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Retrospective study of lumpy skin disease in Guraghe Zone, Ethiopia, 2015-2020

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Abstract

Background: Lumpy skin disease (LSD) is among the most economically significant viral diseases of cattle caused by Neethling virus prototype strain classified in the genus *Capripoxvirus*of family *Poxviridae*. It is economically devastating viral diseases which cause several financial problems in livestock industries. In Ethiopia lumpy skin disease was first observed in the northwestern part of the country (southwest of Lake Tana) in 1983. **Objective:** to describe LSD trend by time, age and across wereda between 2015 and 2020. **Method:** Retrospective study was carried out to describe LSD burden by animal, place, time in Guraghe between 2015 and 2020. **Result:** From 2015 to 2020 a total of 32 disease outbreaks of LSD have been documented. From the retrospective study, the highest outbreak was in 2015 and 2017 9(28%) and the lowest was in 2019 and 2020 2(6.25%). The highest outbreak was registered in Abeshgewereda and the lowest in Chehawereda. All age group are susceptible however, young are particularly less susceptible to clinical disease than adults and categorized all age groups. The highest outbreak was registered in October 8(25%) and the lowest was registered in June and August 1(3.12%).The highest LSD was registered in spring season17 (53.12%) and lowest in summer 2(6.25%). The various agro climatic conditions, introduction of new animals to the herd and the presence communal watering bodies are regard as major risk factors that would facilitate the spread of outbreaks in different weredas. **Conclusion:** LSD is transmitted by mechanical vector insects, contacts and also wildlife plays a potential role in its maintenance. Effective control measures of this disease is achieved through mass vaccination, import restrictions of livestock and their products, control of vectors and quarantine station.

Keywords: Guraghe, Retrospective, LSD, Epidemiology

Introduction

In Ethiopia, with the total of about 59.5 million cattle population, livestock production constitutes a vital part of the agricultural system and it accounts about 40% of the agricultural gross domestic product (GDP) (CSA, 2017; Gebreegziabhare, 2010). Livestock diseases are the major production constraints in Ethiopia in addition to poor nutrition, low genetic potential of indigenous livestock, lack of marketing infrastructure and water shortages (Gebreegziabhare, 2010). Lumpy skin disease (LSD) is one of the most economically important viral diseases listed as modifiable trans-boundary animal diseases by the World Organization for Animal Health (OIE) and the second significantly important cattle disease in Ethiopia (Gelaye *et al*., 2015; OIE, 2017).

Lumpy skin disease (LSD) is an infectious viral disease of cattle caused by LSD virus of the genus Capripoxvirus and the disease often occurs as epidemics. It has spread from Zambia, where it was first observed in 1929 to most African countries (except Libya, Morocco, Algeria and Tunisia), Middle

Eastern countries, and more recently also to European countries. LSD can occur in diverse ecological zones from the very dry semi-desert, the wet and dry areas to the high altitude temperate areas (Davis, 1991).Typically, LSD outbreaks occur in epidemics several years apart. The existence of a specific reservoir for the virus is not known, nor is how and where the virus survives between epidemics. Outbreaks are usually seasonal but may occur at any time because in many affected regions no season is completely vector-free (Tuppuramine *et al.*, 2017).

Lumpy skin disease (LSD) is endemic in most areas of the GHoA and has been reported in other areas of Africa. This disease, caused by a poxvirus, is an infectious, eruptive and occasionally fatal disease of cattle characterized by nodules on the skin. Cattle and water buffaloes are the only livestock species affected, with high morbidity rates but low mortality (around 1 per cent). Death rates are greater among calves. It causes damage to hides, loss of milk and beef production, abortions and sterility. It is thus a disease with serious socio-economic status (AU-BAR, 2015).

LSD was introduced in Ethiopia, for the first time, through north-west (Gojjam and Gondar) in 1981 with subsequent introductions in the West (Wollega) in 1982 from Sudan and in the central part (Shewa) in 1983 (Mebratu *et al.*, 2010).After the introduction, the disease initially spread Eastwards, later to all directions and currently it has affected all regions and agro-climatic zones of the country (APHRD, 2012).The spread of LSD was enhanced by uncontrolled cattle movements, communal grazing and watering, and pastoralism (Gari *et al.*, 2010). The poor animal health situation, inefficient prevention and control efforts in combination with late detection of the disease have further contributed to the spread of LSD in Ethiopia (APHRD, 2012).

