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### **All correspondences should be addressed to:**

Editor, Tanzania Veterinary Association, P.O. Box 3021, Chuo Kikuu, Morogoro, Tanzania.

e-mail: [nongahezron@yahoo.co.uk](mailto:nongahezron@yahoo.co.uk) OR [zmakondo@gmail.com](mailto:zmakondo@gmail.com)

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## Knowledge, perceptions and practices regarding brucellosis in pastoral communities of Kagera Region, Tanzania

J. B. Ntirandekura<sup>1</sup>, L. E Matamba.<sup>2</sup>, H. A. Ngowi<sup>1</sup>, S. I. Kimera.<sup>1</sup> and E. D. Karimuribo<sup>1</sup>

<sup>1</sup>Sokoine University of Agriculture, College of Veterinary Medicine and Biomedical Sciences, Department of Veterinary Medicine and Public Health, Morogoro, Tanzania; <sup>2</sup>National Institute for Medical Research, Morogoro, Tanzania.  
Email: bojenti2010@gmail.com

### SUAMMARY

A cross-sectional study was conducted in June 2017 to assess the knowledge, perception and practices of brucellosis by pastoralists of Kagera ecosystem, Tanzania using qualitative methods. Five focus group discussions of six participants were conducted with livestock farmers, administration leaders, religious representatives and youth. In addition, discussions with three key informants were conducted, involving officials of livestock, wildlife and public health department in each district. Data were analyzed using content analysis with inductive and deductive methods. This study revealed low knowledge regarding brucellosis by interviewees. Although participants recognized brucellosis as a zoonotic disease, they seemed to consider it of less importance. In addition, participants had low knowledge on causes, symptoms and mode of transmission of this disease. However, they perceived the interactions between humans, livestock and wildlife together with the neighborhood with other countries to be potential risks for introduction of brucellosis in their communities. Moreover, their habit of drinking unpasteurized milk, the lack of protective gears assisting animals giving birth and poor vaccination program need to be improved by community health education. A coordinated one Health approach is needed and further studies are suggested to reveal the status of brucellosis in Kagera ecosystem to guide its control and prevention.

**Key words:** Knowledge, practices, brucellosis, pastoral communities, Kagera, Tanzania.

### INTRODUCTION

Brucellosis is a worldwide zoonotic disease for both public health and economic importance, affecting humans, livestock and wildlife. Brucellosis has a worldwide distribution where Africa continent is one of the endemic areas (Corbel, 1997). This infectious disease causes important losses and human burdens in infected zones (Boschiroli *et al.*, 2001). Different *Brucella* species are identified as causative agents of brucellosis and some of them are known to be pathogenic to humans: *B. abortus*, *B. canis*, *B. inopinata*, *B. melitensis*, *B. pinnipedialis*, and *B. suis* (Tiller *et al.*, 2010; Zheludkov and Tsirelson, 2010; Whatmore *et al.*, 2014). It is known that brucellosis is endemic in several areas in East African region (Chota *et al.*, 2016) and it reduces productivity through abortions and weak offsprings; causing a major threat in national and international livestock trade.

In Tanzania, some previous studies have reported existence of risk factors for brucellosis transmission in pastoral communities such as occurrence of abortions in herds, assistance of animals during parturitions, individuals living in close proximity with livestock and animal slaughtering occupation (Swai and Schoonman, 2009; John *et al.*, 2010; Assenga *et al.*, 2016). Brucellosis is associated by many communities to people who drink raw-milk/

animal blood, consume raw meat; or to those who share a bed or utensils with brucellosis patients (Mubyazi *et al.*, 2013). Lessons learnt from public and local knowledge, perceptions and practices regarding infectious diseases and other communicable diseases in selected areas of Tanzania demonstrated higher understanding by pastoralist of the existences of a number of certain diseases transmitted between humans and animals (Swai *et al.*, 2010; Mangesho *et al.*, 2017). Moreover, livestock keepers could recognize abortions, emaciation, a drop in milk production and fever as clinical signs associated with brucellosis (Shirima, 2005). Despite the good perception and knowledge of common diseases circulating in their area, livestock farmers needs to improve their practices to control those diseases, which most of the times leads to failure at individual and national levels (Chengula *et al.*, 2013). The activities undertaken for controlling brucellosis, may involve the capacities for detection of the disease, the participation of the stakeholders for mass vaccination or culling; the epidemiosurveillance system based on the perception of the risk for the humans, livestock and wildlife in the ecosystem. Despite their knowledge and perception of the threat caused by certain diseases in their communities, pastoralists adopt some cultural behaviors which

could favor the transmission of infectious disease in the localities (Musallam *et al.*, 2016).

