

Prevalence of Bovine Trypanosomosis and Tsetse Fly Density in Different Regions of Ethiopia: A Review

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Abstract

Ethiopia is known for its large and diverse livestock resource endowments and Bovine Trypanosomosis has long been recognized as a massive constraint on animal husbandry, livestock production and mixed farming in vast areas of rural sub-Saharan Africa. In Ethiopia, trypanosomosis is widespread in domestic livestock in the Western, South and Southwestern lowland regions and the associated river systems. The tsetse flies in Ethiopia are confined to the southern and western regions. Out of nine region of Ethiopia, five (Amhara area, Benshangul-Gumuz, Gambella, Oromia and Southern Nations Nationalities and Peoples' Regional State) are infected with more than one species of tsetse flies and there are five species of tsetse flies in those mentioned regions. For this systematic review more than 60 published paper from 2000-2019 which were done in Amhara, Oromia, SNNPRs, Benshangul Gumize and Gambella regions, respectively. According to this review the overall prevalence of bovine trypanosomosis in five regions of Ethiopia revealed that 8.6%, 9.3%, 11.2%, 10.6% and 18.1% in Amhara, Oromia, SNNPRs, Benshangul Gumize and Gambella, respectively. Furthermore this review indicted that high infestation of tsetse fly in Oromia region by four species namely *Glossina pallidipes*, *Glossina morsitans*, *Glossina fuscipes* and *Glossina tachinoide* followed by *G. pallidipes*, *G. fuscipes* and *G. longipennis* in SNNPRs, *G. m. submorsitans* and *G. tachinoide* in Amhara, *G. morsitans* and *G. tachinoide* in Benshangul Gumize and *Glossina pallidipes*, *Glossina morsitans*, *Glossina fuscipes* and *Glossina tachinoide* in Gambella. In conclusion the review showed that there was no a significant variation in prevalence of bovine trypanosomosis in five regions except in Gambella region, therefore the national institute of trypanosomosis and tsetse fly investigation and control should covered all tsetse fly infested region of the country together with controlling the mechanical transmission by biting flies.

Keywords: Ethiopia; Prevalence; Trypanosomosis; Tsetse Fly Density (TFD)

Introduction

Trypanosomosis has long been recognized as a massive constraint on animal husbandry, livestock production and mixed farming in vast areas of rural sub-Saharan Africa [1]. Ethiopia is known for its large and diverse livestock resource endowments. Livestock is primarily kept on small holdings where it provide drought power for crop production, manure for soil fertility and fuels, serves as a sources family diet and sources of cash income (from livestock and livestock products). Despite large livestock population, Ethiopia fails to optimally utilize this resource due to different constrains facing the livestock subsector [2].

Since more than 90% of crop production in Ethiopia are dependent on animal draught power mainly on ploughing oxen, many large fields lie fallow due to lack of these animals in trypanosomiasis infested area [3], which worsen the food supply and living conditions in affected areas. Trypanosomes are flagellated protozoan parasites that live in the blood and other body fluids of vertebrate hosts [4]. Bovine trypanosome is one of the diseases that are caused by this flagellated protozoal parasite belonging to the genus trypanosome. This group of diseases caused by protozoa of the genus *Trypanosoma* affects all domestic animals [5].

The major veterinary species are *Trypanosoma congolense*, *Trypanosoma vivax*, *Trypanosoma brucei*, and *Trypanosoma simiae*. *Trypanosoma brucei rhodesiense* and *Trypanosoma brucei gambiense* are zoonotic, with people as the predominant host. Animal are mainly affected by tsetse-transmitted trypanosomes and in geographic areas where tsetse transmitted trypanosomiasis occurs [6]. In Ethiopia, trypanosomosis is widespread in domestic livestock in the Western, South and Southwestern lowland regions and the associated river systems (that is Abay, Ghibe Omo and Baro/Akobo) [7].

The tsetse flies in Ethiopia are confined to the southern and western regions between longitude 33° and 38°E and latitude 5° and 12°N. The infested area extends from the southern part of the Rift Valley, around the south-western corner of the country and along the western lowlands and escarpments to the Blue Nile [2,8].

Out of nine region of Ethiopia, five (Amhara area, Benshangul-Gumuz, Gambella, Oromia and Southern Nations Nationalities and Peoples Regional State) are infected with more than one species of tsetse flies [9]. Currently about 220,000 km² areas of the above mentioned regions are infested with five species of tsetse flies namely *Glossina pallidipes*, *Glossina morsitans*, *Glossina fuscipes*, *Glossina tachinoide* and *Glossina longipennis* [8,10].