The disease is now the problem of almost all the regions and agroecological zones of Ethiopia. A major outbreak of LSD has occurred in different regions of Ethiopia like Amhara and W/Oromia regions in 2000/2001, Oromia and Southern nations' nationalities and people (SNNP) regions in 2003/2004, and Tigray, Amhara, and Benishangul regions in 2006/2007 (Ayelet *et al.*, 2014). In addition, this situation contributes a negative impact on the national economic growth through the loss of meat and milk production and poor quality of skin and hides (Gelaye *et al.*, 2013).

Objectives of Study: Specific objectives:

- To describe LSD trend by time;
- To describe LSD outbreak by age; and to describe LSD trend across wereda.

Materials and Methods

Study area

The current study wasconducted from January 2021 to April 2021 in Guraghe Zone, Southern Ethiopia.Guraghe zone is found in southern Ethiopia. The district is located 125Km south west of Addis Ababa and generally characterized by highlands and lowlands.Geographically, it located between $7^0$76' and $8^0$45'N latitude and $37^0$46' and $38^0$71'E. The border area is Awash River in the North, the Gibe River, and a tributary of the Omo River, to the southwest, and LakeZway in the east.The zone has 13 districts and two administrative cities (Welkite and Butajira town). It covers an area of about 5932km. there are 403 rural and 20 urban kebele (the smallest administrative units with population of 5000 on average) in the zone. There were a total of 1,542,131 populations in 2016, about 84% of which live in the rural areas (SNNPRDH, 2016).Guraghe zone is rich in livestock with a population of cattle 2223527, sheep 785575, goat 733520, poultry 3686801, horse 123404, mule 31409, and donkey 252706(GZAFRD, 2020).

Source and study population

Animals involved in this retrospective study were all indigenous and crossbred cattle population of all age groups above twelvemonth. The area were purposively selected based on the accessibility, lack of seroprevalence information, presence of livestock markets activity, production and management system, history of contact with wild life and transboundary animal's movement from other area of neighboring Oromia Regional State of Ethiopia. These districts share similar farming system but different in agrological locations.

Study design and study period

Retrospective study was carried out to describe LSD burden by animal, place and time in Guraghe between 2015 and 2020.

Data collection

Relevant data such as the disease (LSD) occurring periods/years, different districts and the type of species affected by the disease of six years were collected by the DOVAR report data from different districts of weredas, Guraghe Zone Animal and Fisheries Resource Office and Sodo Regional Veterinary laboratory center.

Data management and analysis

The data were obtained from DOVAR II in Microsoft access database maintained by Federal Agriculture Minister, Animal health department. Those data were transferred into a spreadsheet program (Microsoft excel 2007). The main variables in this study were; the number of animal at risk, number of suspected cases and deaths due to LSD, month and year of LSD outbreak, district in the zone, and age and species of animal affected. Analysis of the data was performed by using pivot table on the excel-sheet.

Operational definitions

Operational definitions: LSD, 2015-2020. Based on the title of the project work the followings are terms and their corresponding definitions.

"Analysis" means an investigation of the component parts of a whole and their relations in making up the whole;

"Data" means a collection of facts from which conclusions may be drawn;

"District" means a region marked off for administrative purpose or for other purposes;

"Fatality rate" means the ratio of deaths in an area; expressed per 1000 per year;

"Infection" means the pathological state resulting from the invasion of the body by pathogenic microorganism;

"Morbidity" means the relative incidence of a particular disease;

"Mortality rate" means the ratio of deaths in an area to the population of that area; expressed per 1000 per year;

"Outbreak" means a sudden violent spontaneous occurrence of a disease;

"Population" means the entire aggregation of items from which samples can be drawn**;**

"Surveillance" means the ongoing systematic collection and analysis of data about an infectious disease that can lead to action being taken to control or prevent the disease;

"Suspected Case" means an animal showing clinical signs overlapping the main characteristics of the disease.

