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Study on Spatial Distribution of Tsetse Fly and Prevalence of Bovine Trypanosomosis and other Risk Factors: Case Study in Darimu District, Ilu Aba Bora Zone, Western Ethiopia

Fedesa Habte Assefa Kebede Tekalegn Desta
School of Veterinary Medicine, Jimma University College of Agriculture and Veterinary Medicine, P.O. Box: 307 Jimma, Ethiopia

Abstract
African Animal Trypanosomosis is one of the major impediments to livestock development and agricultural production in Ethiopia, which negatively affect the overall development in agriculture in general, and to food self-reliance efforts in particular. Currently, about 180,000 to 200,000km^2 of fertile arable land of west and southwest of the country is underutilized. Darimu district is one of the areas with such problems. Therefore, a cross-sectional study was conducted with the objectives of assessing the prevalence of Bovine Trypanosomosis and determines spatial distribution and apparent density of tsetse and other biting flies in the study area. In current study, a total of 650 blood samples were collected from randomly selected animals and subjected to Buffy coat parasitological laboratory technique and positive samples were subjected to thin blood smear followed by Giemsa staining. Out of the total blood sampled, 7.1% tested positive for trypanosomosis. Out of positive cases, *Trypanosoma congolense* (82.61%) was the dominant trypanosome species followed by mixed infection (*Trypanosoma congolense* and *Trypanosoma vivax*) (8.67%). Infection with *Trypanosoma vivax and Trypanosoma brucei* were equally prevalent 4.35% (2/46). Statistically significant difference (P<0.05) was observed in the prevalence among the species of trypanosomes. Trypanosomosis prevalence based on body conditions were found to be: 11.43%, 5.40% and 4.16% in poor, medium and good body condition, respectively and there were statistically significant difference (P<0.05) in infection rate among animals of different body conditions. The mean packed cell volume (PCV) values of parasitaemic and aparasitaemic animals were 21.18±2.91 and 28.28±3.82, respectively and was statistically significant (P<0.05). Furthermore, for entomological survey, a total of 1170 flies were caught by deploying 70 monopyramidal shaped traps. Of these flies, 962 (82.22%) were *Glossina*, whilst the remaining flies were either *Stomoxys* (12.56%) or *Tabanus* (5.21%). The overall apparent densities of tsetse flies, *Stomoxys* and *Tabanus* were 6.87 f/t/d, 1.05 f/t/d and 0.44f/t/d, respectively. Generally, this survey showed that despite frequent control strategy is implemented; trypanosomosis is still a core problem for livestock production in the study area. Therefore, the current control strategies implemented in the area should be assessed and integrated disease and vectors control approaches should be practiced.
Keywords: Prevalence; Bovine Trypanosomosis; Buffy coat; Spatial distribution, Tsetse fly; Darimu

INTRODUCTION

Ethiopia has huge and diverse livestock population that plays an important role in the economy and livelihoods of farmers, and pastoralists. Livestock are a 'living bank' or 'living account' for rural and urban poor farmers and livestock owners. They serve as financial reserves during period of economic distress such as crop failure as well as primary cash income. Among livestock, cattle are the primary resource for people and government of Ethiopia. Despite the large animal population, productivity in Ethiopia is low and even below the average for most countries in eastern and sub-Saharan African countries, due to poor nutrition, reproduction insufficiency, management constraints and prevailing animal diseases [1].

Trypanosomosis is one of the major impediments to livestock development and agricultural production, which negatively affect the overall development in agriculture in general, and to food self-reliance efforts of the nation in particular. While tsetse borne trypanosomosis is excluding some 180,000 to 200,000 km^2 of agriculturally suitable land in the west and southwest of the country, 14 millions heads of cattle, an equivalent number of small ruminants, nearly 7 million equines and 1.8million camels are at risk of contracting trypanosomosis at any time [2,3]

Trypanosomosis is a complex disease caused by unicellular parasites (Genus: *Typanosoma*) found in the blood and other tissues of vertebrates including cattle (livestock), wild life and people [4]. The most important trypanosome species affecting livestock in Ethiopia are *Trypanosoma congolense, Trypanosoma vivax*, and *Trypanosoma brucei* in cattle, sheep and goats, *Trypanosoma evansi* in camels and *Trypanosoma equiperdium* in horses [5].

