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Prevalence of Bovine Trypanosomosis and Farmers' Perception of the Disease and Its Management in Guangua and Dangila Districts

Dereje Ayenalem[1] Tesfa Mossie[2]*
1.Addis Ababa University, College of Veterinary Medicine and Agriculture, Addis Ababa, Ethiopia
2.Researcher at Ethiopian Institute of Agriculture Research, Jima, Ethiopia

Abstract
This study was carried out from November 2013 to April 2014 to assess farmers' perception on the presence, management and the need of intervention programs of bovine trypanosomosis and tsetse fly through a semi-structured questionnaire survey as well as to determine the prevalence of bovine trypanosomosis using a cross-sectional study in Guangua and Dangila Woredas, Northwestern Ethiopia. Blood sample for thin blood smear examination was collected from 384 cattle of all age groups and both sexes. Of the 384 animals examined three animals were found positive for trypanosomosis, overall prevalence of 0.8%. The species of trypanosome identified were two *T. vivax* and one *T. conglonse*. The most important livestock constraints considered by farmers in the selected districts were disease (81.2%), improper grazing land management (12.1%) and feed shortage (6.7%). Trypanosomosis was considered the most economically important disease problem for 95% of the respondents. Of these, 73.3 % of them assumed trypanosomosis as a problem of cattle, equines and small ruminants. Forty percent positive respondents in Dangila and 60% in Guangua appreciated the presence of the problem and the difference between the two groups is statistically significant (P=0.012). Trypanocidal drugs remain the principal method of animal trypanosomosis control. Overall preventive or curative treatments were administered in 40% of the cases by animal health assistant, while for the remaining 60 % was done by farmers themselves. Almost all farmers (100%) did not know the causal association between biting flies and trypanosomosis. As higher proportion of trypanocidal drugs were administered by livestock keepers there may be a development of drug resistance due to misuse of these drugs. Despite the low prevalence detected the study revealed the occurrence of *T. vivax* and *T. congolense*. In the study area trypanosomosis is considered as the most important livestock health problem by the majority of the farmers. Therefore, further study is needed on the prevalence of the disease in wet season using more sensitive diagnostic techniques to correlate the difference between the prevalence and the respondents' perception of bovine trypanosomosis.
Keywords: Selected districts, Prevalence, Farmers' perception, Trypanosomosis, Bovine

1. INTRODUCTION

Tsetse-transmitted trypanosomosis is one of the most ubiquitous and important constraints to agricultural development in the sub-humid and humid zones of Africa. Trypanosomosis has direct impacts on livestock productivity, livestock management and human settlement; through those direct impacts, the disease has indirect impacts on crop agriculture and human welfare (Swallow, 1999). It is responsible for the death of 3 million heads of cattle yearly, with 50 million animals at risk in sub-Saharan Africa (Simbarashe *et al*., 2011). The annual estimated direct and indirect losses due to the disease run into billions of dollars (Mattioli *et al.,* 2004).

Trypanosomosis can be transmitted cyclically by the tsetse flies or mechanically by other biting flies resulting in sub acute, acute or chronic disease characterized by intermittent fever, anemia, occasionally diarrhea, rapid loss of body condition and often terminates in death. (Mare, 1998). Tsetse flies inhabit many parts of the continent that extend about 15°N and 20°S of the equator (Donelson, 2003;Urquhart *et al*., 1992). Ethiopia is situated at the East end of the African tsetse belt. In Ethiopia, tsetse flies are confined to southwestern and northwestern regions between longitude 33°and 38°E and latitude 5°and 12°N an area covers 220000 km² (NTTICC, 2004).

The presence of animal trypanosomosis is a major constraint to the introduction of highly productive exotic dairy animals and draught oxen to lowland settlement and resettlement areas for the utilization of large land resources (Getachew, 2005; Cherenet *et al*., 2006). Since more than 90 percent of crop production in Ethiopia is dependent on animal draught power mainly on ploughing oxen, many large fields lie fallow due to a lack of these animals in trypanosomosis infested area, which worsens the food supply and living conditions in affected areas (MoARD, 2007).

