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Protecting Livestock – Improving Human Lives

Baseline study for the integration of novel treatments, vaccines and diagnostics into Animal African Trypanosomosis control programmes

Ethiopia Field Study Report

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Table of contents

Foreword

Animal African trypanosomosis (AAT) is an important constraint of livestock production and threat to food security in sub-Saharan Africa [1]. Of the 37 sub-Saharan African countries affected by trypanosomosis, 21 are among the world's 25 poorest [2]. Reduced productivity of cattle due to trypanosome infection has been estimated at approximately 10-20% across a range of parameters including mortality, calving rate, meat production, milk production and draught power. It also reduces the area which could potentially be used for livestock production; as cattle density is very low in areas with a high tsetse-trypansome burden. In these areas farmers are often more reliant on crop farming however trypanosomosis reduces the availability of draught animals to plough fields and manure for fertiliser.

This is one of five country specific sub-Saharan African studies (conducted in Ethiopia, Burkina Faso, Cameroon, Uganda and Zambia) which aimed to generate baseline information that could inform the integration of novel treatments and diagnostics into control programs for AAT. A previous systematic review of recent and on-going Trypanosome & Tsetse control programs has been the basis for the geographic focus of the five studies.

This report summarizes the results of the study which was carried out in Ethiopia (South West area: Oromia region and Southern Nations, Nationalities and People's region). Trypanosomosis is considered endemic in South West Ethiopia and is one of the biggest constraints of livestock production [3]. Four study areas were selected on the basis of environment (including ecoregion) and predicted AAT risk: Goma and Setema (Ethiopian montane grasslands and woodlands- moderate predicted AAT risk); Goro and Cheha (Ethiopian montane forests: High predicted AAT risk); Limu Seka (East) (Ethiopian montane grasslands and woodlands- moderate to high predicted AAT risk); Limu Seka (West) (Ethiopian montane forests- moderate to high predicted AAT risk).

The study results will inform the refinement of existing decision support tools to aid evidence-based decisions on the use of novel drugs and diagnostics as part of integrated Trypanosome & Tsetse control programs.

Study Aims and Methodology

1. Introduction

1.1 Aim of the study and approach

The aim of the study was to assess the current AAT situation in the tsetse infested study areas of Ethiopia and the scope for improving AAT control by introducing or integrating new control measures into future or existing AAT control programs.

The relative extent to which AAT constrains livestock production in the study areas was ascertained by comparing farmers' attitudes regarding AAT frequency and economic impact (mortality, loss of earnings and cost of treatment) with their attitudes towards general livestock diseases in their herds. Successful control of AAT is dependent on farmers' motivation to control the disease individually, and to cooperate with externally-led control programs. The scope for improving AAT control in the study areas was assessed and the demand for, and likely uptake of, new treatments, diagnostics and preventative measures was inferred from data regarding existing control and consumer willingness to use and pay for new trypanocides, diagnostic tests and vaccines.

1.2 Background

The study was conducted in the South-West of Ethiopia as a previous systematic literature review of AAT and FAO predicted tsetse distribution maps indicated that this area had the highest tsetse population and trypanosome burden (Figure 1)[3-6]. According to available data; *Trypanosoma vivax* is the predominant trypanosome, followed by *T. congolense* [7]. *Glossina fuscipes*, have the highest apparent density of tsetse species in the area followed by *G. pallidipes*, and there are also some *G. morsitans* present [8]. AAT is responsible for losses in cattle production in the area including increased calf mortality and abortions [4]. AAT has also been reported as an important disease in other species especially in equines and goats. There have been reports of drug resistance within Ethiopia, particularly against diminazene aceturate and some isometamidium chloride [4, 5].

Five *Woredas* (districts) were included in the study namely Setema, Goma, Limu Seka, Goro and Cheha. These woredas were classified into four study areas on the basis of environment (including ecoregion) and predicted AAT risk from a systematic review [3]. Table 1 summarises the data gathered on the study areas prior to the conduction of the study. Figure 1 shows the two

ecoregions in the study area [7]: Ethiopian montane grasslands and woodlands; and Ethiopian montane forests. Based on the characteristics of each woredas the following study areas were selected:

Goma (East) and Setema (South)

- Ethiopian montane grasslands and woodlands ecoregion
- Little data was available regarding the disease itself, but predicted tsetse distribution was high [3, 6]. Therefore the area was predicted to have a **moderate risk of AAT.**

Goro and Cheha

- Ethiopian montane forests ecoregion
- In nearby Sokoru district, trypanosomosis was reported to be the most important disease in cattle. High cattle mortalities in the Goro district are attributed to trypanosomosis and predicted tsetse distribution is high therefore the area was predicted to have a **high risk of AAT.**

Limu Seka (East)

- Ethiopian montane forests ecoregion
- Trypanosomosis in considered endemic in the region with tsetse vector present and therefore it was predicted to have a **moderate to high risk of AAT**.

Limu Seka (West)

- Ethiopian montane grasslands and woodlands ecoregion
- Trypanosomosis is a reported constraint to livestock and crop production and tsetse are present; hence this area was predicted to have a **moderate to high risk of AAT** [3].

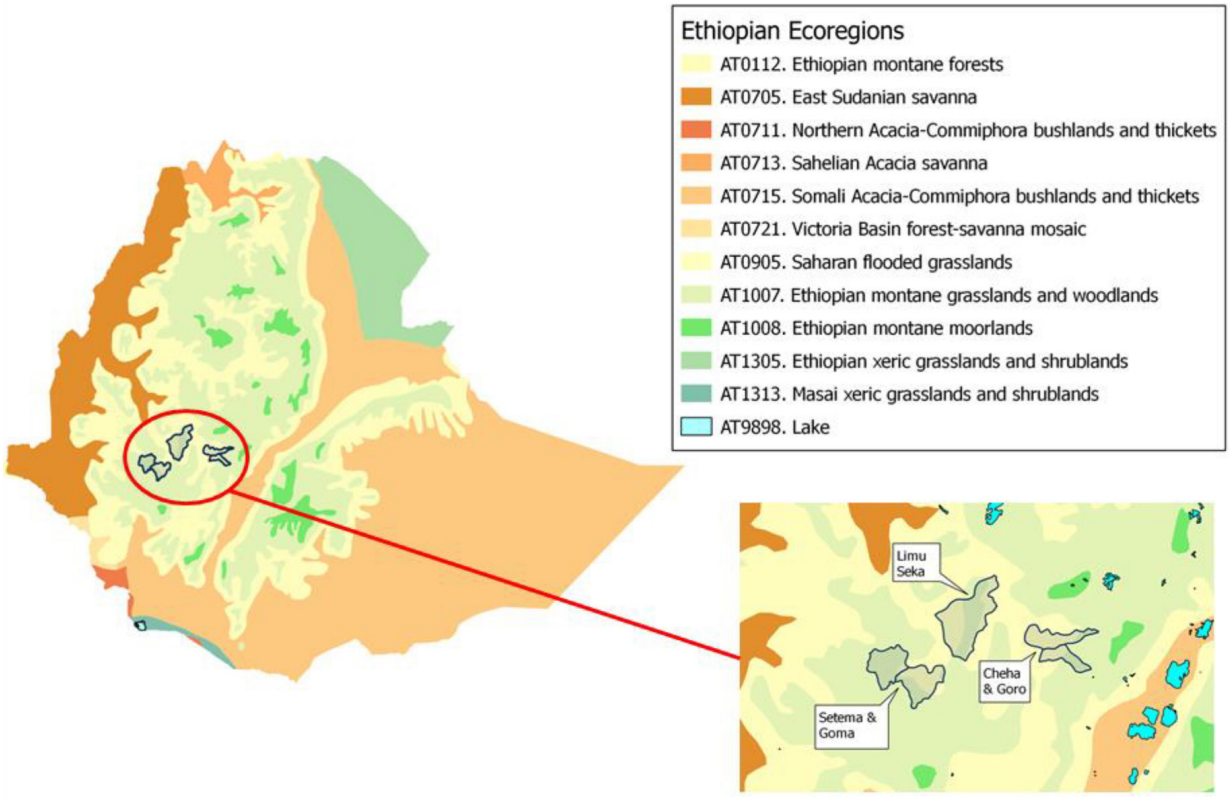


Figure 1: Map showing the study area and ecoregions, according to Olson (2001), in Ethiopia and the five *Woredas* (districts) included in the study.

	Goro (East) & Setema (South)	Goro & Cheha (East)	Limu Seka (East)	Limu Seka (West)
Ecoregion	Ethiopian Montane Grasslands & Woodlands	Ethiopian Montane Forests	Ethiopian Montane Grasslands & Woodlands	Ethiopian Montane Forests
Ecosystem	Montane grasslands and shrublands	Tropical and Subtropical Moist Broadleaf Forest	Montane grasslands and shrublands	Tropical and Subtropical Moist Broadleaf Forest
Predicted AAT risk	Moderate	High	Moderate to High	Moderate to High
Livelihood systems	Highland coffee-cereal -livestock mixed livelihood system	Highland enset-cereal mixed livelihood system	Midland coffee-cereal-livestock mixed livelihood system	Midland cereal-oil livelihood system
Woreda population	Setema: 105,299 Goma: 237,695	Goro: 169,000 Cheha: 160,296	119,258 (total)	119,258 (total)
Altitude	2000 to 2870m	1500 to 2000m	1650 to 1780m (overall)	1650 to 1780m (overall)

Table 1: Overview of the study areas [6, 9-12].

Study Aims and Methodology

2. Methods for data collection

2.1 Sampling of the study areas and households

The study was conducted in June 2013 and there were four study areas covering five woredas; Setema and Goma (Ethiopian Montane Grasslands and Woodlands: moderate predicted AAT risk), Limu Seka (East: Ethiopian Montane Grasslands and Woodlands: high AAT risk and West: Ethiopian Montane forests: moderate to high AAT risk) and Cheha and Goro (Ethiopian montane forests: high predicted AAT risk).

Within the Woreda a list of village names were obtained for each study area and these villages were selected for incorporation in the study using random sampling. The community leader(s) of each village were then contacted in order to gain permission to work in the village. The sampling unit was a household (or homestead), defined as a group of people who normally cooked, ate and lived together. Households were selected using systematic sampling from a central point in the village; a random direction was selected and every fifth household was approached for inclusion in the study. If the household selected did not own cattle, or the head of the household was not present, the next closest cattle-owning household was studied instead.

2.2 Data collection

The head of the household was contacted and asked if they would be willing to take part in a study which aimed to collect data on cattle health and production in the area, there were no refusals to participate. The study was conducted by trained enumerators who were qualified veterinarians or animal health assistants (AHAs). Once sampling of the village was completed the enumerators would provide information, including public health risks regarding AAT and other livestock diseases to the community. They would also answer any questions the farmers had regarding livestock production and disease.

Study Results

3. Ethiopian Profile

3.1 Description of the study areas and summary of the results

Goma and Setema (Ethiopian montane grasslands and woodlands: moderate predicted AAT risk)

Goma and Setema are *Woredas* in the Oromia Region of Ethiopia, within the Jimma Zone. Most (94%) of the population live in rural areas and there are two predominant farming systems in the area; coffee-livestock mixed and cereal-livestock systems. In Setema maize and enset are the major staple food crops grown and teff is produced as a cash crop. Enset is a staple food crop that grows in the less arid highlands of South West Ethiopia; the starchy stem of the plant is consumed but the entire plant is used as a material for roofs, packaging etc. It is known as the 'false banana' as it resembles the banana plant it is extremely hardy

and contributes to food security in the area. Goma has two state coffee farms, which cover an area of 2.7km2 and coffee is the predominant cash crop in the area; fruits, avocadoes and spices are also important [6].