Tsetse flies in Ethiopia are confined to Southern and Western regions between a longitude of 33^o and 38^{o}E, and latitude of 5^o and 12^{o}N [6]. Tsetse infested areas lie in the lowlands and in river valley of Abbay (Blue Nile), Baro, Akobo, Didessa, Ghibe and Omo [2]. Out of the nine regions of Ethiopia five (Oromia, SNNPR, Amhara, Beninshangul Gumuz, and Gambella) are infested with more than one species of tsetse flies [6].

Consequently, new areas are being invaded and settled communities are being continually evicted by the advancing tsetse. Five species of *Glossina* (*G.m. submorsitans*, *G.pallidipes*, *G. tachinoides*, *G.f. fuscipes*, and *G. longpennis*) have been recorded in Ethiopia [5]. According to NTTICC [7], tsetse transmitted animal trypanosomosis is still remain as one of the largest causes of livestock production losses in Ethiopia. Therefore, the objectives of the present study were:

- To determine the prevalence rate of bovine trypanosomosis,
- Identify trypanosomosis species affecting bovines and
- To assess the spatial distribution and apparent density of vectors and other biting flies in Darimu district

MATERIALS AND METHODS

Study Area

The study was conducted in Oromia regional state, Iluababor zone and Darimu districts lies at longitude 35°15' to 35°32'E and latitude 8°30' to 8°44'North of equator. Altitude of the area ranges from 792-1800 meter above sea level. The agro-ecological zone of the woreda is 54% Woina dega and 46% Kola. Distance of the district from zone is 64km and 664km from Addis Ababa, in western direction of the country. According to the Darimu Woreda Agricultural and Rural Development Office (2013), the climatic condition fluctuates with long summer rainfall (June to September), short rainy seasons (March to April) and winter dry seasons (December to February) and the mean annual rainfall ranges from 1172-1740 mm. The mean annual temperature of the district ranges from 18-25^{0}c 15°C and the areas of the district are 1387.97km$^{2.}$

There are tributary rivers that flow throughout the year to Baro Akobo River basin; namely Baro Kala, Birbir River, Siba River, Ganakor River and Fincha River and other seasonal Rivers which tribute of Birbir and Baro Kala Rivers are also found Geba River, Asassi River, and Golo River flow from Darimu Disstrict to Birbir River [8].

The dominant vegetation types are *Acacia jacaranda*, *Ficas sycomors* and *Cordial africana* trees. The wood grass land (savannah) is dominated with *pillistigma* trees. It has long perennial grass with mountains and hills of various heights. Wild games like buffalo, bush, pig, kudu, warthog, hippo and crocodiles are the most commonly found in the study area. Agriculture is the main stay of livelihood of people with mixed farming system and livestock plays an integral role for agriculture. The main crop types cultivated include barley, sorghum, coffee, teff and beans [8].

