



SURVEY ON ANIMAL HEALTH PROBLEMS AND DISEASE INVESTIGATION IN THE SELECTED KEBELLES OF BAMBASI DISTRICT

ASMAMAW AKI*, BIRHANU ETICHA, G/HIWOT W/MICHALE*, ABEBE BULCHA*, GEZACHEW WUBAYE, DEGENE TSEHAYNE AND BAYISA KENAW

Assosa, Regional Veterinary Diagnostic, Surveillance, Monitoring and Study Laboratory, P.O. Box 326, Assosa, Ethiopia; asmamawaki@gmail.com, phone: 0902330029
Benishangul gumuz regional state, Bureau of agriculture and Natural resources Bureau,

ABSTRACT: Questionnaire Survey on animal health problems and disease investigation in the five kebeles of Bambasi district, with the objectives to identify the main constraints related with livestock production and productivity and cause morbidity, mortality and associated risk factors. In this survey, the demographic features of respondents were assessed. 91.04% and 8.95% of respondents were males and females respectively. 98.50%, and 95.52%, and 88.06% of study participants stated as disease occurrence, shortage of water, shortage of feed and communal grazing land were priority constraints while 7.46%, 4.48% and 5.97% of respondents indicated, unresponse to treatment, unwillingness to vaccinate, and uncontrolled animal movement as lowest constraints inline with the response rate in the community. The highest and lowest (9.47%) and (1.01%) crude mortality rate were recorded in poultry and cattle respectively. Kebeles animal health workers retrospective case book clinical cases indicated that, 25.37% of Trypanosomosis, 31.23% of CBPP, and 28.30% of pasteurellosis, were recorded as highest morbidity rate; while the lowest 1.02% of shoat pox, and 1.12% of avian salmonella of proportional morbidity rate were investigated. 98.55%, 97.01% and 89.55% of respondents were noted as (Trypanosomosis, CBPP and NCD) highest priority animal diseases while, (4.47 %) and (4.47%) of respondents indicated, Shoat pox and Rabies as lowest priority diseases respectively. Besides this, frequency of treatment per animal in the villages, averagely were 17, 3, 2 of cattle, shoat and equines respectively, were come to nearby veterinary health posts in a year. Perception of the community in controlling disease problems by kebele animal health workers were willingness to vaccinate (80%), un willingness to vaccinate (40%), treat animal by their own (20%), and bring animal to veterinary health posts (60%). Therefore, strategic prevention and control policy would be implemented properly in study area so as to prevent problems encountered.

[ASMAMAW AKI, BIRHANU ETICHA, G/HIWOT W/MICHALE, ABEBE BULCHA, GEZACHEW WUBAYE, DEGENE TSEHAYNE AND BAYISA KENAW. **SURVEY ON ANIMAL HEALTH PROBLEMS AND DISEASE INVESTIGATION IN THE SELECTED KEBELLES OF BAMBASI DISTRICT**. *Researcher* 2022;14(8):6-23] ISSN 1553-9865 (print); ISSN 2163-8950 (online) <http://www.sciencepub.net/researcher>. 02. doi:[10.7537/marsrsj140822.02](https://doi.org/10.7537/marsrsj140822.02).

Keywords: *Bambasi, Constraints, morbidity, mortality, respondents, risk factors*

1. INTRODUCTION

Ethiopia is one of the richest countries in livestock population. Central statistical Authority report of (2016/17) showed that the country has about 59.49 million heads of cattle, 60.90 million shoats, 11.01 million equines, 1.23 million camels and 59.50 million poultry, in Africa.

Livestock is an integral part of agriculture in Ethiopia, and provides with a vast range of products and services such as meat, milk, cheese, butter, eggs, honey, horns, bones, manure and urine for cash, security, gifts, religious rituals, medicines (Alemu and Merkel, 2008). It plays an important role in providing export commodities such as live animals, hides and

skins to earn foreign exchanges to the country. On the other hand, draught animals provide power for cultivation of the smallholdings and for crop threshing virtually all over the country and are also essential modes of transport to take holders and their families long distances to convey their agricultural products to the market places and bring back their domestic necessities (CSA, 2016/17). The sector contribution to the economy accounts for about 41.4% of the Gross Domestic Product of the country and 20% of export earnings (BAHS, 2012; World Bank, 2006).

The contribution of the livestock sector to the livelihoods of producers in particular and to the national economy in general can be explained in terms

of food production, supply of inputs and services for crop production, raw material for agro-industry, cash income and export earning, savings and investment, and its role as a generator of employment, most people in rural areas of these countries depend on agriculture sector for their livelihood, which plays a great role in the socio-economic development (Behnke and Metaferia, 2011).

Despite the large number of livestock, productivity in general is low in the country, mainly due to the low genetic quality of local breeds, poor nutrition, and animal health problems. Similar to low-income African countries, per capita consumption of food from a livestock origin is low, as a result of uncontrolled animal diseases, poor husbandry system, and poor infrastructure (Negassa *et al.*, 2011).

The main constraints of livestock production include animal health problems, disease occurrence, inadequate nutrition, unimproved management, poor genetic makeup and lack of animal welfare. Health problems which are of diverse origin have been repeatedly incriminated as the main impediments for production and productivity of the sector as well as agricultural development. Diseases may be caused by environmental, nutritional, congenital, hereditary and immunological factors and also be resulted from pathogenic organisms including viruses, bacteria, fungi, parasites (Radostitis *et al.*, 2000).

Benishangul-Gumuz Regional State is one of the regions, which is found in the Northwestern part of the country, having favorable agro-climatic conditions in its all parts and suitable for animal rearing. The animal population of the region were estimated to be 777,915 cattle, 100,013 sheep, 431,216 goats, 82,080 equines and 1,249,578 poultry (CSA, 2016/17). Poultry is the highest in population size and is kept almost by all people in the region for egg production and as a source of income. Cattle and goats are the second and third widely available species. Cattle, Sheep, Goat, Equine and Poultry were study population included in the survey. As Central Statistical Authority (CSA) of (2016) on the livestock deaths in the region indicated that, the mortality rate ranges between 12.7% - 48.06%. As reported by (Asmamaw, *et al.*, 2017), the overall mortality rate in cattle, sheep, goat and equine was 21.46%, 22.1%, 22.52% and 6.75% respectively.

In this case the common animal production constraints such as improper handling/backward husbandry system/, infectious and non-infectious diseases occurrence in outbreak and endemic forms that hinder overall effort made to develop livestock sector and improve the livelihood of farmers in Bambasi district. Therefore, the present survey was conducted to assess the problems related with livestock production and/or health including morbidity, mortality and management aspects in domestic animals and the existing problems in the livestock that hinder livestock production and productivity in the region in general and in the district in particular.

1.1 OBJECTIVES

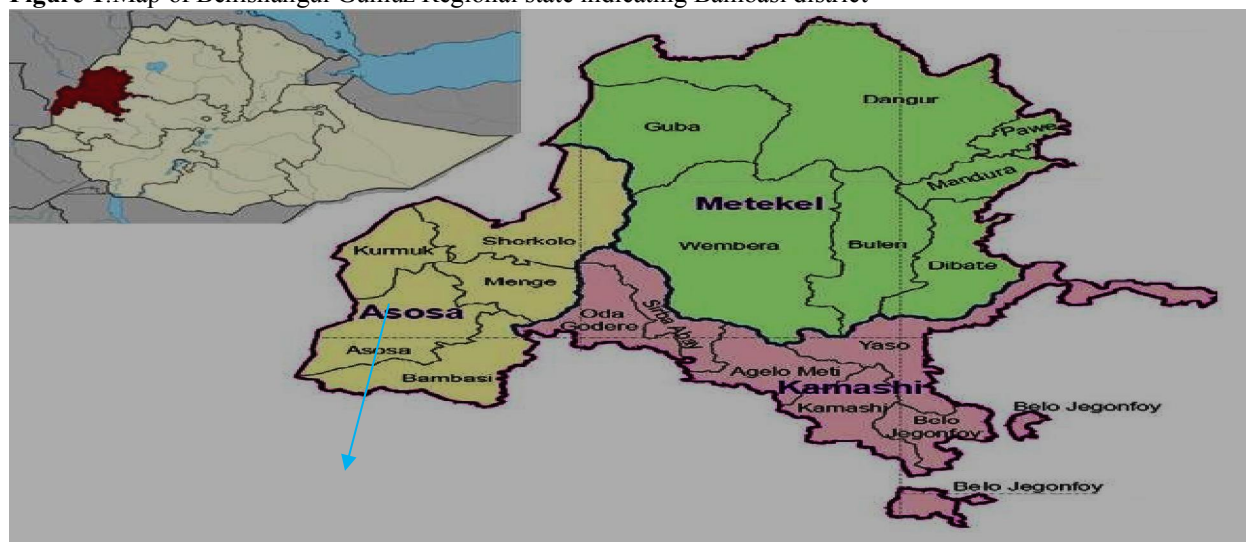
- To identify the main constraints related with livestock production in selected kebeles of Bambasi district,
- To assess the major cause of morbidity, mortality and associated risk factors