These *Woredas* receive belg rains from February, with intermittent rains continuing through October. The area features river networks and frequent waterholes which provide a reliable water source for livestock and humans (Image 1). The frequent rivers and waterholes and the grass and shrubland landscape interspersed with wooded areas make the area a favourable habitat for tsetse populations. Livestock species include cattle, which are often used as draft power, small ruminants (sheep and goats), aquaculture, poultry and equines.

Image 1: Watering hole for cattle in Goma and Setema study area.

Image 2: Cattle being used for draught power in Goro and Cheha region.

Goro and Cheha – (Ethiopian Montane forests: High predicted AAT risk)

Limu Seka is in the Oromia Region of Ethiopia, within the Jimma Zone. Teff, sorghum, maize, barley, honey, coffee and chat are produced in the area and cattle, goats, sheep and poultry are all kept by livestock owners. The study area has hills and plains and moderately dense vegetation coverage including forests, bushes, shrublands and grasslands. This area has a one-season extended rainfall period which starts in April and crop production is totally dependent on it. Water sources for humans and livestock during the wet season are minor rivers and seasonal pools, while major rivers are the only water sources during the dry season. Trypanosomosis, Contagious Bovine Pleuropneumonia (CBPP) and anthrax affect livestock production. The area is moderately populated and with moderate access to markets [9].

Limu Seka (West) (Ethiopian Montane forests: moderate to high predicted AAT risk)

Teff and coffee are the predominant cash crops with sorghum, millet, noug and honey also produced. The geographic features include rivers and mountains and the soil is highly productive; wells and springs are major sources of water during the wet and dry seasons; humans and livestock tend to source drinking water from different sources. Market access is considered poor as road access is restricted during the wet season.

Results summary

An overall summary of the findings from each study area are presented in the table on the following page. The report then goes into comprehensive detail of the results in the sections that follow.

Goro and Cheha appeared to have the highest AAT risk; the disease was constantly present, the impact on income was estimated to be very severe and more than half of interviewees reported experiencing treatment failure (55.6%). Although there was some AAT control present in the area; farmers insecticide treat cattle and this was organised by officials. Cattle mortalities were lower than in the Limu Seka study areas. Both these study areas reported that AAT was more present in certain seasons, although it was present throughout the year. In addition, no households regularly kept trypanocides in the house and AAT control appeared

to be non-existent. The percentage of farmers experiencing AAT cattle mortalities and treatment failure was higher in Limu Seka West, compared to households in the East of Limu Seka.

AAT appeared to have a lower impact in Goma and Setema; most households reported the disease as being seasonal. They mostly used animal health workers to treat against the disease and less than a third had experienced treatment failure. Interestingly, this was the area which exhibited the highest willingness to pay for novel AAT products.

3.2 Study population characteristics

A total of 151 households were included in the study. The number of households studied according to study area is presented in Table 2. In the study population, the median number of active household members (aged 6 to 50) was 6 and the median number of dependent household members (aged ≤ 5 and > 50) was 1. The median household size according to study area is presented in Table 2.

Study areas	Households studied	Median household size (Q1 & Q2)
Goma & Setema (Ethiopian montane grasslands & woodlands)	45	6 (5 to 8)
Goro & Cheha (Ethiopian montane forests)	36	6.5 (5 to 7)
Limu Seka (E) (Ethiopian montane grasslands & woodlands)	34	7 (6 to 8)
Limu Seka (W) (Ethiopian montane forests)	36	8 (7 to 8)

Table 2: Number of households studied and median (second quartile) household size with lower (first) quartile and upper (third) quartile (Q1 & Q3) in each study area[1] (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

The main sources of income according to study area are presented in Figure 2. Crop farming was the primary source of income in all study areas, except for Limu Seka West where livestock were the primary income source for the majority of households (64%). All studied households had permanent access to land (95.4%).

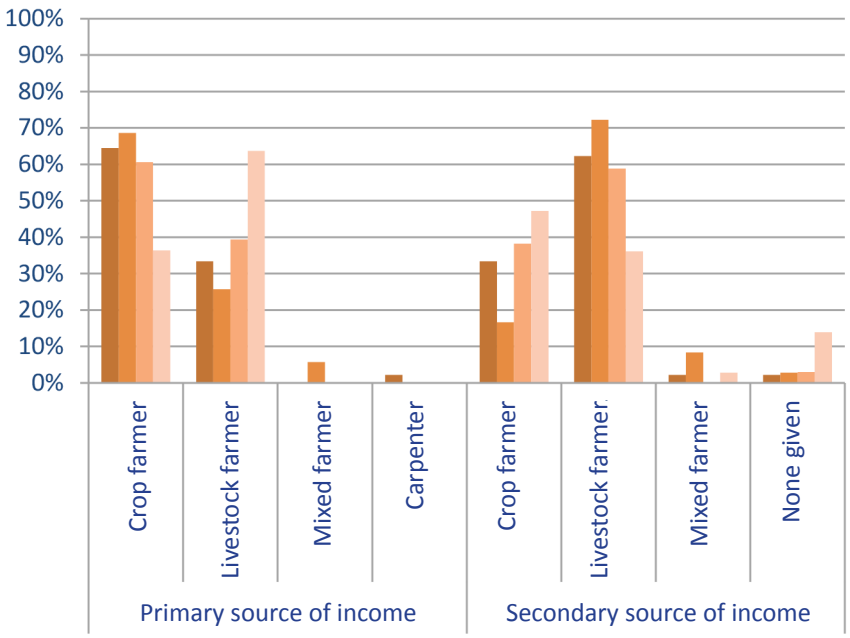


Figure 2: Source of income, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

Goma & Setem (Ethiopian montane grasslands and woodlands)
Goro & Cheha (Ethiopian montane forests)
Limu Seka (E) (Ethiopian montane grasslands and woodlands)
Limu Seka (W) (Ethiopian montane forests)

Ecological System and District

	Goma (East) & Setema (South) Ethiopian montane grasslands & woodlands	**Goro & Cheha** Ethiopian montane forests	**Limu Seka (East)** Ethiopian montane forests	**Limu Seka (West)** Ethiopian montane grasslands & woodlands
General livestock keeping data				
Primary source of income	Crop farming (64%)	Crop farming (69%)	Crop farming (61%)	Livestock farmer (64%)
Median no. of cattle (Q1 & Q2)	9 (6 & 11)	6 (3.3 & 8.8)	7.5 (6 & 10)	7 (6 & 9)
Predominant cattle breed	Zebu (Trypanosensitive)	Zebu (Trypanosensitive)	Zebu (Trypanosensitive)	Zebu (Trypanosensitive)
Predominant cattle rearing system	Free-grazing	Free-grazing	Free-grazing	Free-grazing
Other important species livestock	Poultry (82%), Equines (56%), Sheep (40%)	Equines (78%), Poultry (69%), Goats (61.5%)	Poultry (88%), Equines (5.8%), Goats (52.9%)	Equines (86%), Goats (67%), Poultry (67%)
Impact of AAT				
Perceived AAT occurrence in herd/disease ranking	Constant (75%) Ranked no. 1	Constant (72%) Ranked no. 1	Constant (71%) Ranked no. 1	Constant (72%) Ranked no. 1
Seasonality	Seasonal	Throughout the year	Some seasonality	Some seasonality
Perceived AAT impact on income	Severe	Very severe	Severe to very severe	Very severe
Main losses in livestock outputs due to AAT	Draught power & milk production	Draught power & milk production	Draught power & milk production	Draught power & milk production
AAT treatment failure/perceived reason	Moderate (29%) Resistance > misdiagnosis	High (56%) Resistance > misdiagnosis > fake drugs	Low/moderate (20%) Resistance > misdiagnosis	Moderate (36%) Resistance > misdiagnosis
Current AAT control				
Trypanocides kept in household	Diminazene aceturate	Diminazene aceturate	None	None
Treatment of AAT	Animal health workers > Farmers	Farmers > Animal health workers	Animal health workers	Animal health workers
Cost per AAT treatment: Median (Q1& Q2)	$0.64 (0.64 & 1.33)	$1.07 (1.00 & 1.33)	$0.80 (0.64 & 1.45)	$1.07 (0.8 & 1.07)
Level of knowledge of AAT control/disease	Moderate/High	High/Moderate-high	High/Moderate	High/Moderate
Point/location of sale of veterinary products	Vet pharmacy > animal health worker Nearby town	Vet pharmacy > general shop Nearby town	Vet pharmacy Nearby town	Vet pharmacy > general shop Nearby town
Existing AAT control/facilitators	Negligible (97%)/official > NGOs	ITC (67%)/officials	None (97%)	None (100%)
Future AAT control				
Willingness to use/pay higher price for new AAT drugs	95.6%/95.6%	100%/97.2%	100%/97.1%	100%/100%
Willingness to use/pay for new AAT diagnostic	91.1%/88.9% - median: $1.20	100%/38.9% - median: $0.20	97.1%/26.5% - median: $0.26	100%/30.6% - median: $0.26
Willingness to use/pay for novel AAT vaccine	97.8%/95.6% - median: $0.20	97.2%/47.2% - median: $1.07	100%/64.7% - median: $0.53	100%/69.4% - median: $0.53
Problems with AAT treatments	Clean water > weight estimation > dosing > consumables	None mentioned	None mentioned	None mentioned
Perception of fake AAT drug circulation	Low/moderate	Moderate	Low/moderate	Low
PRIORITY AREA FOR AAT CONTROL (based on farmers' perceptions)	**Moderate priority** **High risk: seasonal, some control, lower impact**	**High priority** **High risk, treatment failure, higher impact**	**High priority** **High risk, little existing AAT control, higher impact**	**High priority** **High risk, little existing AAT control, higher impact**
Likely eco-epidemiological cycle	**ENDEMIC AAT**			

Household amenities according to study area are presented in Figure 3. Few households had electricity at home, except in Goro and Cheha (36%) and some in Goma and Setema (22%). No households in the study area had water at home but most of them had water in the community. Walking distance from households to the nearest water point is presented in Table 3. Most households also had toilets in the household and a mobile phone.

[1] Quartiles are equal divisions of an ordered set of data values. The lower quartile (Q1) is the midpoint between the smallest value and the median (lowest 25% of data). The upper quartile (Q3) is the midpoint between the median and highest value (highest 25% of data).

