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Research Article

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Participatory epidemiological study on the occurrence of reportable priority cattle diseases in two selected districts southern nations, nationalities and peoples' regional state

Abstract

A participatory epidemiological (PE) study was conducted between October 2016 and March 2017 in Southern Nations, Nationalities and Peoples Regional State (SNNPRS) to assess occurrence of reportable cattle diseases and the level of awareness of livestock keepers' towards cattle diseases. The PE study was conducted on 12 key informant groups (each comprising 8-12 members) selected from two districts (Bensa and Boloso Sore). Data collection tools used in PE study consisted of semi-structured interviews, simple scoring, matrix scoring, pair-wise ranking, proportional piling and seasonal calendars. Non-parametric tests and descriptive statistics were used to analyze data generated from PE. The study revealed that cattle are the most frequently kept and valuable livestock for the farmers (Kendall's coefficient of concordance, W = 0.79 & 0.80; p = 0.001 &<0.001). The informants underscored that they keep cattle mainly for cash income, traction power, milk production, meat production, and breeding in descending order of priority. However, diseases, feed and water shortage, labor power, inadequate veterinary service and poor market availability were claimed by the farmers to be the main constraints for cattle production. Based on the impact of the diseases on the morbidity and mortality of cattle and livelihood of farmers, the key informant ranked anthrax as the first disease followed by blackleg and HS. In pair-wise ranking of the diseases for their impact, a strong agreement was noted among the key informant groups in both of the districts (W = 0.95 & 0.47; p<0.001 & 0.023). The informant groups estimated that 31.5% of the total cattle population became ill by the five top diseases they listed during the year preceding this study of which 31.3% were died. Good agreement was evident among the informants groups concerning the seasonal occurrence of blackleg, HS, LSD, FMD and rabies (W = 0.42 – 0.93; p<0.05; <0.01 &<0.001) while weak agreement was obtained for seasonality of anthrax (W = 0.16; p>0.05). Informants agreed that the incidence of HS, LSD, FMD and rabies is higher in the long rainy season (Jun-Aug) while blackleg occurs most often in the dry season. In conclusion, in the PE study, a strong level of agreement was noted between the key informant groups in ranking the diseases in their frequency of occurrence, impact and seasonal distribution showing that livestock keepers have a good perception about cattle diseases occurring in their localities.

Keywords: constraints, epidemic disease, keepers, outbreak, participatory epidemiology, season

Volume 9 Issue 4 - 2020

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Received: July 27, 2020 | **Published:** August 25, 2020

Introduction

According to recent estimates, Ethiopia has 56.71 million cattle, 29.33 million sheep, 29.11 million goats, 1.16 million camels and 56.87 million poultry.[1–14] The predominant livestock production system in Ethiopia is extensive, where indigenous breeds are kept under low-input/low-output husbandry practices. Despite the huge resource, Ethiopia's livestock productivity is lower than the Africa's average. The major biological constraints contributing to low productivity include low genetic potential of the animals, poor nutrition and the prevailing animal diseases.[13] The main effect of the diseases include mortality, low production, reduced quality of animal products such as milk and meat, decreased drought power and risk of zoonotic diseases to man. Ethiopia ranks highest in Africa in the health burden of zoonotic diseases.[14–20]

In Ethiopia, there are several endemic and epidemic animal diseases caused by bacteria, viruses, protozoa, and parasites that compromise the productivity of the livestock sector. Among, the most important diseases are: LSD, CBPP, FMD, Blackleg, Anthrax, Hemorrhagic septicemia and so on.[21–24] The spatial distribution of major priority diseases among African countries in 2010 mirrors that of the previous years with a significant number of countries affected by LSD (63.26%), CBPP (48.97%) and FMD (48.97%).[25–28] Risk factors for disease occurrences are host factors, environmental factors, pathogen factors and climate condition are the most important.[5,29]

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Most of diseases are transmitted and gain entrance to the body by ingestion, inhalation, or through the skin contact. While the exact mode of infection is often in doubt, it is generally considered that most animals are infected by the ingestion of contaminated food or water.[18,22] The most serious priority diseases are caused by rapidly transmitting pathogens that produce acute and serious disease in large numbers of hosts.[19]

