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Knowledge and perceptions of traditional livestock keepers on tick-borne diseases and sero-prevalence of *Theileria parva* around Lake Victoria Basin

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Abstract

A study was conducted in three districts around Lake Victoria; Kisumu (Kenya), Kiruhura (Uganda) and Tarime (Tanzania) to assess the farmers' perceptions on tick-borne diseases (TBDs) and resistance of their local cattle breeds to TBDs. Knowledge and perception of farmers on production constraints, tick species, TBDs and their control measures and resistance of local cattle to TBDs were assessed through individual interviews and group discussions. The extent of East Coast fever (ECF) infection in local cattle was assessed by measuring serum antibodies to *Theileria parva*. The prevalence of serum antibodies to *Theileria parva* was determined using an enzyme-linked immunoassay technique. The breeds kept were Nyanza zebu, Tarime zebu and Ankole in Kisumu, Tarime and Kiruhura, respectively. Livestock diseases were ranked as the most important constraints to cattle production.

Tick-borne diseases ranked higher than the other diseases. Most livestock farmers knew well the signs of the TBDs. The main symptoms mentioned were circling/high stepping, red urine, hard dung and swollen lymphnodes for heart water, babesiosis, anaplasmosis and East Coast Fever (ECF), respectively. The most prevalent ticks were brown ear ticks (*Rhipicephalus appendiculatus*) (97.5%), blue ticks (*Boophilus spp*) (75.8%) and bont ticks (*Amblyloma spp*) (81.5%). About 85, 12.5 and 7.5% of the respondents in Kiruhura, Kisumu and Tarime, respectively, knew that ECF is caused by the presence of ticks on the animals. The majority of the farmers did not associate the other TBDs with ticks. The farmers (59%) were using acaricide to control ticks. The most common method of application was hand spraying. Most farmers used Oxytetracycline to treat all TBDs, however, some farmers (20%) used local herbs. About 75 to 92.5% of the farmers considered their breeds to be resistant to ticks and ECF. The reasons given included not applying acaricide for a long time, animals always carry ticks without getting sick or dieing and ECF affects only calves and not adult animals. The serum antibody prevalence was 80.1, 78.2 and 60% in Tarime, Ankole and Nyanza zebu cattle, respectively. The prevalence of antibodies to *Theileria parva* did not differ significantly ($P > 0.05$) between calves (75.5%), yearlings (80%) and adult animals (73.4%).

It is concluded that *Theileria parva* infection in cattle around the Lake Victoria basin is highly prevalent. The farmers know the signs of ECF, but do not spray/dip their animals on a regular basis because of economic reasons and also they consider their breeds to be resistant to ticks and ECF.

Keywords: Ankole cattle, East Coast fever, production constraints, ticks, zebu cattle

Introduction

Keeping of cattle is one of the major economic activities in the Lake Victoria basin and makes a significant contribution to food security and income of smallholder farmers. Indigenous cattle kept by the agro-pastoralists and pastoralists comprise over 95% of the cattle herd in the region. The indigenous cattle are the major source of meat and milk in the region and they provide a genetic resource base which is abundantly available and can be exploited for improvement of the livelihoods of rural people.

Diseases and parasites are serious constraints affecting cattle production in East Africa. Ticks and tick-borne diseases (TBDs) in particular – Theileriosis (East Coast fever), babesiosis, anaplasmosis and cowdriosis (heart-water) are most prevalent and exert the greatest impact on cattle in the region (Rubaire-Akiiki et al 2004; Okuthe and Buyu 2006; Swai et al 2007). These diseases affect livestock production in various ways, such as reduced growth rate, milk production, fertility and value of hides and mortality, thus cause considerable economic losses to livestock keepers. In Tanzania, for example, about 80% of the national cattle head are at risk of being infected with tick-borne diseases each year and the direct economic losses are estimated at US$ 248 million, including an estimated mortality of 0.92 million animals per year (Kivaria 2006). The TBDs can be prevented by either controlling the vector (ticks) that transmits the pathogens or treating the disease by chemotherapy. But prevention is most commonly achieved through the control of the vectors. The recommended method for controlling the ticks involves the use of acaricide, mainly by dipping or spraying at weekly intervals. However, this has failed, probably due to financial constraints of the livestock keepers. Acaricides are too expensive for the average agro-pastoralist and pastoralist (Mugisha et al 2005). Furthermore, the intensive application (weekly application) of acaricide is uneconomical and unsustainable in indigenous cattle (Pegram et al 1993). Because of high price of acaricide, livestock keepers use inappropriate rate of acaricide than that recommended by the manufacturer (Okello-Onen and Rutagwenda 1998).

