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Epidemiological Analysis of Surveillance Data on Reportable Priority Cattle Disease Outbreaks and Vaccination Coverage in West Arsi Zone, Oromia, Ethiopia

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Abstract: A retrospective study was conducted from July 2022 to September 2022 at West Arsi Zone, Oromia Region, Ethiopia, to identify major reportable cattle disease outbreaks and to understand the incidence, seasonal distribution, vaccination coverage and the trend of cattle disease outbreaks using passive surveillance data (DOVAR). From 1,560 DOVAR reports expected to be obtained at West Arsi Zone Agriculture Office Epidemiology Unit between 2012 and 2021, only 1,476 (11%) reports were available. A total of 1,496 cattle disease outbreaks with 1,889 cases and 346 deaths were recorded. The outbreaks were caused by Lumpy Skin Disease (LSD) (35.7%), Blackleg (21.43%), Bovine pasteurellosis (15.71%), Foot and Mouth disease (FMD) (14.3%), Anthrax (11.42%) and Rabies (1.43%) in decreasing order. LSD was responsible for the highest cases (30.2%) followed by FMD (23.9%) while blackleg and LSD were the leading causes of cattle deaths, which accounted for 34.4% and 28.9% of the deaths recorded, respectively. In contrast, the lowest number of outbreaks, cases and deaths of cattle was caused by rabies. Disease outbreaks occurred in all the seasons of the year; however, a relatively higher number of outbreaks (60%) were recorded in the early dry season (September to November). This study has shown a very low level of disease outbreak reporting rate in the West Arsi Zone, which may be due to no reporting or no outbreak of diseases. Generally, this study generates information that will be used as a baseline for further epidemiological studies for the development of sustainable programs for the control of cattle disease outbreaks in the study area.

Key words: Epidemiology · Outbreak · Retrospective · Seasons

INTRODUCTION

Ethiopia has the greatest livestock population in Africa with 52 million cattle, 33 million sheep, 30 million goats and 2.5 million camels [1]. The predominant livestock production system in Ethiopia is an extensive system. The productivity of Ethiopia's livestock is lower despite the vast resource [2]. The animals' low genetic potential, inadequate nutrition and the widespread animal diseases are the main biological factors causing low productivity [1, 2]. The diseases' primary effects include death, low productivity, reduced quality of animal products including milk and meat, reduced ability to withstand drought and risk of zoonotic infections spreading to humans [3].

When it comes to the health impact of zoonotic diseases, Ethiopia tops Africa [4]. Numerous endemic and epidemic animal diseases in Ethiopia are caused by bacteria, viruses, protozoa and parasites, which reduce the production of the livestock industry. LSD, CBPP, FMD, Blackleg, Anthrax and Hemorrhagic septicemia are among the most important animal diseases (LDMFSB, 2016). A considerable number of countries were affected by LSD (63.26%), CBPP (48.97%) and FMD (48.97%) in 2010, mirroring the spatial distribution of the continent's key priority diseases in the past years [5]. Host factors,

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environmental factors, pathogen factors and climate conditions are the most significant risk factors for disease occurrence [6, 7]. The majority of infections spread and enters the body by skin contact, ingestion, or inhalation [8, 9]. The most serious priority diseases are caused by rapidly transmitting pathogens that produce acute and serious diseases in large numbers of hosts [4]. Their occurrence is maintained when an agent and susceptible hosts are present in adequate numbers and the agent can be effectively conveyed from a source to the susceptible hosts [10].

The controlling and management measures involve treating the cases, preventing the further spread of the disease and monitoring the effects of control measures [11, 12] and ring vaccination is sometimes termed 'emergency vaccination' (all susceptible animals on farms within a certain radius of the farm [13] and movement restriction [14, 15]. In Ethiopia, priority was given to decreasing the morbidity and the mortality of production-related diseases (mainly external and internal parasites); to trade-limiting diseases (FMD, ovine/caprine pox, LSD, CBPP); and to the prevention of other economically important diseases (blackleg and anthrax) [16].

Epidemiological analysis of accumulated passive surveillance data of animal diseases holds great potential in uncovering disease trends both temporally and spatially and ?aws if any on the passive surveillance mechanisms in place. In addition, it may expose new knowledge gaps to inform research and provide critical information for the formulation of control programs. Compared to active and passive surveillance methods in the detection of cerebrovascular disease, active surveillance had a lower positive predictive than passive surveillance. In addition, passive surveillance systems are usually less costly [17].

Data from DOVAR reports were obtained from West Arsi Zone Agriculture Office Veterinary Epidemiology Department and case records of thirteen [13] woredas of West Arsi Zone. The surveillance data of woredas are collected from the farmers at the clinic level and shared with the zone agriculture office, the Asella regional veterinary laboratory, the Oromia Agriculture Office and the Ministry of Agriculture Epidemiology Directorate. It is in line with the government's organizational structure. Copies of some of the reports (DOVARs) are retained in the woredas and Zone office. This study also revealed that there is a problem with the quality of animal health surveillance data. As a rule, woredas report disease outbreaks (whether an outbreak occurs or not) once every month.

