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Reporting Trends, Distribution and Economic Burden of Transboundary Animal Diseases in Same District, Tanzania: Insights from EMA-*i* Database (2020-2023).

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SUMMARY

Transboundary animal diseases are largely threatening the livestock sector worldwide. A retrospective study using EMA-*i* data collected from July 2020 to June 2023 was conducted in Same district to assess the reporting trends and their distribution, magnitude and direct financial losses associated with transboundary animal diseases. The distribution of transboundary animal diseases was illustrated using geographical maps and graphs, while reporting trends were analyzed by comparing the number of reported cases to the population of the respective species. Statistical tests were used to assess the spread and magnitude of the diseases, and direct financial losses were estimated based on animal mortalities. The results indicate that Contagious Bovine Pleuropneumonia (CBPP), Foot and Mouth Disease (FMD), Lumpy Skin Disease (LSD), Contagious Caprine Pleuropneumonia (CCPP), Peste des Petits Ruminants (PPR), and Newcastle Disease (ND) were the reported transboundary animal diseases. CBPP, CCPP, and FMD were the most widespread, affecting seven wards, followed by LSD in five wards, ND in three wards, and PPR in two wards. Among the six reported diseases, PPR had the highest relative reporting rate (0.4%), while ND had the lowest (0.03%). The case fatality rate was highest in ND (71.4%) and lowest in FMD and LSD, which had no recorded fatalities. Additionally, the estimated direct financial loss over the four-year period was USD 21,891. The persistent occurrence of transboundary animal diseases underscores the need to explore effective control measures to enhance livestock production and minimize financial losses for farmers.

Key words: *Prevalence, Same, Transboundary animal diseases, Tanzania*

INTRODUCTION

Livestock sector in Tanzania is one of the most economically satisfying activities to the daily farmer's needs. It contributes incomes, livelihood improvement and national food security. The sector has a major impact to National economy as it contributes about 18% of the total GDP (Mellau *et al.*, 2011). Despite its

importance, the sector is constrained by many challenges including diseases. The periodic occurrences of livestock diseases are largely influenced by traditional livestock farming system (i.e., nomadism type of farming system). Such livestock diseases include Tick-borne diseases (TBDs), Vector-borne diseases (VBDs) and

other diseases (Kiswaga *et al.*, 2014; Kivaria, 2006). In addition, lung diseases like Contagious Bovine Pleural Pneumonia (CBPP), Contagious Caprine Pleural Pneumonia (CCPP) and Peste des Petits ruminant (PPR) are the most important threatening diseases which cause considerable morbidities and mortalities in ruminants.

The negative effects of climate change and variability is greatly impacting the livestock sector specifically in water and pastures availability. However, the infectious diseases also constitute a major health constraint in livestock production in sub-Saharan Africa (Mbatia *et al.*, 2002; Okuthe and Buyu, 2006). It was described that the diseases of great importance in cattle in sub-Saharan Africa include TBDs, VBDs (Perry and Young, 1995), Foot and Mouth Disease (FMD), Contagious Bovine Pleuropneumonia (CBPP), Lumpy Skin Disease (LSD) and helminthiasis. Among of these diseases, TBDs were found to be one of the major limiting factors in eastern, central and southern Africa since they are associated with high morbidity and mortality rates (Msami, 2001; Munyaradzi *et al.*, 2010) and economic losses (Brown, 1997; Okuthe and Buyu, 2006).

However according to Otte *et al* (2004), Transboundary Animal Diseases (TADs) are largely threatening the livestock sector. The Ministry of Livestock and Fisheries (2019) described the (TADs) as among of the threatening diseases to livestock sector in Tanzania concomitantly with TBDs. These prioritized TADs include CBPP,

FMD, LSD, PPR, Newcastle disease (ND), African Swine Fever (ASF), Contagious Caprine Pleuropneumonia (CCPP), Sheep Pox and Goat Pox. The occurrence of animal diseases in Tanzania are thought to be an outcome of poor vaccination campaign regime, inadequate active surveillance due to scarce of financial resources and the collapse of the dipping scheme following the withdrawal of public services in the animal health sector, beginning the mid 1980's (Rutabanzibwa, 2002).

