Research Article

The impact of Gibe III hydroelectric dam on the situation of livestock diseases with particular emphasis on bovine trypanosomosis in Southern Ethiopia

Solomon Mekuria[1,2], Hoges Ashenafi[2], Nigatu Kebede[3], Tadesse Eyasu[1], Saifemichael Ushecho[1] and Getachew Terefe[2]*

[1]Faculty of Veterinary Medicine, Hawassa university, Hawassa, Ethiopia

[2]Department of Pathology and Parasitology, College of Veterinary Medicine and Agriculture, Addis Ababa University, Bishoftu/Debre Zeit, Ethiopia

[3]Aklilu Lemma Institute of Pathobiology, Addis Ababa University, Addis Ababa, Ethiopia
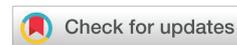
Abstract

This study was initiated to explore the impact of Gibe III dam on the situation of livestock diseases with emphasis on trypanosomosis in upstream and downstream districts. Focus group discussions with 15 groups each with 6-20 members were conducted using participatory research approach. Data were collected through simple ranking, proportional piling and matrix scoring. Level of agreement among groups analyzed was determined by Kendell's coefficient concordance (W). Proportional piling revealed that bovine trypanosomosis ranked first followed by blackleg and anthrax. Study participants identified livestock diseases by name and described the most salient features of each disease. Community perception on clinical signs, disease transmission, seasonality, of tsetse vectors, socio-economic impacts, control methods commonly of trypanosomosis was in a good agreement (W > 0.38***; p<0.001). Livestock disease outbreaks and the challenge from tsetse and trypanosomosis were perceived significantly reduced after dam construction in the upstream villages whereas dam construction and the artificial lake created thereof had little impact on the situation of trypanosomosis and the tsetse population in the downstream villages along the Omo river. Therefore, any tsetse and trypanosomosis control program should take into account the basic differences in the two sites and accordingly provide customized services.

Abbreviations

SNNPRS: Southern Nations, Nationalities and Peoples Regional State; FGD: Focus Group Discussion; m.a.s.l: meter above sea level; PA's: Peasant Associations

Introduction

Under mixed crop–livestock production system, livestock production plays significant roles not only as a main source of draught power for crop production but also for meat and milk production and means of income generation and household insurance. However, the contribution of livestock in Ethiopia is often undermined by production limiting factors such as shortage of feed and rampant diseases. African animal trypanosomosis is one of the diseases severely affecting cattle production in the West, Northwest and Southern part of the country [1].

Because they live under the treats of plethora of livestock

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diseases, farmers often have their own local names for each of the most important diseases and are able to describe associated signs, their impacts and for some of them traditional remedies. More importantly, their knowledge and experiences to differentiate among the many diseases is essential in the ranking of livestock diseases according to their level of importance/impact. The information and data collected from a community with little formal education is best reliable when obtained through focus group discussions by using the method of participatory epidemiology. In complex situations like for livestock diseases, individual farmers are less likely to provide actual data and hence, group discussion could provide relatively better information than a questionnaire survey [2]. Participatory epidemiology uses a combination of practitioner communication skills and participatory methods to improve the involvement of animal keepers in the analysis of animal disease problems and the design, implementation and evaluation of disease control programs and policies [3,4].

Farmers in Kindo Didaye and Loma districts depend on mixed crop-livestock production system, like in most part of Ethiopia. The two districts are in the Southern Nations, Nationalities and People Regional State (SNNPRS) of Ethiopia. In these two districts, there is a hydro-electric dam (Gibe III), where an artificial Lake that covers 200km² area of land has been created. Dam construction was started in 2006 [6] and completed in 2016. Human activity due to dam construction has changed the natural fauna and flora and consequently human settlement and livestock distribution both in areas surrounding the dam and along the banks of the Omo River on which the dam was constructed. The area is also known to have animal trypanosomosis [7-9] since long time. The distribution of this disease is expected to change with the negative or positive changes in the tsetse vector distribution as a result of the change in the ecology of the area which is caused by the presence of the dam. The economic impact of bovine trypanosomosis on crop production is severe in tsetse infested areas, where cattle population reduces by up to 37-70%, and milk and meat off-take reduces by about 50% [10].

In this regards, participatory epidemiological techniques are believed to generate valuable information on the perception and ranking of communities, residing in the upstream and downstream from the dam, on the situation of livestock diseases in general and bovine trypanosomosis in particular before and after the construction of the dam. Understanding community perception on major livestock diseases, their socio-economic impact and control methods are paramount important to complement conventional epidemiological diagnostic methods for further intervention activities [2,3,11,12]. The objective of this study was therefore, to assess community perception and knowledge on the relative importance of livestock diseases and socio-economic impact of bovine trypanosomosis through participatory epidemiological technique.