The understanding and the eradication of brucellosis, needs a characterization of the disease, the multidisciplinary actions from different stakeholders in the infected zones (Zinsstag *et al.*, 2005). Also, the transboundary transmission of zoonotic diseases may be considered and be evaluated from the local understanding of communities; this reinforced by cross-border molecular tracing which can confirm brucellosis as a zoonosis of concern for regional public health (Gwida *et al.*, 2012). Little is known about the local understanding of brucellosis by pastoralists in Kagera, Tanzania. This study was conducted to assess the knowledge, perception, and practices regarding brucellosis of different stakeholders in the pastoral communities of Kagera Region; an ecosystem located on borders between Tanzania, Burundi, Rwanda and Uganda.

## **MATERIALS AND METHODS**

### **Study area**

This study was conducted in two districts namely Karagwe and Ngara, of Kagera Region, in north-western part of Tanzania. Livestock contributes significantly to the economy of Kagera region, and animals are exported to neighboring countries (Ministry of Livestock and Fisheries Development, 2011). According to National Sample Census of Agriculture report of 2012, cattle population in Kagera region was 837,204. Other animals were 593,607 goats, 53,061 sheep, 44,402 pigs, 1,005,415 poultry, 2 water buffaloes, 15,627 rabbits, 40,471 dogs, 159 donkeys, 18 horses and 6,629 cats. Dairy farming is spread throughout the Region with an estimated 21,438 dairy cattle. Kagera ecosystem is subdivided into three agro-ecological zones (Lake Shore and Islands, Plateau Area and Low land) in which crops grown are mainly bananas, cassava, beans, maize, coffee and tea. The area has game reserves such as Kimisi and Burigi in which zebras, impalas, buffalos, elephants, giraffes, leopards, hippos and crocodiles can be found. Health facilities are distributed in all districts and various transport means link Kagera to other regions and neighboring countries particularly Burundi, Rwanda and Uganda. The climate is equatorial with temperatures ranging between 20°C and 28°C. Kagera Region, in general has rainfall ranging between 900 - 2,000 mm per annum.

### **Study design**

A cross-sectional study design was used to assess the knowledge, perception and practices of brucellosis by the pastoral communities of Kagera in June 2017, using a qualitative research method.

### **Participants selection and data collection procedure**

Two focus group discussions (FGDs) and one Key Informants Interview (KIIs) were conducted in Ngara district, while three FGDs and one KII were done in Karagwe district. Each FGD involved a minimum of six persons selected purposively: three farmers, one person from local administration, youth representative, and one person from religious confessions. Discussions in KIIs involved three persons of government officials from animal health, public health and wildlife departments at each district level. Participants were originated from five villages selected purposively (urban, peri-urban and rural areas) to get a variation of insights on brucellosis from different people according to their location. FGDs and KIIs approaches were combined to get coverage of information from experts and non-experts regarding brucellosis disease.

The FGDs and KIIs were conducted in the respective communities of the participants; i.e, ward executive and district official's offices (hospitals). Digital recording by mobiles phones was used to record discussions and to take pictures. FGDs were conducted in Swahili language by a facilitator, while interviews with KI were conducted in English by the researcher. The interview guide was structured around four main themes as follows:

(i) Perception of brucellosis by the population in Kagera ecosystem: Participants were asked about the local name of brucellosis, existence of the disease in their locality. The knowledge on the causes, the presenting symptoms, and the mode of transmission of brucellosis were also assessed. Furthermore, the socio economic impact and the prophylactic approach of this zoonotic disease in the ecosystem were discussed.

(ii) Risk factors for brucellosis prevalence in Kagera ecosystem,

(iii) Potential for transmission of brucellosis in Kagera ecosystem due to neighboring with other countries

(iv) Roles of different stakeholders in the ecosystem in the control of brucellosis.

The facilitator introduced the aim of the study, explaining each theme clearly to participants. The discussions lasted for approximately 45 minutes. For the KIIs, the interviews were conducted in

English by the researcher and both FGDs and KIIs

### Data analysis

Data recorded from FGDs were transcribed verbatim to Microsoft Word and later translated from Swahili to English. The coding of the categories was done manually using Microsoft Excel inasmuch as, the data were small and themes and sub themes were identified. Later the content analysis was done with inductive and deductive methods based on the categories grouped in different themes and subthemes as well as emerging themes. Themes and subthemes were analyzed in their chronologic order of inquiry.

