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Prevalence of Bovine Trypanosomosis, its Vector Density and Distribution in Dale Sadi District, Kellem Wollega Zone, Ethiopia

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Abstract: A cross sectional study was conducted in Dale Sadi district of west Oromia regional state to determine the prevalence of bovine trypanosomosis and apparent vector density using parasitological and entomological survey from November, 2013 to April, 2014. Blood samples from 710 randomly selected cattle of both sex and different age groups were collected and examined with conventional hematological and parasitological techniques. Out of the total examined animals, 45/710 (6.34%) cattle were infected with trypanosomes. Most of the infections were due to *Trypanosoma congolense* 30/45 (66.67%) followed by *Trypanosoma vivax* 13/45 (28.89%), *Trypanosoma brucei* 1/45 (2.22%) and the rest were mixed infections of *T. congolense* and *T. vivax* 1/45 (2.22%). The prevalence of the disease between the sex was 7.22% for males and 5.47% for females without statistically significant difference (P>0.05) during study period. In similar manner there was no statistically significant difference among age groups (p>0.05). The overall mean PCV values were significantly different between aparasitaemic and parasitaemic animals (p<0.05). *Glossina morsitans sub-morsitans* and *Glossina pallidipes,* Tabanus and Stomoxys were caught. The entomological survey showed that the apparent densities of different flies in the study area were 0.05, 2.42, 3.89, 1.29 fly/trap/day for *Glossina morsitance* s*ub-morsitans, Glossina pallidipes,* Stomoxys and Tabanus respectively. The study revealed that trypanosomosis is the main constraint to livestock production and agricultural activity in Dale Sadi, Western Ethiopia. Finally, a few points of recommendations are forwarded to alleviate the problem.

Key words: Bovine · Dale Sadi · Prevalence · Tsetse Flies · Trypanosomosis

INTRODUCTION

Trypanosomosis is among the well-known constraints to livestock production in Africa as it causes serious and often fatal disease of livestock mainly in the rural poor community and rightfully considered as a root cause of poverty in the continent [1]. The 31 species of tsetse flies that invade one-third of Africa through the trypanosomes they transmit to humans and animals overshadow and darken the public health and agriculture sector in 38 African countries via exposing 160 million cattle for the risk of anemia, emaciation and death. Not only had these but also exposed 60 million people to the risk of sleeping sickness [2]. Tsetse-transmitted trypanosomosis (Nagana) is one of the most ubiquitous and important constraints to agricultural development in the sub-humid and humid zones of Africa including Western and South Western parts of Ethiopia [3, 4].

Ethiopia is chiefly an agricultural country whose economy is largely dependent on crop and livestock production. Besides its direct contribution in terms of Gross domestic product (GDP) and foreign earning, livestock provides virtually all the draught power for cultivation, transportation of agricultural crops and people in rural country [5]. Despite the importance of livestock to the larger sector of the population and to the economy at large, the subsector has remained untapped. The little benefit from the enormous livestock resource of the country is attributable to a multitude of problems. This comprises of diseases, age-old traditional management

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system, inferior genetic make-up coupled with under nutrition and complicated by malnutrition and absence of well-developed market infrastructure [6].

In Ethiopia, Trypanosomosis is wide spread in domestic livestock in the Western, South and South-western lowland regions and the associated river systems (Abay, Ghibe Omo and Baro/Akobo) [7,8]. About 220,000 Km^2 areas of the above mentioned regions are infested with five species of tsetse flies namely *Glossina pallidipes*, *G. morsitans submorsitans, G. fuscipes, G. tachinoides and G. longipennis* [3]. Economically the tsetse transmitted trypanosomes (*T. congolense, T. vivax* and *T. brucei*) are most important in the livestock of Ethiopia [9].