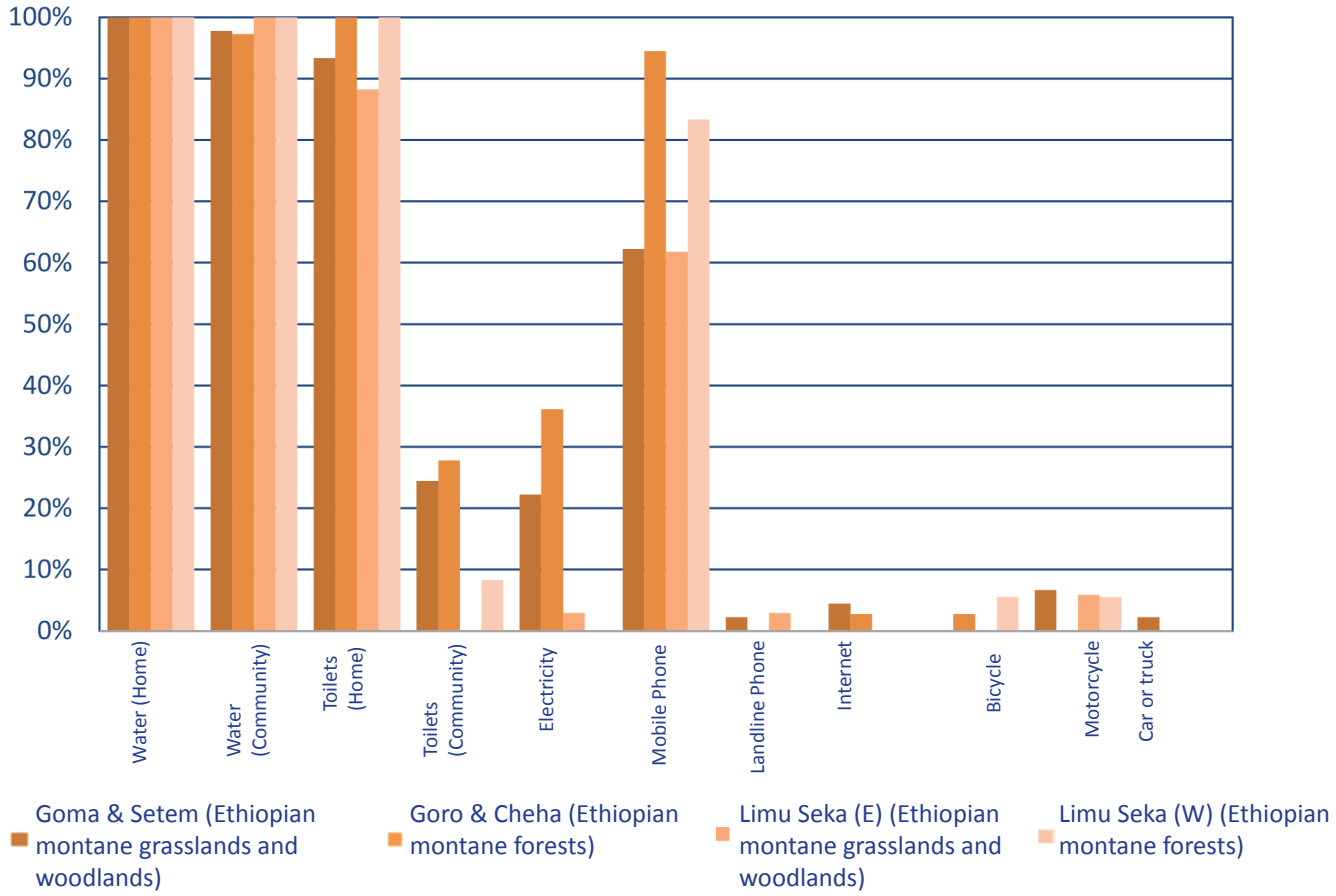


Figure 3: Percentage of households with each amenity, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

Study areas	Median minutes (Q1 & Q2)
Goma & Setema (Ethiopian montane grasslands and woodlands)	10 (5 to 15)
Goro & Cheha (Ethiopian montane forests)	15 (8 to 30)
Limu Seka (E) (Ethiopian montane grasslands and woodlands)	20 (10 to 29)
Limu Seka (W) (Ethiopian montane forests)	15 (10 to 20)

Table 3: Walking distance from households to the nearest water point (in minutes) (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

Households in all areas had access to health care; most households (96.7%) said they would visit a local health worker for the first opinion regarding health problems. If this did not resolve the problem, they would usually visit a local medical centre (96%). When asked about the main issues they face, interviewees mentioned health of household members (96%) and health of livestock and crops (100% and 23.8% respectively). Issues households were facing according to study area are presented in Figure 4.

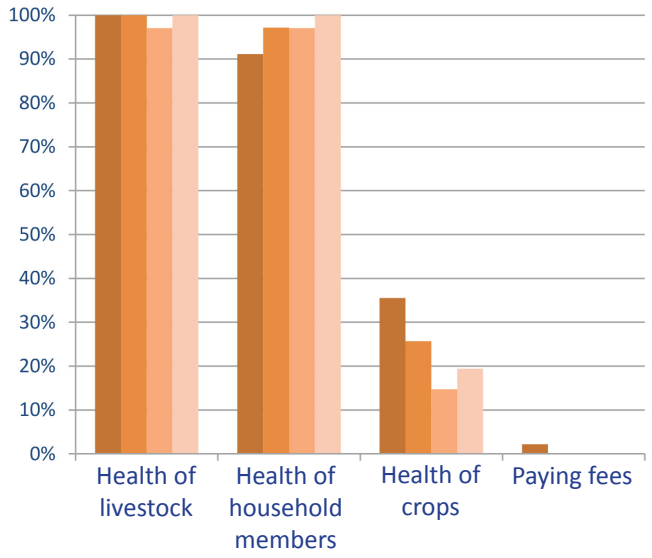


Figure 4: Percentage of households mentioning each major issue, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

3.3 General livestock keeping data

The number of livestock kept per household according to species is presented in Table 4. Cattle grazing practices are also presented; cattle were mostly free-grazed. Small ruminants were free-grazed or tethered.

	Goma & Setema	Goro & Cheha	Limu Seka (E)	Limu Seka (W)
Total number of cattle: Median (Q1 & Q2)	9 (6 & 11)	6 (3.3 & 8.8)	7.5 (6 & 10)	7 (6 & 9)
Adult Female cattle: % households owning at least 1 Median (Q1 & Q2)	97.8% 3 (2 & 5)	80% 3 (2 & 4)	88.2% 3 (2 & 4)	97.6% 3 (2 & 4)
Adult Male cattle: % households owning at least 1 Median (Q1 & Q2)	95.6% 3 (2 & 4)	96.7% 2 (2 & 4)	100% 3 (2 & 4)	97.6% 3 (2 & 4)
Calves: % households owning at least 1 Median (Q1 & Q2)	80% (2 & 4)	60% 2 (1 & 2.8)	85.3% 2 (1 & 3)	92.9% 2 (1 & 2)
Cattle rearing system: Free grazing Free grazing & tethered Free grazing & zero grazing	97.7% 3% -	91.7% 8.3% -	96.7% 0% 2.3%	85.7% 14.3% -
Sheep N (%) of sheep owning households	18 (40%)	2 (5.5%)	13 (38.2%)	13 (36.1%)
Goats % households owning at least 1 Median (Q1 & Q2)	17.7% 2 (1.8 & 3)	61.1% 3.5 (2 & 4.8)	52.9% 3 (3 & 4)	66.7% 3.5 (2.8 & 5.3)
Pigs N (%) of pig owning households	1 (2.2%)	-	1 (3%)	1 (2.7%)
Poultry % households owning at least 1 Median (Q1 & Q2)	82.2% 5(3 & 7)	69.4% 6(4 & 8)	88% 6 (4.3 & 9.8)	66.7% 8.5 (4.8 & 12)
Equines N (%) of households owning Median (Q1 & Q2)	55.5% 1(1 & 1)	77.7% 1(1 & 2)	55.8% 1(1 & 1)	86.1% 1(1 & 1)

Table 4: Livestock composition of households according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

All cattle kept by households in the study areas were zebus. When asked about choice of breed, all households said there is no particular reason for keeping zebus.

4. Veterinary practises

4.1 Veterinary services

Veterinarians are qualified professionals and tend to be employed by the government and distributed throughout Ethiopia, however each of these veterinarians are responsible for covering very large areas. AHAs support veterinarians and are trained in the diagnosis and treatment of the veterinary diseases and conditions most relevant to the areas they operate. These AHAs serve a much smaller area than the qualified vets and are therefore more commonly used by farmers (although vets are available for consultation). Often in Ethiopia the farmer (or community of farmers) that request attendance of veterinarians/animal health of assistants are responsible for repaying the cost of travel to the village site. As such villagers often visit veterinary pharmacies in the nearest town and describe the problem and ask for advice and recommended drug(s).

4.2 Veterinary practises

Around 78% of the households reported consulting an animal health worker (AHA, veterinarian or similar) when their livestock are sick. Households were less likely consult an animal health worker in Goro and Cheha (58.8%) than the other study areas (Table 5). The main point-of-sale households used for veterinary products are presented in Figure 5; most households used vet pharmacies (Agro-Vet) although households in Goma and Setema also used animal health workers (69%) and general shops were used by households in Goro and Cheha (53%) and Limu Seka West (40%). Most interviewees went to a nearby town to source their livestock products.

Participants were asked about drugs they often keep in their household and were also asked to present the packages for any drugs currently in their household. The most common drugs were antibiotics, mainly oxytetracyclin and trypanocides (mainly diminazene aceturate) were mostly kept in Goro and Cheha and Setema and Goma. The households in both Limu Seka study areas did not appear to regularly keep any drugs in the households (<6%). Only 1 household in Goma and Setema said they kept acaracides but were non-specific about the type.

	Goma & Setema	Goro & Cheha	Limu Seka (E)	Limu Seka (W)
Action when cattle are sick				
Consult animal health professional	75.6%	58.8%	97%	88.9%
Consult if disease unknown	22.2%	29.4%	3%	11.1%
Do not consult animal health professional	2.2%	11.8%	-	-
Point of sale of livestock products				
Nearby town	100%	86%	71%	95%
Nearby town & this village	-	3%	12%	5%
This village	-	10%	18%	-
Livestock products in the household				
Diminazene aceturate	13.3%	22.2%	-	2.2%
Isometamidium chloride	2.2%	2.2%	-	-
Ethidium bromide	4.4%	-	-	-
Dewormer	20%	-	-	-
Antibiotics	35.6%	26.6%	-	4.4%
Acaracide	2.2%	-	-	-
No drugs in households	64.4%	75%	97.8%	94.4%

Table 5: Factors related to veterinary treatment practices (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

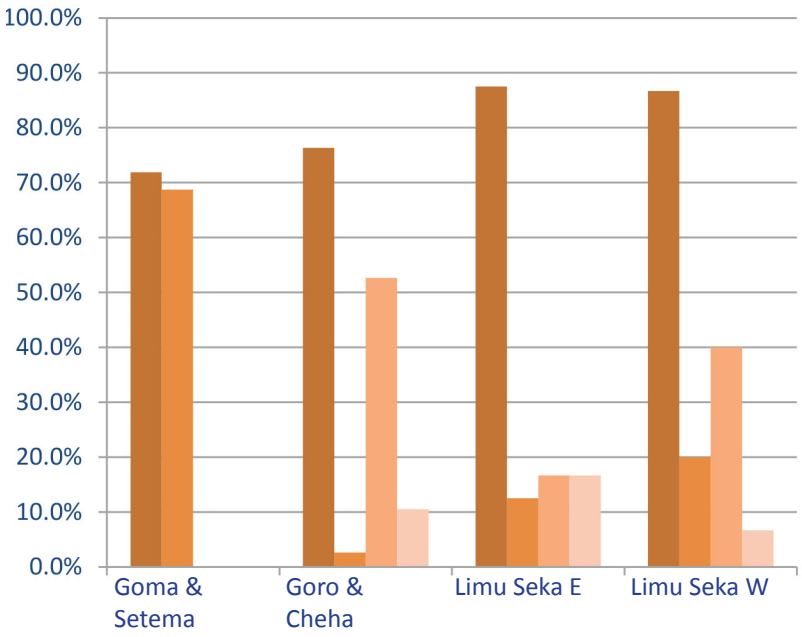


Figure 5: Location of veterinary products point-of-sale, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

Many interviewees did report vaccinating against some diseases (Figure 6). Households reported vaccinating against anthrax (45.9%), pasteurellosis (19.9%; mainly Limu Seka) and blackleg (11.0%; mainly Goma and Setema). All the households said they vaccinate only when there is an official vaccination programme taking place and do not ever vaccinate their animals individually.

