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Knowledge, attitude, and practices about tsetse control among communities neighbouring Serengeti National Park, Tanzania



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Abstract

Tsetse flies are vectors of blood parasite of the genus *Trypanosoma*, which causes African trypanosomiasis to both human beings and animals. Large losses due to *nagana* have been reported; and this indicates the importance of tsetse control to avoid estimated losses. This study assessed the knowledge of tsetse and control practices, attitude towards control practices against tsetse, and the actual control practices used by the local communities in Serengeti District near the Serengeti National Park (SENAPA). Data for this study were collected using various methods. An interview schedule was administered to 70 randomly selected households, 12 focus group discussions with men and women farmers, and four key informant interviews with technical staff were held. The data were analysed using largely descriptive statistics and content analysis method. The farmers had inadequate knowledge of tsetse such that they confused them with other similar flies. On the other hand, they demonstrated knowledge of tsetse control measures, and these included some, which were not among those recommended by the extension staff. While the attitude towards control methods was positive most of the farmers did not use the recommended methods largely due to the cost

associated with them. This suggests that the positive attitude towards a recommendation by itself is not sufficient to influence its use. Besides, poor management of dipping facilities for tsetse control and inadequate supervision by district staff impacted on the quality of services offered. Thus enabling local community members to have clear knowledge of tsetse flies is an important starting point for mobilizing them to take appropriate control measures against tsetse. Also, district authorities need to take an active role in monitoring the performance of the dipping facilities in the district by taking up appropriate measures to ensure quality control of services offered. Moreover, there is need for the district authorities and the central government to address the challenges which privatization of veterinary services posed to animal health and the wellbeing of people who depend on livestock for their livelihood.

Keywords: Sociology, Infectious disease, Public health

1. Introduction

Tsetse flies are vectors of blood parasite of the genus *Trypanosoma*, which causes African trypanosomiasis. It is a debilitating and often fatal disease unique to Sub-Saharan Africa that affects both man [Human African Trypanosomiasis (HAT)] and livestock [African Animal Trypanosomosis (AAT)] or *nagana* (Vale et al., 2013; Vale et al., 2015; Wamwiri and Changasi, 2016). In Tanzania tsetse infestation rate was about 33% against 60% documented earlier (Daffa et al., 2013). Furthermore, estimates show that about 4 million people and 7 million livestock are at risk of contracting trypanosomiasis (Ibid).

Besides causing mortality and morbidity in both animals and humans, tsetse and trypanosomiasis have prohibited human occupation of some areas and precluding agricultural and livestock keeping activities in a large part of Tanzania (Matemba et al., 2010; Malele, 2011). Also, *nagana* causes a loss in animals in terms of mortality and reduced milk yield, both of which are estimated at US\$ 7.98 million annually (Malele, 2011) underscoring the importance of tsetse control. In particular, availability and quality of animal health services have some heavy influence on the attainment of full productive potential of the livestock sector (Umali et al., 1994).

Most recently the control of tsetse and/or *nagana* have featured as part of knowledge, attitude and practice (KAP) studies including the one conducted in the cotton zone of West Africa (Grace et al., 2009) and many others which have been carried out in Tanzania (Kinung'hi et al., 2006; Magwisha et al., 2013; Byamungu et al., 2016). Building on earlier studies this study adopted a mixed methods research design to assess the knowledge of tsetse and control methods, attitude towards control methods against tsetse, and the control practices used among members of the local communities in Serengeti District near the Serengeti National

Park (SENAPA). The main purpose of the study was to get an understanding of KAP with respect to tsetse and control methods, attitude to control methods, and methods employed, and ultimately to contribute to effective control interventions against tsetse and thus overcome its detrimental effects in the area and possibly in the country. The study was done as part of the sociological study for a project on “Human African trypanosomiasis: alleviating the effects of climate change through understanding human-vector-parasite interactions”.