Same District is among of the Districts in Tanzania with TADs endemicity. In 2017, the Food and Agriculture Organization (FAO) of the United Nations in collaboration with the government of United Republic of Tanzania instituted the Animal disease reporting system called Event Mobile Application (EMA-*i*) as one of the Livestock diseases surveillance tools. For about seven years since its inauguration, the data analysis and interpretation had not been done to different reported livestock diseases which could have been contributed to the respective authority to plan the livestock diseases control strategy in the district. Furthermore, Kiswaga *et al* (2014) has tried to establish the magnitude of TBDs only in Same District during livestock disease paper-based reporting set-up. Therefore, the study was aimed at identifying the reported TADs in Same District within a period starting from July 2020 to June 2023 and specifically determining the distribution, magnitude and estimating the DFL due to their mortalities.

MATERIALS AND METHODS

Study area

This study was conducted in Same District, located in the Kilimanjaro Region of northeastern Tanzania. As one of the seven districts in the region, Same covers an area of 6,221 square kilometers and has a population of approximately 300,000

residents, based on the 2022 Tanzania National Census. The majority of the population engages in mixed farming, combining crop cultivation with livestock rearing. The primary livestock species kept by residents include cattle, goats, sheep, pigs, and chickens.

According to 2024 records from the district council office, Same District has an estimated livestock population of 103,033 cattle, 117,169 goats, 73,684 sheep, and 223,658 chickens. While most livestock are raised in small backyard settings, a significant number of agro-pastoralists maintain larger herds, particularly of cattle, sheep, and goats. The district experiences continuous movement of livestock both within and beyond its borders, with frequent exchanges occurring with neighboring districts and the Republic of Kenya, which lies to the northeast.

Study Design and Data Source

This study employed a repeated cross-sectional design, analyzing retrospective data collected over a three-year period (2020–2023). The data were obtained from disease reports submitted by livestock officers in Same District through the EMA-i system, covering the period from July 2020 to June 2023.

Data Collection

The study utilized routine animal health reports from Same District. In Tanzania, the government—through the Ministry of Livestock and Fisheries and the President’s Office Regional Administration and Local Government—implements the Event Mobile Application (EMA-i) system as a digital tool to strengthen disease surveillance and reporting in the livestock sector. Field-based livestock officers, who are trained in using the system, systematically record cases of sick or deceased animals encountered during their routine activities. These cases may be reported to them directly or observed during farm and household visits.

For this study, researchers accessed the EMA-i system data and extracted records of

transboundary diseases, including details such as the date, location, clinical features of the affected animals, and disease prognosis

Data analysis

The TADs report from database were summarized in Microsoft Excel 2019 and exported to Epi Info™ (Version 7, Centre for Disease Control, Atlanta, USA) for comparison of proportions. To compare the proportions (%) of TADs, *Chi-square* test was used at critical probability of $P < 0.05$ using Stat Calc function of Epi Info™. The quantification of economic losses due to TADs’ mortalities was estimated using Microsoft Excel spreadsheet. The relative reporting rate was determined as number of reported or observed cases regulated to 100,000 animals of a given livestock type. This figure was interpreted with the understanding that not all cases of illness or mortality would be reported. Economic losses were assessed based on the number of mortalities, the total weight of carcasses resulting from these deaths, and the prevailing local market price per kilogram. Direct financial loss was estimated using a formula as described by Ejeh et al. (2014);

$$DFL = nW \times Av.P / Kg$$

Where:

DFL stands for direct financial losses due to mortalities

n stands for total number of Mortalities

W stands for weight of carcass due to mortalities (in Kgs) and

Av. P/Kg stands for average price of carcass per Kilogram (in US\$)

The average price per Kilogram of carcass was estimated to be USD 3.34 for cattle, USD 4.32 for goats and USD 4.13 for chickens.

RESULTS

Reporting rate of the TADs

Over the study period, six transboundary diseases were recorded in the EMA-*i* database including CBPP, FMD, LSD, CCPP, PPR and ND. The results revealed that, among the six reported TADs, PPR became more prevalent (0.4%) followed by CBPP (0.1%), FMD (0.1%) and CCPP (0.1%). Both LSD and ND found to have the

least prevalence (0.03%). The Case Fatality Rate (CFR) was high in ND (71.4%) followed by PPR (50.8%), CCPP (16.7%) and CBPP (5.0%). There were no deaths in FMD and LSD as shown in table 1. The reporting rate is regulated per 100,000 animals (referring the total number of animals in the district) as presented in Figure 1.