2. METHODOLOGY

2.1 Study area

The present survey was conducted from April to May 2022 in Bambasi district, which is found in Assosa zone of the Benishangul Gumuz Regional State. It was conducted in five kebeles hereafter called sites namely: Sonka, Mender 46, 47, 48, and 49. Bambasi district is situated at a distance of 633 kilometers from Addis Ababa. It shares boundary with Oromia in the East and South direction, Buldigilu district in the North, Ma'o and Komo special district in Southwest and Assosa district in the west. Geographically, the district is located at 9.45 – 9.75° N and 34.35 – 34.88° E, with a minimum and maximum altitude of 1350 and 1770 meters above sea level. The district has 44 kebeles, stretches over an area of 2210.16 kilometers square with human population of 62,693. Its average annual rainfall is between 1350-1400 mm with unimodal type of rainfall that occurs between April and October; while average annual temperature ranges between 21°C-35°C. The livelihood of the society largely depends on mixed livestock and crop production having livestock population of 36,735 Cattle, 10,732 Goat, 3,739 Sheep, 4,467 Equines, 41,438 Poultry and 23,423 beehives (Bambasiworeda, Agricultural office annual report, 2015).

Figure 1:Map of Benishangul Gumuz Regional state indicating Bambasi district



Bambasi

2.2 Study Population

The study population includes major livestock species reared in the district namely: *cattle, sheep, goats, equine, and poultry*. All age groups and both sexes were included in the study. Similarly, Animal health workers and Livestock owners were involved as key respondents in this retrospective survey.

2.3 Study Design

Retrospective and semi-structured questionnaire survey were used.

2.4 Sample size and Sampling method

The present study was conducted in Sonka, Mender-46, Mender-47, Mender-48 and Mender-49 kebeles of Bambasi district. In five kebeles, (N=80), that is 75 livestock owners and 5 animal health workers were taken as target populations, which were representing the populations in the kebeles. Study kebeles were selected purposively as convenient. For this survey, an estimated 72 respondents (67 livestock owners and 5 animal health workers) were interviewed in the respective villages to generate baseline information with related to animal health problems, and animal diseases in veterinary health posts as well as household levels. So respondents of the kebeles were randomly selected in the community. District animal health experts and kebelles animal health assistance were participate during questionnaire survey. The sample sizes was determined by using (Yemane, 1973) formula.

$$n = \frac{N}{1 + N(e)^2}$$

$$1 + N(e)^2$$

Where:

n = the required sample sizes for the study

N = total population of the kebeles

e = the level of accuracy 0.05

$$n = \frac{80}{1 + (80 \cdot 0.05)^2}$$

= **67**, Therefore, the required sample size was 67;

however, it was increased to 72 respondents in order to increase the precision.

2.5 Study Methods

2.5.1 Interview with kebele community livestock owners

The questionnaire survey was used to assess the livestock owners on livestock constraints and diseases investigation in Bambasi district of selected five kebeles (Sonka, Mender - 46, Mender-47, Mender-48, and Mender-49). A detailed and organized questionnaire format (**Annex I**) was designed and an attempt was made to generate base line information related to the most important livestock existing constraints, most important problems that hinders animals production, list of priority animal diseases occur in areas, the frequency of treatment for individual animal in a year, cost of treatment per animal once treated, rating of livestock based on the importance, number of animals diseased and died in the kebeles. Animal production constraints and level of importance of solution (treatment, vaccine and management (lower, medium, high) were surveyed in the villages. About 67 livestock owned respondents were involved in the interview in the studied kebeles. The questionnaire was framed in such a way that farmers

could give information that are recent and easy to recall, and it was filled directly by interviewing randomly selected livestock owner from different villages of the five peasant associations.

2.5.2 Interview with kebele Animal Health workers

Five (5) animal health workers were involved in the studied kebeles. In the sekebeles, veterinary health posts, retrospective baseline information were inspected in the case books from 2019 to 2021, which includes the list of common priority animal diseases, recommended drugs for suspected diseases, veterinary diagnostic equipments, number of animals diseased and died in the years, animal vaccine type and the number of animals vaccinated in the last three years (2019, 2020, 2021) were assessed in the veterinary health posts during the questionnaire survey. Besides this, animal population of the village, the main animal health constraints, participation of the community in controlling animal health problems in this village (e.g. management, vaccination activities), problems regards to materials needed to give veterinary services, were assessed in the veterinary health post of case book document.

3. DATA MANAGEMENT AND ANALYSIS

All questionnaire data collected from five (5) kebeles and 67 animal owners and 5 animal health workers

were recorded and handled carefully and enter to Microsoft excel sheet (MS) and analyzed. Descriptive statistics were used to estimate community livestock owners and kebele animal health workers of response rate from interviewed questionnaire survey.

- Animal crude mortality rate = $\frac{\text{number of died within the period}}{\text{Population at risk}} \times 100\%$

Population at risk

- Animal moribidity rate = $\frac{\text{number of sick within the period}}{\text{Population at risk}} \times 100\%$

Population at risk

4. RESULTS

4.1 Questionnaire survey with livestock owners

Among 67 livestock owned respondents' in five kebeles, the majority of respondents (91.04%) were males whereas 8.95% were females. 65.67%, 7.46%, and 5.97% of education categories were illiterate (didn't get educations), 1-8, and 8-10 grades respectively. Of the 67 respondent age categories, 5.97%, 40.29%, and 53.73 % were <30 years, 30-50 years, and >50 years of age respectively. Of the age categories, most of the respondents (53.7%) were between 30 up to 50 years old (*Table 1*).

Table 1: Demographic features of the respondents

Respondents/ variables/	Categories	Frequency	Response rate (n=67) %
Sex	Male	61	91.04
	Female	6	8.95%
Education level	Illiterate	18	26.86
	1-8	44	65.67
	8-10	5	7.46
Age	<30yrs	4	5.97
	30-50 yrs	27	40.29
	>50 yrs	36	53.73

Table 2: Domestic animals species in selected villages by their importance

Animal species	Kebeles					Response rate	
	Sonka	M47	M48	M46	M49	N=67	%
Cattle	11	14	17	12	12	66	98.50
Sheep	1	3	4	4	4	16	23.88
Goat	10	6	4	4	4	28	41.79
Equine	4	11	17	10	10	52	77.61
Poultry	9	14	14	9	12	58	86.56
Dog	0	2	0	1	1	4	5.97
Cat	0	1	4	0	3	8	11.94

NB: M= mender

In the study area, animals are used for different purposes and hence they are considered as backbone of the livelihood of the community as indicated in (Table 2), 66 (98.50%) of respondents 'selected cattle as primary importance, it plays in providing export commodities such as live animals, hides and skins to earn foreign exchanges to the country, Serve as traction power and its product such as meat, milk, cheese, butter, bones, and manure.

58(86.56%) of respondents selected poultry as secondary importance, because of their product such as eggs, meat, as income generator and easily reared. 52(77.61%) of respondents selected equines (donkey) as

3rd importance due to draught power for cultivation, crop threshing and also essential modes of transport to take holders and their families long distances to convey their agricultural products to the market places and bring back their domestic necessities. 28(41.79%) of respondents selected Goat as 4th importance, then 16 (23.88%) of respondents selected sheep as 5th importance, according to community livestock owners preference. Whereas Cat was selected as 8(11.94%) 6th importance in domestic household followed by Dog, based on their importance in five kebeles as present survey indicated.