Several studies have been done in Ethiopia on the prevalence and tsetse fly density but there was no documented data in collective manner which clearly shown the status of trypanosomosis and its vector in different regions of the country. Therefore, the objectives of this review paper are: to present the available evidence on prevalence of bovine Trypanosomosis and its vector in different regions of Ethiopia in a systematic way. And to show research gaps on prevalence of trypanosomosis and tsetse fly density in Ethiopia.

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Literature Review

Different literature shown that five regions in Ethiopia are infested with four species of *Glossina* namely *Glossina pallidipes*, *Glossina morsitans*, *Glossina fuscipes* and *Glossina tachinoide* and the remaining one species *G. longipennis* are reported in SNNPRS, south Omo Zone, particularly in Mago national park by Arba Minch tsetse fly and trypanosomosis investigation and control center. Based on this holistic review no report have been indicated the prevalence of bovine trypanosomosis and tsetse fly in natural reservoir of the disease like wild animal and national parks which are believed to be the pocket area for the tsetse fly to live and this could be one of the research gap this review identified in Ethiopia.

Amhara region

Amhara region is one of the potential regions in livestock population in the country and according to different authors in the region the area is highly infested with two tsetse fly species. From 2000-2019 only 12 published paper from different article are included and some of them are done in the same woreda by different author but their finding was different this is due to the use of different diagnostic methods and traps for catching tsetse fly [11-13].

Based on this review out of 16592 samples from different study area 1427 (8.6%) was positive for the parasite, out of this the most prevalent species of *Trypanosoma* in the region was *T. vivax* followed by *T. congolense*; *T. brucei* was rare species only reported in few area as stated in the Table 1 below [11-32]. This could be due to the experience of the personal to identify and the use of common laboratory technique. The entomological survey by different authors indicted that *G. m. submorsitans* and *G. tachinoides* are the two tsetse fly species in the region (Table 2) [12,14,15]. There was only few published work that shown tsetse fly density in the region and this was one of the area to further investigate the tsetse fly density in the region and to plan the control programme in the area.

Oromia region

According to CSA, 2017/2018 Oromia is the first in livestock population in Ethiopia but this huge resource is highly challenged by one of economically devastating disease and the region was one of the trypanosomosis and tsetse fly investigation and control center last one decade due to its high tsetse fly infestation.

From the year 2000-2019 almost 25 published papers on prevalence of Bovine trypanosomosis were identified in Oromia as stated in Table 3. Based on the review of this paper out of 18673 total samples 1734 (9.3%) were positive for the disease and among which *T. congolense* was the most prevalent species in different Zones and Woredas of the region followed by *T. vivax* and *T. brucei* as indicated in the Table 3 below [33-54].

Among 25 published papers 18 studies were reported the tsetse fly density of the region and out of five species of tsetse fly which are found in Ethiopia, four species of tsetse fly were infested the region namely *G. morsitans*, *G. pallidipes*, *G. tachinoides* and *G. fuscipes* and this region were highly infested with only *Glossina longipennis* is an exception (Table 4) [33-55].

Southern Nation Nationalities Peoples Regional State (SNNPRS)

This region is the 2nd in livestock population in Ethiopia with high risk of bovine trypanosomosis and tsetse fly infestation and there are