Table 1. Shows the Prevalence and CFR of each reported TAD in Same District from July 2020 to June 2023

Disease	Animal spp	Population (N)	Cases reported (n_1)	Deaths reported (n_2)	Prevalence ($P = \frac{n_1}{N} \times 100$)	CFR ($CFR = \frac{n_2}{n_1} \times 100$)
CBPP	Cattle	103,033	101	5	0.1	5.0
FMD	Cattle	103,033	106	0	0.1	0
LSD	Cattle	103,033	30	0	0.03	0
CCPP	Goats	117,169	120	20	0.1	16.7
PPR	Goats	117,169	459	233	0.4	50.8
ND	Chicken	223,658	63	45	0.03	71.4

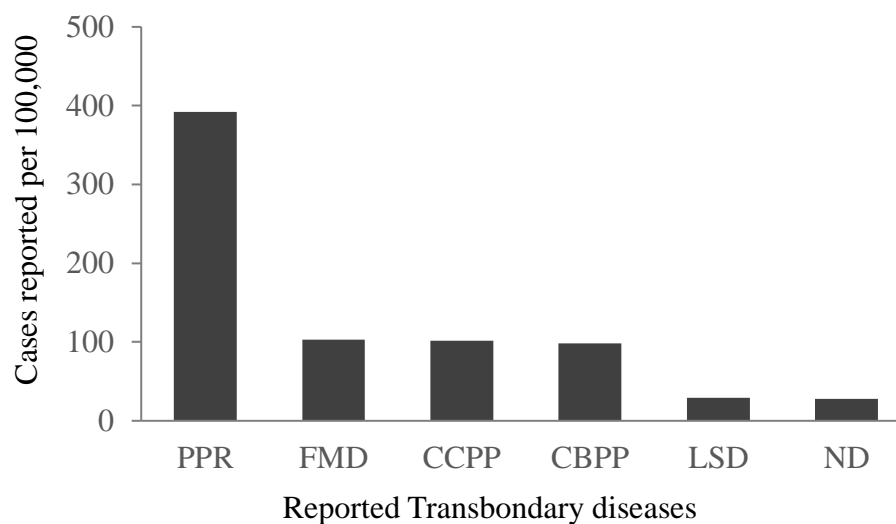


Figure 1. Case report rate, regulated per 100,000 animals

The results also shown that the significant difference ($p < 0.05$) of proportions exists between CBPP and LSD; CBPP and PPR; CBPP and ND; FMD and LSD; FMD and PPR; FMD and ND; LSD and CCPP; LSD

and PPR; CCPP and PPR; CCPP and ND; and PPR and ND. Table 2 shows the comparisons of proportions of the reported TADs in Same District.

Table 2. Comparison of report rate of the reported TADs

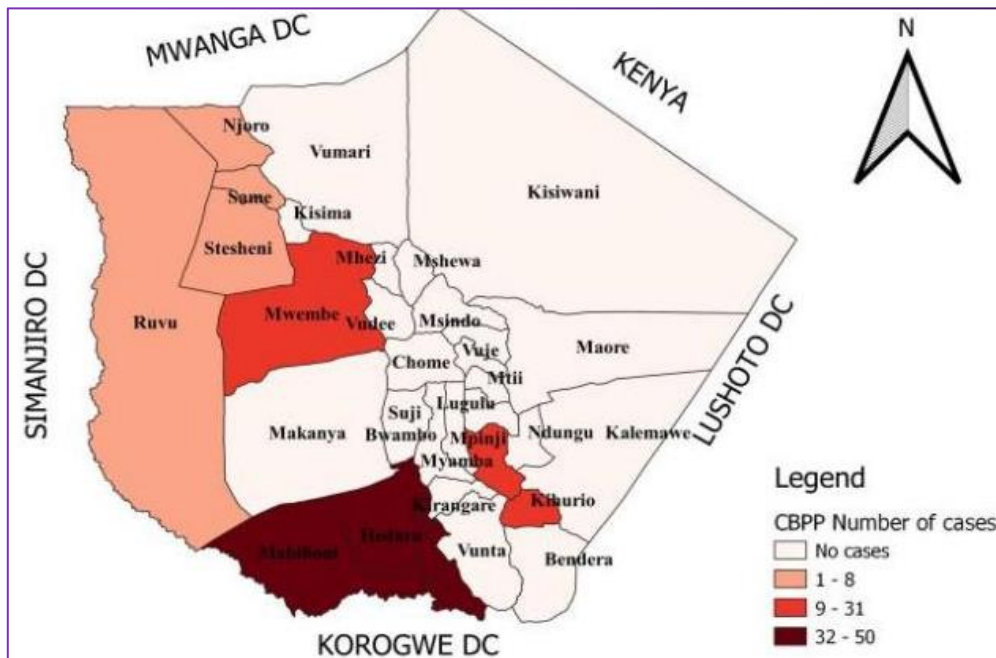
	CBPP	FMD	LSD	CCPP	PPR	ND
CBPP	-	0.7809	<0.0001	0.8532	<0.0001	<0.0001
FMD		-	<0.0001	0.9729	<0.0001	<0.0001
LSD			-	<0.0001	<0.0001	0.9699
CCPP				-	<0.0001	<0.0001
PPR					-	<0.0001

