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A Retrospective Study on Foot and Mouth Disease Outbreaks and Vaccination during 2017-2023, North Shewa, Ethiopia

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ABSTRACT

Foot-and-mouth disease (FMD) is a highly contagious viral disease that reduces livestock productivity in Ethiopia. The present study aimed to assess the spatial and temporal patterns of FMD outbreaks and associated morbidity, mortality, case-fatality rates, and vaccination coverage in the North Shewa Zone from 2017 to 2023. Data were collected from the Disease Outbreak and Vaccination Activities Reports (DOVAR) of the North Shewa Zone Livestock Office and analyzed using descriptive statistics. A total of 162 outbreaks were recorded across 24 districts and 374 peasant associations (PAs) over the study period, resulting in an overall outbreak proportion of 43.4% (162/374 PAs), with considerable variation between years. The highest number of outbreaks was recorded in 2023 (30.9%), followed by 2021 (22.2%), while the lowest was in 2020. Overall, there were 5,246 recorded FMD cases and 67 deaths among 269,704 cattle at risk, yielding morbidity, mortality, and case-fatality rates of 1.95%, 0.02%, and 1.28%, respectively. Outbreak occurrence differed by season, peaking in the dry season (October to January) at 57% and reaching its lowest in the rainy season (June to September) at 21%. Morbidity and mortality were highest in the dry season (3.05% and 0.05%, respectively). Outbreaks and cases were unevenly distributed across districts, with BassonaWorana, Midda, and Menz-Gera reporting the highest outbreak frequencies, while Merhabet and Siyadeber exhibited relatively higher morbidity rates relative to their cattle populations. Over the seven years, vaccine coverage was limited, reaching only 12.3% of the at-risk population. Years with a high incidence of FMD were generally correlated with low vaccination coverage. Endemic FMD across the North Shewa Zone, along with increasing outbreaks, dry-season peaks, district hotspots, and inadequate vaccination coverage, highlighted FMD as a significant obstacle to livestock productivity. The results indicated the critical need for targeted vaccination programs and strengthened control strategies, particularly in high-risk districts.

Keywords: Epidemiology, Foot and mouth disease, Morbidity, Mortality, Outbreak, Vaccination

INTRODUCTION

Ethiopia has the largest livestock population in Africa, with approximately 70 million cattle, 42.9 million sheep, and 52.5 million goats (Legesse et al., 2023). The Amhara Region alone accounts for about 16.4 million cattle, while the North Shewa Zone of Ethiopia has an estimated 1.7 million cattle (North Shewa Livestock Office, 2022/23). The livestock sector plays a significant role in the country's economy, contributing roughly 45% of agricultural gross domestic product (GDP), about 19% of total national GDP, and between 16% and 19% of foreign exchange earnings (Seifu et al., 2023). In addition to its economic benefits, livestock serves as a vital source of high-quality protein and provides essential industrial raw materials, including milk, meat, hides, and skins (Countryman et al., 2024; Getiso and Mijena, 2024).

Despite the substantial economic and nutritional contributions of the livestock sector, its productivity and market potential are considerably hindered by transboundary animal diseases (TADs), which restrict the movement and export of animals and animal products, thereby restricting Ethiopia's participation in profitable international markets (Jemberu et al., 2016; Shapiro et al., 2017). Among TADs, foot-and-mouth disease (FMD) is particularly important due to its highly contagious nature, widespread distribution, and substantial socioeconomic impacts. Foot-and-mouth disease is caused by the foot-and-mouth disease virus (FMDV), a member of the *Picornaviridae* family. The virus has seven immunologically distinct serotypes, including O, A, C, Asia-1, Southern African Territories (SAT)-1, SAT-2, and SAT-3, none of which confer cross-protective immunity (Sangula et al., 2010; Chestley et al., 2022). In Ethiopia, five serotypes, O, A, C, SAT-1, and SAT-2, have been identified. Among these, serotypes O, A, SAT-1, and SAT-2 continue to cause recurring outbreaks (Jemberu et al., 2016; Seyoum and Tora, 2023).

Foot-and-mouth disease is characterized by very high morbidity (up to 100% in susceptible herds), while mortality in adult animals is generally low (1-5%); however, mortality in young animals may reach or exceed 20%, often due to acute myocarditis (WOAH, 2023). In addition to mortality, FMD leads to substantial production losses, including

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reduced milk yield, abortion, and decreased fertility, thereby severely affecting household livelihoods and national productivity.

Transmission occurs through direct contact, aerosols, fomites, animal products, and mechanical vectors, with the virus shed in nearly all bodily secretions and excretions, including saliva, milk, semen, and exhaled air, facilitating rapid spread within and between herds (WOAH, 2023). Although diagnosis is often based on clinical signs, laboratory confirmation is essential for accurate serotype identification. There is no specific treatment for FMD; therefore, control relies on movement restrictions, quarantine, strategic vaccination, surveillance, and biosecurity measures rather than slaughter policies, which are economically unfeasible in Ethiopia (Jemberu et al., 2014; Zewdie et al., 2023). However, inconsistent vaccine supply, limited vaccine strain matching, and weak coordination continue to undermine effective and sustainable disease control efforts (Jemberu et al., 2016; Tesfaye et al., 2020).