The controlling and management measures involve treating the cases, preventing further spread of the disease, monitoring the effects of control measures[8,29–35] and ring vaccination is sometimes termed 'emergency vaccination' (all susceptible animals on farms within a certain radius of the farm on which infection has been detected are vaccinated in an attempt to limit the spread of the disease agent)[16] and movement restriction.[21,33] In Ethiopia, priority was given to decrease the morbidity and the mortality of production related diseases (mainly external and internal parasites); to trade-limiting diseases (FMD, ovine/caprine pox, LSD, CBPP). Participatory Epidemiology (PE) is based on communication and transfer of knowledge, using a variety of methods such as informal interviewing (semi-structured interviews with key informants, focus-group discussions or individual livestock keepers), ranking and scoring (simple ranking, pair-wise ranking, proportional piling, matrix scoring) and visualization (mapping, timelines, seasonal calendars, transect walks).[23]

Therefore, the objective of the study was to assess the occurrence of priority reportable cattle diseases and the level of awareness of the local community about those diseases in selected districts of Southern Nations, Nationalities and Peoples' Regional State.

Materials and methods

Study area

Study was conducted in two selected districts of Southern Nations, Nationalities and Peoples' Regional State (SNNPRS). The region has about 14 zones which are subdivided in to 147 districts. Total land area is about 113,543 Km^2 and the altitude of ranges from 372 – 4,206 meter above sea level. Geographically, the region is located between 4.43 – 8.58° (6.505°) North latitude and 34.88 – 39.14° (37.01°) East longitude. The agro-ecology of the region is characterized as semi-desert (6.2%), *Kolla* (lowland) (49.8%), *woyna dega* (midland) (36.5%) and *dega* (highland) (7.5%). Total cattle population of the region is 11,215,636.[7]

Study design and sample size

The participatory epidemiological study was employed to carry out survey of the farmers' perception about the common cattle diseases occurring in their localities which were used for comparing the level of awareness in local cattle keepers. Among districts, two districts were purposively selected based on accessibility. These were Bensa district from Sidama Zone and Boloso Sore district from Wolaita Zone. A total of 12 key informant groups (six groups from each), each comprising of 8 – 12 members, were selected from the two districts. The study was conducted in 12 kebeles (PA) (peasants association) (six from each district) which were selected based on their accessibility. The total number of key informants selected from two districts were 111 and their group composition was made to include different community members by sex (male = 89 and females = 22), skill (educated = 72 and illiterate = 39), development workers (male = 3 and female = 1) and cattle owners (male = 86 and female = 21), religious leaders (male = 2) and social status for all participatory approaches done with groups.

Data collection

Participatory epidemiological study

This study was conducted between October 2016 to March 2017 using PE techniques as described.[11] Data collection tools consisted of semi-structured interviews, simple scoring, matrix scoring, pair-wise ranking, proportional piling and seasonal calendars. Discussions with the participants were conducted in the local languages by the researcher who asked most of the questions and facilitated the discussion, a community mobilizer, a recorder and a translator.

Within each method, cross-checking and probing were done to verify internal consistency of information, make sure that the informants understood the different items to be scored or ranked, and to gather more detailed information on a particular subject. Efforts were made to ensure all members of the discussion group expressed their opinions, and that discussion was open and not dominated by one or a few individuals. The informants were given time to discuss and reach consensus.

Participatory epidemiological tools

Semi-structured interview (SSI)

The primary source of data was obtained using semi–structured interviews guided by a check list. Specifically, semi-structured interviews were used to gather qualitative data on predetermined topics using open-ended questions. The topics included were the common livestock species kept, number of animals, purpose of cattle keeping; constraints of livestock production, major diseases affecting cattle in the locality and other relevant information were collected. The interview was conducted in the local language and an interpreter from the local community assisted the researchers in translating the discussion into Amharic and then to English.

Ranking of livestock species by numbers (population)

Simple ranking of common livestock species kept and frequency of cattle diseases

The informant groups were asked to rank and compare the domestic animals species they kept based on number, relative importance and purpose of production using piles of 100 maize seeds. Ranking on the given topics was done one after another. They were also asked to rank and compare the frequency of occurrence of common diseases using the same piles of maize seeds. The item with the highest score was ranked number one.