Distribution of Transboundary Animal Diseases (TADs)

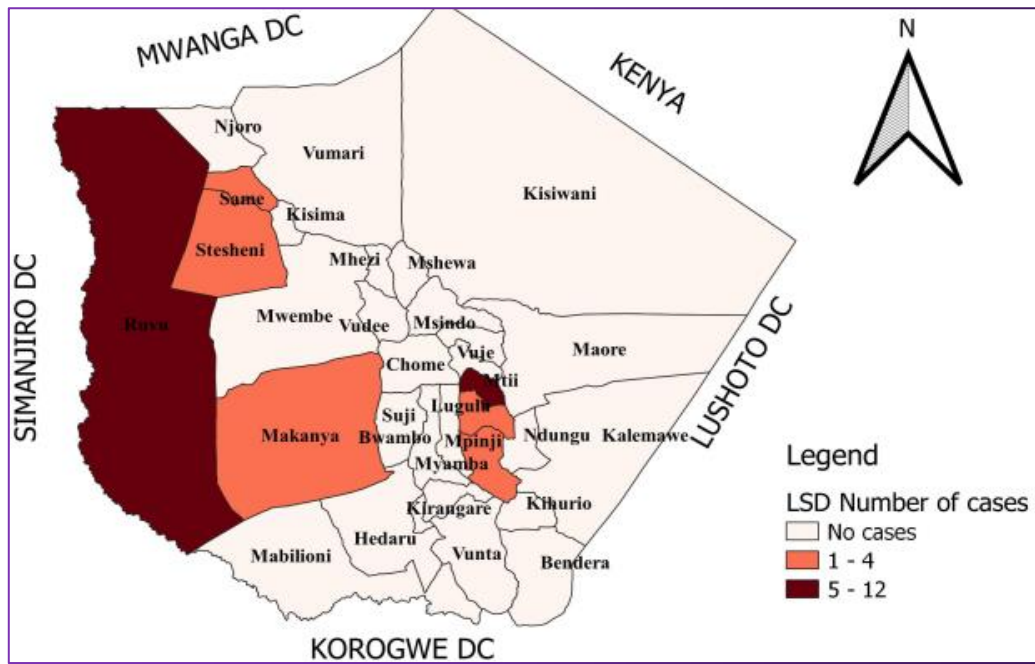
The TADs were reported in 14 of 30 wards of the Same district. It was evident that CBPP, CCPP and FMD were widely distributed in all 14 wards with at least one reported TAD (Ruvu, Njoro, Same, Stesheni, Mabilioni, Lugulu, Myamba,

Hedaru, Kihurio, Makanya, Mwembe, Maore, Vuje, and Mshewa). LSD was reported in six wards (Ruvu, Stesheni, Same, Makanya, Lugulu, and Myamba) and ND in four wards (Same, Stesheni, Njoro and Mwembe). PPR was the least, being reported in only two wards (Ruvu and Mabilioni) in Same District.

