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Assessment of Economic Impacts Against Bovine Trypanosomosis in Selected Tsetse Infested Districts of Western Amhara Region, Northwest, Ethiopia

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Abstract: A cross sectional study was conducted in Dembecha and Jabitehenan districts of Western Amhara region. Questionnaire surveys were administered randomly to 278 farmers during study period on purposively selected five kebeles of two districts to collect information on the impact of animal trypanosomosis. The economic impact of bovine trypanosomosis from farmer's perspective was determined by estimation of the direct (visible) production losses such as milk loss, mortality loss and draft power loss and indirect impacts like control costs (e.g. treatment expenditure) per affected herd using economic model. Households were selected by using simple random sampling as final sampling units.The average household cattle herd size in Dembecha district (6 heads of cattle per herd) was lower than Jabitehenan district (7 heads of cattle per herd). Oxen represented the highest percentage of the herd in both district. Almost all herds in two districts were managed under extensive farming system. The overall average economic loss due to mortality per household per year associated with bovine trypanosomosis was estimated to be 2905.4 ETB.The highest averages economic loss at household level was due to mortality which was, followed by the losses resulting from draft power which was on an average loss accounted to be 1132 ETB. The third largest losses were due to milk production loss which represented 410.17 ETB as average total economic loss per household in affecting milking cow.The overall average treatment expenditures cost per household was 283.5 ETB which was the least contributor to herd level losses. The average total economic loss associated with bovine trypanosomosis at herd level was estimated to be 4731.16 ETB.

Key words: District · Economic · Herd · Impact · Loss · Trypanosomosis

INTRODUCTION

Ethiopia is believed to have the largest number of livestock population in African countries with estimation of 53.99 million cattle, 24.06 million goats, 25.49 million sheep, 0.35 million mules, 1.91 million horses, 6.75 million donkeys and 0.92 million camels [1]. In Ethiopia, livestock is an important economic sector as it contributes 35.6% to the agricultural Gross Domestic Product, equivalent to 16.5% of the national GDP [2]. A-round 12% of annual foreign exchange earnings amounts were a contribution of livestock [3]. It also provide for farmers household income through sale of animals or sale and consumption of animal products. Livestock are form of savings and insurance for the poor as sale of animals provide immediate cash to deal with significant or unexpected expenditures such as school or medical fees [4].

The disease is one of the major productivity constraints of the livestock industry in many tropical countries in Africa and Asia [5]. It directly impacts the milk and meat productivity of animals, reduce the birth date and increase the abortion rates as well as mortality rate these affect the herd size and hared composition [6]. The aggregated annual economic loss from animal diseases through direct mortality and reduced productive and reproductive performance in Ethiopia is estimated to be US$ 150 million [7].

Trypanosomosis is the main constraint among well-known animal diseases to the cattle production in Africa as it causes a serious and often fatal disease of livestock mainly in rural poor community and rightfully considered as a root cause of poverty in the continent [4]. Trypanosomosis is a complex disease caused by unicellular several species of protozoan (trypanosomes)

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parasites found in the blood and other tissues of vertebrates including livestock, wild life and people. Bovine trypanosome is one of the diseases that are caused by this flagellated protozoal parasite belonging to the genus trypanosome. The most important trypanosome species affecting livestock in Ethiopia are *Trypanosoma congolense, Trypanosoma vivax* and *Trypanosoma brucei* in cattle, sheep and goats, *Trypanosoma evansi* in camels and *Trypanosoma equiperdum* in horses [8, 9]. The disease is mainly transmitted cyclically by several species of blood sucking flies of the genus *Glossina*, commonly known as tsetse flies and mechanically by several biting flies (*Tabanids*, *Stomoxyes*, etc.) except *Trypanosoma equiperdum* which follows sexual means of transmission through coitus among equine species in its endemic area [10].

Tsetse flies are largely responsible for an uneven distribution of cattle in Africa, leading to over grazing and severe environmental degradation in some areas and preventing the introduction of productive farming and livestock systems in other areas. Tsetse and trypanosomosis are problems that are closely linked with rural poverty, thus, tsetse fly is frequently referred to as the "poverty insect" [11]. The economic impacts of African animal trypanosomosis involve decreased livestock productivity (meat and milk yield), birth rates and ability to work as traction animals and increases abortion as well as mortality [12]. It is also responsible for an annual loss of millions of dollars in livestock production as a result of the cost related to treatment, prevention and vector control efforts [13] and death of animals [14]. In Africa, about 3 million cattle die each year due to bovine trypanosomosis and approximately 35 million doses of trypanocidal drugs are being administered every year to enable livestock to survive in tsetse-infested areas [15, 16]. A total of US$ 35 million is spent per annum for the treatment of the disease [17]. The direct losses due to trypanosomosis is estimated to be between US$ 1-1.2 billion each year. The total losses for the total tsetse-infested lands in terms of agricultural GDP are US$ 4.75 billion per year [18].