Pair-wise ranking and comparison of cattle diseases

It is comparison and a slightly more complex method of ranking where each item is compared individually with all the other items one-by-one. It can be used to understand the relative importance of different diseases. In this study, the key informants were asked to compare individual cattle diseases identified during semi-structured interview with other cattle diseases one by one. The names of cattle diseases were written vertically (y-axis) and horizontally (x-axis) on a piece of cardboard. For each pair of diseases (x, y), participants were asked which was more important. Probing questions such as why a participant felt a chosen disease was more important than another were asked. Diseases were ranked first to fifth according to the score

they got during pair-wise ranking. That is, a disease with the highest score ranked first and that with the lowest score ranked last. This activity was conducted with 12 informant groups in the two districts.

Proportional piling of disease incidence

Proportional piling proved to be an interesting and useful exercise to determine the frequency and importance of livestock diseases. Proportional piling was used to estimate the incidence, mortality and case fatality rate of the five most important cattle diseases, using the method described.[10] Each informant group was provided with a pile of 100 maize seeds that represented the number of cattle in a herd in their village. First, the informant group was asked to divide the seeds into two, a pile representing the proportion of the herd that got sick and those that remained healthy during the past one year prior to the onset of the present study. The pile representing the proportion of animals that became ill was further subdivided into 5 piles corresponding to the proportion of animals that got each of the five diseases during the past one year. This activity provided estimates of the annual incidences of the diseases. Subsequently, each group was asked to remove some of the already-allocated seeds representing the sick, to indicate the proportion of dead animals for each of the five prioritized diseases during the past one year.

Seasonal calendar

Seasonal calendars were used to describe the seasonal occurrence of cattle diseases. Farmers in the study areas divided the year into four main weather seasons as follows. In Bolo Sore districtthe four seasons are *Baligo agina* (long rainy season extending from June to August), *Ofinta agina* (early dry season extending from September to November), *Boniya agina* (dry season extending from December to February), *and Bad'esa agina* (short rainy season extending from March to May), whereas in Bensa district the seasons are named as *Hawado wogate* (long rainy), *Birate wogate* (early dry), *Ari wogate* (dry) and *Bad'esa wogate agana* (short rainy). Each season was represented on the ground or a white paper using an object placed along the top "x-axis" and sketch illustrations of diseases were placed along the "y-axis" of the diagram. The informants were given 30 maize seeds and asked to show the relative occurrence of each disease in each season. When placement of the seeds for one disease against the season was complete, the group was requested to thoroughly check the scores and if they wanted, rearrange the scores until they were contented with the result. This activity was carried out on a total of 12 key informant groups in the two district selected.

Statistical analysis

Non-parametric tests and descriptive statistical procedures (frequencies, median and range) were used to analyze the PE data, using Statistical Package for the Social Sciences (SPSS) version 22.0.[32] The level of agreement between informant group was assessed using Kendall"s coefficient of concordance (*W*). A p-value was assigned to *W*. Evidence of agreement between informant groups was categorized as "weak" ($W < 0.26$, $p > 0.05$), "moderate" ($W = 0.26$-0.38, $p < 0.05$) and "strong" ($W > 0.38$, $p < 0.01$) as previously.[9]

Result

Participatory epidemiological study results

Livestock species kept, purpose of production and constraints of production

Major livestock species kept

Based on the information obtained from the key informants, the most common livestock species kept in the study areas (Boloso Sore and Bensa district) were cattle, sheep, goats, chicken, and equine (donkey, horse and mules). While horses and mules were found only in Bensa district, all other animal species were kept by informants in both of the districts included in the survey. Key informants explained that cattle, chicken, goats, sheep and donkeys in descending order were the major livestock species kept in Boloso Sore district. In Bensa district, the major livestock species kept in descending order were cattle, chicken, sheep, donkeys, horse, goats and mule. There was strong agreement in scoring between the informant groups in both of the districts ($W = 0.79$ & 0.80; $p = 0.001$ &<0.001) (Table 1).

