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REGULAR ARTICLES

Factors associated with persistence of African animal trypanosomiasis in Lango subregion, northern Uganda

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Abstract

African animal trypanosomiasis (AAT) continues to inflict heavy losses on livestock production especially cattle in terms of decreased production and productivity in Uganda. AAT is a disease complex caused by tsetse fly-transmitted *Trypanosoma brucei brucei, Trypanosoma brucei rhodesiense, Trypanosoma congolense, and Trypanosoma vivax.* The disease is most important in cattle but also known to cause serious losses in pigs, camels, goats, and sheep. Several control measures including live bait technology, mass treatment of cattle with trypanocidal drugs, and deployment of tsetse traps have been used in the past 10 years, but the problem still persists in some areas. This necessitated an exploration of the factors associated with continued trypanosome infections in cattle, which are also known reservoirs for the zoonotic trypanosomiasis. A structured questionnaire was administered to 286 animal owners from 20 villages purposively selected from Lira, Kole, and Alebtong districts of Lango subregion to obtain information on the factors associated with persistence of infection. Over 50% of the respondents reported trypanosomiasis as a major challenge to their livestock. Land ownership ($P = 0.029$), type of livestock kept ($P = 0.000$), disease control strategy employed ($P = 0.000$), source of drugs ($P = 0.046$), and drug preparation ($P = 0.017$) were associated with persistent AAT infection. We recommend continued farmer sensitization on the threat of AAT and the available prevention and control options. The use of isometamidium chloride for prophylaxis against trypanosomiasis is highly recommended. There is also a need to foster qualified private veterinary drug supply in the region.

Keywords African animal trypanosomiasis · Uganda · Lango sub region · Isometamidium chloride · Trypanosomes

Abbreviations

AAT	African animal trypanosomiasis
COCTU	Coordinating Office for the Control of Trypanosomiasis in Uganda
TIBA	Tackling Infections to Benefit Africa
UBOS	Uganda Bureau of Statistics, *T.vivax*, *Trypanosoma vivax*; *T.congolense*, *Trypanosoma congolense*

Introduction

According to Uganda Bureau of Statistics (UBOS), Uganda has an estimated 14 million cattle, 4 million sheep, and 14 million goats, most of which are kept in the semi-arid cattle corridor. The Lango subregion forms part of the cattle corridor. The delivery of veterinary services in this area was severely affected by the civil conflict that ravaged the region between 1986 and most of the 1990s. Postconflict initiatives including livestock restocking exercises have been undertaken to ensure recovery of this region. However, these initiatives have been blamed for the spread of human trypanosomiasis from endemic areas of southeastern Uganda to these formerly sleeping sickness–

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free areas (Fèvre et al. 2001; Picozzi et al. 2005; Welburn et al. 2001). The spread of trypanosomiasis is also associated with factors such as hard-to-reach populations living in remote areas. Lango subregion is a hard to reach area and the prevalence of animal trypanosomiasis in the subregion has been reported to be 17.5% (Selby et al. 2013). Despite the various control interventions especially targeted at cleansing the cattle of infection under the Stamp Out Sleeping Sickness (SOSS) project (Mukiibi et al. 2017; Waiswa and Kabasa 2010), *T. brucei brucei, T.congolense,* and *T.vivax* still persist in the cattle reservoir (Von Wissmann et al. 2011). Several factors including the gradual decline in the delivery of state veterinary services especially due to unfavorable policies and insecurity in some parts of Uganda (Bugeza et al. 2017) could be contributing to the persistence of trypanosome infection in cattle. Other possible drivers include communal grazing of livestock which has been associated with high probability trypanosomiasis infections (Von Wissmann et al. 2011). Affordability of acaricide/insecticides and trypanocidal drugs is another factor where farmers who can afford are less likely to report cases of trypanosomiasis compared with those that are cannot afford the drug. The age of cattle that has also been associated with trypanosomiasis, where older cattle (greater than 36 months) are more likely to be infected compared with the young cattle (less than 18 months) (Miller 2017; Rutto et al. 2013; Von Wissmann et al. 2011). Rutto et al. (2013) have also reported that farming communities in trypanosomiasis endemic areas who know and understand the drivers leading to persistence of trypanosomiasis are more likely to report trypanosomiasis cases than their uninformed counterparts. The implementation of the structural adjustment programs in the late 1980s resulted in the Uganda liberalization and decentralization of the provision of veterinary services in Uganda. Consequently, many actors became involved in the provision of veterinary services in Uganda (Ilukor et al. 2013). These actors came with varying capacities, interests, and relevance, yet they were not effectively regulated (Mbowa et al. 2012). As a result, the veterinary market has been flooded with cheap substitutes from competing pharmaceutical companies all over the world yet the quality of some of these substitutes is questionable (Mbowa et al. 2012). Moreover, there is great misuse of these pharmaceutical products by farmers due to lack of access to qualified veterinary professionals in hard to reach postconflict areas. This has negatively affected the efficacy of animal drugs and has contributed to antimicrobial resistance in both animals and humans (Byarugaba 2004; Byarugaba et al. 2011; Joloba et al. 2001) that may also be partly responsible for the persistence of trypanosomes in cattle in the Lango subregion. These observations necessitated an in-depth assessment of the factors associated with the persistence of trypanosomiasis in cattle in the Lango subregion.