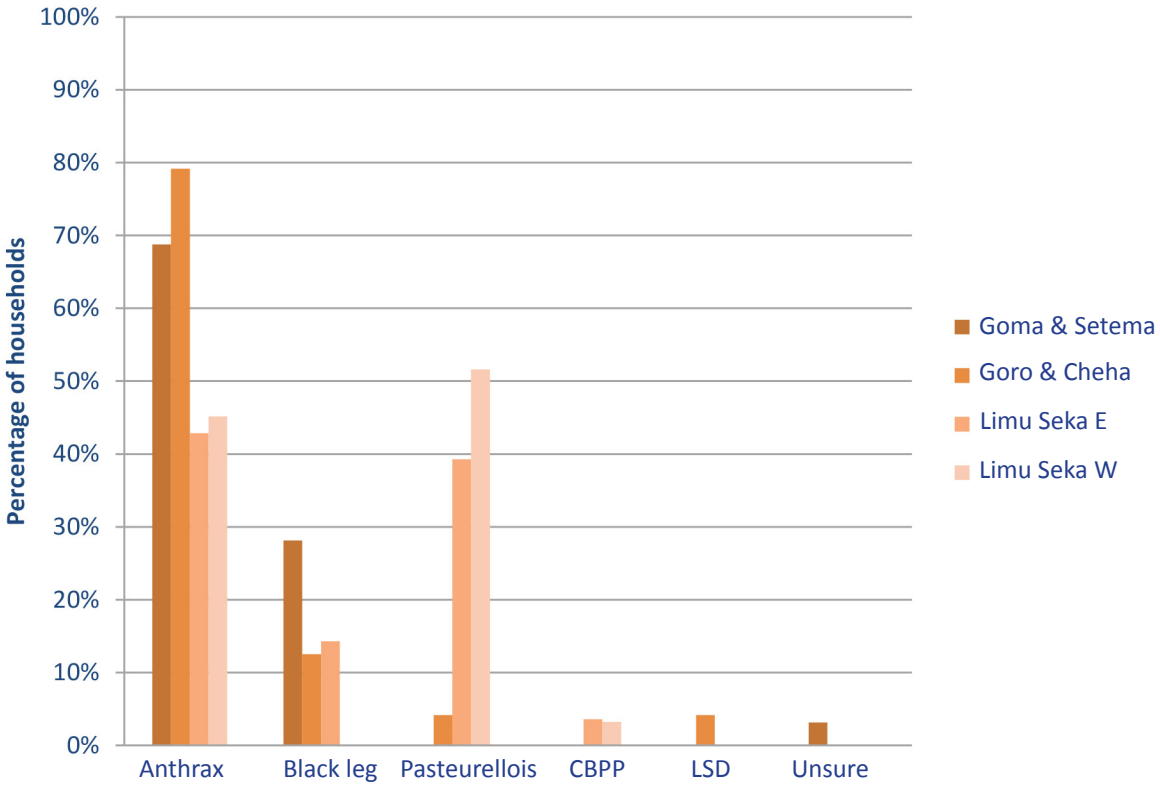
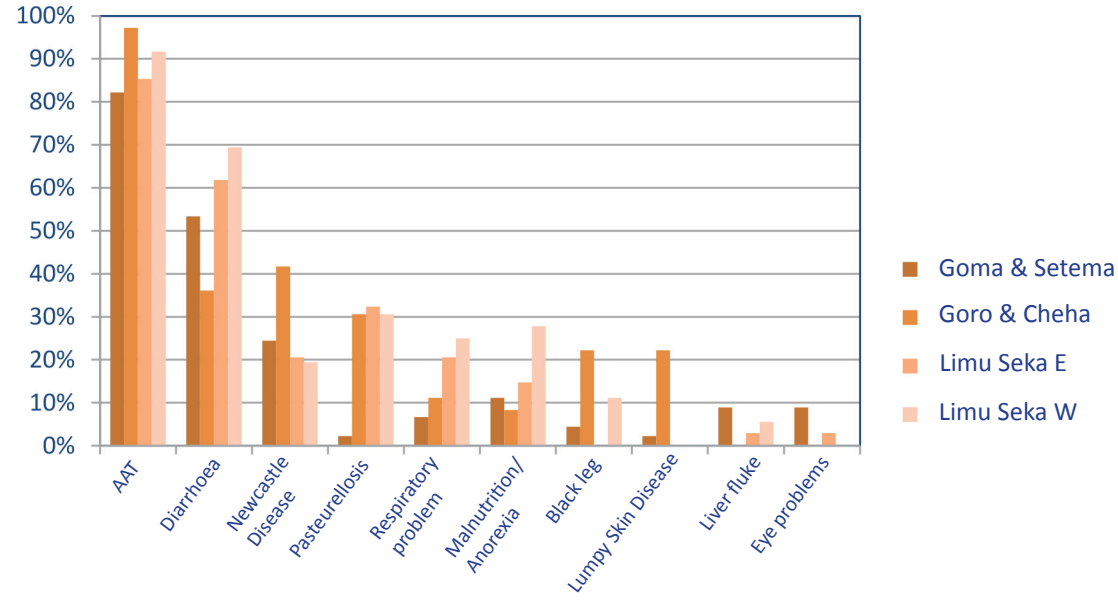


Figure 6: Main diseases cattle were vaccinated against, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

5. Perceived impacts of AAT in the study areas

5.1 Perceptions of AAT occurrence

The following results were obtained when interviewees were asked non-specific questions regarding livestock diseases in the area, with no mention of AAT. When participants were asked to name the major livestock diseases in terms of monetary loss, the majority of households in all study areas mentioned AAT (>80%). In Table 6 diseases are ranked in accordance with the number of households reporting them as problems, according to study area. AAT was ranked as the most important disease in all study areas; diarrhoea, Newcastle disease and pasteurellosis were also commonly mentioned. When asked about insects causing problems in their livestock most interviews mentioned ticks (~90%) and approximately half the households in each study area mentioned tsetse flies; 44%, 53%, 47% and 47% in Goma and Setema, Goro and Cheha and Limu Seka East and West, respectively.



Disease	Rankings
AAT	1
Diarrhoea	2
Newcastle Disease	3
Pasteurellosis	4
Respiratory problems	5
Malnutrition/Anorexia	6
Black leg	7
Lumpy skin disease	8
Liver fluke	9
Eye problems	10

Figure 7 & Table 6: Top 10 diseases according to percentage of households mentioning them as 'important diseases in terms of monetary losses' (data from 151 households interviewed in Ethiopia in April/May 2013).

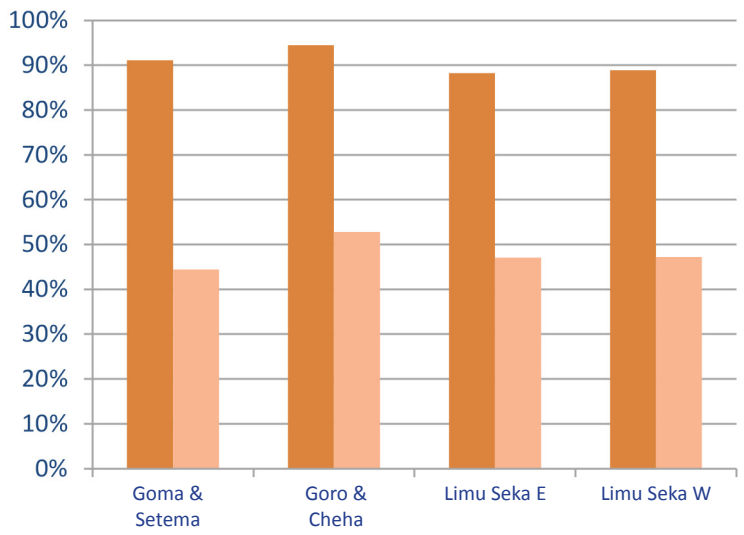


Figure 8: Insects which were reported as causing a problem to livestock according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

Households were shown a picture of a cow suffering from AAT, although the clinical signs exhibited by the cow were non-specific. This information was used as an indication of the relative importance of AAT in the different areas i.e. in areas where AAT was a major problem a household would be more likely to suggest the cow was suffering from AAT. Almost 95% of the households suggested that the cow was infected with AAT; the remainder of the households were unsure and one household said it was nutritional deficiency rather that AAT.

Image 3: AAT infected cow showing typical wasting signs, interviewees were asked to suggest what was wrong with the cow.

After non-specific disease questions were posed to interviewees; the interviewer then asked whether they had heard of AAT. All households said that they had heard of the disease and they were then asked a series of questions to acquire further information on the relative impact of AAT in the areas.

Most livestock keepers considered AAT to be a constant problem in their livestock; 75%, 72%, 70.5%, and 72% in Goma and Setema, Goro and Cheha, Limu Seka East and Limu Seka West, respectively. The remaining households in each study areas said that AAT occurred in their herd at least once per year. Most households reported a seasonal pattern to AAT occurrence, particularly in Goma & Setema and Limu Seka East (>97%). Some households in Goro and Cheha (38.9%) and Limu Seka West (22.2%) said that AAT occurrence was constant (Figure 9).

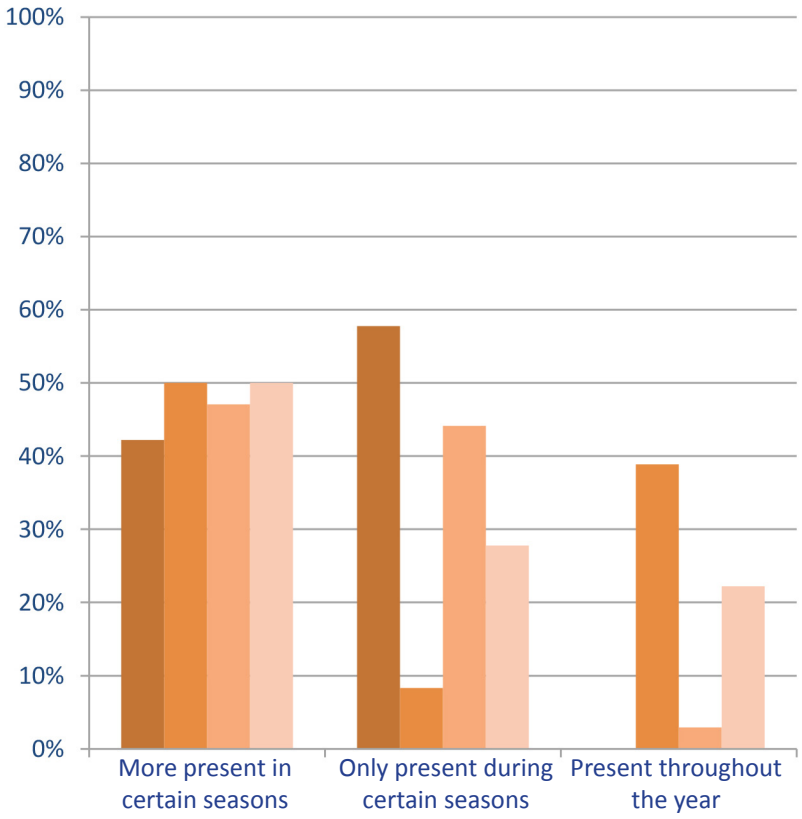


Figure 9: Seasonality of occurrence of AAT according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

5.2 Perceptions of AAT economic impact

The perceived economic impact of AAT varied across study areas as shown in Figure 10. It was mainly estimated as severe or very severe for total income and losses in milk production and draught power. Meat production was affected to a lesser extent. Goma and Setema had the lowest percentage of households reporting very severe losses. In terms of mortality, 67.6% of the households had lost at least one cow due to illness in the past two years. In the Limu Seka study areas a large majority of cattle deaths were due to AAT (Figure 11).