S. No	Study Area	Sample size	Prevalence in %	Spp of Trypanosoma	References
1	Jabi Tehenan and Bahar dar Zuria	1435	175 (12.2%)	Overall	[11]
			102 (7.1%)	<i>T. congolense</i>	
			67 (4.67%)	<i>T. vivax</i>	
			6 (0.43%)	Mixed infection	
2	Dembecha and Jabi Tehenan	1648	242 (14.7%)	Overall	[12]
			175 (10.61%)	<i>T. congolense</i>	
			61 (3.7%)	<i>T. vivax</i>	
			2 (0.14%)	<i>T. brucei</i>	
3	South Achefer District	384	4 (0.25%)	Mixed infection	[26]
			16 (4.2%)	Overall	
			5 (1.3%)	<i>T. congolense</i>	
			10 (2.6%)	<i>T. vivax</i>	
4	Wemberma district (West Gojjam)	384	1 (0.26%)	Mixed infection	[27]
			30 (7.81%)	Overall	
			24 (6.25%)	<i>T. vivax</i>	
5	Mecha Woreda (west Gojjam zone)	384	6 (1.56%)	<i>T. congolense</i>	[28]
			8 (2.10%)	Overall	
			8 (2.10%)	<i>Trypanosoma vivax</i>	
6	Jabi Tehnan District	164	25 (15.24%)	Overall	[13]
			20 (12.2%)	<i>T. congolense</i>	
			5 (3.04%)	<i>T. vivax</i>	
7	Quara Woreda	384	26 (6.77%)	Overall	[29]
			1 (0.26%)	<i>T. congolense</i>	
			25 (6.51%)	<i>T. vivax</i>	
8	Guangawa and Jawi (Awi zone)	405	39 (9.6%)	Overall	[14]
			28 (6.9%)	<i>T. congolense</i>	
			7 (1.73%)	<i>T. vivax</i>	
			3 (0.74%)	<i>T. brucei</i>	
			1 (0.23%)	mixed infection	
9	Amhara Region	7079	501 (7.07%)	Overall	[30]
			29 (0.41%)	<i>T. congolense</i>	
			450 (6.35%)	<i>T. vivax</i>	
			6 (0.08%)	<i>T. brucei</i>	
10	Dejen, Machakel, and Baso-liben (East Gojjam zone)	3360	275 (8.2%)	Overall	[31]
			11 (0.34%)	<i>T. congolense</i>	
			249 (7.6%)	<i>T. vivax</i>	
			15 (0.44%)	mixed infection	
11	Ankesha District (Awi Zone)	384	28 (7.3%)	Overall	[32]
			9 (2.4%)	<i>T. congolense</i>	
			19 (4.9%)	<i>T. vivax</i>	
12	Debre Eliays (North-western)	581	62 (10.67%)	Overall	[15]
			27(4.65%)	<i>T. congolense</i>	
			35 (6.02%)	<i>T. vivax</i>	

Table 1: Systematic summary of publication on prevalence of bovine trypanosomosis in Amhara Region.

five national parks namely Omo, Mago, Nech Sar, Maze and Chebera Churchura which can be act as a good habitat for tsetse fly. From 2000-2019 GC only 15 published studies were done on prevalence of Bovine trypanosomosis. Among 13 zones of the region; studies were done by different author in 6 zones with various woredas. This indicated that most of the studies were concentrated in limited parts of the region, due emphases should be given to assess prevalence of the disease and its vector density in the region to alleviate the impact of this disease in the productivity of livestock. Out of 7404 samples 825 (11.2%) animals were positive for the disease and of which *T. congolense* was the dominant species of Bovine trypanosomosis in the region followed by *T. vivax* and *T. brucei*. According to Kidanemariam et al. [16] *T.*

No	Study Area	Type of Trap Deployed	No of Trap deployed	Glossina spp.	Tsetse fly density F/T/D	References
1	Debre Eliays (North-western)	monoconical	4	<i>Glossina spp</i>	16.0	[15]
2	Dembecha and Jabitehenan wereda (West Gojjam Zone)	Monoconical, Biconical and NGU traps	142	<i>Glossina m. submorsitans</i>	0.68	[12]
3	Guangawa and Jawi (Awi zone)	Monopyramidal	138	<i>G. tachinoides</i>	1.71	[14]

Table 2: Systematic summary of publication on Tsetse fly density in Amhara Region.