### Ethical considerations

This study was approved by institutional review board of Sokoine University of Agriculture, and ethics clearance was also obtained from the Medical Research Coordinating Committee of the National Institute for Medical Research (ref: NIMR/HQ/R.8a/Vol.IX/2456). Verbal consent was obtained before conducting each FGD by all the team members. For confidentiality matter, participants were ensured for none use of their names during analysis, report or publication. Approval by participants for recording and taking pictures was requested before starting this activity.

## RESULTS

### Socio-demographic description of the participants

*Thirty seven participants from six villages of Karagwe and Ngara districts were recruited to participate into Focus group discussions. The mean age of the participants was 49 years with a standard deviation of 10.55 and 30.55% of participants were females. The focus group discussions involved farmers, youth, religious leaders and local administration representatives. Four of the participants had no formal education, 21 had primary education, and 12 had secondary school or higher education. Key informants interviews were conducted in group of three individuals from public health, livestock and wildlife departments at district level (Table1). All the key informants were degree holders.*

groups were asked the same questions.

### The knowledge and perceptions on brucellosis by the pastoral communities of Kagera ecosystem

The understanding brucellosis among the study participants in Kagera Region was not direct because some of them confused this disease with the “abortion process”. In Tanzania, brucellosis is normally known in Kiswahili as “ugonjwa wa kutupa mimba” meaning the “disease of abortion”. The facilitator had difficulties to get the right words in local language to signify “brucellosis”. Describing the disease to participants, the term abortion was used as a prominent symptom; but, it wasn’t enough to differentiate brucellosis from other abortive diseases which people are accustomed to see or to report in humans and their livestock. Explanations and discussions were needed to make participants understand the phenomena of abortions, which was influencing much the answers given in the focus group discussions conducted in the two Districts.

Participants gave different local names of brucellosis: Amakole, Omwizi, Entandago, Kuramburura, and Kururumura. However, the most common local name of brucellosis used in the two districts was “Kutoroga”.

Also, the existence of brucellosis in their locality, as well as the zoonotic nature of the disease was recognized by all the groups who participated in this study. However, participants provided different causes of brucellosis. Five groups out of seven believed that brucellosis is caused by seasons (three groups mentioned dry season and two groups mentioned rain seasons), while three groups said that brucellosis is caused by other diseases (malaria, foot and mouth disease). One group mentioned vectors (tsetse flies, mosquitos), age, contaminated water, drought and famine as causes of this disease.

*“..... Few days ago, I was a farmer this disease can occur when the cattle drink contaminated water with bacteria. Also dry season causes abortion because of high temperature. There are so many causes’ including different diseases. That’s what I know.”* (FGD Bweranyange- Karagwe District).

Six out of seven groups mentioned abortion as a symptom of brucellosis in humans and livestock. Other symptoms in humans mentioned were fever, tiredness, skin changes, and the two key informants groups insisted on the fact that brucellosis may have a resemblance of symptoms with other febrile diseases such as malaria.

In livestock, participants mentioned additional symptoms of brucellosis such as fever, hygroma, vaginal discharges, skin changes, inappetence,

*“The signs are the same, cattle can feel like fever, then hair rise up and blood start to come out, and abortion can occur almost within two days. We as farmers are very*

orchitis, tiredness, general weakness and coughing. Only one group of key informants mentioned hygroma as symptom of brucellosis observed in wildlife.

*accustomed to the problems of cows than those riches (cattle owners) who give us the cattle to graze for them” (FGD conducted in Nyakasimbi-Karagwe District - farmer).*

**Table1.** FGDs per District and locations

District	Village	Characteristic	Participants		No. of FGDs conducted
			Female	Male	
	Bweranyange	Rural area participants	1	6	1
Karagwe	Nyagasimbi	Rural area participants	1	5	1
	Nyakahanga	Urban and peri-urban area participants	2	4	1
	Kayanga	Officials from Livestock, Public health and wildlife department	1	2	1
	Benako	Rural area participants	3	3	1
Ngara	Ngara mjini	Urban and peri-urban area participants	2	4	1
	Ngara	Officials from Livestock, Public health and wildlife department	1	2	1
Total			1	26	7

Mode of brucellosis transmission also retained the attention of participants when they mentioned different ways in humans: consumption of uncooked meat and unpasteurized milk, sexual intercourse and unprotected assistance of their animals during parturition. In addition, they mentioned the poor disposal of aborted materials and placentas. In livestock, participants centered the transmission of brucellosis on the sharing of pasture and water between domestic animals and wildlife, the physical and sexual contact between animals, vectors (mosquitos and tsetse flies) and contact with vaginal discharges of infected animals. Two groups mentioned the interactions between animals and the dissemination of vaginal discharges as source of contamination of brucellosis in wildlife.

