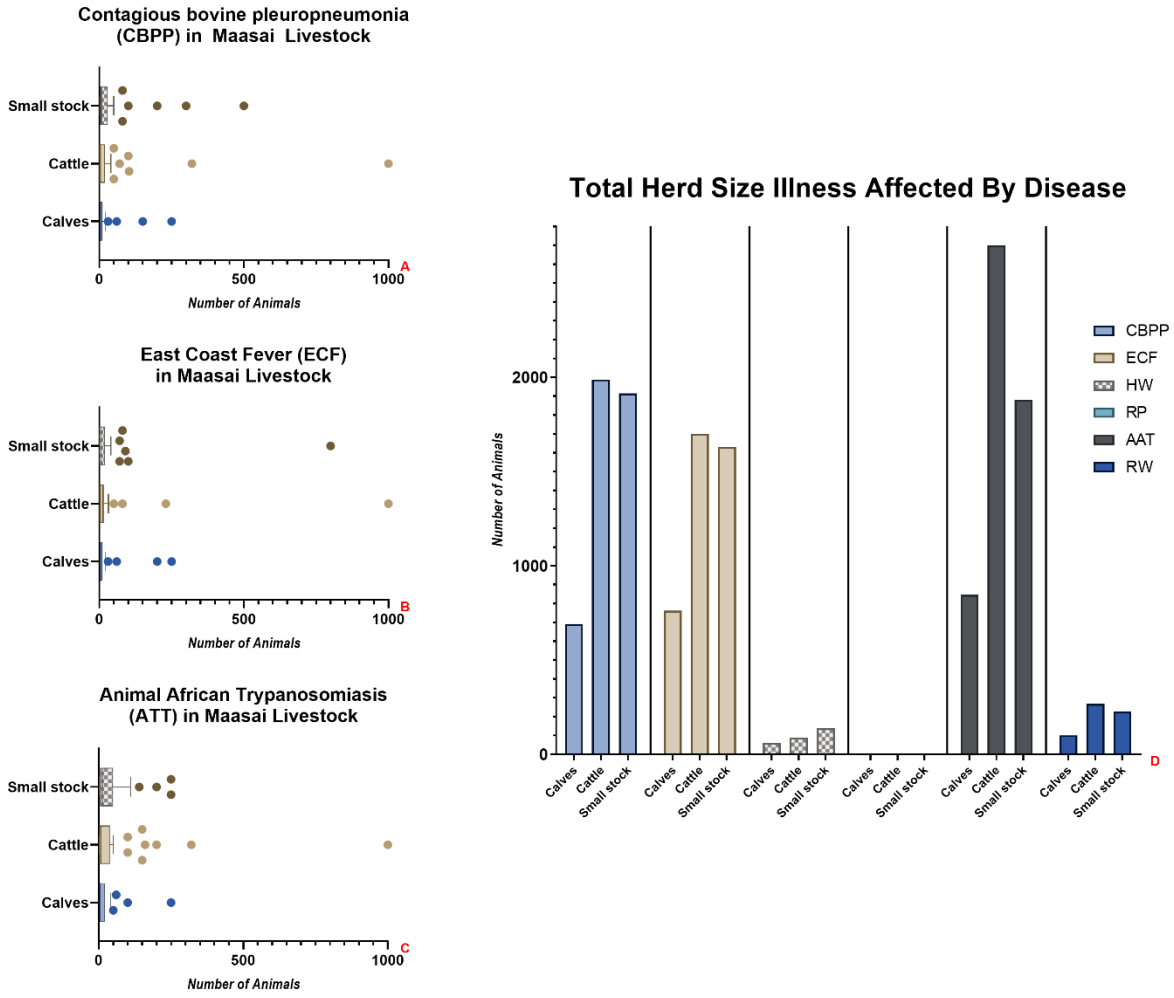

Figure 4 Totals of livestock illnesses per disease. A) The median count of animal species deaths due to CBPP. CBPP was the second most impactful cause of illnesses across animal species throughout the village. B) The median count of animal species illnesses due to ECF. ECF was the number third most impactful cause of illnesses in animal species in the village. C) The median count of animal species deaths due to HW. HW was the number one most contributing disease for illnesses across animal species in the village. D) Total herd size count of animal species involving the six common diseases reported from Boma, showing a simplified visual of what diseases were most impactful to the village for animal species sickness.

