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A Retrospective Study of Foot and Mouth Disease out Breaks from 2010 to 2018 in Southern Nations Nationalities and Peoples' Regional State, Ethiopia

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Abstract: Foot and mouth disease is an acute viral transboundary disease of cloven-hoofed animals responsible for considerable loss of production and restriction of trade of animals both locally and internationally. A retrospective study was conducted to describe FMD outbreaks by animal species, place and time in Southern Nations, Nationalities and Peoples Region from 2010 to 2018. Data about the incidence of FMD outbreaks in the region was obtained from the DOVAR II database with the Ministry of Agriculture and it was summarized using tables and figures. During the period, 131 outbreaks of FMD were recorded in 65 (47.8%) of the 136 woredas (districts) in the region. The highest number of outbreaks occurred in 2016 (n=36; 27.5%) and the lowest in 2014. Seasonal trends were observed in the occurrence of outbreaks, the highest number of outbreaks occurring during the dry season (December to February 66%); whereas, the lowest (7%) in early dry season (September to November). The majority of the outbreaks were reported from Central and Western parts of the region with the highest number of outbreaks from the Sidama zone (n=24; 18.3%) while the least (only one outbreak) was from the Sheka zone. All age groups of cattle was affected but the disease was more common in adult animals above 3 years (61.4%). Cattle were the most predominant species affected with FMD (99%). 388, 307 doses of FMD vaccine were given during the 9-year period as control (365, 405) and prophylaxis (22, 902). In conclusion, FMD is endemic in SNNPR and the incidence of the disease had been increasing from time to time. Therefore regular vaccination of cattle before the anticipated season of the outbreak is recommended for prevention of the disease. However, the circulating FMD serotypes need to be identified through continuous surveillance of the disease before any vaccination is undertaken.

Key words: Foot and Mouth Disease · Epidemiology · Retrospective · SNNPR

INTRODUCTION

Foot and Mouth Disease (FMD) is a highly contagious viral disease, which affects all cloven-hoofed domestic animals including cattle, sheep, goats, pigs and buffalo [1]. Transmission of FMD virus occurs mostly by direct contact or aerosol droplets; although indirect transmission through animal products, fomites and wind are also possible [2]. FMD is one of the most important livestock diseases worldwide that causes direct and indirect economic losses. The direct losses of the disease consist of loss of milk production, loss of draft power, retardation of growth, abortion and delayed breeding and mortality especially in young animals. The indirect losses are related to the restriction of trade of animals both locally and internationally [3, 4].

Foot and mouth disease is endemic in Ethiopia [5]. Since the first case in 1957, several outbreaks have occurred in the country [6]. Moreover, several serological studies have shown the importance of the disease in the country. According to recent serological surveys in different parts of the country, the seroprevalence of the disease ranges from 5% to25% at the animal level and reaches up to 60% at the herd level [7-11]. Factors such as the presence of high numbers of susceptible animals, wild and domestic animals sharing common grazing pastures and watering points in areas where wild life occur, as well as lack of control of animal movement were reported to contribute to the frequent occurrence of FMD outbreaks in the country [12].

Studies undertaken in Southern Nations, Nationalities and Peoples' Regional State (SNNPRS)

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revealed the existence of the disease in different parts of the region and that outbreak from the disease has been increasing over recent years. The reported seroprevalence varies from 2.2 % in Darra woreda, Sidama zone to 23.3% in Benatsemay woreda, South omo zone [5, 8, 12-14]. However, information on the spatiotemporal distribution of the FMD outbreaks in the region is lacking. This information is crucial for designing feasible FMD control and prevention strategies in the region as well as in Ethiopia. Therefore, the present study aimed to generate information on the geographical and temporal distribution of FMD outbreaks and the morbidity and mortality rates of the disease in SNNPR.

MATERIALS AND METHODS

Study Area: The study was conducted in SNNPR, Ethiopia during the period from December 2018 to March 2019. SNNPR is subdivided in to 14 zones, 4 special districts and 1 city administration. It is geographically located between 6°03' 31" N latitude and 36°43' 38" E longitudes and covers a land area of 112, 323.19 sq. kms.