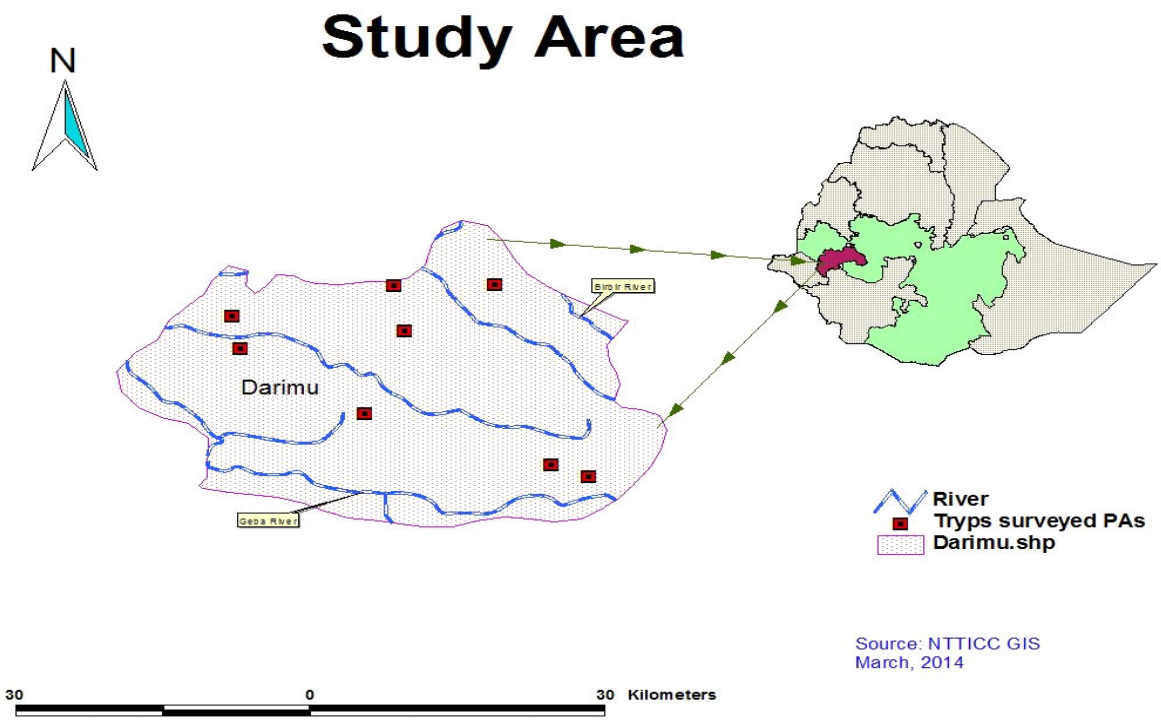

Figure 1: Geographic location of the study area and trap deployed sites in Darimu District, West Oromia
Source: [7]

Study Population

Animal population of the district is 102,484 cattle, 34,432 sheep, 20,556 goats, 1,252 horses, 587 mules and 4,004 donkeys and 89,921 poultry [8]. The study animals were indigenous zebu cattle of all age group and the cattle

involved in the study were maintained under traditional management (extensive) system.

Study Design

A cross sectional study was conducted from November 2013 to March 2014 to determine the prevalence of trypanosomosis in study animals. On the other hand, for entomological survey baited traps were deployed at 200-250 intervals.

Animal Sampling Methods

Sample size determination

The number of animal required for the study will be determined according to [9].

$$N=\frac{1.96^2 P_{exp}(1-P_{exp})}{d^2}$$

Where N= required sample size

P_{exp}= expected prevalence and

D= desired absolute precision (usually 0.05)

The size of the sample is determined using 95% level of confidence, 50% expected prevalence and 0.05 desired absolute precision. The required sample size was 384 animals; however a total of 650 animals were sampled to increase the precision.

Sampling strategy

The study was conducted in eight PAs (peasant associations), namely Abuna gali, Bena 1, Bena 2, Dade botoro, Elala, Gobora, Hana efa and Uche, which were selected purposively based on the extent of the existing problems, the complaints of farmers and the level of medium to high tsetse challenge in the areas. The study animals were selected by using simple random sampling method by taking age, sex, and body conditions in to account according to [10, 11] and all the animals in the selected areas had equal chances to be selected for this study.

Study Method and Procedures

Parasitological studies

Blood sample were collected from the marginal ear vein by using sterile blood lancet and capillary tubes. A pair of capillary tubes was filled with blood from animals to ¾ of their height centrifuge symmetrically and centrifuged at 12000 rpm for 5 minutes and packed cell volume (PCV) was determined. After the PCV was read, capillary tube was broken 1mm below the buffy coat to include the red blood cells layer and the content expressed in the microscopic slide and mixed and covered with 22x22 mm cover slip. The content examined under x40 objective using dark ground Buffy coat technique [12]. From positive samples thin blood smears were made, fixed with methanol for 5 minutes and stained with Giemsa solution for 30 minutes and examined using oil immersion under x100 objective to detect the species of trypanosomes [13].

