# Spatiotemporal Distribution of Foot and Mouth Disease in Southern Highlands of Tanzania: A Five-Year Retrospective Analysis (2019 – 2023)

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# Spatiotemporal Distribution of Foot and Mouth Disease in Southern Highlands of Tanzania: A Five-Year Retrospective Analysis (2019 – 2023)

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## ABSTRACT

A retrospective study was conducted to determine the Spatial and temporal distribution of Foot and Mouth Disease in the Southern Highland Zone Tanzania. The present study used data from archived information of animal disease surveillance reports in form of weekly reports submitted to the Zonal Office from Local Government Authorities (LGAs) for the past five years from January 2019 to December 2023. The present study found that out of 31 Local Government Authorities (LGAs) in the Southern Highland Zone 26 reported the disease in the past five years. Moreover, 25,60 6 cases, and 389 deaths were reported. Therefore, 5.3%, 1.7%, and 0.1% were reported as FMD prevalence, case fatality rate, and mortality rate, respectively. It was also revealed that there was a clear temporal pattern of FMD occurrence, with more cases being reported between January and April which is the rainy season. In conclusion, FMD is a seasonal problem in Southern Highland Zone Tanzania, Therefore Strategic vaccination of animals should start at least a month prior to the onset rainy season to ensure immunity against the virus, together with restrictions on animal movements during rainy season and farmers have to be aware about the risk of unrestricted animal movement.

***Key words;*** *Prevalence, Foot and mouth disease, Southern Highland Zone, Tanzania*

## INTRODUCTION

Animal production is one of the important agricultural activities for most rural communities in Tanzania. The sub-sector provides multitudes of services including quality protein in form of meat and milk and source of money. Tanzania ranks third in Africa in the richness of livestock resources having a population of 37.9 Million, cattle, 27.6 Goats, 9.4 Sheep and 3.9 Pigs However, the contribution of livestock sector to the National GDP is only 6.7%(URT, 2024). The optimum utilization of these resources is below its potential and is known to be limited by numerous factors including diseases which leads into production and economic losses due to morbidity, mortalities and costs associated with treatment and management of sick animals during the course of the disease outbreak. (Knip, 2004).

Foot and Mouth Disease (FMD) is one of the most important animal diseases hindering livestock production in Tanzania. It is among the highly contagious viral diseases of livestock that has significant economic impact. The disease causes highly morbidity, some mortality with great loss of production and restriction of cross-border livestock and livestock products trade activities. FMD affects all cloven-hooved animals both domestic and wild ungulates such as cattle, swine, sheep, goats buffalo, antelope, zebra and Wilder-beasts (Jamal and Belsham, 2018).The infection results in vesicular lesions in and around the mouth and on the feet, resulting in the reluctance of an animal to eat or move. Sometimes the lesion extends to animal udder resulting into mastitis with tremendous drop in milk production and permanent teat lesions (Azeem *et al*., 2020).

FMD is caused by the Foot and mouth disease virus (FMDV) of the genus *Apthovirus* of family *Picornaviridae* (Carrillo *et al.*, 2005*;* OIE Terrestrial Manual, 2009). There are seven distinct recognized FMDV serotypes (A, O, C, SAT1, SAT 2, SAT 3, and Asia 1) with different global distribution. Serotype A and O occurs in Africa, Asia and South America marking the broadest distribution among the seven serotypes. SAT 1, 2 and 3 serotypes are restricted to Africa whereas Asia 1 serotype is restricted to Asia. Each serotype is known to have several strains with incomplete cross-protection which jeopardizes its prevention and control via vaccination(Brito *et al*., 2017). FMD infection is transmitted via direct contact with infected animals or indirect contact with secretions or excretions from infected

animals or by mechanical vectors e.g. people, clothing, equipment and vehicles.

