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Epidemiology of Animal Trypanosomosis in Bullen District of Benishangul Gumuz Region, North Western Ethiopia

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Abstract: A cross- sectional study was carried out in Bullen District of Benishangul Gumuz Regional State, from November 2017 to February 2018 to determine the prevalence of animal trypanosomosis, the prevailing species of trypanosomes, and to identify associated risks factors and its vector density. Blood samples were collected from 400 randomly sampled Bovine, Caprine, Ovine and equines for parasitological (buffy coat technique) and hematological (PCVdetemination) procedures. The prevalence of cattle trypanosomosis infection was calculated as a number of parasitological positive animals as examined by buffy coat method to the total population at risk. An overall, 137/400 (34.3%) prevalence was recorded from domestic animals. The highest and the lowest prevalence were recorded in Baruda 56 (45.9%) and Bullen town 14 (24.1 %) kebele's respectively, which was significantly associated ($P < 0.02$). Similarly, the highest prevalence was 36.84% in bovine whereas the lowest prevalence was 26.53% in donkey species, which was not significant ($P > 0.05$). The study revealed that 80.29%, 12.41%, 4.37% and 2.92% of animls were infected with *T. congolense, T. vivax, T. brucei* and mixed infection, respectively. As present study indicated, 32.25% of animals were anaemic and 15.25 % were non-anaemic. Furthermore, the mean PCV of parasitaemic animals (21.29 ± 3.52) was significantly lower ($P<0.05$) than the aparastiemic animals (27.67±1.91). From a total of 1410 flies caught, 972 (68.9%) of them belongs to Glossina tachinoides, the remaining 684 (48.5%) were Stomoxys- a genius of biting flies. Economical and environment friendly community based tsetse fly and trypanosomiasis control program should be designed and implemented in the areas to improve the productivity on animals in the working areas.
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Key words: *Bullen, Blood, Cattle, Trypanosomosis, Tsetse fly, risk factor*

1. INTRODUCTION

1.1. Background and Justifications

Based on the reports of Food and Agricultural Organization of the United Nations, trypanosomosis is probably the only disease which has a significant effect on the settlement and socio-economic development of a major part of Sub Saharan Africa (SSA). Trypanosomosis is a haemoprotozoan disease, mostly transmitted by the tsetse fly (*Glossina* spp.), that causes severe disease in humans and animals in the continent. The disease results in loss of livestock and agricultural productivity with severe socio-economic impacts (Samson Leta *et al.*, 2016). Trypanosomosis is argued to be the single most important constraints to animal agriculture in the sub humid and non-forested portion of humid zone of Africa (Demelash M *et al.*, 2017). Trypanosomes are unicellular in which the trypanosomes is classified as flagellated protozoa from genus trypanosomes of the family trypanosomatide which belongs to the order kinetoplastide of class zoomastigophora. The zoomastigophora is classified under the phylum sarcomastigophora (FAO, 1998).

African Animal Trypanosomosis is disease complex caused by tsetse fly transmitted *T. congolense, T. vivax* or *T. brucei* or simultaneous infection with one or more of these trypanosomoses. African animal trypanosomosis is important in cattle, but can cause serious losses in pig, camels, goat, and sheep (Brown *et al.*,1990). The disease is characterized by intermittent fever, anaemia, lymphadenopathy, splenomegally and cachexia often followed by death in untreated cases. The most important trypanosomes in terms of economic loss in domestic livestock and by the way of cyclical transmission are the tsetse transmitted species such as *T.congolense, T.vivax and T.brucei* (Mulligan, 1970).