One contributing factor to the failure of the livestock keepers to adhere to the recommended dipping/spraying regime is that the tick and TBDs control programmes were developed mainly to protect European breeds and the recommended control strategies do not take into consideration the knowledge and perception of livestock keepers and thus they are not integrated in the production systems of traditional livestock keepers. Hence, the whole concept of tick and TBDs control programme need to be revised to incorporate indigenous knowledge of livestock keepers on diseases and predisposing factors. An important step in improving technology and

information packages so as to maximize their uptake and impact is to understand farmers' perceptions on the constraints and the benefits of different technologies in solving these constraints (Geerlings 2001). For TBDs control, farmers' perceptions of disease risk and the inherent benefits associated with available disease control options are important criteria in adoption decisions. In addition, good epidemiological information is required in order to design effective control measures. Therefore, this study was conducted to assess the farmers' knowledge and perceptions on livestock production constraints, tick-borne diseases and the control measures. The opinions of farmers with regard to resistance of their breeds to TBDs were assessed. Also, the study assessed the magnitude of East Coast fever infection caused by *Theileria parva* by measuring antibody levels in local cattle.

Materials and methods

Study areas and cattle breeds

The study was carried out in Kisumu district (western Kenya), Kiruhura district (south-western Uganda) and Tarime district (north-west Tanzania) between October 2005 and January 2006. Agriculture is the major economic activity in these districts and main source of income for the population, employing about 90% of the total working population. The majority of the people practice cattle rearing and livestock products such as milk, meat, hides and skins and ghee provide household income. The types of cattle kept in Kisumu and Tarime districts are the Nyanza zebu and Tarime zebu, respectively. Both of these are strains of the Small East African Zebu Breed. In Kiruhura district the breed kept is the Ankole Long Horn Breed. The farming system in the study areas could be described as agro-pastoralism. In Uganda, most people practiced herded grazing in communal land. However, some had big parcels of land with perimeter fences and animals were grazed only on their land. In Tanzania, all farmers were taking animals for communal grazing in rangelands and fallow lands. In Kenya, some farmers practiced herded grazing in communal lands while those with few animals were tethering.

Sampling procedure

In this study a multistage sampling technique was employed and the sampling frame was district, village, and finally a household. Purposive sampling was used to pick the districts and villages with large numbers of Ankole cattle in Uganda, Tarime zebu in Tanzania and Nyanza zebu in Kenya. In each district four villages were selected, hence, a total of 12 villages were surveyed in the area around the Lake Victoria basin. Within a village the list of households keeping these breeds was used as a sampling frame from which respondents were picked randomly using a table of random numbers. Ten households per village were sampled, giving a sample size of 40 households in each district. The heads of the households were the main respondents;

however, other members of the household attended the interview so as to provide supplementary information.

Data collection

Socio-economic survey

The aim of this study was to determine the level of awareness of livestock keepers to ticks and tick-borne diseases. The research tools were based on participatory appraisals which are used for assessing community situations in order to capture the knowledge of cattle owners in the study areas. Techniques that were used for the present study included individual interviews using semi-structured questionnaire, participant observation and group discussions with key informants. These techniques are widely used and are recognized as effective ways of getting valid and detailed information from local communities (Bayer and Waters-Bayer 1994). Individual interviews of selected farmers were conducted using questionnaires targeting household heads and herdsmen. Both closed and open-ended questions were included in the questionnaire administered to the respondents. The questionnaires were designed to seek information on household socio-economic characteristics (age, education, experience on cattle keeping, major source of income), herd size, constraints to cattle production, common tick species, control measures and treatment of ticks and TBDs and perception on resistance of local cattle to ticks and TBDs.

In addition, focus group discussions with key informants were conducted in each village to supplement the information collected through individual interviews. The discussions involved herd owners, herdsmen and other people familiar with indigenous cattle production so as to get an overview of the opinion of livestock keeping communities. A checklist was used to guide the discussions during interviews. Aspects such as ranking of cattle diseases according to importance and perception on resistance of local cattle to ticks and TBDs were addressed.