FMD is globally distributed affecting all continents. Few developed countries managed to eradicated FMD and uses enormous resources to maintain the status in terms of disease surveillance and response, laboratory diagnosis and quarantine (Knight-jones and Rushton, 2013). However, the disease is endemic in many Middle income and developing countries of Africa and Asia. Tanzania diagnosed FMD for the first time in 1927 in Arusha region and Kahama district in Shinyanga region and since then the disease has never been eradicated and is endemic in the country (Kivaria, 2003; Chibunda *et al*., 2006) . Four serotypes (A, O, SAT 1 and SAT 2) are common in Tanzania FMD outbreaks (Genchwere and Kasanga, 2014). The study aimed to assess the spatial and temporal distribution of Foot and Mouth Disease (FMD) cases in Southern High Zone from 2019 – 2023

## MATERIALS AND METHODS

### Study Area

This study was conducted in Southern Highland Zone (SHZ) of Tanzania. The zone consists of five (5) administrative regions which are Iringa, Mbeya, Njombe, Ruvuma and Songwe and with thirty one (31) Local Government Authorities (LGAs). These regions are characterized by diverse agro-ecological zones varying in climates. Livestock husbandry is mainly characterized by extensive farming system in which animals are allowed to graze freely during day time and housed only during night time. A zone has animal population of Approximate 1,933,447 Cattle; 942,322 Goats; 217,685 Sheep; 602,201 Pigs; and 30,740 Donkeys (Zvc Iringa, 2024)

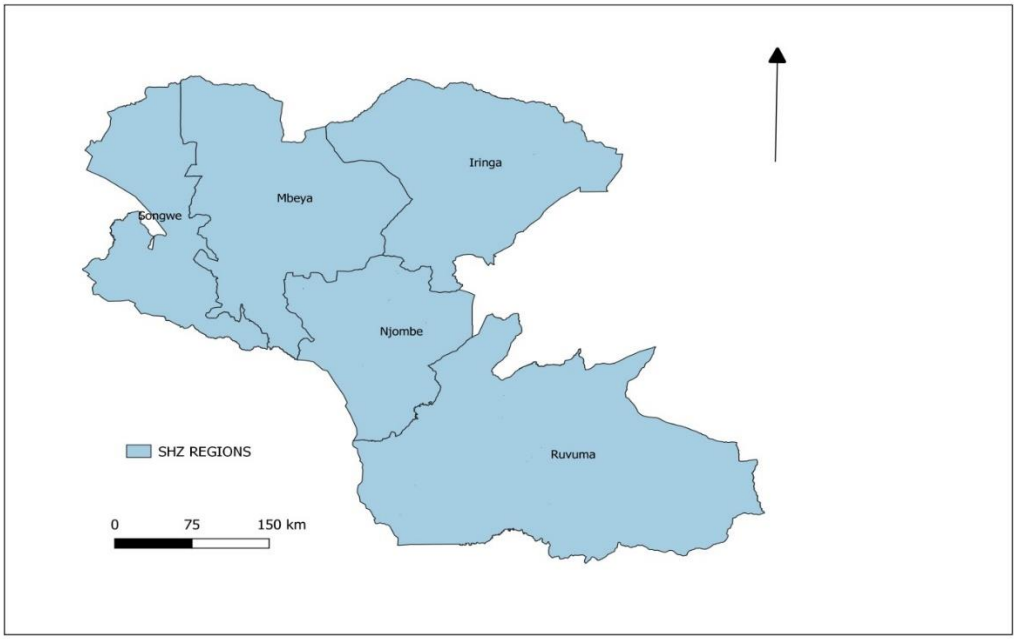


***Figure 1:*** *Southern Highland Zone regions.*

**Study Design**

A repeated cross-sectional study design was employed in this study. Animal disease surveillance reports data from LGAs for the past five years from January 2019 to December 2023 were retrospectively retrieved. The key variables retrieved were FMD case reports, the population at risk, Mortality, LGA name, and observation date.