*“In animals, the transmission can be due to the increase of the number of cattle in the same area where self-infection between those cattle can occur; or, if the livestock is not well vaccinated, also during the sharing of pastures with those cattle which are not vaccinated well. It may happen that you perform vaccination very well but the problem becomes on sharing pastures with others who have some diseases. This may result in the*

*transmission of some diseases which you cannot recognize” (FGD - Nyakahanga-Karagwe District Farmer1).*

Throughout the discussions, the participants talked about the social impact of brucellosis in their localities. Three out of seven groups believed that brucellosis could affect their willing of raising animals and could lose their faith in their marriage. In addition, the economic impact of brucellosis was pointed on the issue of the loss of milk production, unnecessary expenditure to cover the treatments (incomes decrease), which could also contribute to the inability to pay school fees for their children. All the groups converged to say that brucellosis decreases the total number of livestock. Furthermore, participants highlighted the negative impact of brucellosis on their health through the loss of pregnancies, the deaths and the nutrition problems due to the decrease of milk production.

*“Maybe on medical aspect, first of all, if you fail to diagnose brucellosis timely, you will not treat correctly and result into an avoidable death, if you treat wrongly the patient, thinking that maybe is malaria or typhoid while is not, the outcome of improper*

*treatment is bad consequences to the patient, like death; and misuse of medicines”* (KIII- Ngara District).

*“... but this problem can cause the fall of production for both animals and humans.”* (Cheikh - FGD Ngara District).

Regarding the prophylactic approach for brucellosis, focus group participants agreed that women actually are seeking in general for medical care in health centers and hospitals. Key informants groups specified the use of antibacterial drugs such as doxycycline and rifampicin as treatment options in case of suspicion of brucellosis, even if according to them, some of these drugs particularly rifampicin were commonly used to treat tuberculosis. For livestock sector, farmers in all groups attested to call for veterinary services, also they confirmed buying drugs themselves and rarely applying for

### **Risk factors for brucellosis in humans, livestock and wildlife**

The important risk factors for brucellosis mentioned by participants (five groups) were: a movement of livestock and wildlife in the ecosystem, the sharing of pastures and watering points between wildlife and livestock.

*“....because most of the people who are living here close to this Kimisi game reserve are involved in movement in game reserve. They take their livestock to graze inside the game reserve. So, their interaction with wildlife can increase the disease. So, these animals can cunningly increase the risk”* (KII- Karagwe District-wildlife official).

KII groups recognized the existence habits of drinking unpasteurized milk, poaching and the poor disposal of aborted material (placentas and aborted materials are thrown in the environment or given to dogs) as major risk factors for brucellosis in humans in the communities. Climate change, consumption of uncooked meat and sexual intercourse (favored by the movement of people in the ecosystem) were also reported as risk of introduction of brucellosis in the study area by two groups.

### **The risk for transmission of brucellosis in Kagera ecosystem due to neighboring with other countries**

Six groups stated that the interactions observed on borders between livestock and wildlife and the existence of games reserves on borders constitute a

vaccination program. The use of traditional medicine to treat brucellosis in livestock and humans in case of abortions was mentioned by two groups during discussions.

*“Ah no, when you suspect something even if it is not yet confirmed, but if you see that it is likely to be, you start to treat. So alternatively, we use doxycycline; even if it is not available in the hospital, in the pharmacies, it is available”* (KIII Ngara District).

*“Here the government has never provided such vaccine or medicine but ourselves when the problem happens, we go to the pharmacy to buy some medicines for treating our livestock. But about prevention cases from the government; we didn't receive any.”* (FGD Bweranyange- Karagwe District farmer2).

risk for transmission of brucellosis from others countries. Furthermore, the existence of movement of people crossing borders for pastoralism and business (commercial activities), the migration of people (sites for refugees) were evidenced by different groups as potential risks for the introduction of brucellosis from neighboring countries.

