# Systematic Review on the Prevalence of Bovine Trypanosomiasis from 2008-2023 in Benishangul - Gumuz Regional State, Western Ethiopia

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**Abstract:** Tsetse-transmitted trypanosomiasis in Ethiopia is widely distributed in the western and southwestern lowlands and the major river valleys. This systematic review of bovine trypanosomiasis assessed 15 years of articles from 2008–2023 in the Benishangul Gumuz region. The systematic review was accomplished according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) protocol; published articles were collected from Google Scholar and PubMed. As a result, the three-trypanosome species *T. congolense*, *T. vivax*, and *T. brucei* were recorded from different articles. The mean prevalence of trypanosomiasis in the region was 13.6%, and in all the cases, *T. congolense* was found to be the most prevalent species and *T. brucei* was the least prevalent species. Based on the entomological analysis, G. *moristans submorsitans* was the most commonly occurring species of tsetse fly in the region, while *G. tachinoides* was recorded only from Oda Buldiglu district of Assosa zone and Pawe district of Metkel zone. The highest FTD of 7.7 and the lowest FTD of 0.32 tsetse fly caught were recorded from Bambasi district in the same year at different times of the study. Most of the trypanosomiasis studies concentrated on the years 2015 to 2020. The prevalence of trypanosomiasis is gradually decreasing from 2011 to 2023. It indicated the scarcity of data in some areas of the region and seasons of the year. So, to reduce the prevalence of trypanosomiasis and its impact, unintegrated tsetse and trypanosomiasis prevention and control methods should be implemented in the region. Tsetse and trypanosomiasis surveillance should address untouched areas of the region and all seasons of the year.
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**Key words:** *Brucei, Congolense, Systematic review, Trypanosomiasis, Vivax*

## 1. Introduction

Trypanosomes are protozoan parasites belonging to the family *Trypanosomatidae* and the genus *Trypanosoma*. The genus *Trypanosoma* comprises many species, such as *T. brucei*, *T. congolense*, *T. equiperdum*, *T. evansi*, *T. simiae*, *T. suis*, and *T. vivax*, which cause diseases called trypanosomiasis/ in different mammalian hosts, including humans (Stevens *et al.*, 2004). Trypanosomes are flagellated protozoan parasites that live in the blood and other body fluids of vertebrate hosts. They swim in body fluids by flagellum, boring their way between cells (Magona *et al.*, 2003).

Tsetse-transmitted trypanosomiasis in Ethiopia is widely distributed in the western and southwestern lowlands and the major river valleys (Urquart *et al.*, 1995). It is a major problem for the utilization of large land resources (Gelaye and Fesseha, 2020). The epidemiology of trypanosomiasis is highly dependent on the parasite, vector, and host factors. Tsetse-borne trypanosomiasis invades 180,000 to 200,000 km of agriculturally suitable land in the west and southwest of the country. 14 million heads of cattle, an equivalent number of small ruminants, nearly 7 million equines, and 1.8 million camels are at risk of contracting trypanosomiasis at any time (Dumesa and Demessie, 2015).

Trypanosomiasis is a fatal and economically devastating disease and a major constraint on production by causing the loss of livestock (Feyera, 2015). Trypanosomiasis is a complex disease of protozoa that is caused by different species of unicellular parasites found in the blood and other tissues of vertebrates, including livestock, wildlife, and people (Uilenberg, 1998). Trypanosomiasis is a progressive and not always fatal disease, and its main features are anemia, tissue damage, and immunosuppression (Taylor and Authié, 2004). Trypanosomiasis is a chronic disease that extends over several months and usually terminates fatally if untreated. The effect of trypanosomiasis causes direct losses resulting from mortality, morbidity, and

infertility in infected animals (Claes *et al.*, 2005). Annual estimated losses for Ethiopia as a result of trypanosomiasis are roughly $200 million, in terms of mortality and morbidity losses in livestock, excluding the failure to utilize fertile land for crop and livestock production and the costs included in controlling the disease (Dereje, 2019).