There were a few outbreaks of cattle diseases in various regions of the country. This may be due to underreporting of outbreaks by their administrative kebeles or woredas. Hence, the cumulative effects of these errors result in a small number of outbreaks documented in Ethiopia. A study by Bayissa and Bereda [18] indicated that transport and communication were the two limiting factors in disease reporting in Ethiopia. 'These problems could result in irregular or absence of outbreak reports for some remote health posts. Web-based software, such as ADNIS, which was recently created for reporting livestock diseases in Ethiopia, would make it possible to track field instances of all diseases on a daily basis and aid in the improvement of the prompt reporting of animal disease outbreaks.

General Objective of the Study:

- To identify major priority reportable cattle disease outbreaks and to assess the trends and vaccination coverage in West Arsi Zone, Oromia, Ethiopia.

Specific Objective of the Study:

- To assess the occurrence of cattle disease outbreaks, cases and deaths
- To identify the season of major priority reportable cattle disease outbreaks
- To assess vaccination coverage
- To determine the trend of cattle disease outbreaks

MATERIALS AND METHODS

Study Area: The study was carried out in West Arsi Zone, Oromia Regional State, of Ethiopia from July 2022 to September 2022. West Arsi Zone is one of the 21 zones of Oromia regional states, which was established on May 1998 E.C. Shashemene town is the administrative center of the zone. It is situated about 245 Km south of Addis Ababa, the Capital city of Ethiopia It is located in the rift valley region. The zone extends from 6012'29" to 7042'55" latitude and 38004'04" to 39046'08" longitude. Most parts of the zone have elevations of ranging from 1500 to over 2300 masl with a mean annual temperature of 20-25°C in the highland and 10-16°C in the lowland area as well as annual rainfall of 1300 mm. The zone is divided into three main agro-climatical zones, highland, midland and lowland which comprise 45.5%, 39.65% and 14.9%, respectively [19]. According to the data recorded in the zone office, the livestock population of the zone is; cattle: 2,705,019; goats: 491,394 sheep: 1,016,129; horses: 248,231; donkeys: 236,665 and poultry: 85,492 [19].

Study Design: A retrospective study design was employed to identify priority reportable cattle disease outbreaks between 2012 and 2021 which was extracted from the Veterinary Epidemiology Department of West Arsi Zone Agriculture Office as well as from the Agriculture Office Animal Health Department of each woreda. Disease outbreak reports collected from all woredas in the zone were searched thoroughly.

Study Population: The study includes all indigenous and crossbred cattle populations of all age groups in the area.

Data Collection Methodology: The records of priority reportable cattle diseases documented in all 13 woredas of West Arsi Zone over the past ten (10) years were reviewed from the DOVAR report and then recorded in a specially designed format. Factors that affect the occurrence of disease outbreaks, vaccination activity and the agroecology of the Woredas were also assessed.

Study Procedure: The records included information such as woredas, zone, species affected, index date, number of cases, number of outbreaks, number of deaths, number of animals vaccinated and the population at risk. For this study, DOVAR reports of woredas were assessed and reported outbreaks were extracted and recorded. During data collection, consent was taken from the Epidemiology Unit of West Arsi Zone Agriculture Office Animal Health Department to use the data for this study.

Data Management and Analysis: The data were checked manually for inconsistencies, recording errors, or missing data. The potential errors were evaluated and corrected. Data with suspicious values were excluded. Lastly, the data were coded and entered into the spreadsheets of a Microsoft Excel and analyzed. Descriptive statistics were used to summarize the number of outbreaks, cases and deaths that occurred during the period in animal, place and time.

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

Data: Means a collection of items of information;

Woreda: Means a region marked off for administrative purposes or other purposes;

Case Fatality Rate: Measures the severity of a particular disease by defining the total number of deaths as a proportion of reported cases of a specific disease at a specific time;

Infection: Means the pathological state resulting from the invasion of the body by a pathogenic microorganism;

Morbidity: Means the amount of disease in a population (commonly defined in terms of incidence or prevalence);

Mortality Rate: Means an incidence rate in which the numerator is the number of deaths occurring in a population over a defined period. The denominator is the population at risk over that time period;

Outbreak: Means an identified occurrence of disease involving one or more animals. The term sometimes refers to a bout of disease occurrence stemming from a single source, irrespective of the number of premises involved;

Population at Risk: Means the population that is naturally susceptible to disease;

Surveillance: Is the systematic ongoing collection, collation and analysis and interpretation of data and the timely dissemination of information to those who need to know so that action can be taken;

Suspected Case: Is an individual animal or herd which exhibits the clinical signs and symptoms of the disease. This includes signs and symptoms frequently found for that disease or signs and symptoms that help distinguish the disease of interest from other diseases.