No	Study Area	Sample size	Prevalence %	Spp of Trypanosoma	References
1	Didesa District	556	27 (4.85%)	Overall	[33]
			17 (3.05%)	<i>T. congolense</i>	
			9 (1.61%)	<i>T. vivax</i>	
			1 (0.17%)	mixed infection	
2	Sayo District	860	96 (11.16%)	Overall	[34]
			50 (5.81%)	<i>T. congolense</i>	
			31 (3.6%)	<i>T. vivax</i>	
			10 (1.10%)	<i>T. brucei</i>	
3	Yayo District (Illubabor Zone)	488	5 (0.58%)	mixed infection	[35]
			19 (3.9%)	Overall	
			16 (3.3%)	<i>T. congolense</i>	
			2 (0.4%)	<i>T. vivax</i>	
4	Dale Wabera District of Kellem Wollega Zone	384	1 (0.2%)	<i>T. brucei</i>	[36]
			11 (2.86%)	Overall	
			7 (1.82%)	<i>T. congolense</i>	
			3 (0.78%)	<i>T. vivax</i>	
5	Guto Gida District (East Wollega Zone)	384	1 (0.26%)	<i>T. brucei</i>	[37]
			30 (7.81%)	Overall	
			16 (4.17%)	<i>T. congolense</i>	
			9 (2.34%)	<i>T. vivax</i>	
6	Diga and Sasiga districts (East Wollega zone)	386	5 (1.3%)	<i>T. brucei</i>	[38]
			33 (8.55%)	Overall	
			24 (6.22%)	<i>T. congolense</i>	
			9 (2.33%)	<i>T. vivax</i>	
7	Yayo District (Illuababora Zone)	408	30 (7.4%)	Overall	[39]
			20 (4.9%)	<i>T. congolense</i>	
			8 (2%)	<i>T. vivax</i>	
			2 (0.5%)	Mixed infection	
8	Dale Wabera District, Kellam Wollega Zone	391	48 (12.3%)	Overall	[40]
			29 (7.42%)	<i>T. congolense</i>	
			13 (3.32%)	<i>T. vivax</i>	
			6 (1.53%)	<i>T. brucei</i>	
9	Darmu district (Illubabor zone)	392	45 (11.5%)	Overall	[41]
			40 (10.2%)	<i>T. congolense</i>	
			5 (1.3%)	<i>T. vivax</i>	
10	Didessa Woreda	364	21 (5.76%)	Overall	[42]
			13 (3.57%)	<i>T. congolense</i>	
			5 (1.37%)	<i>T. vivax</i>	
			2 (0.55%)	<i>T. brucei</i>	
			1 (0.27%)	Mixed infection	
11	Dale Sadi, Dale Wobara and Hawa Galan (West Wollega Zone)	1132	97 (8.6)	Overall	[43]
			82 (7.2%)	<i>T. congolense</i>	
			12 (1.1%)	<i>T. vivax</i>	
			3 (0.3%)	Mixed infection	
12	upper Didessa, Birbir and Sore-Geba river valleys (western Ethiopia)	904	70 (7.74%)	Overall	[44]
			54 (5.98%)	<i>T. congolense</i>	
			12 (1.32%)	<i>T. vivax</i>	
			3 (0.33%)	<i>T. brucei</i>	
			1 (0.11%)	Mixed infection	

13	Pawi (Metekel Zone)	135	28 (20.7%)	Overall	[14]
			24 (17.77%)	<i>T. congolense</i>	
			3 (2.20%)	<i>T. vivax</i>	
			1 (0.73%)	<i>T. brucei</i>	
14	Chewaka Settlement (Ilubabor Zone)	566	24 (4.24%)	Overall	[45]
			15 (2.65%)	<i>T. congolense</i>	
			7 (1.24%)	<i>T. vivax</i>	
			2 (0.35)	<i>T. brucei</i>	
15	Bako Tibe (West Shoa) and Gobu Seyo (West Wollega Zone)	384	24 (6.25%)	Overall	[46]
			14 (3.65%)	<i>T. congolense</i>	
			9 (2.34%)	<i>T. vivax</i>	
			1 (0.26%)	<i>T. brucei</i>	
16	Metekel district	484	83 (17.2%)	Overall	[47]
			40 (8.3%)	<i>T. congolense</i>	
			43 (8.9%)	Other spp.	
			33 (9%)	Overall	
17	(Sibu Sire) and (Guto Gida) districts (East Wollega Zone)	368	12 (3.26%)	<i>T. congolense</i>	[48]
			21 (5.70%)	<i>T. vivax</i>	
			33 (8.6%)	Overall	
			24 (6.25%)	<i>T. congolense</i>	
18	Hawagelan district, West Wellega	384	7 (1.82%)	<i>T. vivax</i>	[49]
			2 (0.52%)	<i>T. brucei</i>	
			42 (10.8%)	Overall	
			23 (5.9%)	<i>T. congolense</i>	
19	Hawa-Gelan district (Wollega Zone)	389	9 (2.3%)	<i>T. vivax</i>	[50]
			10 (2.6%)	<i>T. brucei</i>	
			6 (1.4%)	Overall	
			2 (0.47%)	<i>T. congolense</i>	
20	Ameya District (South West Shewa)	436	3(0.7%)	<i>T. brucei</i>	[51]
			1(0.23%)	Mixed infection	
			675(9.61%)	Overall	
			513(7.3%)	<i>T. congolense</i>	
21	south-western Ethiopia	7021	122(1.7%)	<i>T. vivax</i>	[52]
			24(0.34%)	<i>T. brucei</i>	
			16(0.27%)	Mixed infection	
			101(16.9%)	Overall	
			80(13.35%)	<i>T. congolense</i>	
22	Sayonole District (Western Oromia)	599	11(1.83%)	<i>T. vivax</i>	[53]
			10(1.72%)	Mixed infection	
			70 (12.45%)	Overall	
			57(10.14%)	<i>T. congolense</i>	
23	Didessa valley (western Ethiopia)	562	9(1.6%)	<i>T. vivax</i>	[54]
			4(0.71%)	Mixed infection	
			41(13.14%)	Overall	
			35(11.22%)	<i>T. congolense</i>	
24	Seyo district (Kellem Wollega zone)	312	3(0.96)	<i>T. vivax</i>	[24,25]
			3(0.96)	Mixed infection	
			47(12.24%)	Overall	
			28(7.3%)	<i>T. congolense</i>	
25	Botor Tolay District (Jimma Zone)	384	12(3.12%)	<i>T. vivax</i>	Megersa <i>et al.</i>
			7(1.82%)	Mixed infection	