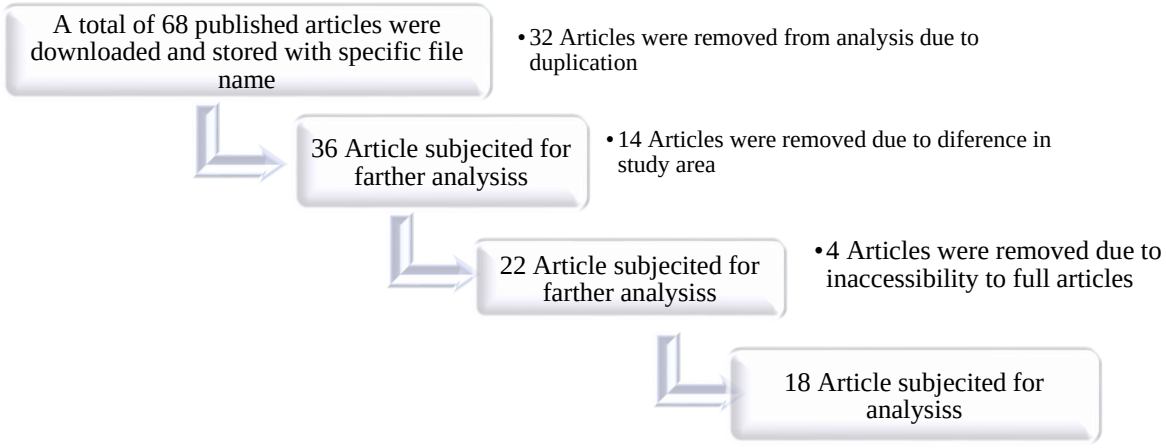
Trypanosomiasis is an important disease of livestock in Ethiopia. Six pathogenic species of trypanosomes exist in the country, namely *T. vivax, T. congolense, T. brucei, T. evansi, T. equiperdum,* and *T. rhodesiense*. But the most important trypanosomes are *T. vivax* and T. *congelense*. *The tsetse fly T. congolense, T. vivax, and T. brucei are found in the Benishangul Gumuz region (*Dereje, 2019). Tsetse flies in Ethiopia are confined to the western and south-western parts of the country between 33° and 38° E longitude and 5° and 12° N latitude. It is estimated to cover an area of 140, 000–220, 000 km2 (NTTICC, 2004). Tsetse-infested areas follow the major river systems of Abay (Blue Nile), Baro, Akobo, Didessa, Ghibe, and Omo, which are found partially in the territory and are also close to the boundary of the present study area. In the Benishangul Gumuz region, trypanosomiasis is found to be one of the factors that hampered livestock rearing, which may need researcher observation (Reta *et al.*, 2015). Therefore, the present study designed to review the prevalence of bovine trypanosomiasis in the Benishangul Gumuz region from 2008 to 202, to estimate the flies/trap/day of tsetse flies in the region during the study period and to evaluate the pattern of bovine trypanosomiasis in the next 15 years.

## 2. Materials and methods

This systematic review is accomplished according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) protocol defined by (Moore *et al.*, 2009*)*. Searching the literature was done on Google Scholar and PubMed using terms like: prevalence, incidence of bovine trypanosomiasis, tsetse fly FTD, trypanosomiasis occurrence, risk factors for bovine trypanosomiasis occurrence, and a review on bovine trypanosomiasis in the Benishangul Gumuz region from 2008–2023. A total of 68 published articles were downloaded after a thorough search on Google Scholar and PubMed. All the downloaded published articles were named with the first author and year of publication and stored in a specific folder. Then screening for possible duplication and analysis of articles for eligibility with the objective of this review were performed. Finally, 18 articles were used for quantitative analysis of the article review.

Figure 1 shows the Map of the study area.


Figure 1. Article screening approach flowchart at each stage




### 2.1. Data management and analysis

Data from all eligible published articles was entered into Microsoft Excel 2016 spreadsheets, and analysis was performed using descriptive statistical packages. The test applied in all cases of the published articles was the buffy coat technique, as indicated by the respective authors. The findings were presented using paragraphs and tables.

## 3. Findings

### 3.1. Parasitological Findings

In most of the cases, the three Trypanosoma species *T. congolense*, *T. vivax*, and *T. brucei* were found concurrently recorded. In all the cases, *T. congolense* was found to be the most prevalent species, and *T. brucei* was the least prevalent species.