The analytical framework, which was adopted for this study draws from the knowledge, attitude, and practice (KAP) model. The model has been widely used in studies covering various phenomena especially health (Mazigo et al., 2010; Angadi et al., 2013; Magwisha et al., 2013; Singh et al., 2014; Alobuia et al., 2015; Li et al., 2015). Generally, in a KAP survey data are collected from a representative study of a specific population on what is known (knowledge), believed (attitude), and done (practice) in relation to a particular topic (WHO, 2008) such as tsetse control. As such, at the end, a KAP study tells us what people “know about certain things, how they feel and also how they behave” (Kaliyaperumal, 2004: 7).

More specifically, the knowledge possessed by a community is understood as it is the case with any given topic such as tsetse and its control; attitude refers to people’s feelings towards a given subject, as well as any preconceived ideas which they may have towards it; and practice refers to the ways in which people demonstrate their knowledge and attitude through their actions (Ibid). Consequently, the advantage of understanding the levels of knowledge, attitude and practice regarding tsetse and its control is twofold: firstly, that it would enable a more efficient process of awareness creation and secondly it would enable the design of intervention, which is more appropriately tailored to the needs of the communities in the study area (WHO, 2008).

2. Methods

2.1. The study setting

This study was conducted from May 2014 to December 2015 in four villages, namely Bonchugu and Rwamchanga villages near Ikorongo Game Reserve and Makundusi and Natta near Grumet Game Reserve located to the western side of the Serengeti National Park. These villages were selected for the study because of their proximity to Serengeti National Park where cases of human trypanosomiasis which are associated with tsetse have been reported (Simarro et al., 2012). Also in these villages, livestock and in particular cattle keeping forms an important part of the livelihoods of the local people. The ethnic groups found in the area include the Ikoma, Sukuma, Ikizu, Nata, and Taturu.

The area practices a mixed farming system, which involves livestock and crop production. Most households in the area keep livestock, such as cattle, goats, sheep and chicken. Crop production involves the cultivation of various food crops such as finger millet, sorghum, sweet potatoes, and cassava. Also, households produce cotton and tobacco to a limited extent. In most cases, crops are grown on small plots of land averaging half an acre to one acre. Bush meat hunting is also practised to meet protein needs and household expenditure needs including education and health. The practice is, however, illegal.

2.2. Research design and data collection

This study adopted a mixed methods research design involving both quantitative and qualitative approaches. This design has been widely advocated in social science research (see for example, [Creswell, 2009](#); [Johnson et al., 2007](#); [Johnson and Onwuegbuzie, 2013](#)). In particular, the adoption of the quantitative approach aimed at quantification of key study variables. On the other hand, the qualitative approach and specifically the use of focus group discussions (FGDs) and in-depth interviews allowed further exploration of issues covered in the survey.

The study was carried out in three phases: In the first phase, a household survey was carried out whereby an interview schedule was administered to a random sample of 70 households, 35 households each in Bonchugu and Natta villages respectively. The household interview schedule contained questions on knowledge of tsetse, methods of tsetse control, and attitude towards tsetse control methods. In the second phase, in addition to Bonchugu and Natta, two more villages – Rwamchanga and Makundusi, were covered by the study. In this phase, six FGDs were done each with men and women farmers separately. Thus in total, 12 FGDs with an average number of 10 participants; and four in-depth interviews with resident technical staff were carried out. In both cases the topic guide was used and the interviews and discussions were recorded digitally. In the third phase, the preliminary study results were presented at the results sharing workshops which were held in Bonchugu and Natta villages respectively. In these workshops, representatives from among the men and women farmers, village government officials, and extension staff from Bonchugu, Rwamchanga, Makundusi, and Natta participated and gave their feedback on the preliminary study results.

2.3. Ethical considerations

This study observed ethical considerations, which involved seeking for a permit from the Tanzania National Institute for Medical Research (NIMR) of conducting the study. Consent was sought from participants in the household survey, FGDs, in-depth interviews, and in two results sharing workshops. In this regard, the contents of the forms were read before the participants. After all questions were

answered and clarifications made, the participants were asked to sign the consent forms indicating their agreement to participate. Each of those who could not sign used their fingerprints to sign the forms in the presence of a literate colleague who was asked to write and sign against his/her name on the form. All the signed forms are kept in a secure place at Sokoine University of Agriculture (SUA). Moreover, digital recording of the FGDs and interviews were carried out after obtaining the consent of the participants during the different phases of the study.