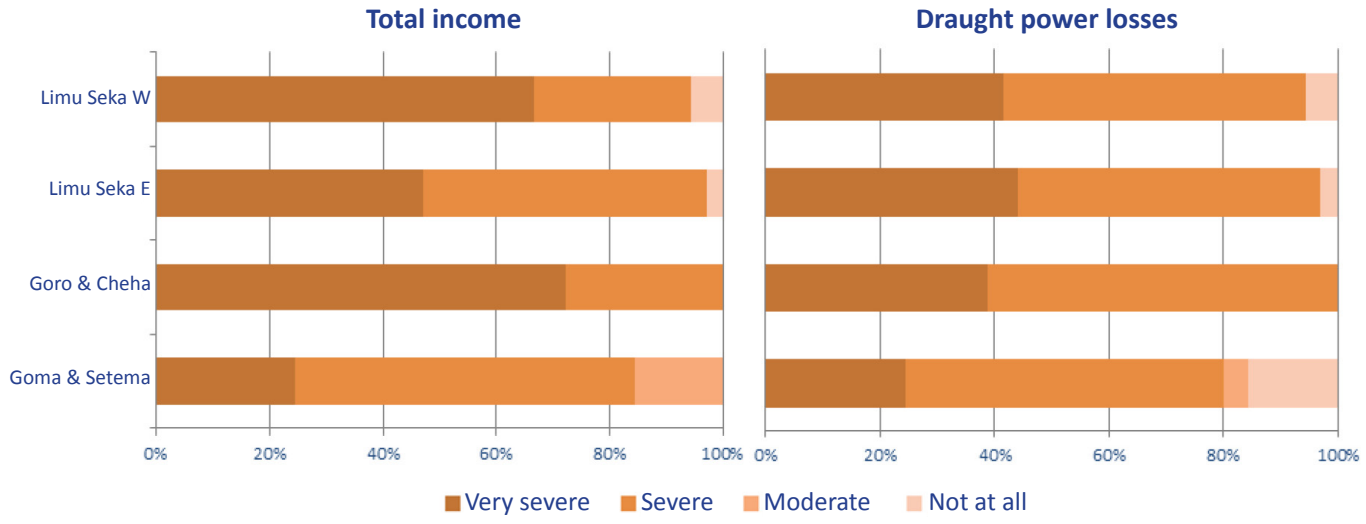


Figure 10: Perception of production losses due to AAT according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

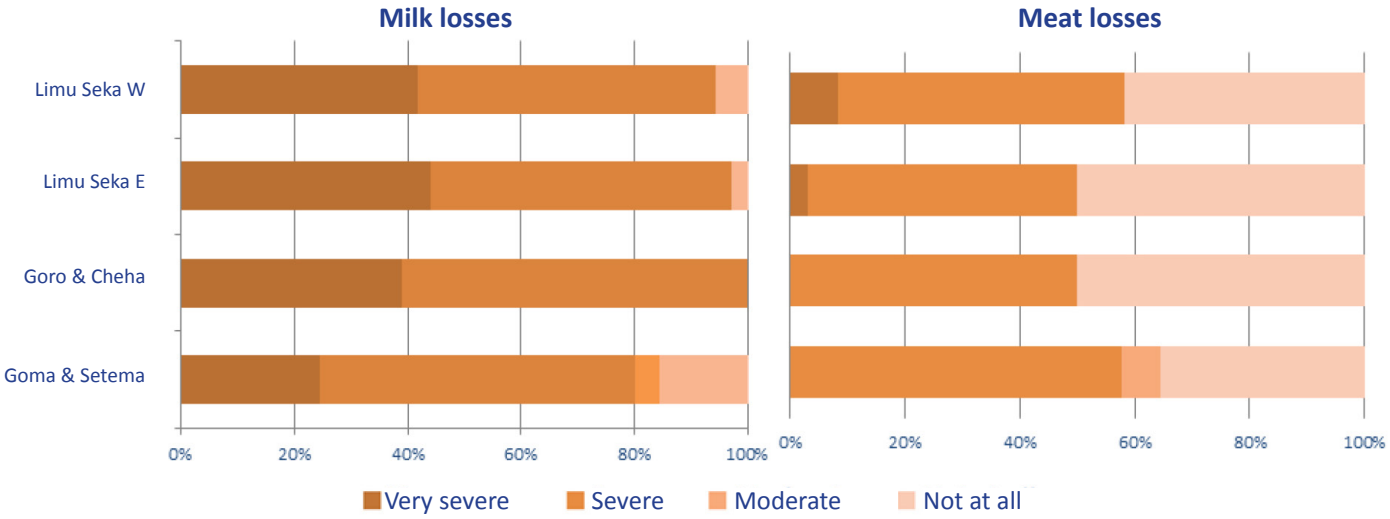


Figure 10 (continued): Perception of production losses due to AAT according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

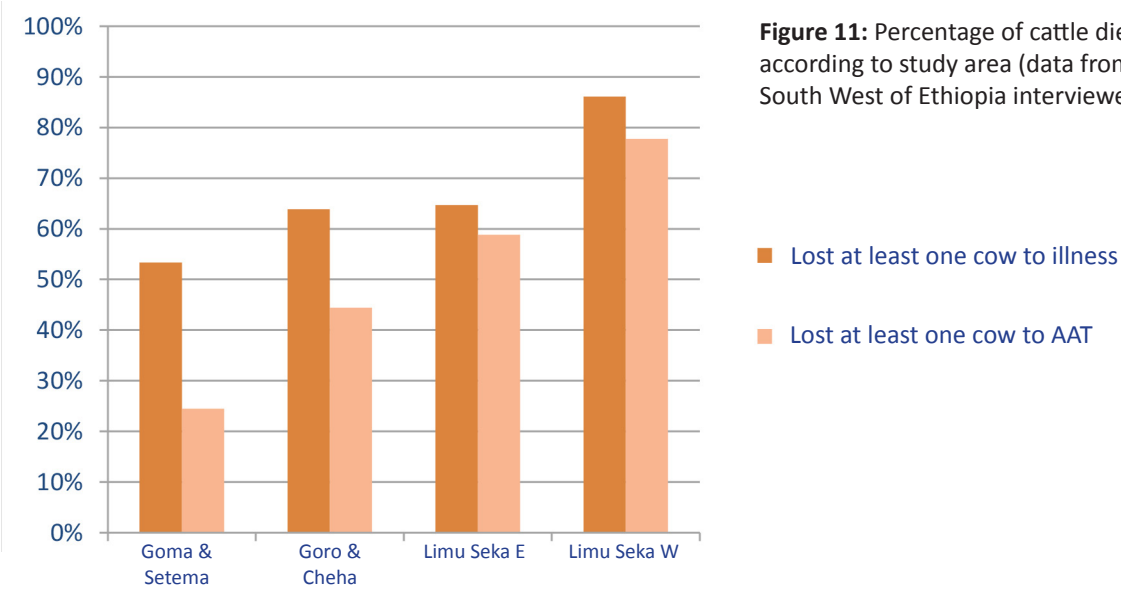


Figure 11: Percentage of cattle died in that past two years according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

Information on total costs of treatment and mortality for all diseases in general, and specifically AAT, are presented in Table 7. Costs of treating AAT tended to be highest in Goro and Cheha and Limu Seka West.

	Goma & Setema	Goro & Cheha	Limu Seka (E)	Limu Seka (W)
Cost (US$) per individual AAT treatment: Median (Q1 & Q3)	 0.64 (0.64 & 1.33)	 1.07 (1 to 1.33)	 0.80 (0.64 & 1.45)	 1.07 (0.8 & 1.07)
Total cost (US$) AAT diagnosis & treatment: % households > 0 Median (Q1 & Q3)	 95% 16.5 (10.7 & 24)	 100% 34.8 (21.4 & 53.5)	 97% 21.4 (16.1 & 37.5)	 97.2% 26.8 (18.1 & 38.8)
Total cost (US$) disease diagnosis & treatment: % households > 0 Median (Q1 & Q3)	 100% 26.8 (16 & 48.2)	 100% 48.1 (32.1 & 80.3)	 97% 32.1 (24.7 & 46.8)	 100% 42.8 (26.8 & 49.5)
Cattle deaths AAT: % households > 0 Median (Q1 & Q3)	 24.4% 3 (3 & 4.5)	 52.8% 2 (2 & 2.25)	 58.8% 2 (1 & 2)	 77.8% 2 (1 & 2)
Cattle deaths (all disease): % households > 0 Median (Q1 & Q3)	 45.7% 3 (1 & 3)	 63.9% 2 (1.5 & 3)	 64.7% 2 (1 & 2)	 86.1% 2 (1 & 2)
Small ruminants deaths AAT: % households > 0 Median (Q1 & Q3)	 2.2% 2 (2 & 2)	 2.8% 2 (2 & 2)	 2.9% 1 (1 & 1)	 - -
Small ruminants (all disease): % households > 0 Median (Q1 & Q3)	 8.9% 2 (1 & 3.25)	 13.9% 2 (1 & 3)	 2.9% 2 (2 & 2)	 19.4% 2 (1.5 & 3.5)
Equines deaths AAT: % households > 0 Median (Q1 & Q3)	 - -	 5.5% 1 (1 & 1)	 2.9% 1 (1 & 1)	 11.1% 1 (1 & 1)
Equines deaths (all disease) % households > 0 Median (Q1 & Q3)	 20% 1 (1 & 1)	 25% 1 (1 & 1)	 14.7% 1 (1 & 1)	 30.5% 1 (1 & 1)

Table 7: Direct losses from AAT and other livestock diseases in terms of treatment costs in US dollars and mortality[2]; null values are excluded from the calculation of medians and quartiles (data from 151 households interviewed in Ethiopia in April/May 2013).

5.3 Attitudes and practices towards AAT diagnosis and treatment in cattle

Diagnosing and treating AAT

The majority of households reported consulting an animal health worker if they suspected their animal had AAT (Figure 12). However, almost half of households interviewed in Goro and Cheha reported dealing with the problem themselves. This is probably because of the constant presence of AAT; therefore farmers are use to dealing with it.

Regarding drug administration, most households always use animal health workers or similar to treat their animals (82.7%), but more than half of households in Goro and Cheha and a third of households in Goma and Setema reported always or often treating their livestock themselves. Those that self-treated reported dosing treatment 'by eye' i.e. they assessed animals' weight by estimating correct dosage based on visual size which could lead to misdosing and potentially resistance.

[2] The study was conducted in June 2013 and at this time the exchange rate of the Ethiopian Birr (EBR) to the Unites States Dollar (USD) according to www.xe.com was 18.08 EBR = 1USD.