*“During the conflicts war in Rwanda and Burundi I was here and during that time I was keeping goats but this disease was already there before the refugees came here. But during that period there are some refugees who brought some cattle and used to sell it to indigenous people but there were no any benefit from this, because all of them died. We are not sure if those cattle died because of this disease or if the problem was the climate changes they faced once they arrived here. But I think the problem was the environment, they were not support the weather. After the refugees returned to their home, the process of keeping animals increased in high percent and lobbors of cattle increased also.”* (Pastor in FGD in Benako- Ngara District).

During the discussions, five groups mentioned also the uncontrolled movement of wildlife on borders (wild animals don't know borders) to be a risk of introduction of brucellosis from a country to another.

### **The role of different stakeholders in the ecosystem in the brucellosis control**

Actually brucellosis is not controlled in the pastoral communities of Kagera. Little is being done for the

effective surveillance of this zoonotic disease. All the groups confirmed that few farmers were vaccinating their animals. Otherwise, participants from all groups requested the government to apply for the community health education (trainings and seminars) and they shared the opinion about the necessity of mass vaccination program against brucellosis as it is done for others diseases (Foot and mouth disease, east coast fever CF). Two groups implored the improvement of the equipment in health facilities, also solicited the reinforcement of livestock service in the local communities (increase of the field livestock officers).

*"...so, it's better if the government can bring the service near and if possible every village should have an animal health*

## **DISCUSSION**

This study revealed low knowledge, poor perception and practices regarding brucellosis in pastoral communities of Kagera Region, northern Tanzania. Previous studies in Tanzania informed on the magnitude on brucellosis in some areas of the country (Assenga *et al.*, 2016; Kiputa *et al.*, 2008; Kunda *et al.*, 2005; Roug *et al.*, 2014), indicating the disease being one of important threats to both veterinary and public health in the country. Qualitative research studies like the current study are limited and provide further understanding of the problem, and hence, contribute to improved in this study. On the other hand, a study conducted in Tanga and Arusha revealed that rabies, tuberculosis and anthrax were considered the three most common zoonotic diseases (Swai *et al.*, 2010). After all, farmers understand the possibility of transmission of infectious diseases from animals to humans without much consideration for their threat (Mangesho *et al.*, 2017). A study conducted in Kenya showed a high level of knowledge of brucellosis in pastoral communities where respondents reported brucellosis to be a zoonotic disease and abortion as its common symptom (Obonyo and Gufu, 2015). But, in Ethiopia, none of the respondents to a study reported the zoonotic importance of brucellosis (Tsfaye *et al.*, 2013). Brucellosis was perceived by the participants in this study to be caused by others diseases such as malaria in humans, FMD in livestock; which indicates that brucellosis could be less considered among the principal threats in the study area. In addition, if brucellosis is one of the causes of losses in their communities, this situation could lead to ignore its real contribution, and to attribute abusively its burdens to other diseases. Although

*center."*(Farmer2- FGD Bweranyange-Karagwe District).

The Key informants proposed to build a laboratory for the diagnosis of brucellosis, to conduct research for mapping brucellosis in the area and they advocated for multisectorial collaboration (sharing information between livestock, wildlife and public health department) about brucellosis.

*"I think there is a need of having a research to be sure if really brucellosis is existing or not? We are assuming and assumption can be possible, but from what is happening. It is likely that brucellosis exists. To be sure of that, we need to have a research to confirm, to see the magnitude of the problem"* (KII-Ngara District).

surveillance and management of brucellosis (Mangesho *et al.*, 2017) in affected communities.

All participants described brucellosis as a zoonotic disease while most admitted existence of the disease in their localities. Nevertheless, the presence of a disease can't be confirmed from mere perceptions of people. For example, some local names like "Okutoroga" didn't mean exclusively brucellosis as a disease, but they were indicating the process of abortion in general, which could be attributed to the existence of other abortive diseases in the area. The knowledge of brucellosis by population in Kagera as a zoonotic disease resorte

abortion was mentioned by all FGD groups as common symptom of brucellosis in humans and livestock, women who participated in this study affirmed not to observe a big number of abortions in humans nowadays and, according to them, the rare cases which can occur could not be associated to brucellosis. Studies also documented that *Brucella* species occasionally are causing spontaneous human abortions, but the contribution of brucellosis to abortions in women is still controversial (Khan *et al.*, 2001; Kurdoglu *et al.*, 2015).