"TADs" means transboundary animal diseases; are those livestock diseases which have high economic importance and have a nature of epidemic, pandemic and sporadic;

"Zone" means a region marked off for administrative purpose or for other purposes but a little bit it's wider than a district;

Results

LSD burden by time

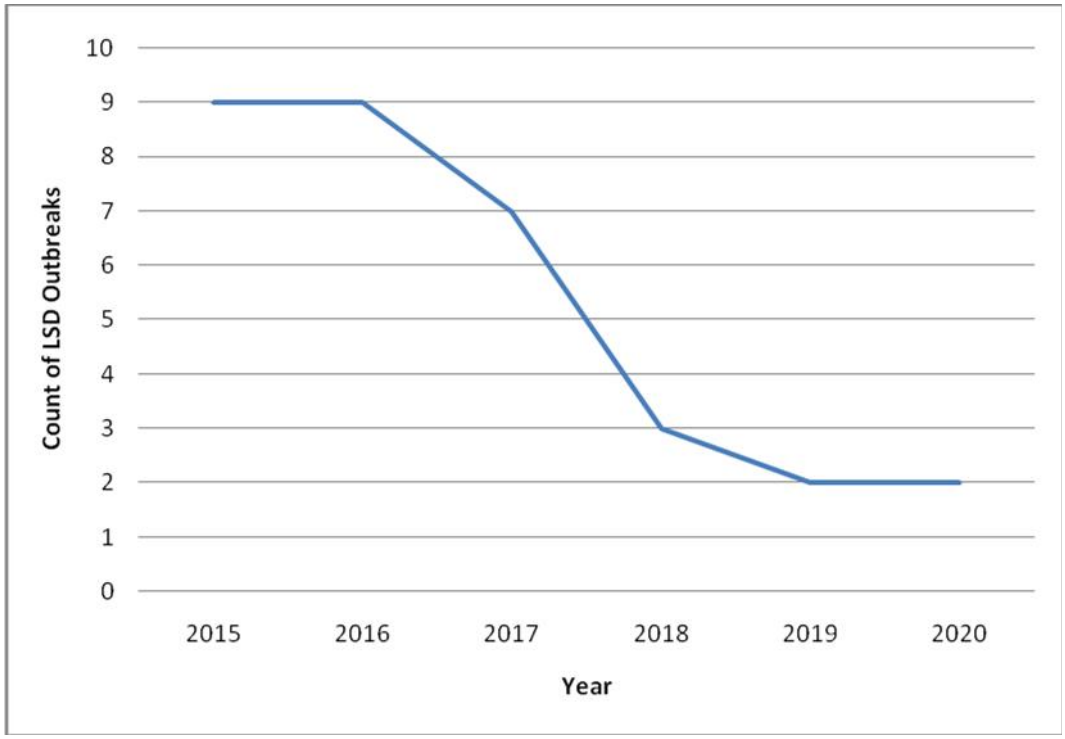
The results of this retrospective study showed that a total of 32 outbreaks of LSD were recorded at the wereda level from 2015 to 2020 with 4710 cases and 17 deaths were reported. The largest number of cases was recorded in 2015, which was 1,611 (34.20%) and least in 2018 which was 36 (0.76%). On the other hand, highest number of deaths was recorded in 2019, 7(41.18%); whereas in 2018 and 2020 no death was reported(Table 1).

Table1: LSD outbreaks by year, suspected cases and death, 2015-2020

Year	No. of outbreak	No. of Cases	No. of Death
2015	9	1611	6
2016	9	1017	2
2017	7	891	2
2018	3	36	0
2019	2	138	7
2020	2	1017	0
Grand Total	**32**	**4710**	**17**