2.4. Data analysis

Attitude towards recommended methods of control of tsetse was measured using a Likert scale of three categories of response: agree; neutral/undecided; and disagree. The Likert scale consisted of ten items, among these, five were positive and the other five were negative. These items covered the following domains: whether or not it was beneficial to use control methods; effectiveness of control methods; the cost of control methods; the possibility of controlling tsetse using the recommended methods; and whether or not it was easier to use control methods. The addition of negative items to the scale has been recommended “to reduce the acquiescence bias occurs when people tend to agree with statements without regard for their actual content . . .” (Salazar, 2015:192). The ten items were further combined to get composite scores on attitude towards tsetse control methods. The use of multiple-items to measure psychological attributes is more desirable because individual items have a considerable random measurement error. As such, the measurement error averages out when individual scores are summed to obtain the total score (McIver and Carmines, 1981; Spector, 1992 and Nunnally and Bernstein, 1994).

Quantitative data were analysed using descriptive statistics and the results were presented as frequencies and percentages. Qualitative data were analysed using the content analysis technique. This involved reading and rereading transcribed data from interviews and FGDs with much attention paid to their meanings.

3. Results

3.1. Profile of respondents

Table 1 shows that majority (67%) of the sampled respondents were males; the largest percentage (34.3%) belonged to 41–50 years of age category; most (91.4%) respondents were married majority (83%) had primary education; and most (91%) respondents were involved in livestock keeping and crop production as their primary occupation.

Table 1. Profile of the respondents.

Characteristic	Frequency	Percentage
Sex		
Male	47	67.1
Female	23	32.9
Total	70	100.0
Age (years)		
20-30	6	8.6
31-40	20	28.6
41-50	24	34.3
51-60	11	15.7
Above 60	9	12.9
Total	70	100.0
Marital status		
Married	64	91.4
Never married	2	2.9
Widow	4	5.7
Total	70	100.0
Level of education		
Never been to school	3	4.3
Primary education	58	82.9
Beyond primary education	9	12.8
Total	70	100.0
Primary occupation		
Livestock and crop production	64	91.4
Livestock keeper	5	7.1
Trader	1	1.4
Total	70	100.0

3.2. Knowledge of tsetse

The survey results show that most respondents (90%) indicated to have had knowledge about tsetse flies while 7.1% had either no knowledge or were not certain that they knew tsetse. In FGDs, most of the men and women participants indicated to have seen tsetse flies either within their community boundaries or mostly in the game reserve. However, since it is prohibited to graze livestock in the game reserves, most participants did not acknowledge having been to the game reserves with their livestock. Apart from entering the reserve for grazing animals, participants reported to have been to the game reserves for other reasons including searching for water, collecting fuel wood and building poles. When asked to

describe tsetse flies the respondents used various criteria to describe tsetse flies (Table 2). Accordingly, the most frequently used criterion to identify and thus describe tsetse was the size and thus, they described tsetse as having more or less the same size as that of a housefly (about 30%), this was followed by having long mouth parts for biting (23%), having a narrow shape when at rest (17%), having brown/grey-brown dark colour (18%), and having dark and light patches on the body (11.5%).

In Kiswahili tsetse flies are called *mbung'o* or *ndorobo*. The insects are also known by different ethnic languages such as *rishaghi* among the Nata and the Ikoma while the Kurya and the Sukuma refer to them as *iribhaghi* and *mbumbulu* respectively. In the FGDs, participants were asked to identify tsetse from among the specimens presented to them. Often, participants in the FGDs could not distinguish between tsetse and other insects such as stomoxis and tarbanids. Similarly, in the feedback workshop conducted in Bonchugu village size was used as a criterion for identifying tsetse flies. As such, the big ones most likely tabanidae were called *mbung'o* while the small ones most likely *Stomoxys calcitrans* were referred to as *ndorobo* (Table 3).

