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Spatiotemporal epidemiology of Lumpy Skin Disease in Tanzania from 2018 to 2023

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Abstract

Lumpy Skin Disease (LSD) is a significant Trans-boundary Animal Disease (TAD) affecting cattle, whose causative agent is Capripoxvirus of family poxviridae. Despite its importance, there is limited information on its epidemiology in Tanzania. This study aimed to describe spatiotemporal epidemiological features of LSD in cattle from all 26 regions of Tanzania mainland from 2018 to 2023. Retrospective data on LSD cases in regions and districts obtained from the Ministry of Livestock and Fisheries were analysed using space-time scan statistics. The data were presented as spatial distribution maps at regional and district levels and temporal patterns as histograms. Between 2018 and 2023, 13,339 LSD cases were reported in the country. All 26 regions (100.0%) reported at least one case during this period. At the district level, LSD was reported in 83.0% (155 out of 185 in the country) of the district councils. The highest number of cases in regions were reported in Dodoma (2,287), Kagera (1,395), Iringa (1,040), and Mbeya (1,012). The lowest number of cases were reported in Shinyanga (109), Mtwara (107), Mwanza (69), Geita (67), Pwani (59), Simiyu (49), Lindi (30), and Dar es Salaam (2). The year with the highest number of LSD cases was 2021 (4,701), while the lowest number was 2018 (415). Although LSD cases were reported throughout the year, the highest number was observed from January to March. Cluster analysis identified six regional- and ten district-level distinct clusters of LSD cases. Arusha, Kilimanjaro, Iringa, and Mbeya regions were identified as the highest-risk clusters at the regional level. These findings suggest that LSD is endemic in Tanzania, occurring in all regions and most districts. The results provide a foundation for further investigation through active surveillance to determine the true prevalence and identify the risk factors contributing to its persistence. This information will be crucial for developing effective control measures in endemic hotspots.

Keywords: *Lumpy Skin Disease; Spatiotemporal epidemiology; Spatial analysis; space-time; cluster analysis; Tanzania*

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Introduction

Tanzania's national economy benefits greatly from the livestock sector since it offers a good source of animal protein, guarantees food security and is a dependable source of income, manure, drought animal power, and other socio-economic services. Products from livestock such as meat, milk, hides, and skin, have considerable contributed 13% to the Agricultural Gross

Domestic Product (GDP) and 7.0% to the National Gross Domestic Product (GDP) (ASSP II, 2022). According to the United Republic of Tanzania report (2021) and Ulega (2023), the livestock sector is growing at an annual rate of 5.0%. One of the main factors for the low contribution of the livestock sector to the economy is the high prevalence of diseases especially Trans-boundary diseases (TADs) including Lumpy Skin Disease (Gelaye & Lamien, 2019)

Lumpy Skin Disease is an important TADs of cattle, caused by a virus in the *Capripoxvirus* genus and *poxviridae* family (Tuppurainen *et al*., 2017). The disease also affects water buffaloes and other species of wild animals including antelopes and giraffes. Sheep and goats are not affected by LSD, but suffer from sheep and goat pox, respectively, which are caused strains of poxvirus, within the genus Capripoxvirus. LSD is mainly transmitted by blood-sucking vectors such as stable flies, mosquitoes (*Aedes aegyptii*), and hard ticks of the genera *Rhipicephalus* and *Amblyomma* (Sprygin *et al*., 2019). Uncontrolled movement of cattle contributes significantly to the spread of infection from one place to another due to the fact that the virus may spread by direct contact with the skin lesions, saliva, milk, nasal discharge, and semen of the infected animals (CFSPH, 2008). The disease affects cattle of all ages and breeds causing financial losses associated with reduced milk production, draft power loss, abortions, infertility, lameness, and damage to hides (CFSPH, 2008). The burden of LSD is high and commonly faced by poor individuals who rely heavily on livestock for their livelihoods.

According to (Azza & Ezzeldin, 2023) the disease is endemic in Sub-saharan Africa and Middle Eastern countries and has been reported to spread to other countries in South East and Southern Asia as well as Europe. In the eastern Africa region, LSD outbreaks have also been reported in Kenya and Uganda (Olaho-Mukani *et al*., 2019)

Currently, global efforts to control LSD have been challenged by the increasing trade in animals and animal products, other socio-economic factors, and ecological changes (Wong and Schipp, 2013). Domestic and wild animals share the disease, which could have an impact on the livestock industry and wildlife conservation (Tuppurainen *et al*., 2015). Seasonal fluctuations in the incidence of infectious diseases are common in both temperate and tropical regions which is attributed to changes in vector populations. Understanding the seasonal patterns of disease outbreaks is crucial for comprehending disease dynamics and developing more effective control strategies (Grassly and Fraser, 2006). Lumpy Skin Disease cases are prevalent during the rainy season when arthropod vector populations are abundant, whereas the incidence of LSD significantly decreases during the dry and cold seasons (Molla *et al*., 2017). The recurrence of the disease has consistently been linked to high rainfall, the emergence of large numbers of vectors, and low herd immunity (Molla *et al*., 2017).