Table 3: Systematic summary of publication on prevalence of bovine trypanosomosis in Oromia Region.

vivax was the most prevalent species in Kindo Koisha district (Wolaita Zone) (Table 5) [56-68].

This region was the most tsetse fly infested area in the country, due to this reason the country had been started to eradicate tsetse fly as a project (Southern tsetse fly eradication project) covering 25,000 square kilometers 20 years ago and this project brought important change in livestock sectors of the region and now it was changed in to national

institute of trypanosomosis and tsetse fly investigation and eradication with expansion of its coverage in to 79, 000 square kilometers (mainly in Oromia, SNNPRs, Amhara, Benshamgul Gumize).

Based on this systematic review most of the studies done in this region were concentrated on prevalence of trypanosomosis and its vector density were overlooked due to this, only two studies dealt with tsetse fly density (Figure 1). This review found that *G. pallidipes* and

S. No	Study Area	Type of Trap Deployed	No of Trap deployed	Glossina spp.	Tsetse fly density F/T/D	References
1	Didesa District	Monoconical trap	40	<i>Glossina tachinoides</i>	1.27	[33]
2	Sayo District	Monoconical trap	80	<i>G. m. submorsitans</i>	0.88	[34]
				<i>G. pallidipes,</i>	0.81	
				<i>G. tachinoides and</i>	0.28	
				<i>G. fuscipes</i>	0.8	
				Overall	2.78	
3	Yayo District (Illubabor Zone)	monoconical traps	56	<i>G. m. submorsitans</i>	0.69	[35]
				<i>G. pallidipes,</i>	0.05	
				<i>G. tachinoides and</i>	1.09	
				<i>G. fuscipes</i>	0.6	
				Overall	2.44	
4	Diga and Sasiga districts (East Wollega zone)	monoconical traps	21	<i>Glossina tachinoides</i>	13.04	[55]
5	Yayo District (Illuababora Zone)	monopyramidal traps	45	<i>G. pallidipes</i>	423.7	[39]
			<i>G. f. fuscipes</i>	3.53		
6	Dale Wabera District, Kellam Wollega Zone	monopyramidal traps	20	<i>G. m. sub morsitans,</i>	1.88	[40]
				<i>G. pallidipes</i>	1.56	
				<i>G. tachnoides</i>	0.55	
				Overall	11.98	
7	Darmu district (Illubababor zone)	Monopyramidal traps	52	<i>G. m. sub Morsitans</i>	6.22	[41]
				<i>G. pallidipes</i>	2.08	
				<i>G. fuscipes</i>	0.34	
				Overall	11.77	
8	Pawi (Metekel Zone)		77	<i>G. tachnoides</i>	15.06	[14]
9	Chewaka Settlement (llubabor Zone)	mono pyramidal	56	<i>G. m. sub Morsitans</i>	0.45	[45]
				<i>G. tachnoides</i>	9.16	
				Overall	9.62	
10	(Sibu Sire) and (Guto Gida) districts (East Wollega Zone)	monoconical traps	28	<i>G. tachinoides</i>	8.57	[48]
11	Hawa-Gelan district (Wollega Zone)	biconical traps	71	<i>G. Morsitans</i>	4.42	[50]
				<i>G. pallidipes</i>	4.93	
				<i>G. fuscipes</i>	1.15	
				Overall	10.5	
12	Ameya District (South West Shewa)	monopyramidal traps	40	<i>G. pallidipes</i>	0.23	[51]
13	south-western Ethiopia	monopyramidal traps	1046	<i>G. m. submorsitans</i>	1.05	[52]
				<i>G. pallidipes,</i>	1.83	
				<i>G. tachinoides and</i>	3.65	
				<i>G. fuscipes</i>	0.49	
				Overll	7.02	
14	Sayonole District (Western Oromia)	mono pyramidal	43	<i>G. m. submorsitans</i>	0.02	[53]
				<i>G. pallidipes,</i>	3.58	
				<i>G. tachinoides and</i>	0.21	
				<i>G. fuscipes</i>	9.2	
				Overall	13.01	
15	Didessa valley (western Ethiopia)	monoconical	82	<i>Glossina Morsitans</i>	2.25	[54]
16	Seyo district (Kellem Wollega zone)	mono-pyramidal	47	<i>G. m. submorsitans</i>	1.29	[24,25]
				<i>G. pallidipes</i>	0.94	
				<i>G. tachinoides</i>	2.04	
				Overall	4.26	
17	Gimbi district (West Wollega)	mono-pyramidal	45	<i>G. m. submorsitans</i>	0.02	[35]
				<i>G. tachinoides</i>	0.41	
				Overall	0.43	
18	Botor Tolay District (Jimma Zone)		52	<i>G. morsitans,</i>	3.81	[36]
				<i>G. pallidepes</i>	3.4	
				<i>G. fuscipes</i>	3.69	
				Overall	10.9	