Trypanosomosis is one of the most livestock problems in the study area (Dale Sadi district). For the district inhabitants, it is potentially productive place for agricultural activities and rearing livestock but the district is infested with tsetse flies. As a result, the people suffer from low level of draught power and productivity that compromise the socio-economic and nutritional status of inhabitants. Thus, knowing the current status of typanosomosis and its vectors are crucial to integrate all efforts towards combating the disease and reducing economic losses. Even though this is so, there is scant report from western tsetse belt of the country as it is constrained by inadequate study and accessibility where experts, resources and facilities are largely accumulated. Thus, Understanding the distribution of vectors in relation to the trypano-somosis status in tsetse endemic area of western Ethiopia is important to launch control strategies in the future. Therefore, the objectives of the study were to determine the prevalence of bovine trypanosomosis, apparent vector density and distribution; to determine the species and relative distribution of vectors of tryanosomosis in Dale Sadi district.

MATERIALS AND METHODS

Study Area: The study was carried out from November, 2013 to April, 2014 on the prevalence of bovine trypanosomosis and apparent vector density in Dale sadi district Peasant associations (Pas) namely: Awetu Birbir, Village-19, Bikila Birbir and Jajjo Akakil of Kelem Wollega zone, Oromia Regional state. The area is situated at about 510 km West of Addis Ababa. The study area is bordered by: Ilubabor to the South, Dale wabara to the West, Ayra Gulisso to the North and Lalo kile to the East. The area lies between 08°N 25' 56' to 08°N 58'05' and 034°E 33' 41' to 035°E 28' 48' and has average altitude of 1150 meters above sea level. The area has temperature range of 33-35°C with more agricultural crops and people in rural of the country. The climatic condition alternates with long summer May to August and short rainy seasons from March to April. The winter dry seasons (November to February) with mean annual rain fall of 1200mm [10].

In the study Peasant associations, there are river basins which flow throughout the year to Baro Akobo system namely Birbir River, Bosoka River, Lagga shantama, Karsa River and other seasonal rives which tributes to Birbir River. Wild animals like bush buck, bush pig, warthog, crocodile, Buffalos, kudu and hippopotamus are the most dominant and hence tsetse flies are believed to be depending, for their blood meal. Agriculture is the main lively hood of people with mixed farming system and livestock plays crucial role in agriculture.[10].

Study Population: the Study animals were zebu cattle kept under extensive traditional husbandry condition. The animals graze the communally owned pasture land throughout the year. They are managed under the same agro-ecology without any additional supplementary feedings. In the study area human population is estimated to be 34,314 and the livestock population of bovine is 80,952, equine 4,293, caprine 18,415, ovine 26,181, poultry 877,868 and beehives of 75,601 and large amount of wild animals [10].

The study was conducted on 710 local breed cattle selected from four peasant associations in the district. Of these animals, 184 were from Awetu Birbir, 134 were from Village 19, 223 were Bikila Birbir and 169 were fom Jajo Akakil. The origin, sex, age and body condition of the animals were explanatory variables used to associate with prevalence rate.

Study Design: Cross-sectional study was conducted to determine the prevalence of bovine trypanosomosis and apparent density of vectors (tsetse population and other biting flies).

Sample Size and Sampling Methods: The sampling method applied was simple random sampling. The sample size was calculated at 50% prevalence with the expected precision at 5% and at 95% confidence interval. The required sample size was 384 animals; however a total of 710 animals were sampled to increase the precision [11].