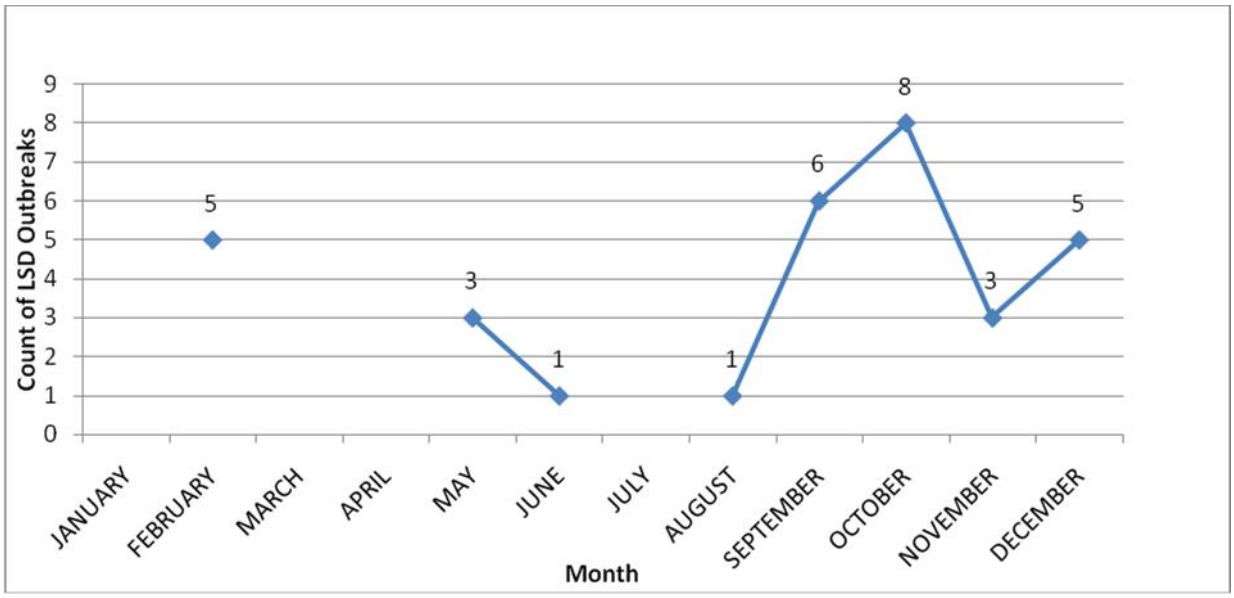
Table 1 and Figure 1 illustrate that highest number of outbreaks were reported from 2015 and 2016, 9(28.12%). The lowest report were 2019 and 2020, was 2(6.25%). Others, 2017 were reported 7(21.88%) and 2018 were 3(9.38%).

Figure1: Number of LSD outbreaks, Gurage 2015-2020



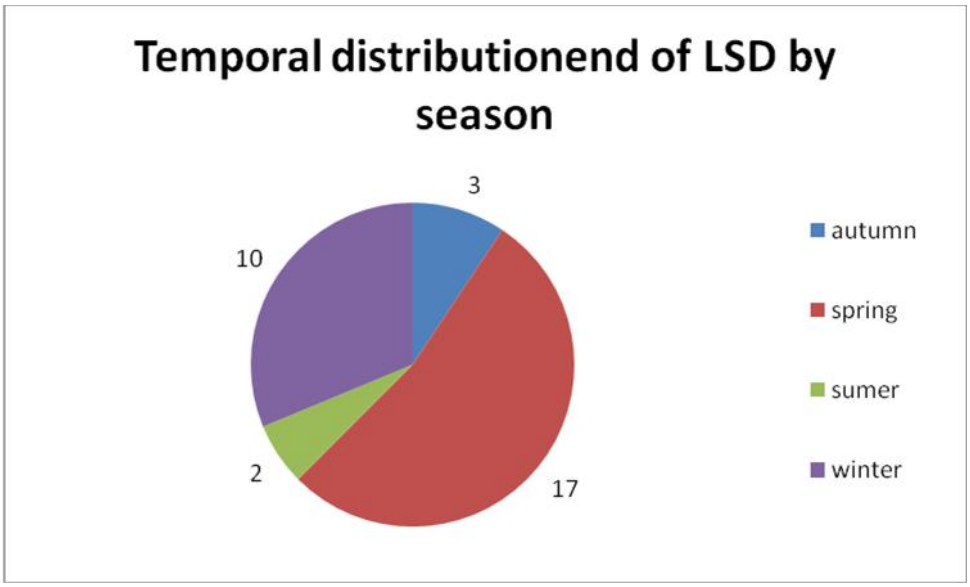
During the period from 2015-2020, 32 LSD outbreaks were reported in eight months. The most LSD outbreaks were reported in October 8(25%) and the least were the same in June and August 1(3.12%) No outbreak occurrences were reported in January, March, April and July during the period 2015-2020 as indicated in figure 2.