Testing for serum antibodies against Theileria parva

During the socio-economic survey, blood samples were collected from cattle in the same households which were selected for the interview. A total of 49, 176 and 80 animals with the age of one to four months were sampled in Kiruhura(Uganda), Tarime (Tanzania) and Kisumu (Kenya), respectively, between October 2005 and January 2006. In Uganda samples were also collected in yearlings (35 animals) and adult animals (64 animals). In Tanzania additional samplings were done from the same animals in April (176 animals) and August 2006 (80 animals) in order to assess the prevalence of antibodies to Theileria parva in older calves (5 – 12 months) and in different seasons. Blood samples were collected from each animal by jugular venipuncture into 10 ml vacutainer tubes. Samples were labelled and put into a cool box with ice while in the field during the day. Then the blood samples were

refrigerated overnight in a local laboratory and the aliquots of sera were obtained by centrifugation of the blood samples at 3000 g for 20 minutes. Sera were then stored in a freezer at -20^{o}C until when the analysis was done. Antibodies against *Theileria parva* were detected in sera using an enzyme-linked immunoassay technique as described by Katende et al (1998). The results were expressed as percent positivity (PP) as follows: PP = (optical density of test serum/optical density of strong positive) x 100 (According to Wright et al 1993). A sample was considered positive if the PP value was 20 or above, hence, animals were classified as positive or negative depending on whether they were above or below the cut-off PP value.

Data analysis

Data derived from questionnaires were coded and recorded into the spreadsheets for statistical analysis. The data were analyzed using SPSS statistical software Release 11.5 (SPSS 2002) and the following descriptive statistics were generated: means, standard deviations, frequencies and percentages. Data based on group discussions were synthesized and summarized. For ELISA data, sero-prevalence was computed as the percentage of animals tested positive. The chi-square test in SAS statistical software Release 8.1 (SAS 2000) was used to assess the significance of differences in sero-prevalence among breeds, months and animals of different age.

Results

Household socio-economic characteristics

Table 1 shows the characteristics of the respondents.

Table 1. Household socio-economic characteristics

Variable	Kiruhura (Uganda)		Tarime (Tanzania)		Kisumu (Kenya)	
	Females, %	Males, %	Females, %	Males, %	Females, %	Males, %
Age						
≤ 35 years	2.5	5	5	10	7.5	17.5
> 35 years	17.5	75	15	70	17.5	57.5
Level of education						
Primary school	10	57.5	20	75	22.5	60
Secondary school and tertiary education	15	17.5	0	5	5	12.5
Experience on cattle keeping						
≤ 10 years	0	7.5	5	12.5	0	12.5
> 10 years	17.5	75	15	67.5	27.5	60
Major farming activities						
Livestock Keeping	35		2.5		5	
Livestock keeping and crop production	65		97.5		95	
Major source of income						
Livestock alone	62.5		37.5		42.5	
Livestock and crops	37.5		62.5		57.5	

Out of the 120 respondents interviewed in the three countries, 78.3% were males and 21.7% were females. Most respondents (84.2%) had the age of above 35 years and very few (15.8%) aged below 35 years. In all countries most of the respondents (95% in Tanzania, 82.5% in Kenya and 67.5% in Uganda) had primary school education. However, in Uganda the proportion of those with secondary school/tertiary education (32.5%) was higher than in Tanzania (5%) and Kenya (17.5%). The major economic activities in the study areas were livestock keeping and crop production, this was mentioned by 85.8% of the respondents from all the three countries. However, in Uganda there were more farmers whose major economic activity was livestock keeping alone than in Kenya and Tanzania. The majority (87.5%) of the respondents reported that they had been keeping cattle for more than 10 years and some farmers said that they had 40 – 50 years of experience in keeping cattle. The major sources of household income in the study areas were sales of livestock, livestock products and crop produce. Livestock were reported to be the only major source of income by 47.5% of the farmers from the three countries.

The herd size of most farmers in Tanzania (75%) and Kenya (95%) ranged from less than 20 to 50 animals per household while in Uganda all farmers interviewed had more than 50 animals (Table 2).

Table 2. Herd size and ranking of reasons for keeping cattle

Variable	Uganda	Tanzania	Kenya
Herd size			
≤ 20 (%)	0	45	47.5
21 – 50 (%)	0	30	47.5
> 50 (%)	100	25	5
Ranks for purposes of keeping cattle			
Milk (rank)	2	4	1
Meat (rank)	3	5	6
Income from livestock products and live animals sales (rank)	1	1	3
Work / draught power (rank)	8	2	4
Dowry (rank)	6	3	2
Manure (rank)	5	6	5
Social status (rank)	7	7	7
Hides (rank)	4	8	8

The main purposes of keeping cattle were ranked differently in the three countries. In Kiruhura district (Uganda), provision of cash income, milk, meat and hides were ranked as first, second, third and fourth reasons for keeping cattle, respectively, while in Tarime (Tanzania), the first, second, third and fourth ranks were given to provision of cash income, draught power, dowry and milk, respectively. In Kisumu (Kenya), provision of milk, dowry, cash income and draught power were ranked as first, second, third and fourth purposes for keeping cattle, respectively. Provision of hides was ranked as the last reason for keeping cattle in Kenya and Tanzania, but in Uganda the last rank was given to provision of draught power. Cash income was obtained from sales of live animals, milk, hides and ghee.