The host range of trypanosomosis includes domestic and wild animals as well as human beings. The vector includes several species of tsetse flies and biting flies. Tsetse flies are grouped in the three categories: *Glossina morsitans* group (savanna areas), *Glossina fusca* group (forest areas) and *Glossina palpalis* group (river and lake areas). There are five species of Glossina in Ethiopia: *G. pallidipes, G. morsitans submorsitans, G. fuscipes, G. tachinoides and G. logipennis* (Shimelis, 2005).

The most important *Trypanosoma* species affecting cattle in Ethiopia are *Trypanosoma congolense*, *Trypanosoma vivax* and *Trypanosoma brucei* in cattle, sheep and goats. Camels are affected by *Trypansosoma evansi* which is common species in camel rearing areas of the country while equines mainly horses are affected by *Tryranosoma equiperdum* in some highland parts of the country (Abebe, 2005).

Approaches to developing better control methods of can be exercised at several levels, including eradication of tsetse flies and use of prophylactic drugs against trypanosomosis. Tsetse flies can be partially controlled by frequent spraying and dipping of animals, aerial and ground spraying of insecticides on fly-breeding areas, use of insecticide-impregnated screens and targets, bush clearing, and other methods. The Sterile Insect Technique (SIT) has been used with success in Zanzibar and is expected to be used in other area-wide control operations after suppression of tsetse populations by insecticides. There is renewed international interest in large-scale tsetse eradication through the Pan African Tsetse and Trypanosomosis Eradication Campaign (PATTEC) supported by the African Union. Animals can be given drugs prophylactically in areas with a high population of trypanosome-infected tsetse. Drug resistance must be carefully monitored by frequent blood examinations for trypanosomes in treated animals (Holmes, 1998). Better diagnosis of the disease would help researchers define the disease problem more precisely and enable control workers to monitor the effects of implementing various control programs more effectively. Improved diagnostic techniques are needed to detect trypanosomes in the tsetse fly as well as in the mammalian host (http://www.ilri.org/InfoServ/Webpub/fulldocs/ilrad89/Trypano.htm#TopOfPage).

Tsetse and trypanosomosis control and eradication would benefit to promote human and livestock health, diversified agricultural systems, food production and security, and livelihood of the community and utilization of available natural resources (PATTEC, 2000; Maudlin, 2004)). For the success of trypanosomosis and tsetse flies control strategies greater involvement of farmers and communities in decision making, program designing, program implementing, program evaluating and creating awareness are crucial (Dransfield and Brightwell, 2004; Sindato, 2008). Understanding of farmers' knowledge and perceptions on the impacts of trypanosomosis and tsetse fly and their participation in developing intervention strategies are prerequisites for effective implementation of such control programs (Machila, 2003). Following successful control or eradication, re-invasion must be controlled in order to sustain livelihoods.

Due to the privatization of veterinary services in most parts of Africa, farmers have easy access to these trypanocides and this has resulted in rampant misuse and under-dosage of the medications, actions which have been blamed for the emergence of trypanocidal drug resistance (Geerts *et al*., 2002; Connor *et al.,* 20005).

Therefore, the objectives of this study were:

- To estimate the prevalence of bovine trypanosomosis in selected areas of Awi zone (Guangua and Dangila Woreda) using thin blood film
- To assess farmers' perception of the disease in the study area
- To assess management practices against trypanosomosis in the study area

2. MATERIAL AND METHODS

2.1. Study area and animals

The study was conducted in Guangua and Dangila district of Awi zone in Amhara regional state located 485 and 502kms Northwest of Addis Ababa, Ethiopia respectively. Guangua woreda has a longitude and latitude of 10.950°N 36.500°E with an elevation of ranging from 1583 to 1710 meters above sea level and its temperature ranges from 22 to 31c^{o} with annual rainfall of 1300-1800mm whereas Dangila woreda is located in longitude and latitude of 11.267°N 36.833°E with an elevation of 1809-2137 meters above sea level. Dangila woreda has a temperature ranges from 14c^{o} to 31c^{o} and the minimum and maximum annual rainfall of it is 1500 and 2200mm respectively.