Table 1: Distribution of Trypanosomes Species in Benishangul Gumuz Region, 2008-2023

| Study area | Trypanosoma species | Prevalence | References |
|---|---|---|---|
| Mao-Komo, Special District | *T. congolense*<br>*T. vivax*<br>*T. brucei* | 63.2<br>13.6<br>11.6 | Dawud *et al.*, 2011 |
| Assosa, Assosa Zone | *T. congolense*<br>*T. vivax*<br>*T. brucei* | 66.7<br>9.3<br>4.6 | Shimelis *et al.*, 2011 |
| Asossa, Assosa Zone | *T. congolense*<br>*T. vivax* | 85.1<br>12.77 | Bayisa *et al.*, 2015 |
| Dangur, Metkel Zone | *T. congolense*<br>*T. vivax* | 77.55<br>18.37 | Bayisa and Getachew, 2015 |
| Benishangul Gumuz Region | *T.congolense*<br>*T. vivax*<br>*T, brucei* | 76.54<br>18.63<br>2.48 | Asmamaw *et al.*, 2016 |
| Pawi, Metkel Zone | *T.congolense*<br>*T. vivax* | 75.86<br>24.14 | Asmamaw and Getachew, 2016 |
| Assosa, Assosa Zone | *T. congolense*<br>*T. vivax*<br>*T. brucei* | 14.3<br>2.2<br>0.9 | Shibabaw *et al.*, 2016. |
| Assosa, Assosa Zone | *T. congolense*<br>*T. vivax*<br>*T. brucei* | 58.75<br>20<br>10 | *Dawit and Nuraddis*, 2017 |
| Oda Buldigilu, Assosa Zone | *T. congolense* | 55.31 | Mekonnen and Negesse, 2017. |

| | | | |
|---|---|---|---|
| | *T. vivax* | 38.29 | |
| | *T. brucei* | 1.12 | |
| | *T. congolense* | 51.76 | |
| Bambasi, Assosa Zone | *T. vivax* | 28.23 | Yalew and Fantahun, 2017 |
| | *T. brucei* | 11.76 | |
| | T. congolense | 3.13 | |
| Mao-Komo, Special District | T. brucei | 1.04 | Geremew and Oda, 2018 |
| | T. vivax | 0.52 | |
| Dibati, Metkel Zone | T. congolense | 0.16 | Kedir *et al.*, 2018 |
| | T. vivax | 2.07 | |
| | *T. congolense* | 66.11 | |
| Bulen, Metkel Zone | *T. vivax* | 13.5 | Walkite *et al.*, 2018 |
| | *T. brucei* | 5.56 | |
| Assosa Zone | *T.congolense* | 77.7 | Asmamaw *et al.*, 2019 |
| | *T.vivax* | 22.2 | |
| | T. congolense | 13.2 | |
| Assosa, Assosa Zone | T. brucei | 3.2 | Fantahun *et al.*, 2019. |
| | T. vivax | 2.9 | |
| | *T. congolense* | 7.7 | |
| Bambasi, Assosa Zone | *T. vivax* | 0.9 | Morka and Hika, 2020. |
| | *T. brucei* | 0.2 | |
| | *T. congolense* | 56 | |
| Bambasi, Assosa Zone | *T. vivax* | 24 | Mubarik and Haile, 2020 |
| | *T. brucei* | 12 | |
| | *T. congolense* | 58.33 | |
| Bambasi, Assosa Zone | *T. vivax* | 25 | Mubarik *et al.*, 2023 |
| | *T. brucei* | 8.33 | |

### 3.2. Prevalence

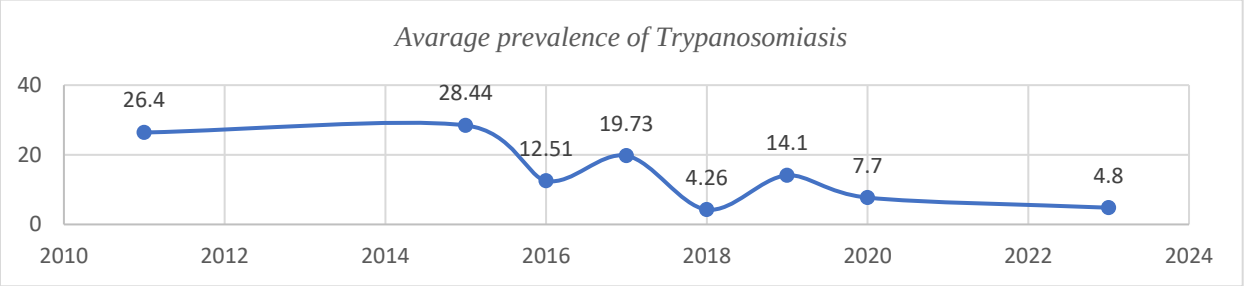
The highest trypanosomiasis prevalence (28.1%) was recorded in Assosa, while the least (2.23%) was recorded in Dibati districts, and the mean prevalence of trypanosomiasis in the region was 13.6%. Even if the objective of the review extended from 2008 to 2023, the earliest articles published on trypanosomiasis in the Benishangul Gumuz region were in 2011 to the best of my knowledge. Most of the study's location concentrated in Assosa and Bambasi districts, and the study's intensive time was from 2015 to 2020.