In many province of Ethiopia, bovine trypanosomosis locally referred as "Ghendi" is one of the most important disease limiting livestock productivity and agricultural development due to its high prevalence in the most arable and fertile land of South-west and North-west part of the country following the greater river basins of Abay, Omo, Ghibe and Baro with a high potential for agricultural development. More than 90% of crop productions in the country are dependent on animal draught power mainly on ploughing oxen. Many large fields lie fallow due to lack of these animals in trypanosomosis infested area which worsen the food supply and living conditions in affected areas. It is estimated that about 38% of the national cattle herd affected or at risk of trypanosomosis infection [19].

More than 20,000 heads die per annum; and annual loss attributed to the diseases is estimated to be over US$ 236 million, whereas loss due to reduce meat, milk and draft power is not applicable to this figure [20].

Tsetse transmitted trypanosomosis is becoming a serious threat for livestock production and agricultural activity in western part of Amhara Regional State bordering the Abbay river. This area is one of the North Western tsetse belt areas of Ethiopia [21]. In districts bordering the Abbay river basin, the problem was prominent where both cyclically and mechanically transmitted trypanosomosis were reported. Particularly, Dembecha and Jabitehenan, districts of west Gojjam zone are such districts where there are serious complaints of the disease. In these two districts, Dagnachew revealed on the previous studies with 20% total prevalence of trypanosomosis [22].

Although there have been few reports on the prevalence of this disease in these districts, there has no or very limited work carried out to estimate the economic impacts against bovine trypanosomosis. The current study at hand was planned and carried out to fill such gap in western Amhara region particularly in west Gojjam to estimate the economic impacts of bovine trypanosomosis. This study enhance our understanding for further designing and implementation of appropriate control strategies to improve the production and productivity of livestock in our country and generate interest in investing in this area. It is also essential to provide producers, policy makers and development partners to all other stakeholders in livestock sector with the objective assessment of economic situation of parasitic diseases, mainly African animal trypanosomosis. In addition, the findings of the research will serve as benchmarks for further studies in the area.

Therefore, the objective of this study was to assess the economic impacts of bovine trypanosomosis in selected districts of Western Amhara region.

MATERIALS AND METHODS

Study Area Description: The present study was carried out in five kebeles of Dembecha and Jabitehenan districts of west Gojjam administrative zone of Amhara regional state, northwest Ethiopia located about 380 Km northwest of Addis Ababa and 220 Km southeast of Bahirdar the

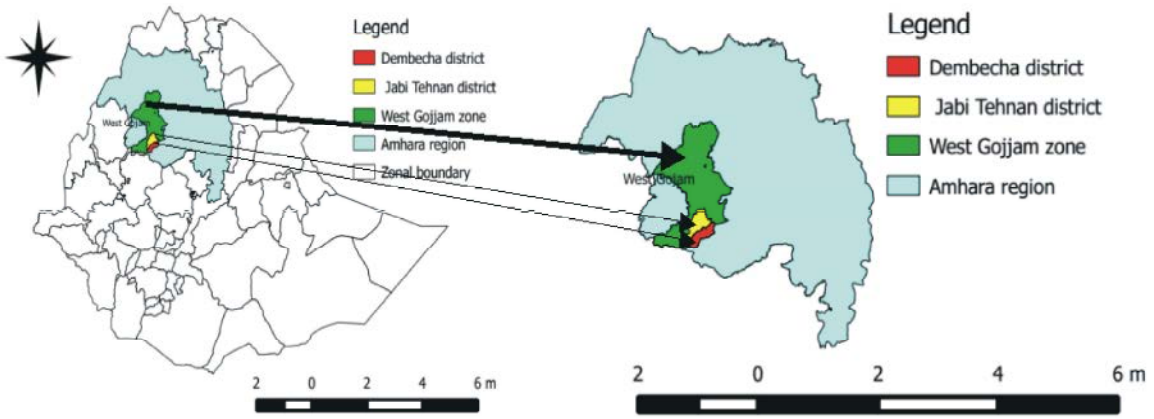

Fig. 1: Map of Ethiopia showing Amhara regional state, the study zone and districts

capital city of Amhara region. The zone is found at 37°29' East longitude and 10°30' North latitude. The climate of the area alternates with long summer rainfall between June-September and winter dry season between December-March with mean annual rain fall of 1200-1600 mm. The mean temperature is between 10-20°C and the altitude of each district; 1100-1500 m.a.s.l for Jabitehenan and 1400-2300 m.a.s.l for Dembecha [1].