DISEASE RANKING	ILLNESSES	DEATHS
1ST	AAT	CBPP
2ND	CBPP	ECF
3RD	ECF	HW
4TH	RW	RP
5TH	HW	RW
6TH	RP	AAT

Table 2 Diseases ranked by illnesses and deaths by the most impactful disease being 1st and the least impactful bring 6th.

	ILLNESSES			DEATHS		
DISEASE RANKING	**Calves**	**Cattle**	**Smallstock**	**Calves**	**Cattle**	**Smallstock**
1ST	AAT	AAT	CBPP	CBPP	CBPP	ECF
2ND	ECF	CBPP	AAT	ECF	ECF	CBPP
3RD	CBPP	ECF	ECF	HW	HW	HW
4TH	RW	RW	RW	RW	RW	RP
5TH	HW	HW	HW	AAT	AAT	RW
6TH	RP	RP	RP	RP	RP	AAT

Table 3 Comparing diseases ranked by most impactful to least impactful based on certain species of animals.

	Total TLUs	**Death TLUs**	**Proportion TLUs Loss**
Calves	133.3	53.3	0.3998
Cattle	3404.45	831.4	0.2442
Goats	415.31	198.7	0.4784
Sheep	476.68	122.7	0.2574
Other small stock	303.28	96.2	0.3200

Table 4 Tropical Livestock Units (TLUs) for total herd size and deaths on livestock throughout Sukuro Village. This is done by multiplying the TLU per animal by the total herd size. (1 head of calves = 0.1, 1 head of cattle = 0.71, 1 head of small stock = 0.17)

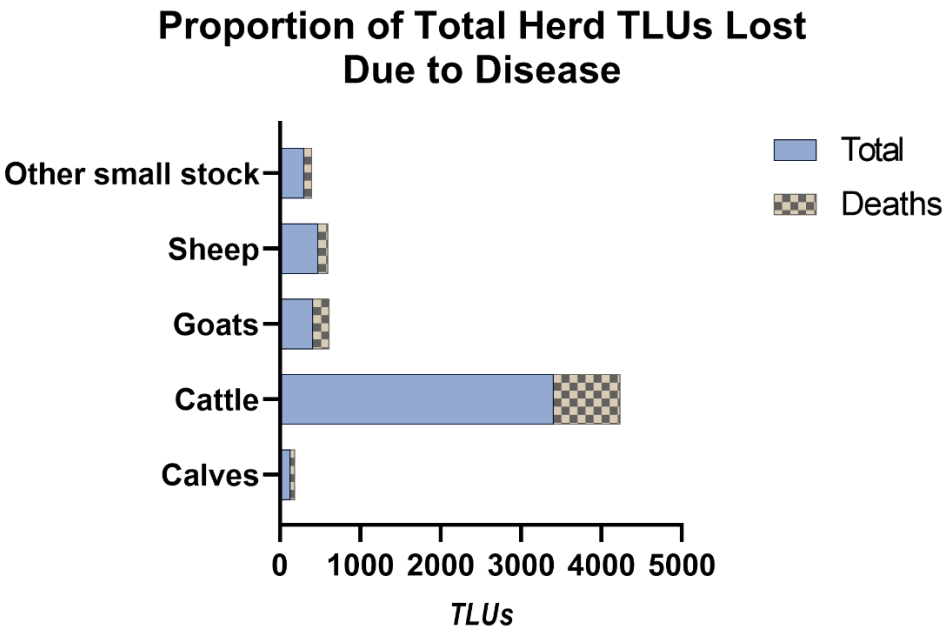

Figure 5 TLUs of total herd size and TLUs death of livestock throughout Sukuro Village due to disease.