Where,

$$n = \frac{a^2 \, pex \, (1-pex)}{d^2}$$

$$= \frac{(1.96)^2 (0.5)(1-0.5)}{(0.05)^2}$$

=384

n = the required sample size

Pex = the expected prevalence

d = Desired absolute precision

a = Constant at 95% confidence level

Study Method and Sample Collection

Parasitological Survey: to determine the prevalence of bovine trypano-somosis, cross sectional parasitological survey was conducted. Blood was taken from each animal into heparinized hematocrit tubes from the cattle ear vein after piercing the ear vein using lancet. Then, the tube was sealed and heparinized capillary tube containing blood was centrifuged for 5 minutes at 12,000 revolutions per minute. After the centrifugation, tubes were then placed in hematocrit reader and recorded for each sample. Then, the readings were expressed as a percentage of packed red cells to the total volume of whole blood. Animals with Packed Cell Volume (PCV < 25%) were considered to be anaemic [12]. Trypanosomes were usually found in or just above Buffy coat layer. So, capillary 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. The content of the capillary tube was expressed on to slide, homogenized on to a clean glass slide and covered with cover slip. The slide was examined under 40x objective and 10x eye pieces for the movement of parasite. The Species were identified based on the characteristic morphology of Trypanosomes [13].

Entomological Survey: During the study period 45 baited traps were deployed along livestock grazing areas, watering points, wild game reserve areas, savanna grass land and sub-savanna area of dense river side forests in the Districts. Out of 45 traps, 12 were deployed in Awetu Birber, 6 were deployed in Village-19, 17 were deployed in Bikila Birber and 10 were deployed in Jajo Akakil. Every Monopyramidal, Bioconical and NGUE-2 traps baited with acetone, octenol and cow urine where each deployed at an interval of about 100-200 meters along riparian vegetation to assess the fly density. 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 and the area was located by Global Positioning System. The trap deployment time was 48 hours. After the flies captured in the collecting cage, they were then sorted by sex, species and sites [14]. The Species of tsetse were identified based on the characteristic morphology and other biting flies were also separated according to their morphological characteristics such as size, color, proboscis and wing venation structures at genus level [15, 16].

Data Management and Analysis: The data collected from the study area were entered in to micro soft 2007 excel spread sheet program to create data base and it was filtered before the analysis. Descriptive statistics was used to calculate the percentage of cattle in each peasant associations. For the analysis of data, statistical software program (STATA version 11.0) was used. The risk factors like: age, sex, PCV, body conditions of the animals were compared by using chi-square test and also logistic regression was used to see the combined effect of the above risk factors. In all cases 95% CI and $p < 0.05$ was used for the significance differences.

RESULTS

Parasitological Findings: The overall prevalence of bovine trypanosomosis in the study area was 6.34%. The prevalence of bovine trypanosomosis in the four PAs was determined to be 5.43%, 4.14%, 8.52%, 6.71% in Awetu Birber, Village-19, Bikila Birber and Jajo Akakil respectively. Among those four PAs, Bikila Birber showed the highest prevalence rate 8.52% but the lowest being in the village-19, 4.14%. The prevalence of bovine trypanosomosis and the corresponding infection rate in four selected PAs in the study area were summarized in Table (1).

Most of the infections were due to *Trypanosoma congolense* 30/45 (66.67%) followed by *Trypanosoma vivax* 13/45 (28.89%), *Trypanosoma brucei* 1/45 (2.22%) and the rest were mixed infections of *T. congolense* and *T. vivax* 1/45 (2.22%) as indicated in Table 1.

Table 1: The prevalence of bovine trypanosomosis in the PAs of Dale sadi district

Pas	Number of animals exa mined	Infected animals	Non infected animals	Trypanosome species diagnosed T.c	T. v	T.b	Mixed	Prevalence (%)
Awetu Birbir	184	10	172	5	5	0	0	5.43%
Village- 19	169	7	162	1	5	0	1	4.14%
Bikila Birbir	223	19	205	17	2	0	0	8.52%
Jajo Akakil	134	9	126	7	1	1	0	6.71%
Total	710	45	665	30	13	1	1	6.34%

(Note:*T.c=Trypanosoma congolense, T.v=Trypanosma vivax,T.b=Trypanosoma brucei,* Mixed=T.c,T.v).