Livestock production constraints

The constraints to cattle production in the Lake Victoria basin are shown in Table 3.

Table 3. Ranking of constraints to cattle production in the study areas

Constraints	Ranking order		
	Uganda	**Tanzania**	**Kenya**
Diseases	1	1	1
Shortage of feeds and grazing land	2	2	2
Shortage of water	3	3	3
Low genetic potential of the animals	5	8	5
Conflict between livestock keepers and crop farmers	-	9	-
Shortage of labour	9	10	6
Lack of markets for livestock products	7	6	-
High price of veterinary drugs	6	4	4
Lack of dips	-	5	-
Theft	-	7	-
Lack of AI services	8	11	-
Bush fire	10	-	-
Poor fertility of the animals	4	-	7

In all countries livestock diseases, shortage of feeds/grazing land and water were ranked as the first, second and third most important constraints. The ranking of the other problems differed between countries (Table 3).

Table 4 shows the most important diseases in each district.

Table 4. Ranking of the most important diseases in the study areas

Disease	Ranking order		
	Uganda	**Tanzania**	**Kenya**
Heart water	4	1	-
Babesiosis	-	2	7
Contagious Bovine Pleuropneumonia (CBPP)	7	3	-
Anaplasmosis	5	4	5
Foot and Mouth Disease (FMD)	-	6	3
Lumpy skin disease (LSD)	9	7	9
Trypanosomiasis	2	8	2
ECF	1	5	4
Helminthiasis	3	9	6
Anthrax	-	10	1
Brucellosis	6	-	-
Mastitis	8	-	8

In Kiruhura, Uganda, East Coast Fever (ECF), trypanosomiasis, helminthiasis, heart water and anaplasmosis were ranked as the most important diseases affecting cattle. In Tarime, Tanzania, the most important diseases were heart water, babesiosis, Contagious Bovine Pleuropneumonia (CBPP), anaplasmosis and ECF. In Kisumu, Kenya, the most important diseases were anthrax, trypanosomiasis, foot and mouth disease (FMD), ECF and anaplasmosis.

The tick species which were commonly seen by farmers in the study areas are shown in Table 5.

Table 5. Common tick species, methods used to control ticks and opinions of livestock keepers on resistance of their animals to ticks and tick-borne diseases

Variable	Uganda, %	Tanzania, %	Kenya, %
Type of ticks commonly seen by farmers			
Brown ear ticks	100	97.5	95
Blue ticks	57.5	95	75
Bont ticks	72.5	95	77.5
Dipping/spraying with acaricide for controlling ticks			
Apply	100	37.5	40
Do not apply	0	62.5	60
Causes of ECF			
Ticks	85	7.5	12.5
Do not know	15	92.5	87.5
Animals are tolerant to ticks			
Yes	85	92.5	87.5
No	15	7.5	12.5
Animals are resistant to ECF			
Yes	85	75	87.5
No	15	25	12.5

The majority of the farmers mentioned that the common ticks in their areas were brown ear ticks (*Rhipicephalus appendiculatus*) (97.5%), blue ticks (*Boophilus spp*) (75.8%) and bont ticks *(Amblyloma spp*) (81.5%). Most of the farmers mentioned that the brown ear tick is commonly seen on both calves and adults while the other ticks are rarely seen on calves. In Tanzania and Uganda, ticks were said to be most common after the rains. However, in Kenya there were mixtures of responses with some respondents saying that it was before the rains, others after the rains and during the rains. This gave an impression that they were not much concerned with tick numbers as animals carry ticks throughout the year.

Perceptions of livestock keepers on tick-borne diseases

The majority of livestock farmers mention correctly the signs of the common TBDs. For heart water the farmers in Tarime said that the diseases is known as “mageka” in Kurya language and is characterized by “kizunguzungu”, which means circling. Babesiosis was described by farmers in swahili as “kukojowa damu”, which means urination of red urine. For anaplasmosis, the farmers said that the animals suffering from this disease produce hard dung. The livestock keepers in Tarime district were aware of the signs of ECF. They said that the disease is called “chintura” in Kurya language and it is characterised by swollen lymphnodes and the disease is important only in calves.