Figure 2: LSD outbreaks by months of the year, Gurage, 2015-2020



When the overall data were grouped by season, the highest occurrence was reported in spring 17(53.12%) followed by winter 10(31.25%). The lowest occurrence was in Sumer 2 (6.25%) as indicated in (Figure 3).

Figure 3: LSD outbreaks by season of the year, Gurage, 2015-2020



As shown in Table 2 below, the highest morbidity rate was in 2017 (2.43%) and the lowest was in 2018 (0.28%). The highest case fatality rate was in 2019 (5.09%). However, the mortality rate was generally very low.

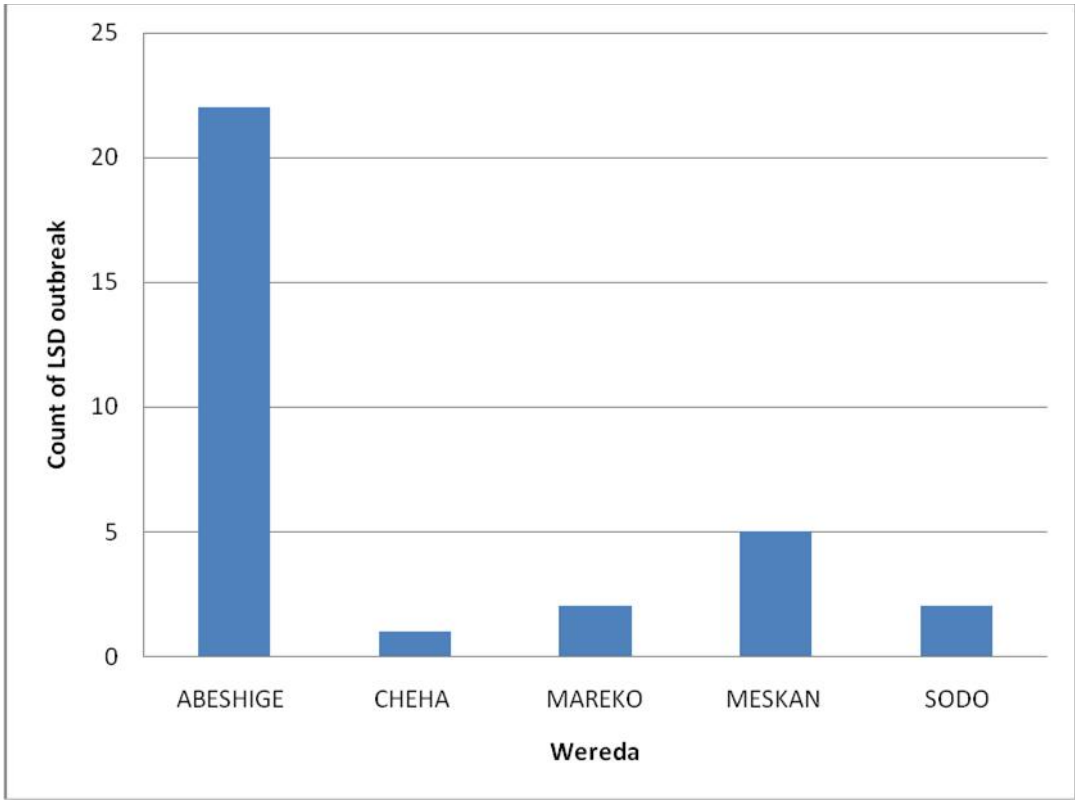
Table 2: LSD Morbidity rate, Mortality rate and CFR by year, Gurage, 2015-2020

Year	Morbidity rate %	Mortality rate %	CFR %
2015	1.13	0.004	0.37
2016	2.38	0.004	0.19
2017	2.43	0.005	0.22
2018	0.28	0.00	0.00
2019	0.76	0.03	5.07
2020	2.05	0.00	0.00

LSD burden by districts: Spatial distribution

LSD outbreaks were reported from five districts out of 13 weredas in zone, between 2015-2020. From the five districts, LSD outbreaks were reported from Abeshge district was the highest, 22(68.75%) and the lowest was reported in Cheha district, 1(3.13%). No occurrences of disease were reported in eight weredas such as;Gumer, Enemor, Welene, Essia, Muhuraklil, Geta, Endegagn and Kebena. The majority of the outbreak reports were from low land parts of the zone; and Abeshge and meskanweredas were the most frequently affected weredas (Figure 4).