Entomological studies

Entomological study was also carried out to assess the apparent density, species of tsetse and other biting flies in the study area. During the study 70 mono pyramidal traps were deployed in selected sites which seem suitable habitat for tsetse flies at approximate interval of 200-250m [14]. Every trap was odor baited with acetone and cow urine (Tsetse flies attractants). The underneath of each trap pole was smeared with grease in order to prevent the ants climbing up the pole towards the collecting cage that could damage the tsetse flies. The trap deployment time was 48 hours. After the flies captured in the collecting cage they were then sorted by sex and species and recorded. The species of tsetse was identified based on the characteristic morphology. Other biting flies were also separated according to their morphological characteristics such as size, color, proboscis and wing venation structures at the genus level [2, 15]. Sexing was done for tsetse fly just by observing the posterior end of the ventral aspect of abdomen by hand lens, as result male flies easily identified by enlarged hypopygium [2, 16].

Data Management and Analysis

For analysis, the data recorded was entered into Microsoft excel database system and statistical analysis was done. The SPSS versions 20 software of computer program was applied for the statistical analysis. The prevalence of trypanosome infection was calculated as the number of positive animals as examined by Buffy coat divided by the total number of animals examined at a particular time multiplied by 100. The determinant factors were investigated using percent values and Pearson's Chi-square (χ^2). A statistically significant association between variables was said to exist if the calculated $p<0.05$ at 95% confidence level. Finally, the density of fly population was calculated by dividing the number of flies caught by the number of traps deployed and number of days of deployment and expressed as fly/trap/day.

RESULTS

Parasitological Findings

From 650 examined cattle in eight peasant associations, 7.1% (46/650) were found to be positive for trypanosomosis. The highest (13.33%) and lowest (2.47%) prevalence was recorded in Bena II and Uche respectively. There was no statistically significant (P>0.05) variation in prevalence of trypanosomosis among the different study sites. Prevalence of the disease across the different study sites and its univariate association is given in table 1.

Table 1: The prevalence of bovine trypanosomosis on basis of study sites

Sites	Total animals examined	Number of positives	Prevalence (%)	95% confidence interval	
				Lower	Upper
Abuna geli	90	7	7.78	0.0318	0.1537
Bena I	76	2	2.63	0.0032	0.0918
Bena II	75	10	13.33	0.0658	0.2315
Dade botro	68	4	5.88	0.0162	0.1438
Elala	74	5	6.76	0.0223	0.1506
Gobora	82	7	8.53	0.0350	0.1680
Hanna ifa	104	9	8.65	0.0403	0.1579
Uche	81	2	2.47	0.0030	0.0863
Total	**650**	**46**	**7.1**	**0.0522**	**0.0932**

(X^2=10.248, P= 0.175)

T. congolense was the most prevalent 82.61% (38/46) trypanosome species followed by mixed infection of *T.vivax* with *T. congolense* 8.67% (4/46). Infection with *T.vivax and* T. *brucei* were equally prevalent 4.35% (2/46). The difference in the prevalence among the different species of trypanosomes was statistically significant (P<0.05).