TADs: Means Trans boundary animal diseases; are those livestock diseases that have high economic importance and have a nature of epidemic, pandemic and sporadic;

Zone: Means a region marked off for administrative purposes or other purposes which is a little bit it's wider than a woreda;

RESULTS

Priority cattle disease outbreaks, cases and deaths reported from West Arsi Zone between 2012 and 2021) are summarized in Table 1. Though the total number of

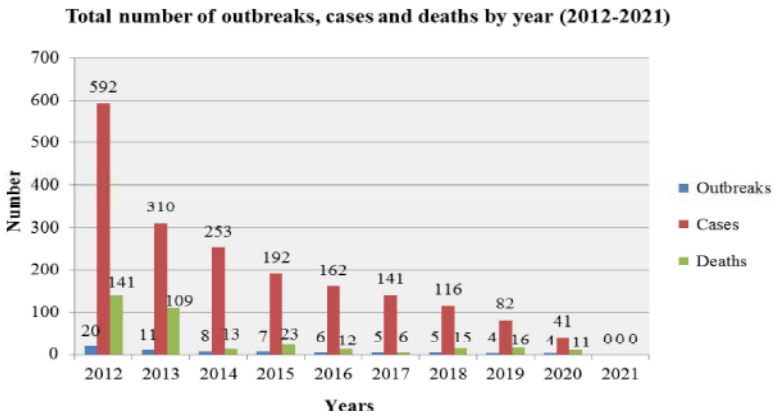

Fig. 1: Total number of cattle disease outbreaks, cases and deaths at West Arsi Zone (2012-2022)

Table 1: Total number of cattle disease outbreaks, cases and deaths reported during the period (2012-2021)

S.N	Woreda	No. of reports expected	No. of reports submitted	Total Outbreak	Total cases	Total deaths
1	Shashemene	120	105 (87.5)	10 (14.3)	389 (20.6)	69 (19.9)
2	Arsi Negelle	120	106 (88.3)	5 (7.1)	49 (2.6)	17 (4.9)
3	Wondo	120	114 (95)	0 (0.0)	0 (0.0)	0 (0.0)
4	Heban Arsi	120	100 (83.3)	12 (17.1)	170 (8.9)	43 (12.4)
5	Shalla	120	103 (85.8)	3 (4.3)	66 (3.5)	25 (7.2)
6	Siraro	120	88 (73.3)	2 (2.8)	12 (0.6)	5 (1.4)
7	Kofele	120	104 (86.6)	3 (4.3)	675 (35.7)	43 (12.4)
8	Dodola	120	114 (95)	2 (2.8)	22 (1.2)	9 (2.6)
9	Gedeb Hasasa	120	109 (90.8)	5 (7.1)	54 (2.8)	22 (6.3)
10	Adaba	120	111 (92.5)	9 (12.8)	137 (7.3)	38 (10.9)
11	Kokosa	120	110 (91.6)	2 (2.8)	123 (6.5)	12 (3.5)
12	Nensebo	120	101 (84.2)	16 (22.8)	182 (9.6)	58 (16.7)
13	Kore	120	105 (87.5)	1 (1.4)	10 (0.5)	5 (1.4)
Total		1,560	1,370 (87.8)	70	1,889	346

reports expected during the period is 1,560; only 1,370 (87.8%) is available. The highest numbers of DOVAR reports were from Wondo and Dodola woredas while the lowest report was from the Siraro woreda (73.3%). The study revealed that the total number of outbreaks, cases and deaths was 70, 1889 and 346 respectively. The highest number of disease outbreaks was reported from the Nensebo woreda (22.9%).

Cattle Disease Outbreaks Burden by the Time: The results of this study showed that a total of 70 cattle disease outbreaks occurred in the area from 2012-2021 with 1889 cases and 346 deaths. The highest case was reported in 2012 (31.3%). On the other hand, the highest number of deaths was recorded in the same year (40.7%) followed by 2013 (31.5%), 2015 (6.6%) and 2019 (4.6%). The lower number of deaths was reported in 2017 (1.7%) and no outbreak was reported in 2021 as shown in Figure 1.

The temporal distribution/ pattern of cattle disease outbreaks showed that the occurrence was declining (Figure 2).

From the thirteen (13) woredas of West Arsi Zone, a higher number of cattle disease outbreaks was reported from Nensebo woreda 16 (22.9%) and the lowest was reported from Kore woreda, 1 (1.4%). No disease outbreak occurred in Wondo wereda (Figure 3).

Based on the report of symptomatic diagnosis, the outbreaks reported are caused by six diseases, namely Anthrax, Blackleg, Bovine pasteurellosis, Foot-and-Mouth disease (FMD), Lumpy Skin Disease (LSD) and Rabies. The highest number of outbreaks reported were caused by LSD 25 (35.7%) followed by Blackleg 15 (21.4%), Bovine pasteurellosis 11 (15.71%), FMD 10 (14.3%), anthrax 8 (11.4%) and rabies 1 (1.43%). Concerning the number of cases, LSD was the highest (30.2%) followed by FMD (23.9%), Blackleg (20.1%), Bovine pasteurellosis (16.3%) and anthrax (8.6%).

