Bovine Trypanosomiasis Epidemiology and Tsetse Fly Density in Jimma Arjo District, East Wollega Zone, Oromia Regional State, Ethiopia

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Background: Bovine trypanosomosis remains a vital livestock disease and constraint which is intimidating livestock health and production, regardless of ongoing tsetse and trypanosomosis control struggles in Jimma Arjo district, East Wollega zone, Ethiopia.

Methods: A cross-sectional study was carried out with the objective of determining prevalence of cattle trypanosomiasis and apparent tsetse fly density in six randomly selected peasant associations of Jimma Arjo District from April 2018 to January 2019.

Results: From overall 819 arbitrarily selected cattle (n= 36; 4.39%), infection rate was recorded. Selected animals were invariably infested with different trypanosome species among which Trypanosoma congolense (80.55%) was the most common, followed by T. vivax (11.11%), T. brucei (5.55%) respectively. Co-infection of T. vivax and T. congolense accounted for 2.77% of total infection rate. This finding indicates a statistically significant difference (p<0.05) among good, medium, and poor body condition animals with respect to Trypanosomosis infection rate. Poor body condition animals were highly infected with trypanosome parasite as compared to medium and good body condition score animals. This study shows statistically significant association was obtained between mean packed cell volume (PCV) and trypanosomiasis infection rate (P<0.05). The lower mean PCV value (21.14%) were highly affected as compared with high mean PCV value animals (25.26%). The result of entomological survey, by using mono pyramidal traps deployed near animal grazing field and rivers of selected peasant association (PA), showed presence of four Glossina species namely Glossina morsitans, G. pallidipes, G. tachinoides, and G. fuscipes with high fly density per trap in Meta PA. Higher catches of G. fuscipes were registered as compared to other vectors.

Conclusion: Generally, this study indicated the disease is still a main problem for livestock health and production in the study area and it necessitates disease and tsetse fly control.

Keywords: bovine trypanosomiasis, buffy coat, Jimma Arjo, prevalence, tsetse flies

Introduction

For the vast majority of African people, livestock is their mainstay. It contributes a huge percentage of the continents’ GDP. Livestock also constitutes a major source of foreign currency earning for a number of African and other continents/countries. Production of livestock, indeed, contributes to improve food security and poverty alleviation in the developing world. Ethiopia is one of the countries with huge and diverse livestock population that plays an important role in the livelihoods of farmers, pastoralists, and economies of the country at large. For these reasons,
they are a “Living bank” or “Living account” for both rural and urban poor farmers or livestock owners.¹

Ethiopia’s economy is, to a large extent, reliant on crop and animal production. In addition to its direct contribution in terms of GDP and foreign exchange, cattle provides draught power for cultivation whereas equines are used for transportation of agricultural crops and people in rural parts of the country.²

African animal trypanosomiasis (AAT) caused by six trypanosomes species is a major animal health problem over a large area of tsetse belt region of the continent. In sub Saharan Africa, it jeopardizes the lives of around 55 million people. African animal trypanosomiasis is a chronic debilitating protozoan disease of livestock which greatly affects the economy of different countries. The vascular trypanosome namely T. vivax and T. congolense are the most pathogenic, economically significant, and extensively dispersed in Ethiopia.³

Trypanosome transmitted by Tsetse fly continues to be a major constraint in livestock production. It is also a major risk of infection in humans. The disease greatly affects social, economic, and agricultural development of communities in tsetse infested areas.⁴ The resistance of trypanosome to existing antitrypanosomal drugs, increasing vectors’ resistance to insecticides, absence of effective vaccines, and adverse effects of existing antitrypanosomal drugs are challenges in controlling the disease. People have been using both plant and animal species for treatment and control of Trypanosomiasis and as tsetse fly repellent in Ethiopia.⁵–⁷

Eighty-eight percent (88%) of human population and 70% livestock population exist in the highland area of Ethiopia. From the total land coverage of the country, 36.3% of it is highland which is heavily degraded and unable to provide enough food for the community living there. In contrast, low lands of the country that accounts for 63.7% of the total land coverage, supports about 12% of humans and 33% of livestock population. Tsetse and Trypanosomiasis threat have rendered these fertile lands inaccessible. The North West region is affected by tsetse and non-tsetse transmitted trypanosomiasis.⁸–¹⁰ In Ethiopia, tsetse fly vectors are limited to Western and Southern regions of the country between longitude 33° and 38° E and latitude 5° and 12° N infesting areas which together account for 97,855 Km².¹¹,¹²