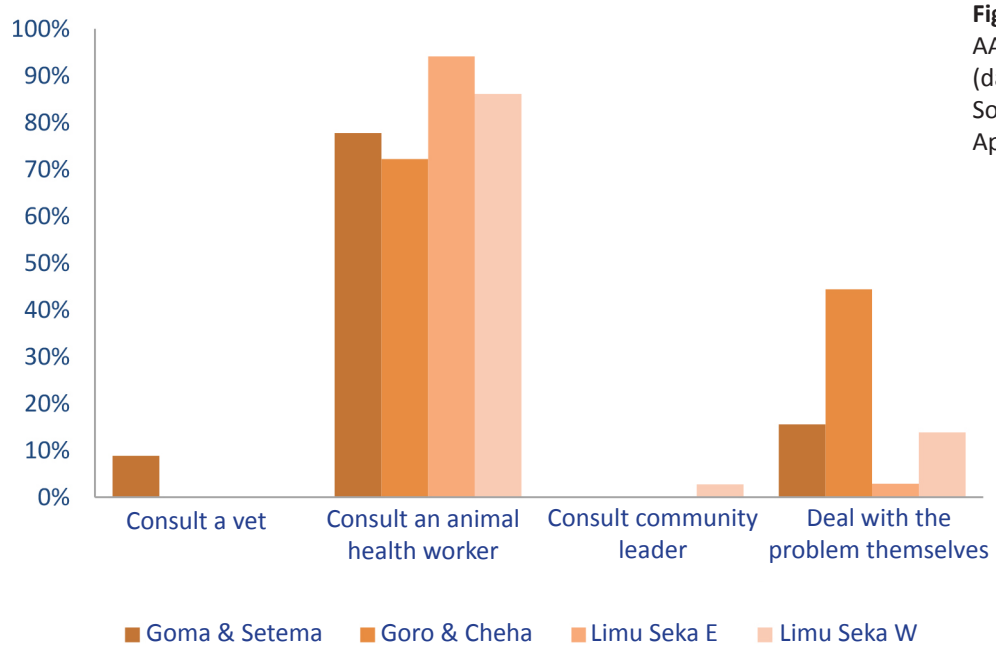


Figure 12: Household action in case of AAT suspicion, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

When asked about the main inconveniences with AAT treatment most interviewees did not provide an answer. Those that did were mainly in Goro and Cheha and these household mentioned obtaining clean (30.6%) or sterile (13.9%) water, correct weight estimation (16.7%) and dosing (13.9%), acquiring consumables (11.1%) and preparing the drugs (8.3%).

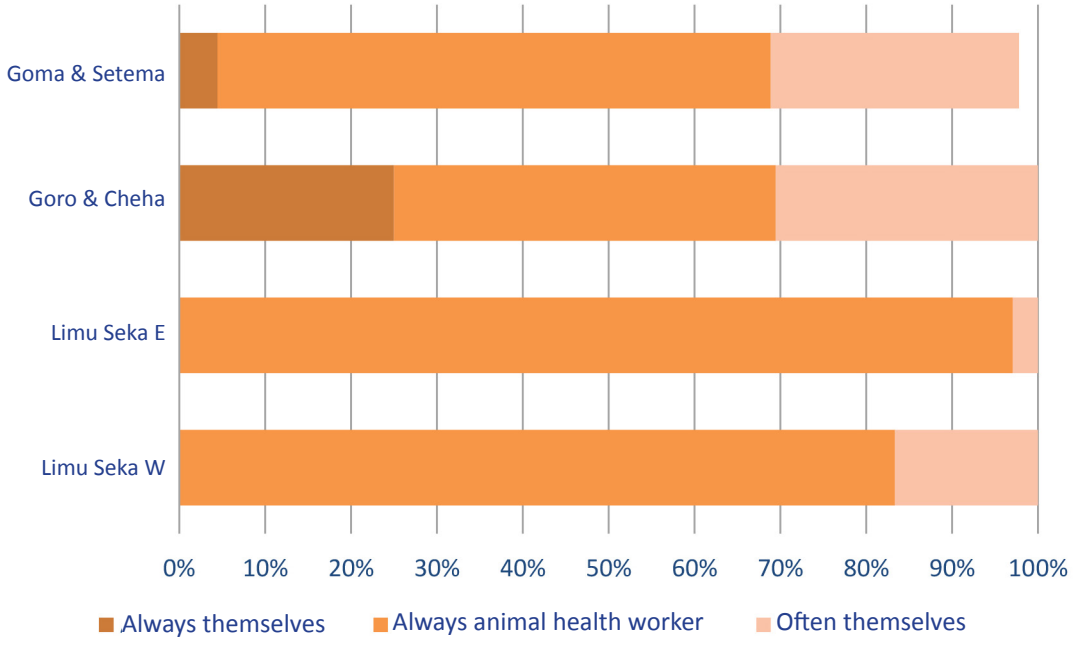


Figure 13: Who treats animals against AAT according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

Perceived treatment failure

Figure 14 shows the percentage of households which experienced treatment failure; and whether this was reported as rare or frequent. Less than a third of households in Limu Seka East (29.4%) and Goma and Setema (20%) had experienced treatment failure. However, more than half (55.6%) of households in Goro and Cheha had reported treatment failure and 38.9% of these reported it to be frequent. Households which had experienced treatment failure mainly attributed it to resistance or misdiagnosis. Additionally, some households in Goro and Cheha also mentioned fake drugs or using the 'wrong drug' (Figure 15).

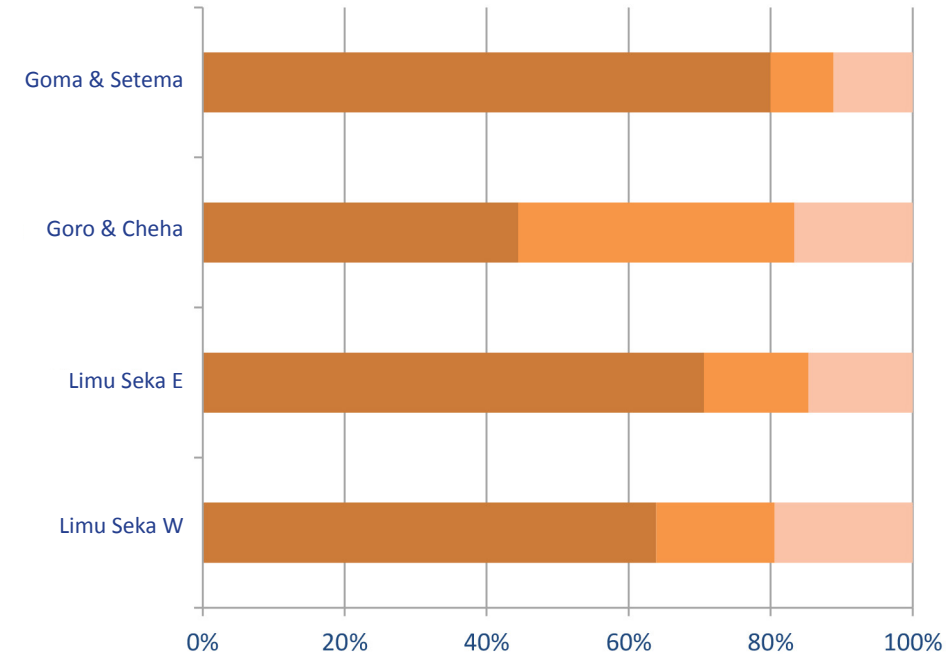


Figure 14: Household perceptions for AAT treatment failure, according to study area (data from 151 households interviewed in Ethiopia in April/May 2013).

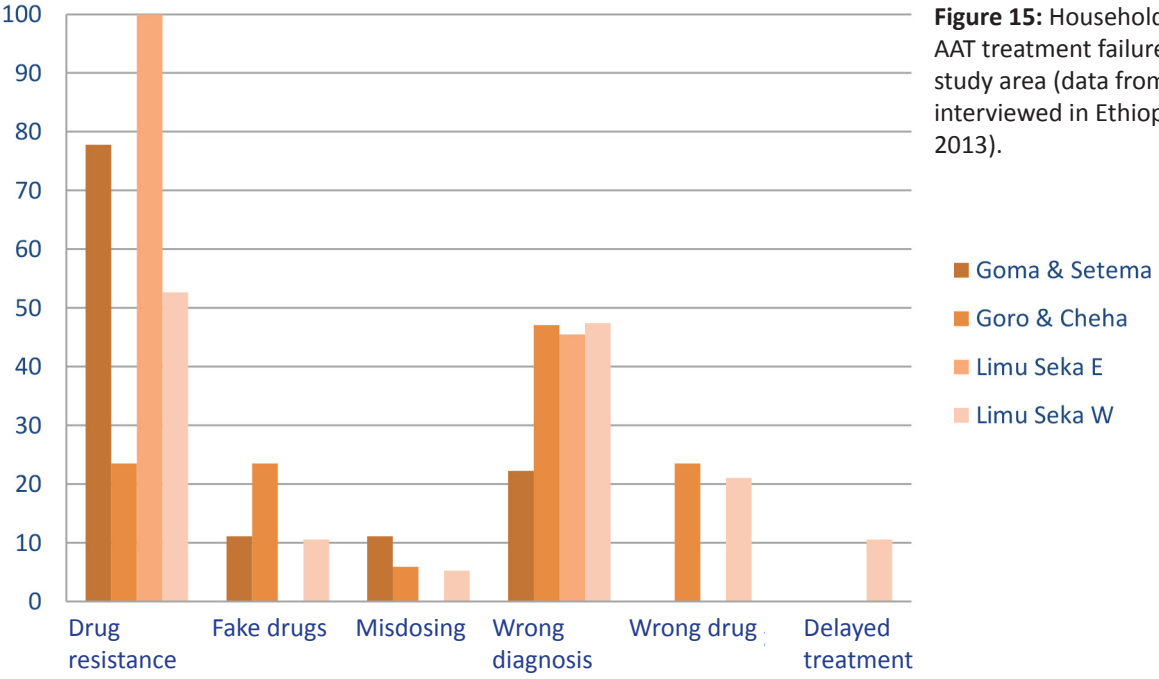


Figure 15: Household perceptions for AAT treatment failure, according to study area (data from 151 households interviewed in Ethiopia in April/May 2013).

5.4 Existing AAT control

Most households did not report any form of existing AAT control except in Goro and Cheha (50%). No households in Limu Seka West reported control and only 2 (4.4%) and 1 (2.9%) households in Goma and Setema and Limu Seka East reported any AAT control, respectively. The types of AAT control mentioned, which was largely insecticide treat cattle (ITC), according to study area, are presented in Figure 16. Figure 17 shows who is responsible for AAT control, according to area (the percentage of interviewees who gave answers to this question is likely to be higher due to AAT control programmes which have occurred in the past).