Monitoring animal diseases is crucial for understanding a country's disease status. In Tanzania, surveillance is mainly passive due to limited diagnostic facilities, financial, and human resources, leading to disease reports based on clinical observations. The country has a structured Animal Health Surveillance system operating from community to national levels (Mremi *et al*., 2023). Due to limited information on spatiotemporal distribution of LSD in Tanzania, this study aimed to describe the spatiotemporal epidemiological features of LSD to aid policymakers in planning effective prevention and control measures.

Materials and Methods

Study area

The study focused on data from the national level to document spatial and temporal distribution of LSD cases in Tanzania. Tanzania is located in the eastern part of Africa, between latitudes 5.1094 and 11.7461 S and longitudes 29.3398 and 40.4432 E with an area of about 945,087 km^2. It is bordered by the Indian Ocean to the East, Rwanda, Burundi, and the Democratic Republic of the Congo to the West, Kenya and Uganda to the North, and Zambia, Malawi, and Mozambique to the South. The northern part of the country includes a considerable portion of Lake Victoria, which is shared with Kenya and Uganda. The country experiences temperatures ranging from 20°C to 30°C, with the hottest months typically from December to March. The country receives an average annual rainfall of about 550 mm to 1200 mm and is situated, on average, at an altitude of about 1018 m (3,609 ft) above sea level.

Currently, the country is divided into 26 regions,139 districts and 185 councils (URT,2021). Each district is further divided into divisions, which are subdivided into wards; each ward consists of several villages in rural areas and streets in urban areas.

Study design and Data collection

A retrospective study design was used to establish the spatial and temporal distribution of LSD in the country, using the weekly surveillance reports retrieved from the Ministry of Livestock and Fisheries from 2018 to 2023.

LSD cases were reported through a structured hierarchy starting from the village, they are escalated to the ward, then to the district, followed by the zonal level, and finally to the Ministry. In this study, a case was defined as an animal (cattle) displaying clinical signs or circular, firm, nodules varying from 1 to 7 cm in diameter characteristic of LSD, regardless of whether a laboratory confirmation was obtained. Because the exact locations of all affected areas were not documented, the geographic coordinates of each district were represented by the district's centroid. Variables retrieved included the number of cases reported, the population at risk, the number of deaths reported, dates when the case was observed and reported, and other variables such as region, district, ward, and villages.

Data analysis

Data were entered and coded in Microsoft Excel 2013, and analyzed for space-time scan statistics using SaTScan™ v10.1.2. SaTScan was employed for cluster detection and statistical inference. QGIS version 3.22.1 with GRASS 7.8.5 and shapefiles from DIVA GIS (Retrieved in January 2024) were used to create maps for the spatial distribution per region and district from 2018 to 2023. Additionally, graphs were generated to determine the trend of the cases and to determine cases per year. Relative risk was calculated by dividing the number of observed cases within a window by the number of expected cases across the study area. To estimate the expected number of cases, a standard population-based model was applied using the total population at risk within the region, adjusted for the size and density of cattle populations. The window with the highest log likelihood ratio (LLR) was identified as the most likely cluster. Scans were conducted to identify high-rate and low-rate areas, comparing the risk within a window to that outside. Centroids were evaluated as potentially affected locations, and the maximum possible size for spatial and/or temporal clusters was limited to 25% of the total at-risk population. Monte Carlo simulations (n = 999 permutations) were used to assess the significance of the detected clusters. Also, analysis of covariance (ANOCVA) was used to investigate the factors (region, number of cattle, average annual temperature, and average annual rainfall) determining the number of cases reported in the study.