Table 1 Simple ranking of livestock species in Boloso Sore and Bensa District, 2017

Animal species	Boloso sore			Bensa		
	N[a]	Median score	Rank	N[a]	Median score	Rank
Chicken	6	22.5 (20-36)	2	6	19.5 (8-22)	2
Cattle	6	35 (23-37)	1	6	28 (25-36)	1
Sheep	6	13 (9-19)	4	6	15.5 (9-17)	3
Goats	6	15.5 (9-20)	3	6	9 (8-20)	6
Donkeys	6	12 (10-17)	5	6	13.5 (13-15)	4
Horse	6	-	-	6	9.5 (0-12)	5
Mule	6	-	-	6	5.5 (3-7)	7
W[b]		0.79			0.80	
P		0.001			<0.001	

[a]Number of informant groups

[b]Kendall's Coefficient of Concordance

Values in parenthesis are minimum and maximum median scores

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Based on the benefits livestock provide, informants ranked cattle, donkeys, chicken, sheep and goats in descending order as the most valuable animals in Boloso Sore district. The order of ranking was the same in Bensa district as well except that the informants added horses and mules as the sixth and seventh most important animals, respectively. Strong level of agreement was evidenced between the informants groups in ranking in both of the districts (W = 0.67 & 0.8; p = 0.003 &<0.001) (Table 2).

Table 2 Simple ranking of domestic animals based on their relative importance to the farmers in both districts, 2017

Animal spp	Boloso sore			Bensa		
	N[a]	Median score	Rank	N[a]	Median score	Rank
Chicken	6	19.5 (13-26)	3	6	15 (8-17)	2
Cattle	6	34.5 (31-37)	1	6	35 (29-43)	1
Sheep	6	14 (8-16)	4	6	11.5 (8-17)	3
Goats	6	13 (8-26)	5	6	10.5 (8-23)	4
Donkeys	6	21 (14-22)	2	6	15 (7-23)	2
Horse	6	-	-	6	6 (0-8)	5
Mule	6	-	-	6	5 (4-8)	6
W[b]		0.67			0.80	
P		0.003			<0.001	

[a]Number of informant groups

[b]Kendall's Coefficient of Concordance

Values in parenthesis are minimum and maximum median scores

Purpose of cattle keeping

During participatory epidemiological survey, informants conveyed many ideas on the purpose of cattle keeping. The five most frequently scored purposes of cattle production in both of the districts were income generation, milk production, meat production, breeding and draught power. Based on median score values done by the informants, farmers rear cattle for income generation, draught power, milk, meat and breeding purposes in decreasing order of importancein both of the districts. Strong agreement was noted between the informant groups in both of the districts (W = 1 & 0.94; p<0.001) (Table 3).

Table 3 Simple ranking of the different purposes of cattle keeping by the informants in both districts, 2017

Purpose	Boloso sore			Bensa score		
	N[a]	Median score	Rank	N[a]	Median score	Rank
Income	6	34.5 (31, 40)	1	6	31 (28, 32)	1
Milk	6	19 (16, 20)	3	6	19 (18, 26)	3
Meat	6	14 (13, 16)	4	6	13.5 (6, 18)	4
Breeding	6	9 (7, 11)	5	6	9.5 (9, 15)	5
Draught	6	24.5 (20, 26)	2	6	27 (22, 29)	2
W[b]		1			0.94	
P		<0.001			<0.001	

[a]Number of informant groups

[b]Kendall's Coefficient of Concordance

Values in parenthesis are minimum and maximum median scores

Constraints for cattle production

DuringSSI, factors like diseases, feed and water shortage, labor shortage, inadequate veterinary extension and poor market availability were identified by the key informants as constraints for livestock production. Participants were argued and discussed on these influencing factors to cattle keeping based on their heaviness. Accordingly, informants in Boloso Sore district ranked feed shortage, water scarcity, diseases, labor shortage, poor market availability and inadequate veterinary extensive services in descending order as major constraints for cattle production in their localities; while informantsin Bensa district ranked in descending order feed shortage, water scarcity, diseases, inadequate veterinary extensive services, labor shortage and poor market availability as the major constraints. There was strong agreement from ranking between informant groups for constraints in both of the districts (W = 0.76 & 0.94; p<0.001) (Table 4).