The Study Population: The study population was cattle and shoat population in SNNPR region. All age groups of animals were included in the study.

Study Design and Study Period: A retrospective study was carried out to describe FMD burden by animal, place and time in SNNPR from 2010 to 2018.

Data Source: In Ethiopia, FMD is a notifiable disease and it is required that all occurrences of this disease have to be reported monthly to the National Epidemiology Directorate within the Federal Ministry of Agriculture. Data on the outbreaks of FMD in all districts of SNNPRS from January 2010 to December 2018 were obtained from the monthly Disease Outbreak and Vaccination Report (DOVAR II) database maintained by the National Epidemiology Directorate. When a case of FMD is suspected, Community Animal Health Extension Workers report to the district level veterinarian or other animal health professional. In response to the disease outbreak report, the district-level veterinarian pays a visit to the village where the outbreak occurred to make a tentative diagnosis based on the clinical symptoms observed. He/she then notifies the regional veterinary laboratory, which then conducts an epidemiological investigation to confirm the presence or absence of the disease. Diagnosis is usually done based on the clinical signs and other epidemiological features. Some of the tissue samples are further sent to the National Animal Health Diagnostic and Investigation Center (NHADIC) for confirmatory diagnosis and for virus serotyping.

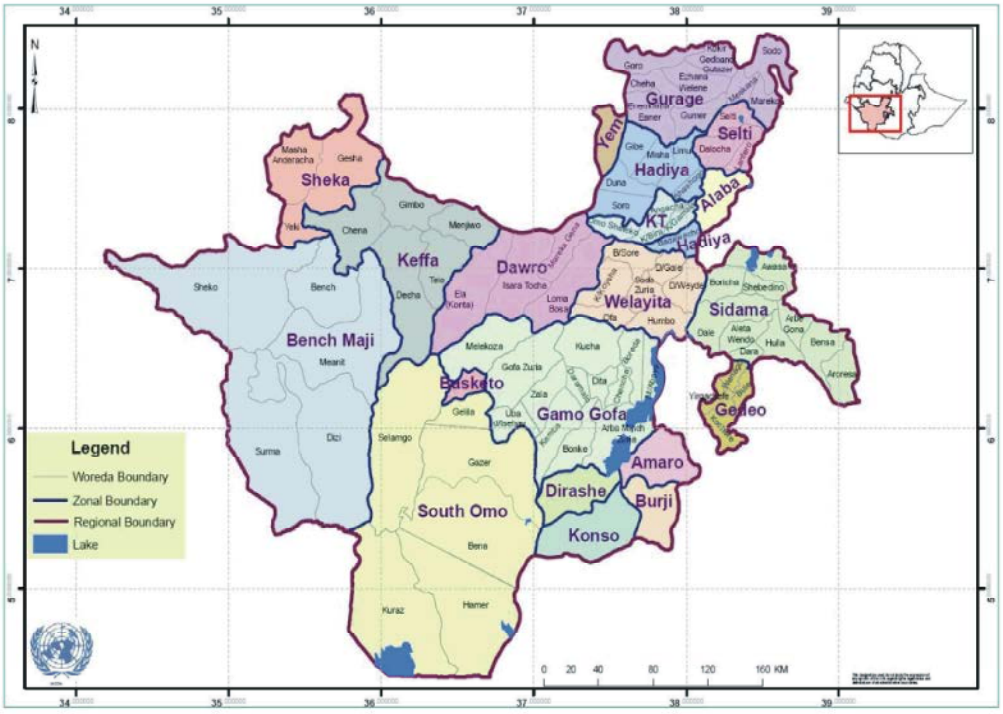

Fig. 1: Administrative Map of SNNPR [15]

Data Management and Analysis: The data was obtained from DOVAR II in the Microsoft access database maintained by Federal Agricultural Minister, animal health department. The disease was diagnosed throughout the country passive surveillance system operated by a network of Regional Veterinary Laboratories (RVL) located across the country. Those data were transferred to a spreadsheet program (Microsoft Excel 2007).