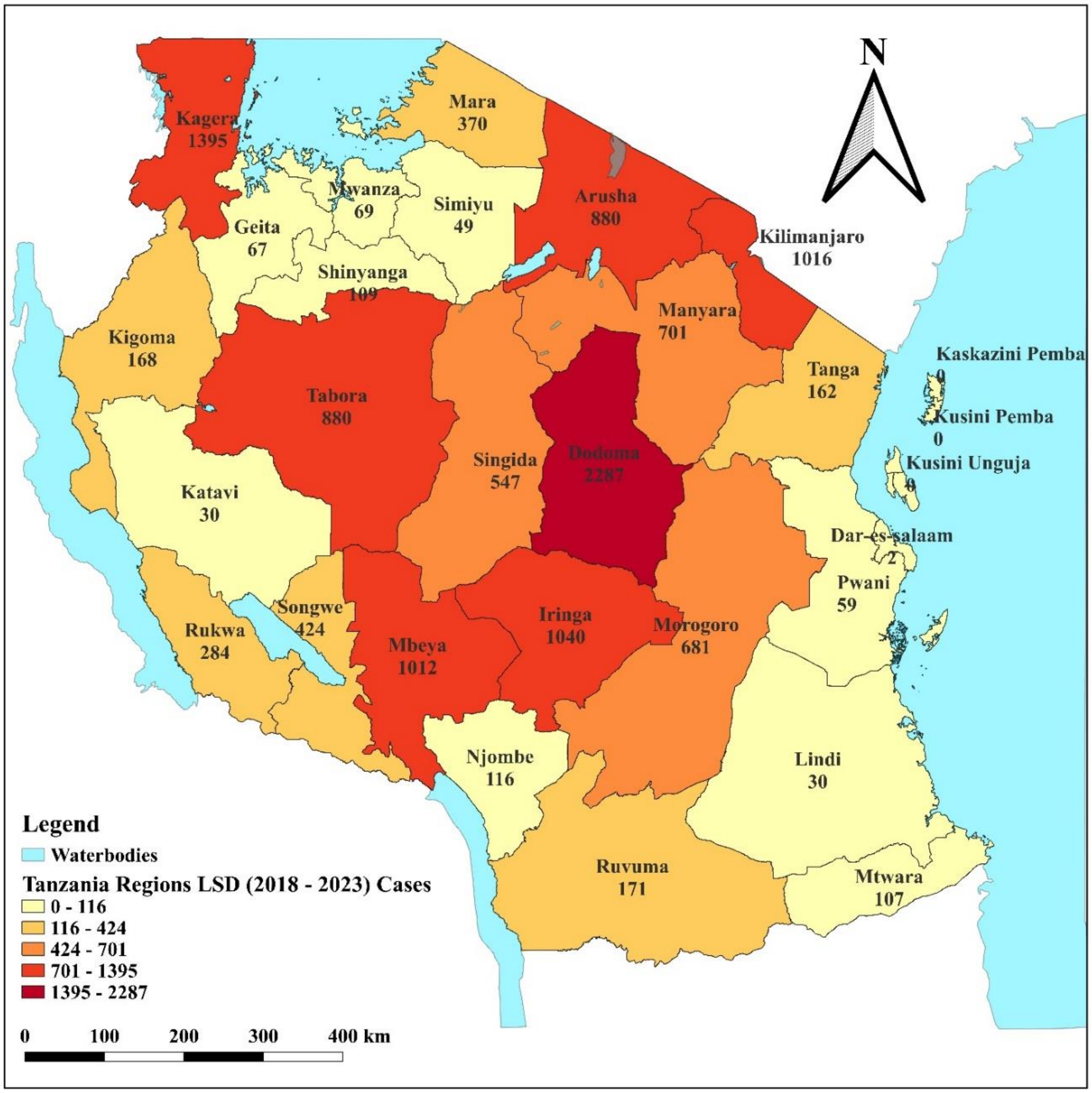
Results

Spatial distribution of LSD in Tanzania

A total of 13,339 LSD cases were reported in Tanzania between 2018 and 2023 from all 26 regions (100%) with at least one case reported during the study period. However, the cases were only reported in 155 (83%) out of the total 185 councils in the country. In regions the highest number of cases were reported in Dodoma (2,287), followed by Kagera (1,395), Iringa (1,040), Kilimanjaro (1,016), Mbeya (1,012), Arusha (880) and Tabora (880) and the lowest were reported in the South regions of Lindi (30) and Mtwara (107), Dar es Salaam (2), Pwani (59), Njombe (116), Katavi (30) and those situated along the Lake Victoria zone including Simiyu (49), Geita (67), Mwanza (69) and Shinyanga (109) regions **(Figure 1).**