The North Shewa Zone of the Amhara Region of Ethiopia is at high risk for FMD outbreaks due to different well-established epidemiological risk factors, including a large livestock population, communal grazing systems, frequent animal movements through markets, shared watering points, and low vaccination coverage (Zewdie et al., 2023). Such conditions are known to facilitate the introduction, transmission, and persistence of FMD within endemic settings by increasing contact rates among susceptible and infected animals and enabling virus circulation across herds and locations (Woldemariyam et al., 2022). The present study aimed to assess the temporal and spatial trends of FMD outbreaks in domestic ruminants in North Shewa Zone, Amhara Region, Ethiopia, from 2017 to 2023.

MATERIAL AND METHODS

Ethical approval

The present study was based on a retrospective analysis of secondary surveillance and vaccination data obtained from the North Shewa Zone Animal Health Office. The data were aggregated at the peasant association (PA) and district levels and did not include individual animal identifiers or personal information. As the study did not involve experimental investigations on animals or human participants, formal ethical approval from an institutional review board or ethics committee was not required. Permission to access and use the data for study and publication purposes was obtained from the relevant authorities.

Study location

The present study was conducted in the North Shewa Zone of the Amhara Region, Ethiopia, located 130 km northeast of Addis Ababa. The zone encompasses 24 districts and includes 374 peasant associations. The area is geographically located at approximately 9˚46′8.4″ N latitude and 39°40′4.8″ E longitude (Figure 1). North Shewa is bordered by multiple administrative regions, including the south and southeast by the North Shewa and East Shewa zones of the Oromia Region; to the west, north, and northeast by the East Gojjam Zone, South Wollo Zone, and the Oromia Special Zone of the Amhara Region, respectively. To the east, the zone is bordered by the Afar region. Topographically, the zone ranges from 1500 m in the lowland to over 3000 m in the highland. The differences in topography lead to variations in climate. In the highlands, the temperatures range between 10 and 20˚C, while in the lowlands, temperatures reach 20-30˚C. The rainfall pattern is bimodal, with a long rainy season extending from June to September, a shorter rainy season occurring from February to May, and a dry period from October to January. The average annual rainfall in the zone ranges between 1085 and 1199 mm (Kassa, 2015).

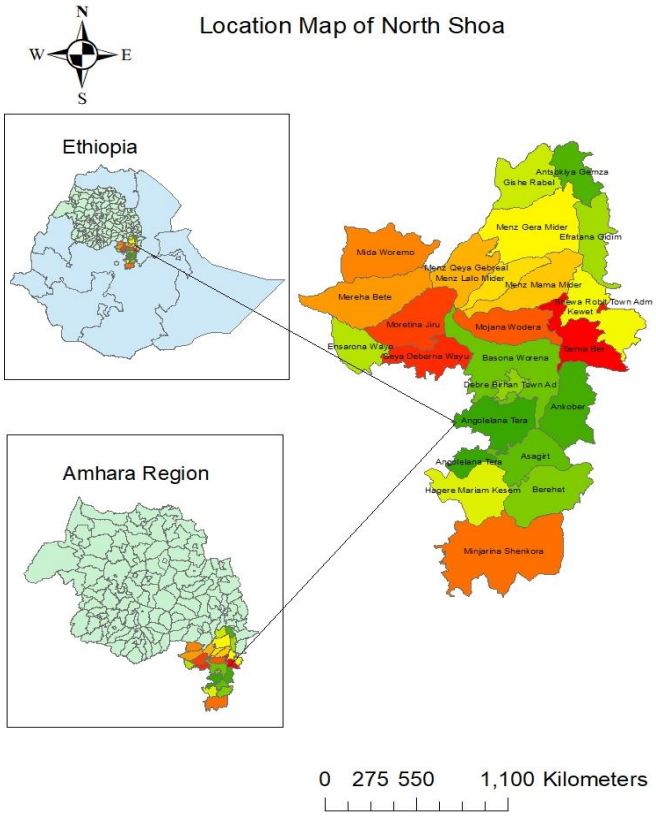

Figure 1. Geographical location of the study area, Amhara region, North Showa zone districts, Ethiopia (ArcGIS, 2021)

Study population

During the study period, no FMD cases were reported in small ruminants due to the absence of visible clinical signs; therefore, the study focused on cattle. The total cattle population at risk in affected PAs across the study districts was 269,704. All reported PA-level outbreaks were included, and all cattle within affected PAs were considered at risk, irrespective of age. The cattle were managed predominantly under different production systems, including extensive, semi-intensive, and intensive, and comprised indigenous, exotic, crossbred, and local breeds.

Study design

A retrospective observational study was conducted to assess the patterns of FMD outbreaks and associated vaccination activities in the North Shewa Zone, Amhara Region, Ethiopia, using data collected from 2017 to 2023. The PAs served as the primary spatial units, and reported FMD outbreaks constituted the units of analysis. The outcome variables included FMD occurrence, case counts, and the spatial and temporal distribution of outbreaks. The explanatory variables included the at-risk cattle population, PA-level features, and vaccination status.

Data collection

Data on FMD outbreaks and vaccination trends were obtained from the North Shewa Zone Animal Health Office through the Disease Outbreak and Vaccination Activity Report (DOVAR), which was compiled from reports submitted by government animal health services across all 24 districts of Ethiopia. The data, organized by month, year, and district, included information on FMD cases, deaths, and populations at risk, as well as morbidity, case fatality, and the number of cattle vaccinated with the A, O, and SAT2 serotypes.