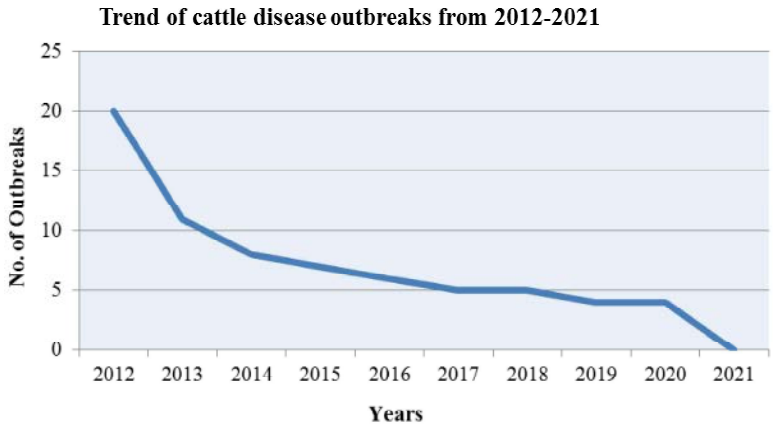

Fig. 2: Trend of cattle disease outbreaks over the last 10 years at West Arsi Zone

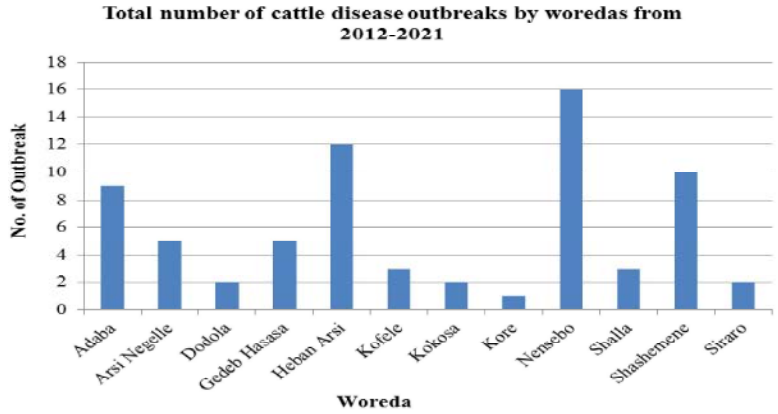

Fig. 3: Cattle Disease Outbreaks by Woredas of West Arsi Zone (2012-2021)

Table 2: Number of outbreaks, cases and deaths reported to West Arsi Zone during 2012-2021

	Outbreaks		Cases		Deaths	
Diseases	Total number	Proportion (%)	Total number	Proportion (%)	Total number	Proportion (%)
Anthrax	8	11.42	162	8.6	30	8.67
Blackleg	15	21.43	380	20.1	119	34.4
Bovine Pasteurullosis	11	15.71	308	16.3	57	16.47
LSD	25	35.7	570	30.2	100	28.9
FMD	10	14.3	452	23.9	35	10.11
Rabies	1	1.43	17	0.9	5	1.46
Total	70	100	1889	100	346	100

Blackleg and LSD were the leading causes of cattle deaths, which accounted for 34.4% and 28.9% of the deaths recorded, respectively. The study revealed that Rabies outbreak occurred in cattle rarely. (Table 2).

The spatial distribution of the disease outbreaks displayed in Figure 6 shows that a higher number of anthrax and FMD outbreaks were reported from Heben Arsi woreda, Blackleg and Bovine pasteurellosis from Nensebo woreda and LSD outbreak from Shashemene woreda while rabies from Shalla woreda only.

The seasonal distribution of outbreaks from each disease is presented in Figure 7. It can be noted that anthrax and bovine pasteurellosis outbreaks were reported in all seasons of the year. Higher numbers of outbreaks were recorded in the early dry, Dry, Long rainy and Short rainy seasons in descending order. The highest frequency of occurrence especially due to anthrax, blackleg, bovine pasteurellosis and LSD was recorded in the early dry season (Sep-Nov). The occurrence of FMD outbreaks was similar in the early dry (44.4%) and dry (44.4%) seasons than in other seasons.