The modern classification of Trypanosomiasis is rearranged in to two sections, the Stercoraria which is non pathogenic to man and animals with few exceptions and the Salivaria which is pathogenic to human and other animals (Kassa, 2005). Trypanosomes are

microscopic, elongated and flattened cell which move with the help of single flagella directed towards, at the base of which has characterstic structure, the kinetoplast (Jemere, 2004). The distribution of trypanosomosis is depending on three factors: the distribution of vectors, the virulence of the parasite and the response of the host. Epidemiologically trypanosomes are distributed in the tropical Africa in the latitude of 14^0c and 29^0c where they are associated with their vectors, Glossina, the tsetse fly (Urquhart *et al.*, 1996). The tsetse flies (vectors), *G. fusca*; the bush fly, *G. morsitans*, which inhibit principally savannah area and *G. palpalis*; a riverine species, effectively prevent the rearing of the cattle over the large area of the Africa (Blood *et al.*,1989). Trypanosomosis is a complex disease transmitted by tsetse flies cyclically (biologically), none cyclically (mechanically) by other biting flies and by other means like venereal, Iatrogenic and by coitus of transmission (Awoke, 2000). Trypanosomosis is transmitted by tsetse and other biting flies through the transfer of blood from one animal to another. The most important mechanical vectors are flies of the genus Tabanus, stomoxys, Haematopota, hiperosia and chrysops flies (Urquhart *et al*., 1996).

T. vivax and *T .brucei* have spread beyond the tsetse fly belts where transmission by biting flies (FAO, 1998), with single exception of *T. equiperdium* of equines which is venereal disease. Treatment and control of trypanosomosis in order to be effective treatment should be given early in the initially phase of parasitaemia. As no new drugs have been withdrawn because of resistance; treatment is now essentially limited to two compounds, diaminazene aceturate and homidium salts (either chloride or bromide) (IAEA, 2002).

In countries like Ethiopia trypanosomosis is among the major setback to cattle production with direct and indirect economic loss. It is a serious constraint to agricultural production in extensive area of the tsetse infested Ethiopian low land (Demelash Mekonnen *et al.*, 2017). Trypanosomosis directly affects the milk and meat productivity of animals, reduces birth rates, increases abortion as well as mortality rates; all of these reduce the herd size and herd composition (Samson Leta *et al.*, 2016)

In Ethiopia, bovine trypanosomosis is widely distributed in western and south-western parts of the country. It is estimated that 10 to 14 million heads of cattle in Ethiopia are exposed to the risk of trypanosomosis (Samson Leta *et al*., 2016). Benishangul-Gumuz regional state pertains nearly 31,000 km^2 or 62% of the region's total land area is believed to be infested with tsetse fly (NTTICC, 1996). Despite this fact, very scant information is available about the epidimology of trypanosomiasis disease epidemiology and its vector with published baseline data in the Bullen district. In Bullen district trypanosomosis was found to be one of the most important factors that hampered livestock rearing in almost all peasant associations. Hence, a study on the status of the disease and investigating the vectors and their relative abundance is crucial for a successful prevention and control in the area.

1.2 Objectives

1.2.1 General Objectives

- To assess the epidemiology of animal trypanosomosis in Bullen district

1.2.2 Specific objectives

- To estimate the prevalence of animal trypanosomosis
- To determine the dominant species of *Trypanosoma* in Bullen district
- To estimate the potential risk factors for animal trypanosomosis

2. MATERIALS AND METHODS

2.1. Description of the Study Area

The study was conducted in Benishangul Gumuz region from November 2017 to May 2018 in selected kebeles of Bullen district. The selected kebeles were Bullen town, Mora, Mata, Dobi and Baruda. The district is about 472km from Asossa town which is the capital city of the Regional State. It has common boundaries with Dibate, in the North East, Blue Nile river in South and Wombera in the West (Figure 3). The district has 19 kebeles covering an area of 3,252.97km2 with human population of 46,920. The area lies at latitude of 10°36'N and longitude of 36°04'E at an altitude of 1465 meter above sea level. Annual average temperature of the area is 29.5°C and its rainfall ranges from 900 to 1100 mm. The major Agricultural activity in the area is mixed farming system where diverse crops are cultivated and different species of livestocks are kept (NMSA, 2007). Extensive livestock production system was the dominant one in the working area. In the district, livestock has been kept for the purpose of meat, milk, and ploughing. Socio economy of the people in the area was mainly depending on mixed farming (BWAO, 2016).