Figure 4: LSD outbreaks by weredas, Gurage, 2015-2020



LSD burden by animal age

Animals were grouped into two age categories: young (1-3 years) and adult (>3 years). The most LSD were reported from all age groups 23(71.88%) and the least were between twelve months and thirty six months age 3(9.38%). Highest LSD cases were reported from all age groups 3243(68.85%) where as the lowest cases were between twelve months and thirty six months 528(11.21%) as indicated in (table 3).

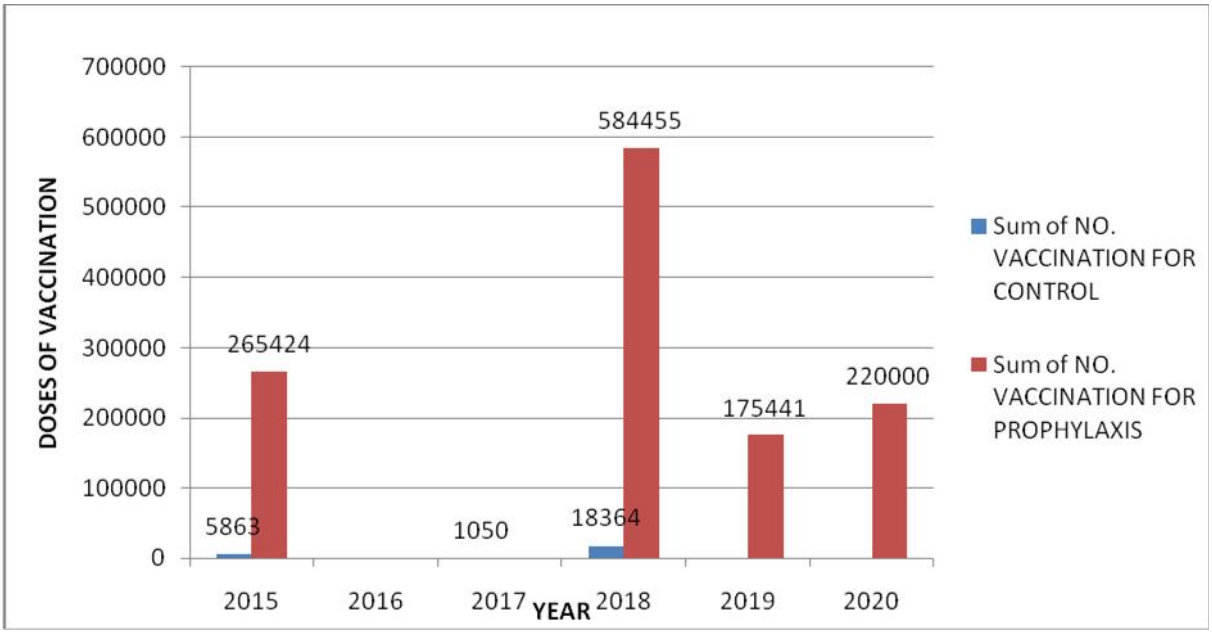
Table3: LSD cases by age, Gurage, 2015-2020

Year	1-3	>3	All age	Total no. of cases
2015	450	551	610	1611
2016	78	388	551	1017
2017	-	-	891	891
2018	-	-	36	36
2019	-	-	138	138
2020	-	-	1017	1017
TOTAL	**528**	**939**	**3243**	**4710**

LSD vaccination

The result of analysis revealed that a total of 1,269547 doses of vaccine were given during the 6-year period as a control and prophylaxis against LSD. Vaccination coverage of LSD is presented on figure 5 below. Highest number of prophylaxis vaccination was recorded in 2018 year (602819 doses of vaccine). As shown on the figure, vaccine given for prophylaxis of LSD (n= 1,244270 dose, 98%) was higher than that of vaccine given as control (n= 25277dose, 1.99%).

Figure 5: LSD vaccinations, Guraghe, 2015-2020



Discussion

This retrospective study revealed that high number of LSD outbreak occurred from August to January and this is comparable with the available LSD outbreak time series data and the reappearance of the seasonality in the original time series (Wassie *et al.*, 2017).