Study Population: The study was carried out on local zebu cattle above one year of age, which are usually kept under traditional extensive husbandry management system with communal herding were selected to determine the impact of trypanosomosis in cattle.

Study Design: The study design was based on cross sectional study including questionnaire survey that was carried out from February 2017 to January 2018. Questionnaire survey was employed to generate information on economic impact of bovine trypanosomosis.

Sampling Technique: Purposive sampling procedure was applied to select two districts (Dembecha and Jabitehenan) and five kebeles from tsetse infested areas of Amhara National Regional state to represent trypanosomosis of western Amhara region. Selections of districts and kebeles were made in consultation with regional laboratory and zonal livestock health experts respectively based on trypanosomosis occurrence records from the year preceding the start of the study. Villages were selected based on their accessibility from each kebeles. The study villages were geographically representative to the rest of the villages in the study districts. Households were selected by using simple random sampling as final sampling units.

Sample Size Determination: A total of 278 farmers or livestock keepers (150from Dembecha district and 128 from Jabitehenan district) were randomly selected to participate in house-to-house interview in order to assess economic impacts of bovine trypanosomosis. The sample size of respondents was determined using the formula ($n = 0.25/SE^2$) given by Arsham at the standard error (SE) of 0.03 with 95 % confidence level [23].

Estimation of Economic Losses: The economic impact of bovine trypanosomosis from farmer's perspective was determined by estimation of the direct (visible) production losses such as milk loss, mortality loss and draft power loss and indirect impacts like control costs(e.g. treatment expenditure) using economic model by Knight-Jones and Rushton [24] framework which was described in Jemberu [25] and Molla [26]. However, due to information paucity, impacts of the other direct losses due to reduced bodyweight, abortion and decrease fertility were not considered in this study.

Mortality Loss: The economic loss due to mortality per herd was calculated by considering the seven categories of animals (calf, bull, heifer, dry cow, pregnant cow, lactating cow and ox) that died and their corresponding market price which was collected from four primary market in the study area namely Nebersa Kendamue, Enewend, Gedeb, Regeb Kebero Meda and Weyenema Workema. Therefore, the economic loss due to mortality per herd was calculated as:

$$LMi = \sum_{j=1}^{7} NMCij * PCij$$

where LMi represents the economic losses due to bovine trypanosomosis induced death of herd$_i$; NMij is the number of animals that died in each category j of herd$_i$ and PCijis the price of that animal.

Milk Loss: Trypanosomosis cause milk yield reduction or cessation of milking in lactating cows for the duration of the illness and sometimes beyond. Economic losses due to milk loss per affected herd were estimated based on formula.

$$Lmilki = Ncowi*Q_i*Tmilki*Pmilki$$

where LMilki represents the economic losses due to milk loss for $herd_i$; Ncowi the number of lactating cows affected in $herd_i$; Qi the average quantity of milk lost in liters per affected cow per day in $herd_i$; Tmilki the average duration of illness in days of affected lactating cows in $herd_i$, Pmilki the price of milk per liter for $herd_i$.

Draught Power Losses: The disease of trypanosomosis impacts on the use and effectiveness of draught power is crucial. A diseased draft ox cannot plough or provides less draft power. The loss from draft power reduction can be captured from effective working days lost. Economic losses due to draft loss per herd equaled to

$$Ldraft = Noxeni*Tdrafti*Pdraft*65/365$$

where Ldrafti represents the economic loss due to draft power loss for $herd_i$; Noxeni the number oxen affected in herdi, Tdrafti the average duration of illness in days of an affected ox in $herd_i$, Pdraft the price of draft power rent of an ox per day and 65/365 is an adjustment factor for effective working days.