Generally, in FGDs it was apparent that the term *ndorobo* is used to refer to the parasite or disease interchangeably. In fact, different ethnic groups have different names for *nagana*. For instance, among the Ikoma, *nagana* is called *andorobo* while the Kurya and the Sukuma refer to it as *endorobo* or *umuchohe* and *ntorobo* respectively. Besides, the study shows that the respondents described various symptoms of animal trypanosomiasis or *nagana* (Table 4). Accordingly, three most frequently mentioned symptoms include the cows looking thin (21.6%), followed by low milk production (20.8%), and low reproduction rate (20.4%). Other symptoms were only mentioned by small proportions of the respondents.

In addition, the results on the respondents' perceived causes of *nagana* are presented in Table 5. Although there were various perceived causes of the disease,

Table 2. Description of tsetse flies.

Criteria	Number	Percentage
More or less same size as housefly	70	29.8
Long mouthparts for biting	55	23.4
Brown/grey-brown/dark in colour	42	17.9
Narrow in shape when at rest	41	17.4
Body with darker and light patches	27	11.5
Total responses	235	100.0

Table 3. Kiswahili and local names of tsetse flies according to size.

Size	Kiswahili name	Local name		
		Ethnic group	Singular	Plural
Big	Mbung'o	Ikoma	Elishaghi	Amashaghi
		Kurya	Esaghi	Ichishaghi
		Sukuma	Salii	-
Small	Ndorobo	Ikoma	Asurumuti	Chasurumuti
		Kurya	Endrobo	Chindrobo
		Sukuma	Surumuti	-

tsetse recorded the highest frequency (46.9%) of the responses while absence of preventive measures recorded the lowest frequency of the responses (3.1%).

The respondents also pointed out the adverse impacts that *nagana* caused to livestock owners, and these included animal deaths, reduced income and loss of market value of the animals. Continued presence of *nagana* was therefore a source of concern to the members of the communities in the study area. Results in Table 6 show lack of education on *nagana* as the leading reason for the persistence of the disease in the community.

3.3. Knowledge of tsetse control methods

Interviews with extension staff indicated that the farmers were advised to use various methods for tsetse control. These included dipping, traps-impregnated, sprays using chemicals with residual effects, bush clearing, and fire. However, about two thirds (67%) of the respondents were not knowledgeable of control methods against tsetse while about 31% (31.4%) reported of having knowledge on

Table 4. Symptoms of *nagana* as described by the respondents.

Symptom	Number	Percent
Cows looking slim	53	21.6
Low milk production	51	20.8
Low reproduction rate	50	20.4
Intermittent fever	43	17.6
Laboured breathing	25	10.2
Beating the head on mangers or walls	12	4.9
Nervous symptoms like walking in circles	11	4.5
Total responses	245	100.0

Table 5. Perceived causes of *nagana*.

Perceived cause	Number	Percent
Presence of tsetse flies	45	46.9
Wild animals migrating into community residential areas	16	16.7
Do not know	16	16.7
Presence of bush and forests around communities	10	10.4
Source of water for livestock being in park area	6	6.3
Absence of preventive measures	3	3.1
Total responses	96	100.0

the control methods. Further, follow-up questions and responses during FGDs showed that the farmers had good knowledge of the control methods against tsetse. It was also evident that they considered dipping as the major tsetse control method.

3.4. Attitude towards tsetse control methods

As earlier indicated, five domains each with negative and positive items on the scale, were used to test the respondents' attitude towards recommended methods of tsetse control. Results are summarized in Table 7. In general, the responses to statements which sought to find out whether the control methods were easy or difficult to use had rather unexpected trend where majority (80%) of the respondents expressed agreement and 54.3% expressed disagreement. On the other hand, the responses to statements on the other domains showed that majority of the respondents consistently indicated a positive attitude towards tsetse control methods.

Furthermore, as was the case with individual statements (Table 7), the results in the combined statements on obtaining composite scores on attitude towards tsetse

Table 6. Reasons for persistence of *nagana* in the community.