Table 2: Distribution of trypanosomes in relation to sex, age, body condition and PCV

Risk factors	Category	Non infectedanimals	Infected animals	Prevalence (%)	p-value	95% CI
Body	Good	194	14(31.11%)	6.73%	-	-
condition score	Medium	374	29(64.44%)	7.19%	0.688	.4238108-1.761693
	Poor	97	2(4.44%)	2.02%	0.174	.6175394-14.3133
Age	≤3 years	260	18(40%)	6.47%	-	-
	>3years	405	27(60%)	6.25%	0.884	.5368045-2.059262
sex	Female	331	19(42.22%)	5.42%	-	-
	Male	334	26(57.78%)	7.22%	0.335	3778812-1.392434
PCV	<25	221	34(75.56%)	13.30%	-	-
	≥25	444	11(24.44%)	2.42%	0	2.961351- 12.62043

Among the overall prevalence of Trypanosome infection (6.34%), in the Dale Sadi District, 4.23% (30/710) were *T. congolense*, 1.83% (13/710) was *T. vivax*, 0.14% (1/710) was *T. brucei* and 0.14% (1/710) was mixed infection. Based on age, 242 young animals examined were not positive for trypanosomes, but in animals greater than 3 years old 6.25% (27/432) and in animals 1-3 years 6.47% (18/278) prevalence was recorded.

Table 3: Apparent density (F/T/D) of fly at different PAs of Dale Sadi district

PAs	Altitude Range(m)	Fly species caught Stomoxys	Tabanus	Glossina	No of traps	Mean catch (F/T/D)
Awetu Birbir	1400-1460	112	27	54	12	8.04
Village 19	1405-1480	44	7	11	6	5.16
Bikila Birbir	1300-1400	124	74	142	17	10
Jajo Akakil	1350-1420	70	8	26	10	5.2
Total	-	350	116	233	45	7.77

F/T/D = Fly/Trap/Day

Table 4: Mean catch of *Glossina* species in four PAs of Dale sadi district

Pas	Altitude Range(m)	*G. pallidipes* Male	Female	*G.morsitans* Male	Female	*G.tachnoides* Male	Female	F/T/D
Awetu Birbir	1400-1460	28	25	0	0	0	1	2.25
Village- 19	1405-1480	1	1	0	0	3	6	0.91
Bikila Birbir	1300-1400	52	85	4	1	0	0	4.17
Jajo Akakil	1350-1420	22	4	0	0	0	0	1.2
Mean catch(F/T/D)	-	1.44	1.28	0.04	0.01	0.03	0.078	2.59

F/T/D=Fly/Trap/Day

The prevalence rate of infection in male and female were 7.22% and 5.47% reespectively. The prevalence rate of infection in male was higher than female. How ever, there there was no stastically significant difference (p>0.05) in trypanosome infection beetwen male and female animals.

Out of infected cattle, 4.44% were from poor body condition, 64.44% with medium body condition and 31.11% were from good body condition. A higher prevalence rate 4.08% was seen in medium body condition and followed by good body condition 1.97% than that of poor body condition 0.28%. Table 2 shows the number of animals with the different body conditions, age, sex and PCV that is examined and found positive for blood parasite.

Entomological Findings: *Glossina pallidipes* and other biting flies like Stomoxys and Tabanus were caught. A total of 233 tsetse flies were trapped and among them 5 were *G. m. submorsitans*, 218 were *Glossina pallidipes,* 10 were *G. tachnoides* and a total of 350 Stomoxys and 116 Tabanus were caught during the study period. The apparent densities of 0.05 for *G. m. submorsitans*, 2.42 for *G. pallidipes*, 3.89 Stomoxys and 1.29 Tabanus and were recorded and summarized in Table (3) as follows.

In four PAs the already caught tsetse flies were analyzed and the higher Fly per trap per day (FTD) catch for tsetse flies were obtained from Bikila Birbir (4.17); followed by Awutu Birbir, JajoAkakil (1.2) and Vilage-19 (0.91) PAs. A total of 233 tsetse flies caught during the study period were subjected for sexing. Accordingly, 47.2% (110/233) males and 52.79% (123/233) were females. At all sites in each PAs female tsetse flies were trapped than males and summarized in Table 4 as follows.