The main variables considered in this study were the number of animals at risk, the number of suspected cases and deaths due to FMD, the month and year of FMD outbreak, the district and zone in the region and the age and species of animal affected. The animal level morbidity rate was determined as the number of animals infected during the outbreak divided by the total number of animals at risk. The mortality rate was determined as the number of animals that died of FMD during the outbreak divided by the total number of animals at risk. Analysis of the data was performed by using the Pivot table on the excel-sheet.

RESULTS

Temporal and Spatial Distribution of FMD Outbreaks: The results of this retrospective study showed that a total of 131 outbreaks of FMD were recorded in SNNPRS between December, 2010 and March, 2018 with a reported 21, 318 cases and 172 deaths. The record showed that FMD outbreaks occurred every year with the highest in 2016. Likewise, the greatest number of morbidity cases was recorded in 2016 (30.6%) while the least in 2014. On the other hand, highest number of deaths from FMD was recorded in 2013. Cattle and goats were the only domestic animals affected by the outbreaks with a total of 21, 298 and 20 cases, respectively (Table 1).

During the period, FMD outbreaks were observed all year round showing that the disease is endemic in the region (Figure 2). However, there was considerable variation in the number of outbreaks across the months of the year. The highest frequency of outbreaks was reported in January (n = 77) which accounted for 58.8% of all the outbreaks reported and the lowest in April (Figure 3). When the overall data were grouped by season, the highest incidence was reported in the dry season (December – February, n=86; 66%) followed by heavy rainy season (June – August, n=25; 19%) and the short rainy season (March - May, n=11; 8 %). The lowest incidence was recorded in the early dry season (September - November, n=9; 7%) (Figure 4).

As shown in Table 2 below, the morbidity rate and CFR (Case Fatality Rate) was highest in 2013 in relation to the other years; the least was 2016. However, the mortality rate was generally very low.

Table 1: FMD outbreaks by year, species, suspected cases and deaths in SNNPRS from 2010 up to 2018

			Number of suspected cases		Number of death	
Year	No. of outbreaks	Proportion (%)	Bovine	Caprine	Bovine	Caprine
2010	6	4.6	3, 991	20	15	
2011	14	10.7	2, 879		37	
2012	11	8.4	486		6	
2013	27	20.6	4, 620		59	
2014	4	3.1	161		0	
2015	8	6.1	392		7	
2016	36	27.5	6, 535		48	
2017	19	14.5	1, 390		0	
2018	6	4.6	844		0	
Total	131	100	21, 298	20	172	