Statistical analysis

The retrospective data were entered into Microsoft Excel for data management, visualization, and the calculation of key epidemiological parameters, including the frequency of outbreaks, morbidity, mortality, and case fatality rates of FMD. The morbidity, mortality, and fatality rates were calculated using the following formulas (Thrusfield, 2005).

Morbidity rate = (number of cases/total population at risk) × 100

Mortality rate = (number of deaths/total population at risk) × 100

Fatality rate = (number of deaths/number of cases) × 100

RESULTS

Temporal distribution

Across 24 districts and 374 PAs, a total of 162 outbreaks were reported between 2017 and 2023, with marked year-to-year variation. An overall outbreak proportion of 43.4% was observed. The highest outbreak burden was observed in 2023, with 50 outbreaks (30.9%) and the highest occurrence rate (13.4%), followed by 2021, which recorded 36 outbreaks (22.2%) and an occurrence rate of 9.65%. Earlier years contributed substantially fewer outbreaks, with 2017 reporting 32 outbreaks (19.8%), while 2018 and 2019 recorded relatively low proportions at 5.6% and 8.6%, respectively. The lowest outbreak activity was observed in 2020, with only 2 outbreaks (1.2%) and an occurrence rate of 0.5%. Although outbreaks declined from 36 (22.2%) in 2021 to 19 (11.7%) in 2022, the 2022 level remained higher than in previous years. Overall, despite constant geographic coverage, outbreak occurrence increased markedly in the later years, peaking in 2023 (Table 1 and Figure 2).

Table 1. Yearly distribution of outbreak occurrence and proportion across 24 districts and 374 kebeles in North Shewa Zone, Ethiopia, from 2017 to 2023

Year	Outbreaks numbers	Occurrence of outbreaks (%)	Proportion outbreaks (%)
2017	32	8.6	19.8
2018	9	2.4	5.6
2019	14	3.75	8.6
2020	2	0.5	1.2
2021	36	9.65	22.2
2022	19	5.09	11.7
2023	50	13.40	30.9
Total	162	43.4	100

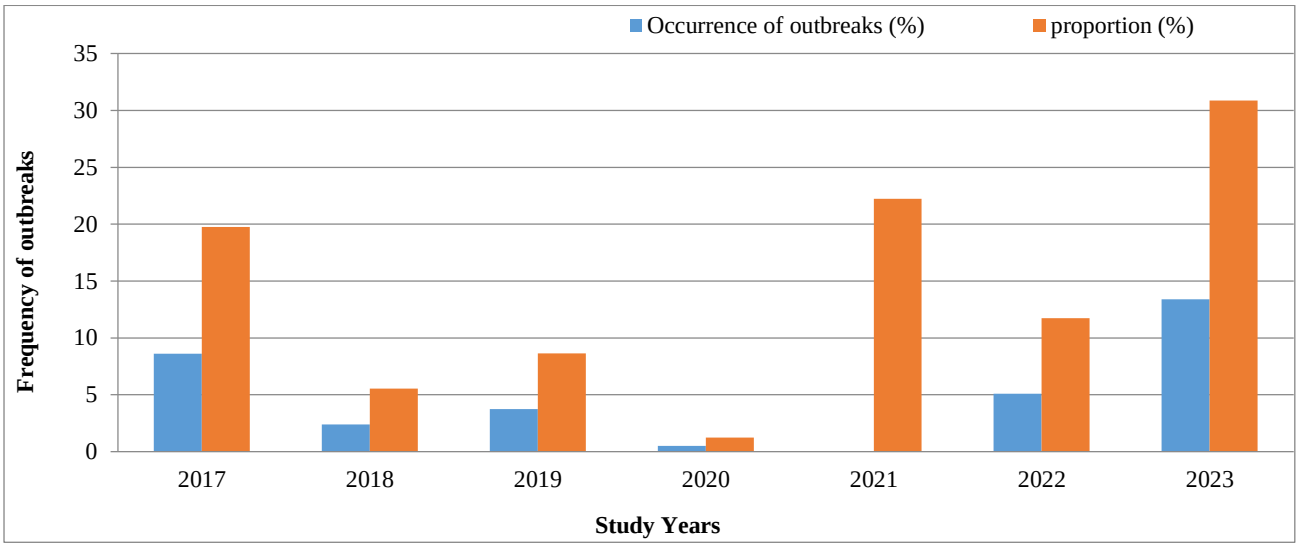

Figure 2. Number of foot-and-mouth disease outbreaks by year in North Shewa Zone, Ethiopia, from 2017 to 2023

Seasonal analysis indicated variation in FMD occurrence across the study period. When the overall data were categorized by season, the highest number of outbreaks occurred during the dry season (October-January; n = 93, 57%), followed by the short rainy season (February-May; n = 35, 22%). The fewest outbreaks were recorded during the long rainy season (June-September; n = 34, 21%; Figure 3). Of the 269,704 cattle considered at risk, 5,246 were affected, and 67 deaths were documented. The outbreak resulted in an overall morbidity rate of 1.95%, a mortality rate of 0.02%, and a case fatality rate of 1.28%. The highest numbers of cases and deaths were recorded during the dry seasons, with 2,839 reported cases and 45 deaths in the 93,104 cattle at risk. The corresponding values for the morbidity rate, mortality rate, and case fatality rate for the dry season were 3.05%, 0.05%, and 1.59%, respectively. The longer rainy season had a relatively lower impact, with 1,472 cases and 8 deaths reported among the 115,191 cattle at risk. Hence, the lower values for the morbidity rate, mortality rate, and case fatality rate for the longer rainy season were 1.28%, 0.007%, and 0.54%, respectively. During the short rainy season, there were 935 cases and 14 deaths among 61,409 cattle at risk, resulting in morbidity, mortality, and case fatality rates of 1.52%, 0.02%, and 1.49%, respectively (Table 2).