DISCUSSION

The overall prevalence of bovine trypanosomosis in the present study area was 6.34%, but it was low in prevalence as compared to the previous studies done by different authors in different part of Ethiopia. A prevalence of 25% and 13.44% in Gawo Dale district [3, 17], 17.2% in Metekel [18] and 17.5% in the Upper Didessa valley of tsetse infested regions [19] were reported.

In the present study, sex was found to be the risk factor; it was higher in male animal than female animal. The Prevalence of infection between sex categories was 7.22% for male and 5.47% for female, but there was no significance difference between sex group (p>0.05). It was in agreement with [18] and the possible suggestion to this finding could be that male animals are more used for draught purposes, travel long distances to an area of tsetse challenge for grazing or plowing thus, stressed by draught power. As a result, the risk of contracting trypanosomosis is high [20].

In this study, age was also taken as a risk factor. But, there was no significance difference observed in age group in the study period, but relatively higher rates observed in older. These results agree with that of Dagnachew and Shibeshi [21] as a higher prevalence was observed in adult animals (>3 years) and but lower in animals = 3 years of age. This could be associated to long distance travel for grazing as well as for draught in areas of high tsetse challenge. This is in agreement who stated that calves and young animals have low prevalence [22]. In Dale Sadi district suckling calves didn't go out with their dams but graze at homesteads until they are weaned off. This could result in nil prevalence in calves. *Trypanosoma congolense* infection is usually higher in adult animals than young [23, 24] found that cows >9years old had 1.2 times higher trypanocidal drug treatment than < 3 years old animal. This is an indication of higher risk of trypanosomosis in adult animals than the young/calves.

Measuring PCV values for each animal samples in the pre-intervention survey in all four peasant associations were analyzed and marked difference was noticed. Accordingly, parasitaemic animals had generally lower mean PCV value than aparasitaemic ones. And in addition to this, about 75.56% of the parasitaemic animals had their mean PCV below 25%. This results in agreement with the work of Bekele [25] in which the mean PCV of parasitaemic animals became 94.87% in site one and 81.25% in site two in southern valley and [26] in which 88% of all parasitaemic animals had mean PCV below 26% in Abbay basin of North west Ethiopia, Bekele *et al.,* [16] in which they had reported the mean PCV aparasitaemic and parasitaemic animal 25.65% and 18.8% respectively. As anemia is the classical sign of the disease pathogenicity [27] the low PCV in parasitaemic animals could have contributed in reducing the mean PCV for cattle. The difference in mean PCV between parasitaemic and aparasitaemic animals indicates that, trypanosomosis involves in reducing the PCV values in infected animals.

The appearance of parasitologically negative animals with PCV values of less than the threshold value (25%) may be due to the inadequacy of detection method used [27] or delayed recovery of anemic situation after current situation after current treatment with trypanocidal drugs and occurrence of positive animals with PCV greater than

25% might be thought of recent infection of animals. The trypanosome infection and mean values obtained from the study in the parasitaemic animals was found to be highly associated. Similar reports were reported by Bekele [25] at southern valley in southern Ethiopia that as PCV increased the proportion of samples detected parasitaemic correspondingly decreased. Hence, the mean PCV could be an indicator of the healthy status of cattle population under study. It was generally accepted that the mean PCV value is affected by many factors other than trypanosomosis. However, these factors are likely to affect both trypanosome positive and negative animals [28]. Other diseases considered to be affecting the PCV values in animals are helminthiasis, tick borne diseases and nutritional imbalance. On the other hand most of the parasitaemic animals in the lowland areas were in good body condition despite having low PCV values. This could be attributed to the fact that animals in low altitude were at high plane of nutrition due to availability of sufficient pasture [21].