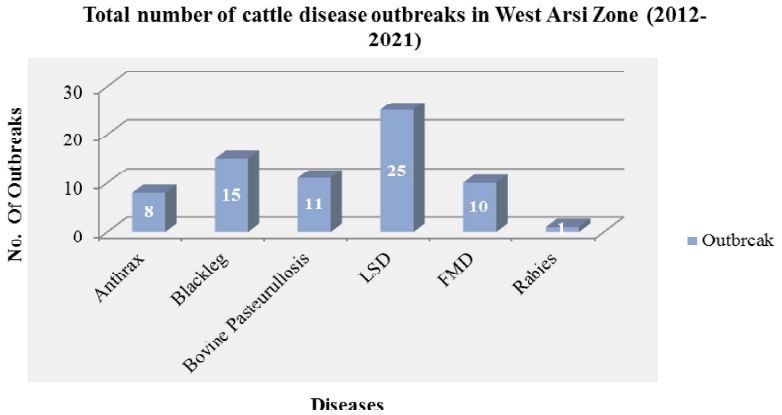

Fig. 4: Number of outbreaks reported during 2012-2021 in West Arsi Zone, Oromia, Ethiopia

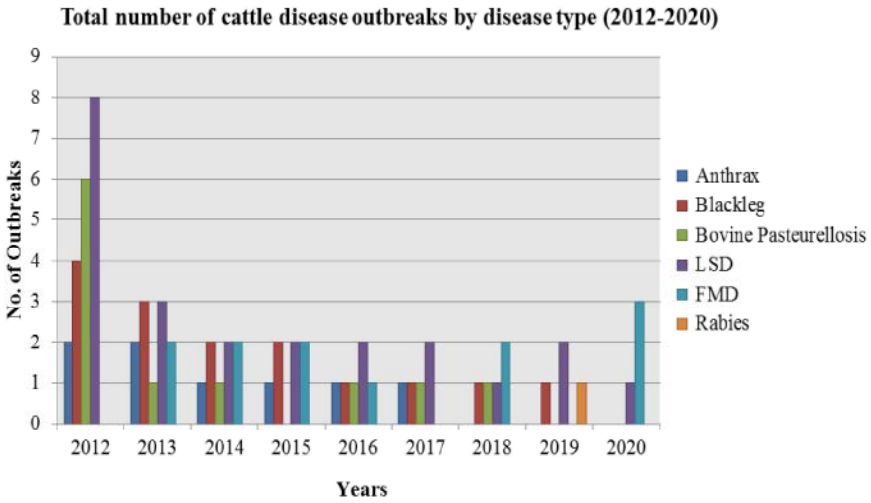

Fig. 5: Total number of cattle disease outbreaks by disease type from 2012-2021

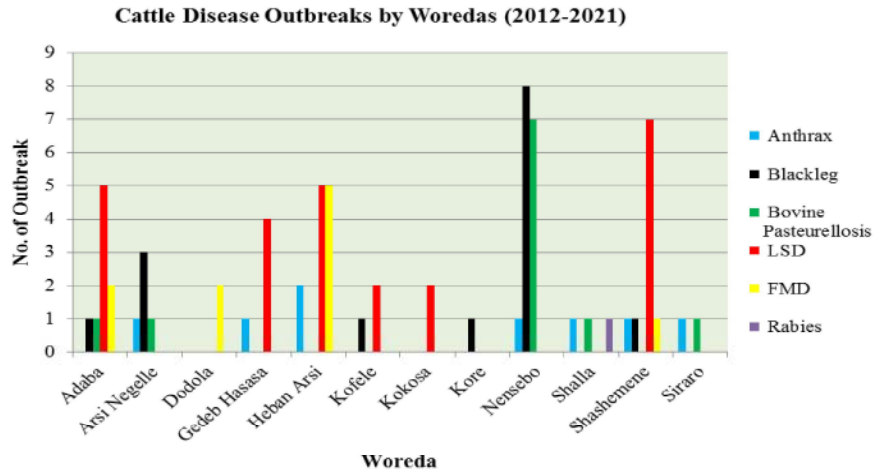

Fig. 6: Spatial distribution of disease outbreaks recorded by disease type in woredas'

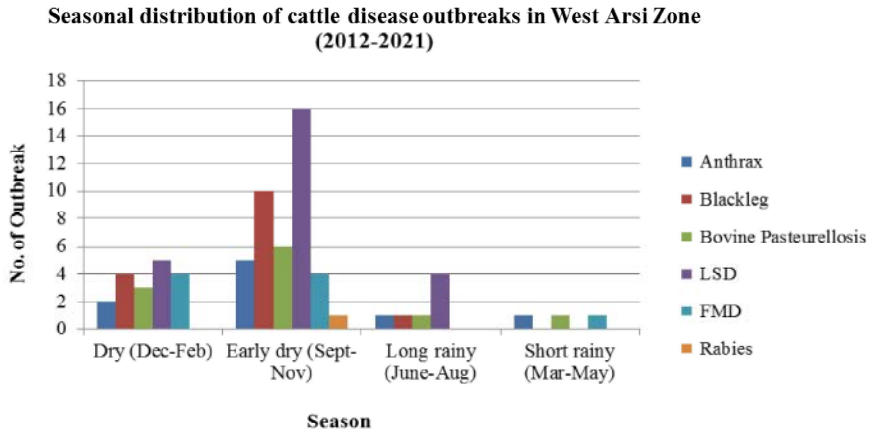

Fig. 7: Seasonal distribution of cattle disease outbreaks in West Arsi Zone (2012 – 2021)