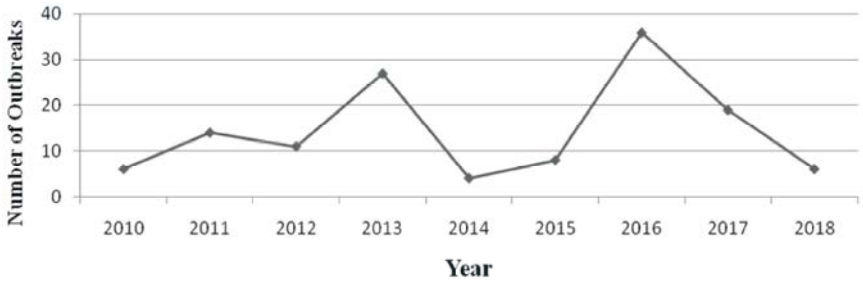

Fig. 2: Number of FMD outbreaks by year (2010-2018) in SNNPRS

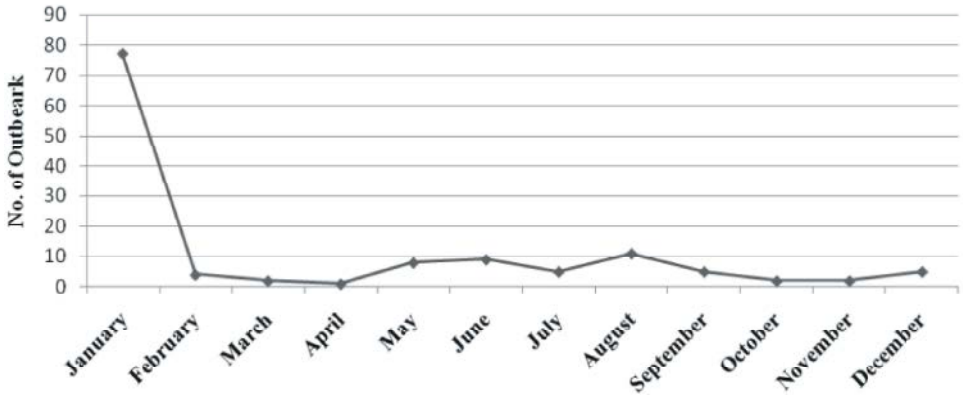

Fig. 3: FMD outbreaks by months of the year (2010-2018), SNNPRS

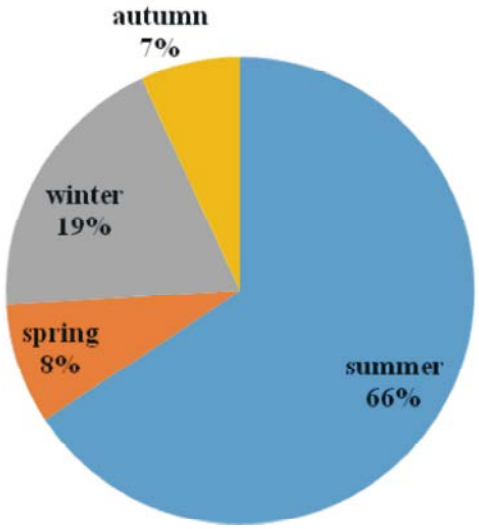

Fig. 4: FMD outbreaks by seasons of the year (2010-2018), SNNPR

Table 2: FMD Morbidity rate Mortality rate and case fatality by year, SNNPR, 2010-2018

Year	Population at risk	Number of cases	Morbidity rate (%)	Number of deaths	Mortality Rate (%)	Case Fatality Rate (%)
2010	57, 041	4, 011	7.0	15	0.026	0.4
2011	318, 820	2, 879	0.9	37	0.011	2.1
2012	113, 841	486	0.4	6	0.005	1.2
2013	607, 550	4, 620	0.8	59	0.009	6.3
2014	18, 633	161	0.9	0	0	0
2015	61, 000	392	0.6	7	0.011	2.2
2016	195, 935	6, 535	3.3	19	0.009	1.2
2017	74, 230	1, 390	1.9	0	0	0
2018	105500	844	0.8	0	0	0

FMD was reported from 65 of the 136 districts in the region between 2010 and 2018. The disease was recorded in all the zones of the region except in Dawro zone. The highest and the lowest number of outbreaks were reported from Sidama zone (18.3%) and Sheka zone (n=1), respectively. The majority of the outbreaks were reported from the Central and Western parts of the region such as Sidama, Kaffa, Hadiya, Gurage and Bench Maji zones in descending order of the frequency of outbreaks (Figure 5). Approximately 50% (65/136) of the woredas in the region had a reported occurrence of one or more outbreaks of FMD.

Cattle were the most predominant species affected with FMD, being involved in all of the outbreaks reported. Goats were the other affected domestic species being involved in only one outbreak (Figure 6). Animals were