Table 3: Duration (time interval) of animal rearing of respondents

Years	Kebeles					Response rate	
	Sonka	M47	M48	M46	M49	(67=N)	%
1-5 yrs	2	0	0	1	0	3	4.47
6-10 yrs	1	1	1	1	0	4	5.97
10-20yrs	2	3	6	2	3	16	23.88
>20yrs	6	10	11	8	9	44	65.67

As Table 3 indicated, of 67 livestock owned respondents, 4.47% of community animal owners were 1-5 years in animal rearing, 5.97% of respondents were 6- 10 years, 23.9% of the community were 10 – 20 years and 65.6% of respondents were more than 20 years of animal rearing experiences.

Table 4: Main constraints in the selected kebeles of Bambasi district

Main constraints	Villages					Responserate	
	Sonka	M47	M48	M46	M49	(n=67)	%
Disease occurrence	11	14	17	12	12	66	98.50
Shortage of water	11	14	15	12	12	64	95.52
Lack of feed and grazing land	11	10	14	12	12	59	88.06
Insufficient drug	5	9	15	6	2	37	55.22
Increased- cost of drug	6	6	12	8	8	40	59.70
Tsetse infestation	0	2	5	2	4	13	19.40
Un response to treatment	1	2	3	0	0	6	8.95
Poor management	0	2	0	3	0	5	7.46
Lack of training for farmers	4	4	3	2	1	14	20.89
Un willingness to vaccinate	0	3	0	0	0	3	4.48
Uncontrolled animal movement	0	2	0	0	2	4	5.97

As *Table 4* indicated; 66 (98.50%), 64(95.52%), 59(88.06%), 37(55.22%), 40(59.0%), 13(19.40%), 6(8.95%), 5(.46%), 14(20.89%), 3(4.48%) and 4(5.9%) of five kebeles sampled respondents reported animal health problems as disease occurrence, shortage of water, lack of feed and communal grazing land, insufficient provision of drugs, increased cost of drugs per animal, Tsetse infestation in the kebeles, unresponse of animal disease to treatment, poor management of animals, lack of training for farmers, un willingness to vaccinate and uncontrolled animal movement respectively.

As the kebele animal owners noted, most of animal diseases were occurring usually at beginning and end of rainy season. Most of outbreak diseases were seasonal. Fly infestation is highly reported at the entrance of rainy season in the areas. During dry season, water and feed shortage was encountered. When drug shortage was observed, cost or price of drug was increased due to shortage and inavailability of drugs in the market. In kebeles veterinary health posts, there is no laboratory based diagnostic service carried out. So that, as case book of patient animals in the veterinary health posts inspection indicates, diagnosis was tentative.

As result, animals which were went to the veterinary health post were not cure easily. And at the same time

animal owners in the kebeles were treating their animals by their own by buying drugs from vendors. And hence unresponse of drugs to suspected disease, morbidity and mortality of animal increased from time to time. Feed shortage is the main problem especially during dry season in the study area to maintain market oriented livestock development extension. The respondents also reported that feed availability depends on seasons. As solutions, they collected cereal straws, hay and overcome the temporary problem faced in the dry seasons (*Table4*). Shortage of water encountered during drought dry season especially during January to April in the kebeles for animals rearing in the villages. At these time farmers use pond and well as mechanism of adoptability water shortage problems. In the study site, they have water sources for watering animal like rivers, streams, ponds and well during the rainy season. Majority of the owner use river and streams for watering animals, these water sources not available throughout the year.

Uncontrolled animal movement could be cause of disease spread and death of animals in the areas. Even though, poor management is the predisposing factor for the disease occurrence, respondents did not rank as major problems in the areas (*Table 4*).

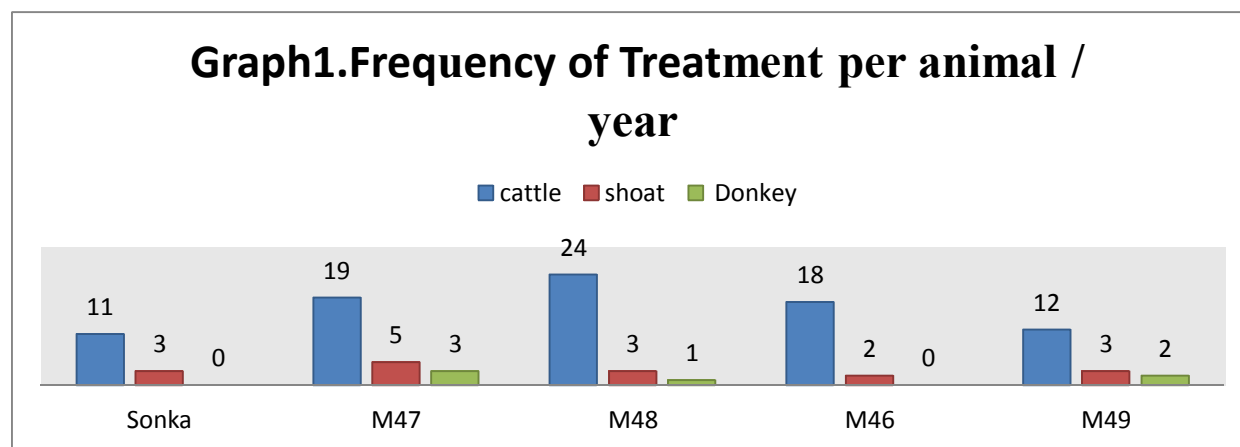
Table 5. Common animal diseases in the areas

No.	Animal disease in the area	Kebeles					Response rate	
		Sonka	M47	M48	M46	M49	N=67	%
1.	Trypanosomosis	11	14	17	12	12	66	98.50
2.	CBPP	10	14	17	12	12	65	97.01
3.	PPR	8	11	13	8	12	52	77.61
4.	Anthrax	2	0	2	2	1	7	10.44
5.	Black leg	2	1	11	4	8	26	38.80
6.	Pasteurellosis	4	8	11	6	8	37	55.22
7.	Endo parasite	2	8	8	9	6	33	49.25
8.	Ecto parasite	2	6	3	6	5	22	32.84
9.	NCD	9	12	16	11	12	60	89.55
10.	Rabies	2	0	1	0	0	3	4.47
11.	LSD	1	3	8	0	3	15	22.39
12.	FMD	3	3	3	1	3	13	19.40
13.	Shoat pox	0	2	0	0	1	3	4.47

As **Table 5** Showed that, 66 (98.50%) , 65(97.01%), 52(77.61%), 7(10.44%), 26(38.80%), 37(55.22%), 33(49.25%), 22(32.84%), 60(89.55%), 3(4.47%), 15(22.39%), 13(19.40%) and 3(3.47%) respondents of five kebeles of community livestock owners indicated; Trypanosomosis, CBPP, PPR, Anthrax, Black leg, Pasteurellosis, Endoparasites, Ectoparasites, NCD, Rabies, LSD, FMD and Shoat pox respectively were scored as priority animal diseases in the villages.

biting and tsetse flies were transmitting diseases. CBPP was 2nd priority diseases of the villages in reducing production and productivity. This disease was mostly occur during the rainy season and entrance of rainy season and also sometimes at dry season. So strategic prevention methods should be implemented in the kebeles so as to safeguard the infection. PPR disease is the primary cause of death in goat and sheep in the kebeles. NCD is the cause of death in chickens and hens. As it is transmitted via contaminated materials, feeds, and waters in the poultry farm and back yard poultry rearing areas.

Trypanosomosis, was the primary priority animal diseases, and concentrated in the rainy season and so



Graph 1 indicated, as community livestock owners respond, frequency of treatment per animal/ year to veterinary health posts for diseased Cattle, Shoat and Equines were averagely, 17, 3 and 2 respectively in five kebeles.