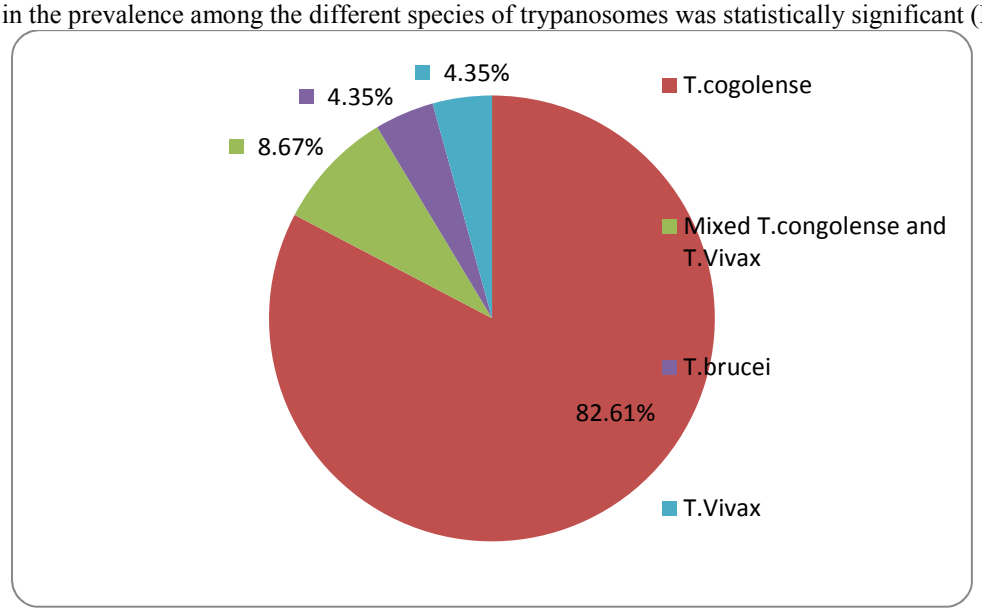

Figure 2: Relative abundance of trypanosome species in study areas

A comparison of trypanosome infection between male and female was made. The overall prevalence in male and female were 8.17% and 6.02%, respectively. The prevalence of trypanosome in male was relatively higher than female. However, there was no statistically significant difference (P>0.05) in trypanosome infection between male and female (table 2).

Table 2: Prevalence of trypanosomosis based on sex

Sex	Total No. of animals examined	No. of positive	Prevalence (%)	95% confidence interval		X^2-value	p-value
				Lower	Upper		
Male	318	26	8.17	0.0541	0.1175	1.44	0.285
Female	332	20	6.02	0.0371	0.0915		

The prevalence of trypanosome infection between age category: age ≤ 2 years, age 2≤5 years and age >5 years) were 4.35%, 8.1% and 6.5%, respectively. There was no statistically significant variation (p> 0.05) in prevalence of infection among the animals in the different age category (table 3).

Table 3: Prevalence of trypanosomosis among different age categories

Age group	Total No of cattle examined	No of positive cattle	Prevalence (%)	95 % confidence interval		X^2-value	p-value
				Lower	Upper		
≤2	69	3	4.35	0.0090	0.1218		
2≤5	335	27	8.1	0.0537	0.1150	1.396	0.498
>5	246	16	6.5	0.0376	0.1034		

The highest prevalence (11.4%) was seen in animals with poor body condition while the lowest (4.16%) was recorded in good conditioned animals. There was statistically significant difference (P<0.05) in prevalence of infection among the different body conditioned animals (table 4).

Table 4: Prevalence of trypanosomosis based on body condition score

Body condition	Total No of examined cattle	No of positive cattle	Prevalence (%)	95 % confidence interval		X^2-value	p-value
				Lower	Upper		
Poor	210	24	11.43	0.0746	0.1652		
Medium	296	16	5.40	0.0312	0.0862	9.16	0.010
Good	144	6	4.16	0.0154	0.0884		

Hematological Findings

The mean PCV value for the parasitemic cattle was 21.18±2.91 SD whilst the mean PCV value for the aparasitemic cattle was 28.28±3.82 SD. In the current study, 13.1% of cattle were both anemic (PCV ≤ 24%) and positive for trypanosomosis whereas; 3.1% were non-anemic (PCV>24%) but positive. There was statistical significant variation (p<0.05) in mean PCV value between parasitemic and aparasitemic cattle.

Entomological Findings

A total of 1170 tsetse and other biting flies were caught during the study period from eight different peasant associations. Out of these, 962 (82.2%) belong to tsetse flies of the genus *Glossina*, and the remaining is shared by two genera namely *Stomoxys* and *Tabanus* with score of 147 (12.56%) and 61 (5.21%), respectively. Two tsetse species have been identified. The proportion of *G. morsitans* and *G. pallidipes* were 823(85.55%) and 139(14.45%), respectively. The apparent density of *Glossina*, *Stomoxys* and *Tabanus* were 6.87f/t/d, 1.05f/t/d and 0.44 f/t/d, respectively. From overall the study sites, the highest (10.95 f/t/d) and lowest (0.75 f/t/d) tsetse fly density was recorded in Hana ifa and Bena I respectively. From total tsetse fly trapped, females occupied larger proportion and out of 962 tsetse flies captured, 520(54.1%) flies were females while the rest 442(45.9%) flies were males (table 6).