The proportion of *T. congolense* in all sites of this study was highest 66.67%. This result is consistent with the report by Abebe and Jobre [29] in which they reported 58% of the total trypanosomes detected were *T. congolense*. The four PAs in the current study have shown insignificant difference in trypanosome prevalence ($p>0.05$).

The entomological survey indicated that the apparent densities of different flies during the study period was 0.05 fly/trap/day for *G. m. submorsitans*, 2.42 for *G. pallidipes*, 0.11 for *G. tachnoides*, 3.89 for Stomoxys,1.29 for Tabanus. The overall mean catch of tsetse flies was 2.5 flies/trap/day. This result was not in agreement with the previous by Tilahun *et al.* [29] in which they reported the fly density between 16 to 22.4 flies/trap/24 hrs in Tana Beles valley and by Abebe and Regassa [31] where they reported the mean catch of tsetse flies was 10.68flies/trap/day in upper Didessa valley. This finding was higher than the result obtained during the study by Bekele [25] in which he had caught 1.35 flies /trap/day in site one and 0.9 flies/trap/day in site two of his study area. This is of course far from the work of study by Sinshaw [32] in which they had caught no tsetse fly.

The entomological survey data revealed that for Bikila birbir and Awetu birbir showed insignificant difference. This had been related to the similarity in the categorization of ecological situations in two sites but there is significance difference between two PAs and the rest which has been related to the difference in habitat classification particularly riverine was available and in addition to grass lands and bush lands. The population of *Glossina pallidipes* were highest than *G. morsitans sub morsitans*. This could be related to varieties in the type of vegetation. On the other hand, difference had occurred in the mean catch of tsetse flies with respect to classification of vegetation types in which grass land type had higher results. Such results of higher catch was reported by Hasan [33] where he indicated the highest total catch to grass land vegetation classification (47% in dry season and 72% in wet season). Msangi [34] stated that *Glossina pallidipes* was wide spread being detected in all types of vegetation, the highest relative density being detected in bush land vegetation. According to Leak [35] vegetation is vital for providing a suitable condition.

Catching of female tsetse flies showed a less degree of deviation from the expected 50:50 ratio with significant relationship. Females accounted for 52.79% catch during this study. This result is somewhat approached to the report of Bekele [25] and Bancha [36] where this indicated about 63.2% and 60% catch of female respectively. Female *G. pallidipes* showed relative high density than others in which this result is found to be highly consistent with previous study by Bekele *et al.* [16] in which they reported 63.2% female *G. pallidipes.* Love more and Phelps [37] associated higher catches of female *G. pallidipes* to be attributable due to their longer life span (average of 8 weeks) than males living about 4 weeks, so that more catch of females could appear.

CONCLUSION AND RECOMMENDATIONS

Trypanosomosis is most important constraint for livestock production. The results of the present study revealed that the overall prevalence of bovine trypanosomosis was 6.34% and the highest prevalence of was due to *T. congolense* (4.23%) followed by *T.vivax.* (1.83 %). The occurrence of trypanosomosis is associated to tsetse flies and other biting flies. The high prevalence of the disease and the high catch of tsetse fly in all cases showed the seriousness of the problem. Trypanosomosis is still the major constraint in the area, although different control measures were applied by National Tsetse and Trypanosomosis Investigation and Control Center (NTTICC). Situation is getting worse as the control and prevention of trypanosomosis is facing a challenge due to limitation of vector control activities and drug resistance.

Taking into account the above mentioned points, the following recommendations were forwarded:

- Designing and implementation of control strategies for trypanosomosis focusing on sustainable, community based, simple, cost effective, environmentally friendly, integrated approach should be undertaken in the Dale sadi district
- Extension service implemented by MoARD should have to incorporate participatory packages on public awareness creation in the control of tsetse flies and trypanosomosis.
- Veterinary clinics should be expanded with trained veterinarian and supply of appropriate prophylactic and therapeutic drugs to control trypanosomosis.
- The survey of tsetse flies and trypanosomosis done by NTTICC should be continued to challenge the intervention prematurely.

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