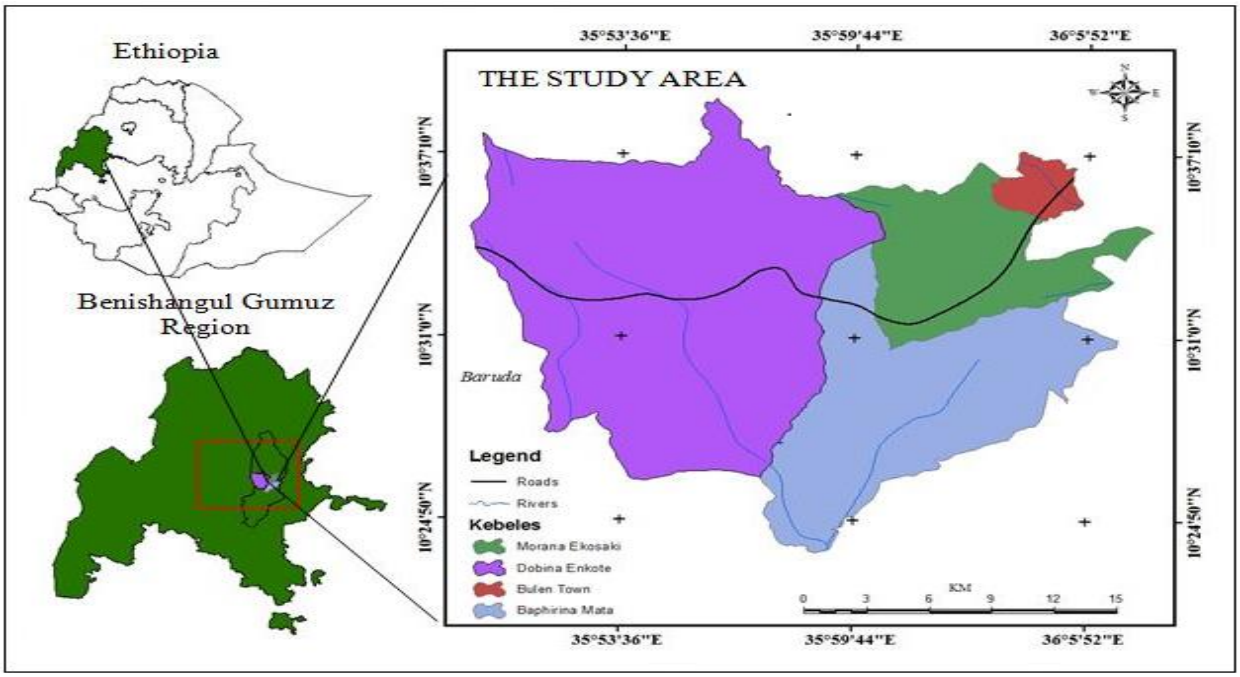

Figure 1. Map of the study area

2.2. Study design and Sampling methods

Multistage sampling was used to select study areas. Working kebeles were purposely selected based on the information collected from Animal health professional and technician those had experience the presence of trypanosomis; while villges and animals were selected with simple random sampling technique. Animals on the selected herd were temporarly coded for the study period.

Cross - sectional study was conducted twice during the study period; in the late rainy season (September to May 2016) and during dry season (October to April 2017) in five selected kebeles.

2.3. Study animals

The study animals were domestic animals which are found in the study area like Bovine, Ovine, Caprine, Equine and they were catagorized in different Body conditions (good, medium and poor) according to Nicholson and Butterworth (1986), Age group (<2 years= calves and 2-7 years = matured and >7 years= Adult) accrding to MAAFRMD (1998) and other factors like sex, origin and breed were also included as a factor for the study disease. The study includes bovine, ovine, caprine and equines species. All domestic animals were kept under extensive traditional management system.

2.4. Sample size determination

The sample size was determined as per Thrusfield (2005). As the previous study indicates, the overall trypanosome prevalence of the near by woreda (Mandura) was 13% (Aki and Dinede, 2016). This figure was directly taken to estimate the present sample size with 95% confidence level. The formula used to calculate the sample size is shown below (Thrusfield, 2005).

$$N= (1.96)^2 Pexp (1-Pexp)/d^2$$

Where, N= required sample size for one strata /woreda

P exp= expected prevalence (in this case 50%)

d= desired absolute precision (in this case 5%), Therefore; $1.96^2 x\ 0.13\ (1-0.13)/\ (0.05)^2 =$ 174, but inorder to increase the precision the sample size was increased to 400.