Materials and methods

Study location

This study was conducted in Lango subregion found in Northern Uganda as shown in Fig. 1. The region was purposively selected for this study because it had persistence of *Trypanosoma brucei rhodesiense* infection in cattle reported in the 2015 survey by the Coordinating Office for Control of Trypanosomiasis in Uganda (COCTU). Additionally, COCTU was still receiving reports of sleeping sickness in the selected districts between by 2017.

Study design

A cross-sectional design was adopted for this study. The study was carried out between April and May 2018. Three districts (Lira, Kole, and Alebtong), 11 subcounties, and 20 villages were purposively sampled based on the 2015 survey carried out by University of Edinburgh and COCTU. All the 20 villages included in the study registered high prevalence of *Trypanosoma brucei rhodesiense* in cattle. All willing livestock owners from the targeted villages who offered their cattle for blood sampling during the Tackling Infections to Benefit Africa (TIBA) rapid impact study were recruited for questionnaire administration. A total of 286 farmers participated in the study. The farmers were taken through the questionnaire by the interviewer with the responses recorded by the interviewer.

Data analysis

Data was entered into Ms. Excel (Microsoft Office 2011) and exported to SPSS version 20 for analysis. Frequency distributions and percentages were used to summarize the data. The chi-square test was used to establish the relationship between the dependent variable (continued trypanosome cattle infection) and each independent variables and $P < 0.05$ was considered significant.

Results

Distribution of respondents across the sampled villages

There were 286 respondents distributed in the 20 villages as indicated in Fig. 2.