In the present study, the distribution of LSD outbreaks varies among areas. The highest LSDwas in hot dry lowland areas and the lowest in warm moist highland. This indicate that the parts of the zone which receive relatively high rain fall for a reasonable period of time is conducive for the replication and survival of blood feeding arthropods and then for the spread of the disease in the geographical areas Gari *et al.*, 2010; Ayelet *et al.*, 2014 and ETWW, 2016. The LSD outbreak incidence indicated for the different districts should be treated consciously because under reporting might result in an underestimated incidence and there might be data quality problems at the wereda level during reporting a monthly disease surveillance report /DOVAR.

In this study, it became clear that the occurrence of LSD in districts is sporadic. However, endemicity of the disease is maintained in the zone because the outbreaks in different districts do not occur at the same time which is in line with (Gari *et al.,* 2010).

The seasonal LSD outbreak variation might be related to the variation in temperature and rainfall between seasons leading to varying arthropod densities in the environment (Grassly and Fraser, 2006). Identification of temporal patterns can indicate times when particular attention should be paid to control the disease (Thrusfield, 2007). This might be attributed to the absence of a specific national strategy for LSD control or eradication (APHRD, 2012).

According to the result, the doses of prophylaxis vaccination given to the animals increased, the number of LSD outbreaks reported in zone decreased. However, research findings indicate that the vaccine used in Ethiopia is not fully protective (Ayelet *et al.*, 2013) which might be the reason for the increase in incidence of LSD outbreaks observed over the current study period. Because there is no regular vaccination program against LSD, this might attribute to a drop of herd immunity below the critical point and for the reoccurrence of the disease. Outbreak of LSD is controlled by ring vaccination (MOA, 2012).So far; it has not been possible to prevent the introduction of the infection in non-infected areas by applying measures of restriction and quarantine. Nevertheless, attention should be paid to introducing only those animals which comes from infection free regions in to areas where the disease has not so far been prevalent (Wassie, 2017).

The morbidity, mortality and case fatality rates of LSD were low respectively, indicating an impact posed by the disease is low to very low in the area. This may be due to the farming and management system practiced in the area which favors the vector transmission and poor nourishment of diseased animals which will die due to secondary disease. The morbidity rate was lower to report from the study in central Ethiopia with 13.61% (Ayelet *et al*., 2014) and morbidity (21.2%), and mortality rates (4.5%) Wassie *et al.*,2017) from Ethiopia than the current study were previously reported. On the other hand, morbidity rate of the disease in the current study was higher than the reported result from 0.65% in Turkey (Ince *et al*., 2016).

This study showed that suspected cases were recorded more in the age category of >3 years. This may be indicative of prevailing passive maternal immunity and low frequency of exposure. Similar to this finding Rweyemamu *et al.*, (2000) reported that, suckling calves showed the lowest attack rate, though in the dynamic model younger cattle did not show higher susceptibility to Infection in their study of mathematical modeling and evaluation of the different routes of transmission of lumpy skin disease virus during a certain outbreak. There were no previous reports of age related susceptibility to LSD. A possible alternative explanation for the lower outbreaks recorded in young in this study may be associated with lower susceptibility of young to biting by flies as previously described(Troyo*etal.*, 2008). Another potential explanation can be associated with location, as the lowest prevalence was documented in the calves, which were kept at homestead where there is less insect vector activity. The study revealed high outbreaks (71.88 %) in adults, in which the maternal immunity level drops and exposed to diseases, as the age increases.

Conclusions

From 2015-2020 32 LSD outbreaks were registered. The outbreaks were reported in most parts of the zone, especially from the hot and dry lowlands and the warm highlands. The disease was highly occurred and reported every year in Abeshgewereda next to Meskan at Guraghe zone. LSDwas mostly occurred at spring and winter season and; all ages of cattle were affected by the disease but young are less susceptible. Based on the conclusion, the following recommendations are forwarded.

Further research is required to know the major risk factors associated with the transmission of LSDV and their dynamics in different districts, implementation of quarantine system before new animals introduced to the herd and to develop the main method to control LSD is through ring and mass vaccination of cattle during summer season at guraghe.

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