EISSN: 2707-0425

East African Journal of Science, Technology and Innovation, Vol. 6 (Special Issue 3): October 2025

Seroprevalence and risk factors of *Brucella* infection in commercial cattle farms in the Lake Zone of Tanzania

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Abstract

Brucellosis is an important zoonotic disease among livestock and humans worldwide and in Low-and-Middle Countries (LMICs) including Tanzania. The aim of this study was to determine the factors that could influence seroprevalence of brucellosis in commercial cattle farms. A cross-sectional study was conducted in a total of 54 commercial cattle farms randomly selected in Kagera, Mara, and Mwanza regions of the Lake Zone in Tanzania. Serum samples were collected from 1,080 cattle comprising both dairy and beef animals of both sexes and tested for *Brucella*-specific antibodies using Rose Bengal Plate Test (RBPT). Positive samples were confirmed by using competitive Enzyme-linked Immunosorbent Assay (c-ELISA). Animals in each farm were randomly selected for blood collection whereby a total number of 20 adult animals from both sexes were involved in the study. Descriptive statistics and multivariable regression analysis were conducted to assess the risk factors associated with brucellosis.The overall seroprevalence of brucellosis was 6.9% at the animal level and 51.9% at the farm level. Medium scale farms Odds ratio (OR = 11.304; Confidence Interval 95% CI 1.140 – 112.108;) and small - scale farms (OR = 37.170; 95% CI 1.119 – 1235.006) demonstrated a significantly higher likelihood of seropositivity to brucellosis than large - scale farms. Dairy cattle farms were less likely to be seropositive (OR = 0.046; 95% CI 0.003 – 0.728;) than beef cattle farms. The findings from the present study indicated that more than half of the farms are positive for *Brucella* antibodies. The study also revealed that the scale of production and functional type of cattle increase the risk of seropositivity. The findings provide baseline information for the development of targeted intervention programme in the control of brucellosis.

Key words: *Bovine brucellosis; c-ELISA; RBPT; Zoonotic*

Cite as: Tluway *et al.* (2025): Seroprevalence and risk factors of *Brucella* infection in commercial cattle farms in the Lake Zone of Tanzania. *East African Journal of Science, Technology and Innovation 6(Special Issue 3).*

Received: 10/02/25
Accepted: 13/08/25
Published: 30/09/25

Introduction

Brucellosis is a worldwide distributed zoonotic disease of importance to public health and livestock industry. The term brucellosis is generally used to refer to infections caused by *Brucella abortus*, *Brucella melitensis*, *Brucella suis, Brucella canis, Brucella ovis, Brucella ceti* and *Brucella pinnipedialis* (WOAH, 2022). The causative agent in cattle is *Brucella abortus* and in endemic areas *B. melitensis* is likely to be causing clinical disease in cattle (Mengele et al., 2024). Brucella bacteria are small in size (0.5 – 0.7 by 0.6 to 1.5µm), non- motile, Gram's negative and facultative intracellular parasites, with rod shaped, non-spore forming and they are non-encapsulated (Mathew *et al.*, 2015, Ntirandekura *et al.*, 2020). These bacteria can survive on exposure to freezing and thawing, however, most disinfectant that are active against gram's negative bacteria can kill *Brucella* (Kiros *et al.*, 2019). In female cattle the characteristics of late term abortion, foetal death and reduced milk production is observed (Warioba *et al.*,2023). A number of predisposing factors for brucellosis have been reported which include herd size, intermingling with other animals and age of the animal (Mcdermott and Arimi, 2002).

The disease can go further to chronic stage which is indicated by the presence of hygromas on leg joint of infected cattle (Tulu, 2022). The disease in male animals is characterized by the orchitis and epididymitis (Alton, 2019). Different Brucella species such as *Brucella melitensis, Brucella suis* and *Brucella abortus* can be transmitted from livestock to human causing a disease known as undulating fever (Galińska et al., 2013).