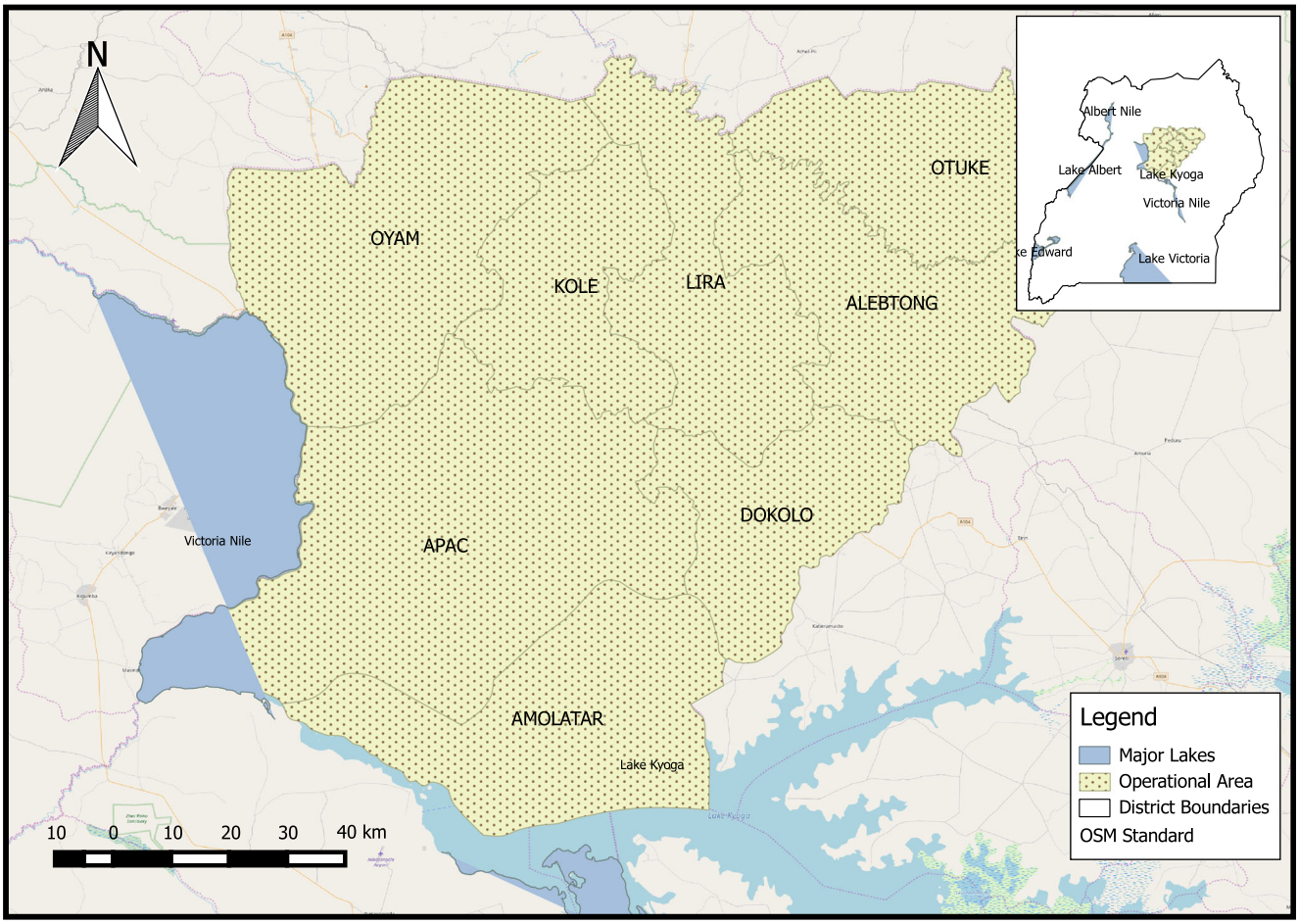

Fig. 1 Map of Uganda showing Lango subregion

Type of livestock kept

Seven (7) livestock types were registered from respondents. More than 31% of respondents keep cattle, 25.2% keep goats, 9% keep pigs, 28.6% keep chicken, 5.5% keep sheep, and 0.2% keep donkeys as shown in Fig. 3. Over 90% of the cattle kept were indigenous breed and the majority of cattle owners (76.6%) keep them as a source of alternative income while others keep them for other reasons including hobbies.