Materials and methods

Study area

The study was conducted between November 2018 and June 2019 in Loma and Kindo Didaye districts near to Ghibe-III hydro-electric dam in SNNPRS Ethiopia. The study area classified as upstream and downstream in reference to the dam, where Loma (upstream) located near to created Lake whereas Kindodidaye(downstream) is located immediately below the dam. The average annual rainfall at Ghibe III basin is 1,426 mm. High rainfalls recorded from May to September. Mean annual temperature is 20.4°C [6]. The altitude of the downstream ranges between 672m to 1200 m a.s.l.; whereas, the altitude of upstream ranges between 830m and 1250 m a.s.l. The created Lake has occupied about 200km² areas. Five Peasant Associations (PAs), located near the Ghibe III dam reservoir and natural river bank, were selected. Zima waruma, Subotulema and Deneba Bolla PAs of the Loma district, whereas Zero and Bereda PAs of Kindo Didaye district in the downstream (Figure 1).

Data collection methods

Participatory epidemiology tools: Participatory epidemiology tools were used as described by Catley, et al. [2] and Catley [4] which included proportional piling, matrix scoring on assessments of socio-economic impact, disease control methods and seasonality. Fifteen focus group discussions (FGD) were employed using bean-sized stones as counter for scoring and ranking purposes. Only those key informants willing to participate in the study were enrolled in the discussion and equal chance was given to reflect their opinion to avoid biasness toward the dominant discussant. Facilitators have monitored the discussion until participant's agreed on each discussion point. Finally, upon agreement, stones were piled, the number of which reflects the weight given by the focus group discussants and those piled stones were counted and recorded.

Proportional piling: Proportional piling was used to estimate the relative livestock population in the area and the most important cattle diseases encountered. A total of fifteen groups (6-20 members/group) were used: eight groups from Kindo Didaye and seven groups from Loma districts. At the beginning of the discussion, participants were allowed to list types of livestock kept in their area and then share 100 stones according to the estimated number of livestock species kept in the area. This was followed by listing and ranking of cattle diseases and proportional piling of stones according to disease importance (severity and/or occurrence) [4].

Matrix scoring: Matrix scoring method was used to understand community perception about the clinical signs, socio-economic impact, seasonality, age variability and control methods of the diseases as described by [2] and Catley, et al. [4]. This method was implemented to verify how well they were associating specific indicators or with specific cattle disease. Diseases that were commonly known by facilitators and participants were included as control diseases to cross check respondents knowledge about bovine trypanosomosis [5] as already described by Catley, et al. [4]. Participants' responses were compared with descriptions in standard veterinary text books [14]. Following adequate discussion, FGD participants were allowed to pile stones the number of which shows the degree of association between the selected indicators and
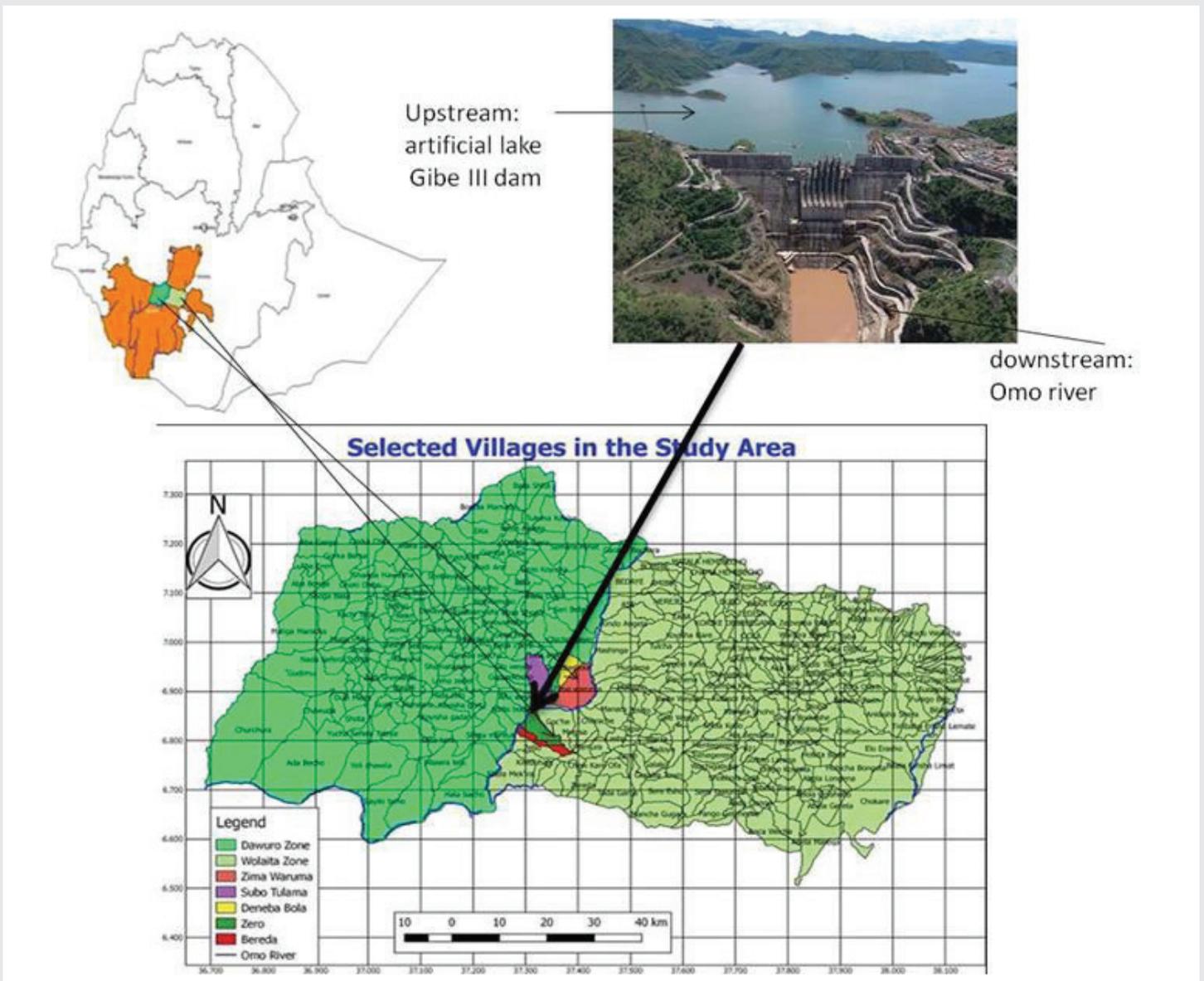
Figure 1: Map of Ethiopia showing study sites in Lomma (left side) and Kindo Didaye (right side) district (Dam image: https://www.salini-impregilo.com).