A total of 5,246 cases of FMD and 67 deaths were recorded among the 269,704 cattle at risk over the seven-year study period of 2017-2023, resulting in an overall morbidity rate of 1.95%, a mortality rate of 0.02%, and a case fatality rate of 1.28%. Annual FMD occurrence varied considerably across the years. The highest numbers of cases were reported in 2023 (1,796 cases) and 2017 (1,374 cases), corresponding to morbidity rates of 1.93% and 2.27%, respectively. Similarly, 2021 recorded 1,355 cases with a morbidity rate of 2.17%. In contrast, lower case numbers were observed in 2018 (157 cases) and 2019 (242 cases), with morbidity rates of 1.03% and 1.51%, respectively. The lowest number of cases was recorded in 2020, with 17 cases from a relatively small at-risk population of 450 cattle; however, this year revealed the highest morbidity rate (3.78%) among all study years. Deaths were reported in all years except 2020, with the highest number observed in 2023 (33 deaths), followed by 2021 (18 deaths) and 2017 (6 deaths). Annual mortality rates remained low throughout the study period, ranging from 0.00% to 0.04%. Case fatality rates differed across years, with the highest recorded in 2019 (2.07%) and 2023 (1.84%), while no fatalities were reported in 2020 (Table 3).

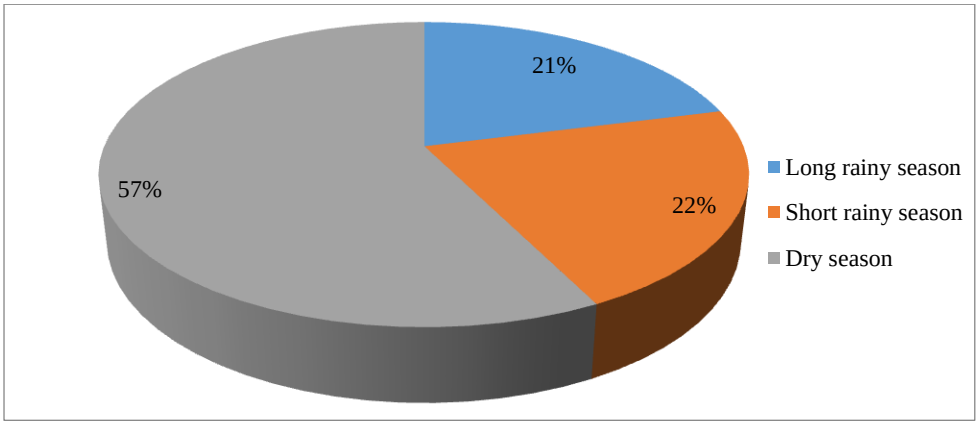

Figure 3. Foot-and-mouth disease outbreaks by season in the North Shewa Zone, Ethiopia, from 2017 to 2023

Table 2. Number of foot-and-mouth disease cases and deaths, and the rates of morbidity, mortality, and fatality across seasons in the North Shewa zone, Ethiopia, from 2017 to 2023

Seasons	Population at risk	Cases (number)	Deaths (number)	Morbidity rate (%)	Mortality rate (%)	Case fatality rate (%)
Long rainy season	115,191	1,472	8	1.28	0.007	0.54
Dry season	93,104	2,839	45	3.05	0.05	1.59
Short rainy season	61,409	935	14	1.52	0.02	1.49
Total	269,704	5,246	67	1.95	0.02	1.28

Table 3. Foot-and-mouth disease morbidity, mortality, and fatality rate across years in the North Shewa zone, Ethiopia, from 2017 to 2023

Year	Population at risk	Cases (number)	Deaths (number)	Morbidity rate (%)	Mortality rate (%)	Case fatality rate (%)
2017	60479	1374	6	2.27	0.01	0.44
2018	15192	157	1	1.03	0.01	0.64
2019	15943	242	5	1.51	0.03	2.07
2020	450	17	0	3.78	0.00	0.00
2021	62500	1355	18	2.17	0.03	1.33
2022	22288	305	4	1.37	0.02	1.31
2023	92852	1796	33	1.93	0.04	1.84
Total	269704	5246	67	1.95	0.02	1.28

Spatial distribution

In total, 162 outbreaks were reported in the 24 districts of the North Shewa zone, Ethiopia, during the study period, with 5,246 animals infected and a population at risk of 269,704 cattle. The overall morbidity, mortality, and case fatality rates were 1.95%, 0.02%, and 1.28%, respectively, indicating widespread disease but low mortality. Outbreaks were not evenly distributed across the study area. The highest number of outbreaks was reported in Bassonaworana (27 outbreaks; 16.7%), followed by Midda (17; 10.5%) and Menz-gera (15; 9.3%), whereas Shewarobit and Gishi recorded only one outbreak each (0.6%). Similarly, the number of cases ranged from the highest in Siyadeber (544), Hagermariam (531), and Minjar (542) to the lowest in Shewarobit (6) and Gishi (7).