Reason	Frequency	Percent
Not educated on <i>nagana</i>	36	40.9
Living near national park	20	22.7
No experts	19	21.6
Presence of tsetse fly	10	11.4
Do not know	3	3.4
Total responses	88	100.0

Table 7. Attitude towards tsetse control recommended methods.

Statement	Response			Total
	No answer	Agree	Disagree	
Recommended methods of tsetse control are easy to use	0 (0)	56 (80)	14 (20)	70 (100)
Recommended methods of tsetse control are quite effective	0 (0)	49 (70)	21 (30)	70 (100)
Recommended methods of tsetse control are cheap	1 (1.4)	25 (35.7)	44 (62.9)	70 (100)
It is possible to control tsetse using recommended methods	1 (1.4)	61 (87.1)	8 (11.4)	70 (100)
It pays for individuals to use recommended methods to control tsetse	2 (2.9)	54 (77.1)	14 (20)	70 (100)
Recommended methods of control of tsetse are expensive	1 (1.4)	51 (72.9)	18 (25.7)	70 (100)
Recommended methods of control of tsetse are difficult to use	4 (5.7)	38 (54.3)	28 (40)	70 (100)
It is impossible to control tsetse using recommended methods	2 (2.9)	27 (38.6)	41 (58.6)	70 (100)
Recommended methods of tsetse control are not effective	2 (2.9)	29 (41.4)	39 (55.7)	70 (100)
It does not pay for individuals to use recommended methods to control tsetse	1 (1.4)	23 (32.9)	46 (65.7)	70 (100)

Figure in brackets are in percentages.

control methods, (Table 8) showed that majority (about 70%) of the respondents had a positive attitude towards tsetse control methods.

In addition, chi square tests were carried out to determine the association between attitude and selected respondents' individual characteristics. Results in Table 9 show that, there was no statistically significant difference between respondents' characteristics and attitude towards the recommended tsetse control methods.

3.5. Use of control methods against tsetse

Even though majority (71.4%) of the respondents indicated a positive attitude towards control measures (Table 8), the study shows that majority (70%) of the respondents had not used any control methods against tsetse. Besides, those who reported to have been using control methods, majority (58%) reported to have been using either spraying or dipping while the rest (42%) indicated to have been using treatment.

Table 8. Attitude towards tsetse control methods.

Response category	Frequency	Percentage
Agree	50	71.4
Neutral	20	28.6
Disagree	0	0.0
Total	70	100.0

Table 9. Cross tabulation of respondents' characteristics and attitude towards the recommended tsetse control methods.

Characteristic	Attitude towards the recommended methods		Total	P value
	Agree	Disagree		
Sex				
Male	36 (72.0)	11 (55.0)	47 (67.1)	0.259
Female	14 (28.0)	9 (45.0)	23 (32.9)	
Total	50 (100.0)	20 (100.0)	70 (100.0)	
Age (years)				
20-30	3 (6.0)	3 (15.0)	6 (8.6)	0.252
31-40	13 (26.0)	7 (35.0)	20 (28.6)	
41-50	17 (34.0)	7 (35.0)	24 (34.3)	
51-60	8 (16.0)	3 (15.0)	11 (15.7)	
Above 60	9 (18.0)	0 (.0)	9 (12.9)	
Total	50 (100.0)	20 (100.0)	70 (100.0)	
Marital status				
Married	44 (88.0)	20 (90.0)	64 (91.4)	0.269
Never married	2 (4.0)	0 (.0)	2 (2.9)	
Widow	4 (8.0)	0 (.0)	4 (5.7)	
Total	50 (100.0)	20 (100.0)	70 (100.0)	
Level of education				
Never been to school	3 (6.0)	0 (.0)	3 (4.3)	0.518
Primary education	41 (82.0)	17 (85.0)	58 (82.9)	
Beyond primary education	6 (12.0)	3 (15.0)	9 (12.8)	
Total	50 (100.0)	20 (100.0)	70 (100.0)	
Primary occupation				
Livestock and crop production	48 (96.0)	16 (80.0)	64 (91.4)	0.070
Livestock keeper	2 (4.0)	3 (15.0)	5 (7.1)	
Trader	0 (.0)	1 (5.0)	1 (1.4)	
Total	50 (100.0)	20 (100.0)	70 (100.0)	

In the FGDs, the participants saw tsetse flies as posing a serious threat to their communities especially as a result of spreading *nagana*. Also, they indicated dipping and hand spraying as the major methods used in tsetse control. However, in the FGD held in Bonchugu village, a government male official made the following clarification on dipping:

Dips were in another village located far. The villagers had no dips but they had used spray pumps. But the largest percentage of the people has no means of

dipping livestock because of the cost of spray pumps. Those with spray pumps are only about one percent.