Figure 1

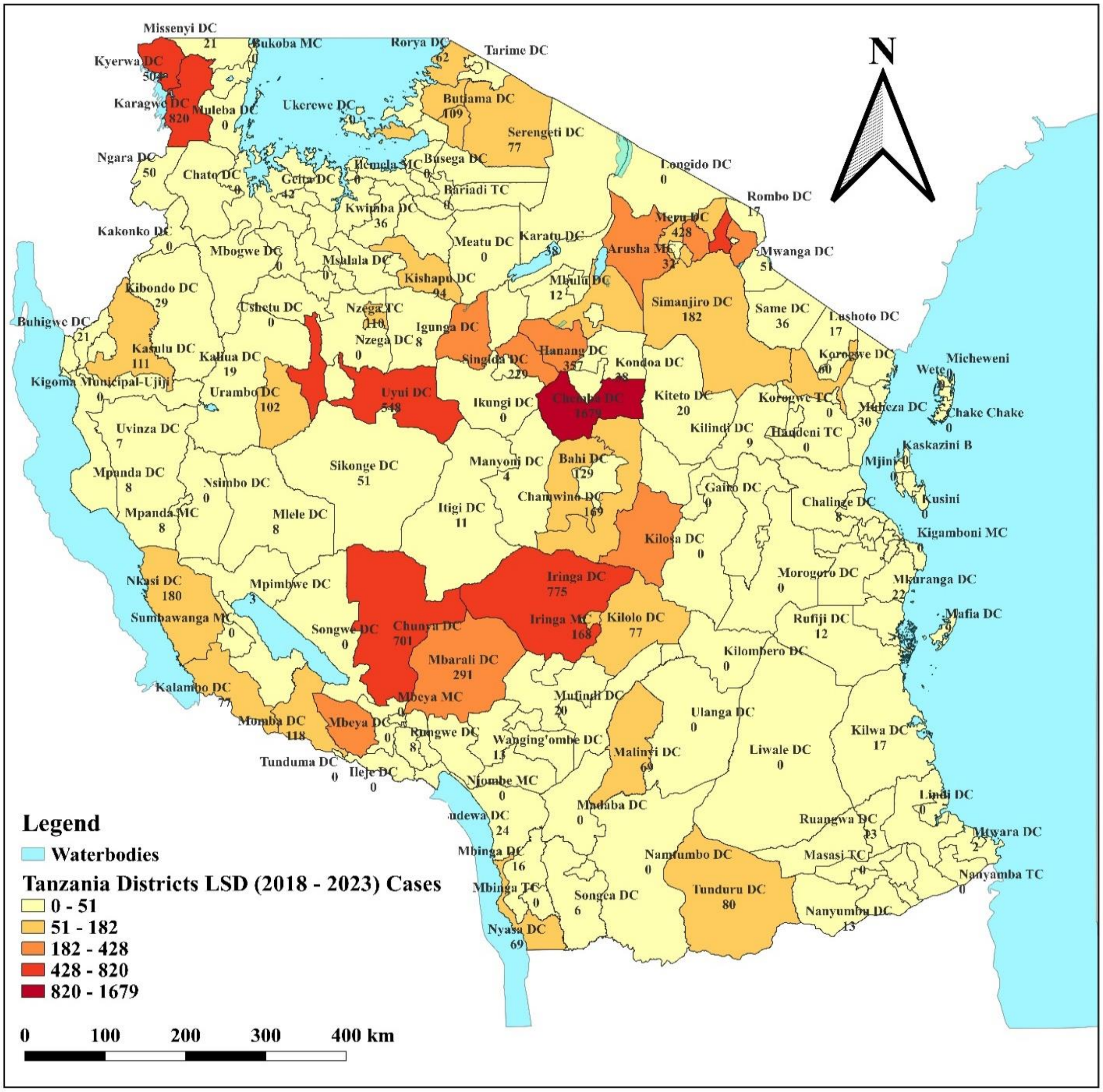
Map of Tanzania showing the total number of cases of Lumpy Skin Disease reported at regional level from 2018 to 2023.



At the district council (DC) level, highest LSD cases were reported from Chemba (1679), Karagwe (820), Iringa (775), Chunya (701), Uyui (548) and Kyerwa (504) (**Figure 2**).

Figure 2

Map of Tanzania showing spatial distribution of Lumpy Skin Disease cases at the district council level from 2018 to 2023.