Accordingly a total of 400 blood samples were collected from selected working villages of the District. The samples were drawn randomly from the total population of the study kebeles; that is, 209 bovine, 65 ovine, 77 caprine and 49 equine based on the available animal population of the sites.

2.5. Collection of blood sample

Hematological examination: Marginal ear vein blood was collected using heparinized capillary tubes. The tubes were sealed at one end using sealant, put in haematocrit centrifuge and centrifuged at 12,000 rpm for 5 minutes. Subsequently, the tubes were placed in the haematocrit reader to measure the length of packed red blood cells that is used as its percentage of the total volume of blood. Animals with PCV less than 24% were considered to be anemic). As an indication of anaemia,

the packed cell volume (PCV) of each animal was obtained by reading the red cells portion in the capillary tube in the above procedure. The PCV was read on a microhaematocritreader (Hawksley and Sons Ltd).

Bold buffy coat technique (Concentration method): The centrifuged tube was cut using a diamond tipped pen 1 mm below the buffy coat to include the upper most layers of the red blood cells and 3 mm above to include the plasma. Fluid was poured onto a glass slide, covered with cover slip, and then examined microscopically for movement of parasite using a 40x objective lens and 10x eye piece (Paris *et al*., 1982). Blood was drawn in a heparinised microhaematocrit capillary tube (Hawksley and Sons Ltd) up to ¾ of the tubes' length, one end was sealed with cristaseal (Hawksley and Sons Ltd) and placed on a microhaematocrit centrifuge and spun at 12,000 r.p.m (Hawksley and Sons Ltd) for 3 minutes. Each capillary tube after being centrifuged will be placed on a McMaster slides' chamber, a drop of clean water added and the buffy coat examined under a light microscope at 10x objective magnifications. A thin smear was prepared of the buffy coat, fixed in absolute methanol for 2 minutes and stained with Giemsa stain (10%), rinsed in phosphate buffered water, dried and examined at 100x oil immersion lens to identify Trypanosoma species.

Parasitological examination*:* After centrifugation, the capillary tube was cut down using diamoned pointed pen 1mm below the buffy coat to include the upper most layers of the red blood cells and 3mm above to include the plasma so that the contents be gently expressed on to a slide, mixed and covered with a cover slip (22 x 22mm). The preparation was then be examined fewer than 10X eye piece in combination with a 40X objective microscopes to get optimum view allowing large visual field and sufficient magnification for easy identification of trypanosomes. And hence for their morphological features, stained smear/giemsa stain under 100x objective was used (Murray and Mcodimba, 1982).

Entomological survey:

To assess the apparent density, species of tsetse fly and other biting flies in relation to season, altitude levels, trap and vegetation types, sampling were done in selected sites of the study area. The altitude levels and vegetation types were recorded during the sampling period. Entomological data were collected twice during the study period; in the late rainy season in September to May 2017/18 and during the dry period in end of October to April 2017.

A total of 34 odourbaited traps (5 monopyramidal, 10 monoconical and 19 biconical) were deployed at 200-250 m intervals to assess the density and species of tsetse flies during the study in both season. Each and every trap was odour baited with acetone and cow urine. The underneath of each trappole was smeared with grease in order to prevent ants climbing up the pole towards the collecting cage that could damage the tsetse flies. The trap deployment time was 48 hours. After capturing the flies 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 (Fischer and Say, 1989). Sexing was done for tsetse fly just by observing the posterior end of the ventral aspect of abdomen by hand lens; accordingly, male flies were easily identified by enlarged hypophageum. The apparent density of tsetse flies was determined based on the daily mean number of flies captured in odour-baited traps and recorded as fly per trap per day (F/T/D) (Leak *et al.*, 1987).