Keeping goats and sheep near dairy cattle has been associated with an increased risk of brucellosis in cattle. Cattle can be infected with *B.melitensis* or occasionally *B.suis* when small ruminants and pigs interact regularly with livestock at the farm (Mengele *et al.,* 2023). The limited number of studies have been reporting the seroprevalence in small ruminants in Tanzania, were brucellosis prevalence ranges from 0.0% to 20.0% in goats and 0.0% to 13.8% in sheep (Chota *et al.*, 2016).

The disease in cattle is suspected based on clinical signs such as abortion. In order to confirm brucellosis, bacterial isolation is recommended but it is slow, expensive and cumbersome. A number of serological test are available, although few are approved for international trade including Rose Bengal Plate Test (RBPT) for rapid screening suitable in field condition in endemic areas due to high sensitivity, Compliment Fixation Test (CFT) as confirmatory test,with high specificity, it is ideal in control programs and Enzymelinked Imunosorbent Assay (ELISA) suitable for both screening and confirmatory test due to high sensitivity and specificity for the purpose of surveillance (Vhoko et al., 2018).

Molecular characterization technique such as Polymerase chain reaction (PCR) are used for speciation, which enable differentiation between various species of *Brucella.* The technique is also useful in broader pathogen characterization (Kiros *et al.,* 2019). The increase in the occurrence of brucellosis in LMIC is influenced by sanitary, socioeconomic and political factors (Pappas *et al.*, 2006). Sanitary factors like poor veterinary infrastructures, socioeconomic including poverty and low awareness and limited access to veterinary services, political factors including lack of government prioritization of zoonotic disease and weak enforcement of animal movement and vaccination regulations are common factors which influence prevalence of brucellosis.

The African countries in the recent years highlighted zoonotic diseases under Global Heath security Agenda, and brucellosis was among the zoonotic diseases which require control efforts (Ducrotoy *et al.,* 2017, Sambu *et al.*, 2021). In Tanzania brucellosis was prioritized as zoonotic disease from 2017 and several control measures have been implemented such as formation of national control strategies, establishment of vaccination guidelines and commencement of vaccination campaign (Sambu *et al.*, 2021).

Globally, human brucellosis is still enormous leading to 500,000 infections and above per year with a noticeably high adverse effect to livestock keepers in sub-Saharan Africa (Dean *et al.,* 2012). The infected human manifest typical symptoms and clinical signs which involve febrile illness, weakness, headache, muscle, joint and back pain (Enström *et al.,* 2017). The disease can be confused with other infections like malaria, tuberculosis

and fungal infection. Since in Sub Sahara Africa including Tanzania, the malaria is widespread, the mis-diagnosis of brucellosis commonly practiced (Kiros *et al.*, 2019). The effect of disease to human extends to loss of labor and serious decrease of much required animal protein in human nutrition.

Bovine brucellosis is endemic in Tanzania with a prevalence ranging between 0.3% to 60.8% in cattle (Alonso *et al.*, 2016, Mirambo *et al.*, 2018, Mengele *et al.*, 2023). Human brucellosis has been reported in different parts of Tanzania with prevalences ranging between 0.7% and 20.5% placing a significant public health threat and economic burden resulting from high treatment cost, and lowered work capacity (URT, 2021, Mengele *et al.*, 2023).

The challenge in controlling the disease is linked to the economic burden caused by reduced livestock productivity, increased food insecurity limited oppurtunities for livestock trade and low investment in disease surveillance (Sambu *et al.*, 2021). Generation of evidence to support in the implementation of the control measures is an ideal step in the control of bovine brucellosis while improving cattle productivity in commercial farms and protecting the public against the disease.

The present study therefore aimed to estimate prevalence through sero-survey and identify and quantify risk factors associated with brucella seropositivity in commercial cattle farms of Lake Zone in Tanzania.