**Data Analysis and Management**

The data retrieved and extracted were managed and analyzed in Microsoft Excel 2010. A descriptive statistic was used to compute FMD prevalence, mortality rate, case fatality and in determining FMD trends. The prevalence of FMD was calculated using the Prevalence formula (P: n//N), where P is the prevalence, n is the number of sick animals in a specific place and at a specific time, and N is the population at risk at the same time(Joffe *et al*., 2011). Mortality was calculated by dividing the number of cattle that died during the referenced period by the population at risk over the same period(Chaudhary *et al*., 2013). Case fatality was estimated by dividing the number of animals died from FMD by the number of cases(Ghani *et al*., 2005). Quantum Geographical Information System (QGIS) software was used to generate maps which

demonstrated the geographical distribution of FMD incidents in the SHZ.

## RESULTS

### Descriptive results

During the period of five years from January 2019 to December 2023, a total of 25,606 FMD cases and 389 animal deaths were recorded from all five regions of SHZ. Of the recorded FMD cases, 21399 were from cattle, 1221, sheep and goats, and 32 pigs. There were a variable number of FMD cases recorded in different years. More FMD cases were recorded in year 2020 and the lowest in year 2022 with annual average of 4530.8 FMD cases. It was observed that for the five years of study Iringa region recorded more cases whereas Songwe region had fewer cases.

**Table 1**. The number of Foot and Mouth Disease cases and deaths reported in Southern Highland Zone Tanzania from 2019 to 2023

| Year | Affected Districts | Population at Risk | Cases | Deaths |
|---|---|---|---|---|
| 2019 | 10 | 0 | 5723 | 6 |
| 2020 | 30 | 14158 | 8036 | 159 |
| 2021 | 23 | 192810 | 3644 | 52 |
| 2022 | 26 | 9482 | 422 | 2 |
| 2023 | 19 | 206045 | 4829 | 170 |
| **Total** | | **422495** | **22654** | **389** |

### Prevalence of Foot and Mouth Disease

In total of 26 out of 31 LGAs reported the disease in the past five years. The overall prevalence of FMD was 5.3% (22343/422110) ranging from 0% in Njombe District council to 66.7% in Madaba DC. The mortality rate was recorded at 0.1% (387/422110), while case fatality was 1.7% (387/22343). (See table 02).