Dissection of Glossina species:

Tsetse flies were dissected using dissecting equipment under 40x objective magnification of the dissecting microscope. Dissecting equipment included hand forceps and a number of fine needles. After separating the mouthparts and salivary glands from the head of the fly, the former organs was placed on a clean slide, covered with a cover-slip; a drop of water was added and the material was examined using low (10x10) objective magnification of the light microscope. The midgut of each non-teneral tsetse fly was placed on a clean slide, covered with a cover-slip and examined at low (10x10) magnification of the light microscope. The stages of *Trypanosoma* species was identified according to their shape and site of development inside the fly (FAO, 1998; Appendix 1).

2.6. Data Management and Analysis

During the study period, data were collected using the sample collection format and entered into Microsoft Excel. Then, the data from the Microsoft excel sheet were processed and analyzed by using Stata (version 11) statistical software program. Chi square was used to compare the prevalence of trypanosomosis in different variables and to determine the association between variables. Data collected on PCV values were analyzed by ANOVA to compare the mean PCV values of infected animals against that of non- infected animals and also it was analyzed in two ways as categorical and continuous variables. 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 (F/T/D). The association between trypanosome infection and risk

factors or variables (age, sex, species, and body condition and origin/peasant association) was determined by chi-square test. A statistically significant difference between variables exists when $p<0.05$ at 95% confidence level (CI). The prevalence of animal trypanosomosis infection was calculated as a number of parasitological positive animals as examined by buffy coat method to the total population at risk (Thrusfied, 2005).

3. RESULT AND DISCUSION

3.1. Parasitological results

A total of 400 animals were examined to determine the presence of trypanosomosis by Buffy coat technique and thin blood smear. Trypanosomosis were detected in 137 cattle with an overall prevalence of 36.84%. The highest and the lowest prevalence were recorded in Baruda 56 (45.9%) and Bullen town 14 (24.1 %) PA's respectively, which was significantly associated ($P < 0.02$). Similarly, in animal based trypanosomosis, the highest prevalence was 36.84% in cattle whereas lowest prevalence was recorded in donkey 26.53%, which was not statistically significant ($P > 0.05$) (Table 6).

The overall prevalence of trypanosomosis in this study was higher when compared with the reports of Mekonnen G, and Negesse M, (2017), Bahilu Yigzaw *et al*.,(2017), Gamechu F, *et al.,* (2015) and Abayneh Acha (2018) who reports the prevalence of Trypanosome infection in cattle was 11.89% in Oda Buldigilu district, 2.1% in Sheka Zone, 4.86% in Didessa district of Oromia and 6.1% in Kindo Koysha district of Wolaita Zone, respectively. This might be due to difference in using controlling methods of trypanosomosis, climate and ecological conditions such as altitude, rainfall, and temperature and livestock management system.

The prevalence of trypanosomosis between kebele was significantly different and high prevalence of trypanosomosis was recorded in Baruda than other kebeles. This might be due to controlled animal movements between kebele's, presence of favorable environment, moisture and vegetation for replication of vectors (Shimels T, and Bosona F, 2017).

The present study indicated that prevalence of Trypanosomosis had indicated a difference in sex; female animals were slightly higher than males. Similarly, the prevalence of Trypanosomosis among age group was also not found to be statistically significant. However, adult age group (2-7 years) had higher prevalence than the other age groups as indicated in table 6. This might be due to both sex and age groups are equally susceptible to the disease. This can be also associated to the fact that adult animals travel long distance for feed and water to escape drought to tsetse infected areas (Dano T, *et al.,* 2015). The finding was agreed with the reports of Mezene W, *et al.* (2014) in Bure district and Bahilu Y, *et al.* (2017) in Sheka zone.

Eventhough, there was no stastisticaly difference ($P > 0.05$) between body condition; the study indicated that poor body conditioned animals had higher prevalence of trypanosomosis than medium and good body conditioned animals. This is due to poor body condition animals are susceptible to the infectious disease; that might be due to reduced performance of the animals created by lack of essential nutrients and poor animal management by the owners. This result agrees with the reports of Mekonnen Golessa and Negesse M, (2017), Mezene W, *et al.* (2014) and Taye I, and Kumela L, (2017).