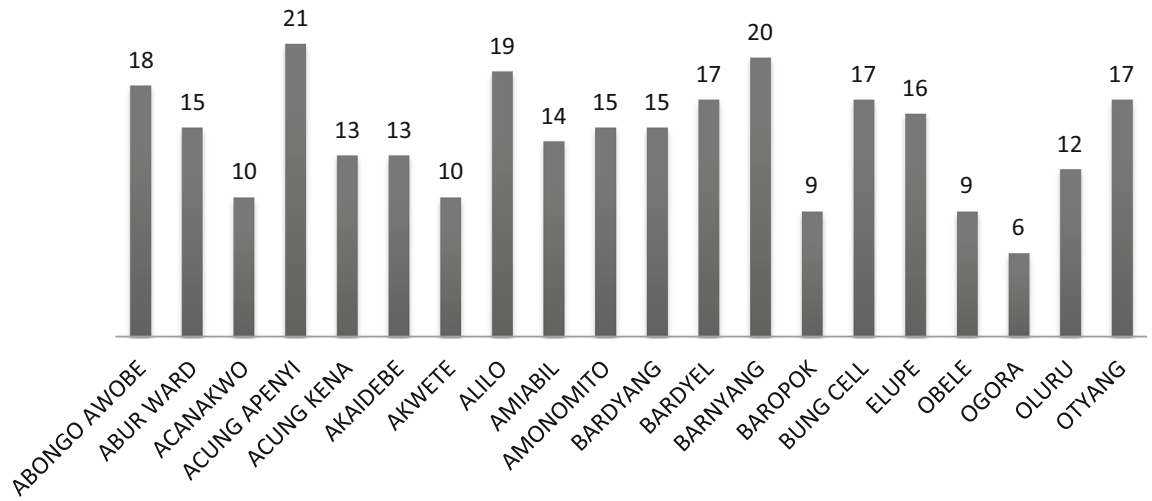

Fig. 2 Distribution of respondents across the sampled villages

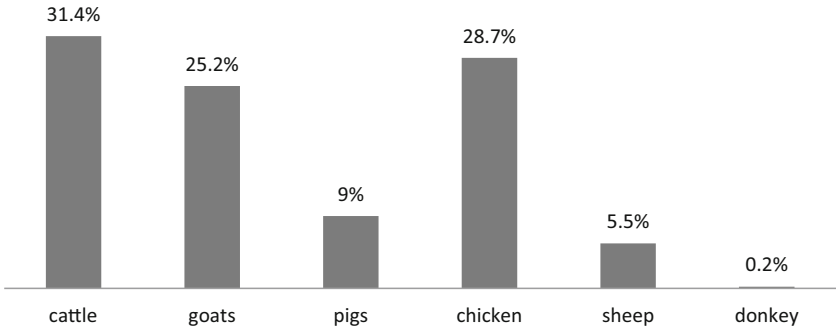

Fig. 3 Type of livestock kept

Diseases affecting livestock and their treatment/control

Over 50% of the respondents said that AAT was the major disease affecting their cattle, followed by lumpy skin disease (7.3%), tick-borne diseases (8.5%), and diarrhea (11.6%) as shown in Fig. 4.

Over 49% of the respondents treated their cattle with diminazene diaceturate as a curative treatment for trypanosomiasis in cattle and 14.7% used albendazole for deworming. Over 9% of the farmers used tetracycline, 5% used Colvasone (dexamethasone) and 4.2% used penicillin and streptomycin. The treatments given indicate that trypanosomiasis, worm infestation, and bacterial infections are the major livestock health challenges in the area.

Type of flies affecting livestock and trypanosomiasis control strategies

Most of the respondents (90%) reported stomoxys flies as a major burden, 9% reported tabanids, and 1% reported tsetse flies (Fig. 5). Over 45% of the respondents reported to control trypanosomiasis using prophylactic treatment, 19.2% using curative treatment, 34.5% avoid grazing their animal in shrubs, while 1% do nothing about it. Over 99% of the respondents reported that they treat animals by themselves, and only 0.2% reported using government veterinarians. Over 86% of respondents reported sourcing their veterinary drugs from agro vet shops, 10.1% from the local vets, while 3.6% from the markets. Ninety-five percent (95%) of the respondents were using an insecticide to spray their cattle while 5% were not spraying at all. Over 20% of farmers reported spraying their cattle using amitraz, 6% using Cypertix (cypermethrin), 1% using Norotraz (amitraz 12.5%), 69% using tsetse traps and none of the respondents reported using deltamethrin to spray their cattle.

Factors associated with continued trypanosome cattle infection

There was a significant relationship between continued trypanosomiasis infection in cattle and land ownership ($P = 0.029$). Over 73% of the respondents reported that they grazed