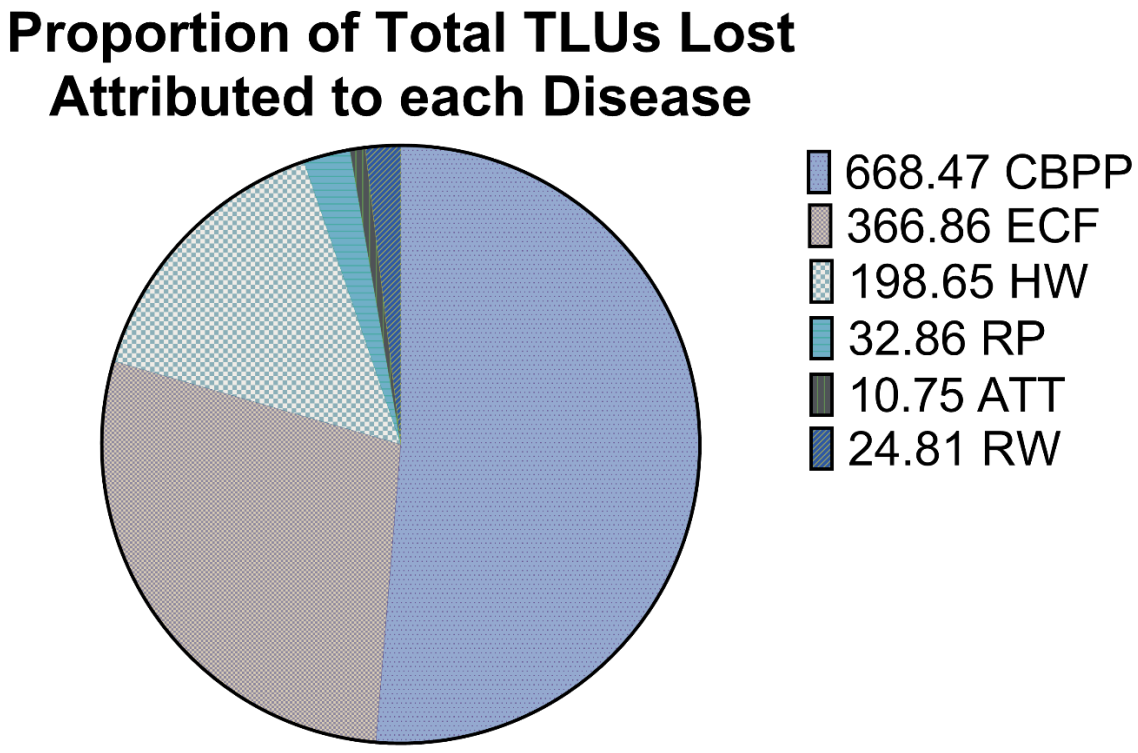

Figure 6 TLUs total herd deaths of all species of animal for each of the common diseases reported by Boma.