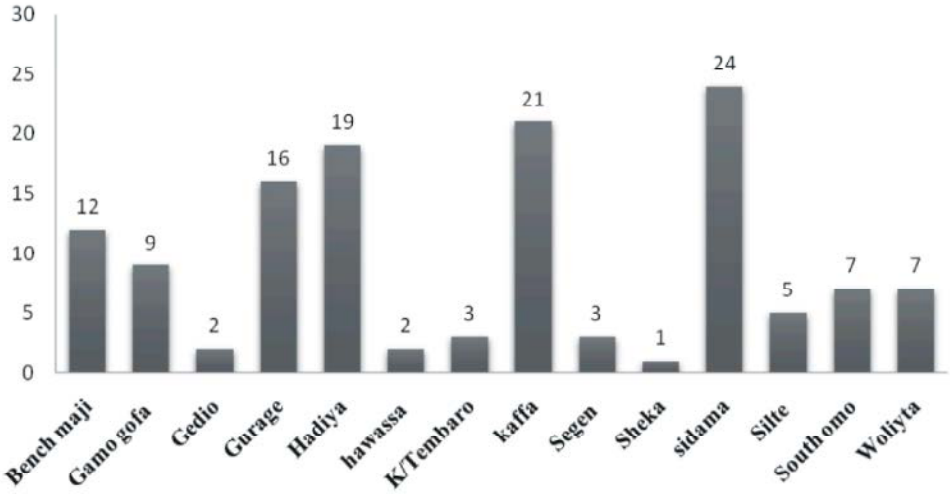

Fig. 5: FMD outbreaks by zones in SNNPR from 2010 to 2018

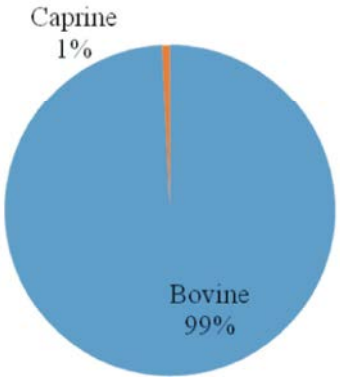

Fig. 6: FMD cases by species in SNNPR from 2010 to 2018

Table 3: FMD cases by age in SNNPR from 2010 to 2018

	Age of Animal			
Year	1-3	>3	All age	Total Number of Cases
2010	35	3, 976		4, 011
2011	1, 439	1, 440	-	2, 879
2012	26	460	-	486
2013	706	3, 914	-	4, 620
2014	100	61	-	161
2015	-	13	379	392
2016	178	2, 591	3, 766	6, 535
2017	-	126	1, 264	1, 390
2018	-	511	333	844
Grand total	2, 484	13, 092	5, 742	21, 318

grouped into two age categories: young (1-3 years) and adult (>3 years). Table 5 shows that suspected cases were recorded more frequently in the adult animals over 3 years of age (n=13, 092, 61.4%).

FMD Vaccination: The result of record analysis revealed that 388, 307 doses of vaccine were given during the 9-year period as a control and prophylaxis against FMD. Vaccination coverage of FMD is presented on Figure 7 below. Highest number of control vaccination was given in 2016 (198, 435 doses of vaccine). As shown on the figure, vaccine given for control of FMD (n=365, 405 dose, 94.1%) was higher than that of vaccine given as prophylaxis (n=22, 902 dose, 5.9%).

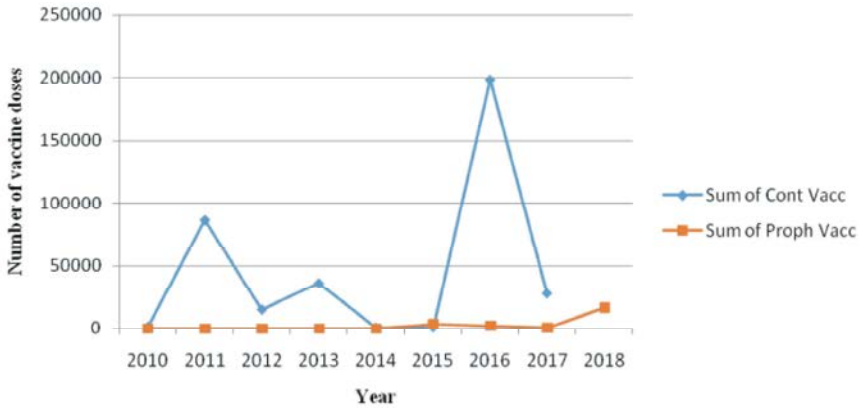

Fig. 7: FMD vaccination in SNNPR from 2010-2018

DISCUSSION

The current retrospective study revealed that FMD is endemic in the SNNPRS especially in the Central and Western parts of the region. Those parts were found to have relatively more outbreaks than other parts in the region. The present study is in close agreement with a previous study by Gelaye *et al.* [13], who reported that FMD is a significant disease in south-western Ethiopia. Therefore, for future disease surveillance and control, it would be appropriate to target those zones located in the central and western parts of the region.