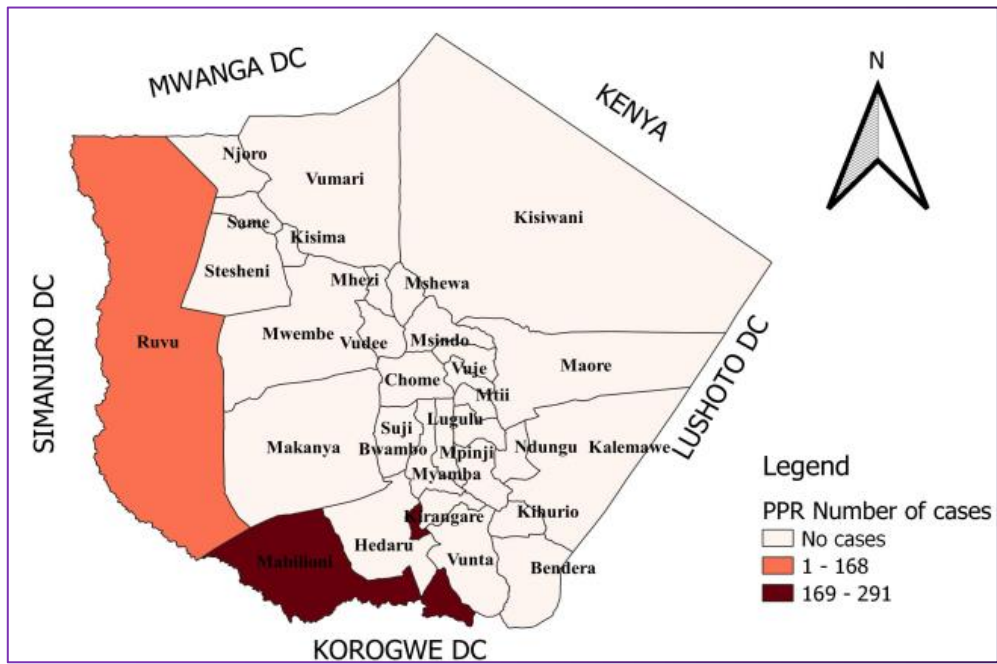
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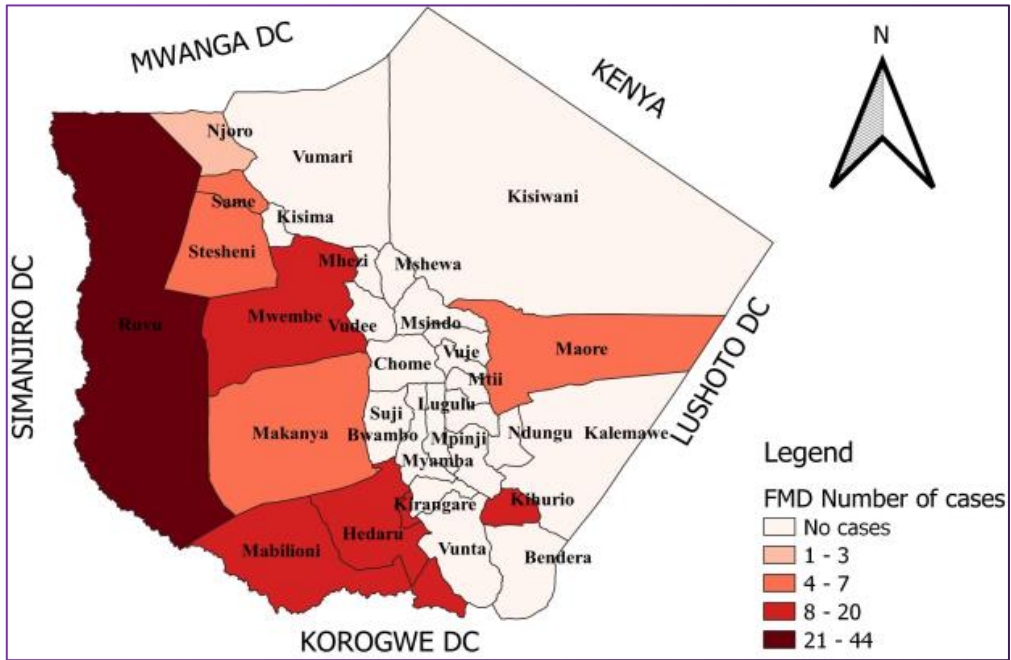
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