Table 6: Animal Cost of Treatment performance in the five selected villages

No.	Animal	animal population	Treated animal no	Average Rx cost per animal					(Mean=X)	Treatment cost in birr
				Sonka	M47	M48	M46	M49		
1	Cattle	17257	786	50	46	41	54	51	48.4	38,042.4
2	Shoat	3225	346	19	13	12	24	18	17.2	5,951.2
3	Equines	1260	30	19	45	19	54	14	30.2	904
Total										44,899.6

Table 7: Animal crude mortality rate in selected kebeles by livestock owners (2019 to 2021)

No	Animal type	no of animal population	no of animal died	crude mortality rate %
1	Cattle	17257	175	1.01
2	Sheep	920	9	0.98
3	Goat	2305	143	6.20
4	Equines	1260	11	0.87
5	Poultry	13925	1319	9.47
Total death			=1657	

As Table 7 indicated, total of **1657** animals died from different causes in the last three years. 1.01% cattle, 0.98% sheep, 6.20% Goat, 0.87% equines and 9.47% poultry were recorded mortality rate in the study areas. So, high mortality was registered in poultry, followed by goat, cattle, sheep and equines respectively.

Table 8: Animal mortality and economic losses in five villages by livestock owners (2019 - 2021)

No.	Animal type	No of animal died	Average per animal price in birr(cost)	Total price	Economic loss/impact/to mortality in birr
1.	Cattle	175	30000	5,250,000	5,250,000
2.	Sheep	9	3000	27,000	27,000
3.	Goat	143	2800	400,400	400,400
4.	Equine	11	12000	132,000	132,000
5.	Poultry	1319	250	329,750	329,750
Total					6,139,150

Based on animal mortality studied result, economic losses on to livestock owners due to death of animal population were estimated as **6,139,150** birr (Table 8).

Table 9: Morbidity rate of diseases in animals (2019-2021)

Diseases	Species	No. of sick	Morbidity rate (n= 2689)
Trypanosomosis	Cattle	332	12.34
CBPP		292	10.85
Pasteurellosis	Cattle, sheep	330	12.27
PPR	Shoat	120	4.46
Shoat pox	Shoat	30	1.11
CCPP		28	1.04
Pneumonia	Equine	30	1.12
NCD	chicken	867	32.24
Avian salmonella		660	24.54
Total =2689			

As **Table 9** indicated that, a total of **2,689** animals were sick from different causes. According to livestock owners report, from the total number of sick animals in last three years, the highest (32.24%) proportional morbidity rate was registered in NCD disease whereas the lowest (1.04%) proportional morbidity rate was reported in CCPP diseases.

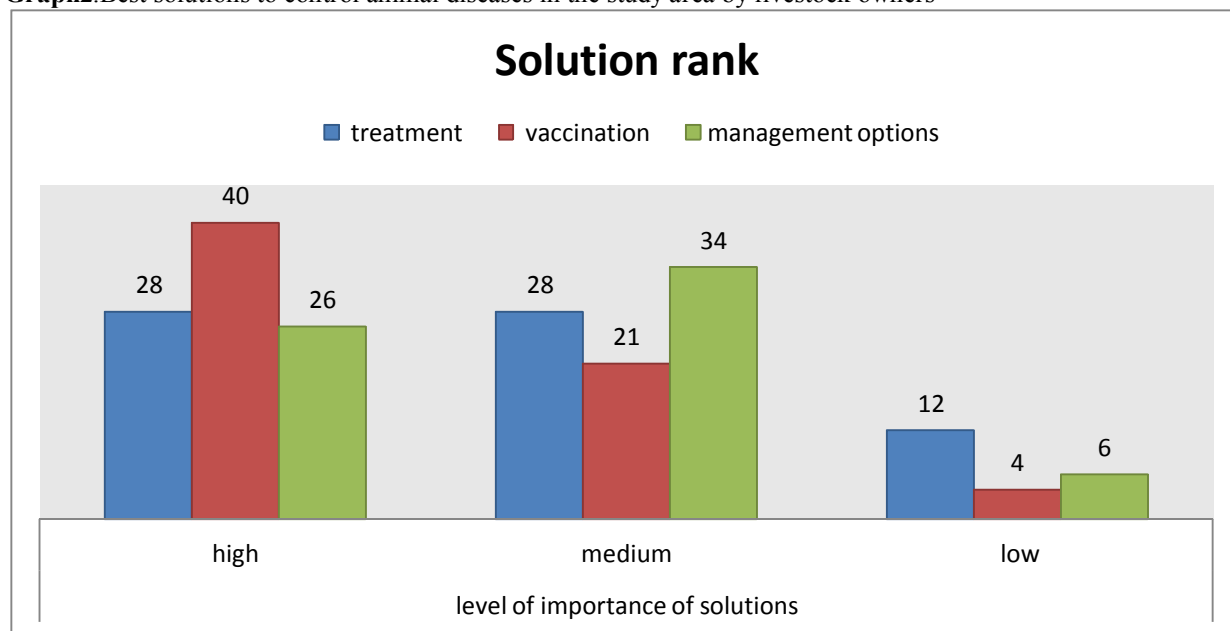
Table 10. The main problem identified in the villages and solutions taken by livestock owners

No.	Main problems	Solutions /measures taken by respondents	Response rate	
			(N=67)	%
1.	Animal disease	Bring sick animals to veterinary health posts / clinics for treatment	57	85.07
		Vaccination	10	14.92
2.	Shortage of water	additional water provision	30	44.77
		No measure taken	13	19.40
3.	Shortage of feed and grazing land	Provide additional feed (hay)	41	61.19
		No measure taken	5	7.46
4.	Tsetse Fly	Delthamethrinpou on and target	9	13.43
5.	Shortage of drugs	Brought from private pharmacy	36	53.73
		No measure taken	1	1.49
6.	Unscheduled vaccination	Reporting to concerned body	9	13.43
7.	Un response to Treatment	No measure taken	5	7.46
		Research will be conducted	1	1.49
		Reporting to the concerned bodies	1	1.49
8.	Un controlled animal movement	No measure taken	1	1.49

As Table 10 indicated, problems were identified in the villages and also solutions were given by respondents; So that, 85.07%, 14.92%, 44.77%, and 61.19% of respondents bring their sick animals to veterinary health posts for treatment in the villages, bring their animals for vaccinations in kebeles, provide additional water, and feed or hay respectively.13.43% of respondents said, tsetse fly challenges in the communities, were controlled by integrated approaches. That was, using deltamethrin pour on

techniques and by deploying targets and traps in the riverine, bushes and forest areas and treating infected one. 53.73% of respondents brought drugs from private pharmacy, 1.49% of respondents in the studied villages of Bambasi district said that treated animals in the villages are not give response to treatment. Therefore, for investigated animal health problems, their was measures taken or solutions given by animal health workers in the communities (Table 10).

Graph2.Best solutions to control animal diseases in the study area by livestock owners



Graph 2. Showed that, animal health problems control measures such as treatment, vaccination and management options shows as high, medium and low level of solutions as respond by livestock owners in kebeles.

Table 11: Level of disease symptoms in the villages by livestock owners (2019-2021)

Animal disease symptoms	Level of disease symptoms / importance by respondents (N=67)	Ranking
Sudden death	37	3
Itching or wool loss or skin problem,	32	5
Diarrhea,	40	2
Losing body condition,	51	1
Bloating or swollen belly,	22	7
Nervous symptoms,	18	9
In appetite,	34	4
Lambing problems,	25	6
Blindness	19	8

As *Table 11* indicated, clinical animal disease symptoms such as losing of body conditions, diarrhea, sudden death, in appetite, itching or wool loss or skin problems, lambing problems, bloating or swollen belly, blindness, and nervous symptoms were addressed as major clinical diseases of livestock, scored as 1- 9 based on their veterinary importance as respondents reported.

4.2 Interview with kebeles Animal health workers

Five animal health workers (respondents) were involved in the studied kebeles. In the kebele veterinary health posts, retrospective information were assessed from the case book documents from 2019 to

2021, which were related to list of common priority animal diseases, and recommended drugs for suspected diseases, veterinary diagnostic equipments, morbidity and mortality data (number of animals diseased and died in the years) , animal vaccine type and the number of animals vaccinate in the last three years, were surveyed in the veterinary health posts during the questionnaire survey. Main animal health constraints such as disease occurrence, shortage of feed, water, drug, un willingness to vaccinate and shortage of veterinary equipments of constraints were reported by animal health workers in the kebeles. That is 80%, 100%, 100%, 80%, 60% and 80% of response rate respectively as *Table 12* indicated.