District-level analysis indicated that FMD morbidity was generally low (<5%) across most districts in the North Shewa Zone, Ethiopia. In contrast, markedly higher morbidity was recorded in Merhabet (17.07%), Siyadeber (9.06%), and Minjar (4.99%), indicating more intense outbreaks in these districts. Mortality rates were consistently low across all districts, with the highest value (0.15%) observed in Merhabet. Although overall case fatality rates were low, comparatively higher rates were noted in Angolela (5.09%), Ankober (4.26%), and Moretena-Jiru (3.7%; Table 2). These findings indicated that FMD was widely distributed throughout the North Shewa zone of Ethiopia, but exhibited pronounced spatial heterogeneity in morbidity and outbreak severity, underscoring the need for targeted vaccination and control interventions in high-risk districts (Table 4).

Table 4. Spatial distributions of foot-and-mouth disease cases, deaths, and rates of morbidity, mortality, and fatality in districts in North Shewa Zone, Ethiopia, from 2017 to 2023

Districts name	Frequency of outbreak	Proportion (%)	Cases (number)	Deaths (number)	Population at risk	Morbidity rate (%)	Mortality rate (%)	Fatality rate (%)
Deberbirhan	6	3.70	128	0	6700	1.91	0	0
Bassonaworana	27	16.7	416	13	29164	1.43	0.44	3.13
Ankober	4	2.47	47	2	4712	0.99	0.04	4.26
Mojanawodera	8	4.94	228	4	24686	0.92	0.01	1.75
Taremaber	5	3.09	138	0	15456	0.89	0	0
Kewot	3	1.85	74	1	15429	0.48	0.01	1.35
Shewarobit	1	0.62	6	0	580	1.03	0	0
Eferatagidem	3	1.85	51	0	5525	0.92	0	0
Antsokeya	2	1.23	25	0	5656	0.44	0	0
Gishi	1	0.62	7	0	1240	0.56	0	0
Menz-qeya	11	6.79	215	7	14787	1.45	0.05	3.26
Menz-gera	15	9.26	229	0	27572	0.83	0	0
Menz-lalo	4	2.47	385	7	8006	4.80	0.09	1.82
Menz- mama	2	1.23	160	0	3550	4.50	0	0
Angolela	9	5.56	157	8	29900	0.53	0.03	5.10
Asagiret	5	3.09	280	3	6948	4.03	0.04	1.07
Hagermariam	9	5.56	531	5	11300	4.69	0.04	0.94
Minjar	8	4.94	542	6	10847	4.99	0.06	1.11
Berehet	4	2.47	216	0	9652	2.24	0	0
Siyadeber	7	4.32	544	2	6005	9.06	0.03	0.37
Moretena-jiru	2	1.23	54	2	3253	1.66	0.06	3.70
Ensaro	7	4.32	91	0	2750	3.31	0	0
Merhabet	2	1.23	350	3	2050	17.07	0.15	0.86
Midda	17	10.49	372	4	23936	1.55	0.02	1.08
Total	162	100	5246	67	269704	1.95	0.02	1.28

Vaccination utilization

From 2017 to 2023, FMD in the North Shewa Zone of Ethiopia revealed marked annual variation. Overall, 162 outbreaks were recorded, with a peak in 2023 (50 outbreaks across 15 districts) and a minimum in 2020 (two outbreaks across two districts). The population at risk differed over time, reaching its highest level in 2023, coinciding with the outbreak peak. During the study period, 33,155 cattle of all age groups were vaccinated against FMD using the A, O, and SAT2 serotypes. However, overall vaccination coverage remained low, reaching only 12.3% of the at-risk population. Vaccination coverage was relatively higher in 2017 (19.2%) and 2022 (17.9%) but notably lower in 2018 (3.6%) and 2021 (5.1%), with no vaccination conducted in 2020. Years with a high number of outbreaks often coincided with low vaccination coverage, suggesting that inadequate vaccination may have contributed to the persistence of FMD outbreaks (Table 5 and Figure 4).

Table 5. Foot-and-mouth disease outbreaks in North Shewa, Ethiopia, showing annual occurrence, number of affected districts, and number of vaccinated animals from 2017 to 2023

Year	Outbreaks (number)	Districts with FMD number	Population at risk	Vaccinated cattle (number)	Vaccine coverage (%)
2017	32	15	60479	11610	19.2
2018	9	5	15192	550	3.6
2019	14	6	15943	2750	17.2
2020	2	2	450	0	0
2021	36	15	62500	3180	5.1
2022	19	7	22288	4000	17.9
2023	50	15	92852	11065	11.9
Total	162	-	269,704	33,155	12.3