Tsetse fly vector found in Ethiopia are uneven and livestock interference is constantly increasing. Accordingly, additional areas are being infested and newly settled communities are being continually affected by the progressing tsetse. This progression of tsetse fly is commonly found in Ghibe Omo with its tributaries, upper Didessa valley, Rift Valley areas of north and north-eastern edge of Lake Abaya.¹³

Tsetse fly vector and Trypanosomiasis control schemes have become focused in particular areas of higher priority where control is technically feasible and economic returns are measurable.¹⁴ In an attempt to reduce this disease which is the bottleneck of the country’s economy, it requires further up-to-date research on description of host, agent, and environment relationship in Jimma Arjo. The present research was initiated to assist in decision making to oversee suitable tsetse and Trypanosomiasis control strategy. The present study was therefore aimed at the following objectives:

- To determine the prevalence of cattle Trypanosomiasis in selected PA’s of Jimma Arjo district.
- To measure the type and apparent density of vector tsetse flies and other mechanical vectors in the study area.

**Materials and Methods**

**Ethical Approval**

Ahead of starting data collection, ethical clearance was obtained from research ethics committee of School of Veterinary Medicine, Wollega University dated 20/07/2017 with minute no. SVM.RERC/008. Data were collected after getting the permission from animal owners to collect samples from animals. During the course of data collection, information received was nameless, and confidentiality of data was secured.

**Study Area**

This study was conducted in Oromia regional state, Eastern Wollega Zone, Jimma Arjo District located at 50 Km distance from Zonal city. According to the district’s agricultural and rural development office, (2010) the climatic condition interchanges with winter dry seasons (from December to February), short rainy seasons (March and April) and long summer rain fall (from June-September). This study was conducted in 6 PAs, namely Badasa Didessa, Meta, Cafe Arjo, Jammo Giros, Hara Keku and Tuqa. The area has different vegetation type, livestock and Wild game such as crocodiles, hippos, buffalos, Kudu Bush pig, and warthog.
Since the area has fertile land the community’s livelihood mainly depends on agriculture with mixed farming system. Livestock production mainly acts as fundamental part of mixed livestock production and agricultural land farming system.

**Study Population**
Zebu cattle kept under extensive traditional husbandry form were included.

**Study Design**
Cross-sectional study design using simple random sampling method was employed to determine the prevalence of cattle trypanosomiasis. Baited traps with different fly attractants were deployed at an interval of 200 to 250 meters for entomological survey.15

**Sample Size Determination**
The total number of animals required for this study was determined using the formula given by Thrushfield.16

\[
\text{Required sample size (N)} = 1.96^2 \times \text{Expected Prevalence} \times (1 - \text{P Expected Prevalence})/d^2
\]

Where, \(d\) = desired absolute precision at 95% confidence level and 5% absolute precision. Since there was no previous report from the same area 50% expected prevalence was assumed. Though 384 had to be included 819 animals were examined to increase the precision.

**Study Method and Sample Collection**

**Parasitological Survey**
Blood samples were collected into capillary tubes after piercing ear vein of the selected animal by lancet. One end of the capillary tube was closed by sealant; centrifuged at 12,000 rpm for five minutes to separate blood cells and to concentrate trypanosome using centrifugal force. Then PCV was calculated using hematocrit reader. Anemia was estimated by comparing PCV in which they were considered anemic, if their PCV<24.17,18 Capillary tubes were then broken just below buffy coat and exposed on microscope slide and covered by cover slip of 22×22 mm. It was then observed under 40X objective using dark ground buffy coat technique to detect the existence of parasites. For positive samples Giemsa stain of thin blood films were made.19,20

**Entomological Survey**
To assess the apparent density and species of tsetse and other biting flies, 90 baited monopyramidal traps were deployed in different vegetation types at the side of river and woody grassland,21 fifteen each in selected PAs. Each trap was odor baited either with acetone, octanol or cow urine which attracts tsetse flies. The lower part of each trap stick was smeared with grease to prevent ants mounting up the stick toward the gathering cage to prevent tsetse fly damage in the cage. The trap was deployed for a total of 48 hours. After flies were captured in the collecting cage they were sorted and recorded by species, sex, and sites of collection were recorded. The flies captured per trap were counted, identified, and apparent fly density per trap (f/d/t) was calculated by adding the total number of flies and dividing by the number of traps per day.15 Characteristic morphology was used for identification of sex of tsetse flies. Other biting flies were also separated according to their characteristic morphology such as color, size, proboscis and venation of the wing structures at the genus level.22,23