Table 12: Main constraints of animal health in five villages by kebele animal health workers

Constraints	Kebeles					Response rate	
	M48	M49	M47	M46	Sonka	N=5	%
Disease occurrence	1	1	1	0	1	4	80
Shortage of feed	1	1	1	1	1	5	100
Shortage of water	1	1	1	1	1	5	100
Shortage of drug	1	1	1	0	1	4	80
Un willingness to vaccinate	0	1	1	1	0	3	60
Shortage of veterinary equipments	1	1	1	0	1	4	80

Table 13: Perceptions of the community in controlling disease problems by animal health workers

Perceptions of community	Kebeles					Response rate	
	M48	M49	M47	M46	Sonka	N=5	%
Willingness to vaccinate	1	0	1	1	1	4	80
Un willingness to vaccinate	0	0	1	1	0	2	40
Treat animal by their own	0	0	1	0	0	1	20
Bring animal to vet. clinic	1	0	1	1	0	3	60

As Table 13 indicated that, perception of community in controlling animal disease problems such as willingness to vaccinate their animals, un willingness

to vaccinate their animals, treat animal by their own, and bring animals to veterinary clinics were respond as 80%, 40%, 20% and 60% respectively.

Table 14: Animal mortality rate in five villages in (2019 to 2021) by animal health workers

No	Animal type	no of animal population	no of animal died	crude mortality rate %
1.	Cattle	17257	176	1.02
2.	Sheep	920	66	7.17
3.	Goat	2305	104	4.51
4.	Equines	1260	57	4.52
5.	Poultry	13925	676	4.85
	Total death		=1078	

As Table 14 indicated that, crude mortality rate in animal type were 1.02% cattle, 7.17 % sheep, 4.51 % goat, 4.52% equines and 4.85% of poultry in the study areas. High mortality rate were recorded in sheep

whereas the lowest mortality rate were recorded in cattle in the studied areas from case book document inspections.

Table 15: Diseases responsible for animal morbidity in kebeles of Bambasi District by animal health workers (2019-2021)

Diseases	Species	No. of sick	Proportional morbidity rate (n= 34,166 diseased)
Trypanosomosis	Cattle, shoats, equine	9,333	27.32
CBPP	Cattle	10,669	31.23
Pasteurellosis	Cattle, sheep	9,669	28.30
PPR	Sheep	611	1.79
Shoat pox	Shoat	350	1.024
CCPP	Goat	1705	4.99
Equine pneumonia	equine	865	2.53
NCD	Chicken	582	1.70
Avian salmonella		382	1.12
		=34166	

As Table 15 indicated, 27.32% Trypanosomosis, 31.23% CBPP, 28.30% pasteurellosis, 1.9% PPR, 1.02% Shoat pox, 4.99% CCPP, 2.53% pneumonia of equines, 1.7% NCD, 1.12% avian salmonella disease

complication of morbidity rate were surveyed in the five villages. As the assessment indicated, high morbidity rate were registered in CBPP and followed by pasteurellosis whereas lowest in shoat pox.

Table 16: Animal mortality and economic impact in villages by animal health workers (2019-2021)

No	Animal species	No. died	Average per animal price (birr)	Total price	Economic impact (mortality) in birr
1.	Cattle	176	30000	5,280,000	5,280,000
2.	Sheep	66	3000	198,000	198,000
3.	Goat	104	2800	291,200	291,200
4.	Equine	57	12000	684,000	684,000
5.	Poultry	676	250	169,000	169,000
	Total				6,622, 200 birr

Based on animal mortality studied result, economic losses on to animal owners due to death of animal population were estimated as **6,622, 200 birr** (Table 18).

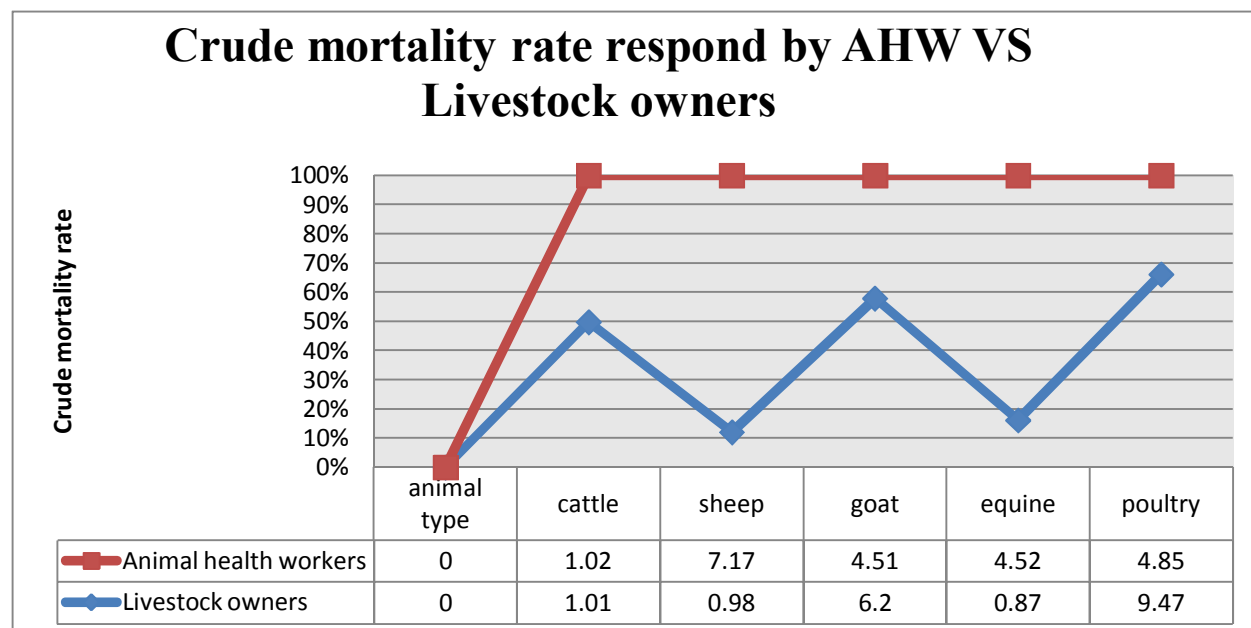
Table 17: Type of vaccines and animal vaccinated from 2019 – 2021 years

Type of vaccine	Animal vaccinated in years			Total	
	2019	2020	2021		
CBPP	2550	3100	3000	8650	17600
Bovine Pasteurellosis	3600	2050	2200	7850	
Black leg	1100	0	0	1100	
PPR	332	547	666	1545	
Shoat pox	600	130	433	1163	
NCD	7335	7200	10000	24535	24535
Rabies	12	0	10	22	22