Table 6: Apparent densities of flies caught during the study period in different areas of survey sites in Darimu woreda

Trapping site	No of traps	Tsetse flies caught					f/t/d	Biting flies	
		Species						Stomoxys	Tabanus
		G.m.m		G.p		Total			
		M	F	m	F				
Abuna geli	10	87	119	8	3	217	10.85	23	3
Bena I	8	6	6	0	0	12	.75	18	12
Bena II	9	74	86	15	20	195	10.83	16	9
Dade botoro	8	28	46	29	24	127	7.94	19	12
Elala	9	30	27	0	0	57	3.17	10	7
Gobora	8	24	28	4	8	64	4	23	3
Hana ifa	10	98	102	5	14	219	10.95	21	8
Uche	8	32	30	2	7	71	4.44	**17**	7
Total	70	379	444	63	76	962(82.22%)	6.87	147(12.56)	61(5.21)

*G.p = *Glossina pallidipes*
*G.m.m = *Glossina morsitans submorsitans*
*f/t/d= fly per trap per day

DISCUSSION

The overall prevalence of bovine trypanosomosis in the study area was 7.1%, which was relatively lower than previous reports: 8.55% in the Diga and Sasiga, East Wollega Zone, [17]; 12.41% in the Metekel and Awi zones of northwest Ethiopia [18]; 9.1% and 15.1% in Mada Talila and Gudina Wacho Kebeles of Hewa Gelan, Western Ethiopia [19] and 23.0% in Daremello district, southwestern Ethiopia [20]. The relatively low prevalence of

trypanosomosis in this study might be related to low tsetse distribution and low fly–animal contact in the area due to the ongoing parasite and vector control programmes practiced in the area by NTTICC. There was no statistical difference in the prevalence of trypanosome infection between study sites. These might be because of the areas are close to each other in almost a similar climatic and agro ecological condition. The occurrence of trypanosomosis frequently corresponds with the fly density (occurrence of the vectors) which is in turn dependent on those climatic factors as temperature, humidity and vegetation coverage of the area [21, 22]. It may be also associated with the equal intervention done in the districts by NTTICC.

The finding of this study revealed that the majority of the infection was due to *T. congolense* (82.61%) and the least was infection by equal prevalence of *T.vivax* (4.35%) and *T.brucie* (4.35%). Mixed (*T. vivax* and *T. congolense*) infection was also prevalent (8.67%). The higher infection rate of *T. congolense* in the study area was in agreement with different trypanosome species prevalence reported from other tsetse-infested region of Ethiopia. The dominancy of *T. congolense* (82.61%) in the present study is in agreement with previous results of [23] at Daremello district (82.35), [24], in the Ghibe Valley, South west Ethiopia (84%), [25] at Arba minch zuria wereda (85.2%), [26] at Kone (75%). The predominance of *T. congolense* infection in cattle may be due to the high number of serodems of *T. congolense* as compared to *T. vivax* and the development of better immune response to *T. vivax* by the infected animal [27; 28]. Moreover; the results of [26], at Village I (93%) settlement area of west Ethiopia, and [20] at Arbaminch, Ethiopia (92.9%) had shown relatively higher results than the present findings. The results of [29] at Arba Minch, Southern Ethiopia (61.4%), [30] at Jabi Tehennan West Gojjam, North Western Ethiopia (54.3%), and [31] in selected sites of southern region (63.4%) had shown lower results of *T. congolense* than the present findings. These suggest that the major cyclical vectors or *Glossina* species are more efficient transmitters of *T. congolense* than *T. vivax* in east Africa [2]. According to [5], *T. congolense* and *T. vivax* are the most prevalent trypanosomes that infect cattle in tsetse infested and tsetse free areas of Ethiopia respectively. The epidemiology of trypanosomosis is determined mainly by the ecology of the prevalence among the tsetse fly, nevertheless the disease due to *T. vivax* is also based on the distribution of the mechanical vectors like *Tabanus* and *Stomoxy*. The density of tsetse population in the area and the level of their contact with the host, will determine the level of infection [32].