Due to seasonality in crop production, draft power for crop production (plowing and threshing) is not needed throughout the year. A draft ox in smallholder farm of Ethiopia works for about 65 days in a year [27]. Therefore, 65/365 is taken as an adjustment factor to change the days of illness to actual working days lost. Farmers whose draft oxen are affected with trypanosomosis have to rent, purchase a replacement ox or borrow animals for cultivation. An ox can be rented from a farmer owning surplus oxen mainly on cashor grain basis.

Treatment Expenditure: Treatment costs of bovine trypanosomosis were considered to consist of diagnosis and medication costs and extra labour costs for seeking treatment for sick animals. The clinical treatment of affected animals was at the farmers' own expense. Hence, the economic cost of treatment expenditure was calculated as per formula.

$$TrCosti = (NTri * PTri) + (NhoursLi * Pdli)$$

where TrCosti represents the treatment cost for affected herdi; NTri the number of animals treated; PTri the average per head expenditure to trypanosomosis treatment; NhoursLi the average number of working hours lost for seeking treatment for sick animals and Pdli the average payment rate of replacement labourer per hour in the locality of $herd_i$.

Total Economic Losses: The total economic losses (TEL) were obtained per individual herd by adding losses arising from mortality, milk production loss, draft power loss and treatment expenditure calculated as

$$TELi = LMi + LMilki + LDrafti + TrCosti$$

where TELi represents the total economic losses for $herd_i$; LMi the economic losses due to mortality in $herd_i$; LMilki the economic losses due to milk loss in $herd_i$; LDrafti the economic losses due to draft loss for $herd_i$; TrCosti represents the treatment cost for affected $herd_i$. The average economic loss in the affected herds per individual head of cattle was estimated by dividing the total economic losses in the herd by the total number of cattle in the herd.

Data Management and Analysis: The questionnaires were administered to obtain information on economic impact of bovine trypanosomosis. Microsoft Excel spread sheets program was used to enter and manage the recorded data to create a data base. Both IBM SPSS statistics version 20 and STATA-12 statistical analysis tools were used to analyze and interpret the data. The qualitative data were analyzed using descriptive statistics (frequency, percentage and average).An independent samples t-test was used to evaluate differences in herd level of the average annual economic losses between districts. A one-way ANOVA was used to test the differences between kebeles within districts.

RESULTS

Cattle Herd Size and Structure: A total of 278 smallholder farmers with 1783heads were surveyed in the two districts of study area. The study population comprised 14.97% calves, 7.85% heifers, 7.35% bulls, 6.28%,dry cows,3.42% pregnant cows, 15.03% lactating cows and 45.09% oxen. Herd size varied from two to twelve cattle. About 90% of the herds consisted of less than 12 cattle. The average household cattle herd size in Dembecha district (6 heads of cattle per herd) was lower

Table 1: Cattle herd size and structure by district

	District	
	Dembecha	Jabitehenan
Number of herds	150	128
Average herd size	6	7
Cattle category (%)		
Calve	14.55	15.39
Heifer	7.16	8.53
Bull	7.05	7.64
Dry cow	7.05	5.5
Pregnant cow	3.24	3.59
Lactating cow	14.66	15.39
Ox	46.24	43.93

Table 2: Economic losses due to mortality per household by Kebele and district

District	Kebele	No of calve died	No of heifer Died	No of bull died	No of dry cow died	No of preg.cowdied	No of lact.cow died	No of ox died	Average economic loss per household (ETB)
Dembecha	Nebersa Kendamue	4	1	1	1	0	3	6	2976
	Enewend	3	2	0	0	1	3	5	2740
	Gedeb	0		2	1	1	4	8	4056
	Overall	7	4	3	2	2	10	19	3219.9
Jabitehenan	RegebKeberoMeda	0	0	2	2	1	3	11	3332
	WeynemaWorkema	4	2	0	0	0	2	3	1480.1
	Overall	4	2	2	2	1	5	14	2547.3

Preg. and lac. Show pregnant cow and lactated cow respectively

Table 3: Economic losses due to draft power loss per affected herd by kebele and district

Districts	Kebele	Average duration of trypanosomosis illness (days)	Average effective working lost days	Average economic loss (ETB)
Dembecha	NebersaKendamue	22.16	3.94	1174
	Enewend	20.94	3.72	1006
	Gedeb	23.16	4.12	1091.3
	Overall	22.08	3.93	1090.5
Jabitehenan	RegebKeberoMeda	22.7	4.04	987.4
	WeynemaWorkema	24.27	4.32	1414.5
Overall		23.41	4.2	1180.9

An adjustment factor of 0.178 (65/365) was used to change duration of illness into effective working days lost

than Jabitehenan district (7heads of cattle per herd).Oxen represented the highest percentage of the herd in both district. Almost all herds in two districts were managed under extensive farming system. The herd size and structure in both districts are presented in Table 1.