The study was carried out on 384 cattles of all age groups of both sexes that are kept under extensive management system. Animals were classified as young (below 3 years) and adults (> 3 years) according to the classification used by Bitew (2011).

2.2. Study design

The study design was based on cross sectional study on the prevalence of trypanosomosis and questionnaire surveys to assess the perception of farmers and their management practices, which were carried out from November 2013 to April 2014.

2.2.1. Cross-sectional study

A cross-sectional study design was used to determine the prevalence of bovine trypanosomosis and to identify the *Trypanosoma* species. Five Kebeles from each Woreda was selected based on accessibility and history of trypanosomosis. Then two villages were selected randomly from the list of villages in each Kebele. From each village, cattle owning farmers/households were again selected randomly in such a way that 20 animals are sampled from each kebele to fulfill the desired sample size. The sample size was determined following the

formula given by Thrusfield (2005), $N= 1.96^2[Pexp-(1-Pexp)]/d^2$, where N is the required sample size, Pexp was the expected prevalence and d is the desired absolute precision. An expected prevalence of 50% was used to increase the degree of precision and considering a 5% absolute precision and at 95% confidence level gave us 384 sample sizes.

2.2.2. Questionnaire survey

A semi-structured questionnaire survey was employed to generate information on the knowledge and attitude of farmers on the presence impact and management of bovine trypanosomosis. The sample size of participants was determined using the formula ($n = 0.25/SE^2$) given by Arsham (2002) at the standard error (SE) of 0.05 with 95% confidence interval. Therefore, the total sample size was 100 respondents, distributed across the ten selected Kebeles (peasant association), were interviewed in the study areas.

2.3. Blood sampling techniques

A drop of blood was obtained on one end of a clean microscope slide by puncturing the marginal ear vein with a lancet\needle after cleaning the site with alcohol. Then blood was spreaded by using another clean slide at an angle of 45°. The smear was air dried and then fixed for three minutes in methyl alcohol; air dried again and stored in a slide box until staining. The thin smear was flooded with Giemsa's stain (1:10 solution) for 30 minutes, then washed, and dried. The slide was examined under the microscope using oil immersion objective lens for the presence of trypanosome parasites (OIE, 2008).

2.4. Data analysis

Microsoft Excel spread sheet program was used to manage the raw data. SPSS version20 statistical analysis tools were used to analyze and interpret the data. Descriptive statistics (frequency, percentage and chi - square test,) was used to analyze the qualitative data.

3. RESULTS

3.1. Prevalence of bovine trypanosomosis

Of 384 animals examined using thin blood smear, only three animals were found positive for trypanosomosis showing an overall prevalence of 0.8% where 2 were due to *T.vivax* and 1 was caused by *T.conglonse* (Table1).

Table 1: Prevalence of bovine trypanosomosis.

Area	Total sampled	positive	*T.vivax*	*T.conglonse*	prevalence	x^2	p-value
Dangila	1		-	1	0.3%	0.19	0.66
Guangua	2		2	-	0.5%		
Total	3		2	1	0.8%		

3.2. Farmers' perception of the problem of livestock trypanosomosis

3.2.1. Constraints associated with livestock production

Respondents reported different livestock constraints that hinder the success of livestock production. Diseases (81.2%), shortage of feed (6.7%) grazing land problem (12.1%) were most frequently reported constraints of livestock production in the study districts.

3.2.2. Respondents' knowledge of trypanosomosis

As indicated in Table 2 trypanosomosis was considered the most economically important disease problem for 95% of the household respondents. Of these,73.3 % of them assumed trypanosomosis as a problem of cattle, equines and small ruminants whereas the rest believed that it affects only cattle. Similarly, 40% positive respondents in Dangila and 60% of them in Guangua appreciated the presence of the problem (locally called "Gendi) and the difference between the two groups is statistically significant (P=0.012).