Inrelation to species of trypanosomiasis, the study revieled that 80.29%, 12.41%, 4.37% and 2.92% of aniamls were infected with *T. congolense*, *T. vivax*, *T. brucei* and mixed infection, respectively (Table 7). The prevalence difference among species composition of trypanosome was statistically significant ($P<0.000$). *T. congolense* was the predominant species followed by *T. vivax* and such a high ratio of *T. congolense* may suggest that the major cyclical vectors of Glossina species (*G. tachinoide, G. morsitans* and other species) are more efficient transmitters of *T. congolense* than *T. vivax* (Demelash M, *et al*., 2017). The transmission of *T. congolense* is cyclical; it requires the presence of tsetse flies whereas *T. vivax* is more rapidly transmitted via mechanically by biting flies than tsetse fly.

Table 1. Chi square analysis of prevalence trypanosomosis with associative risk factors in all animals

Risk factors			N	No of positive	Prevalence %	X^2	p-value
Location		Bullen town	58	14	24.13	18.97	0.02
		Mora	55	21	38.18		
		Mata	60	17	28.33		
		Dobi	105	29	27.61		
		Baruda	122	56	45.9		
Species		Bovine	209	77	36.84	3.28	0.77
		Ovine	65	23	35.38		
		Caprine	77	24	31.16		
		Equine	49	13	26.53		
All species	Sex	Male	156	49	31.41	1.61	0.44
		Female	244	88	36.06		
	Age	≤ 2 years	139	40	28.7	6.48	0.16
		2-7 years	172	65	37.79		
		> 7 years	89	32	35.95		
	Body conditions	Good	125	40	32	6.86	0.33
		Medium	182	59	32.41		
		Poor	92	38	41.3		

Table 2.Prevalence and Species composition of trypanosome in all animals

Parasite species	No of positive	Prevalence (%)	X^2	p-value
T. congolense	110	80.29	316.49	0.000
T. vivax	17	12.41		
T. brucei	6	4.37		
Mixed	4	2.92		

3.2. Hematological Findings

Animals with mean PCV values ≤ 24% were considered anaemic (Van den *et al*., 2000). In the current study, 32.25% of the parasitemic animals were anaemic. In addition, out of 201 aparasitemic animals 15.25% were anaemic (Table 8). Furthermore, the mean PCV of parasetemic animals (21.29±3.52) was significantly lower ($P<0.05$) than the aparastiemic animals (27.67±1.91) (Figure 4).

The lowered PCV of parasitemic animals was similar with previously study by Demelash Mekonnen *et al*. (2017) who reported that the mean PCV of parasetemic animals (22.94 ± 2.70%) was significantly lower ($P<0.05$) than the aparastiemic animals (27.24 ± 5.02%).

This might be due to trypanosome infection which produces erythrophagocytosis anemia (destruction of red blood cells) carried out by enzymatic and immunological mechanism during infection in parasitaemic animals (Budovsky *et al.*, 2006). However, it also disagrees with the report of Mezene Woyessa *et al.* (2014) who repoted that animals without parasites were observed with a higher mean PCV value 53.6% as compared to parasitaemic animals 1.6%.

The finding of aparasitemic animals with mean PCV values of ≤ 24% might be due to the inadequacy of the technique used for detection or delayed recovery of anaemic situation after recent treatment with trypannocidal drugs or factors other than trypanosomosis such as compound effects of poor nutrition and blood feeding helminth infections such as haemonchosis and bunostomosis (Afework *et al.*, 2000).

Table 3. Mean PCV comparison of parasitaemic and aparasitaemic animals

Status	Frequency	Mean PCV± SE	X^2	p- value
Parasitaemic	203	21.29 ± 3.52	125.98	0.000
Aparasitaemic	197	27.67 ± 1.91		