Table 4: Systematic summary of publication on Tsetse fly density in Oromia Region.

S. No	Study Area	Sample size	Prevalence in %	Spp of <i>Trypanosoma</i>	References
1	Dara District (Sidama Zone)	384	57 (14.8%)	Overall	[56]
			26 (45.6%)	<i>T. congolense</i>	
			18 (31.6%)	<i>T. vivax</i>	
			8 (14.0%)	<i>T. brucei</i>	
			5 (8.8%)	Mixed infection	
2	Kindo Koisha district (Wolaita Zone)	1008	152 (15%)	Overall	[16]
			43 (28.4%)	<i>T. congolense</i>	
			108 (71%)	<i>T. vivax</i>	
			1 (0.6%)	Mixed infection	
3	Arba Minch Zuria	384	68 (17.7%)	Overall	[57]
			45 (11.76%)	<i>T. congolense</i>	
			23 (5.88%)	<i>T. vivax</i>	
4	Wozeka grid (Arba Minch zuria)	461	127 (27.5%)	Overall	[58]
			78 (17%)	<i>T. congolense</i>	
			18 (4%)	<i>T. vivax</i>	
			31 (6.7%)	Mixed infection	
5	Gena-Bossa (Dawuro Zone)	384	59 (15.38%)	All type	[59]
6	Benatsemay district (South Omo zone)	217	64 (29.5%)	Overall	[60]
			43 (19.8%)	<i>T. Congolense</i>	
			21 (9.7%)	<i>T. vivax</i>	
7	Kindo Didaye District (Wolaita Zone)	120	7 (5.83%)	Overall	[61]
			4 (3.33%)	<i>T. congolense</i>	
			2 (1.67%)	<i>T. vivax</i>	
			1 (0.83%)	mixed infection	
8	Enemorena Ener Woreda (Gurage Zone)	384	20 (5.2%)	Overall	[62]
			17 (4.42%)	<i>T. congolense</i>	
			3 (0.78%)	<i>T. vivax</i>	
9	Zala Woreda (Gamo Gofa Zone)	384	10 (2.6%)	Overall	[63]
			6 (1.56%)	<i>T. congolense</i>	
			4 (1.04%)	<i>T. vivax</i>	
10	Chena district	391	27 (6.9%)	Overall	[64]
			19 (4.86%)	<i>T. congolense</i>	
			6 (1.54%)	<i>T. vivax</i>	
			2 (0.50%)	<i>T. brucei</i>	
11	Kindo –Koysha, Kindo-Didaye, Kucha, Demba-Gofa, Humbo, Damot-Woyde, Diguna Fango, Abaya and Arba Minch	1838	133 (7.2%)	Overall	[17]
			89 (4.8%)	<i>T. congolense</i>	
			44 (2.4%)	<i>T. vivax</i>	
12	Ghibe valley of Southwestern Ethiopia	411	24 (5.83%)	<i>T. congolense</i>	[65]
13	Guraferda and Sheko districts (Bench Maji Zone)	384	17 (4.4%)	Overall	[66]
			6 (1.56%)	<i>T. congolense</i>	
			3 (0.76%)	<i>T. vivax</i>	
			2 (0.52%)	<i>T. brucei</i>	
			6 (1.56%)	Mixed infection	
14	Bodi and Mursi (South Omo Zone)	409	25 (6.1%)	Overall	[67]
			14 (3.4%)	<i>T. congolense</i>	
			10 (2.4%)	<i>T. vivax</i>	
			1 (0.3%)	<i>T. brucei</i>	
15	Humbo district (Wolayta zone Southern)	246	35 (14.2%)	Overall	[68]
			23 (9.3%)	<i>T. congolense</i>	
			7 (2.8%)	<i>T. vivax</i>	
			5 (2.1%)	Mixed infection	