FMD: Foot and mouth disease

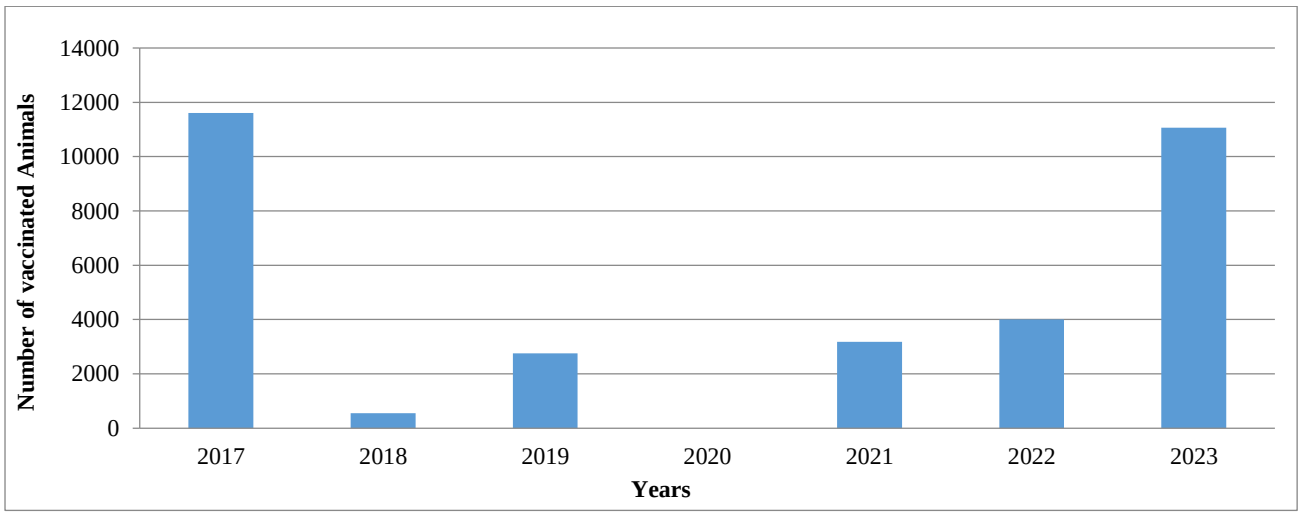

Figure 4. Number of foot-and-mouth disease-vaccinated animals in North Shewa, Ethiopia, from 2017 to 2023

DISCUSSION

The present study indicated that FMD was widespread and recurrent in the North Shewa Zone, Ethiopia, with 162 outbreaks reported across 24 districts and 374 kebeles between 2017 and 2023. Outbreak frequency differed markedly over time, peaking in 2023 (50 outbreaks; 30.9%), followed by 2021 (36 outbreaks; 22.2%) and 2017 (32 outbreaks; 19.8%). The fewest outbreaks occurred in 2020 (2 outbreaks; 1.2%), which may reflect reduced transmission, underreporting, or disruptions in animal movement and surveillance during that year. The temporal fluctuations aligned with recent Ethiopian studies documenting irregular but recurrent FMD patterns with intermittent annual peaks (Woldemariyam et al., 2022; Zewdie et al., 2023; Gizaw et al., 2025).

Seasonal analysis revealed that FMD cases and deaths were highest during the dry season, with morbidity, mortality, and case fatality rates of 3.05%, 0.05%, and 1.59%, respectively. In contrast, lower rates were observed during the long and short rainy seasons, indicating a clear influence of seasonal factors on FMD transmission dynamics. These findings are consistent with previous studies in Ethiopia, which reported increased FMD incidence during the dry season, largely attributed to intensified animal movement, livestock marketing, and congregation of animals at communal grazing and

watering points, where close contact facilitated viral transmission (Aman et al., 2020; Woldemariyam et al., 2022; Demil and Tadesse, 2025; Gizaw et al., 2025). The current findings align with previous studies, supporting the fact that dry-season environmental conditions and livestock management practices facilitated the spread of FMD. However, some studies have indicated that seasonal variation alone did not fully explain outbreak dynamics, as sporadic introductions of infected animals, heterogeneous vaccination coverage, and gaps in herd immunity may contribute to outbreaks (Aman et al., 2020). Therefore, although the dry season represented a clear high-risk period, FMD epidemiology in the study area was likely multifactorial, driven by interactions among animal movement patterns, production systems, and immunization status. The current findings highlighted the importance of implementing seasonally targeted control strategies, particularly pre-dry-season vaccination campaigns, strengthened animal movement control, and improved surveillance systems, to reduce the risk and impact of FMD outbreaks in the region.

The study found an overall morbidity of 1.95%, mortality of 0.02%, and a case-fatality rate of 1.28%, indicating widespread infection of FMD, but low fatality. District-level analysis revealed a heterogeneous distribution of outbreak severity. Bassonaworana, Midda, and Menz-Gera experienced the most outbreaks, whereas Shewarobit and Gishi recorded fewer. Elevated morbidity rates were noted in Merhabet (17.1%) and Siyadeber (9.1%), whereas most districts had rates below 5%. The current results supported the findings of Aman et al. (2020) and Gizaw et al. (2025), highlighting diverse patterns of FMD distribution across Ethiopian districts and pointing out specific high-risk zones.