SE= standarded Error, PCV= packed cell volume

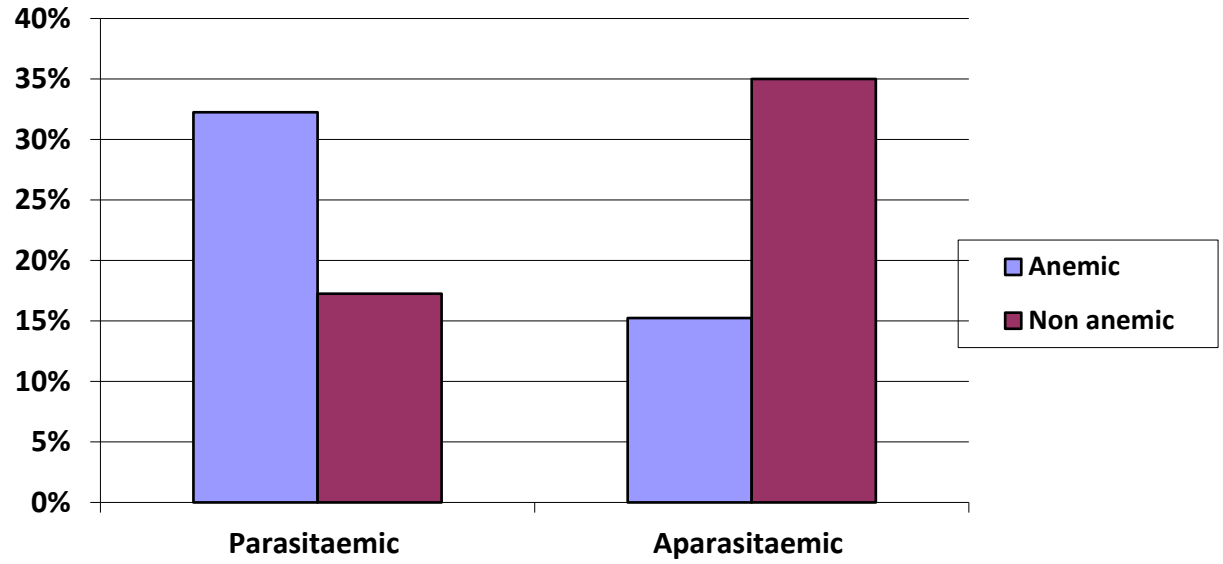

Figure 2. Proportion of anemia in parasitaemic and aparasitaemic animals

3.3 Entomological survey

The entomological survey was conducted by using three different types of traps, biconical, monoconical and monopyramidial each trap could catch mean of 9, 10.38 and 9.48 fly per trap per day, respectively (Table 11).

It was shown that a total of 34 traps were used for two season; dry and late rainy seasons and deployed for two consecutive days (48 hrs) at five kebele's, a total of 1410 flies were caught. Of these 972 (68.9%) belongs to Glossina species, the remaining 684 (48.5%) were Stomoxys- a genius of biting flies. The overall caught density of tsetse and biting flies were 7.1 and 2.5 flies per trapper day, respectively. This result was in agreement with report of Mezene Woyessa *et al.* (2014) who reported the overall mean catch of tsetse flies was 7.3 flies/trap/day in Bure District. However, it was higher than the repots of Shimels T, and Bosona F, (2017) who reports the total trapped tsetse flies only Glossina species with 4.95 flies/trap/day mean apparent density were found in Bambasi woreda. In contrary this result was also lower than with the report of Megersa L, *et al* (2019) who reported that the overall 11.6 flies/trap/day apparent density of the tsetse flies was recorded in Botor Tolay district. This difference could be attributed to environmental conditions, agro ecological differences, the trap type and the season in the study area. The presence of other biting flies was playing important role in the non-cyclical transmission of trypanosomosis in the study area (Taylor *et al*., 2015).

The entomological survey was also identified only one species of Glossina (G. tachinoides) and three genera of biting flies (Tabanus, Stomoxys and Heamatopota) in the study area during entomological survey. The Abundence of *Glossina tachinoides* and other biting flies were different during among dry and late rainy

season and it was highly abundet during late rainy season (Table 9 and 10). This finding was similar with report of Gamechu F, *et al.* (2015) only one species of tsetse fly identified was G. tachinoides and among mechanical transmitters of trypanosomosis found in Didesa District of Oromia Region were Tabanus, stomoxy and haematopta.