Materials and methods

Study area

Three regions (Kagera, Mara and Mwanza) in the Lake Zone were involved in the current study, in each region three district were sampled due to their similar farming environments, which support diverse farming characteristics ranging from small-scale to large-scale. Kagera Region is situated in northwestern Tanzania, covering an area of 40,838 km^2, of which 28,953 km^2 is land and 11,885 km^2 is water bodies, primarily Lake Victoria. It spans at Latitude 02°09'54.72'' South, and longitude 31°34'41.16'' East, bordering Uganda, Rwanda, and Burundi to the West, and includes diverse ecosystems of lake shores, plateaus, and low lands. The region has a cattle population of 886,474 (URT, 2007) Mara Region, located in northern Tanzania, covers 30,150 km^2 and is divided into five administrative districts. It lies between latitudes 1°45'02.52'' South, and longitude 34°00'20.88'' East, bordered by Arusha to the East, lake Victoria to the West, Mwanza and Shinyanga to the South, and Kenya to the North. With an elevation of 1,316.98 meters above sea level, Mara region has a cattle population of 10,099,068 (URT, 2007). Mwanza Region is in the northern part of Tanzania, spanning at latitude 2°27'04.68'' South and longitudes 32°49'35.40'' East, with a significant portion surrounded by Lake Victoria. It covers an area of 35,187 km^2 including 20,095 km^2 of Lake Victoria. Mwanza borders Kagera to the West, Shinyanga to the South, and Mara to the Northeast, with a cattle population of 1,718,191 (URT, 2007)

Figure 1

Study area showing regions of the Lake Zone of Tanzania where Serum Samples were collected for Seroprevalence Study

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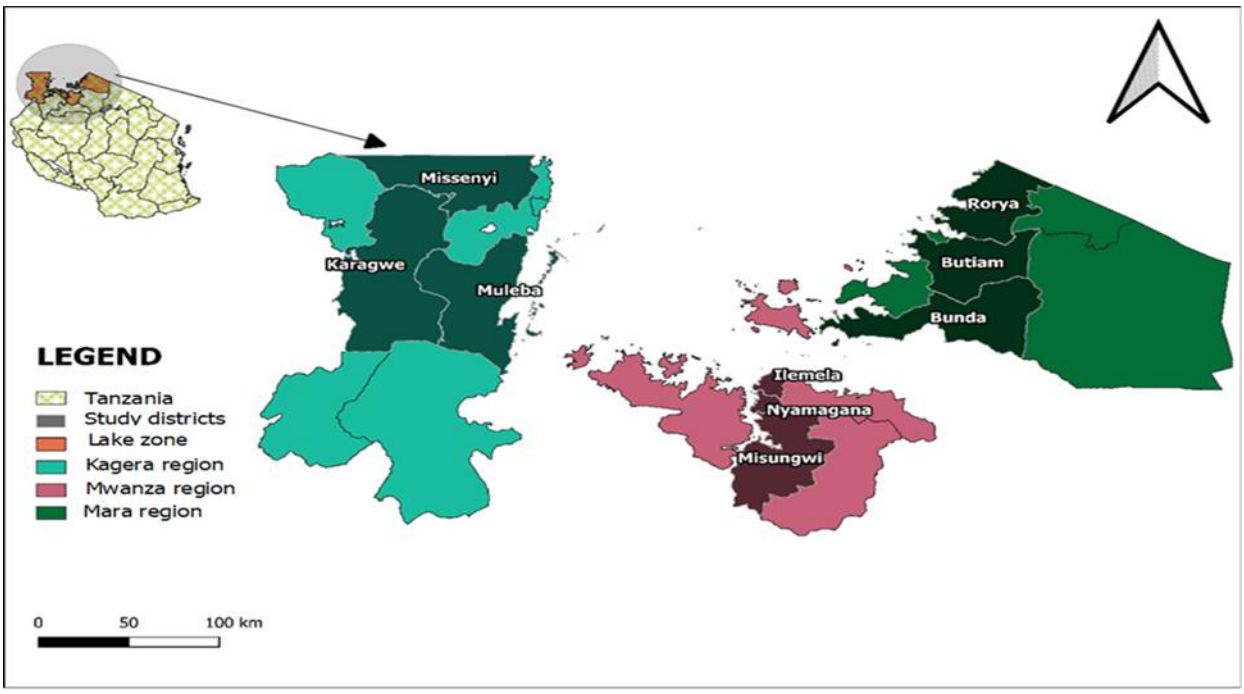