Although participants confirmed to have a habit of consumption of unpasteurized milk and non-inspected meat in the area, these animal products were only reported by key informants among the modes of transmission of brucellosis. Others studies in Tanzania reported findings in which pastoralists did not perceive the products from animal origin to be dangerous (Bashaka, 2015; Mangesho *et al.*, 2017; Swai *et al.*, 2010). However, participants had a focus on the interactions between wildlife and livestock, when they share pasture and water, as a

privileged mode of transmission of brucellosis in Kagera Region. Respondents in a study conducted in Uganda also believed that the proximity of livestock to wildlife contributes to the presence of brucellosis (Kansiime *et al.*, 2015).

impact of brucellosis on the decrease of milk production and its negative implications on nutritional health problems at the moment of paying the tuition fees for their children. In fact, zoonotic diseases like brucellosis can cause losses with far-reaching social impacts (Ducrotoy *et al.*, 2014). Losses particularly due to brucellosis are remaining to be quantified through epidemiological studies, because abortions due to brucellosis in humans and livestock are not much understood. Furthermore, studies on the economic impact caused by brucellosis in livestock are reasonably consistent in different production systems in Africa and Asia (McDermott *et al.*, 2013). Economic burden in pastoralist areas are also due to others infectious diseases, but generally in Africa, in regions where the infection rate can reach 30% for bovine brucellosis, the economic losses are calculated to 5.8% of gross income per animal reared (Domenech *et al.*, 1982).

During the discussions, participants explained their prophylactic practices regarding brucellosis. The key informants from public health were treating suspected cases of brucellosis with doxycycline, specifically those patients who demonstrated long febrile periods; but, they affirmed to do it without any diagnosis protocol. A systematic review on treatment of brucellosis in human for the recent twenty years, concluded with similar data where doxycycline-aminoglycoside combination was the first choice with doxycycline- rifampin and the study recommended doxycycline-cotrimoxazole to be the alternative regimens (Alavi and Alavi, 2013). Treating suspected cases combined with self-medication by people suggests that population of Kagera Region could be exposed to an antimicrobial resistance threat in humans and their livestock. In fact, Tanzania is placed among countries which are in need of standard surveillance of antimicrobial resistance in human and livestock pathogens (Mshana *et al.*, 2013). Diseases can be misdiagnosed in the population because of the absence of diagnostic tools. Furthermore, sound control of diseases requires relevant skills and information about their causes, symptoms and mode of transmission (Lindahl *et al.*, 2015). The results from this study showed that few farmers are individually vaccinating their animals. Despite the difficulties to eradicate brucellosis in field conditions, different vaccines have been applied to control this disease. Efforts are need to sensitize

Participants perceived in this study the impact of brucellosis by underlining the losses of pregnancies in humans and the loss of willing for raising animals after abortion cases. They had also knowledge of the people for mass vaccination against brucellosis which could lead to the control of it zoonotic transmission (Olsen and Stoffregen, 2005). Some participants' reported to use local medicines to treat brucellosis in humans and animals. This practice is shared by smallholder dairy farmers in Pakistan (Arif *et al.*, 2017). Actually, 193 plants are documented in East Africa region to be used by farmers for treating diseases of their livestock including brucellosis (Katerere and Luseba, 2010). However, these practices are sometimes kept jealously by farmers and are transmitted from generation to generation. Moreover, traditional medicine are valuable resources for new agents against antibiotic-resistant strains, and studies have been conducted in this sector (Motamedi *et al.*, 2010; Noudk *et al.*, 2017; Sheng, 1993).

Practices of assisting animals during parturition without any protection and the disposal in the nature of placentas and aborted materials could be associated to the lack of community health education. Moreover, protective gears during assistance of parturition could not be available in pastoral areas; and the limited incomes from small farmers could perpetuate such poor practices. In addition, this behavior can be related to the low risk perception of brucellosis in the communities. Small scale farmers in Tajikistan didn't use any protection when handling cows having an abortion or when dealing with aborted materials (Lindahl *et al.*, 2015). The results from this study pointed also the interactions between wildlife and livestock, poaching activities as potential risk factors for brucellosis infections to humans and livestock. In fact, scholars have documented the presence of brucellosis in wildlife (Fyumagwa *et al.*, 2009; Godfroid, Nielsen *et al.*, 2010; Muma *et al.*, 2010; Waghela and Karstad, 1986; Williams *et al.*, 1993). However, the role played by wild species in spillover of brucellosis to livestock remains to be cleared. In addition, in this study, little was discussed by participants about the mode of transmission, the risk factors or the impact of brucellosis in wildlife in their communities. In reality, experts from wildlife sector could increase the diagnosis and surveillance of prevalent diseases and share the information with the rest of stakeholders in the communities. These interactions may be controlled to minimize the risk as the main reservoirs of brucellosis in the ecosystem are domestic and wild animals which may carry

*Brucella* regardless of infection prevalence in the main hosts (Zheludkov and Tsirelson, 2010).