Most of the respondents in Uganda (85%) mentioned that ECF is caused by the presence of ticks on the animals (Table 5). However, some few farmers said that ECF is caused by flies (2.5%) and some did not know the causes of ECF (5%). In Tanzania, 7.5% of the farmers could associate the disease with ticks and only one respondent mention the Brown ear tick as the cause of ECF. The majority of the respondents (92.5%) could not associate ECF with any cause or ticks. Similarly, in Kenya very few farmers (12.5%) knew that ticks transmit the parasite that causes ECF. Some said that ECF is caused by allowing the calf to suckle excessive quantities of milk from the dam. Almost all farmers in the three countries were not aware of the causes of heart water, babesiosis and anaplasmosis.

Tick and tick-borne diseases control methods used by farmers

Almost all respondents reported that they use conventional methods for controlling ticks and TBDs. Out of 120 farmers interviewed, 59.2% said that they apply acaricide while 40.8% replied that they do not use acaricide to control ticks in their herds. For those who use acaricide, hand spraying was the commonest method of application. Only the livestock keepers in Uganda were found to adhere to a two weekly or monthly dipping/spraying routine. Most of the farmers in Tanzania and Kenya said that they dip/spray their animals only when they have money to buy the acaricide. Other farmers said that they apply the acaricide only twice a year. Most farmers reported that they start spraying the calves at the age of five to six months.

With regard to treatment of TBDs, 30% of the respondents reported that they seek assistance from government Veterinarians or Livestock extension officers for treatment of their animals while 50% said that they buy the drug and administer themselves and the remaining 20% reported that they either give local herbs or do nothing. Those who do the treatment themselves, when asked about the type of drug they use, the majority mentioned Oxytetracycline (10%) as the drug used to treat heart water, babesiosis, anaplasmosis and ECF. Other drugs mentioned included diminazene for babesiosis and butalex and parvexon for ECF. To confirm their answers the farmers were showing the bottles which contained the drugs. Some farmers mentioned wrong treatments such as Nilzan for ECF, Novidium and Albendazole for Anaplasmosis, Novidium, Samorin, Sulfadimidine for babesiosis. The majority (90%) of livestock keepers in Kisumu district did not know the treatment of any tick borne diseases and were not using modern medicine to treat the diseases. Burning was mentioned by many respondents as the commonest mode of treatment (Lymphnode burning as treatment of ECF and burning of head areas as treatment of heart water). Traditional herbs were also reported to be used for treatment of heart water and ECF. When asked on the type of the herbs, the farmers did not mention the names of the herbs they were using.

Farmers' perception on tolerance of Small East African Zebu and Ankole cattle to ticks and ECF

The perception of the livestock keepers on tolerance of their animals to ticks and ECF is shown in Table 5. Most of the farmers in Uganda (85%), Tanzania (75 – 92.5%) and Kenya (87.5%) considered their animals to be tolerant to both ticks and ECF. When asked why they think that their animals are resilient to ticks, they said that the animals always carry ticks but they do not become sick or die. Some said that they are no dips in their localities and they have not sprayed the animals with acaricide for many years, yet their animals survive and reproduce. With regard to ECF, most farmers said that adult animals are tolerant because ECF affects only calves and once a calf attains the age of nine months, it will never succumb to the disease. Even for calves, only few do die because of being infected with ECF, the majority recover.

Prevalence of serum antibodies against *Theileria parva* infection

A total of 305 calves were tested for the presence of antibody to *Theileria parva*. Overall the prevalence of antibodies to *Theileria parva* was 74.1%. The seroprevalence differed significantly ($P < 0.05$) among the breeds. On average the levels of antibody was higher in Tarime cattle than in Ankole and Nyanza zebu (Figure 1).