Table 4 Simple ranking of major constraints for livestock production by informants in both districts, 2017

Constraints	Boloso sore			Bensa		
	N[a]	Median score	Rank	N[a]	Median score	Rank
Disease	6	19 (12, 28)	3	6	16 (11, 19)	3
Water scarcity	6	21.5 (9, 24)	2	6	19.5 (14, 25)	2
Feed shortage	6	29.5 (26, 39)	1	6	37.5 (26, 54)	1
Labour shortage	6	13.5 (9, 21)	4	6	9.5 (6, 16)	5
Poor market	6	7 (1, 19)	6	6	4 (3, 12)	6
Inadequate extension service	6	10 (2, 13)	5	6	11 (6, 18)	4
W[b]		0.76			0.94	
P		<0.001			<0.001	

[a]Number of informant groups

[b]Kendall's Coefficient of Concordance

Values in parenthesis are minimum and maximum median scores

Major cattle diseases in Boloso Sore and Bensa districts

Frequency of occurrence

In simple ranking, informants in Boloso Sore district ranked HS, blackleg, anthrax, FMD and LSD in descending order as the most frequently occurring cattle diseases in their localities. They have their own local names for each disease as *Duluwa* (anthrax), *Tilkiya* (blackleg), *Garanduwa* (FMD), *Ahera* (HS), *Borquwa or Galba hargiya* (LSD) and *Kana hargiya* (rabies). The corresponding rank by informants in Bensa district was HS, blackleg, rabies, LSD and anthrax in descending order (Table 5). In Bensa district, the diseases are locally named as *Butamo* (HS), *Adwayiho*(blackleg), *Kisinimo wushicho* (rabies), *Kada* (LSD)and *Hadiyicho* (anthrax).

Table 5 Simple ranking of the common cattle diseases by their frequency of occurrence by informants in Boloso Sore and Bensa Districts, 2017

Disease	Boloso sore			Bensa		
	N	Median score	Rank	N	Median score	Rank
Anthrax	6	19.5	3	4	9.5	5
Blackleg	6	25.5	2	6	33	2
HS	6	29	1	6	39.5	1
LSD	6	11	5	6	10	4
FMD	6	15.5	4	-	-	-
Rabies	6	-	-	4	17	3

n – Number of informant groups

Pair-wise ranking

After simple ranking for frequency of occurrence, informants conducted pair-wise ranking of the five selected diseases based mainly on morbidity and mortality rates, loss of production and impact on the cattle keepers' livelihood. Accordingly, anthrax (*Duluwa)*, blackleg (*Tilkiya*), hemorrhagic septicemia (*Ahera*), FMD (*Garanduwa*) and LSD (*Galbahargiya*) were ranked in descending order as the most important cattle diseases by informants in Boloso Sore district. Pair-wise ranking in Bensa district revealed that anthrax (*Hadiyicho*), blackleg (*Adwayiho*), hemorrhagic septicemia (*Butamo*), rabies (*Kisinimowushicho*) and LSD (*Kada*) were the most important cattle diseases in that order. Blackleg, HS and LSD were mentioned in the pair-wise ranking activity in every informant group in both districts. While anthrax was listed in every informant group in Boloso Sore district, it was not reported by two of the groups in Bensa. Rabies was

not reported to occur by every informant group in Boloso Sore district while FMD in Bensa. Kendall's coefficient of concordance (W) for informant groups for the diseases indicated strong agreement in both Boloso Sore (W = 0.95; p<0.001) and Bensa (W = 0.47; p = 0.023) districts (Table 6) (Figure 1).

Table 6 Pair-wise ranking of major cattle diseases by informants in both districts, 2017

Disease	Boloso sore			Bensa		
	N[a]	Median score	Rank	N[a]	Median score	Rank
Anthrax	6	32 (29, 38)	1	4	32 (0, 40)	1
Blackleg	6	24.5 (20, 26)	2	6	29.5 (20, 46)	2
HS	6	19 (16, 21)	3	6	20 (14, 35)	3
LSD	6	12 (7, 17)	5	6	10 (4, 19)	5
FMD	6	13.5 (10, 16)	4	-	-	-
Rabies	6	-	-	4	16 (0, 21)	4
W[b]		0.95			0.47	
P		<0.001			0.023	

[a]Number of informant groups

[b]Kendall's Coefficient of Concordance

Values in parenthesis are minimum and maximum median scores

Figure 1 Simple ranking of disease by key informants in Bensa district.