the diseases. The level of agreement across the groups was analyzed using Kendall's coefficient of concordance [15].

Triangulation: Triangulation was made using laboratory confirmation [4,11] to demonstrate the parasite from suspected animal as indicated by clinical signs in the matrix score. Participants were allowed to select trypanosomosis suspected animals (based on agreed up on clinical sign) from the nearby cattle herd. A total of 50 cattle were used for triangulation. The selected animals were bled and examined first with wet film and then thin smear prepared and fixed with methanol from positive ones. Fixed slides were transported to Soddo Regional Veterinary Laboratory for Giemsa stain and species identification.

Data management

Collected data were entered into Microsoft Excel spread sheet. The data were then exported to Statistical Package for Social Sciences (SPSS®) base 20 (Inc. Chicago IL., USA)

for statistical analysis. Kendall's coefficient of concordance (W) was used to determine the level of agreement among groups. According to critical values for Kendall's coefficient concordance (W) provided by [15] agreement was termed as weak, moderate and good if W=values were less than 0.26, between 0.26 and 0.38 (p<0.05) and greater than 0.38 (p<0.01 to<0.001), respectively.

Results

Type of livestock and their proportion

The focus group discussions in Loma and Kindo Didaye districts gave a general picture on types of livestock kept and their relative proportion in the area. According to median score results in both districts, *Mizza* (cattle) ranked first followed by *Desha* (goat), *Quttuwa* (Poultry), *Dorsa* (sheep) and *Harria* (equine) consecutively, as shown in Table 1.

Livestock management system differs in two districts.

Kindo didaye farmers keep their animals overnight in the house and allow grazing in open land the whole day. On the contrary, in the selected village of Loma district, farmers keep milking cow tethered at home whereas other cattle herds are kept far away from home near to Ghibe-III water reservoir. Except recently born calves, lambs and kids, sheep and goat are also managed together with cattle. Grazing land, and land covered by forest, bushes and shrubs are much wider in Loma than in Kindo-Didaye district.

Major livestock diseases

Participants' in focus group discussion have listed a number of diseases in local names by describing clinical signs, severity and lesions. The seven most frequently mentioned and one other (with no agreement between groups) diseases were used for further matrices. The local name of each disease described by the group was translated by the facilitator: Accordingly, *Shulula* (Trypanosomosis), *Tilikia* (Blackleg), were ranked in the first and second place, respectively (Table 2). Though, major diseases ranking varied between the districts, the type of diseases mentioned by respondents were similar except that *Aheeraa*/tick born or tick associated disease was mentioned only in Kindo Didaye and *Gerenda* (pasteurellosis) only in

Table 1: Proportional piling of major livestock population in Loma and Kindo didaye districts.

Kindo Didaye(n=8)				Loma district(n=7)			
*Local name	Common name	a Range	Median score	Local name	Common name	Range	Median score
Mizza	Cattle	34-59	41	*Mizza*	Cattle	32-46	36
Desha	Goats	20-31	24	*Desha*	Goats	17-25	23
Dorsa	Sheep	3-14	6	*Dorsa*	Sheep	4-16	8
Quutuuwa	Poultry	11-23	20	*Quutuuwa*	Poultry	13-18	14
Harria	Equine	3-12	8	*Harria*	Equine	3-8	5
Matta	Bee hive	0	0	*Matta*	Bee hive	6-14	9

*local names are in *italics*

Table 2: Major cattle diseases listed by FGD participants in Kindo Didaye and Loma districts.