Table 2: Prevalence of Bovine Trypanosomiasis in the Benishangul Gumuz Region, 2008–2023.

| **Study Area** | **No tested** | **No Positive** | **Prevalence** | **References** |
|---|---|---|---|---|
| Mao-Komo | 385 | 95 | 24.7 | Dawud *et al.*, 2011 |
| Assosa, Assosa Zone | 384 | 108 | 28.1 | Shimelis *et al.*, 2011 |
| Asossa, Assosa Zone | 202 | 46 | 22.8 | Bayisa *et al.*, 2015 |
| Dangur, Metkel Zone | 408 | 46 | 11.27 | Bayisa *et al.*, 2015 |
| Benishangul, Gumuz Region | 1645 | 162 | 9.85 | Asmamaw *et al.*, 2016 |
| Pawi, Metkel Zone | 519 | 29 | 5.58 | Asmamaw and Getachew, 2016 |
| Assosa, Assosa Zone | 322 | 71 | 22.1 | Shibabaw *et al.*, 2016 |
| Assosa, Assosa Zone | 310 | 80 | 25.8 | *Dawit and Nuraddis*, 2017 |
| Oda Buldigilu, Assosa Zone | 395 | 47 | 11.89 | Mekonnen and Negesse, 2017 |

| | | | | |
|---|---|---|---|---|
| Bambasi, Assosa Zone | 400 | 85 | 21.5 | Yalew and Fantahun, 2017 |
| Mao-Komo Special District | 384 | 18 | 4.69 | Geremew and Oda, 2018 |
| Dibati, Metkel Zone | 627 | 14 | 2.23 | Kedir *et al.*, 2018 |
| Bulen, Metkel Zone | 306 | 18 | 5.88 | Walkite *et al.*, 2018 |
| Assosa Zone | 340 | 18 | 5.29 | Asmamaw *et al.*, 2019 |
| Assosa, Assosa Zone | 310 | 71 | 22.9 | Fantahun *et al.*, 2019 |
| Bambasi, Assosa Zone | 638 | 58 | 9.1 | Morka and Hika 2020 |
| Bambasi, Assosa Zone | 400 | 25 | 6.25 | Mubarik and Haile, 2020 |
| Bambasi, Assosa Zone | 250 | 12 | 4.8 | Mubarik *et al.*, 2023 |
| **Mean** | **457** | **51** | **13.6** | |

Table 3. The average prevalence of trypanosomiasis during the years 2011–2023.




### 3.3. Entomological Finding

Based on the entomological analysis, G. *moristans submorsitans* was the most commonly occurring species of tsetse fly in the region. While *G. tachinoides* was only recorded in the studies from Oda Buldiglu district of Assosa zone and Pawi district of Metkel zone. The highest FTD of 7.7 and the lowest FTD of 0.32 tsetse fly caught were recorded from Bambasi district in the same year at different times of the study.

Table 4. Tsetse flies species distribution in the Benishangul Gumuz region, 2008–2023.

| Study Area | Tsetse Species | FTD | References |
|---|---|---|---|
| Benishangul, Gumuz Region | *G. moristans submorsitans* | 2.49 | Asmamaw *et al.*, 2016 |
| Pawi, Metkel Zone | *G. tachinoides* | 5.03. | Asmamaw *and Getachew*, 2016 |
| Oda Buldigilu, Assosa Zone | *G. moristans submorsitans* | 2.05 | Mekonnen and Negesse, 2017 |
| Bambasi, Assosa Zone | *G. moristans submorsitans* | 4.95 | Yalew and Fantahun, 2017 |
| Assosa Zone | *G. moristans submorsitans* | 1.39 | Asmamaw *et al.*, 2019 |
| Benishangul-Gumuz Region | *G. tachinoides* | 2.38 | Gebre *et al.*, 2022 |
| Bambasi, Assosa Zone | Glossina species | 7.7 | Morka and Hika 2020. |
| Bambasi, Assosa Zone | *G. moristans submorsitans* | 0.325 | Mubarik and Haile, 2020 |
| Benishangul-Gumuz Region | *G. tachinoides* | 2.38 | Gebre *et al.*, 2022 |
| Bambasi, Assosa Zone | *G. moristans submorsitans* | 0.39 | Mubarik *et al.*, 2023 |
| Mean FTD | | 2.41 | |