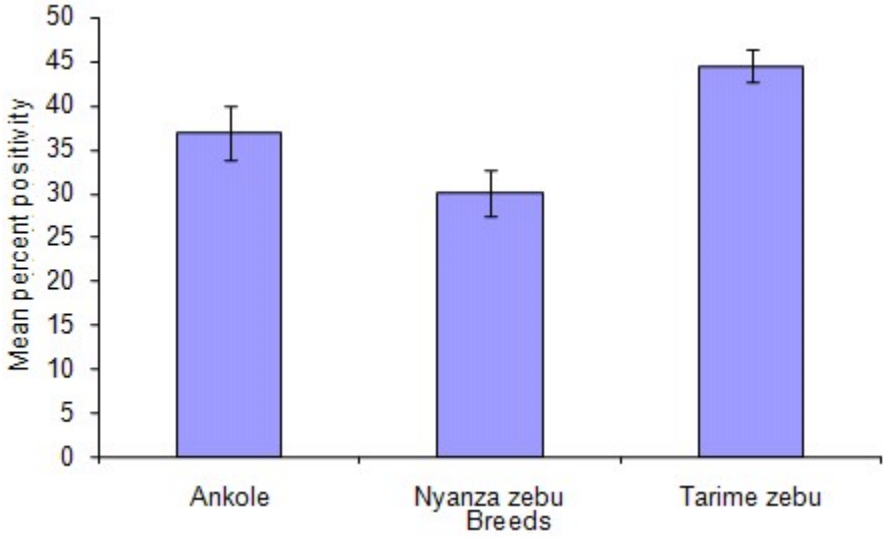

Figure 1. Average (±SE) seropositivity for antibody to *Theileria parva* infection in three breeds around the Lake Victoria basin

Similarly, the highest serum antibody prevalence was observed in Tarime cattle (80.1%), followed by that of Ankole cattle (75.5%) and Nyanza zebu (60%) (Table 6).

Table 6. Prevalence of serum antibody to *Theileria parva* in the study areas

	Number of animals sampled	**Seroprevalence, %**	**P value in Chi-square test**
Breed/Location			
Ankole (Kiruhura, Uganda)	49	75.5	
Nyanza zebu (Kisumu, Kenya)	80	60.1	
Tarime zebu (Tarime, Tanzania)	176	80.1	
Age (only for Ankole)			0.078
Adults	64	73.3	
Yearlings	35	80.0	
Calves	49	75.5	
Period of the year (only for Tarime)			*0.101*
January	176	80.1	
April	176	71.0	
August	80	87.5	

The seroprevalence of antibody to *Theileria parva* at different period of the year is also shown in Table 6. The Table shows that the sampling period did not significantly ($P > 0.05$) influence the prevalence of antibodies. However, animals sampled in the dry season (August) had slightly higher (87.5%) seroprevalence than those sampled in the rain season (January (80.1%) and April (71%)). Likewise, the age of the animals did not significantly ($P > 0.05$) affect the prevalence of antibodies to *Theileria parva*. However, slightly higher seroprevalence was observed in yearlings (80%) compared to calves (75.5%) and adult animals (73.4%).

Discussion

Constraints to livestock production

Diseases, shortage of pastures/grazing land and water, high price of veterinary drugs and lack of markets for livestock products were the most important constraints to cattle production around the Lake Victoria Basin. In all the three countries livestock diseases were ranked above the other production constraints. This is in agreement with Swai et al (2005), Ohaga et al (2007) and Chenyambuga et al (2008) who reported that the major cattle production constraints according to the order of importance are diseases, shortage of forages and water during the dry season, expensive veterinary drugs and lack of livestock market. Among the cattle diseases, TBDs were singled out and ranked as the most important diseases that affect cattle production in the present study. Similar observation has been made by Swai et al (2005), Ocaido et al (2005), Okuthe and Buyu (2006) and Chenyambuga et al (2008). Other diseases which were ranked high included CBPP, FMD, trypanosomiasis and helminthiasis. However, the Kenyan farmers gave first, second and third ranks to anthrax, trypanosomiasis and FMD. These were followed by TBDs. This ranking agrees with Ohaga et al (2007) who reported that the most important cattle diseases in semi-arid areas of Kenya are trypanosomosis, TBDs, helminthosis, anthrax and FMD.

Perceptions of livestock keepers on tick-borne diseases and their control measures

Among the TBDs, ECF was mentioned to be the most important disease, followed by heart water and anaplasmosis in Uganda while in Tanzania the most important disease was heart water, followed by babesiosis, anaplasmosis and ECF. Other studies based on participatory research methods (Mugisha et al 2005) in Uganda have reported ECF to be the most prevalent cattle disease, followed by trypanosomiasis. In Tanzania ECF, Anaplasmosis and heart water have been reported to be one of the most important killer diseases (Swai et al 2005; Swai et al 2007). However, in this study the livestock keepers in Tarime district considered ECF as a minor problem. This is because adult cattle were regarded as tolerant to this disease. While other TBDs were a problem to all age groups, ECF was said to be a problem of the calves. This is in agreement with Ocaido et al (2005) who reported that ECF is perceived by most farmers as the major disease of calves. Because it was the calves which were affected, there was a tendency by the cattle owners to attach little importance to this disease. Our suggestion is that the calves need to be protected to prevent losses due to death. Death of calves will lead to loss of milk, since in zebu cattle milk production ceases shortly after the suckling calf dies.