Table 2: Livestock diseases listed by respondents

Disease	Dangila		Guangua		Total	
	n	(%)	n	(%)	n	(%)
Trypanosomosis	36	90.0	60	100.0	96	95
LSD	36	90.0	43	71.7	79	80.9
Fasciolosis	25	62.5	22	36.7	47	49.6
Babesiosis	3	7.5	21	35.0	24	21.3
Pasteurellosis	7	17.5	14	23.0	21	20.4
Ectoparasites	12	30.0	-	-	12	15
FMD	1	2.5	-	-	1	1.3
Mastitis	-	-	14	23.3	14	11.7
CBPP	-	-	3	5.0	3	2.5
Blackleg	-	-	3	5.0	3	2.5

Key informants and significant number of household respondents (40.9%) said that the status of trypanosomosis now a day is getting better gradually. In contrast to this, 39.6% and 17.1% of the respondents said that the disease was expanding and getting worse respectively. The difference between the responses is statistically significant (P=0.00).

Table 3: Respondents' perception on the status/trends of trypanosomosis in the area

Status of disease	Dangila		Guangua		Total	
	n	(%)	N	(%)	n	(%)
Getting better	10	25.0	34	56.7	45	40.9
Getting worse	3	7.5	16	26.7	19	17.1
Expanding	27	67.5	7	11.7	34	39.6
No change	-	-	1	1.7	1	0.9
I don't know	-	-	2	3.3	2	1.7

3.2.3. Respondents' description of signs of bovine trypanosomosis

Livestock owners' reported to have noticed different clinical signs of trypanosomosis that could be easily identified through visual observation. Though, the level of precision depends on the experience or knowledge of the livestock keepers, among the observed signs of bovine trypanosomosis, emaciation and death are the most frequent signs observed at Dangila where as emaciation, death, rough hair coat and diarrhea are the most frequently reported signs of trypanosomosis in Guangua woreda (Table 4).

Table 4: Farmers' description of signs of bovine trypanosomosis

Signs	Dangila		Guangua		Total	
	n	%	n	%	n	%
Emaciation	36	90.0	59	98.3	95	94.2
Death	30	75.0	24	40.0	54	57.5
Rough hair coat	12	30.0	29	48.3	41	39.2
Diarrhea	5	12.5	35	58.3	40	35.4
Lacrimation	14	35.0	4	6.7	18	20.9
Constipation	8	20.0	9	15	17	17.5
Depression	7	17.5	5	8.3	12	12.9
Loss of milk	5	12.5	13	21.7	18	17.1
Anemia	1	2.5	8	13.3	9	7.9
Inappetence	-	-	4	6	4	3

(In table 2, 3, 4 'n'= number of respondents)

3.3. Management practices of bovine trypanosomosis

Chemoprophylaxis/chemotrapy was the most commonly employed management practice against trypanosomosis by the farmers in the study areas. Overall preventive or curative treatments were administered in 40% of the cases by animal health personnel, while for the remaining 60 %, by family members or other people (Figure1). From 100 respondents fifty one (51%) and forty nine (49%) of them have been used the available trypanocidal drugs to none clinical cases (as prophylactic) and treatment of affected animals respectively and the difference between the groups is statistically significant (P=0.003).