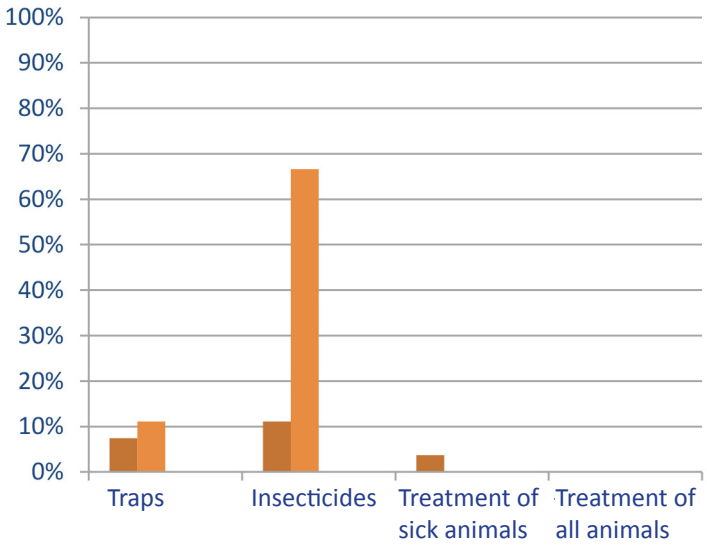


Figure 16: Existing AAT control measures, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

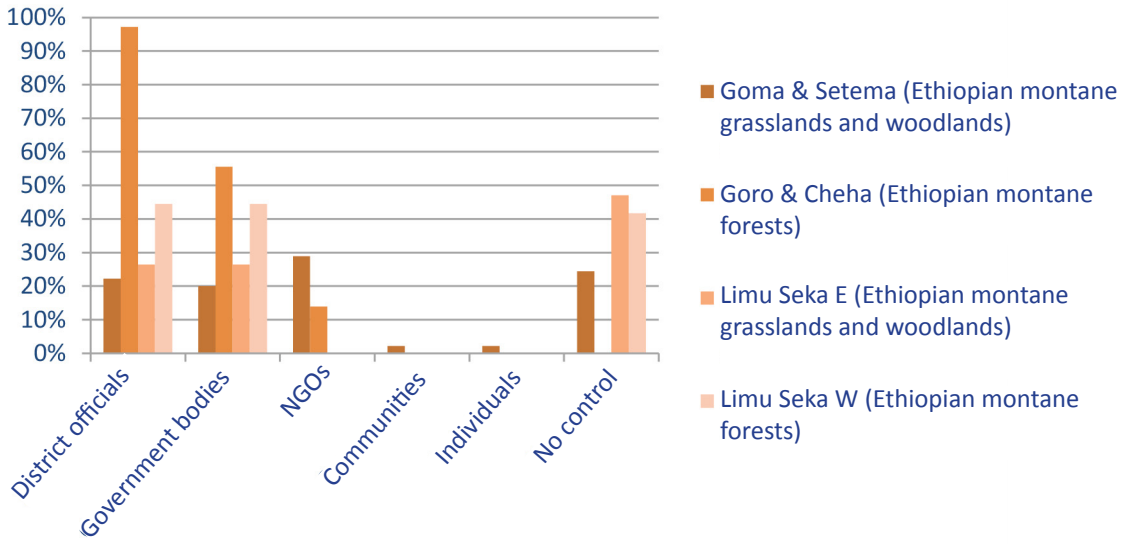


Figure 17: Leaders of AAT control, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

6. Knowledge of AAT

The ability of the interviewees to give accurate information regarding the current AAT situation in the area is dependent on their awareness and knowledge of the disease. Therefore, knowledge of AAT transmission, clinical signs and control was also assessed. Poor knowledge of the disease and control measures could be hindering AAT control in the area, although knowledge is likely to be highly correlated with incidence. When asked to describe AAT; more than half of households described classic symptoms of disease (mainly in Goma & Setema) including; weight loss, malaise and loss of tail brush (Table 8). Almost every household mentioned that it was spread by tsetse flies.

AAT knowledge	% of households
Aware of AAT	
Goma & Setema	95.7%
Goro & Cheha	100%
Limu Seka E	100%
Limu Seka W	100%
Mentioned clinical signs	
Goma & Setema	77.7%
Goro & Cheha	50%
Limu Seka E	55.8%
Limu Seka W	50%
Mentioned that it is spread by tsetse	
Goma & Setema	100%
Goro & Cheha	94.4%
Limu Seka E	100%
Limu Seka W	100%
Mentioned that it is spread by biting flies	
Goma & Setema	44.4%
Goro & Cheha	44.4%
Limu Seka E	44.4%
Limu Seka W	44.4%
Mentioned that it affects other species	
Goma & Setema	2.5%
Goro & Cheha	88.9%
Limu Seka E	35.3%
Limu Seka W	33.3%
Think that AAT is related to human disease	
Goma & Setema	0%
Goro & Cheha	0%
Limu Seka E	2.9%
Limu Seka W	0%

Table 8: General knowledge about AAT, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

Figure 18 shows what species the interviewees named as being susceptible to AAT. All households identified cattle as being susceptible to AAT and some households mentioned donkeys and small ruminants as being affected, mainly in Goro and Cheha.

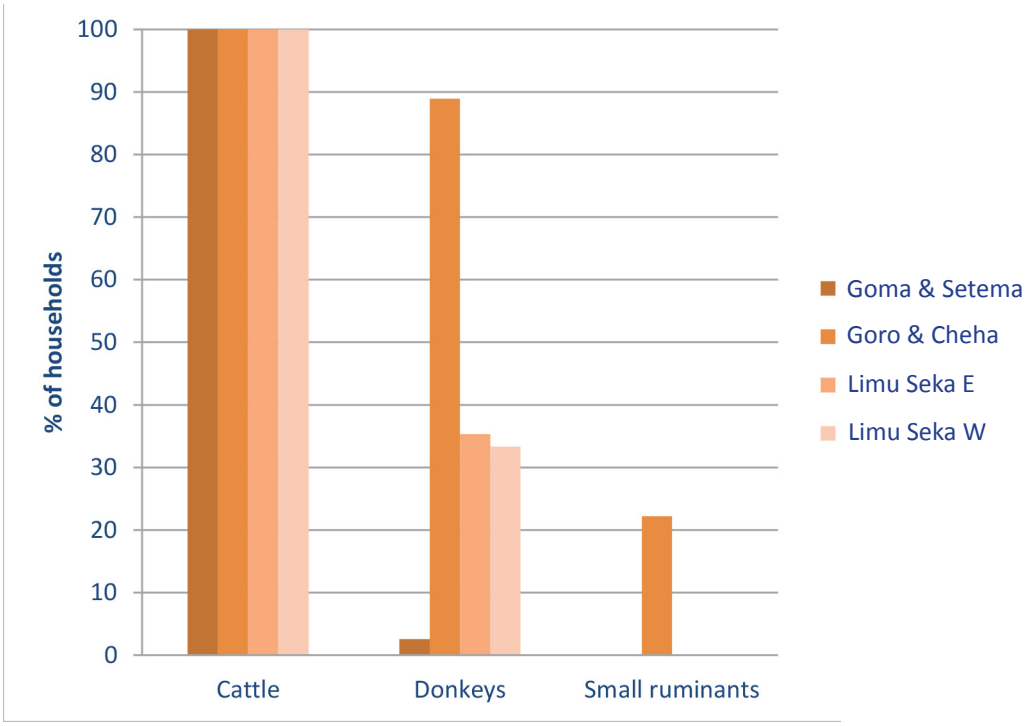


Figure 18: Species farmers think they are susceptible to AAT, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

	Goma & Setema	Goro & Cheha	Limu Seka (E)	Limu Seka (W)
Said they knew how to control AAT: % households	93.3%	97.2%	79.4%	100%
Could identify a picture of tsetse trap: % households	46.7%	100%	76.5%	100%
Control measures mentioned (awareness):				
Tsetse traps	91.1%	100%	79.4%	100%
Insecticide treated cattle	42.2%	100%	8.8%	16.7%
Treat sick cattle	31.1%	66.7%	38.2%	58.3%
Treat all cattle	22.2%	2.8%	2.9%	0%

Table 9: Knowledge of AAT control, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

7. Attitudes towards future AAT control

7.1 Population opinion about new control methods

Consumer willingness to use and pay for new treatments

Most households in all study areas thought there is a need for new drugs and would be ready to pay a higher price than current AAT treatment if it were more effective (Table 10).

	Think there is a need for new AAT treatments	Would be willing to pay for a new treatment
Goma & Setema	95.6%	95.6%
Goro & Cheha	100%	97.2%
Limu Seka E	100%	97.1%
Limu Seka W	100%	100%

Table 10: Proportions of farmers who think there is a need for new drugs and would be ready to pay a higher price for it, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

	Want diagnostic	Willing to pay >0	Median cost (Q1 & Q2) in US$[3]
Goma & Setema	91.1%	88.9%	1.2 (0.76 to 1.73)
Goro & Cheha	100%	38.9%	0.20 (0.26 to 0.5)
Limu Seka E	97.1%	26.5%	0.26 (0.26 to 0.54)
Limu Seka W	100%	30.6%	0.26 (0.13 to 0.40)

Table 11: Proportion of farmers who would use new AAT diagnostics, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

[3] The study was conducted in June 2013 and at this time the exchange rate of the Ethiopian Birr (EBR) to the United States Dollar (USD) according to www.xe.com was 18.08 EBR = 1USD.

Figure 19 and Table 12 show the willingness to pay for a diagnostic test at each price interval (% households willing to pay each price, or higher). Households in Goma and Setema were consistently willing to pay the highest prices.

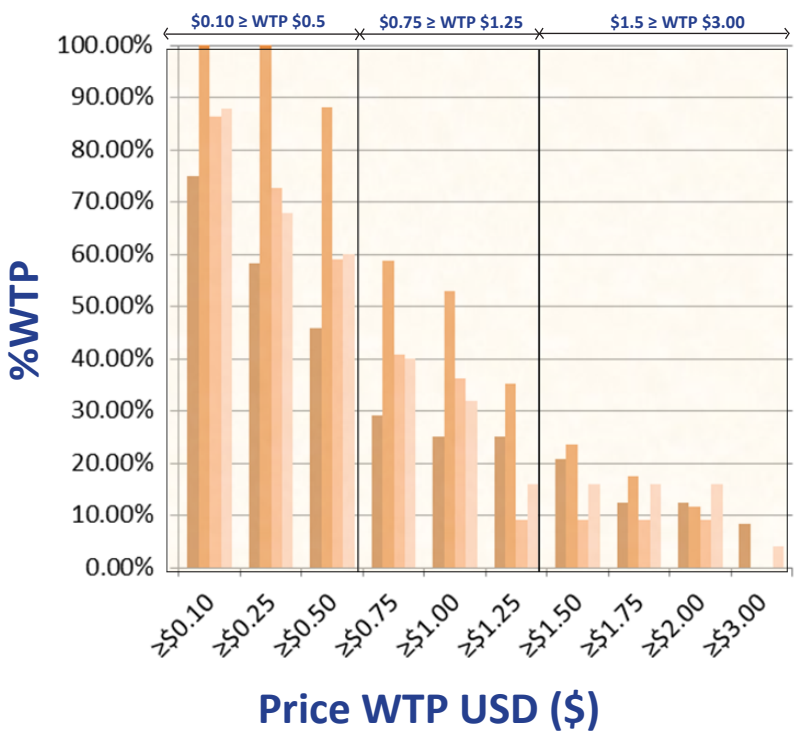


Figure 19: Distribution of the cost (in USD) households would be willing to pay for an individual AAT diagnostic test, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

WTP US$	Goma & Setema	Goro & Cheha	Limu Seka E	Limu Seka W
≥$0.10	10%	10%	10%	100%
≥$0.25	10%	10%	88.9%	63.6%
≥$0.5	91.7%	42.9%	44.4%	27.3%
≥$0.75	75%	7.1%	-	-
≥$1.00	58.3%	7.1%	-	-
≥$1.25	5%	7.1%	-	-
≥$1.5	41.7%	-	-	-
≥$1.75	25%	-	-	-
≥$2	25%	-	-	-
≥$3	8.3%	-	-	-

Table 12: Distribution of the cost (in USD) households would be willing to pay for an individual AAT diagnostic test, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

Consumer willingness to use and pay for AAT vaccines

Most households interviewed would vaccinate their livestock against AAT if a vaccine became available (Table 13). However less than half of households said they would pay for a vaccine in the Goro and Cheha study area.

	Goma & Setema	Goro & Cheha	Limu Seka (E)	Limu Seka (W)
Would vaccinate	97.8%	97.2%	100%	100%
Willing to pay > 0	95.6%	47.2%	64.7%	69.4%
Median cost (Q1 & Q2) in US$[4]	0.2 (0.1 & 0.93)	1.07 (0.53 & 1.33)	0.53 (0.18 & 1.07)	0.53 (0.16 & 1.07)

Table 13: Distribution of the cost (in USD) households would be willing to pay for an individual AAT vaccine, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

Figure 20 and Table 14 show the willingness to pay for a vaccine at each price interval (% households willing to pay each price, or higher). Households in Goro & Cheha appeared more willing to pay for a vaccine, whereas households in Goro and Cheha appeared to be less willing to pay for a novel vaccine.