Economic Losses Related to Mortality Loss: According to information obtained from the interviewed farmers, the mortality rate of cattle as a result of trypanosomosis was 4.31%. The overall average economic loss due to mortality per household was estimated at 2905.4 ETB. District wise, the average loss per household varied from 3219.9 ETB in Dembecha district to 2547.3 ETB in Jabitehenan district (Table 2). The overall average economic loss due to mortality loss were significant association (P = 0.005) among kebeles between districts . The highest average economic loss at household level was due to mortality loss as shown in Table 5.

Economic Losses Related to Draft Power Loss: Most of the interviewees responded that trypanosomosis affects the traction power of animals. The average duration that trypanosomosis puts its effect on draft power out put on oxen was 4 effective working days. The second highest average economic loss due to draft power next to mortality loss at household was accounted to be 1132ETB.The overall average loss due to draft power per affected ox was 394.4 ETB. Similarly, the average economic losses per house hold due to draft power were 1090.5 ETB and 1180.9 ETB in Dembecha and Jabitehenan district respectively (Table 3).

Economic Losses Related to Milk Loss: The report from respondents indicated that the average daily milk loss per cow was 1.1liters and 0.96liters for Dembecha and Jabitehenan district respectively. There were little different losses among two districts, but the overall

Table 4: Economic losses due to milk loss per trypanosomosis affected lactating cow by district and kebele

District	Kebele	Average daily milk loss due to trypanosomosis (L)	Average duration of trypanosomosis illness(days)	Average quantity of milk lost (L)	Average economic losses (ETB)
Dembecha	Nebersa Kendamue	1.12	14.98	30.12	451.8
	Enewend	1.02	11.62	24.36	365.4
	Gedeb	1.17	12.6	29.05	435.75
	Overall	1.10	13.06	27.84	417.65
Jabitehenan	Regeb Kebero Meda	1.05	13.7	28.6	429
	WeynemaWorkema	0.8	14.48	24.54	368.14
Overall		0.96	14.05	26.76	401.4

15ETB was considered as average milk price per litter

Table 5: Average total economic loss of trypanosomosis per herd by district and kebele in ETB

		Production loss			Control expenditures		
Districts	Kebele	Average mortality losses	Average milk losses	Average draft losses	Average treatment expenditure	Average extra labour cost	Average total economic loss
Dembecha	Nebersa Kendamue	2976	451.8	1174	340.6	12.3	4935.9
	Enewend	2740	365.4	1006	274	14.4	4389.5
	Gedeb	4056	435.7	1091.3	272	12.7	5855
	Overall	3219.9	417.6	1090.5	294.9	13.2	5021.8
Jabitehenan	RegebKeberoMeda	3332	429	987.4	272.9	14.3	5021.4
	WeynemaWorkema	1480.1	368	1414.5	267	14	3530
	Overall	2547.3	410.2	1180.9	270.3	14.1	4400.3

average daily milk loss per affected milking cow was 1.04 L. Average daily milk yield of 1.85 L per cow and a total of 180 days lactation period per year for local zebu were obtained from the Central Statistical Agency [28]. The average duration of illness in cows that led to milk reduction was 13 days for Dembecha district and 14 days for the Jabitehenan district. The overall average duration of milk production loss in the current study area was 13.5 days. The overall average quantity of milk production loss per herd was 27.3 L in the districts. Financially, the average total economic loss due to milk production loss in affected milking cow per herd was 410.18 ETB, which was 417.65ETB in Dembecha district and401.4 ETB in Jabitehenan district.

Economic Losses Related to Treatment Expenditures: Based on farmers' response, the overall average treatment expenditures cost per household per year in current study area was 283.5 ETB. The average treatment expenditures to purchase trypanocidal drugs per household per year was 294.6 ETB and 270.3ETB for Dembecha and Jabitehenan district respectively. Relatively, the higher cost for trypanocidal drug was spent in Dembecha than Jabitehenan districts. About 76.1 ETB was the average amount of money a household spending in the area for the treatment of trypanosomosis per head per annum. The cost of time lost for seeking treatment per affected animal could not be estimated as it was common practice that cattle owner took several animals to a veterinary clinic at a time to seek treatment and this is complicated to estimate per head cost. Treatment expenditure for trypanosomosis between kebeles in two districts were significantly different (P = 0.008) as shown in Table 5.