During the study period, the prevalence of bovine trypanosomosis was assessed between sexes of animals and among 46 trypanosome positive animals; 20(6.02%) of them were female animals and 26 (8.17%) of them were male animals. Slightly higher infection rates were observed in male than females in the present study but the difference was not significant. This result is similar to the finding of several researchers such as [23; 33; 31, 34 and 26]. The higher infection rate in males compared to females may be attributed to stress factors related to work where male animals are used for drought purpose and they have to walk long distance in areas where there is a high risk of tsetse challenge.

Age was assumed to be one of the risk factors in my study; accordingly, relatively lower infection rate was observed in animals with ≤ 2 years of age (young) in the study area. Similar results were reported by [35; 36 and 30]. This could be associated to the fact that older animals travel long distance for grazing and draught as well as harvesting crops in tsetse challenge areas [37], in Ghibe valley indicated that suckling calves don't go out with their dams but stay at home until they are weaned off. Besides, young animals are also naturally protected to some extent by maternal antibodies [38]. This could be the reason for lower prevalence of trypanosomosis that was observed in calves. Moreover, tsetse flies are attracted significantly more by odor of large animals and animals that showed less defensive behavior according to [39 and 40].

The prevalence of trypanosomosis in those animals with poor body condition were significantly higher ($P<0.05$) than those in good body condition. This is in agreement with [30; 36 and 20]. Obviously, the disease itself results in progressive emaciation of the infected animals; nevertheless, non–infected animals under good body condition have well developed immune status that can respond to any foreign protein better than those non–infected cattle with poor body condition which can be immune compromised due to other diseases or malnutrition, since malnutrition and concurrent infections depress the immune responsiveness in some cases [41].

During the study period, cattle with PCV≤ 24% were considered anemic [42], which is said to be the principal sign of trypanosomosis in livestock [43]. The present study indicated that the difference between mean PCV values of parastaemic and aparasitaemic cattle of the study area was significant ($P<0.05$). The mean PCV value of parasitaemic animals 21.18±2.91SD and aparasitaemic animals was 28.28±3.82SD. However, trypanosomosis infection and mean PCV values obtained in this study of parasitemic and aparsitemic cattle were in agreement with the report of [44], 21.1% and 26.0% at Awi zone, Northwest Ethiopia, [45], 21.16% and 25.4% at three Woreda of Amhara region, and [46], 20.6% and 25.0% at Asosa district of Benishangul Gumuz, Western Ethiopia, [47], 21.8% and 27.7% at Bench Maji zone southwest Ethiopia, and [48], 22.1% and 29.1% at Abu-Bugar district, central Sudan, for parasitemic and aparasitemic cattle, respectively.

From the total cattle populations sampled during study period, 40% of cattle populations were reported to have a PCV≤24%. The resulting low PCV value may not solely be due to trypanosomosis; however, the difference in mean PCV between parasitaemic and aparasitaemic animals with PCV<24% indicates that

trypanosomosis reduces the PCV values in infected animals. Out of the total animals examined, only 3.1% were non-anemic (PCV>24%) but positive for trypanosomosis; however, the rest 86.9% of cattle with a PCV≤24% were react negatively for trypanosomosis infection. This result agreed with the previous findings of [23; 51] who were concluded that cattle with normal range PCV value to have the parasite. This may have occurred due to the poor detection nature of the test used [12] or delayed recovery of anemic situations after recent treatment with trypanocidal drugs or may be due to the pooled effect of poor nutrition and hematophagus helminth infection such as haemonchosis and bunostomiasis [49]. These suggest that anaemia was an indicator of trypanosomosis infection. PCV values can also be affected by many factors other than trypanosomosis, but these factors are likely to affect both trypanosomosis negative and positive animals [50]. Some trypanosome infected animals can also keep their PCV within the normal range for a certain period of time due to the presence of strong immunity. So, diagnosing of trypanosomosis on the basis of PCV is not specific.