Kindo Didaye(n=8)				Loma (n=7)			
Local name	Common name	Median score	Range	Local name	Common name	Median score	Range
Shululaa	Tryps	31	24-65	*Shululaa*	Tryp's	22	8-28
Karishuwa/ Tilikiaa	Black leg	13	10-18	*Tilikia/ tinticho*	Blackleg	16	14-23
Duluwaa	Anthrax	8	0-9	*Duluwaa*	Anthrax	10	5-20
Aheeraa	TBD	16	9-19	*Garanda*	Pastuerela	12	4-12
Galbbaa Harggiyaa	Mange	6	4-12	*Quacha*	Mange	10	5-12
Danquwanne cuuchaa	Tick & lice	7	3-11	*Danquowa/ cuucha*	Tick & lice	11	8-13
Ulloguxxunniyaa	GIT parasite/ diarrhea	6	5-14	*Gussuwa*	Diarrhea/ GIT parasite	12	6-14
Dumma dummaa	Others	7	3-12	*Duma Duma*	others	12	6-22

Tryps: Trypanosomosis, range = minimum and maximum score by focus group participants

Loma. Proportional piling score was calculated for median score, minimum and maximum range. Trypanosomosis ranked the highest among other diseases. Their main reason for high proportion piling was because of the disease impact throughout the year and its effect on reducing milk yield and bodyweight. In addition, cost of treatment for trypanosomosis was reported as being very high.

Matrix scoring

Perception of participants about clinical signs for each major disease listed above were assessed in both Loma and Kindo didaye districts using matrix scoring technique with 15 focus group discussants' as shown in Figure 2. Particular emphasis was given to trypanosomosis as it was ranked the most important problem and other diseases are taken as controls in the description of clinical signs. Diseases which were not common to the two districts were excluded. The finding shows clinical signs that were scored against trypanosomosis were generally in agreement with the descriptions in reference books [14,16]. The scores allocated to the control diseases indicated that informants understood the scoring method and their reasonable ability to differentiate cattle diseases from one another based on clinical descriptions. For instance, mange mite received high scores for itching and alopecia; diarrheal syndrome/GIT parasite received high scores for diarrhea. No itching sign in trypanosomosis case. They have also clearly differentiated blackleg from anthrax, where they said lameness, shivering and skin swelling is a common sign in blackleg whereas sudden death is common in anthrax. Disease sign of trypanosomosis was indicated mainly by signs of "emaciation, starring coat, diarrhea and inappetance were among other signs, with good level of agreement (W=0.8***; p<0.001). As shown in Table 3 all focus group piled more proportion of stones for trypanosomosis clinical signs than other diseases. Whereas other clinical signs more dominantly indicated for the control diseases mentioned.

Table 3. Summarized matrix scoring (median scores with ranges in parenthesis) of disease signs based on FGD outputs. n=15 groups (6–20 members/group), W=Kendall's coefficient of concordance (***P<0.01 in all cases); local names are in *italics*; *Tryps: trypanosomosis*

Triangulation

For the purpose of understanding how well the community has picked an animal with trypanosomosis based on clinical manifestations they perceive of trypanosomosis, in each focus group, participants were allowed to indicate at least three trypanosomosis infected animals from a herd. Accordingly, out of the fifty animals bled for wet film examination, six animals (6/50) were positive (12%) prevalence. Further thin smear were made for Giemsa stain and confirmed species of trypanosomosis morphologically as shown in Figure 3.

Disease transmission

Trypanosomosis being the center of interest and Black leg and mange serving as control diseases, participants'

responses on disease transmission were assessed using matrix scoring. Understandings were created among participants about disease transmission. For instance, direct contact defined as when healthy animal got in close contact with sick animals. Contact with inanimate object or fly contact were not included in the concept of contact means of transmission. Water contamination, feeding, different fly bites were included in disease transmission. The discussion revealed that trypanosomosis transmission is mainly through different species of biting flies where tsetse fly (*Chebebia)* was given the highest rank. Blackleg transmission was through direct contact, pasture feed and water; whereas participant agreed that mange mite transmission is mainly through direct contact (Table 4). The test agreement indicates that group respondents substantially agreed on means of transmission for each disease. Almost all group agreed that trypanosomosis transmission exists through tsetse fly and biting flies than other diseases with good level of agreement (W= 0.7***; p<0.001).

Figure 2: Participants' active involvement in the allocation of stones for matrix scoring.