Matrix scoring for the clinical signs of major cattle diseases

The results of matrix scoring for local perception of the clinical signs of the five major cattle diseases are illustrated in Table 7. Five identical clinical signs were used for matrix scoring in the two districts. Based on the scoring; blackleg was associated with hair erection, lameness, loss of appetite and loss of body weight. HS was characterized by coughing, hair erection, loss of appetite and loss of body weight. FMD was described as manifesting all the clinical signs listed although it received the highest score for lameness. LSD was noted to show hair erection, loss of appetite and loss of body weight. However, anthrax was not associated with all of the clinical signs mentioned except loss of appetite. The result of matrix scoring indicates that there is good agreement (W = 0.82-0.95; p<0.05) between the informant groups about the clinical signs except for hair erection, where the agreement was not found significant (p>0.05) (Table 8).

Table 7 Summarized matrix scoring of clinical signs of cattle diseases by informants in Boloso Sore and Bensa districts

Indicators	Disease				
	Anthrax	Blackleg	HS	FMD	LSD
Coughing (W = 0.9; p = 0.006)	0 (0, 0)	0 (0, 7)	22 (19, 30)	7 (4, 9)	0 (0, 1)
Hair erection (W = 0.95; p = 0.107)	0 (0, 1)	7 (5, 8)	14 (7, 20)	13 (10, 16)	2.5 (0, 6)
Lameness (W = 0.86; p <0.001)	0 (0, 0)	18 (0, 30)	0 (0, 2)	16 (12, 16)	0 (0, 3)
Loss of appetite (W = 0.82; p = 0.001)	0.5 (0, 2)	8.5 (5, 16)	12 (6, 15)	11.5 (3, 15)	1.5 (0, 6)
Loss of body weight (W = 0.82; p = 0.001)	0 (0, 3)	7.5 (2, 9)	13 (7, 22)	12.5 (5, 14)	1 (0, 9)

Table 8 Median standardised scores of annual incidence, mortality and case fatality estimates for the five top ranked cattle diseases

	Median score for diseases (%)						
	Anthrax	Blackleg	HS	LSD	FMD	Rabies	Overall
Sick	5.5 (0, 8)	8.5 (6, 11)	11 (4, 16)	3 (1, 7)	3.5 (0, 5)	5 (0, 8)	31.5 (14, 42)
Dead	3.5 (0, 5)	3 (2, 6)	2.5 (1, 4)	1 (0, 1)	1 (0, 1)	2.5 (0, 4)	10 (4, 15)
CFR	66.7 (0, 83.3)	33.3 (28.6, 60)	25 (10, 33.3)	26.7 (0, 33.3)	29.2 (0, 33.3)	50 (0, 66.7)	31.3 (22.6, 46.9)

Values in parenthesis are the minimum and maximum median scores; CFR = case fatality rate

Morbidity and mortality of cattle diseases

The overall median scores for annual incidence, mortality and case fatality rates of cattle estimated by informants and attributed to the five top ranked diseases in Boloso Sore and Bensa districts during proportional piling are presented in Table 8. Accordingly, the overall proportion of cattle that became ill during the past one year was 31.5% (range: 14, 42). Overall median deaths from all diseases were 10% (range: 4, 15). The overall median case fatality rate (CFR) from all diseases was estimated to be 31.3% (range: 22.6, 46.9). The highest disease prevalence was caused by HS (11%) followed by blackleg (8.5%) while the highest death rate (3.5%) and CFR (66.7%) were attributed to anthrax.

Seasonality of the major cattle diseases

A summarized seasonal calendar of the top ranked cattle diseases in Boloso Sore and Bensa districts is shown in Table 9. Good agreement was evident among the informants groups concerning the seasonal occurrence of blackleg, HS, LSD, FMD and rabies ($W = 0.42 – 0.93$; $p<0.05$; <0.01 &<0.001) while weak agreement was obtained for seasonality of anthrax ($W = 0.16$; $p>0.05$). Informants agreed that the incidence of HS, LSD, FMD and rabies is higher in the long rainy season (Jun-Aug) while blackleg occurs most often in the dry season. Informants explained that LSD, FMD and rabies do not occur in the dry season.