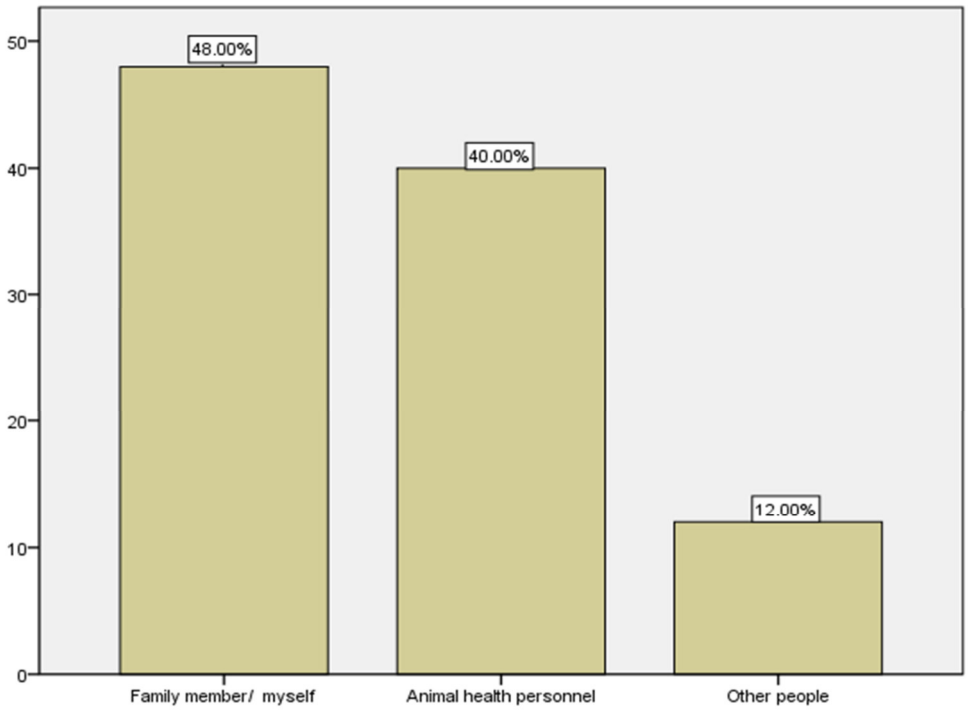

Figure 1: Personnels involved in trypanocidal drug administration

Farmers mentioned that some of the commonly used drugs were become less effective over time. Indeed, 5.8% % of the respondents claimed that trypanocidal efficacy has fallen. Some of the reasons raised by respondents about the ineffectiveness of the drugs were formation of resistance, under or over dosage and dilution problem of the drugs.

Among those responded to have used trypanocides, most indicated Diminazine aceturate (58.7%) and Isomethamedium chloride (Veridium) (42.3%) as the most common drugs used in the study districts. Based on the information acquired from the respondents' Diminazine (67.5%) was maximally used in Dangila woreda, whereas Isomethamedium (50%) was in Guangua woreda which are statically different (p=0.083). These drugs have been mainly sourced from public veterinary clinics and private veterinary drug stores. In this aspect, drug store is the main drug source in both Guangua and Dangila district for 51.7% and 70% respondents respectively that is statistically insignificant (p=0.068).

Almost 100% of the respondents did not involve in the control of biting flies except treating animals with trypanocidal drugs in the study areas. All the interviewed farmers lack knowledge on the transmission of the disease (they did not know the vectors). Based on the information obtained from the respondents animals were treated at different frequencies ranging from one to five times per year (figure 2). Because of the presumed economic burden of the disease, farmers expressed their strong interest and support for the establishment of intervention program in their area.