**Data Management and Analysis**
For the analysis, collected data were entered into MS excel sheets and analyzed using SPSS version 20 software. Difference between different risk factors and disease status were assessed using Chi-squared test and two sample Student’s t-test. Statistically significant difference among parameters was tested at probability levels of P<0.05 and 95% CI. Finally, the fly population was calculated according to15 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**
From 819 animals examined, 36 were found positive for bovine Trypanosomiasis with overall prevalence of 4.4% in the study area. This prevalence was determined to be 4.35% in Badasa Didesa, 7.19% in Meta, 3.94% in Cafè Arjo, 1.86% in Jammo Giro, 8.19% in Hara Keku and 1.98% in Tuqa. Among those six peasant associations the highest prevalence rate was 8.19% in Hara Keku, the lowest being in Jammo Giro, 1.86%. Table 1: summarizes prevalence of cattle trypanosomiasis in six selected PAs. The prevalence of trypanosome infection in males and females was 5.3% and 3.04%, respectively. The prevalence of the disease was higher in males than females (\(\chi^2=2.4064; \ P<0.05\)), though the association was not statistically significant.

Out of the sampled cattle, 24.8%, 51.9%, and 23.3% were recorded as having poor, medium, and good body
condition respectively. A higher prevalence rate, 4.94%, was found in medium body condition animals followed by 4.71% prevalence rate in good body condition animals. The lowest infection rate, 2.95%, was recorded in poor body condition animals. Table 2 summarizes association between BCS, age, and sex with their respective prevalence rate in selected PAs.

Table 3 summarizes the mean PCV of examined cattle in selected PAs.

Statistical test applied to evaluate the presence of association between disease and mean PCV value for the parasitemic cattle showed 21.14±5.45 SD while the mean PCV value for the aparasitemic cattle was 25.26±4.3 SD. There was a statistically significant difference (p<0.05) in mean PCV value between parasitemic and aparasitemic cattle.

Three species of trypanosome were detected namely Trypanosoma congolense, T. vivax, T. brucei and mixed infection of T. congolense, T. vivax. From a total of 36 infected animals, 29 (80.55%) were found to be infected with T. congolense. Therefore T. congolense was considered the predominant species responsible for infection of cattle living in selected PAs. The remaining, 4 (11.11%), 2 (5.55%), 1 (2.77%) were found to be infected by T. vivax, T. brucei and mixed T. congolense and T. vivax respectively.

### Table 1 Prevalence of Cattle Trypanosomiasis in PAs

| Peasant Association | Number of Examined Animals | Tested Positive | Prevalence Rate (%) | χ² | p-value |
|---------------------|-----------------------------|-----------------|---------------------|----|---------|
| Badasa Didesa       | 115                         | 5               | 4.35                |    |         |
| Meta                | 139                         | 10              | 7.19                |    |         |
| Cafe Arjo           | 127                         | 5               | 3.94                |    |         |
| Jammo Giroos        | 215                         | 4               | 1.86                |    |         |
| Hara Keku           | 122                         | 10              | 8.19                |    |         |
| Tuqa                | 101                         | 2               | 1.98                |    |         |
| Total               | 819                         | 36              | 4.4                 |    |         |

### Table 2 Association Between Prevalence and Risk Factors

| Variables | Variable Classification | Non-Infected | Infected | Prevalence (%) | χ² | P-value |
|-----------|--------------------------|--------------|----------|----------------|----|---------|
| BCS       | Good                     | 182          | 9        | 4.7            | 1.35 | 0.510 |
|           | Medium                   | 404          | 21       | 4.9            |    |         |
|           | Poor                     | 197          | 6        | 3.0            |    |         |
| Age       | <2                       | 82           | 3        | 3.7            | 3.38 | 0.781 |
|           | 2–5                      | 204          | 8        | 3.9            |    |         |
|           | >5                       | 533          | 25       | 4.7            |    |         |
| Sex       | Male                     | 464          | 26       | 5.3            | 2.41 | 0.121 |
|           | Female                   | 319          | 10       | 3.1            |    |         |