Table 5: Systematic summary of publication on prevalence of bovine trypanosomosis in SNNPRS.

G. fuscipes the most infested species of tsetse fly in the region [17,18]. According to the report by Arba minch trypanosomosis and tsetse fly investigation and control center; this region was the only region that *G. longipennis* is found but none of the studies were confirmed this hypothesis therefore due attention should be given on the assessment of tsetse fly species including *G. longipennis* found in the region particularly in different national parks (Table 6) [17,18].

Benshamgule Gumuze region

Studies done in this region on the prevalence of Bovine trypanosomosis might be many but from 2000-2019 GC only five published studies were found in this review. Out of 1719 samples 183 animals were positive and the overall prevalence of the region were found to be 10.6% among which in Oda Buldigilu, Bambasi woreda,

Pawe District and Dangur District *T. congolense* was highly prevalent [19-22] whereas *T. vivax* was in Mandura District [23] as shown in the Table 7.

Concerning the tsetse fly infestation of the region; five studies in different parts revealed that *G. morsitans* and *G. tachinoides* were the only species infested the region. This was not enough to conclude the overall tsetse fly density and species in the region therefore this review recommended to researchers in the area to study on the prevalence of bovine trypanosomosis and vector activity of the region at large (Table 8) [18-22].

Gambella region

This region is among highly infested area in Ethiopia and has good potential in livestock resource. From 2000-2019 only one

published paper was found in this review and the prevalence of Bovine trypanosomosis in this region indicted by one study revealed that out of 863 animal the overall prevalence is 143 (16.6%) and *T. congolense*, *T. vivax* and *T. brucei* are available among which *T. vivax* is the most prevalent species in the region [24,25]. Researchers should work more in uncovered parts of the region to know the overall prevalence of bovine trypanosomosis since the area is highly infested with tsetse fly vector (Table 9).

Discussion

As far as concerning the Tsetse fly density of this region was highly overlooked and still the same study indicated that the region was infested with *G. morsitans*, *G. pallidipes*, *G. tachinoides* and *G. fuscipes* like Oromia region. This review identified that the region was

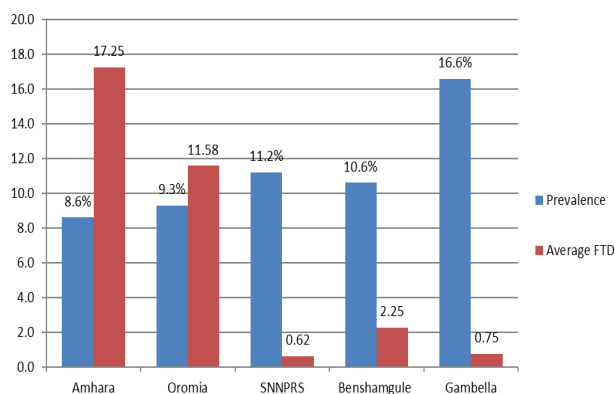


Figure 1: Comparison of prevalence of bovine trypanosomosis and its vector density among region.