Perception on seasonality of the disease

Focus group discussants have also reflected on the seasonality of the occurrence of bovine trypanososmosis and tsetse/biting flies. Three seasons were identified according to participants: namely, "*Boniya* or dry season that occurs from October to March, *Bedessa* or short rainy season (April to June) and *Silla/Belgo* or long rainy season which extend from July to September. Trypanosomosis and tsetse/biting flies were shown to have high occurrence in the rainy season as median score indicates in Table 5, whereas the lowest was indicated to be in dry season. Participants also mentioned that though tsetse flies are low during dry season, animals are unable to clear infection and signs reoccur every 3 weeks due to poor body condition of the animals arising from lack of adequate feed.

Trypanosomosis occurrence in different age groups

Informants categorize cattle ages into three categories: *Mara* (calf), *Mirgowa* (bull/heifer) and *Bora/ Mizza* (adult ox or cow) according to their own local names. Chances were given for group participants to allocate bean sized 30 stones in different age category, according to the occurrence of trypanosomosis in different age groups. The score allocated by fifteen groups were calculated for median and range score as shown in Table 5. Median score in both districts indicates the occurrence of trypanosomosis increases as animal age increases. Majority of participants from both study districts have given higher score for high prevalence of tsetse vectors and the disease trypanosomosis in the long rainy season compared to dry or short rainy season.

Socio-economic impact of diseases

Community perception on the impact of trypanosomosis was revolved around indicators such as milk yield, body weight loss, poor skin quality, unfitness for dowry, cause of abortion, reduction in selling price, cost of treatment and cause of sudden death as indicated by local name(Table 6). To verify whether the responses were in line with the target disease, mange, anthrax diseases were included as shown in Table 6.

Table 3: Summarized matrix scoring (median scores with ranges in parenthesis) of disease signs based on FGD outputs. n=15 groups (6–20 members/group), W=Kendall's coefficient of concordance (***P<0.01 in all cases); local names are in *italics*; *Tryps: trypanosomosis*.

Diseases as translated from local names								
Disease signs	***Tryps***	***Blackleg***	***Anthrax***	***Mange***	***Ticks***	***GIT parasite***	***Others***	**W**
Chirises (starring coat)	15(7-18)	0	2(0-6)	4(0-10)	6.1 (0-9)	13(7-18)	3(0-6)	0.8**
Matta mena (inappetance)	5(3-10)	6(5-10)	7(4-11)	0	0	2(0-6)	4(0-9)	0.8
Lapheses (emaciation)	15(10-18)	0	0	4(0-9)	6.1(0-9)	10(6-18)	3(0-6)	0.8
Kixes/kokorses (skin swelling & shivering)	0	10(8-24)	4(0-7)	0	0	0	6(0-10)	0.9
Wobes (Lameness)	0	12(7-20)	4(0-8)	0	5(0-9)	0	1(0-5)	0.9
Worees/kerekeses (sudden death)	0	11(0-19)	25(20-30)	0	0	2(0-6)	7(0-18)	0.9
Denquwaderess/ maduxise (ticks/ skin lesion)	0	0	0	5(2-18)	15(9-18)	0	4(0-10)	0.8
*Quachises (*Itching)	0	0	0	24(16-30)	4.2(0-6)	0	0	0.9
Xires (alopecia)	4(2-7)	0	0	18(12-30)	4.2(0-8)	0	0	0.9
Gussuses (diarrhea)	10(7-17)	1(0-6)	1(0-10)	0	0	16(9-23)	2(0-7)	0.8

Participants agreed that trypanosomosis reduces milk and meat production, causes abortion and is responsible for high cost of treatment compared to other diseases (W=0.61***; p<0.001). Whereas the impact of anthrax was unanimously agreed for sudden death (*wores*), the impacts of external parasites such as tick infestation and mange indicated by poor quality hide and skin followed by reduction in body weight. The response of focus group discussion signifies how well experienced the community on livestock diseases in their area.

Trend of trypanosomosis and related events before and after Ghibe III dam construction

The findings of the focus group discussion held with community representatives from both Loma and Kindo Didaye districts suggest that situational changes after Ghibe III dam construction have affected both study sites differently.
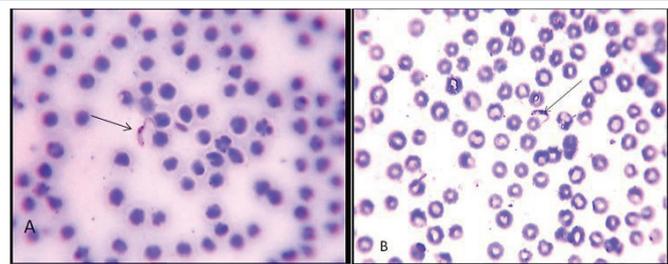
Figure 3: Giemsa stained slides showing *T.vivax* (A) *and T.congolonse* (B) parasites from animals suspected positive for trypanosomosis by study participants.