### Table 3 The Mean PCV of Examined Cattle in Jimma Arjo District

| Result     | Mean PCV | SD    | 95% Confidence Level |
|------------|----------|-------|----------------------|
| Aparasitemic | 25.26    | 4.3   | 24.96–25.56          |
| Parasitemic | 21.14    | 5.45  | 19.29–22.98          |
| Total       | 25.08    | 4.44  | 24.77–25.38          |

### Entomological Finding

Entomological survey indicated 1083 tsetse flies, 33 Stomoxys and 8 tabanus were trapped at selected PAs during study period. This shows the overall 6.01/~d apparent density of tsetse flies trapped. Four tsetse species have been identified. Three hundred and fifty six (32.87%) G. f.fuscipes, 294 (27.15%) G. pallidipes, and 237 (21.88%) G. tachinoides and 196 (18.1%)
G. m. morsitans were collected. From the study PAs, the highest (14.1f/t/d) and the lowest (2.06f/t/d) tsetse catch were in Meta and Caffe Arjo PAs respectively. From a total of 1083 tsetse flies caught, 67.77% (n=734) were female and 32.22% (n=349) were male as shown in Table 4. There was a statistically significant difference between both sexes (P<0.05).

### Discussion

Overall 4.4% (n=36) prevalence of cattle Trypanosomiasis was recorded in the current study. Relatively similar finding (2.0%) of Bovine Trypanosomiasis was reported by Katabazi et al,\(^24\) from Lira District of Uganda and 4.17% by Kivali et al,\(^25\) from Western Kenya. Similarly, Gerem et al\(^26\) reported the overall prevalence of 4.5% of camel trypanosomiasis from Asayita and Dubti area of Afar region. Relatively lower prevalence rate was reported by Girma et al\(^27\) who reported 1.3% in and around Arbaminch area. This finding was relatively lower than reports by Megersa et al\(^28\) who indicated 12.24% from Botor Tolay District and Solomon and Fita, 2011,\(^29\) who reported 12.41 from Metekel and Awi zones of northwest Ethiopia, Miruk et al,\(^30\) who reported 20.4% from Wolayta and Dawuro zones of southern Ethiopia. There are also higher prevalence reports of 41% and 29% from other African countries such as Suba and Teso of Kenya\(^31\) and 20.1% from Busia district of Western Kenya.\(^32\)

The relatively lower prevalence of the disease in this study may be related to lower tsetse distribution and low animal fly contact. Trypanosome parasite and tsetse fly vector control programs practiced in the area by Bedelle branch NTTICC annually contributed to the lower prevalence rate. The prevalence of cattle trypanosomiasis between PAs was not significantly associated and might be due to the homogeneity in agroecology, vegetation and environment of research areas.

The mean PCV values for each animal sample in the pre intervention survey showed marked statistical difference. This finding was in agreement with a report of Bekele\(^33\) and Dagnachew et al,\(^34\) in which parasitaemic animals had mean PCV below 26%. Likewise, Thrusfield\(^17\) indicated that the average PCV of parasitologically non-infected animals was significantly higher than those of infected positive animals. Therefore this disease may significantly lower PCV of infected animals. Though other diseases such as internal parasitosis, tick borne disease and nutritional imbalances contribute to the low PCV values, trypanosome positive (parasitaemic) animals have generally lower mean PCV value than trypanosome negative (aparasitaemic) ones. These factors affect both Trypanosomiasis positive and negative animals.\(^17\) On the other hand, most of the parasitemic animals in lowland area had good body condition despite having low PCV values.

Packed cell value of animals from all PAs did not show marked difference with majority of animals having comparatively medium PCV value, though animals with low PCV values were also found. The existence of parasitologically negative cattle with PCV values of less than the average value (25%) may be due to either inadequacy of detection method\(^20\) or delayed recovery of anemic condition after current treatment with trypanocidal drugs, or other disease. Presence of positive animals with PCV of greater than 25% might be due to recent infection of animals.