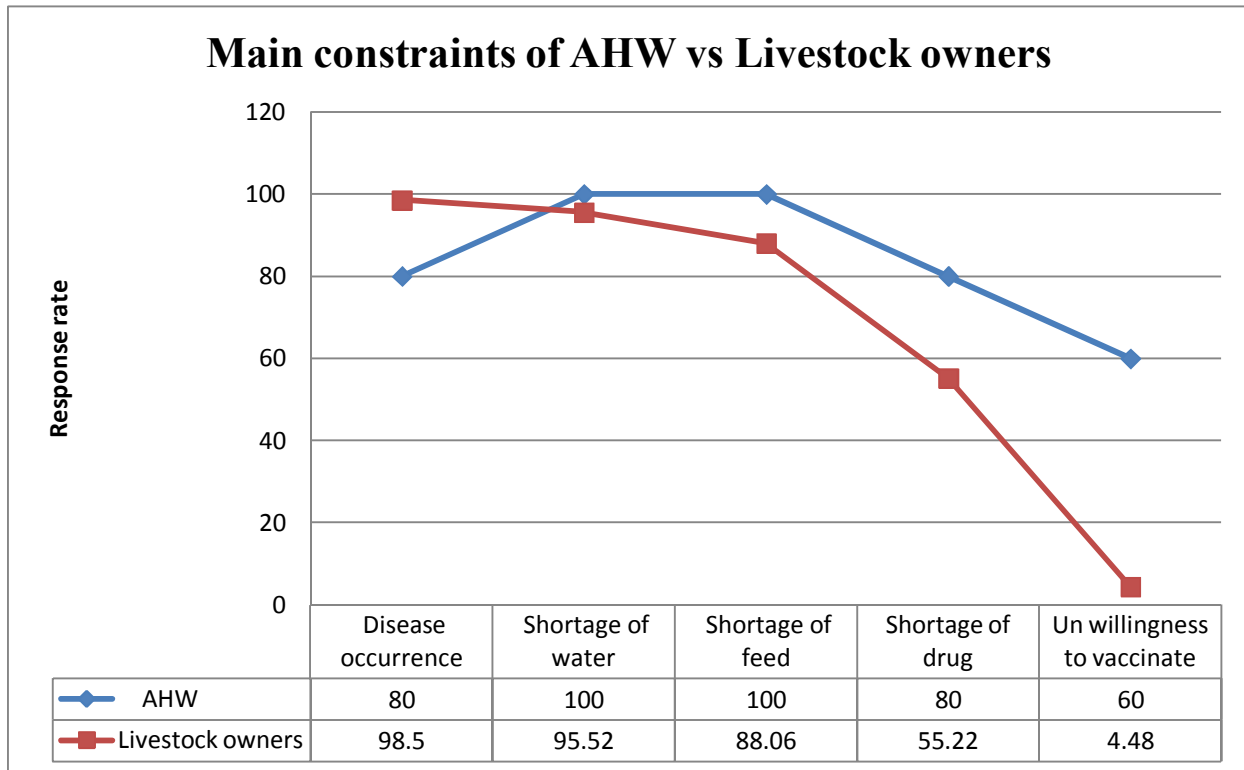
As Table 17 indicated that, 17600 cattle, 2708 Shoats, 24535 poultry and 22 dogs were vaccinated from 2019 to 2021 in five villages of Bambasi district. And also 8650 CBPP, 7850 Bovine Pasteurellosis, 1100 black leg, 1545 PPR, and 1163 Shoat pox vaccines were given in five villages of Bambasi district.

4.3. Comparison of Livestock mortality verses morbidity rate, constraints by respondents

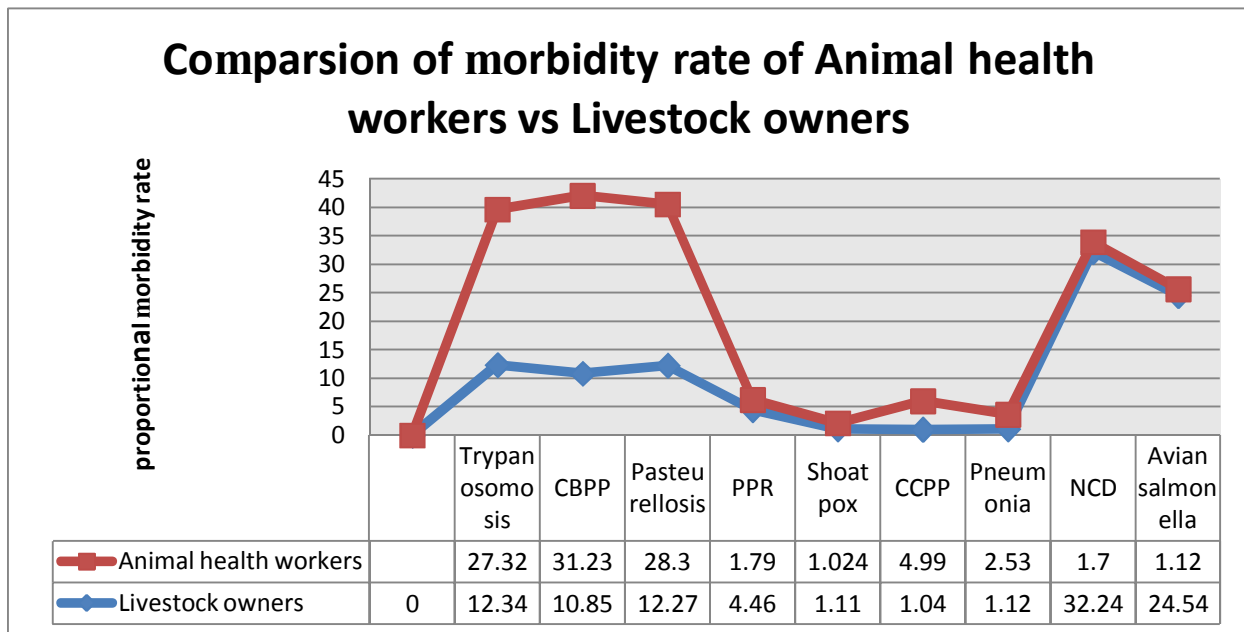
High crude mortality rate 9.47%, was recorded in poultry, as reported by Animal owners, followed by 7.17% of mortality rate in sheep as respond by Animal health workers. 0.87% and 1.02% of low mortality rate were recorded in equine and Cattle by respondents as livestock owners and Animal health workers respectively indicated (Graph 3).



Graph 3: Animal crude mortality rate respond by livestock owners VS animal health workers



Graph 4. Showed that, the comparison of common main constraints respond by animal health workers and Livestock owners



Graph 5. Indicated, the comparisons of morbidity rate of Livestock owners and animal health workers.

5. DISCUSSION

The present survey was conducted in Sonka, Mender -46, Mender-47, Mender-48, and Mender-49 of Bambasi district for disease investigation and animal health problems identification in the areas. Overall 67 respondents of livestock owners and five kebeles animal health workers were interviewed. Animal crude mortality and proportional morbidity rate, treatment cost per animal in a year, frequency of treatment per animal in a year, domestic animal level of importance, livestock health constraints and their solutions given in the villages, disease and syndrome prioritization, and animal population of the last three year from 2019 to 2021, were assessed during the survey.

Of 67 respondents of kebeles rural residents, 91.04% were male, and 8.95% were female. Regarding the educations categories, (26.86%), (65.67%), and (7.46%) of respondents were illiterate, 1-8, and 8-10 grades respectively in the five surveyed sites. And < 30 years, 30-50 years and >50 years of age categories were 5.97%, 40.29%, and 53.73% of respondents in the five villages of study sites. The present findings were concord with the previous findings of Umer seid Geletu *et al.* (2021) in Doba District of West Harerghe Zone, Ethiopia; who indicated Demographic features the respondents. That is 86.7% of males and 13.3% of females of sex groups. 66.7% of illiterate, 24.4% of literate, 8.9% of primary school of education status. And 37.8% of respondents were less than 15 years, 62.2% of respondents of family size were age ranging greater than 15 years. Similarly, Abdihakim M, *et al.* (2022) in Somali Shabelle Zone, Somali Regional State, Ethiopia, showed that, Gender, age, educational level and family size were assessed, that was, 75% of respondent males and 24.5% females of sex groups. 63.5% of respondents illiterate, 26% of primary grade, and 10.5% religious school of educational levels. Furthermore, Gebremedhin A. (2007) who studied that, major animal health problems of market oriented livestock development in Atsbi Womberta woreda, Tigray regional state, that is 82% respondents of males, and 18% of females. Respondents of 82 % of illiterate, 10% of Religious, and 6% of elementary school and 2% of junior and above. 39.8% of respondents were less than 15 years old, and 61.2% of respondents of greater than 15 years of demographic features in the areas.

In the current study, disease occurrence, shortage of water, feed and grazing land, insufficient drug, increased cost of drug, Tsetse fly infestation, un response to treated animals, poor management of animals, unwillingness to vaccinate their animals, and uncontrolled animal movement were livestock health constraints respond by community livestock owners as 98.50 %, 95.52%, 88.06%, 55.22%, 59.70%, 19.4%, 8.95%, 7.46%, 20.89%, 4.48%, and 5.97% of response

rate respectively in five villages of the study sites. Up on investigation of animal health problems, majority of respondents said that disease occurrence, shortage of feed, communal grazing land and water are the most common livestock production limiting factors in the areas. Comparably, Umer seid Geletu *et al.* (2021) in Doba District of West Harerghe Zone, Ethiopia; indicated that, 100% of occurrence of health problems, and 37.8% of animal loss due to diseases were animal health constraints that limit the productivity in the area. Besides this, Birhanu A *et al.* (2015) who studied on Investigation of major cattle production constraints in Kembata Tambaro zone of Southern Ethiopia, showed shortages of feed and free grazing land and diseases as the major constraints affecting production and productivity of cattle and small holders' livelihood. In addition, Markos T, (1999) in a M2-2 sub-agroecological zone with special reference to goat production, who investigated, livestock production constraints as feed shortages, livestock diseases, low genetic potential of indigenous livestock, lack of marketing infrastructure and water shortages.