Limited access to dipping was corroborated in an interview with district officials, who indicated that Serengeti District Council with a total of 91 villages had a total of only 36 dip tanks out of which five (5) required rehabilitation, 21 are operational and the remaining 10 are functional but not in use due to lack of water for the dip tanks. Thus partly, as a result of the constraints discussed in the foregoing paragraphs above, farmers have resorted to hand spraying for tsetse control. However, in an in-depth interview with a community animal health worker (CAHW) at Rwamchanga village indicated that there was dissatisfaction with hand spraying and poor observation of the safety precautions among the people using them:

Many farmers owned hand pumps and as a result they do not dip well their animals because of saving money. Also, they do not use well protective gears such as masks against poison, even after being told about it

Besides, the CAHW was sceptical about the effectiveness of control measures against tsetse:

In my opinion, every month in this village more than five cattle die from diseases without knowing whether or not the disease is AAT. Thus I suspect *nagana* still affects the livestock very much.

However, the remarks by CAHW were contradicted by those of one of the participants in FGD who expressed satisfaction with the effectiveness of dipping by saying that when “livestock are dipped they are secure for it takes about six days before they get attacked by tsetse”.

3.6. Involvement of community in control of tsetse

In the FGDs conducted in the study area it was revealed that there was a limited level of community efforts towards control of tsetse and that it was becoming more of the responsibility of individual livestock keepers. For example, at Natta/Mbisso one of the men participating in FGD confirmed this when he said:

It is true that we are facing it (tsetse control). Each individual has livestock at home thus each individual struggles for his own livestock.

It was evident during discussions that the farmers were used to a situation where the government fully met the costs for dipping. Besides, they were not aware of the fact that the government supported acaricides subsidy programme, which had been implemented from 2007/08 to 2013/14. This programme was intended for the control of ticks and tick-borne diseases, which accounts for over 70% of all cattle deaths in the country annually and costing an annual loss to the nation amounting

to TAS 70 billion (United Republic of Tanzania, 2016). At the same time, according to the district officials, dipping services were privatized. As a result, ownership of the dip tanks was transferred to individuals and organized groups that are now responsible for providing dipping services. However, the district officials indicated that the dipping services provided by the groups were of poor quality largely due to poor management of the facilities and inadequate supervision by district veterinary staff. Similarly, most participants in FGDs were not satisfied with the quality of services provided. In this regard, one of the male participants in a feedback workshop held at Nata made the following comment on dipping:

What is “killing” the dips is the use of poor quality drugs. Since there are many groups the pesticide used don’t take long to get dirty. If you dip the following day if the drug was used today you will find a lot of mud and the insects don’t drop off. Thus you find it is better to have your own pump. These dips were supervised by the government. Now they are owned by private individuals and groups. Now if you go for dipping, even the ticks don’t get killed. I once dipped my livestock and later they started getting lesions on the skin; the experts told me later that the water used in the dip had stayed for too long.

Generally, during the feedback workshop discussions, participants expressed a concern that tsetse control has become the responsibility of an individual livestock owner rather than being a community undertaking. Thus, they suggested for the restoration of the government subsidy on dipping services for effective tsetse control.