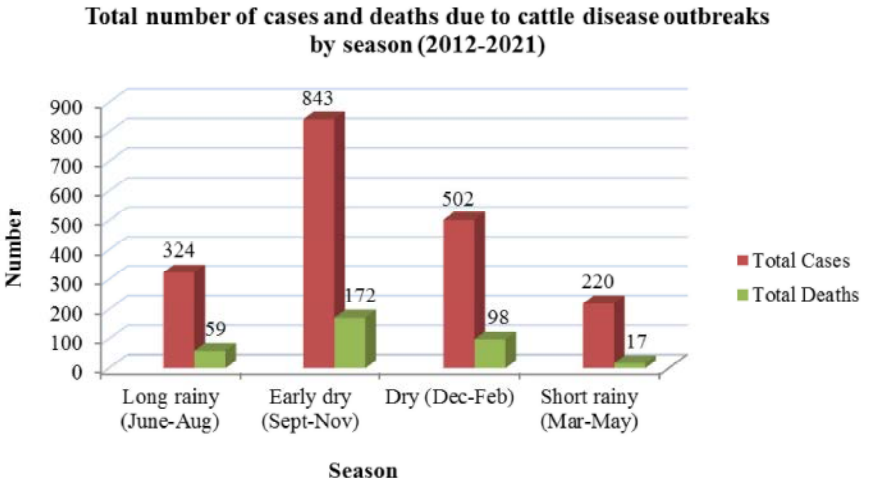

Fig. 8: Total number of cases and deaths by cattle disease outbreaks by season (2012-2021)

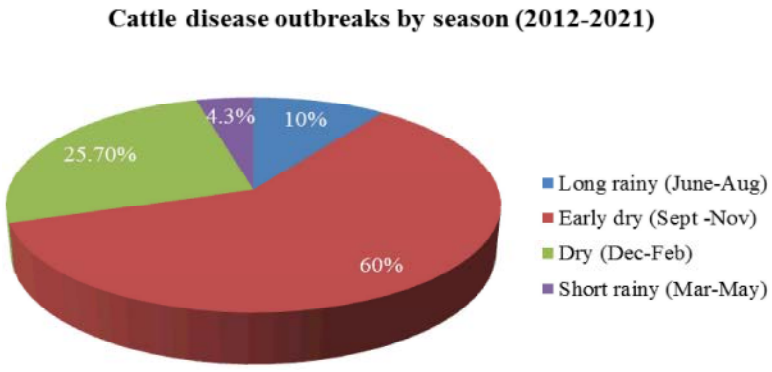

Fig. 9: Proportion of cattle disease outbreaks by season (2012-2021)

The seasonal distribution of cases from each cattle disease during the study period has been shown in Table 3. Morbidity cases from all diseases were reported across all the seasons; however, as with outbreak reports, morbidity cases from Blackleg, Bovine pasteurellosis, LSD and FMD were relatively higher in the early dry than in other seasons. In contrast, anthrax cases were higher in the short rainy than in other seasons. Although the total cases of rabies are fewer compared to other diseases, the frequency of occurrence was relatively higher in the dry season.

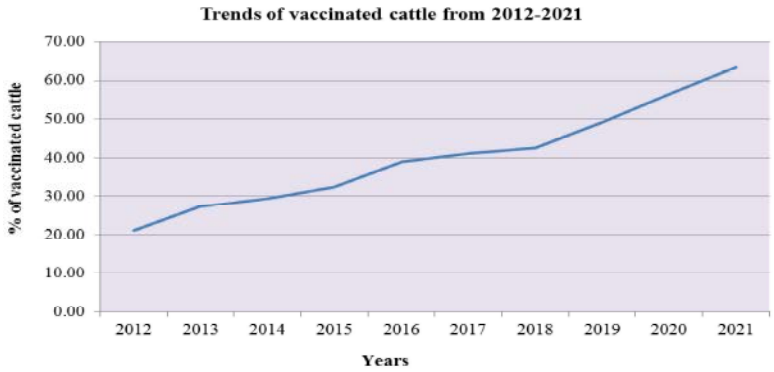

Fig. 10: The trend of vaccinated cattle in West Arsi Zone from 2012-2021

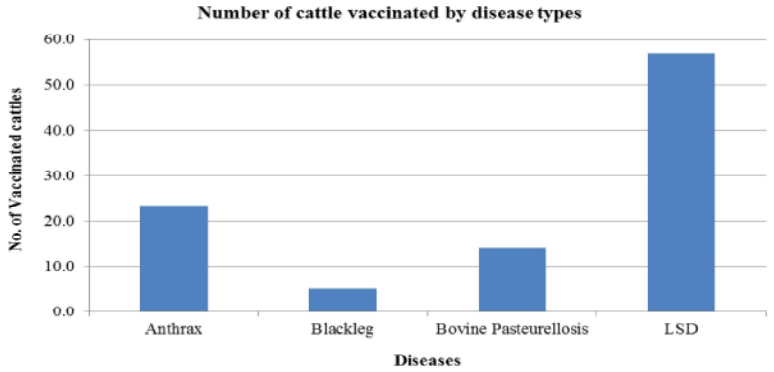

Fig. 11: The number of cattle vaccinated by disease types from 2012-2121

Table 3: Seasonal distribution of cases from each cattle disease outbreak reported