Trends of vaccinations

Vaccination coverage for FMD in the North Shewa Zone, Ethiopia, was generally low and inconsistent, with only 12.3% of the at-risk cattle population vaccinated over the seven-year study period. Vaccination coverage indicated notable fluctuations, peaking in 2017 (19.2%) and 2022 (17.9%), with marked declines in 2018 (3.6%) and 2021 (5.1%). No vaccination activity was recorded in 2020, indicating a complete interruption in immunization efforts during that year.

Periods of high outbreak incidence, particularly in 2021 and 2023, coincided with low vaccination coverage, suggesting that inadequate and irregular immunization may have contributed to the persistence and recurrence of FMD outbreaks in the study area. The temporal overlap between reduced vaccination and increased outbreak occurrence highlighted the potential role of herd immunity gaps in sustaining viral transmission. The current findings were consistent with previous studies in Ethiopia, which have reported that FMD control was constrained by limited vaccine availability, irregular vaccination campaigns, and logistical challenges in delivery systems (Zewdie et al., 2023; Demil and Tadesse, 2025). Although vaccination is a key component of FMD control, outbreak dynamics are influenced by other epidemiological drivers, including animal movement patterns, production systems, and environmental conditions, as noted by Aman et al. (2020). The low and uneven vaccine coverage observed in the present study underscored the need for stronger, consistently implemented vaccination programs, particularly targeted to high-risk periods and high-incidence districts, to effectively reduce FMD transmission in the North Shewa Zone, Ethiopia.

CONCLUSION

The present seven-year retrospective study (2017-2023) demonstrated that FMD was endemic and widely distributed in North Shewa Zone, Ethiopia, with considerable spatial and seasonal variation in outbreak occurrence. A total of 162 outbreaks were reported across all districts, indicating persistent FMD circulation within the study area. The highest numbers of outbreaks and cases were recorded in 2021 and 2023, respectively, suggesting an upward trend in recent years. Major hotspot districts with the highest outbreak frequencies were Bassonaworana, Midda, and Menz-gera, while Merhabet and Siyadeber exhibited particularly high morbidity rates relative to their cattle populations, reflecting intense local disease transmission. Outbreaks occurred more frequently during the dry season, likely due to increased animal movement, livestock marketing, and congregation at communal grazing and watering points. Although mortality and case-fatality rates were generally low, the disease caused substantial morbidity and likely contributed to considerable economic losses through reduced livestock productivity and trade limitations. Low and inconsistent vaccination coverage throughout the study period appeared to play a major role in the persistence and recurrence of outbreaks. However, the present study relied on retrospective surveillance records, which may have underestimated the true burden of disease because of underreporting, incomplete records, and limited laboratory confirmation. The current findings emphasized the urgent need for strengthened surveillance and reporting systems, improved vaccine coverage and serotype matching, targeted strategic prophylactic vaccination of animals before the dry season in hotspot districts, enhanced farmer awareness, and strategic animal movement control measures. Further epidemiological studies are needed to understand transmission dynamics and reduce the impact of FMD in the North Shewa Zone, Ethiopia.

DECLARATIONS

Acknowledgements

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Authors' contributions

All aspects of the study, including study design, data collection, data analysis, interpretation of results, and manuscript preparation, were conducted solely by the author. The author independently conceptualized and designed this retrospective study on FMD in North Shewa, Ethiopia. All data were acquired and summarized solely from Disease Outbreak and Vaccination Activity Report (DOVAR) records and office-documented sources. The author conducted all data cleaning and statistical analyses, including the spatial heterogeneity in morbidity, outbreak patterns, and fatality rates, as well as the interpretation of the results. No external contributions were involved. The manuscript was drafted, critically revised, and finalized by the author, who also read and approved the final edition.

Availability of data and materials

All data are included in this article and its supplementary information files, available from the corresponding author upon reasonable request.

Conflict of interests

The author declared no competing interests.

Ethical considerations

Ethical issues, including plagiarism, consent to publish, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy, have been checked by all the authors. In addition, an AI tool (ChatGPT) was used solely to assist in organizing the flow of ideas and improving the manuscript's clarity, while all scientific content and interpretations were developed and verified by the authors. Following the utilization of AI (Grammarly) for removing grammatical errors, the author has thoroughly reviewed and revised the manuscript and accepted full responsibility for the originality of the submitted manuscript.

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REFERENCES

Aman E, Molla W, Gebreegizabher Z, and Jemberu WT (2020). Spatial and temporal distribution of foot-and-mouth disease outbreaks in the Amhara region of Ethiopia in the period 1999 to 2016. BMC Veterinary Research, 16(1): 185. DOI: https://www.doi.org/10.1186/s12917-020-02411-6

ArcGIS Pro (2021). ArcGIS Pro (Version 10.8). Available at: https://doc.esri.com/en/arcgis-pro/latest/get-started/download-arcgis-pro.html

Chestley T, Sroga P, Nebroski M, Hole K, Ularamu H, Lung O, and Nfon C (2022). Development of reverse-transcriptase, real-time PCR assays to distinguish the Southern African Territories (SAT) serotypes 1 and 3 and topotype VII of SAT2 of foot-and-mouth disease virus. Frontiers in Veterinary Science, 9: 977761. DOI: https://www.doi.org/10.3389/fvets.2022.977761