4. Discussion

Clearly, the household survey results show that despite the fact that most community members indicated to have had knowledge of tsetse, as has also been reported in other studies (see for example, Kinung’hi et al., 2006; Sindato et al., 2008; Magwisha et al., 2013) most of these members were not able to describe tsetse using the various relevant criteria. In fact, the scores on all criteria including size, which registered the highest percentage, were lower than 50%, suggesting that people had inadequate knowledge of tsetse. Furthermore, during FGDs it was revealed that farmers’ criterion for identifying tsetse was simple and largely based on size which, however, as found in this study made it difficult for them to identify tsetse from among similar insects. In a similar study conducted in Uganda it was found that the local communities classified tsetse in local languages simply on the basis of being “the infectious tsetse” and “non-infectious tsetse” with the last being mostly recognized as causing biting nuisance to humans and cattle (Kovacic et al., 2013). However, as evidenced in FGDs conducted during the current study, reliance on size alone was the source of farmers’ inability to distinguish tsetse from other similar flies, suggesting the importance of having knowledge of other criteria

to be able to identify tsetse. In addition, the current study shows that some of the terms such as *ndorobo* have multiple meanings and thus poses the potential risk of miscommunication between technical personnel on one hand and the local people on the other. In addition, the fact that lack of education on the disease among the community members is the leading reason for the persistence of *nagana* in the community points to the reality that there is inadequacy of extension advisory services about tsetse in the study area.

The study shows that farmers' attitude towards tsetse control methods was positive, which however was not influenced by selected individual characteristics of the respondents. In fact, there exists a wide gap between attitude and practice as has also been reported elsewhere (Grace et al., 2009). This is because even though majority of the farmers had a positive attitude towards control methods, majority of them did not use the recommended tsetse control methods. Limited use of dipping is partly due to the fact that there were quite few dips in the whole district; on average, there was about one dip per three villages. Even in cases where farmers had access to the dips, poor quality of the services due to inefficacy of the acaricides used, limited the use of such dips by farmers.

Effective tsetse control requires, among others, community level intervention. In the study area, this has largely involved dipping of animals through government subsidy. Even though the government is supporting subsidy of acaricides, this programme, drawing from the experiences of the farmers, has not been adequately felt. Also, privatization of dipping services which is part of the policies that aimed at cutting down expenditure on public services and compel the livestock keepers to pay for the dipping services (Torr et al., 2005), has not been well received by farmers. It is evident that farmers are not willing to pay for the privatized dipping services as was expected by the government officials. Not only do they doubt the quality of dipping and its effectiveness for tsetse control but they are also sceptical about the quality of privately run dipping services especially in the absence of adequate government supervision. In fact, a study on dipping against ticks in South Africa found that satisfaction with the dipping program affected willingness to pay for the services (Randela et al., 2000).

Handing over of dipping services by the government to individuals and groups at community level has resulted to limited access to and poor quality of dipping services; this has partly compelled livestock keepers to rely on the hand spray pumps in controlling tsetse and hence *nagana*. However given a choice, community members would still prefer dipping facilities managed by government to spray pumps for effective tsetse control. This largely draws from the experience, which shows that government support has been instrumental to the success of previous control programs over a wide area (Bourn et al., 2005) even if such programmes have been expensive and not sustainable (Sindato et al., 2008).

5. Conclusion

The level of knowledge of tsetse is rather limited. The use of size as the major criterion for identifying tsetse posed the danger of confusing it with other types of flies similar to tsetse. While in general, the attitude towards tsetse control methods was positive most of the farmers did not use any of the recommended methods. This suggests that a positive attitude towards a recommendation by itself is not sufficient to influence its use. Even those who have been using dipping facilities questioned the effectiveness of such facilities in tsetse control; while opinions on the effectiveness of spray pumps were mixed. Moreover, absence of adequate quality control measures by the district authorities on privately run dipping services had impacted on the quality of services offered. Thus, enabling local community members to have clear knowledge of tsetse flies is an important starting point in mobilizing them into taking appropriate control measures against them. Also, district authorities need to take an active role in monitoring the performance of the dipping facilities in the district to control quality of the services offered. Finally, there is need for the district authorities and the central government to address the challenges posed by the privatization of veterinary services to animal health and wellbeing of the people who depend on livestock for their livelihood.

Declarations

Author contribution statement

Kinyemi Kigoda, Dismas Mwaseba: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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