Table 9 Summarized seasonal calendar for major cattle diseases in both districts

Diseases	Season			
	Long rainy (June - Aug)	Early dry (Sep - Nov)	Dry (Dec - Feb)	Short rainy (Mar - May)
Anthrax (*W* = 0.16)	8 (6-14)	6.5 (4-10)	6 (1-12)	7 (5-12)
Blackleg (*W* = 0.42**)	9 (2-20)	4 (2-6)	11.5 (6-16)	4.5 (0-9)
Haemorrhagic septicaemia (*W* = 0.91***)	15 (10-18)	7.5 (3-10)	1.5 (0-4)	7 (4-10)
Lumpy skin disease (*W* = 0.83***)	16 (10-19)	7.5 (4-12)	0 (0-5)	6 (3-10)
Foot and mouth disease (*W* = 0.90***)	18 (12-21)	7 (4-9)	0 (0-0)	7 (1-11)
Rabies (*W* = 0.93*)	15 (12-17)	8 (3-9)	0 (0-0)	9 (5-10)

N = 2; W=Kendall's coefficient of concordance (*p< 0:05; **p< 0:01; ***p< 0:001). Numbers are medians and the figures in parenthesis are minimum and maximum values

Citation: Oyda S, Abebe R, Megersa B. Participatory epidemiological study on the occurrence of reportable priority cattle diseases in two selected districts southern nations, nationalities and peoples' regional state. *J Dairy Vet Anim Res.* 2020;9(4):119–128. DOI: 10.15406/jdvar.2020.09.00291

Discussion

The participatory epidemiological study was carried out in two districts (Boloso Sore and Bensa) selected from Wolaita and Sidama zones, respectively. The method was used to verify the actual conditions on the ground or characteristics of the diseases.[12] As stated by participants, among livestock, cattle population in community was ranked as first followed by chicken based on population size.[6] Cattle and donkeys were the first and second top ranked domestic animals based on their importance to the livestock keepers. Cattlehelp as food supply, family nutrition, family income, asset savings,[27] soil fertility, livelihoods, agricultural diversification and sustainable agricultural production, family and community employment, ritual purposes and social status.[26]

Since most of the participants were farmers, they reported that their livelihood is dependent up on agriculture, which in turn relies on oxen power. The informants further stated that cash income from selling of animals, milk, meat and animal breeding and traction power of cattle were decreased due to different constraints prevailing in their localities. This concept agrees with the result of.[15]

Feed shortage was the top ranked constraint for livestock production indicated by the informants followed by water scarcity, diseases, labor shortage, inadequate extension service and poor market.[3] The informants explained that if feed and water were adequately availability; it would not be difficult to manage other problems.[2] A general reduction in availability of feed throughout the region has resulted from climate change, increased population density (humans and livestock) and overgrazing. Informants further explained that outbreak of disease increases during rainy season which is in agreement with other studies.[6,27] Both income and milk production were better in the availability of feed and water (mostly from April to September).This agrees with the report.[6] The strong agreement observed between the informants ($W = 0.76\text{-}0.94$; $p<0.001$) indicates that farmers have a good knowledge about the factors hampering livestock production in their locality and also it shows that same constraints are prevailing in all the study areas surveyed.

Small changes in temperature alter production and health balance significantly and often result in changes in livestock productivity;[34] an implication of this is that significant changes in management of the grazing system may be required to attain the production levels desired.[25,34]

During the study period, participants explained that frequency of diseases occurrence was associated with different factors such as climatic changes, environmental changes, and scarcity of feed and water.[1,17] During the PE study, informants were able to identify and rank the most frequently occurring cattle diseases in their localities. In Boloso Sore district, *Ahera* (HS), *Tilkiya* (blackleg), *Duluwa* (anthrax), *Garanduwa* (FMD) and *Galbahargiya* (LSD) in descending order were the most frequently occurring diseases while in Bensa district HS, blackleg, rabies, LSD and anthrax in that order. In both of the districts, HS and blackleg are the first top ranked diseases in their frequency. FMD and LSD were the 4th and 5th ranked important cattle diseases in Boloso Sore while rabies and LSD in Bensa district. There was strong agreement among the six informant groups in each woreda ($W = 0.47$ and 0.95; $p = 0.023$ and <0.001) indicating that the diseases mentioned were a common problem in the selected *districts*. As participants 'perception, LSD is not a commonly known disease for its impact on the community. Dry conditions contributing to the spread of the disease and poor food supply prior to early dry season may also increase the susceptibility to infection.[31]