The risk of trypanosomosis is also influenced by apparent density and types of vectors prevailing in the area. The apparent density of *Glossina*, *Stomoxys* and *Tabanus* were 6.87 f/t/d, 1.05 f/t/d and 0.44 f/t/d, respectively. Closer results were reported by [18], from Metekel Awi zones of Northwest Ethiopia, who reported 6.49 f/t/d and 0.65 f/t/d for tsetse and biting flies, respectively and [7], from Bure Iluababor zone of Western Ethiopia with annual report of 7.23 f/t/d, 3.13 f/t/d and 0.06 f/t/d for tsetse, *Stomoxys* and *Tabanus*, respectively. However, these results were slightly lower than reported by [23] from Arbaminch, Ethiopia, who reported 14.97 f/t/d for tsetse fly, and [19] from Hewa Gelan, Oromia region Ethiopia, who reported 11.9 f/t/d, 10.2 f/t/d and 0.9 f/t/d for tsetse, *Stomoxys* and *Tabanus*, respectively. The relatively low level of tsetse population in present study may be due to the interventions like insecticide impregnated targets and insecticide-treated livestock undertaken in the area by NTTICC and the expansion of settlements and farmlands in the area in the expense of deforestation limits the tsetse and other flies habitats. It may also be related to the level of dryness, which resulted in the migration of game animals from the study area during the study period. The results also slightly higher than the previous reports 1.45 f/t/d, 0.35 f/t/d and 0.23 f/t/d for tsetse, *Stomoxys* and *Tabanus*, respectively by [17] from East Wollega zone, Ethiopia and 2.83 f/t/d for tsetse flies by [52] from Bench Maji zone, southwest Ethiopia. The relatively increase in the number of tsetse or other flies might be due to differences in climatic, agro ecological condition and level of intervention applied in control of these vectors. Concerning tsetse fly species *Glossina morsitans submorsitans* and *Glossina pallidipes* were reported and among the mechanical transmitters of trypanosomosis *Stomoxy* and *Tabanus* were the major once.

CONCLUSION AND RECOMMENDATIONS

Trypanosomosis is the most important constraint for livestock production. The result of present study indicated that *Trypanosoma Congolese*, mixed (*T. Congolese* and *T. vivax)*, *T. vivax* and *T.brucei* were responsible for Bovine Trypanosomosis in the study area. The occurrence of trypanosomosis was associated to the tsetse flies and other biting flies. Trypanosomosis is still the major constraints in the study area, although different control measures were applied by National Tsetse and Trypanosomosis Investigation and Control Center (NTTICC). This can be due to inadequate control measures and the development of drug resistance. Therefore, a progressive control campaigns at reducing tsetse fly burden would be necessary to minimize the impact of trypanosomosis and further research is needed to investigate efficacy of drugs. From the obtained results of study, the following recommendations were forwarded:

The current control strategies implemented in the area should be assessed and integrated disease and vectors control approaches should be practiced.

- Extension service implemented in MoARD should have to incorporate participatory packages on public awareness creation in the control of tsetse flies and trypanosomosis.
- Attempt should be made to expand government and Private Veterinary Services to serve the community properly.
- The survey of tsetse flies and trypanosomosis done by NTTICC should be continued to implement an appropriate intervention on time
- Further study should be conducted and appropriate, feasible control options of trypanosomosis and/or vector should be implemented.

Conflict of interest

The authors declared that they have no any competing interests.

Authors' contributions

FH: Reviewing the article, collection of blood samples, tsetse fly and processing each sample to generate data, writing up the manuscript. AK: Guiding overall work from proposal writing up to manuscript writing up, data management and preparing for publication. TD: contributed in the laboratory processing and trap deployment to catch tsetse fly. All authors have read and approved the final manuscript.

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