Total Economic Loss: The average total economic losses associated with bovine trypanosomosis at herd level were estimated to be 4731.16 ETB. In terms of district, 5060.8 ETB and 4345.6 ETB were the average total loss for Dembecha and Jabitehenan district respectively. The average total herd level economic losses in Dembecha district were not statistically significant difference than Jabitehenan district (P > 0.05). But the Comparison of average total herd level losses within each kebele between districts using a one-way ANOVA showed a statistically significant (P = 0.01). At herd level, the largest component of the economic loss was due to mortality loss (2905.4ETB) followed by draft loss(1132ETB) and milk loss (410.2ETB). Treatment expenditures were the least contributor to herd level losses.

DISCUSSION

According to the respondents, the average annual overall economic loss (2921.4 ETB) per household via mortality loss due to trypanosomosis recorded in this study was a big loss for farmers whose livelihood depends on crop-livestock farming system. It was lower than the previous report of Seyoum in Guraferda and

Gimbo districts in the Baro Akobo and Gojeb River basins who estimated to be 3501ETB [29]. But it was higher than earlier report by Tesfaye who reported about 1,132 ETB per year per household was lost as a consequence of trypanosomosis-triggered mortalities [30].

The reduced work output of draft oxen due to trypanosomosis was an important loss for the mixed crop livestock farming system of the study area. As herd owners reported that trypanosomosis affected draft animals were not available for field work for an average period of 22.69 days which resulted in average loss of about 4 effective working days. The lost working days lead to reduced crop production either through reduced the area to be cultivated, or through lower yields due to late planting [31]. The average lost effective working days in this study was smaller than the 10 days due to LSD reported by Molla [26]. A farmer in the study area can borrow, rent or request assistance from relatives for cultivation when whose ox is affected by trypanosomosis. The lost effective working days were changed into economic loss based on the daily market price of traction services (cash basis) of an ox gave an overall average loss of 394.4 ETB per affected ox. The result is lower than the loss reported due to FMD by Jemberu and LSD by Molla [25, 26].

According to the herd owners, the third largest losses were due to milk production loss which represented 410.17ETB as average loss per household. The average duration of milk production loss and the average milk production loss in lactating cow that were infected by and survived trypanosomosis was 13.5 days and 27.3L respectively. The average duration of illness and milk production loss indicated here are greater than the loss induced by black leg infected local cattle which were 11 lactation-days and 20.4L respectively for local zebu cattle [32]. The average daily milk loss per infected cow was 1L per day. The losses were lower than the loss reported by Jemberu due to FMD which was 1.8L [25].

In the current studies, the respondents revealed that average total treatment expenditure per household per year on trypanocidal drugs in the study was highest as compared to the study conducted by Tesfaye and Seyoum in northwest and south west Ethiopia that had been reported to be 177.1 ETB and 224.5 ETB respectively [29, 30]. The higher expenditure in the study area could be due to cost of trypanocides usage. The Kebeles in study area are adjacent to the middle Abbay river valley where there has been very limited veterinary service or private veterinary pharmacies. As a result, there might be less information about the proper way of treating animals as well as high cost of trypanocides in the area. That may lead farmers to pay more for the trypanocides. The physical distance between the farmers and the veterinary service is believed to be the main limiting factor for providing an effective animal health service in much of rural Africa by increasing transaction costs [33]. The report of Chanie in Girja district of southern Oromia region indicated that the average annual expenditure on curative trypanocides drugs per house hold also cost to the amount 320 ETB per household [34]. Drug expenditure for the treatment of trypanosomosis was little higher in Dembecha than Jabitehenan district. The higher expenditure of treatment in Dembecha could be due to more frequency treating animals or cost of trypanocides usage and availability of limited veterinary service than Jabitehenan district. The physical distance between the farmers and the veterinary service is believed to be the main limiting factor for providing an effective animal health service in much of rural Africa by increasing transaction costs [33].