When participants were asked to estimate the proportion of cattle affected by and died from the five top ranked diseases by using proportional piling PE tool, they estimated that 31.5% of the total cattle population became ill during the year preceding this study with overall case fatality rate of 31.3%. The estimated annual incidence by disease type was HS (11%), blackleg (8.5%), anthrax (5.5%), rabies (5%), FMD (3.5%) and LSD (3%). Although HS was the leading cause of morbidity, the highest case fatality rate (CFR) was estimated for anthrax (66.7%) followed by rabies (50%).

Regarding the seasonality of the diseases, informants strongly agreed that blackleg occurs mainly in the dry season followed by the long rainy season ($W = 0.42$; $p<0.01$). From participants points of view, January, February, March, April and May contribute major part for the occurrence of outbreak, feed shortage and water scarcity.[4,15] The trend of disease outbreak/epidemics is decreasing in the pattern of occurrence which may be due to control measure taken with integration of government and other stakeholders.[31]

During participatory study, the participants stated that they use different traditional methods to control diseases after occurrence. Most of the farmers use traditional plants/herbs to control diseases outbreak after occurrence (blackleg), using crushed green pepper, garlic and onion apply to mouth (FMD), stay affected animals indoor (LSD).Participatory epidemiological study of key informants group in both districts revealed that cattle diseases have their own seasonal and spatial pattern.[4] In the participatory epidemiological (PE) study, the arrangement of diseases were HS, blackleg, LSD, anthrax, FMD in their descending position. In Boloso Sore district, the participatory epidemiological data collected from informants group revealed position/order of diseases as: blackleg, HS, anthrax, FMD, LSD and rabies.

Conclusion and recommendation

Participatory epidemiological study conducted in two of the districts revealed that cattle are the most frequently kept and valuable livestock for the farmers. The major purpose of cattle keeping was for income generation, milk and meat production, breeding and draught power. However, diseases, feed and water shortage, labor power, inadequate veterinary service and poor market availability were claimed by the farmers to be the main constraints for cattle production. Furthermore, farmers mentioned the same spectrum of diseases documented in the retrospective study as the major diseases affecting cattle in their localities. Based on the impact of the diseases on the morbidity and mortality of cattle and livelihood of farmers, the key informant ranked anthrax as the first disease followed by blackleg. This finding was found to be compatible with the existing scientific knowledge of the diseases. The key informants were also able to estimate or quantify the proportion of cattle affected and died by each of the diseases occurred in their locality during the year prior to the study. A strong level of agreement was noted between the key informant groups in ranking the diseases in their frequency of occurrence, impact and seasonal distribution showing that livestock keepers have a good perception about cattle diseases occurring in their localities.

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

i. Participatory epidemiological studies have shown that cattle disease outbreaks occur in all the seasons of the year. This warrants the need for implementation of awareness creation among veterinarians and policy makers and strategic disease prevention program through vaccination, which should be considered before the anticipated season of outbreak for each disease.

ii. Future participatory epidemiological studies have to be supported by active disease surveillance rather than retrospective survey of disease records so that farmers' perception on livestock diseases can better investigated.

iii. Since some of cattle diseases identified by participatory epidemiological studies were zoonotic and life threatening, enhancing the awareness of livestock keepers about the disease is of paramount importance.

Acknowledgments

None.

Conflicts of interest

Author declares that there are no conflicts of interest.

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Citation: Oyda S, Abebe R, Megersa B. Participatory epidemiological study on the occurrence of reportable priority cattle diseases in two selected districts southern nations, nationalities and peoples' regional state. *J Dairy Vet Anim Res.* 2020;9(4):119–128. DOI: 10.15406/jdvar.2020.09.00291