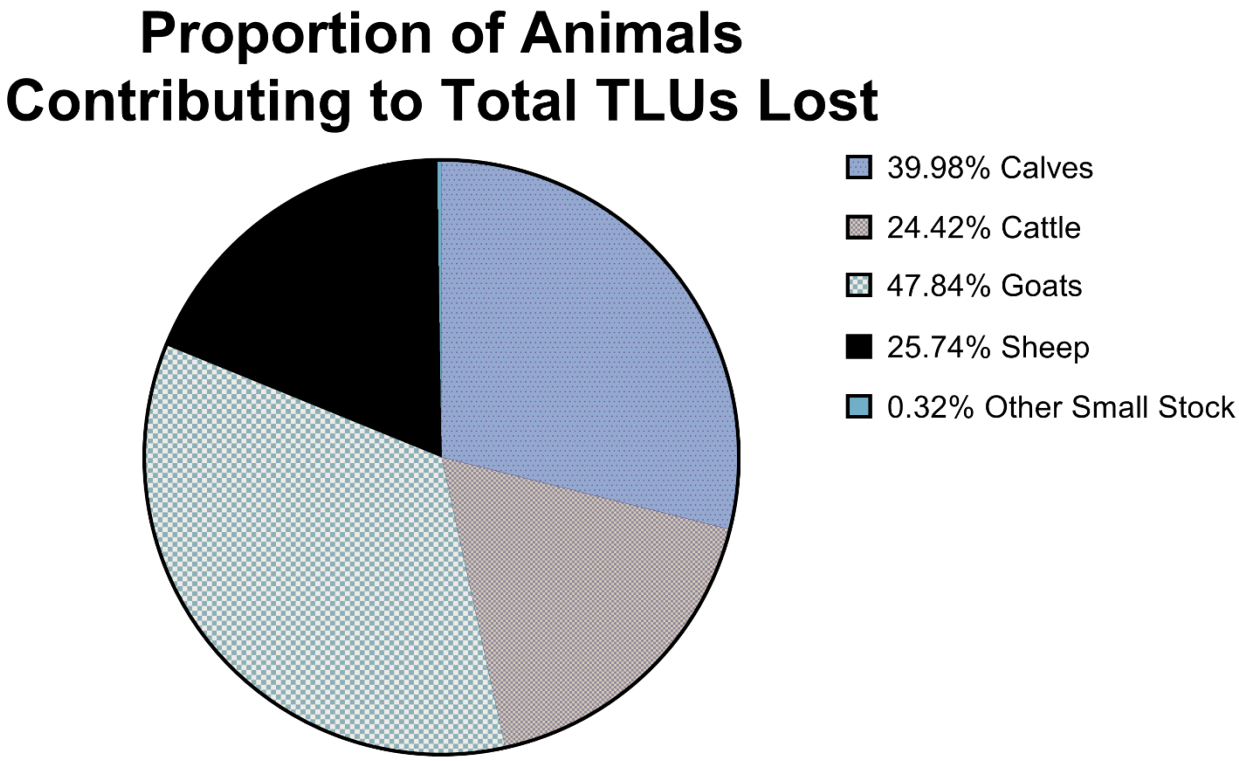

Figure 7 Comparison of total TLUs proportion loss for each animal species in the village of Sukuro.

Discussion

Lynn and Rumas conducted 61 interviews about diseases that were impacting livestock (**Table 1)**. The idea was to get a better understanding of what the top three common diseases were affecting livestock. After further analysis, there was a slight difference of the top three diseases when focusing on illnesses and deaths, separately. (**Figure 3**).

The importance of having herd diversification is to capture nutrients through grazing and browsing through different foraging species. It is also important to understand that having such a diverse range of animals will have an impact on the spread of certain diseases (**Lynn, 2010**). Each animal species provides a source of food security, income, socio-economic factors, and manure for each household (**Ellis & Swift, 1988**).

Total herd size is important to this research for understanding how many total animals were recorded throughout the village before disease struck and depleted herds. Cattle and small stock (comprised of goats and sheep) are the most common livestock households own (**Figure 2**) due to the products and services they provide. The main concerns for the households losing animals to diseases can be prevented by vaccinations or treatments. These preventative measures can be extremely expensive and almost impossible to come by to keep herds healthy.

GraphPad prism software was used to analyze and visualize the impact of each disease. The top three common diseases Maasai livestock died from in the Sukuro village were Contagious Bovine Pleuropneumonia (CBPP), East Coast Fever (ECF), and Heartwater (HW) (**Figure 3**). The common diseases that Maasai livestock became ill from were Animal African Trypanosomiasis (ATT), Contagious Bovine Pleuropneumonia (CBPP), and East Coast Fever (ECF) (**Figure 4**).

Using total herd size, the diseases were ranked most impactful (1^{st}) to least impactful (6^{th}) for illness and death (**Table 2**). Considering each disease affects different animal species, **Table 3** shows the greatest effect of a disease on animal species, with respect to illness and death. Most of the herds cattle and calves were becoming sick due to AAT, while a majority deaths were from CBPP. CBPP was the major cause of illness in small stock, and ECF was the major cause of deaths.

CBPP is an extremely contagious and infectious viral pneumonia that is a persistent pressure on cattle production. CBPP is transmitted through direct contact by the causative agent *Mycoplasma mycoides* subspecies *mycoides* (**Mngumi, 2020**). Infected animals tend to show signs of dry/moist cough, labored breathing, nasal discharge, weight loss, and fever (**Swai, 2013**). The Tanzanian government has spent about 1,000,000 USD investing in 15,185,800 doses of the CBPP vaccine. In the process of purchasing all these vaccines to maintain healthy livestock, national and economical losses have become an issue (**Mngumi, 2020**). Another way of preventing and vaccinating livestock can be done through restricting the animals' movements into areas that are not suitable and by participating in vaccine campaigns (**Msami, 2001**).

ECF, also known as Corridor disease, is caused by the parasite *Theileria parva* transmitted by ticks that will infect the animal host (**Patel, 2019**). These ticks normally infect wild buffalo and can transfer to livestock through poor land-use policies and typically happen during the dry seasons (**Douglis, 2009**). Some signs that should be known are fever, enlarged lymph nodes, anorexia, labored breathing, nonreal opacity, nasal discharge, diarrhea, and anemia (**GALVmed, 2022**). The Muguga cocktail is the most common version of the Infection and Treatment Method (ITM) vaccine (**Teufel, 2021**). This is extremely costly and there is not a lot of evidence as to the benefits for pastoralists. This makes it extremely difficult to prevent and treat.