CONCLUSION AND RECOMMENDATION

The study conducted on economic impacts against bovine trypanosomosis in Dembecha and Jabitehenan districts of western Amhara region, northwest Ethiopia provided important information. In this study, farmers are well aware of trypanosomosis on its impact on production productivity of cattle. The respondents' testimony shows that bovine trypanosomosis impact in terms of production losses and treatment expenditure was high. The average total economic losses in the study area were 4731.2 ETB per trypanosomosis affected herd. The losses were mainly from morbidity and mortality of cattle. The largest component of the economic losses was due to mortality loss followed by draft loss and milk loss at herd level losses. Treatment costs were the least contributor for the herd level losses. Although the presented estimates on the economic losses accounted for only the visible direct impacts of the disease on herd level, these conservative results already signify a potential socioeconomic gain from a control intervention given the current frequency of trypanosomosis.

Therefore based on the above conclusion the following recommendations are forwarded:

- Design and implement sustainable tsetse fly control strategies with chemotherapeutic service to control trypanosomosis effectively.
- Conduct further study using economic model which includes other direct loss like reduced body weight and abortion to estimate economic impact of tsetse and trypanosomosis.

- Continuous community awareness creation should be done about control methods and the risk of trypanocidal drug resistance in tsetse infected area.

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REFERENCES

1. Central Statistical Agency, 2013. Agricultural sample survey. Report on livestock and livestock characteristics. Volume II and IV Statistical Bulletin, Addis Ababa, Ethiopia.
2. Metaferia, F., T. Cherenet, A. Gelan, F. Abnet, A. Tesfaye, J.A. Ali and W. Gulilat, 2011. A review to improve estimation of livestock contribution to National GDP. Ministry of Finance and Economic development and Ministry of Agriculture, Addis Ababa, Ethiopia.
3. NBE, 2014. National bank Annual Report of 2013-2014. National Bank of Ethiopia (NBE), Addis Ababa, Ethiopia.
4. Behnke, R., 2010. The contribution of livestock to the economies of IGAD member states: study findings, application of the methodology in Ethiopia and recommendations for further work. In: IGAD LPI working paper. Odessa Centre, IGAD Livestock Policy Initiative, Great Wolford, UK, 02-10.
5. Zecharias, A. and T. Zeryehun, 2012. Prevalence of Bovine Trypanosomosis in Selected District of Arba Minch, Snnpr, Southern Ethiopia. Global Veterinaria, 8: 168-173.
6. Basaznew, B., W. Kebede and C. Mersha, 2012. Occurrence and Identification of Bovine Trypanosomosis in Genji District, Western Ethiopia. Acta Parasitologica Globalis, 3(3): 38-42.
7. Admasu, B., 2002. Welcome address; Animal health and poverty reduction strategies. In: Prov. 16th Animal Conference of Ethiopia the Ethiopia Veterinary Association (EVA), Held, 56: 117-137.
8. Abebe, G., 2005. Current situation of Trypanosomosis. In: review article on: Trypanosomosis in Ethiopia. Ethiop. J. Biol. Sci., 4: 75-121.
9. Taylor, K.A., 1998. Immune responses of cattle to African trypanosomosis: protective of pathogenic? Int. J. Parasitol., 28: 219-240.
10. Broun, D.M., R.S. Reid, D.J. Rogers, W.F. Shnow and G.R.W. Wint, 2001. Environmental Change and the automous control of tsetse and Trypanosomosis in Sub-Saharan Africa: Case histries from Ethiopia, Gambia, Kenya, Nigeria and Zimbabwe, Environmental research Group Oxford Limited, Oxford, UK , pp: 9-24.
11. IAEA, 2003. Improved attractants for enhancing tsetse fly suppression: Final report of a coordinated research project, 1996–2002. Vienna, Austria, pp: 2.
12. Shaw, A.P.M., 2004. Economics Impacts of African Trypanosomosis. In The Trypanosomosis. Edited by Maudlin, *et al*. Walling ford, UK, CAB International Publishing, pp: 369-402.
13. Samuel, W.M., J.P. Margo and A.A. Kocan, 2001. Parasitic diseases of wild mammals, 4th edn, Blackwell Publishing Company, Malden.
14. Bett, B., N. Machila, P.B. Gathura, J.J. McDermott and M.C. Eisler, 2004. Characterization of shops selling veterinary medicines in a tsetse-infested area of Kenya. Prev. Vet. Med., 117: 185-193.
15. PATTEC, 2001. Pan African Tsetse and Trypanosomosis Eradication Campaign (PATTEC), plan of action. Organization of African unity, Addis Ababa, Ethiopia, Jun 2001.
16. Mattioli, R.C. and J. Slingenbergh, 2013. Program against African Information (PAATI). (Available at http://www.fao.org/PAAT/html/ home.htm Accessed on November 8, 2017).
17. Geerts, S. and P.H. Holmes, 1998. Drug management and parasite resistance in bovine Trypanosomosis in Africa. The program against African Trypanosomosis Technical and Scientific Series I, FAO. Rome, 5-31.
18. FAO, 2000. A field guide for the diagnosis, treatment and prevention of African animal trypanosomosis, 2nd edition. FAO, Rome, Italy.
19. Dagnachew, Z., 1982. Trypanosomosis in Ethiopia. Proceedings of the 3rd International Symposium on Veterinary Epidemiology and Economics, 485.
20. OAU, 2001. Trypanosomosis, Tsetse and Africa. The year book report.
21. Dagnachew, S., A.K. Sangwan and A. Getachew, 2005. The Epidemiology of Bovine Trypanosomosis in Abbay (Blue Nile) Basin of Northwest Ethiopia. Global Veterinaria, 79: 151-157.
22. Dagnachew, S., 2004. Epidemiology of Bovine Trypanosomosis in the Abbay Basin Areas of Northwest Ethiopia. MSc thesis, AAU, FVM, DebreZeit.