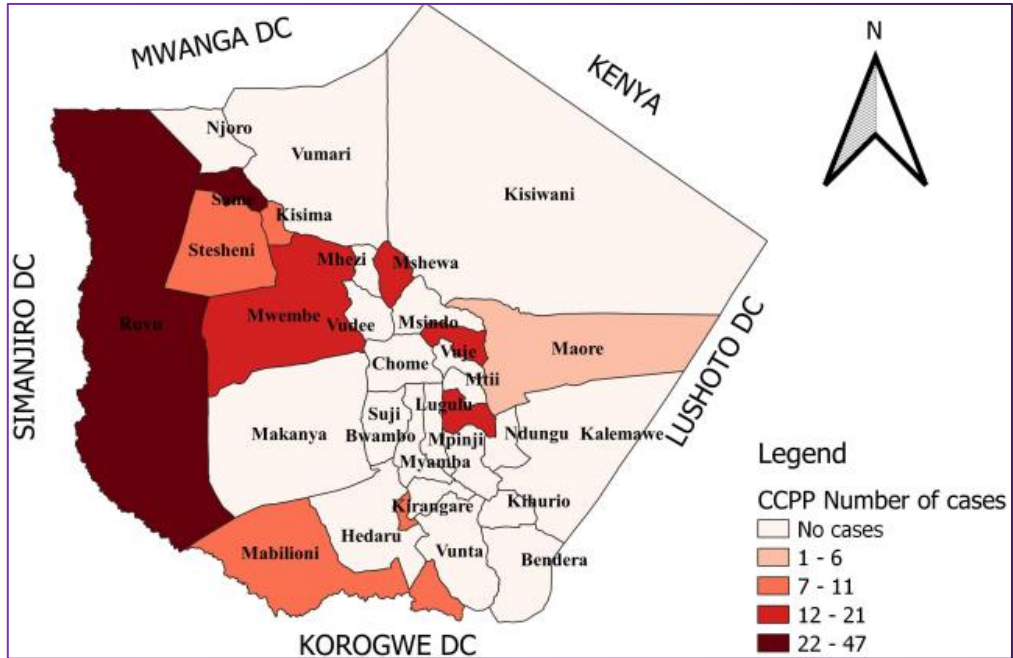
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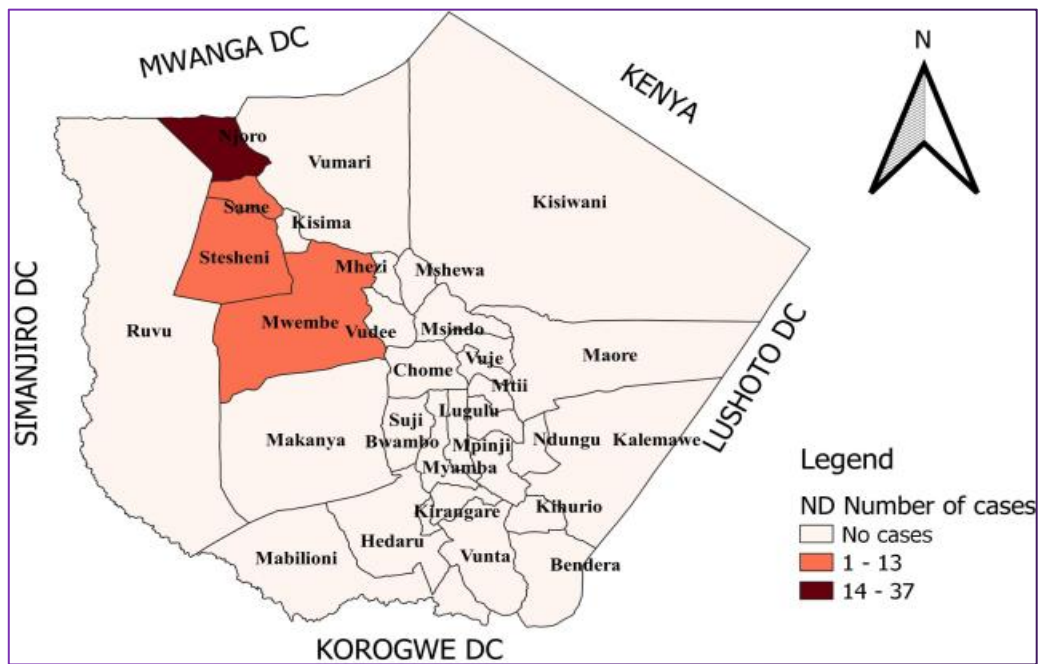