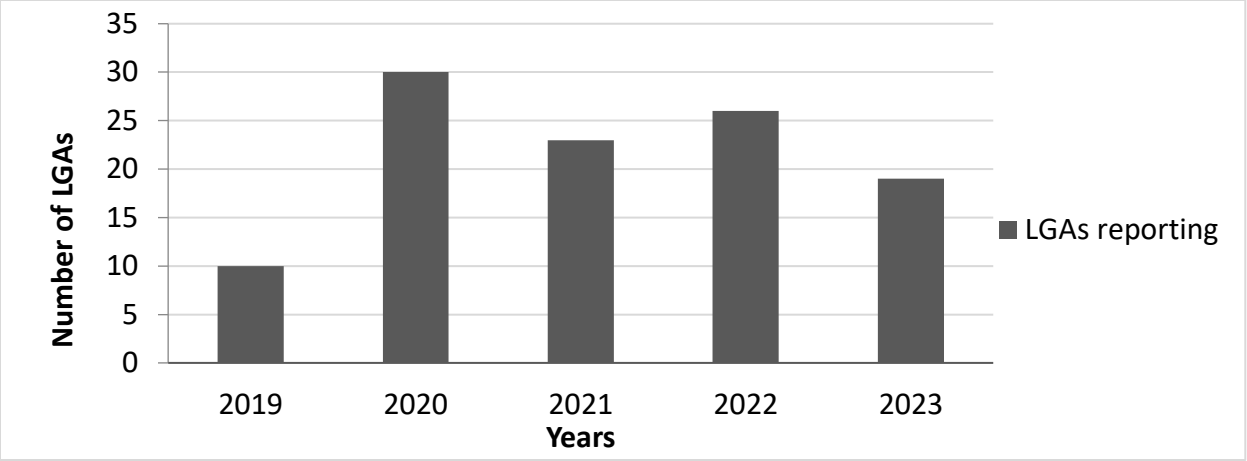


**Figure 2:** Number of LGAs reporting FMD Cases from 2019 to 2023

**Table 2**. Distribution of FMD cases in districts of the SHZ Tanzania from 2019 to 2023

| District | Population at risk | Number of FMD cases | Mortality | Prevalence (%) | Case fatality (%) |
|---|---|---|---|---|---|
| Iringa DC | 5087 | 1622 | 9 | 31.9 | 0.6 |
| Iringa MC | 8408 | 199 | 14 | 2.4 | 7.0 |
| Kilolo DC | 3380 | 1191 | 20 | 35.3 | 1.7 |
| Mafinga TC | 731 | 282 | 2 | 38.6 | 0.7 |
| Mbarali DC | 6161 | 2252 | 16 | 36.6 | 0.7 |
| Momba DC | 15115 | 5615 | 60 | 37.1 | 1.1 |
| Mufindi DC | 61252 | 5758 | 11 | 9.4 | 0.1 |
| Njombe DC | 0 | 149 | 0 | 0 | 0 |
| Njombe TC | 1125 | 2187 | 2 | 194.4 | 0.1 |
| Songwe DC | 27200 | 134 | 9 | 0.5 | 6.7 |
| Busokelo DC | 289 | 31 | 0 | 10.7 | 0 |
| Chunya DC | 274210 | 1417 | 15 | 0.5 | 1.1 |
| Ludewa DC | 2514 | 7 | 0 | 0.3 | 0 |
| Makambako TC | 13875 | 872 | 164 | 6.3 | 18.8 |
| Makete DC | 1024 | 42 | 0 | 4.1 | 0 |
| Mbeya City | 140 | 43 | 0 | 30.7 | 0 |
| Mbeya DC | 122 | 23 | 0 | 18.9 | 0 |
| Mbinga DC | 82 | 24 | 1 | 28.6 | 4.2 |
| Rungwe DC | 955 | 126 | 40 | 13.2 | 31.7 |
| Songea DC | 366 | 146 | 10 | 39.9 | 6.8 |
| Songea MC | 261 | 7 | 5 | 2.7 | 71.4 |
| Tunduma TC | 478 | 7 | 0 | 1.5 | 0 |
| Tunduru DC | 1594 | 124 | 0 | 7.8 | 0 |
| Mbozi DC | 866 | 71 | 2 | 8.2 | 2.8 |
| Ileje DC | 18 | 2 | 0 | 11.1 | 0 |
| Madaba DC | 18 | 12 | 7 | 66.7 | 58.3 |
| **Total/Average** | **422110** | **22343** | **387** | **5.3%** | **1.7%** |

**Trends and distribution of FMD in Southern Highland Zone**

The temporal and spatial pattern of the FMD over the five years is shown in Figure 2 and Figure 3. The disease has been reported in all five years with varying number of incidents or cases. More FMD cases were recorded in year 2020 and the lowest in year 2022 with annual average of 4530.8 FMD cases. Only five (16%) LGAs (Namtumbo District Council, Kyela District Council, Nyasa District Council, Mbinga Town Council and Wanging'ombe District Council didn't report any FMD outbreak for the five years period indicating that the disease is distributed almost throughout the zone. Moreover more FMD outbreaks were observed between January and April in every year.