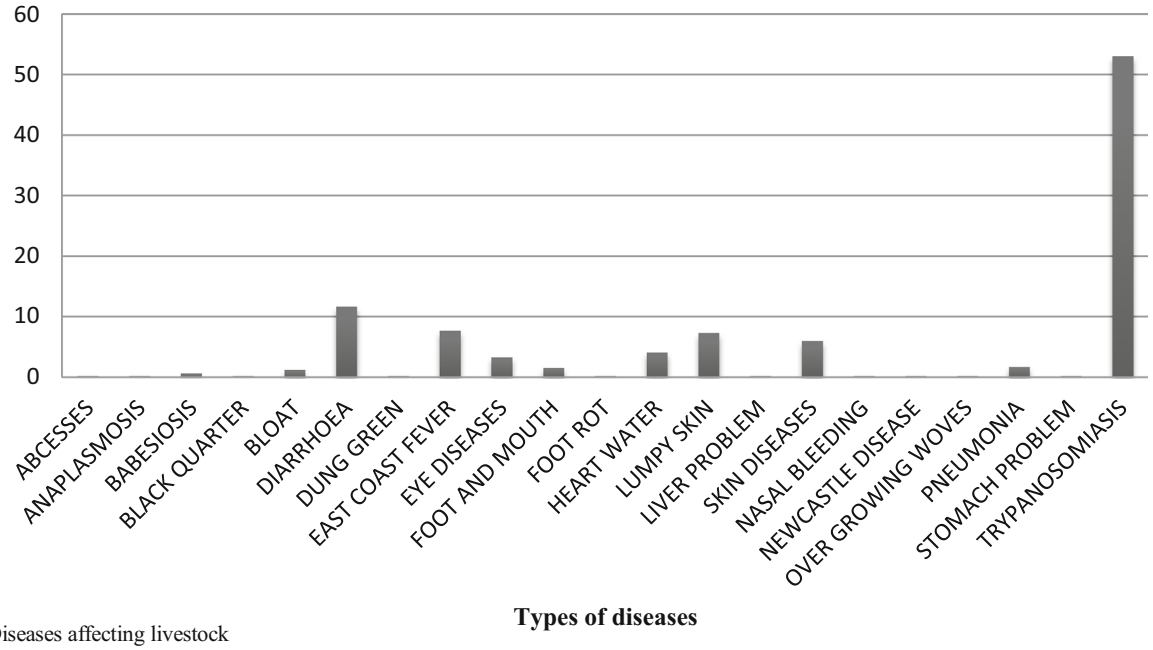

Fig. 4 Diseases affecting livestock

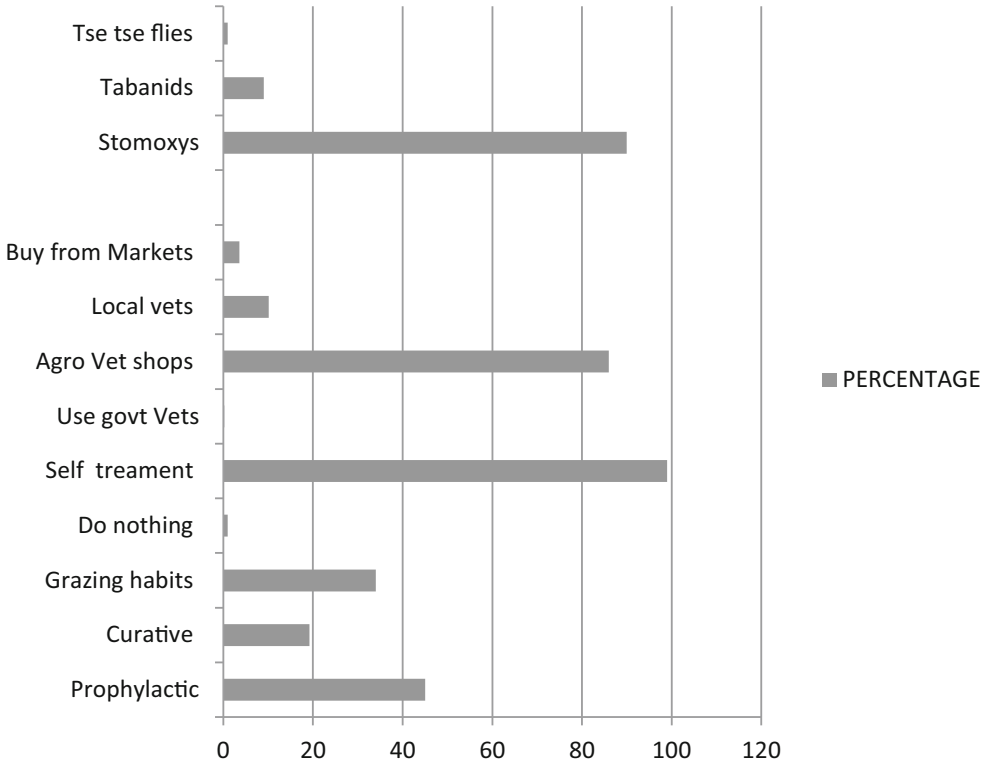

Fig. 5 Type of flies affecting livestock and trypanosomiasis control strategies

on communally owned land and reported cases of AAT as shown in Table 1.