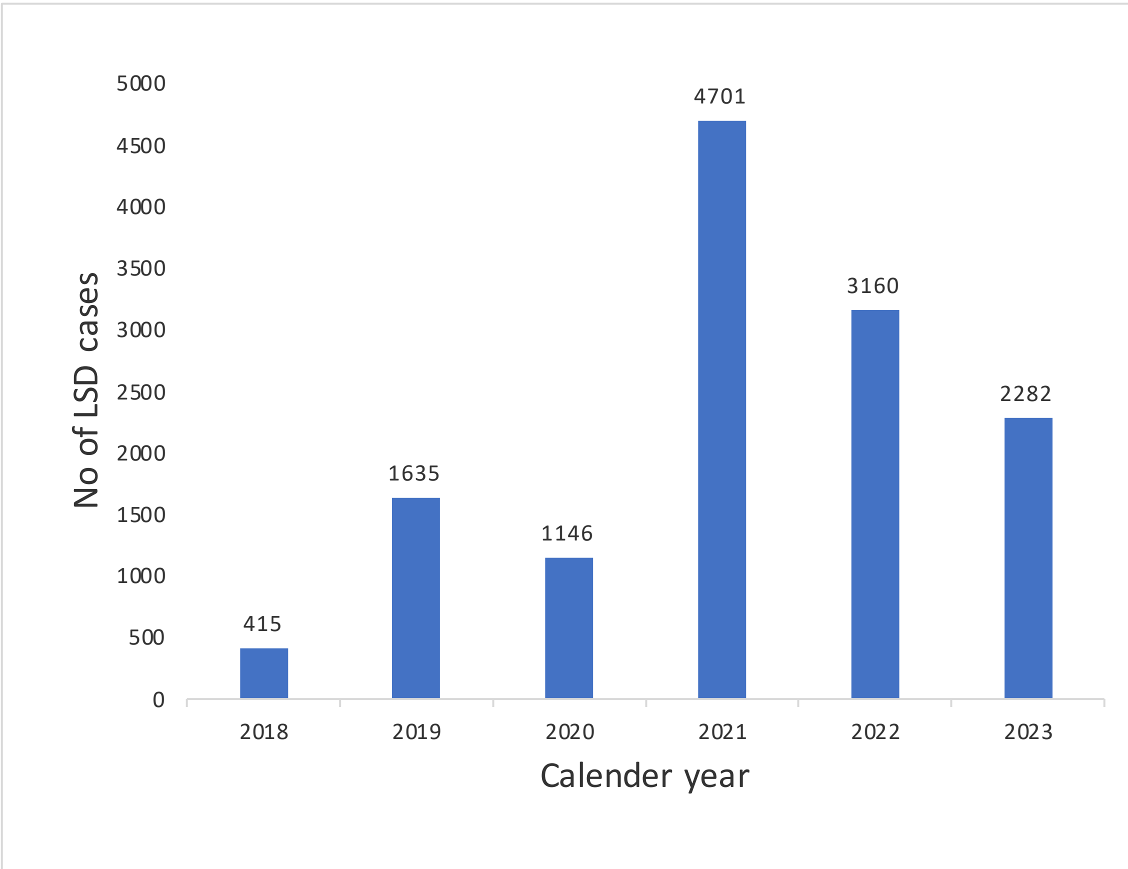


Temporal distribution of LSD in Tanzania

Results of temporal distribution analysis identified 2021 to be the year reported highest cases (4701) followed by 2022 (3160), 2023 (2282), 2019 (1635), 2020 (1146) and the lowest number of LSD cases were reported in 2018 (415) **(Figure 3)**. The number of cases of Lumpy Skin Disease reported monthly from January to December in cattle in Tanzania from 2018 to 2023 are shown in Figure 4. The cases were reported throughout the year but the highest number of cases were observed from January to March (rainy season) in average and dropped in May especially in year 2018 and 2019 (**Figure 4**).

Figure 3

Temporal distribution (in years) of Lumpy Skin Disease in Tanzania from 2018 to 2023



Spatiotemporal clusters of LSD detected

Six clusters were detected within the regions **(Table 1)**. Two clusters with high risk were located in the Northern highlands (Arusha and Kilimanjaro), and the other two clusters with high risk were located in the southern highland zones (one cluster in Iringa and one cluster in Mbeya region). On the other hand, one cluster with low risk was detected in the central zone (Dodoma region) and the lake zone (Kagera region).

Figure 4

The number of cases of Lumpy Skin Disease reported on a monthly based form January to December in cattle in Tanzania from 2018 to 2023.

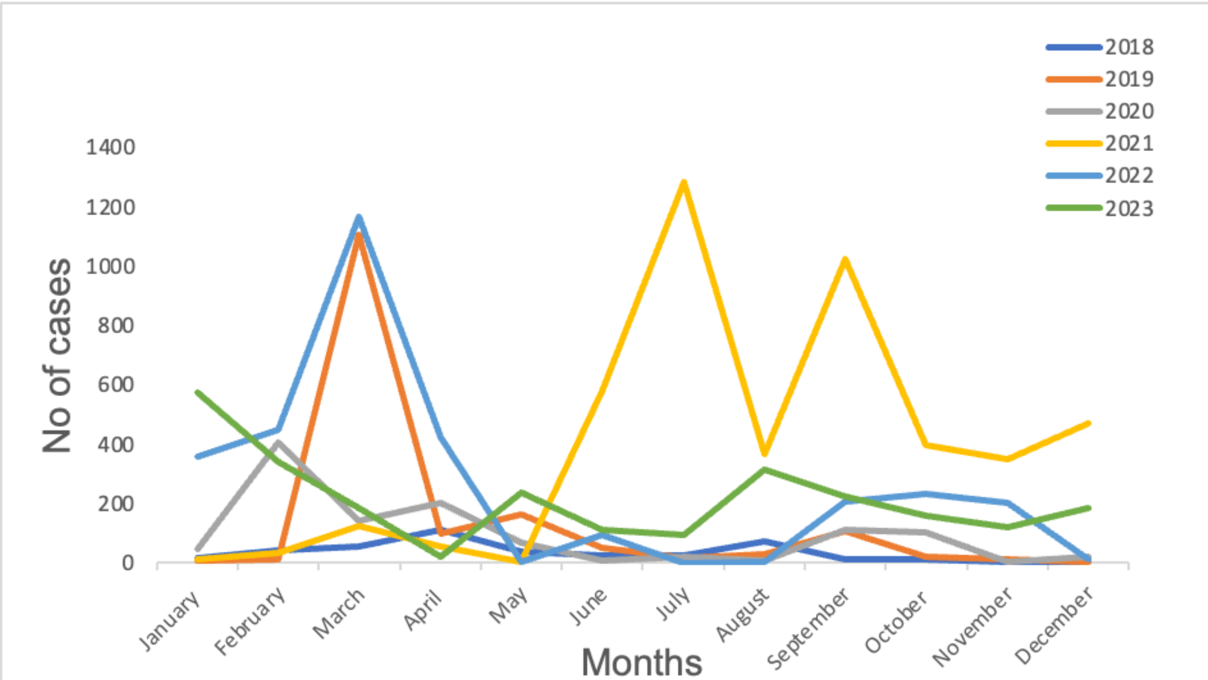


Table 1

SaTScan statistics for spatial temporal clusters detected in regions with significantly higher and lower incidence of LSD in Tanzania from 2018 to 2023