Table 4. Relative abundance of Glossina and other biting flies in study area during dry season

Location	**No of traps**	**Total flies caught**	***Glossina* Specie**				**Other biting flies**			
			GT	Sex		F/T/D	Stomoxys	Tabanid	Haematopota	F/T/D
				M	F					
Bullen twon	7	137	57	19	38	4.07	59	13	8	1.4
Mora	6	68	21	8	13	1.75	28	10	9	1
Mata	7	194	101	34	67	6.31	65	17	11	0.9
Dobi	7	144	85	32	53	6.07	39	13	7	3
Baruda	7	162	104	35	69	7.42	33	16	9	1.5
Total	34	705	364	124	240	5.35	224	69	44	1.56

F/T/D=fly per trap per day, Gt= tachinoides, M=male, F=female

Table 5. Relative abundance of Glossina and other biting flies in study area during late rainy season

Location	No of traps	Total flies caught	*Glossina* Species				Other biting flies			
			GT	**Sex**		**F/T/D**	**Stomoxys**	**Tabanid**	**Haematopota**	**F/T/D**
				M	**F**					
Bullen twon	7	174	94	44	50	6.71	59	12	9	2.6
Mora	6	166	66	20	46	5.5	65	23	12	3
Mata	7	342	159	59	100	11.35	134	29	20	4.2
Dobi	7	274	154	50	104	11	78	23	19	4
Baruda	7	302	135	30	105	9.64	124	26	17	3.8
Total	34	705	608	203	405	8.94	460	113	77	3.52

F/T/D=fly per trap per day, Gt=Glossina tachinoides, M=male, F=femal

Table 6. Mean fly catches by different traps

Trap type	Mean catches / traps				
	G. tachinoides	**Stomoxys**	**Tabanids**	**Haematopota**	**Total**
Biconical	4.45	3.16	0.84	0.54	9
Mono conical	5.17	3.60	0.95	0.64	10.38
Mono pyramidial	4.66	3.35	0.88	0.58	9.48
Total	14.29	10.11	2.67	1.77	28.86

The study also determines the desity of tsetse and other biting flies in vegetation type and tsetse was caught only in riverine and savanna vegetation area. However, other biting flies were found in all vegetation with different number. The density of caught tsetse and other biting flies was higher in riverine and savanna vegetation types than other vegetative types (Table 12). This finding was differ with the report of Hasan (2000) who repoted that the highest total catch to grass land vegetation classification (47% in dry season and 72 % in wet season). Msangi (1999) also stated that G.pallidipes was wide spread being detected in all types of vegetation, on which the highest relative density being detected in bush land vegetation.

This could suggest an absolute increase in the number of tsetse flies due to favourable environment such as enough moisture, vegetation growth and suitable habitat or spread of flies from the rivers and thickets where they usually inhabit during the dry season, to more open areas during the rains increases relative density in open areas. According to Leak (1999), vegetation is vital for providing a suitable condition.

Table 7. Apparent densities of tsetse and other biting flies with different vegetation type

Vegetation	Tsetse	Stomoxy	Tabanid	Hematopota	Total
Riverine	810	183	27	16	1036
Savanna	600	167	37	18	822
Forest	-	131	38	26	195
Cultivated land	-	98	41	27	166
Bushland	-	105	39	34	178
Total	1410	684	182	121	2397

4. CONCLUSION AND RECOMMENDATIONS

Trypanosomiasis is one of the major constraints of production as well as agricultural productivity in the study area. 34.3% of animal prevalence was investigated from domestic animals. The result revealed that *T. congolense* was the most prevalent species in the study area and the infections significantly affect the PCV values. Higher prevalence of trypanosomosis infection was recorded in animals with poor body condition, in sex categories such as female, adult age categories, and in cattle species. Animal origin and PCV were significantly associated with tryanosomosis. The entomological survey, identified *Glossina tachinoides* and Biting flies (Tabanus, Stomoxys and Heamatopota) in the study area. This study also determined density of caught tsetse fly and other biting flie, which were higher in riverine and savanna vegetation types than others.

Based on the facts, the following recommendations were forwarded.

- Particular attentions towards the identified trypanosome species are essential to control the impact of the disease on animal that are potential reservoir of the infections,
- The farmer in the area should be trained how to control the vector of the disease and provided with materials,
- Integrated control approach, tsetse fly and trypanosomiasis control program should be designed and implemented in the area.

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