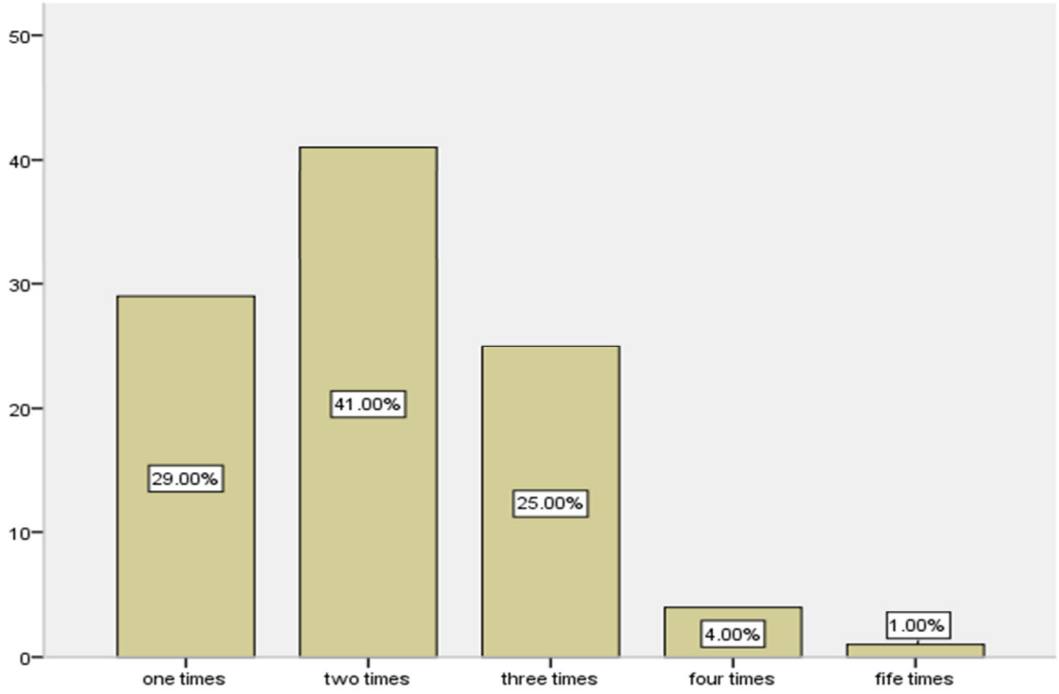

Figure 2: Treatment frequencies per year in the study area

4. DISCUSSION

4.1. Prevalence of trypanosomosis

This study revealed a very low prevalence of bovine trypanosomosis in the study areas. Of 384 sampled animals only three of them were positive that is two *T. vivax* (0.5%) in Guangua and one *T.congolense* (0.3%) in Dangila woreda which were detected in animals that are moved place to place in serearch of feed and during working time in summer season (June to December), otherwise all samples taken from settled animals were negative. This observation agrees with that of Ogunsanmi (1995) indicated that sedentary management of cattle is associated with a reduced Trypanosome infection rate compared to semi sedentary management in Nigeria, MacLennan (983) observed that the innate resistance of cattle was increased by repeated exposure to the same population of Trypanosomes in a given area, Ayana *et al.*(2012) and Abebayehu *et al.* (2011) who reported the overall prevalence of trypanosomosis was 2.1% and 2.66% in mecha woreda of west Gojam zone and Western Tigray, Northern Ethiopia respectively and Tadesse and Tsegaye (2010) showed that 4.4% prevalence at Guraferda and Sheko district of Benchi maji zone south west Ethiopia and 4.2% was also recorded in South Achefer district in Amhara regional state by Denbarga *et al*. (2012). The low prevalence as opposed to some other reports showing higher values may be ascribed to the time of sampling (dry season in our case), and other ecological changes as well as the frequency of trypanocidal drug use that might exist in our study area.

The prevalence rates in these studies were considered to be low when compared with earlier reports from other parts of Ethiopia. Tadegegn (2012) reported 9.98% prevalence in Genji district, western Ethiopia, 10.1% Nigatu and Abebe (2009), in Awi zone and 12.42% from Awi and Metekel zone Northwest Ethiopia. The density of fly population is another determinant factor for occurrence of trypanosomosis, where fly population increases after the short and long rainy seasons, this lies from April to June and September to November. However, this study was conducted from November to April which is in the dry periods, hence lower fly population and consequently lower prevalence of trypanosomosis. In support of this, Sinshaw *et al.* (2006) revealed that reproduction and development of biting flies is best suited to the climatic conditions prevalent during the heavy rainy seasons and high human activity (an increase in agricultural investment) and deforestation also contributed to lower prevalence of bovine trypanosomosis in the current study. When vegetation is cleared, changes occur in the microclimate that may cause the density of forest tsetse species concerned to disappear and treatment of affected animals the method aims first at limiting losses caused by the disease, and second at eliminating trypanosome reservoirs which can be considered to be both a curative and a prophylactic procedure (Finelle1983). In addition, the technique used in detection of Trypanosomes was thin blood smear which is very less sensitive in low parasitemic cases leading to false negative (during the chronic phase the sensitivity is low as, due to the immune response of the host, parasites are scanty and rarely seen in the blood and the sensitivity is almost nil in healthy carriers, where parasites are never seen (OIE, 2013).