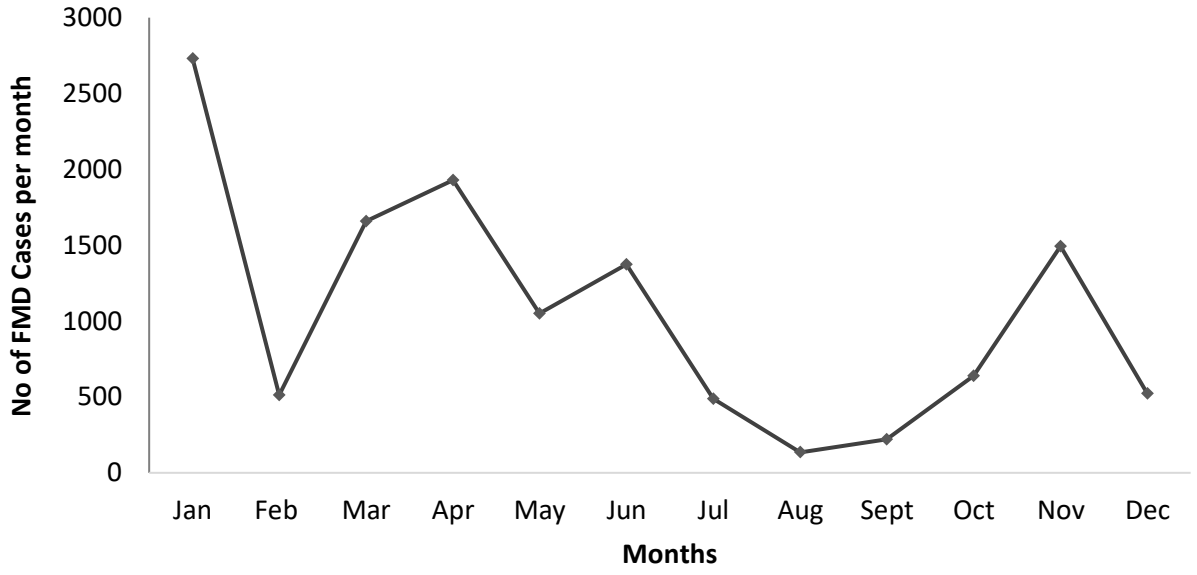


**Figure 3**. Temporal distribution of Foot and Mouth Disease cases reported in Southern Highland Zone from 2019 to 2023

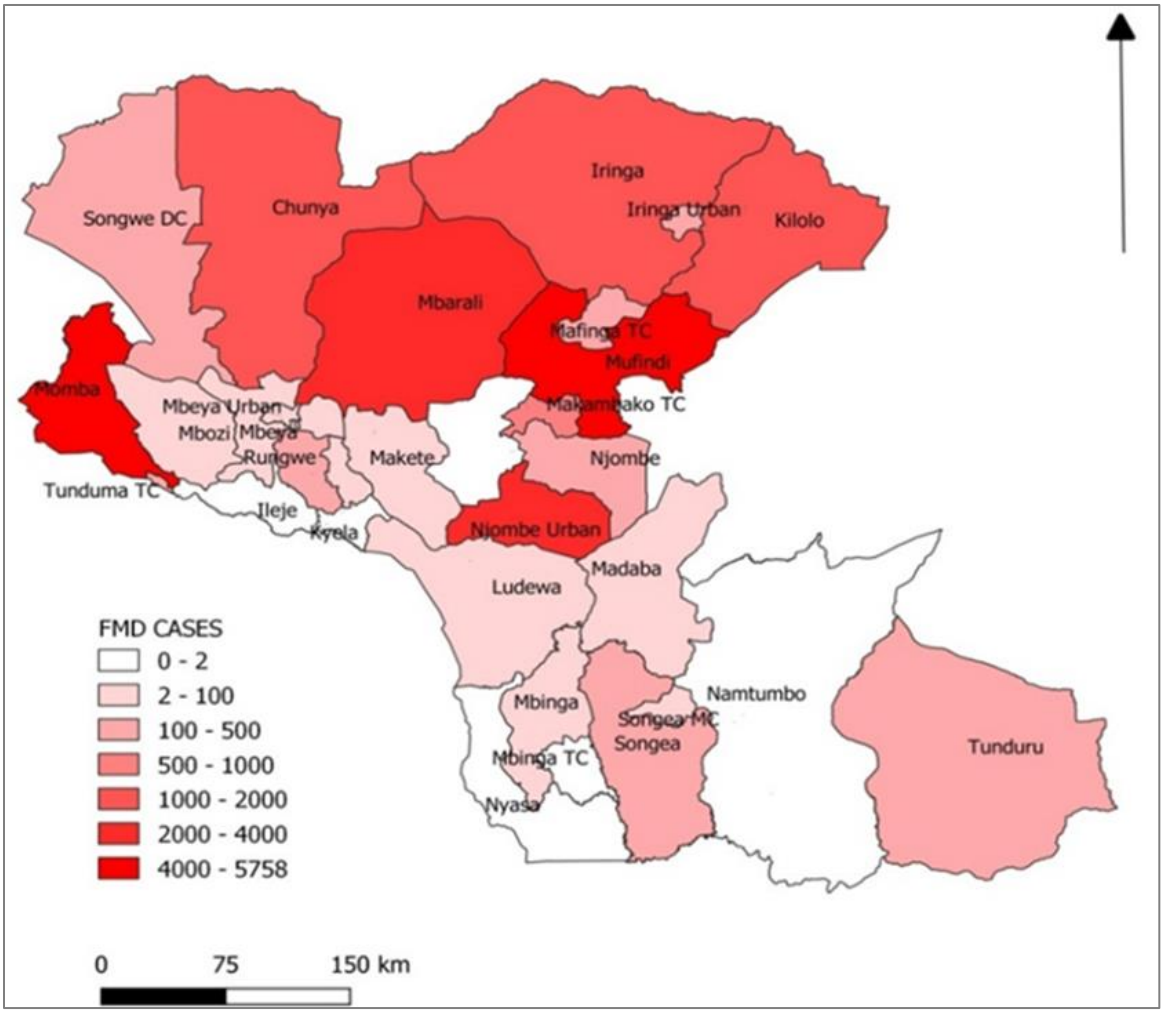


**Figure 4**. Spatial distribution of FMD cases in Southern Highland Zone from 2019 – 2023 (Source; TVLA, SHZ)

## DISCUSSION

The study shows that FMD is endemic and widely spread throughout all five regions of the Southern Highland Zone. The disease is of high economic importance, especially to countries that have an intensive animal industry (Mwiine *et al*., 2010). The overall prevalence, mortality, and case fatality of FMD in this study was 5.3% (22343/422110), 0.1% (387/422110) and 1.7% (387/22343) respectively. This low prevalence, mortality, and case fatality rate could be due to the endemicity of the disease or under-reporting of LGAs. Hence, few FMD cases and deaths were reported to the Zonal office. The present

study demonstrated that a total of 26 LGAs reported FMD in Southern Highland Zone in the past five years except Namtumbo DC, Kyela DC, Nyasa DC, Mbinga TC and Wanging'ombe DC which did not report this disease for the entire period of the past five years. The possible reasons why these five LGAs did not report the FMD cases while other 26 LGAs were reported, could be that some LGAs with good technical veterinary professionals were effective compared to others, that they had good reporting tendencies than others. Therefore, it looks like some LGAs have more FMD cases than others. Also understaffing could be another challenge which causes these five LGAs not to report FMD cases for the entire period of the past five years also to have under report in some LGAs.