23. Ashrams, H., 2002. Descriptive Sampling Data Analysis. Statistical Thinking for Decision (Accessed on Oct., 2017: https://home.ubalt.edu/ntsbarsh/ Business-stat).
24. Knight-Jones, T.J. and J. Rushton, 2013. The economic impacts of foot and mouth disease what are they, how big are they and where do they occur? Prev. Vet. Med., 112: 161-173.
25. Jemberu, W.T., M.C. Mourtis, T. Woldehanna and H. Hogeveen, 2014. Economic impact of foot and mouth disease outbreaks on small holder farmers in Ethiopia. Prev. Vet. Med., 116: 26-36.
26. Molla Wassie, C.M. de Jong Mart, Gari Getachew and Frankena Klaas, 2017. Economic impact of lumpy skin disease and cost effectiveness of vaccination for the control of outbreaks in Ethiopia. Prev. Vet. Med., 147: 100-107.
27. Goe, M.R., 1987. Animal Traction on Smallholder Farms in the Ethiopian Highlands. Department of Animal Science, Cornell University, Ithaca, NY, USA.
28. Central Statistical Agency, 2012. Agricultural sample survey 2011/12 (2004 E.C.), Vol II. In: Report on livestock and livestock characteristics (private peasant holdings). Statistical Bulletin 570. Central Statistical Agency (CSA), Federal Democratic Republic of Ethiopia, Addis Ababa
29. Seyoum, Zewdu, Terefe Getachew and Ashenafi Hagos, 2013. Farmers Perception of the Impacts and Prevalence of Bovine Trypanosomosis and Tsetse Fly in Baro Akobo and Gojeb River Basins, Southwest Ethiopia. MSc thesis submitted to AAU, FVM and DebreZeit, Ethiopia. Bio Medical Center Veterinary Research, 9: 214.
30. Tesfaye Dawit, Speybroeck Niko, De Deken Reginald and Thys Eric, 2012. Economic burden of bovine trypanosomosis in three villages of Metekel zone, Northwest Ethiopia. Trop Anim Health Prod., 44: 873-879.
31. McDermott, J., T. Woitag, I. Sidibé, B. Bauer and B. Diarra, 2003. Field Studies of Drug-Resistant Cattle Trypanosomes in Kénédougou Province, Burkina Faso. Acta Tropica, 86: 93-103.
32. Ayele Birhanu, Tigre Worku and Deressa Benti, 2016. Epidemiology and financial loss estimation of blackleg on smallholder cattle herders in Kembata Tambaro zone, Southern Ethiopia. Springer Plus, 5: 1822.
33. Van des Bossche, P., M. Doran and R.J. Connor, 2004. An analysis of trypanocidal drug use in the Eastern Province of Zambia. Acta Tropica, 75(2): 247-258.
34. Chanie Mersha, Adula Dulecha and Bogale Basaznew, 2013. Socio-Economic Assessment of the Impacts of Trypanosomosis on Cattle in Girja District, Southern Oromia Region, Southern Ethiopia. Acta Parasitologica Globalis, 4(3): 80-85.