4.2. Farmers perception and management practices

The results of questionnaire survey indicated that diseases resulting in high mortality and morbidity were highly prevalent in both districts and considered as the most important constraints associated with livestock production. Among the reported diseases trypanosomososis holds the major constraints to cattle production and impediment for agricultural development in the study areas. In agreement with the findings of Shimelis (2004**),** most livestock keepers in both study woredas reported that they are familiar with bovine trypanosomosis (locally called "Gendi). This is also in agreement with reports of Zewdu (2012), at Gimbo and Guraferda, Ephrem (2012) in East and West Gojam, North western Ethiopia, Mungube *et al*. (2012) in village cattle of south-east Mali who showed the ranking of trypanosomosis as major obstacle to cattle as claimed by a majority of livestock keepers. Moreover, Soudre (2013) showed the ranking of trypanosomosis came once more on the top for the majority of respondents in southwest and the western region of Burkina Faso. In Afework *et al.* (2000) and Tewelde *et al*. (2004) that study farmers strongly recognized trypanosomosis as primary problem for livestock productivity and agricultural development in the Northwestern and Western part of Ethiopia respectively; Shimelis (2005) also revealed that trypanosomosis was the most important problem for agricultural activities and animal production in the Abay Basin areas of Northwest, Ethiopia settled since the 1960s. However, in Kenya, (Machila *et al*., 2003) reported that trypanosomosis was considered to be an important cattle disease problem by only a minority of farmers in the study (11.3%).

Livestock owners' noticed that different clinical signs of trypanosomosis that could be easily identified through visual observation which may be either largely consistent with standard veterinary text or not and are important for diagnosis correctly when the consistent signs are detected. A similar finding was reported by Machila *et al*. (2003) in Kenya. Though, the level of precision depends on the experience of the livestock keepers, most farmers could determine clinical signs suggestive of bovine trypanosomosis that are commonly described for the disease (Maudlin, 2004; Radostits, 2007). Among the observed signs of bovine trypanosomosis are progressive emaciation ,death, rough hair coat and diarrhea were the most frequently reported clinical signs of trypanosomosis by livestock keepers in the study areas. These signs are also some of the common signs listed by other researchers such Machila *et al*., (2003), Zewdu, (2012) and Shimelis (2005).

Chemoprophylaxis/chemotrapy was used by the farmers against trypanosomosis in the study areas. Similarly, Soudre *et al.* (2013), reported trypanosomosis was mainly controlled directly by trypanocidal drugs by a majority of the farmers interviewed in Burkina Faso. The most commonly used trypanocidal drugs in the study areas to farmers were Diminazine aceturate and Isomethamedium chloride and no use of traditional treatment and other management practices for controlling and prevention of trypanosomosis was reported. This observation agrees with the report of Dereje (2012), at Kellem Wellega zone, Diminazine aceturate (70%) and Isomethamedium (10%) and both drugs (30%) were mostly used drugs. However, Dereje (2012) indicated that 20% of farmers were using traditional methods of treatment and management against trypanosomosis in that area. Most of the drugs used by farmers sourced from veterinary clinic and drug stores. Although the origin of the drugs may vary, none of the respondents reported to have obtained them from illegal or open market sources in the study areas. The observation agrees with the report of Ephrem (2012) and Dereje (2012) except that Ephrem and Dereje reported respectively illegal/open market source of trypanocidal drugs being 46.6% and 3.8% response. Tilahun *et al.* (2012) also reported that about 35% of the respondents have shown that they were using different types of trypanocidal drugs buying them from illegal traders on market days from Southwest Oromia, Ethiopia.