The majority of livestock farmers were aware of the symptoms of the different TBDs. The symptoms that were mentioned included swelling of the external lymphnodes and circling or high stepping for East Coast fever and heart water, respectively. Babesiosis was characterised by production of red urine while anaplasmosis was described by emaciation and production of hard dung. These symptoms are consistent with those described in the literature. It seems that TBDs are endemic in the Lake Victoria basin and this has made the livestock keepers to develop adequate diagnostic skills and give names in their vernacular languages for the different types of TBDs. For instance, in Tarime, Tanzania, ECF was called "Chintura" while in Western Uganda it was called "Amasiyo". The observation in the present study concurs with Jacob et al (2004) and Catley (2006) who reported that pastoralists have superior diagnostic skills for animal diseases which conform to the veterinarian disease diagnosis criteria and this knowledge is orally passed on from one generation to the next, particularly from the elders to the young.

The majority of the farmers in Uganda and some in Tanzania and Kenya knew that ticks cause ECF. For the other TBDs most farmers did not know their causative agents. Although they knew the different types of ticks (brown ear ticks, blue ticks and bont ticks), they were not aware that these ticks transmit the pathogens which cause heart water, anaplasmosis and babesiosis. However, the lack of knowledge on the causative agent did not limit them from knowing the right treatment for the diseases. Most farmers were using Oxytetracycline to treat heart water, babesiosis, anaplasmosis and ECF. Other drugs used included diminazene for babesiosis and butalex and parvexon for ECF. For treatment of heart water, herbs were also mentioned to be used. In addition, there were traditional practices like Lymphnode burning with hot iron for the treatment of ECF. This was particularly common in western Kenya and was reported to be very popular since it does not have a cost.

About 59% of the respondents stated that they use acaricide to control ticks. However, acaricide was bought only when there is money and some farmers applied acaricide only twice a year, meaning that the use of acaricide is very irregular and not based on a well planned tick control programme. However, the livestock keepers in Uganda reported that they apply acaricide either every two weeks or monthly. This may be due to the extension training they received for the use of acaricides. The main method of acaricide application was by hand spraying and most farmers thought that spraying is cheaper, convenient and effective. This is in consistence with the observation by Mugisha et al (2005) that spraying is the most preferred method for acaricide application in pastoral and agro-pastoral communities. However, some farmers in this study were just pouring the acaricide on the floor where the animals sleep. This was intended to kill the ticks on the ground in the kraal. Dipping was not commonly used in the study areas because most of the dips were not functioning and the cost of

acaricide was reported to be very high such that the average farmers could not afford to use dips.

Farmers' perception on resistance of Small East African Zebu and Ankole breeds to ticks and ECF

In Western Uganda, the most common breed kept by cattle owners was the Ankole Long Horn Breed. The Ankole cattle were the most treasured breed by the majority of the farmers in Kiruhura district where the study was carried out. The people of this area liked this breed because the animals could tolerate ticks and diseases as compared to the improved breeds. In Western Kenya the predominant breed was the Small East African Zebu (SEAZ), although many people have also attempted to keep other breeds like the Boran and Friesian. Resistance to ticks and tick-borne diseases and the animal's ability of even finishing one year without needing treatment are some of the reasons that were given for the people to prefer this breed. In Tarime district, Tanzania, the Tarime cattle was the dominant breed kept and it has been kept in that area for many years. Some elders clearly stated that 'our animals do not cause enslavement' as they do not require special housing and feeding to make the owner look after them the whole day. Moreover, they can survive without dipping/spraying with acaricide. For all the three countries, disease resistance, low input in terms of treatment and feeding and ability of animals to survive under the harsh local conditions were the main reasons for keeping the local breeds. Important to mention from our observation is that all cattle owners across the three countries were proud of their animals. Statements like "I cannot try other means as I am contented with what I use" were common and are a clear indication that people know the value of their animals in terms of convenience and resistance to harsh conditions such as diseases and drought.