The results indicated that the temporal pattern of FMD outbreaks in the Southern Highland Zone, with more FMD outbreaks reported between January (the rainy season) and the low in August (the dry season). The variation of FMD outbreak in season might be related to the animal movements during grazing due to the availability of plenty pastures and water. Many herds of animals meet at such places, thereby hastening the spread of infection from one herd to another. The possibility of decreasing outbreak reporting rate by the districts cannot also be ruled out. Therefore, it requires further study to conclude that the long-term trend of the disease is decreasing and to know the reason of the decreasing trend. However, despite the imposed quarantines and regular vaccinations in the Southern Highland Zone FMD outbreaks are still frequent. This may be the result of resistance by some residents and leaders to impose quarantines for economic and political reasons.

The study showed that FMD is endemic in Southern Highland Zone and more FMD cases reported during rainy season. Also, the study showed that seasonal movement of Livestock especially during rainy season accelerates the spread of FMD in Southern Highland Zone. The study also revealed that FMD has not spread in all 31 LGAs. Local Government Authorities (LGAs) should ensure strategic vaccination done before the onset of rainy season to ensure immunity against the virus. Also further studies should be done to find out other factors that caused 5 LGAs not to report FMD cases in all 5 consecutive years despite of being surrounded by LGAs that have FMD cases.

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