Figure 1. Spatial distribution of TADs cases; (a) CBPP, (b) LSD (c) PPR, (d) FMD, (d) CCPP, and (f) ND in Same District from July 2020 to June 2023

Estimation of Direct Financial Loss due to mortalities

The direct financial loss (DFL) was calculated as shown in Table 3 using to date

currency conversion rate 20 March 2024. Therefore, the DFL was estimated to be 21,891.14 USD i.e., approximately TZS 55,950,470.17 (1 USD = TZS 2,555.85).

Table 3. Shows the estimation of DFL due to mortalities caused by TADs in Same District from July 2020 to June 2023

Type of animal	Number of deaths (<i>n</i>)	Average weight (Kg)	Average price (USD)	Direct financial loss (USD)
Cattle	5	115	3.34	1,920.50
Goats	253	18	4.32	19,673.28
Chickens	45	1.6	4.13	297.36
Total financial loss				21,891.14

DISCUSSION

The persistent endemicity of infectious animal diseases in Tanzania prompted the FAO, in collaboration with the Ministry of Livestock and Fisheries, to implement the EMA-i system as a key tool for livestock

disease surveillance. This system plays a crucial role in ensuring timely reporting of livestock diseases and enabling immediate action during outbreaks. In Same district, 17 out of 34 ward livestock extension officers were trained to use the EMA-i system for disease reporting. The system helps

maintain a comprehensive database of reported livestock diseases and supports the implementation of contingency plans for outbreaks occurring within or near the affected areas. This database provides essential information for strategic planning in animal disease control and prevention.

The transboundary animal diseases (TADs) identified in Same district are among those prioritized by the Ministry of Livestock and Fisheries (MLF, 2019). Of the nine prioritized TADs, six; CBPP, FMD, LSD, PPR, ND, and CCP have been reported in the district within the study period (2020-2023). This aligns with MLF (2019) findings on the endemic nature of TADs in Tanzania. These diseases are prevalent in wards with high livestock populations and where seasonal animal movements are experienced both within and outside the district. These observations also support previous studies by FAO (2002), Mbatia et al. (2002), Otte et al. (2004), and Okuthe and Buyu (2006), which highlight the persistent endemicity of TADs in Sub-Saharan Africa and globally if appropriate control measures are not implemented.

The prevalence of reported transboundary animal diseases was very low, ranging from 0.03% to 0.4% reflecting the observed low reporting rate between 28-392 per 100,000 animals for each specific species. This may be attributed to the lack of adequate animal disease surveillance and control measures, as well as the endemic nature of transboundary animal diseases (TADs). Widespread movement and intermingling of animals from different areas facilitate the transmission of infectious diseases, as noted by Kiswaga et al. (2014). Furthermore, traditional livestock farming systems are increasingly threatened by the adverse

effects of climate change and variability, which often lead to unpredictable feed and water availability. In Sub-Saharan Africa and Tanzania, climate change significantly influences disease dynamics, as animals migrate in response to resource scarcity, disease outbreaks, and water shortages. These challenges have been identified as major constraints for livestock keepers, as also highlighted by Thornton (2010).

Transboundary animal diseases have significant economic implications, affecting production costs, market prices, trade (both export and import), financial resources for disease control and monitoring, and preparedness for outbreaks (Otte et al., 2004). In this study, direct financial loss observed due to livestock mortalities was estimated at \$21,891.14, for the fourteen wards which recorded animal mortalities in the EMA-*i* system. Given that the livestock sector contributes approximately 18% to Tanzania's GDP (Mellau et al., 2011), implementing robust disease control measures is essential to mitigating the significant economic burden on the national economy.

Persistent threat of TADs in the traditional farming system within the study area underscores the need to assess the knowledge, attitude, and perception of livestock farmers regarding TADs and their control regimes. Understanding these factors will help identify the key drivers of disease endemicity and indicate any possible weaknesses in current control strategies. To ensure effectiveness, this process should be conducted through a participatory approach, fostering the development of a community-responsive control strategies of transboundary animal diseases.

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CONFLICT OF INTEREST

Authors do not have any conflict of interest

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