The Spatial analysis demonstrated that FMD was persistently present in Kaffa and Bench Maji zones. These two zones together accounted for 25% of the total outbreaks. The reasons for this might be the fact that these zones are characterized by pastoral production system where animals travel long distances and can cross national boundaries. This can facilitate contact between different herds from different localities, including neighboring countries and wild ruminants, which are a continuous source of infection. Likewise, a similar result was reported in the Borena pastoral production system [13]. On the other hand, the FMD outbreak report from the south Omo zone, the other pastoral zone in the region, is very low. This might be due to the poor disease reporting system in pastoral communities [14].

The current study showed that disease occurred in a high proportion seen in 2016. These new introductions are likely to have happened through uncontrolled transboundary movements of animals, which constitute a significant risk for viruses crossing the border in both directions. This is due to the lack of strong animal movement regulation across the border and the ability of the virus to transmit with the wind [16]. Cattle were the main species affected with FMD in the region while goats were rarely affected. This result accords with Beyene *et al*. [17] who found significantly higher seroprevalence in cattle (14%) than in small ruminants (sheep 5% and goats 3%). A significant prevalence variation between cattle and small ruminants was also reported by other studies [16, 18].

In the present study, the highest frequency of FMD outbreaks was reported in the dry season (December to February). More than 50% of the total outbreaks were reported in January. In agreement to the present finding, Rufael *et al.* [7] and Molla *et al.* [14] reported that the seasonal incidence of FMD is high during the long dry season (December to February) and lowest in the rainy season (June to July).

This study showed that suspected cases of FMD were recorded more frequently in cattle over 3 years of age. A similar observation was also reported by several studies in Ethiopia [8-10, 16-21]. According to the result of this study, morbidity rate, mortality rate and CFR are low. There is finding by Mahmoud *et al*. [22] who states that morbidity rate in susceptible animals can rapidly approach 100% but CFR is generally very low, about 2% in adults and 20% in young stock. Moreover, the study conducted by Jemberu, *et al.* [23] describes that FMD outbreak in the cattle population of smallholder farmers causes high morbidity and associated economic losses that represent a significant part of smallholders' income. This variation might be due to the strain of FMDV and the susceptibility of animals [24].

Vaccination coverage is also described in the current study. The result of the analysis revealed that the vaccine given for control of FMD was higher than that given as prophylactic. It disagrees with Hirsh and Zee [25] who stated that vaccinations are recommended for prophylactic protection in endemic areas.

CONCLUSION

The current study provides information about the spatial and temporal distribution of FMD in SNNPR. The majority of the outbreak reported from Central and Western parts of the region. The highest cases were recorded in 2016. According to the result, FMD outbreaks occur mostly in the dry season when pasture is dry and reduced. During the long dry season, animal movement peaks due to trade and migration in search of pasture and water. This movement pattern is believed to be partly responsible for the introduction and spread of FMD. In general, FMD is endemic in SNNPR and also the occurrence of the disease is increasing from time to time. The findings from this study can be used as baseline epidemiological data for further study to understand the epidemiology of FMD in SNNPR.

Inline to the above result, the following recommendations are forwarded:

- The capacity of animal health experts should be strengthend in order to improve the quality of data.
- Vaccination should be provided annually before the dry season (September to November).
- The surveillance and reporting system in the region should be improved to prevent and control FMD.
- Attention must be given to those parts of the region with highest number of FMD outbreaks.
- Cattle must be vaccinated to minimize the occurrence of outbreaks.
- Further study on FMD in the region should be conducted to understand the epidemiology of the disease.

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