Clusters	Coordinates/radius	Timeframe	Number of cases	Expected cases	Relative risk	Loglikelihood ratio	P-value
Iringa (Cluster 1)	(9.052334 S, 36.613334 E) / 232.36 km	2019/3/1 to 2019/3/31	761	128.95	5.90	734.267782	< 0.001
Mbeya (Cluster 2)	(8.897832 S, 33.477380 E) / 130.82 km	2020/2/1 to 2020/12/31	631	105.59	5.98	613.238084	< 0.001
Kagera (Cluster 3)	(1.317135 S, 31.804956 E) / 266.63 km	2022/3/1 to 2023/1/31	1187	305.76	3.88	759.176357	< 0.001
Dodoma (Cluster 4)	(5.226486 S, 36.761577 E) / 176.93 km	2021/7/1 to 2022/1/31	1881	847.60	2.22	510.017375	< 0.001
Kilimanjaro (cluster 5)	(3.731624 S, 37.641787 E) / 96.01 km	2021/9/1 to 2021/9/30	516	85.98	6.00	501.703745	< 0.001

Arusha (cluster 6)	(2.672196 S, 35.494820 E) / 172.56 km	2023/8/1 to 2023/11/30	398	52.50	7.58	465.231662	< 0.001

Spatiotemporal cluster was observed in Arusha from August to November 2023 with relative risk of 7.58 while in Kilimanjaro a cluster was detected in September 2021 with a relative risk of 6.00. The cluster in Iringa was detected in March 2019 with a radius of 232.36 km and a relative risk of 5.90, while in Mbeya region cluster was detected in February to December 2020 with a radius of 130.82 km and a relative risk of 5.98. However, a cluster with low risk was detected in Dodoma region (central zone) with a radius of 176.93 km and a relative risk of 2.22.

Ten clusters were detected within district councils **(Table 2)**. Four clusters with high relative risk and two clusters with low risk. The first high-risk cluster was identified in Karatu, Mbulu, and Babati in April 2022, the cluster was the most at risk with a relative risk of 12.24 and a radius of 89.37 km. Another cluster was identified in Iringa DC in March 2019 with a radius of 0 km and a relative risk of 6,50, while the other cluster was detected in Chunya DC and others (within the same cluster) from February to December 2020 with a radius of 180.32 km and a relative risk of 6.37. Igunga and Iramba DC had one cluster which was identified in 2019 with a radius of 67.14 km and a relative risk of 6.19.

However, one low risk cluster was detected in Lushoto DC and others (within the same cluster) which was identified from January to December 2021 with a radius of 193.16 km and a relative risk of 0.15. The second low risk cluster was detected in Uyui DC and Tabora Urban from January to December 2019 with a radius of 55.90 km and a relative risk of 0.

Table 2

SaTScan statistics for spatial temporal clusters in districts/councils with significantly higher and lower incidence of LSD in Tanzania from 2018 to 2023

Cluster	Coordinates/radius	Timeframe	Number of cases	Expected cases	Relative risk	Log likelihood ratio	P-value
Iringa	(7.502077 S, 35.195316 E) / 0 km	2019/3/1 to 2019/3/31	761	117.06	6.50	796.569	< 0.001
Songwe, Chunya,Sumbawanga Sumbawanga Urban, Momba, Mbozi, Kalambo, Mbeya, Mbeya Urban, Mlele, Tunduma, Mbalali	(7.762238 S, 32.684240 E) / 180.32 km	2020/2/1 to 2020/12/31	683	107.22	6.37	701.584	< 0.001
Bukoba, Bukoba Urban, Misenyi, Muleba, Karagwe	(1.431518 S, 31.586198 E) / 65.36 km	2023/3/1 to 2023/3/31	822	198.98	4.13	558.025	< 0.001
Chemba	(5.258049 S, 35.666767 E) / 0 km	2021/7/1 to 2021/11/31	1614	704.74	2.29	461.695	< 0.001

Meru	(3.334993 S, 36.901088 E) / 0 km	2023/8/1 to 2023/11/31	409	79.21	5.16	345.770	< 0.001
Karatu, Mbulu, Babati, Babati urban and Mondulii	((3.552118 S, 35.434329 E) / 89.37 km	2022/4/1 to 2022/4/30	186	15.20	12.24	296.151	< 0.001
Igunga & Iramba	(4.343733 S, 33.687961 E) / 67.14 km	2019/4/1 to 2019/5/31	226	36.53	6.19	223.765	< 0.001
Hai	(3.289209 S, 37.200541 E) / 0 km	2021/9/1 to 2021/9/31	561	220.45	2.54	187.906	< 0.001
Lushoto, Korogwe, Mkinga, Korogwe Urban, Same, Muheza,Tanga Urban, Handeni, Handeni Mji, Pangani, Mwanga, Kilindi, Simanjiro, Moshi, Moshi Urban, Rombo	(4.549834 S, 38.440527 E) / 193.16 km	2021/1/1 to 2021/12/31	37	248.32	0.15	142.575	< 0.001
Uyui & Tabora Urban	(5.103366 S, 33.288096 E) / 55.90 km	2019/1/1 to 2019/12/31	0	82.12	0	82.378	< 0.001