Table 4: Summarized matrix scoring (median scores with ranges in parenthesis**)** of modes of disease transmission based on FGD. n=15 groups (6–20 members/group); W=Kendall's coefficient of concordance (**P<0.01; ***P<0.001); local names are in *italics.*

Disease transmission	Diseases as translated from local names				
	Trypanosomosis	Blackleg	Tick & lice	Mange	W
Gaytyoga(contact)	(0)	14(0-30)	21(0-30)	24(15-30)	0.7***
Hatta(water)	(0)	3(0-7)	(0)	(0)	0.8***
Quuma/Matta(grazing)	(0)	7(0-30)	9(0-30)	0	0.6***
Chibebia(tsetse fly)	14(10-20)	1(0-10)	0	3(0-8)	0.7***
Babanta(Tabanus)	8(3-13)	2(0-11)	0	1(0-4)	0.7***
Boyeboxia(other fly)	8(5-11)	1(0-4)	0	2(0-5)	0.8***
Quuphasa(coughing)	0	2(0-6)	0	0	0.4**

Table 5: Perception of respondents on the occurrence of trypanosomosis in different seasons and animal age category in Loma and Kindo Didaye districts.

Seasonality	Loma (n=7)		Kindo Didaye(n=8)	
	Trypanosomosis	Tsetse/ biting flies	Trypanosomosis	Tsetse/ biting flies
Dry season(*Bonnia*)	12(7-17)	5(0-8)	4(3-6)	3(0-5)
Short rainy season(*Bedessa*)	0	0	8(7-15)	5(5-8)
Long rainy season(*Belgo*)	18(13-23)	27(22-30)	18(16-23)	22(18-26)
Age	Loma		Kindo Didaye	
Calf (*Marra*)	3(0-7)		3(2-4)	
Bull/heifer(*Mirgowa*)	8(8-11)		9(7-11)	
Ox/cow(*Bora/Miza*)	19(13-22)		18.5(15-21)	

*values are median score; range scores are in parenthesis

Table 6: Summarized matrix scoring (median scores with ranges in parenthesis) of socio-economic impact of bovine trypanosomosis based on FGD. n=15 groups (6–20 members/group); W=Kendall's coefficient of concordance (**P<0.01; ***P<0.001),; local names are in *italics.*

Indicators	Disease as translated from local names					
	Tryps	anthrax	mange	Tick & lice	GIT parasite/ Diarrhea syndrome	w
Mattasisena Loss of milk	6(4-11)	0	4(0-9)	6(4-8)	7(5-11)	0.61***
Ashuwasisena Weight loss	4(2-5)	0	3 (0-6)	5(4-7)	7(4-9)	0.68***
Gelbahargia low skin /quality	0(0-2)	0	7(3-11)	6(4-8)	0	0.84***
woytisesina Use for dowry	3(2-4)	0	3(0-8)	2(0-4)	2(0-4)	0.34**
Awucayises Abortion	3(2-5)	0	0	1(0-5)	1(0-7)	0.73***
Hirrayeses Cheap price	4(3-5)	0	0	5(3-11)	4(0-8)	0.72***
Xilliya accoyes Drug cost	7(5-12)	0 (0-2)	6(4-10)	5(4-7)	9(5-16)	0.61***
Wores sudden death	1(0-3)	29(28-30)	0	0(0-2)	0	0.84***

According to the focus group discussion, animal health post establishment and veterinary services improved after dam construction as a result of betterment in access to the area and livestock population was also increased. As a positive outcome, disease outbreak, cattle trypanosomosis and tsetse population perceived to have been significantly reduced mainly in the upstream (Loma) district. On the other hand, discussants reiterated that vegetation cover and wild life population have declined in upstream areas. Downstream, after dam construction was completed, tsetse fly infestation and some wildlife were reported to regain their habitat because of reduced human activity as a result of demolition of construction camps from the site. However, study participants affirmed that the change in the situation of trypanosomosis in this area was minimal (Table 7).

Disease control methods

Knowledge, perception and practice of the participants were assessed about disease control methods. Trypanosomosis disease in association with other diseases (Blackleg, Anthrax, mange mite, tick and lice, GIT parasite) were compared against control methods, meanwhile response of participants monitored whether discussants responding properly or not. Therefore, treatment, spraying, vaccination and traditional medicine were used as an indicator for control method and analyzed against each disease. Good level of agreement (W= 0.75***; p<0.001) was shown among the groups on vaccination, spray and treatment control method against diseases; whereas moderate level of agreement (W=0.36; p<0.01) was observed between traditional methods against diseases (Table 8). Participants were well aware that control methods for trypanosomosis is only treatment and spray whereas blackleg is reported to be controlled by vaccination and treatment as indicated by median score. According to participants anthrax can only be controlled through vaccination because it causes sudden death before it reaches to the treatment service.

Table 7: Event comparison before and after Ghibe III dam construction (with emphasis on trypanosomosis) both in Loma (upstream) and Kindo Didaye (downstream) districts.