There was a strong relationship between continued trypanosomiasis infections in cattle and the type of livestock kept ($P = 0.000$). Over 84% of farmers keeping cattle reported cases of AAT while only 15.7% of those who kept cattle reported other diseases. There was a significant relationship between continued trypanosomiasis infection in cattle and disease control strategy used ($P = 0.000$). Among those who reported using prophylactic and curative treatments, 39.3% and 21.2% reported having cases of AAT respectively. There was also a significant relationship between continued trypanosomiasis infection in cattle and source of drugs ($P = 0.046$). Among the respondents who reported getting their drugs from veterinarians, only 22.7% reported cases of AAT. Among those who reported getting drugs from other sources, 63.6% reported cases of AAT. There was a significant relationship between continued trypanosomiasis infection in cattle and drug preparation ($P = 0.017$). Over 63% of the respondents who reported preparing trypanocidal drugs themselves also reported having AAT cases. Among those who reported using qualified veterinarians to prepare the drugs, only 10.7% reported cases of AAT.

Discussion

The current study shows a significant relationship between continued trypanosomiasis infection in cattle and land ownership ($P = 0.029$). Over 73% of the respondents reported that they owned land communally and reported cases of AAT. As already documented earlier by Von Wissmann et al. (2011), communal grazing of livestock is associated with the probability of cattle becoming infected by trypanosomiasis and could be a factor leading to the persistence of the disease among cattle in some disease-endemic areas of Uganda (Selby 2013). Under communal grazing systems, farmers employ different control strategies. For instance, some spray their cattle but others do not, some give prophylactic treatment while others do not. Moreover, even among those who spray, they may choose to use different acaricides. In fact, this study showed that farmers understand the importance of spraying cattle namely to kill ticks, tsetse flies, and other biting insects. However, we discovered that they use chemicals that may be effective on ticks but not tsetse flies. The reason for not using deltamethrin was probably due to lack of knowledge as farmers think any acaricides/insecticide kills both ticks and other insects. Secondly, the cost of deltamethrin is very high compared with other acaricides making it less popular among farmers and drug stockists. When cattle are grazed communally in the presence of a suitable vector, continuous transmission will be possible because some of the cattle in the communal system will preserve the parasites. Besides, in addition to cattle are important reservoirs of trypanosomiasis, wild ungulates also play an important role in the epidemiological cycle of trypanosomiasis because they too act as reservoirs of trypanosomiasis. The Lango subregion being close to the Murchison falls conservation area still has an abundance of

Table 1 Factors associated with continued trypanosome cattle infection

Variable	*N*	Trypanosomiasis (%)	ChiSq (*P* value)
Type of livestock kept			1.554 (0.000)
Cattle	241	84.3	
Others	46	15.7	
Reasons for keeping livestock			
Hobby	11	3.6	23.545 (0.0000)
Business	52	18.5	
Alternative	171	43.1	
Addition	42	9.6	
Other	4	1.1	
Disease control strategy			
Ignore	2	0.5	48.487 (0.000)
Prophylactic treatment	196	39.3	
Curative treatment	189	21.2	
Who prescribed the drug			
Local vet	371	58.3	1.641 (0.200)
Drug shop	12	1.3	
Do cattle owners recognize trypanosomiasis?			
Yes	243	68.1	
No	27	8.9	2.382 (0.123)
Drug use to treat animal trypanosomiasis			
Yes	167	70.8	
No	11	4.5	0.041 (0.839)
Source of drugs			
Local vet	28	9.4	6.138 (0.046)
Others	240	63.6	
Agrovet shop	10	3.2	
Drug preparation			
Self	214	63.7	5.673 (0.017)
Qualified veterinarian	28	10.7	
Do you use insecticides?			
Yes	266	72.9	0.205 (0.651)
No	14	3.6	
Treatment given			
Diminazene	187	50.9	1.832 (0.000)
Others	139	5.9	