	Number of cases from each disease						
Seasons	Anthrax	Blackleg	Bovine Pasteurellosis	LSD	FMD	Rabies	Total cases
Early dry	45	117	105	213	182	10	843
Dry	44	90	41	123	153	15	502
Short rainy	69	103	70	102	95	12	220
Long rainy	20	98	92	185	50	0	324
Total	178	408	308	623	480	37	1889

The number of cattle vaccinated in ten years period against the four diseases is presented in the following figures. It was noted that nearly 10 million cattle were vaccinated for all diseases during the period and shows an increase in number from year to year; however, the vaccination coverage varied from disease to disease. The highest proportion of vaccination was done for LSD (56.9%) and the lowest for Blackleg (5.2%) while no vaccination was done for rabies and FMD.

DISCUSSION

Retrospective studies, based on data collected through passive surveillance, have contributed greatly to understanding animal disease epidemiology in different parts of the world. However, the findings in this study need to be interpreted with caution because of the likely biases in the reporting system of different woredas of the study area. All reported cattle disease outbreaks in this study were suspect cases that were diagnosed based on the clinical manifestations only.

According to the current study, a total of 70 priority cattle disease outbreaks with 1889 cases and 346 deaths occurred in the study area from January 2012 to December 2021. The study showed that consistently high numbers of cases were reported from Nensebo, Heban Arsi, Shashemene, Adaba and Negelle Arsi woredas. In different parts of the country, there was a little number of outbreaks of cattle diseases which might be due to underreporting of outbreaks by the sub-locals. A study by Bayissa and Bereda [18] indicates that transport and communication were the two limiting factors

in disease reporting in Ethiopia. These problems could result in irregular or absence of outbreak reports for some remote health posts.

The present study revealed that cattle disease outbreaks were caused by LSD (35.7%), blackleg (21.43%), Bovine pasteurellosis (15.71%), FMD (14.3%), anthrax (11.4%) and rabies (1.43%) in decreasing order which is slightly similar with the findings of Berhanu and Shibru [20]. Concerning the number of cases reported, diseases were ranked as LSD (30.6%), FMD (23.6%), Blackleg (20.05%), Bovine pasteurellosis (15.14%), Anthrax (8.75%) and Rabies (1.8%) in descending order.

The temporal pattern of disease occurrence showed a decreasing trend in the number of outbreaks. This change is associated with the application of effective prevention and control measures like prophylactic vaccination because the annual vaccination coverage shows a considerable increase over the period. This finding contradicts Mondal and Yamage [21]. Although disease outbreaks were recorded in all the seasons of a year, more outbreaks were reported in the early dry season (September through November), which comes after the long/heavy rain season (June-Aug) and outbreaks were relatively lower in the short rainy season (March-May) [20, 21].

In this study, there were significant variations in the occurrence of cattle disease outbreaks between woredas, months and years. This agrees with the study conducted by AU-IBAR [22], in the greater horn of Africa and Kenya. According to AU-IBAR [22], seasonal weather variations and livestock mobility causes stress and can compromise the immune response of animals; livestock mobility favors the contact between infected and susceptible herds; the presence of naive populations within an infected region is a major predisposing factor during epidemics; parasitism, bacterial infections and unregulated trade are favoring conditions for the emergence of cattle disease outbreaks. As studied by Zangana and Abdullah [23], poor-conditioned animals, overcrowding, poor feeding, general mismanagement and abnormal uses of vaccination appeared to be the main cause of distribution and susceptibility to infection with the different diseases.

In the present study, Blackleg was responsible for the highest proportion of deaths (34.4%) over the period and its outbreak was noted in the early dry (66.6%) season while the outbreak was not reported in the short rainy season. This is nearly similar to the study conducted in India by Sivakumar *et al.* [24] (33.03%) from March to May. The seasonal occurrence of the disease is mainly observed in early dry (September-November) (30%) followed by dry (December-February) (26%) seasons which indicated that the occurrence of the disease depends on the season Outbreaks are often associated with alternating heavy rainfall and drought and high temperatures [25]. Immature animals and those in good condition are relatively more susceptible and hereditary differences in susceptibility have also been observed [7].

In this retrospective study, the highest number of outbreaks occurred by LSD (35.7.6%) followed by blackleg (21.43%) and Bovine pasteurellosis (15.7%). Blackleg is associated with areas of high humidity and occurs during rainy seasons. There is an agreement with Sutmoller *et al*. [26].