Events	Upstream		Downstream	
	Before	After	Before	After
Number of animal health post	8(6-12)	22(18-24)	10(7-13)	20(17-23)
Level of animal diseases outbreaks	18(16-24)	12(6-14)	14(8-16)	16(14-22)
Level of trypanosomosis occurrence	20(18-22)	10 (8-22)	15(10-16)	15(14-20)
Level of tsetse population	22(19-24)	8(6-11)	16(13-18)	14(12-17)
Number of cattle deaths	21(17-23)	9(7-13)	17(14-19)	13(11-16)
Livestock population	7(5-10)	23(20-25)	13(10-15)	17(15-20)
Forest covered area	17(16-20)	13(10-14)	15(14-16)	15(14-16)
Wild life population	23(18-26)	7(4-12)	16(12-18)	14(12-18)

Values indicate median and (range)

Table 8: Summarized matrix scoring (median scores with ranges in parenthesis) of disease control methods with emphasis on trypanosomosis. FGD: n=15 groups (6–20 members/group); W=Kendall's coefficient of concordance (**P<0.01; ***P<0.001); local names are in *italics*.

Disease name	Control methods			
	Vaccine	spray	Treatment	Traditional medicine
Trypanosomosis	0	12(9-20)	18(10-21)	0
Blackleg	16(5-30)	0	11(0-15)	4(0-12)
Anthrax	29(23-30)	0	1(0-7)	0
Mange/skin disease	8(0-24)	8(0-18)	14(6-20)	0
Tick and lice	0	21(8-30)	8(0-18)	2(0-5)
GIT parasite/diarrhea	0	0	28(21-30)	2(0-9)
W= Kendel's coefficient	0.89***	0.86***	0.75***	0.36**

Discussion

Knowledge, perception and practices of the community on animal trypanossomosis

This participatory investigation was started to understand community knowledge, perception and practices about animal diseases in general and trypanosomosis in particular in two districts around the Gibe III dam in Southern Ethiopia. It was observed that cattle, goats and poultry make the major livestock population in the study area. This agrees with the data reported by the CSA [17] for both Wolayta and Dawro Zones. A number of diseases have been identified by the focus group discussants. Trypanosomosis was ranked as the most important livestock disease in the area. Recent studies conducted in Dawro zone [8,9] have also indicated that trypanosomosis is a major problem in the study area. Similar findings have also been documented by other studies [18,19] in trypanosomosis infected region of Kenya and Tanzania, respectively. In Kaffa zone, which is adjacent to the areas in this study, 94.1% of questionnaire survey respondents considered bovine trypanosomosis as an economically important cattle disease accounting for 64.6% of the total annual deaths in the year 2011/2012 [20].

In this regards, participants were able to differentiate trypanosomosis from other diseases by giving clinical signs such as rough hair coat, loss of appetite, emaciation and the like, whereas they reported only sudden death for anthrax.

Orma community in Kenya reflected similar clinical signs for chronic trypanosomosis infection and hemorrhage and sudden death for the acute form of the disease [3]. The response of the communities was in agreement with existing literature [14,21,22]. It was also evident from the discussions that trypanosomesis is more important in adult animals as compared to younger ones. This supports study reports by Catley, et al. [11] in Tana River district of Kenya, by Adama, et al. [23] in Ghana and by Von Wissmann, et al. [24] in west Kenya. This could be explained by the fact that tsetse feeding preferences for adult cattle due to size and olfactory cues [25,26] or an inherent resistance to trypanosome infections in young animals [27] and/or because calves usually remain around homestead where exposure for tsetse fly is low [28].

Many studies have substantiated that local communities have an accumulated knowledge about their animals and their wellbeing [12]. The strong concordance observed between diseases and clinical symptoms listed for each of them strengthens the above statement. Biting flies, mainly the tsetse were incriminated for the transmission of the disease trypanosomosis (*Shulala*) in cattle whereas direct contact was ranked first for infection by mange mites. This is in agreement with information in various published reports [14,16,22]. It also supports the reports of many studies including those in Serengeti community in Tanzania [29] and in Southern Sudan community [12].

The perceived abundance of flies in rainy season may predispose the animals to higher prevalence of trypanosome infections. In rainy season, despite the presence of adequate feed availability, trypanosomosis prevalence could be high due to the increased tsetse fly challenge [20,30]. The influence of rainfall and temperature on tsetse ecology has also been mentioned by other studies [31]. In contrast, a study with Tanzanian communities revealed that study participants perceived higher trypanosomosis challenge in dry season [19]. This could be explained by the fact that in most dry seasons, shortage of feed and water pushes animals to move down to river side where there is high tsetse fly challenge [32]. On the other hand, the improved access to adequate feed in the rainy season could improve body conditions of animals which may mislead farmers to consider their animals do not have the disease although in real terms they are showing tolerance to the infection due to the good nutrition [33].

Moreover, the list of disease impacts and the possible methods of trypanosomosis control agreed by the study participants implies that any effective intervention program installed to minimize these problems could be easily felt and appreciated by the community. Other studies have shown that more than half of the study participants incriminated draught power reduction and high drug cost to animal trypanosomosis in Metekel and Guji zones of Ethiopia [30,34]. Weight loss and milk reduction were also stated by Nigerian community [35].