Countryman AM, de Menezes TC, Pendell DL, Rushton J, and Marsh TL (2024). Economic effects of livestock disease burden in Ethiopia: A computable general equilibrium analysis. PLOS ONE, 19(12): e0310268. DOI: https://www.doi.org/10.1371/journal.pone.0310268

Demil E and Tadesse B (2025). Spatio-temporal distribution of foot-and-mouth disease outbreaks in Western Amhara Region from January 2018 to June 2023. PLOS ONE, 20(2): e0313305. DOI: https://www.doi.org/10.1371/journal.pone.0313305

Getiso AA and Mijena D (2024). An overview of livestock role in ensuring food and nutrition security: The case of Ethiopia. Journal of Nutrition and Food Processing, 7(8): 1-8. DOI: https://www.doi.org/10.31579/2637-8914/238

Gizaw D, Beyene G, Ashenafi H, Legesse M, and Kassa T (2025). Spatial and temporal patterns of foot and mouth disease outbreaks (2011-2022) in cattle export-sourcing areas of southeastern Ethiopia. BMC Veterinary Research, 21(1): 312. DOI: https://www.doi.org/10.1186/s12917-025-04772-2

Jemberu WT, Mourits MCM, Sahle M, Siraw B, Vernooij JCM, and Hogeveen H (2016). Epidemiology of foot and mouth disease in Ethiopia: A retrospective analysis of district-level outbreaks, 2007-2012. Transboundary and Emerging Diseases, 63(6): e246-e259. DOI: https://www.doi.org/10.1111/tbed.12338

Jemberu WT, Mourits MCM, WoldehannaT, and Hogeveen H (2014). Economic impact of foot and mouth disease outbreaks on smallholder farmers in Ethiopia. Preventive Veterinary Medicine, 116(1-2): 26-36. DOI: https://www.doi.org/10.1016/j.prevetmed.2014.06.004

Kassa F (2015). Ethiopian seasonal rainfall variability and prediction using canonical correlation analysis (CCA). Earth Sciences, 4(3): 112-119. DOI: https://www.doi.org/10.11648/j.earth.20150403.14

Legese G, Gelmesa U, Jembere T, Degefa T, Bediye S, Teka T, Temesgen D, Tesfu Y, Berhe A, Gemeda L et al. (2023). Ethiopia national dairy development strategy 2022-2031. Ministry of Agriculture, Federal Democratic Republic of Ethiopia, Addis Ababa. Available at: https://cgspace.cgiar.org/items/66a57294-98e1-4b1d-b1ac-ae1d4adf0626

Sangula AK, Belsham GJ, Muwanika VB, Heller R, Balinda SN, Masembe C, Siegismund HR, and Alexandersen S (2010). Evolutionary analysis of foot-and-mouth disease virus serotype SAT 1 isolates from East Africa suggests two independent introductions from southern Africa. BMC Evolutionary Biology, 10: 371. DOI: https://www.doi.org/10.1186/1471-2148-10-371

Seifu K, Muluneh A, Getachew Y, Jibril Y, and Negussie H (2023). Epidemiological study and dairy farmers' knowledge, attitudes, and practices on foot and mouth disease in central Ethiopia. Heliyon, 9(5): e15771. DOI: https://www.doi.org/10.1016/j.heliyon.2023.e15771

Seyoum W and Tora E (2023). Foot and mouth disease in Ethiopia: A systematic review and meta-analysis in the last fifteen years (2007-2021). Bulletin of the National Research Centre, 47: 32. DOI: https://www.doi.org/10.1186/s42269-023-01004-1

Shapiro BI, Gebru G, Desta S, Negassa A, Nigussie K, Aboset G, and Mechale H (2017). Ethiopia livestock sector analysis. ILRI project report. International Livestock Research Institute (ILRI), Nairobi, Kenya. Available at: https://cgspace.cgiar.org/server/api/core/bitstreams/dabb7069-888d-4caa-900a-d37dca144fbc/content

Tesfaye Y, Khan F, Yami M, Wadsworth J, Knowles NJ, King DP, and Gelaye E (2020). A vaccine-matching assessment of different genetic variants of serotype O foot-and-mouth disease virus isolated in Ethiopia between 2011 and 2014. Archives of Virology, 165: 1749-1757. DOI: https://www.doi.org/10.1007/s00705-020-04662-y

Thrusfield M (2005). Veterinary epidemiology, 3rd Edition. Blackwell Science Ltd., pp. 228-247. Available at: https://books.google.com.et/books?id=IgMlBQAAQBAJandprintsec=copyright#v=onepageandqandf=false

Woldemariyam FT, Leta S, Assefa Z, Tekeba E, Gebrewold DS, and Paeshuyse J (2022). Temporal and spatial patterns and a space–time cluster analysis of foot-and-mouth disease outbreaks in Ethiopia from 2010 to 2019. Viruses, 14(7): 1558. DOI: https://www.doi.org/10.3390/v14071558

World organization for animal health (WOAH) (2023). Foot-and-mouth disease. Available at: https://www.woah.org/en/disease/foot-and-mouth-disease

Zewdie G, Akalu M, Tolossa W, Abdela N, Asfaw Y, Gizaw D, and Tadesse B (2023). A review of foot-and-mouth disease in Ethiopia: Epidemiological aspects, economic implications, and control strategies. Virology Journal, 20: 299. DOI: https://www.doi.org/10.1186/s12985-023-02263-0