[4] The study was conducted in June 2013 and at this time the exchange rate of the Ethiopian Birr (EBR) to the Unites States Dollar (USD) according to www.xe.com was 5.33 = 1USD.

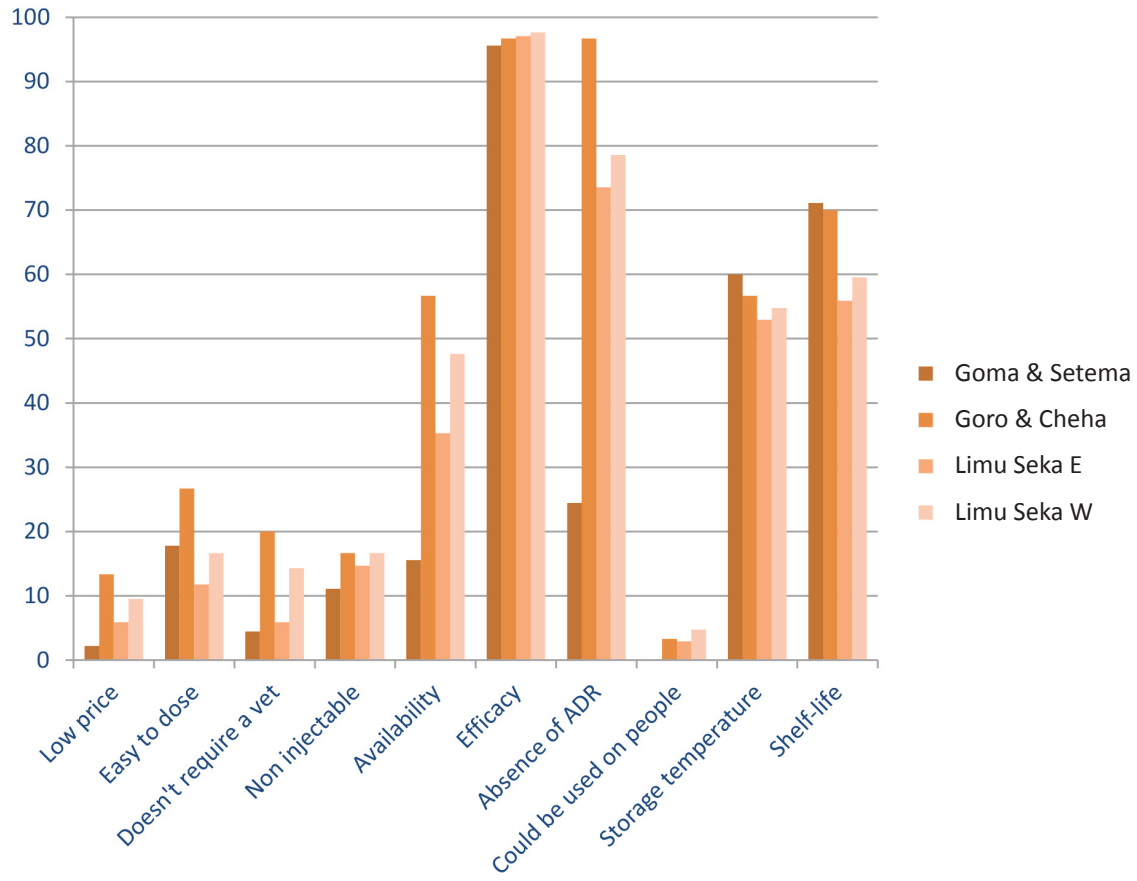
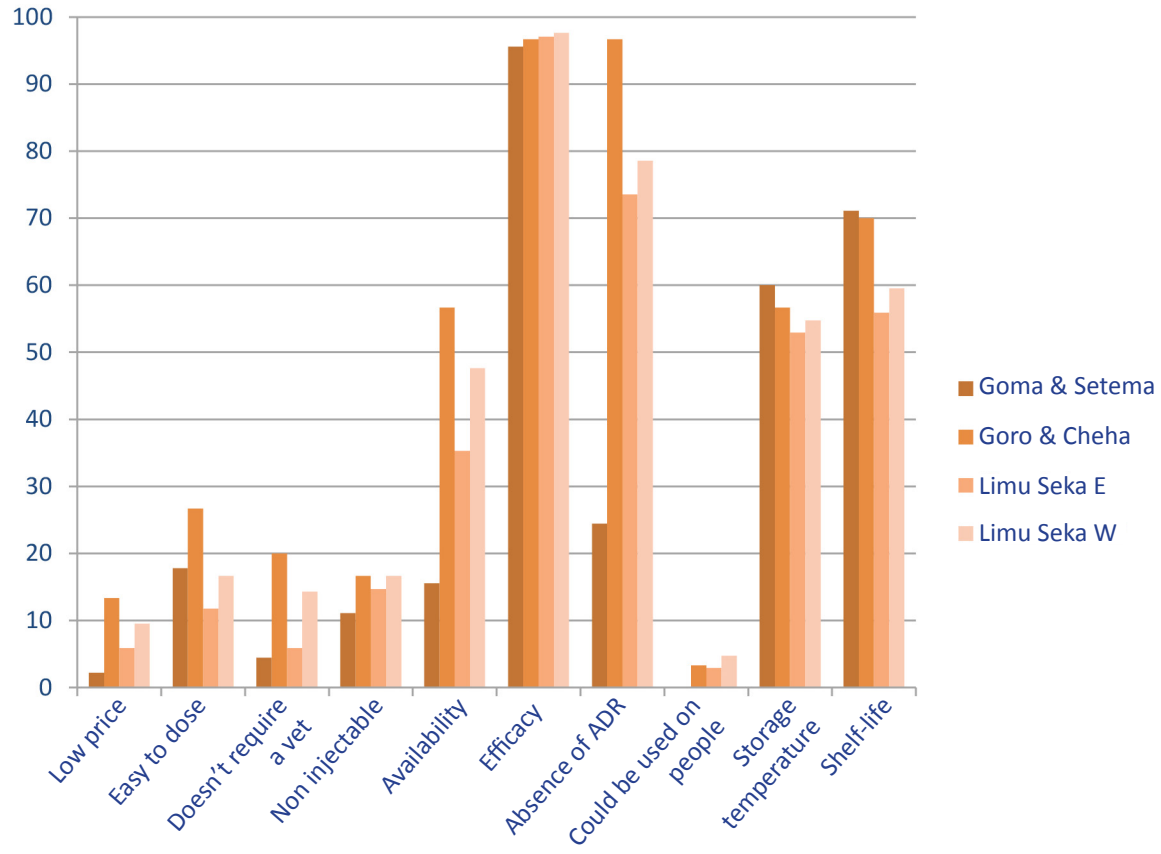


Figure 20 (page 25) and Table 14 below: Cost (in dollars) households would be willing to pay for an individual AAT vaccine, according to study area (data from 151 households in the South West of Ethiopia interviewed in April/May 2013).

WTP US$	Goma & Setema	Goro & Cheha	Limu Seka (E)	Limu Seka (W)
≥$0.10	75%	100%	86.4%	88.%
≥$0.25	58.3%	100%	72.7%	68%
≥$0.50	45.8%	88.2%	59.1%	60%
≥$0.75	29.2%	58.8%	40.9%	40%
≥$1.00	25.0%	52.9%	36.4%	32%
≥$1.25	25.0%	35.3%	9.1%	16%
≥$1.50	20.8%	23.4%	9.1%	16%
≥$1.75	12.5%	17.7%	9.1%	16%
≥$2.00	12.5%	11.8%	9.1%	16%
≥$3.00	8.33%	-	-	4%

7.2 Important factors to take into account for new drug development

During discussions with farmers it became clear that they had difficulties with some aspects of veterinary treatments. The main factors households considered during drug decision making is that they "know the drug works on disease", that there are no Adverse Drug Reactions (ADRs), that the drug "could be kept at room temperature" and "used for later infections", and that the drug was available in local areas.



Conclusions

> Livestock were more likely to be the primary source of income for households in Limu Seka (West); in other areas households were predominantly crop farmers. In addition to cattle, sheep, goats and poultry; equines were of importance in the study areas.

> Livestock were more likely to be the primary source of income for households in Limu Seka (West); in other areas households were predominantly crop farmers. In addition to cattle, sheep, goats and poultry; equines were of importance in the study areas.

> Households mainly kept zebu (Trypanosensitive) cattle and these were free-grazed.

> AAT was constantly present and farmers' generally perceived the impact as severe to very severe; with losses to draught power and milk production. Households in Limu Seka (West) were most likely to have lost at least one cattle to AAT in the previous two years (77.8%) and households in Goma & Setema were the least likely to have experienced this (24.4%).

> Households in Goro & Cheha (22.2%) and Goma & Setema (13.3%) were more likely to regularly keep trypanocides in the household. Most households (although fewer in Goro & Cheha) would use an animal health worker to diagnose and treat AAT. Goro & Cheha were the most likely to report treatment failure and reasons attributed to this were mainly resistance, misdiagnosis or fake or wrong drugs.

> In terms of AAT control, around two thirds of households in Goro and Cheha insecticide treated cattle with district officials or government bodies responsible for AAT control. This area had the best knowledge of AAT control.

> Most households wanted new AAT treatments and were willing to pay more than they currently pay for trypanocides if they were more effective. Households in Goma & Setema had the highest willingness to pay for diagnostics. Goro & Cheha had the highest willingness to pay for a vaccine at most price intervals (should one become available).

References

1. Bossche, P.v.d., et al., A changing environment and the epidemiology of tsetse-transmitted livestock trypanosomiasis. Trends in Parasitology, 2010. 26(5): p. 236-243.
2. PAAT, On Target Against Poverty: The Program Against African Trypanosomiasis. 2008.
3. Selby, e.a., Systematic review of Animal African Trypanosomosis (AAT) in cattle and tsetse control programs in Sub-Saharan Africa. In preperation.
4. Waiswa, C., W. Olaho-Mukani, and E. Katunguka-Rwakishaya, Domestic animals as reservoirs for sleeping sickness in three endemic foci in south-eastern Uganda. Annals of Tropical Medicine and Parasitology, 2003. 97(2): p. 149-155.
5. Mwebaze, S.M.N., Country Pasture/Forage Resource Profiles: Uganda. FAO, 2006.
6. Food and Agriculture Organization of the United Nations, FAO GEONETWORK. 2013, FAO: Rome, Italy.
7. Olson, D.M., et al., Terrestrial Ecoregions of the World: A New Map of Life on Earth. BioScience, 2001. 51(11): p. 933-938.
8. Reynolds, S., J. Suttie, and P. Staberg, Country pasture profiles. 2005: p. unpaginated.
9. Nyeko, P. and F.M. Olubayo, Participatory assessment of farmers' experiences of termite problems in agroforestry in Tororo District, Uganda. Network Paper - Agricultural Research and Extension Network, 2005(143): p. 15 pp.
10. Statistics., U.B.o., Uganda Population and Housing Census 2002.
11. Simarro, P., et al., The Atlas of human African trypanosomiasis: a contribution to global mapping of neglected tropical diseases. International Journal of Health Geographics, 2010. 9(1): p. 1-18.
12. Wortmann, C.S. and C.A. Eledu, Uganda's Agroecological Zones: A Guide for Planners and Policy Maker. 1999: CIAT.

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