Many respondents regarded ticks as not a threat to their local cattle since they considered them to be resistant to both ticks and ECF. There was a general feeling in the three districts that adult animals are not affected by ECF. Most farmers stated that even in the absence of dips, their animals have survived the tick burden and tick borne diseases. According to the livestock keepers in the study areas, ECF is a disease of calves and once the animals are beyond nine months, the risk for being infected is greatly reduced. The resistance to ECF in local animals is also supported by the evidence provided by the respondents that there is usually no need to use veterinary drugs to treat the calves when infected as they could recover without treatment. The general perception of the livestock keepers in the three districts was that their local cattle are resistant to ECF. This indicates that the local breeds around the Lake Victoria basin posses survival traits which enable them to live and produce under tick endemic regions. This conforms with the findings of Wambura et al (1998) who found

zebu cattle to be relatively resistant to tick infestation compared to crossbred animals. Moreover, the results in the present study concurs with Fivaz et al (1992) who reported that zebu cattle can endure tick burden for longer periods without acaricide application. Similarly, the Ankole cattle, which belong to the Sanga type and not zebu, have been shown to exhibit high degree of resistance to ticks (Moran et al 1996). Studies have shown that the resistance to ticks is due to mounting of a protective immune response against ticks by bovine hosts, and this response is heritable (Wikel and Whelen 1986). This resistance has been naturally selected over generations as a result of the constant infection pressure exerted on the cattle population in the endemic areas. According to Rege and Tawah (1999) indigenous cattle are blessed with tick resistance and tolerance to vector-borne diseases and they frequently perform better than exotic breeds under low-input conditions, climatic stresses, especially during times of drought.

Prevalence of serum antibodies against *Theileria parva* infection

Information on the prevalence of *Theileria parva* infection in cattle is useful for assessing the response of the animals to natural infection and the levels of endemic stability in the study area. The present study revealed the presence of antibodies to *Theileria parva* in 74% of all the animals examined and for each breed the seroprevalence was equal or above 60%. This shows that the animals in the Lake Victoria basin are exposed to the causative agent of ECF and that the pathogen exist in a state of endemic stability since endemic stability is likely to exist where the prevalence of serum antibodies to infection is equal or greater than 70% (Lynen et al 1999). According to Lynen et al (1999) in pastoral cattle, *Theileria parva* occurs under endemic stability. Animals in endemic areas respond to *Theileria parva* infection by mounting humoral responses that decline over months in the absence of challenge. The percentage of seropositive animals observed in the present study compares well with the findings of Rubaire-Akiiki et al (2004) who observed a seroprevalence of more than 60% in cattle under free range and tethering systems.

According to the farmers in the study area ECF is a disease of calves and once an animal is over nine months of age, it can rarely suffer from the disease. Using Tarime zebu and Ankole cattle as case studies, the study on the prevalence of serum antibodies against *Theileria parva* did not find a significant difference in seroprevalences among animals of different age groups. These observations suggest that calves, yearlings and adult animals are equally exposed and challenged with *Theileria parva* infection, hence, adult animals maintain the immunity and sero-positivity. It may be that the yearlings and adults tolerate the infection and do not show the obvious signs of ECF that can be noticed by the farmers. Regarding the presence of antibodies in animals with the age of one to four months, it was not

possible to be sure about the source of these antibodies, i.e. whether they had been received colostrally or resulted from infection acquired congenitally or after birth. According to Rubaire-Akiiki et al (2004) the detection of antibodies to tick-borne disease pathogens in calves of less than three months is expected as at this age the passively transferred colostral antibodies are still in high titer in the serum of the animals.

Conclusions

- Livestock diseases are the most important constraints to cattle production in the Lake Victoria basin. These are followed by shortage of forages and water during the dry season and shortage of the grazing land. Among the diseases, tick-borne diseases are the most important diseases that affect cattle production in the region. East Coast fever is ranked high by farmers, followed by heart water and anaplasmosis and babesiosis in Uganda while in Tanzania heart water is more important, followed by babesiosis, anaplasmosis and East Coast Fever. The majority of the farmers in the Lake Victoria basin know that ticks cause East Coast Fever but they do not associate ticks with heart water, anaplasmosis and babesiosis. Most livestock keepers are aware of the symptoms of East Coast Fever, heart water, babesiosis, and anaplasmosis and they use Oxytetracycline to treat these diseases. Most of the farmers do not apply acaricide regularly to control ticks because of economic reasons and they consider that their animals are tolerant to ticks and tick-borne diseases and can survive without the use of acaricide. However, the levels of antibody to *Theileria parva* were high inboth calves and adult animals. Thus, there is a need to develop tick control strategies that can be adopted by farmers in rural areas in order to reduce calf losses due to ECF. These control strategies should be harmonized with the knowledge of the livestock farmers on resistance of their breeds to ticks and tick-borne diseases.

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