The higher proportion of T. congolense (80.55%) in all PAs in the current study was inconsistent with the report by Katabazi et al\(^24\) who reported 81.8% T. congolense

### Table 4 The Mean Catch of Glossina Species in Selected PA of Jimma Arjo District

| PA          | Altitude | G. Morsitans | G. Pallideps | G. Fascipes | G. Tachnoids | No. of Traps | Tot. Fly Caught | F/T/D |
|-------------|----------|--------------|--------------|-------------|--------------|-------------|----------------|-------|
| B. Didesa   | 1371–1386| 14           | 17           | 13          | 16           | 23          | 27             | 15.63 |
| Meta        | 1395–1437| 36           | 50           | 44          | 74           | 37          | 54             | 172.251 |
| H. Keku     | 1417–1437| 7            | 23           | 10          | 11           | 33          | 54             | 59.107 |
| J.Giros     | 1395–1482| 2            | 5            | 19          | 38           | 1           | 34             | 15.18 |
| Caffe Arjo  | 1460–1528| 0            | 0            | 6           | 14           | 17          | 25             | 0.7     |
| Tuqa        | 1472–1648| 16           | 26           | 29          | 20           | 26          | 25             | 83.78 |
| F/T/D       |          | 0.42         | 0.7          | 0.6         | 0.9          | 0.7         | 1.1            | 0.6    |

**Abbreviations:** F/T/D, fly per trap per day; M, male; F , female; B. Didesa, Badasa Didesa; H. Keku, Hara Keku; J. Giros, Jamo Giros.
from the total trypanosomes detected. Similarly, highest prevalence rate of *T. congolense* (59.6%) was indicated by Megersa et al. This high prevalence of *T. Congolense* infection in cattle may be because of high serodemes (serological variation) of *T. congolense* as compared to other Trypanosoma species and development of immune response improvement against *T. vivax* by infected animals (Sinshaw et al.).

The variation in the prevalence of mixed infections involving different species of trypanosome from different regions and countries is due to the accessibility of the trypanosome species to their specific hosts. The presence of suitable mammalian host remains most likely factor for determining the spread and abundance of trypanosome species (Nimpaye et al.). The presence of other biting flies is playing an important role in the non-cyclical transmission of trypanosomiasis in the study area.

The overall mean catch of tsetse flies was 6.1 flies/trap/day. This finding was higher than Bekele (2004) reported, 1.35F/D/T and 0.9F/D/T in site one and two respectively in two of his study areas and Bekele and Beshir, who reported 2.42f/t/d. Conversely, Sinshaw indicated that his trap did not capture any fly. A similar finding was reported from Sayo district by Siyum et al. This result was lower than in previous work by Megersa et al., who reported 11.6 flies/trap/24hrs in Botor Tolay district and by Ragasa and Ababe, who reported 10.68 flies/trap/day in upper Didessa Valley.

The comparatively low level of tsetse fly and other fly populations in this study may be because of the intervention-like placement of insecticide-impregnated traps, targets, and use of insecticide in the area by NICE Tsetse Fly and trypanosomiasis. Female flies constituted 59.26% of the catch during the current study. This result is similar to the report of Bekele and Beshir, who reported 73.2% of catch were female tsetse. *Glossina fuscipes*, *G. tachinoides*, *G. pallideps* and *G.m. submorsitance* were the major tsetse fly species caught. This could be due to long life-span of female compared to male flies.

**Conclusion and Recommendation**

This study indicated *T. congolense*, *T. brucei*, and *T. Vivax* were responsible for cattle Trypanosomiasis with major clinical sign of anemic state hindering health and production of cattle. The occurrence of the diseases was associated with the tsetse and other biting flies. The disease is still a major constraint in animal health and production, although different control measures have been applied by NICETT. This can be due to inadequate control measures and development of drug resistance by Trypanosome. Therefore, a coordinated control campaign aimed at reducing tsetse fly burden would be necessary to minimize the impact of the disease and further research is needed to investigate effective drugs.

**Abbreviations**

BCS, body condition score; NICETT, National Institute for Control and Eradication of Tsetse fly and Trypanosomosis; PCV, packed cell volume.

**Data Sharing Statement**

The datasets that support the findings of this study are available from the principal author upon request.

**Ethical Approval and Consent to Participate**

All participants were informed about the purpose of this study and signed written legal consent for participation prior to the commencement of the study. Study design involved animals for blood sample and human participants for interview on medicinal plant use. The survey protocol and animal handling ethics were approved by Wollega University School of Veterinary Medicine Ethical Review Board. Support letters were also granted from East Wollega zone, Livestock and Fishery resource office, and the administration Office of East Wollega zone.

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**Author Contributions**

The author contributed to data analysis, drafting or revising the article, gave final approval of the version to be published, agreed to the submitted journal, and agree to be accountable for all aspects of the work.

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