S. No	Study area	Type of trap deployed	No of trap deployed	Glossina spp.	Tsetse fly density f/t/d	References
1	Kindo-Koysha, Kindo-Didaye, Kucha, Demba-Gofa, Humbo, Damot-Woyde, Diguna Fango, Abaya and Arba Minch	NGU, Biconical Trap	280	<i>G. pallidipes</i>	0.47	[17]
				<i>G. fuscipus</i>	0.08	
2	Upper Omo Belt (Southern Ethiopia)	biconical traps	10	<i>G. pallidipes</i>	0.067	[18]
				<i>G. fuscipus</i>	0.033	

Table 6: Systematic summary of publication on Tsetse fly density in SNNPRS.

S. No	Study Area	Sample size	Prevalence in %	Spp of trypanosoma	References
1	Oda Buldigilu	395	47(11.89%)	Overall	[21]
			26(55.31%)	<i>T. congolense</i>	
			18(38.29%)	<i>T. vivax</i>	
			1(1.12%)	<i>T. brucei</i>	
			2(4.28%)	Mixed infection	
2	Bambasi woreda	400	85(21.25%)	Overall	[22]
			44(11%)	<i>T. Congolense</i>	
			24(6%)	<i>T. Vivax</i>	
			10(2.5%)	<i>T. Brucei</i>	
			7(1.75%)	mixed infection	
3	Pawe District	519	29(5.58%)	Overall	[19]
			22(4.23%)	<i>T. Congolense</i>	
			7(1.25%)	<i>T. Vivax</i>	
4	Mandura District	405	22(5.43%)	Overall	[23]
			4(0.98%)	<i>T. Congolense</i>	
			18(4.44%)	<i>T. Vivax</i>	
5	Dangur District	543	46(8.5%)	Overall	[20]
			44(8.1%)	<i>T. Congolense</i>	
			2(0.4%)	<i>T. Vivax</i>	

Table 7: Systematic summary of publication on prevalence of bovine trypanosomosis in Benshangule gumuze region.

S. No	Study area	Type of trap deployed	No of trap deployed	Glossina spp.	Tsetse fly density f/t/d	References
1	Oda Buldigilu	monoconical trap	55	<i>G. morsitans submorsitans</i>	0.61	[21]
2	Bambasi woreda	monoconical traps	73	<i>G. morsitans submorsitans</i>	3.3	[22]
3	Pawe District	Monopyramidal, monoconical, biconical, and engu traps	52	<i>G. tachnoides</i>	5.03	[19]
4	Mandura District	mono-pyramidal, bi-conical, mono-conical and NGU	57	<i>G. tachnoides</i>	0.06	[23]
5	Dangur District	Mono-pyramidal trap	78	<i>G. tachnoides</i>	2.43	[20]
				<i>G. morsitans</i>	0.95	
				Overall	3.38	

Table 8: Systematic summary of publication on Tsetse fly density in Benshamgule gumuze region.

S. No	Study area	Sample	Prevalence in %	Species of tryps	References
1	Gambela and Abobo districts	862	143(16.6%)	Overall	[24,25]
			36(4.2%)	<i>T. congolense</i>	
			94(10.9%)	<i>T. vivax</i>	
			4(0.46%)	<i>T. brucei</i>	
			10(1.04%)	Mixed infection	

Table 9: Systematic summary of publication on prevalence of bovine trypanosomosis in Gambella region.

S. No	Study area	Type of trap deployed	No of trap deployed	Glossina spp.	Tsetse fly density f/t/d	References
1	Gambela and Abobo districts	mono-pyramidal trap	145	<i>G. m. submorsitans</i>	-	[24,25]
				<i>G. pallidipes</i>	-	
				<i>G. fuscipes fuscipes</i>	-	
				<i>G. tachnoides</i>	-	
				Overall	0.75	

Table 10: Systematic summary of publication on Tsetse fly density in Gambella region.

overlooked as the disease impose serious challenges on the productivity of livestock in the region, due emphases should be made on the control of the disease and suppression of tsetse fly density in the area. The National Institute of trypanosomosis and Tsetse Fly Investigation and Control should target on alleviation of this problem in the region. Beside that other responsible authority of the region and researchers should work in this regard (Table 10) [24,25].

Conclusion

Out of nine region of the country, this review found more than 60 published papers which are entirely concentrated in five regions of Ethiopia namely Amhara, Oromia, SNNPRs, Benshamgul Gumize and Gambella and the overall prevalence shows no variation among region but only in Gambella there is a significant difference among the other regions. Therefore, a lot of efforts need to be in place to combat the most important constraint of the livestock sector in Ethiopia.

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