HW, also known as cowdriosis, is an infection involving the rickettsia *Cowdria ruminantium* transmitted by a genus of ixodid ticks, *Amblyomma* (**Purnell, 1984**). The nymph ticks prefer to feed on smaller animals, such as goats and sheep, while adult ticks prefer to feed on larger animals, such as cattle (**OIE, 2023**). Signs for Heartwater disease include fever, coughing, mild incoordination, rabies, tetanus, and diarrhea. If left untreated, extreme brain damage can occur and led to death. One preventative measure for controlling HW is by injecting Terramycin/LA intramuscularly or intravenously injecting Liquamycin 100 (**Purnell, 1984**). These injections are costly and hard to come by for pastoralists.

AAT is transmitted through tsetse flies, which can transmit the parasite *Trypanosomiasis spp.* Among animals and humans through biting and consuming a blood meal. In humans, this disease is most known as “sleeping sickness.” The tsetse flies mostly inhabit bushy areas. While land-use planning is pushing villages and their livestock into these areas, it has become a more common disease (**Douglis, 2009**). AAT manifests by showing signs of weakness, loss of appetite, dehydration, weight loss, anemia, swelling, dermatitis, nervous disorders, and death (**Douglis, 2009**, **Venturelli, 2022**). There are drug treatments for this disease, but microbes can become resistant to the treatments. They are also expensive and not in the pastoralist’s budget. The most effective prevention would be to move livestock to areas that are free of tsetse flies (**Douglis, 2009**)**.**

Tropical Livestock Units (TLUs) are a way of standardizing the number of calves, cattle, goats, and sheep. A TLU is equal to the weight of one 250kg animal. When converting to TLUs, 1 calf = 0.1 TLU, 1 head of cattle = 0.71 TLU, and 1 head of small stock (goats and sheep) = 0.17 TLU (**Lynn, 2010**). TLUs are important for understanding the biomass of different animal species in a population and showing the actual amount of loss to the Sukuro village households. Converting the total herd size to Total TLUs and Death TLUs were used to calculate proportion of TLUs lost. The proportion of TLUs of calf’s loss was equal to 39.98% of the starting calf biomass, TLUs of cattle loss were 24.42% of biomass lost, and TLUs for small stock loss was 34.95% of biomass lost (**Table 4 & Figure 7**). By separating diseases and adding together the livestock herds that are affected by each disease, there is a better understanding of Total TLUs lost for each of the six diseases (**Figure 6**).

In the future data analysis, the information from the other two villages that were interviewed will be helpful to understand the overall impact diseases have on a community and the livelihoods of the people who care for livestock.

Conclusions

Livestock is a large part of the Sukuro village and shows to have a large impact on the households' livelihoods that each herd belongs to, especially when animals pass from diseases. There are measures that can be taken to reduce the loss of livestock, but the funds and knowledge of symptoms lack. Government funding of vaccines and treatments would provide households with the ability to grow and stabilize the health to these animals.

Using data from this research will help provide more insight on what diseases are impacting what species of animals and what the result of losing an animal means for the households and villages socio-economic factors. Providing each village with a pamphlet of signs, symptoms, and preventative measures for common diseases would be beneficial in keeping animals and households healthy.

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Appendix 1: Methods Outline

1) Data collection: Done by Stacy Lynn and her colleagues.
2) Data entry and processing: Done by me in google sheets
    a. Each disease has multiple subsections that are in the top row
    b. Each interview of the data is in rows and goes across to each disease they witnessed that made livestock ill or die.
3) Data analysis: Done by Stacy Lynn and I. Going back into the sheets to fill in blanks and narrow down what diseases we are wanting to look at for the time being. The analysis should show how many total animals got ill or died from the 6 diseases and how these losses contributed to the financial struggles for the pastoralists.
4) Putting Pieces Together: What are some factors involved that may have increased the number of animals that became sick or died, how could these diseases be treated and prevented in the future?
5) Results: Done with Graphpad prism and Microsoft Excel