*Keys: FTD= flies/trap/day*

## 4. Discussion

The present systematic review shows that *T. congolense*, *T. vivax*, and *T. brucei* were found commonly and simultaneously in most of the articles although, *T. congolense* is the most prevalent species in all the articles. This is comparable with the findings of Tsegaye *et al.,* (2022) *Trypanosomes congolense* were 61.9%, *T. vivax* 35.9% and *T. brucei* 1.7% prevalence recorded with buffy coat test from western Ethiopia. The present systematic review finding is also consistent with the finding of Reta *et al.,* (2015) whom reported *T. congolense* 76.0 %, *T. vivax 18.1 %*, and *T. b. brucei 3.6 % from* south-western Ethiopia.

The present systematic review indicates trypanosomiasis prevalence is highly prevalent in the Benishangul Gumz region, with a mean prevalence of 13.6%. It is consistent with the report by Reta *et al.* (2015) the prevalence of trypanosomiasis was higher in Benishangul-Gumuz 18.0%, however lower in Amhara 12.0%, Oromia 6.0% and Gambella 5.0 % regions. This finding is also comparable with meta-analysis of trypanosomiasis prevalence 15.1% from 19 countries (Pane *et al.,* 2018). The present finding signifies that the economic impact of trypanosomiasis reported by Zewdu *et al.,* (2013) trypanosomiasis increases the livestock deaths by 33% and production costs by 63% and crop production decreases by 14% when trypanosomiasis and oxen death coexist and estimate the direct economic loss is about US$58,300 per annum in the study districts. The estimated country wide economic loss is about US$94 million per annum.

The present systematic review shows most of the studies were conducted in the years 2015–2020. Even if the objective of this systematic review was to assess 15 years (2008–2023) of literature, this review accessed published articles from 2011–2023 from the Benishangul Gumuz region. Accordingly, the temporal pattern of trypanosomiasis prevalence shows a decrease from the earliest study 28.1% prevalence in 2011 to the latest study 4.8% in 2023. This difference in prevalence could be either due to tsetse and trypanosomiasis prevention and control applied in the area or due to season of the study undertaken. Seasonal occurrence of Trypanosomiasis was 3.1% and 6.8% accounted to dry and wet seasons, respectively (Tadesse *et al.,* 2021). The average seasonal incidence of trypanosome was 21.66, 10, 13.79 and 17.24% during the late rainy, dry, early and wet seasons, respectively (Mulugeta *et al.,* 2013).

Based on spatial analysis, most of the studies were recorded in Assosa Zone and Mao-Komo special district, while fewer studies were reported in Metkel zone, but no articles were published in Kamashi Zone. The highest trypanosomiasis prevalence 28.1% was recorded in Assosa district, Assosa zone, and 2.23% in Dibati district, Metkel zone. This variation in prevalence might be because of ecological differences and vector availability differences. The distribution of tsetse fly and related trypanosomiasis in Ethiopia is associated with the major river systems of the country; such as Abay/Didessa, Omo/Gibe, Baro/Akobo, and the southern rift valley (Abaynew and Haben, 2020). According to the documented tsetse fly species, *G. moristans, submorsitans*, and *G. tachinoides* were found in the region with varied fly per trap per day (FPD). Among the recorded tsetse fly species, *G. moristans submorsitans* were the most commonly existing tsetse flies recorded in all the study areas in the region. While *G. tachinoides* was registered from Pawe district of Metkel zone and Oda Buldiglu district of Assosa zone,

## 5. Conclusion and recommendations

This systematic review accessed published articles from 2011 to 2023 from the Benishangul Gumuz region. It indicated the mean prevalence of trypanosomiasis were 13.6% and is a major challenge for cattle productivity in the region. Most of the trypanosomiasis studies concentrated in the years from 2015–2020. The data was recorded mostly from the Assosa and Bambasi districts of Assosa Zone. The prevalence of trypanosomiasis was gradually decreasing from the year 2011 to 2023. The FTD caught was varied depending on the season of the study. The entomological analysis indicated that G. *moristans submorsitans* was the most abundantly species of tsetse fly found in the region whereas *G. tachinoides* were the least identified. This systematic review indicated the scarcity of data in some areas of the region and some years. Therefore integrated tsetse fly and trypanosomiasis control methods should be implemented in the region and farmers should get advice and awareness creation on the possible prevention and control strategies of the disease in the study areas.

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