The existence of game reserves on borders of all the neighboring countries with Tanzania was seen as a risk for transmission of brucellosis. In fact there are game reserves like Burigi, Kimisi on part of Tanzania, Ruvubu national Park in Burundi, and Akagera National Park on part of Rwanda where an uncontrolled movement of wildlife species can be observed on borders between those countries. Even though the introduction of brucellosis in Kagera region is not documented, observations from a study stated that the potential impact of a disease outbreak can be amplified by interactions of drivers (Suk *et al.*, 2014). Participants of this study mentioned also the movement of refugees with their livestock in the area, together with an increase of sexual intercourses, consequent to cross border exchanges as potential drivers of brucellosis in their communities. Moreover, the increase in animal product demand can favor the spread of transboundary animal diseases (Otte *et al.*, 2004), including brucellosis.

Some recommendations were addressed specifically to the Government to control brucellosis in their communities. Even though the request of infrastructures for diagnosis of brucellosis were prominent, farmers should act through associations or in their cooperatives where indeed mass vaccination programs can be implemented. Participants converged to solicit the community health education for integrating the management of zoonotic diseases, brucellosis included. Other studies recommended also the increase of knowledge of local communities as a strategy for prevention and control of brucellosis (Bashaka, 2015; Obonyo and Gufu, 2015). Key informants in general advocated for the multidisciplinary collaboration, to establish the status of the disease in the area. Indeed, the health education on zoonosis was indicated in a study, as one branch of collaboration between veterinary and public health services (Ward *et al.*, 1993). A reinforcement of livestock personnel skills at community level was proposed. A study conducted in Uganda underlined the training and recruiting more health personnel, education of the communities about brucellosis diagnosis and vaccination as important gaps for the prevention of this disease in the communities (Kansiime *et al.*, 2015). The exchange of information between the neighboring countries at multidisciplinary level could also increase the risk management and control of brucellosis in the ecosystem.

## Study limitations

This study has some limitations based on the fact that the discussions were not directly conducted by the researcher because of language barrier. Even though the facilitator recruited was trained, he got problems to translate to the participants “brucellosis” as a disease and “abortion” as a symptom, because in Swahili, brucellosis is called “Ugonjwa wa kutupa mimba”= “Disease of abortions”. During discussions, there were confusions to understand the difference between brucellosis and others abortive diseases in the area. Participants were requesting for more clarifications to understand difference between abortions as symptom and brucellosis as disease. Discussions with key informants were made in groups of three persons instead of independent interviews due to their lack of time. With such approach, participants could influence each other’s during their responses. However, the information collected from the Key Informants complemented the knowledge from the rest of participants to this study. In fact, the results from this qualitative study can’t be extrapolated to the rest of the population in the Region because, participants were not randomly selected. However, this research was conducted in pastoral communities, where exist strong interactions between humans, livestock and wildlife in an ecosystem located on borders between four countries (Tanzania, Burundi, Rwanda and Uganda), which is the strength for this study.

## Conclusion

This study assessed the knowledge and perception regarding brucellosis in pastoral communities of Kagera Region, Tanzania. Focus group discussions and interviews with key informants revealed a low knowledge, perception and practices of brucellosis in the study area. Participants possessed low knowledge on causes, symptoms and mode of transmission of brucellosis. However, people from these pastoral communities attributed different local names to brucellosis and they were aware that it is pertaining to zoonotic diseases. Despite of their knowledge on the existence of strong interactions between humans, domestic animals and wildlife in the bordering ecosystem, their risk perception of brucellosis is poor due to the neglected and cultural behavior of people in their communities. The improvement of the knowledge and practices regarding brucellosis request a clear community health education program and should involve cross border collaboration with stakeholders in neighboring countries. More researches are needed

to elucidate the status of this transboundary disease in the pastoral areas of Kagera Region.

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