Majority of respondents practice trypanocidal drug administration by self, family member or other people than by animal health personnel. This supports the findings of Machila *et al.* (2003), in Kenya where 66.3% of the cattle treatments were administered by animal owners or fellow farmers. Similarly, Ephrem (2012) also reported that 47% of respondents treat their animals by family member. This suggests that unless the farmers are trained or educated on the handling and utilization of these drugs, there will be risk of development of drug resistance due to drug management problems.

Although majority of the respondents ascertained that treatment response was good, such judgements only indicate clinical cure of the animal and it does not show the total clearance of the parasite from the body. In agreement with the report of Soudre (2012) Farmers mentioned that some of the commonly used drugs became less effective over time. Treatment by non-trained personnel might predispose to underdosabe, overdilution, inappropriate handling and storage and unnecessarily high frequency of treatment due to misdiagnosis all leading to development of drug resistance.

Almost 100% of the respondents did not involve in the control of biting flies except treating animals with trypanocidal drugs in the study areas. All the interviewed farmers lack knowledge on the transmission of the disease (they did not know the vectors). However, in the report of Zewdu (2012), significantly higher numbers of respondents in Baro-Akobo and Gojeb river basins are aware of the causal association between biting flies and bovine trypanosomosis but not considered as the etiological factor, Mugunieri (2003) also reported that from the data collected, 91 % of the farmer's correctly linked the associations between tsetse fly

and trypanosomosis and even they exactly described the likely habitant of the vectors and Tilahun *et al*. (2012) showed that 47% of the respondents were aware of tsetse flies as transmitters of animal trypanosomosis.

Due to the long history of trypanosomosis in the study areas most of the farmers still used trypanocidal drugs excessively by their own which have been mainly sourced from drug stores. This may lead to development of drug resistance. In accordance with that of Mugunieri (2003) the results of the survey suggest the presence of resistance to trypanocidal drugs in Kwale district of Kenya and in Burnkina Faso Bauer *et al*. (1999) showed that the occurrence of resistance to trypanocidal drugs may be due to their prolonged use in an area

5. CONCLUSSION AND RECOMMENDATIONS

The current study showed lower (0.8%) prevalence of bovine trypanosomosis in that area and revealed that livestock keepers are familiar with bovine trypanosomosis. The vectors involved in trypanosomosis transmission are unknown by the majority of farmers in the study areas. Use of trypanocidal drugs as prophylactic and treatment of affected animals were the only ways of managing/combating bovine trypanosomosis in the study districts. The current study also indicated the personnel involved in drug administration where higher proportion of trypanocidal drugs were mainly given by farmers (60.0%) followed by animal health assistant (40.0%). Since *T. congolense* and *T. vivax* infections are detected, the potential impact on production and productivity of cattle shall not be underestimated, control efforts in the study area should target both cyclically and mechanically transmitted trypanosome infections.

Based on the above conclusion the following points are recommended:

- ✓ Despite the low prevalence detected in this study, most farmers ranked first the problem of trypanosomosis. Therefore, further study is needed on the prevalence of the disease in wet season using more sensitive diagnostic techniques
- ✓ Majority of the respondents ascertained that they treat their animals by their own or nonprofessional people. Therefore:
    - The trypanocidal handling practices of the farmers should be studied in detail
    - Trypanocidal drug efficacy test should be undertaken in the area
- ✓ Awareness creation about the causal association between vectors and trypanosomosis and control methods as well as the risk of trypanocidal drug resistance is required in the area.

Although, low prevalence of bovine trypanosomosis was confirmed in the study area, the potential impact of *T. vivax* infection on production and productivity of cattle shall not be underestimated and serious attention and further application of effective control strategies is warranted.

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