Comparably, this finding was in line with the previous finding of Nigatu D. *et al.* (2017) who studied assessment of potential factors contributing to animal health service delivery problems, in Benishangul Gumuz Regional State, Ethiopia and indicated that, shortage and poor quality of drugs, misdiagnosis, lack of consistent and systemic way of monitoring, evaluation, and controlling of service delivery, lack or shortage of diagnostic materials, limitation with timely provision of vaccines and treatment chemicals, biased managers, shortage or lack of infrastructures, lack of initiation, and lack of professional refreshment trainings as existing constraints in selected woreda kebeles of Assosa zone.

As community livestock owners respond, animal crude mortality rate with animal type were 1.01% of cattle, 0.98% of sheep, 6.20% of goat, 0.87% of equine, and 9.47% of poultry. Similarly, as community kebeles animal health workers reported, crude mortality rate in animal type were 1.02% of cattle, 7.17% of sheep, 4.51% of goat, 4.52% of equine, and 4.85% of poultry in the five villages were recorded in the veterinary health posts of cases book documents from 2019 to 2021.

In addition, the current study was concord with the previous findings of Gebremedhin A. (2007) who indicated in Atsbi Womberta woreda, Tigray regional state, as 16.98%, 6.6% of anthrax in cattle, sheep, 15.7%, 14.7% of black leg in cattle, sheep, 10.6% of mastitis of cattle, 8.9%, 17.0% of pasteurellosis in cattle, sheep, 5.3% of LSD in cattle, 7.9%, 53.7% of shoa pox of sheep, goat and 53.7% of NCD of livestock mortality rate respectively, and also, Gebremedhin A. (2007) reported that, during

2005/2006 years, a total of 223 animals died from different causes, but according to farmers, most of sheep died of diseases that is categorized as unknown disease. From the total number of animals died, 12.3% were cattle, 40.8 % were sheep, 20.1% Goat, 18.7% were poultry and 4.1% were equine.

Comparably, the present crude mortality was in line with the previous findings of Asmamaw A *et al.* (2017) which was reported as crude animal mortality rate were, 21.46 % cattle, 22.1% sheep, 22.52 % goat, 6.75 % equines and 75.1 % poultry. Besides this, 2.32% LSD, 2.91% CBPP, 0.87% anthrax, 21.97% PPR, 7.2% Shoat pox, 10.92 % CCPP, 52.32 NCD% and 1.46% Rabies, were reported as proportional mortality rate. These varieties might be due to, the major causes of mortality were poor management problems followed by viral and bacterial diseases. Similarly, it was also slightly inconsistent with mortality rate of 12.17% cattle, sheep 38.06%, goat 68.58% and equines 30.28% and crude mortality rate excluding poultry were 48.63% in Assosa zone woredas' (CSA, 2013).

However, the present finding is lower when compared with the previous findings of, Tesfaye D *et al.* (2011) who indicated, 4.4 % overall mortality rate of cattle due to trypanosomosis and 12.1% of overall prevalence of the disease, during his research activity on economic burden of bovine trypanosomosis in three villages of Metekel zone, Northwest Ethiopia. In addition, it disagrees with the previous findings of Hossain MM *et al.* (2014) who reported, 5.6% average overall mortality rate, and higher mortality of cattle in rainy season (37.98%) followed by winter (33.03%) and summer (28.99%) and also pneumonia (39.91%), Tuberculosis (20.58%) and enteritis (15.58%) cause of deaths. **In addition**, this result was in line with the earlier reports by Solomon w. *et al.* (2014) during their studies on major causes of lamb mortality at Ebinatworeda, Amhara National state, north western, Ethiopia, that, 40% of overall lamb mortality, most of mortalities were due to diarrhea (51.0%), pneumonia (38%) and others 10.0%.

Livestock owners respondents said that, proportional morbidity rate in animal type were 12.34% trypanosomosis, 10.85% CBPP, 12.27% pastuerellosis, 1.04% of PPR, 1.11% of shoat pox, 4.46% of CCPP, 1.12% of equine pneumonia, 32.24% NCD, and 24.54 % of avian salmonella in five villages of surveyed sites. Whereas kebeles animal health workers reported that, 25.37% of trypanosomosis, 31.23% of CBPP, 28.30% of pastuerellosis, 1.79% of PPR, 1.02% of shoat pox, 4.99% of CCPP, 2.53% of equine pneumonia, 1.70% of NCD, and 1.12% of avian salmonella of proportional morbidity rate in the case books which were registered in the past three years (2019-2021).

Comparably, Asmamaw A *et al.* (2017) reported that, 28.72% Trypanosomosis (cattle, shoats), 26.39% internal parasites (cattle, shoat, equines), 13.46% ectoparasites (cattle, shoat, equines) and 31.43% other disease complications were studied as proportional morbidity rate during the study period.

However, the present findings were inconsistent with the findings of Chaudhary JK, *et al.* (2013) who reported an overall bovine morbidity of 31.22%. Besides this, it was in accordance with the study conducted by Kelay B *et al.* (2008) who reported incidence of crude morbidity 61.5%, due to (diarrhea, pneumonia, navel ill, septicemia and congenital disease), during the study of calf morbidity in dairy farms in Debre zeit, its environs, Ethiopia and also the most frequent disease of calf diarrhea with incidence of 42.9%. This variation were due to substantial economic losses and/ or animal mortality, due to disease occurrence, shortage of variety drugs, in appropriate vaccination program, and different health constraints in the areas.

As the present survey indicated that, Trypanosomosis, CBPP, PPR, anthrax, Black leg, pasteurellosis, endoparasite, ectoparasite, NCD, Rabies, LSD, FMD, and Shoat pox were common animal diseases prioritized by respondents as 98.50%, 97.01%, 10.44%, 38.80%, 55.22%, 49.25%, 32.8, 45, 89.55%, 4.47%, 22.39%, 19.40%, and 4.47 % of response rate respectively assessed in the five villages of the sites.

The current finding was similar with the findings of Nigatu D. *et al.* (2017) who indicated, the response of the animal health workers at the public animal health service centers and the common priority animal diseases of the area as, Trypanosomiasis, Pasteurellosis & CBPP, PPR, Pneumonia, ectoparasites and endoparasites, NCD, Salmonella, FMD, Blackleg, Lumpy skin disease, and Sheep and Goat pox, in the study area of Assosa zone of Benishangul Gumuz Regional State.

In the kebeles of the surveyed sites, frequency of treatment per animals per year were averagely, 17, 3, 2 of cattle, shoat and equines respectively, were brought to nearby veterinary health posts in a year as community livestock owners reported. Besides this, because of diseased animal which come to the veterinary health posts, 44,899.5 birr of treatment cost were wasted by community animal owners. According to community livestock owners and animal health workers respondents' indication, economic losses due to animal death were recorded as 6,139,150 birr and 6,622,200 birr respectively. Comparably, Asmamaw A *et al.* (2017) showed that, farmers' household treatment cost because of diseased animals were 1,631,044 birr and economic loss due to death of animal population were estimated as **78,830,840** birr in

the region as retrospective data in the casebooks of the studied area indicated.

The present study indicated that, 48.4 for cattle, 17.2 for shoaat, 30.2 for equine of treatment cost was reported by livestock owners during the survey period. This survey was comparable with the findings of Gebremedhin A. (2007), in AtsbiWombertaworeda, Tigray regional state, who indicated that 42.5% of modern treatment cost, and 35.2% of traditional treatment cost as frequency of treatment. Similarly, 44.0% expensive, 44.0% moderate and 12.0% cheap of degree of treatment cost as respondents in the study areas. This finding was relatively comparable with that of Asmamaw A *et al.*(2017) who showed, the farmers in the area were spending a significantly higher amount of money for the treatment of priority common animal diseases. Many of the farmers prioritized losses of draft power as the most important impact of the disease. The disease burden was significantly higher in the rainy season than at other times of the year.