Alternative, farmers keep livestock as an alternative source of income

Addition, farmers keep livestock as an additional source of income

Other, farmers keep livestock for other reasons such as prestige

free-ranging wild ungulates, which are potential reservoirs of trypanosomiasis. The study also showed a significant relationship ($P = 0.000$) between continued trypanosomiasis infection in cattle and the control strategies used by the livestock owners. Among those who reported using prophylactic treatment as a strategy, 39.3% reported having cases of AAT, and yet only 21.2% of those using the curative treatment strategy reported cases of AAT. These findings are in agreement with those of Waiswa and Kabasa (2010) who found out that affordability of insecticides and trypanocidal drugs have an impact on trypanosomiasis control. Individuals that are able to afford acaricide/insecticides and trypanocidal drugs are less likely to report cases of trypanosomiasis compared with those that are not able to afford drugs. However, affordability without proper knowledge on the use of insecticides and other drugs for prophylactic and curative control of trypanosomiasis is not enough. Therefore, professional handling of drugs and chemicals plus the development of supply chain that could have been affected by two decades of armed rebellion in the Lango subregion is paramount. In this study, the respondents reported using prophylactic treatment as a control strategy, but they were using diminazene diaceturate instead of isometamidium chloride. This indicates that farmers cleanse their animal of trypanosomiasis using diminazene as recommended by observed by Fussgänger and Bauer (1958). Fussgänger and Bauer (1958) observed that diminazene diaceturate is recommended only for use as a therapeutic agent since it is rapidly excreted and therefore thought to have little prophylactic activity. Therefore, the treatment that farmers provide does not protect them prophylactically since they do not use the recommended drug (isometamidium chloride) which has prophylactic properties (Zhang et al. 1991). When used under the recommended prophylactic dose (0.5–1.0 $mgkg^{-1}$ bwt), the productivity of Zebu cattle exposed to tsetse challenge in both village and ranch management systems in East Africa has been maintained (Moloo et al. 1987; Tobler et al. 2003; Trail 1985). Therefore, this knowledge gap in the use of isometamidium chloride instead of diminazene diaceturate for prophylaxis against trypanosomiasis needs to be addressed.

The source of acaricide/insecticide and trypanocidal drugs had a significant relationship with the persistence of trypanosomiasis ($P = 0.046$). Among the respondents who reported getting their drugs from veterinarians, 3.2% reported cases of AAT, and those reported who getting drugs from other sources, 63.6% reported cases of AAT. Farmers obtain drugs from other sources because over the years the district local governments in the Lango subregion only had District Veterinary Officers stationed at district headquarters. Obviously, without the support of frontline extension staff, delivery of services to farmers was severely constrained. In the financial year 2017/2018, the government provided an extension fund to recruit subcounty veterinarians, but still the districts could not attract veterinarians because the Lango subregion is a hard to reach area. Secondary the farmers perceive qualified veterinary services as very expensive compared with other alternatives. This indicates that streamlined veterinary service delivery is critical in the control and elimination of trypanosomiasis. The gradual decline in the delivery of veterinary services due to unfavorable policies and insecurity in some parts of Uganda (Bugeza et al. 2017) is responsible to the persistence of livestock diseases. This could also be attributed to the fact that none of the respondents used

deltamethrin to spray their cattle, yet they recognize biting flies as their biggest challenge. This was earlier recorded by Bardosh et al. (2013) who indicated that although 70.5% of livestock keepers reportedly used insecticide each month during the rainy season, due to a variety of perceptions and practices, nearly half used products only effective against ticks and not tsetse flies. Improving veterinary service delivery to combat and control emerging and reemerging animal disease is critical measure for unraveling the benefits of increased global demand for livestock products to rural poor farmers and reducing associated animal and human health-related risks (Wacher et al. 1994). Drug preparation is also critical for achieving optimum efficacy. This is why 63.7% of respondents who reported preparing trypanocidal drugs themselves reported having AAT cases while those who reported using qualified veterinarians reported lesser cases of AAT. Drug preparation is critical in maintaining drug efficacy. Therefore, farmers who prepare their own drug cannot decipher the dilution rates, proper diluents, the routes of administration, and the dosage regime recommended by the manufacturer. Moreover, in many cattle keeping areas of Uganda, the practice of mixing trypanocidal with antibiotics, the lack of proper equipments, and tools and lack of aseptic procedures also affect the efficacy of the drug. Knowledge of trypanosomiasis treatment, trypanocidal preparations, and administration by the farmers is a major risk factor to continued cattle trypanosome infections. We therefore recommend continued farmer sensitization on the threat of AAT and the available prevention and control options. The use of isometamidium chloride for prophylaxis against trypanosomiasis is highly recommended. There is also a need to foster qualified private veterinary drug supply in the region by all concerned stakeholders.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Statement of animal rights All applicable guidelines for the care and use of animals were followed.

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