Triangulation process on 50 cattle clinically suspected of trypanosomosis by focus group discussants has shown 12% (6/50) of the animals were positive for trypanosomosis using the buffy coat technique which were confirmed by Giemsa

staining for species identification on morphological basis. This is higher than the actual prevalence of the disease (9%) for the same study areas under the same diagnostic technique (unpublished data). On the other hand, since the detection level of parasitological techniques is dependent on the parasite load [36] the real prevalence could be higher among the animals suspected by the community especially in chronic situations where low parasitemia is characteristic[37].

Minimum Buffy coat technique detection depends on types of trypanosome species concentration, where $2.5*10^2$, $5*10^2$ and $5*10^3$ parasite concentrations of *T.congolense*, *T.vivax* and *T.brucei* can be detected, respectively [38].

Perception of trypanosomosis before and after Ghibe III dam construction

The Ghibe III hydro-electric dam occupying vast area of land has resulted in bush clearing for site preparation and its water reservoir has flooded vegetations and lands mainly infested by tsetse and forced wildlife to disperse [6] which probably has also displaced tsetse flies out to areas unsuitable for their survival. This possible negative impact on tsetse population may have made the basis for the positive impression of the study participants on the reduction of animal disease outbreaks and trypanosomosis after the construction of the dam compared to what they knew before that.

Vector borne diseases can be affected by anthropogenic and environmental changes that alter the interaction between the host, the vectors and the parasites in a given area [39,40]. *G.pallidipes* and *G.fuscipes* were the most frequently caught tsetse fly species in the study area, which are highly dependent on bovid hosts such as bushbuck, buffalo, and antelope [16]. However, as these wild animals evacuated, survival of tsetse will depend on domestic cattle which have also been displaced away from the site and hence most tsetse will starve to death. Patz, et al. [41] and Norris [42] have already shown that environmental changes and land use patterns can significantly affect vectors of parasites. On the other hand, Yewhalaw, et al. [43] in their study on Malaria and its vectors around Gilgel Ghibe-I has reported that there was no difference in the incidence of malaria in humans with increasing distance from the dam although the vectors were more abundant near the dam reservoir suggesting that disease transmission can be affected by other factors.

Trypanosomosis situation in the downstream and upstream

Discussant's from downstream indicated that there is no improvement in the situation of animal trypanosomosis and its vectors after the construction of the dam despite the increase in access to veterinary services and the transient decline when dam construction workers were camped in the area. this may suggest that the perceived decline in the impacts of trypanosomosis and its vectors in the upstream areas could be due to the damage to tsetse ecology caused by dam activities and the large water reservoir. Unpublished part of this study in this part of the study area indicates significantly high prevalence of

trypanosomosis and high tsetse and biting fly apparent density corroborating the perception of the community (Solomon, unpublished data). Many research findings indicate micro-environmental changes, due to one or another reason can reduce tsetse population and trypanosomosis [16,39].

Conclusion

This participatory epidemiological study was initiated to explore the impact of Gibe III dam on the situation of livestock diseases with emphasis on trypanosomosis in Loma (upstream) and Kindo Didaye (downstream) districts. It was observed that study participants were able to identify livestock diseases by name and described the most salient features characteristic of each disease. Animal trypanosomosis, with its various impacts, was mentioned the number one animal health problem in the areas. Triangulation technique used to cross check community perception on bovine trypanosomosis showed positive result using wet film and Giemsa staining techniques. Livestock disease outbreaks and the challenge from tsetse and trypanosomosis were perceived significantly reduced after dam construction in the upstream villages. This could be because of the improvement in access to animal health services and the negative impact of the water reservoir on tsetse population as it has occupied most of the previously tsetse infested habitat. However, rehabilitating the vegetation cover which was damaged due to dam construction and reviving the wild life population while strengthening the surveillance and control of trypanosomosis and its vectors is of paramount importance to this specific area. On the other hand, the construction of the dam and the artificial lake created thereof seems to have little impact on the situation of trypanosomosis and the tsetse population in the downstream villages along the Omo river. The improvements in veterinary services in these areas appear to have improved the survival of livestock under constant trypanosomosis challenge. Therefore, any tsetse and trypanosomosis control program should take into account the basic differences in the two sites and accordingly provide customized services. One should bear in mind that the community has a good understanding of any change, positive or negative, resulting from any intervention program implemented in their locality.

Ethical considerations

The permission to carry out this study was granted by the research ethics review committee of the College of Veterinary Medicine and Agriculture of the Addis Ababa University (Reference number: VM/ERC/05/20/11/2018). The study used those ethical approaches, which have been documented by Rollin [44] as a guide line. Informed consent, for willful participation in the focus group discussion and animal blood sampling was obtained from participants prior to the beginning of the study.

Acknowledgement

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