6. CONCLUSION AND RECOMMENDATIONS

The retrospective survey on animal health problems and disease investigation in Sonka, Mender (46, 47, 48, and 49) kebeles of Bambasi district were assessed. 98.50 %, 95.52%, and 88.06%, of study respondents indicated, disease occurrence, shortage of water, shortage of feed and grazing land, as priority constraints while 4.48%, and 5.97% of respondents noticed, un willingness to vaccinate, and uncontrolled animal movement as lowest priority constraints in the areas respectively. As community livestock owners respond, the highest (9.47%) and lowest (1.01%) animal crude mortality rate were registered in poultry and cattle respectively. Similarly, kebele animal health workers respond that, 7.17% and 1.02% of highest and lowest crude mortality rate respectively, were recorded in retrospective cases book documents of kebeles veterinary health posts. Community livestock owners indicated that, 32.24% proportional morbidity rate were reported in poultry, and 1.04 % PPR disease, morbidity rate were recorded in Shoats, whereas kebeles animal health workers reported that, the highest, 31.23% of CBPP morbidity rate of cattle and the lowest, 1.02 % of Shoaat pox morbidity rate were investigated in the retrospective data. Trypanosomosis, CBPP, pasteurellosis and NCD were main animal diseases prioritized by respondents.

Because of animal disease occurrence, shortage of pasture & water, illegal animal movement, and poor management, morbidity and mortality rate were increased. In studied area, un strategic treatment and vaccination service, mis diagnosis, lack of veterinary diagnostic equipments, un willingness to

vaccinate, less monitoring and evaluation system, less surveillance and assessment were main gap identified. Therefore, strategic prevention and control policy would be implemented properly in study area so as to prevent problems encountered.

Based on the above findings, the following recommendation was forwarded:

- Organized and strategic seasonal vaccination program should be implemented,
- While using vaccination, it should be cold chain maintained,
- Legal Animal movement control system could be motivated,
- Illegal animal movement should be managed and owner ship would be created,
- Identification and isolation of major animal disease, and seasonal surveillance could be implemented,
- Community based, animal surveillance team should be established,
- Animal drugs and veterinary diagnostic, laboratory equipment, in type and number should be provided,
- Organized, Tsetse fly control (Sterile insect techniques, Target and trap attractants and delthamethrin pour on techniques system),
- Expertise skill improvement and farmers awareness creation should be parallelelly implemented,
- Improved animal pasture, and feeding system and water provision should be done,
- Continuous monitoring, and disease surveillance should be implemented,
- Adequate , variety and quality drug provision,
- Laboratory based diagnosis, should be implemented in order to reduce mis diagnosis that were raised by community livestock owners,
- Community sensitization/ mobilization could be done in order to increase their perspectives up on animal husbandry, handling, sanitary measures, disease symptoms reporting, management options of communal feeding and watering strategy,
- Capacity building should be given for community front line animal health workers so as to increase their attitude, knowledge and skill regarding advanced veterinary service such as diagnostic, surveillance and monitoring on the animal health problems and constraints encountered during the survey.

7. REFERENCES

- [1]. Alemu Y. and Merkel R.C. 2008. Sheep and Goat Production Handbook for Ethiopia. International Development United States Agency P 3.
- [2]. Asmamaw A, Yami b, and Bayisa k, (2017): Retrospective study on major animal disease and mortality rate in selected woredas, Benishagul - Gumuz Regional state, Western Ethiopia.
- [3]. Abdihakim M*, Kawnin A, Guled H, Abdulahi M, Mahamed H. (2022): Management Practices and Production Constraints of Indigenous Somali Cattle Breed in Shabelle Zone, Somali Regional State, Ethiopia, *Open Journal of Animal Sciences*, 2022, 12, 103-117, [Open Journal of Animal Sciences](https://www.scirp.org/journal/ojas). <https://www.scirp.org/journal/ojas>, DOI: 10.4236/ojas.2022.121008 Jan. 21, 2022 103.
- [4]. Benishangul Gumuz Region Bureau of Communication (BGBoC).2020. *Summary of information on the region*, Assosa Ethiopia.
- [5]. BAHs (2012) :18th Live Stock Census, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture available on <http://dahd.nic.in>. (Retrieval date-11/01/2013).
- [6]. Bambasi Agricultural office annual report, 2015.
- [7]. Birhanu A. & Worku T. & Benti D. (2015): Investigation of major cattle production constraints in KembataTambaro zone of Southern Ethiopia using participatory epidemiology methods. *Trop Anim Health Prod*, DOI 10.1007/s11250-015-0928-y.
- [8]. Benishangul Gumuz regional state, Agriculture bureau (2016): Annual regional animal inventory data
- [9]. Central Statistics Agency (CSA). 2016/17. Federal democratic republic of Ethiopia, Central Statistical Agency Agricultural Sample Survey, volume 2. *Report on Livestock and Livestock Characteristics*; Addis Ababa, Statistical Bulletin 585.
- [10]. Chaudhary JK, Singh B, Prasad S and Verma MR (2013) : Analysis of morbidity and mortality rates in bovine in Himachal Pradesh, *Vet World* 6(9): 614-619.
- [11]. CSA (2012/13): Federal democratic republic of ethiopia central statistical agency agricultural sample survey 2012/13 [2005 e.c.] volume ii report on livestock and livestock characteristics (private peasant holdings).
- [12]. CSA (2009): Central Statistical agency, Federal Democratic Republic of Ethiopia, Agricultural Sample Survey. Statistical bulletin, pp 446:85.
- [13]. CSA(2007): Central Statistical agency
- [14]. Gebremedin R., and weldemelak G., 2020. Knowledge, attitude and practice towards anthrax in northern Ethiopia: a mixed approach study. *BMC infectious diseases*. Vol.20:814. Pp5-17.
- [15]. Gebremedhin A. (2007): Major animal health problems of market oriented livestock Development in Atsbiwombertaworeda, Tigray Regional State. Faculty of Veterinary Medicine, Addis Ababa.
- [16]. National Meteorological Services Agency (NMSA). 2015. Monthly report on temperature and Rainfall distribution for Assosa zone, Regional Metrological Office, Assosa, Ethiopia.
- [17]. Tesfaye D *et al.*, 2011: Economic burden of bovine trypanosomiasis in three villages of Metekel zone, Northwest Ethiopia, April 2012, Volume 44, Issue 4, pp 873-879
- [18]. Radostitis OM, Blood DC, Gay CC (2000): *Veterinary Medicine: A text book of the diseases of cattle, sheep, pigs, goats and horses*. 8th ed.
- [19]. Hossain MM, Islam MS, Kamal AHM, Rahman AKMA and Cho HS (2014): Dairy cattle mortality in an organized herd in Bangladesh, *Veterinary World* 7(5): 331-336.
- [20]. Kelay B *et al.* (2008): Calf morbidity and mortality in dairy farms in D/zeit its environs, Ethiopia.
- [21]. Nigatu D., Himaont D, Asmaaw A. Bayisa K, Haile W. 2017. Assessment of Potential Factors contributing to Animal Health service Delivery problems, in Benishangul Gumuz Regional State, Ethiopia. Assosa University, College of Agriculture and Natural Resource , Department of Veterinary Science in collaboration with Benishagul Gumuz Region of Fishery and Livestock Development agency.
- [22]. Markos Tibbo (1999): Livestock production constraints in a M2-2 sub-agroecological zone of Awassa Zuria district, Ethiopia , with special reference to goat production, pp1-9.
- [23]. Umer Seid Geletu *et al.* (2021): Assessment of Major Animal Health Problems and Their Impact on Beef Cattle Production in Doba District of West Harerge Zone,

- Ethiopia, Veterinary Medicine International
Volume 2021, Article ID 5533398, 5 pages.
- [24]. World Bank. 2006. Africa development indicators. Washington D.C
- [25]. Yamane T (1973). Statistics, An introductory analysis, 2nd Edition., New York: Harper and Row. Link: <https://bit.ly/2YatqSW>.

8/22/2022