In this study, Bovine pasteurellosis was the other major cause of disease outbreak (15.7%) during the period next to blackleg. It is fatal septicemia which is influenced by the season of the year. Its incidence was highest during the early dry season which is similar to the finding of the retrospective study conducted in Bangladesh by Mondal and Yamage [21]. The mean *B. pasteurellosis* mortalities increased with an increase in rainfall [24]. Moist conditions also prolong the survival of the causative agent (*P. multocida*). This concept agrees with the concept of Mondal and Yamage [21].

LSD accounted for the highest (30.6%) proportion of cases over the reporting period and it was responsible for the highest proportion of deaths (28.9%) next to blackleg. The proportion of LSD outbreaks (35.7%) and morbidity cases (30.6%) were found to be higher in the early dry season than in other seasons. This result is due to the fact that LSD is a viral infectious disease of cattle that disseminate through vectors and this season is favorable for vector (culex mirifinces and others) multiplication/ reproduction [27].

The number of FMD outbreaks increased during early dry and dry seasons, probably due to the favorable environmental conditions of dry weather, dry winds and moderately high relative humidity. This is also the time of the year when migration and movement of livestock are common, especially in rural livestock fairs [28]. The disease occurrence is highest in both the early dry season (Sept-Nov) (44.4%) and the dry season (44.4%). Seasonally, the highest number of FMD cases reported was found to be registered in the early dry season (39.8%) followed by dry seasons (25.6%) [21]. The reason for the highest occurrence may be due to the massive movement of the cattle population in search of pasture and water points. So, many herds of cattle meet at such places, thereby hastening the spread of infection from one herd to another [29].

According to the present study Anthrax outbreaks were reported in all seasons but more frequently in the early dry (27.1%) and dry (29.4%) seasons than in the short rainy (25.3%) and rainy seasons (18.2%) [30]. The study conducted in Bangladesh by Mondal and Yamage [21] stated that environmental factors, including high ambient temperature and relative humidity that provide a situation for the germination of anthrax spores from infected carcasses thrown into flood waters or in open fields, may favor the presence of anthrax. Anthrax cases were reported mostly in the short rainy (spring season) (38.7%) which relatively agrees with the finding of Teklu *et al.* [31]. This is possibly due to the fact that this season is often hot and the condition is favorable for spore formation. The soil was also significantly disturbed during this time (cultivation season), which possibly disturbed old anthrax grave sites. This agrees with the concept of Shiferaw [32].

Generally, outbreaks develop when a large population of susceptible animals is present. If immunized animals are present in the herd, then outbreaks cannot occur until a sufficient number of young, non-resistant animals have been bred or non-immune animals from outside are introduced into the herd [33]. Vaccination programs are effective when a large proportion of the population is protected: usually, at least 72% of the susceptible cattle need to be vaccinated [34].

In the study area, the percentage of cattle vaccination against LSD was high. This finding agrees with the findings reported by Mulualem and Fekadu [35], which show that the Lumpy Skin Disease vaccine was increasing year to year, from 10% to 19%. The vaccination service for list A diseases was subsidized to be given free of charge. The prices of vaccination service for list B diseases per dose ranges from 0.90 cents to 1.85 ETB. This service payment may also have an impact on the difference in vaccination numbers between diseases [36-40].

CONCLUSION AND RECOMMENDATIONS

The current retrospective study revealed that Anthrax, Blackleg, Foot and Mouth Disease (FMD), Bovine pasteurellosis, Lumpy Skin Disease (LSD) and Rabies were the major causes of cattle disease outbreaks in West Arsi Zone. LSD was the leading cause of disease outbreaks in cattle followed by Blackleg, Bovine pasteurellosis and FMD while rabies accounted for the least proportion of outbreaks. The occurrence of outbreaks was mostly season-dependent. Seasonally, a dominant cattle disease outbreak was reported in the early dry season. Vaccination coverage was increasing from year to year. A higher number of LSD vaccinations were undertaken from 2012-2021 resulting in decreased outbreak occurrence. A very low level of disease outbreak reports was obtained, which may be due to misreporting or no outbreak of diseases. In general, this retrospective epidemiologic study will aid in the identification of disease risk factors, aiding in the launch of effective local control initiatives.

Based on the above conclusion, the following recommendations are forwarded:

- Differential and confirmatory laboratory diagnosis on the report of outbreaks, cases and deaths should be developed.
- The outbreak, cases and deaths should be reported in a monthly disease occurrence reporting format by woredas without interruptions
- Strategic disease prevention program through vaccination
- Continuous data analysis and feedback to all stakeholders should be conducted on regular bases to improve the quality of animal surveillance data.
- Further research is required to know the major risk factors associated with the transmission of animal diseases and their dynamics in different woredas.
- The disease surveillance and reporting system of woredas should be improved.

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