Factors associated with the observed LSD cases in Tanzania
The result of covariance showed that only region was the significant determinant of these cases with p-value < 0.001 **(Table 3).**

Table 3

Analysis of covariance (ANCOVA) of LSD cases in Tanzania

Source of variation	Sum of squares	Df	Mean square	F-value	P-value
Region	67537.202	27	2501.378	3.674	0.000
Temperature	811.330	1	811.330	1.192	0.275
No of Cattle	686.787	1	686.787	1.009	0.315
Precipitation	170.435	1	170.435	.250	0.617

Error	965463.171	1418
	1162603.000	1449

Discussion

Results from the current study showed that cases of LSD were reported from all 26 regions and majority (83.0%), of the district councils in Tanzania during the period 2018 to 2023. To the best of our knowledge, no similar studies have previously been carried out in this subject in Tanzania, for comparison with the findings from our study. Spatial analysis has shown that the distribution of LSD cases varies from one area to another due to different factors like vector abundance and environmental conditions.

The highest number of cases were from Dodoma, Kagera, Southern highland zone (Mbeya and Iringa) and Northern zone (Arusha and Kilimanjaro). The possible reasons for the high number of cases in these regions could be the presence of suitable disease transmission environment including the presence of vectors in these regions. Dodoma region has many livestock markets, which increase animal movement and transportation of live animals from different places, which could facilitate the transmission of the LSD virus. This finding is in agreement with Motta *et al.* (2019) reported that livestock markets in diverse farming systems globally represent hotspots for the transmission and dispersal of multiple infectious diseases and can play critical roles in LSD outbreaks. Nevertheless, risk of infection is also high in areas with concentration of large numbers of animals in confined spaces where direct contact between infected and susceptible animals is high. This is similar to Ekwem *et al.* (2021), who reported the role of contact risk in systems where herds are mixed extensively and pointed out that wide spread movement and herd contact reflect potentially high disease transmission risks among traditionally managed livestock. However, inadequate biosecurity measures, such as overcrowding, inadequate sanitation, and lack of quarantine facilities, can also facilitate disease transmission within the market premises and surrounding areas.

Other regions with high LSD incidences (Kagera, Mbeya, Kilimanjaro, Iringa and Arusha region) experience relatively moderate to high rainfall that creates the breeding sites of the LSD vectors. This is in line with Molla *et al.*, (2017), who stated that the highest LSD incidences were in warm, moist highland areas and the lowest in hot, dry lowland areas. Another reason for increased cases in these regions might be cattle population and management systems. Large herds with a high number of animals increase the likelihood of LSD transmission due to increased contact rates between infected and susceptible individuals. Conditions such as densely stocked pastures elevate the risk of disease spread, particularly if infected animals are not promptly identified and isolated (Njenga *et al.*, 2020). Additionally, traditional livestock management practices, characterized by communal grazing, shared watering points, and limited veterinary services, may contribute to higher LSD cases (Muema *et al.*, 2022).

Lowest number of cases were reported in the Southern regions of Lindi and Mtwara as well as those situated along the Indian Ocean coastline including, Dar es Salaam and Pwani regions. Other regions which reported lowest number of cases were Njombe, Katavi and those situated along the Lake Victoria zone including Simiyu, Geita, Mwanza and Shinyanga regions. Possible explanation for southern regions and along the Indian coastline regions having fewer cases might be due to low number of cattle and improved management systems. Smaller herds with low number of cattle may experience fewer cases of LSD due to reduced opportunities for disease transmission because the likelihood of direct contact between infected and susceptible individual decrease which help to limit the spread of disease. This is supported (Muema *et al., 2022)* in Kenya who reported significant increase in disease among large herds compared to small herds. However, most of the cattle in these regions are improved breeds where modern management systems that prioritize biosecurity, disease prevention, and vaccination help reduce spread of disease within livestock populations. On the other hand, the reason for fewer cases reported in Katavi, Njombe, Shinyanga, Geita, Simiyu and Mwanza are not known, which necessitates a purposive investigation of these regions. Even so, the observed difference might be due to underreporting and a lack of staff with the ability to diagnose the diseases correctly, hence many cases go unobserved (Ochwo *et al*., 2018). Another reason might be that most of the pastoralists live in remote areas where communication and extension services are difficult so many cases are not reported.

Analysis of temporal distribution (in years) showed that many cases occurred during 2021, followed by 2022, 2023, 2019, 2020 and lastly 2018. A possible reason is that in late 2020, the Ministry of Livestock made improvements to the surveillance system by adding some variables that were missing in the previous system. This stimulated the spirit of reporting cases/events, that is why cases increased in 2021. In 2018, the cases seem to be very few because it was a transition period, switching from a purely paper-based surveillance system, which was collected on monthly basis, to a computer-based system collected on weekly basis. Also, there were missing data for year 2018 in some regions like Lindi, Mtwara, Mbeya and Morogoro, which may have caused a decrease in reported cases of that year. On another hand, according to Tanzania Meteorological Agency (TMA, 2022), in 2021, extreme weather events, particularly heavy rains and high temperatures, were reported. Additionally, the NDJFMA rainy season of 2020/2021 was ranked as the third wettest since 1970, receiving approximately 90 mm more rainfall than the long-term average. Based on this evidence, it's clear that 2021 maintained wet conditions in most parts of the country that supported propagation of the vectors. This is in line with Bekere *et al*. (2023), who stated that more incidences are observed in rain season when a wet and hot microclimate is maintained in the area. However, this trend could be due different factors like underreporting, reporting based on clinical sings, uncontrolled animal movement, herd immunity, management practices, the addition of new animals, the mixing of cattle at pasture and drinking areas, and the unrestricted transfer of animals, all of which contribute to the spread of LSD (Gari *et al*., 2010).

In this study, LSD occurred throughout the year, with cases reported in different months due to climate and high insect population dynamics. The LSD occurrence pattern revealed that the temporal distribution of the cases starts in January to March (during rains) and drops in May towards winter. Our findings seem to contradict with other studies in Ethiopia (Molla *et al*., 2017), which indicate that the number of LSD incidences peaks in October and decreases in May. However, they are supported by Gomo *et al*. (2017) in Zimbabwe, with specific reference to November having low cases. These differences may be attributed by different geographical zones in different countries, leading to variations in conducive environments that support vector growth.

A total of six spatiotemporal clusters in regions and ten clusters in Districts were detected. Four clusters in the regions and five clusters in districts had high relative risk, whereas one cluster in the regions and two clusters in the districts had low relative risk. Clusters with high relative risk indicates that these areas are at high risk of being infected with the disease than the areas with low relative risk (Sindato *et al*., 2014). A possible explanation for high-risk areas might be driven by climate and the presence of wetland in these areas. The climate in most of these areas is moist and humid through the year, with small seasonal temperature differences. These conditions are known to sustain vectors, which aligns with Ochwo *et al*. (2018), who found that moist and humid climatic conditions increased incidences in Kalangala district in Uganda. Additionally, most of the clusters had the radius above 0 km, indicating that the clusters included areas beyond the primary cluster. Possible reasons could be the close proximity between regions and districts, the sharing of water and grazing area (communal grazing), and the movement of herds from one place to another in search of pasture and water. This movement may lead to high risk of disease transmission within and outside the area, thereby increasing the aggregation of cases (clusters) (Molla *et al*., 2017).

We investigated the factors that have contributed to the number of cases observed, and the results showed that only the region was a significant determinant of these cases ($p<0.001$). This is contrary to the study by Ardestani and Mokhtari (2020), who reported that precipitation of coldest season, isothermality and mean annual temperature were the major factors influencing the spatial occurrence of the disease. A possible reason for this difference is that the author did not consider locality/origin in their analysis, and localities always differ in environmental factors that support the survival of biting insects that mechanically transmit Lumpy Skin Disease virus. For example, the environmental factors in the southern highland regions are different from those in the eastern regions, hence the difference in vector abundance. However, much evidence shows that the disease is more related to weather conditions like temperature and humidity, which vary between regions (Abera *et al.,* 2015; Molla *et al.*, 2017).

This study encountered some limitations: poor surveillance systems characterized by different reporting methods and inadequate electronic database systems and reporting bias such as under-reporting, which leads to the overlooking of some potential events. Furthermore, inadequate laboratories for diagnosis pose constraints on livestock disease research because all cases reported are based on clinical signs, which might lead to false positive cases. Also, the reporting system was based on councils rather than districts. This is because the responsible personnel for reporting are under the District Executives Directors (DED's) office and not the District Commissioners (DC's) office. It is important to note that some districts contain more than one council, which makes it difficult to report at the district level and instead necessitates reporting at the council level.

Conclusion

This study establishes that LSD is endemic in Tanzania, occurring in all regions and most districts in the country according to season variations and vector population abundance. Dodoma, Kagera, Iringa, Kilimanjaro, Mbeya, Arusha, and Tabora were the leading regions with the highest cases from 2018 to 2023, with Arusha, Kilimanjaro, Mbeya and Iringa proven to be high-risk areas in Tanzania. Our findings establish a baseline for further research using active surveillance to determine the true prevalence of the disease and identify the risk factors contributing to its persistence. This information will guide the development of appropriate control measures in endemic hotspots.

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