Note: *The map was created using QGIS Software Version 3.14.0 and the shape files for Tanzania administrative boundaries were extracted from www.geoboundaries.org.*

Study design

The cross-sectional study was conducted during the period of December 2023 to May 2024 to estimate seroprevalence of bovine brucellosis and potential risk factors associated with prevalence of the disease in commercial cattle farms in Lake Zone of Tanzania.

Selection of risk factors

In this study the selection of hypothesized risk factors for brucellosis seropositivity was based on previus literature. The variables (independent) included were scale of production, grazing system, other animals in the farms, gestation stage of abortion, farming system, purpose of keeping animal and region which are directly used in regression analysis) vs Brucella seropositivity (dependent variable), sharing of bulls, vaccination against brucellosis and sex of animal. Multivariable logistic regression was used to identify independent risk factors associated with brucella seropositivity. Model fit were assessed by software for the estimation of proportion of variation of Brucella seropositivity, explained by the model.

Study population and sampling

The study targeted both beef and dairy cattle farms (cattle kept for aim of selling beef and milk) with a minimum of 20 animals kept for commercial purpose. The farms were arbitrary divided into three categories ie small, medium and large scale based on the number of animals present at the time of sampling. Farms were considered as small scale when there was 20 to 100 animals; those with 101 to 500 heads were regarded as medium scale farms and those comprising more than 500 cattle were considered as large scale farms. From each farm a systematic random sampling of farms were performed.

From each farm a total number of 20 adult animals (sexually matured) of both sex were randomly selected based on Food and Agricultural Organization (FAO, 2003) for blood collection.

Sample Size

Sample size was estimated using the formula,

$$n = Z^2_{1-\frac{\alpha}{2}} P(1-P)/L^2 \quad (1)$$

(Arya *et al.*, 2012) .

Where n = number of sample size, P = prevalence of Brucellosis, Z = value of the standard normal distribution corresponding to a two sided confidence level of α/2 and L = maximum allowable error. Because the farm-level prevalence of Brucellosis has been reported in one of the regions to be 18.2% (Ntirandekura et al., 2021) the same prevelence level was used to estimates the level of prevalence in other two regions under study based on allowable error of L = 0.05 at 95% confidence level (Naing et al., 2006). Based on information obtained from Zonal Veterinary Office number of farms was estimated to 61 (7 in Mwanza,12 in Mara, and 42 in Kagera). Due to the small number of commercial farms in the area of study, this was adjusted using the finite equation:

$$n = \frac{n_0}{1+\frac{(n_0-1)}{N}} \quad n = \frac{227}{1+\frac{(227-1)}{61}} = 49 \text{ farms} \quad (2)$$

(Nanjundeswaraswamy and Divakar, (2021). Assuming a non-response rate of 10% the total sample was adjusted to 54 farms. Therefore, farms were selected proportional to population size hence 6, 11 and 37 farms from Mwanza, Mara and Kagera regions, respectively were involved in the study. A total of 1080 blood samples were collected including 120, 220 and 740 from Mwanza, Mara and Kagera respectively.

Data collection and measurement tools

A multistage sampling scheme was applied to select farms for the study, with the number of farms randomly chosen in proportion to the target sample size for each study region from a sampling frame of 61 farms. In total, 54 farms were visited, accounting for a 10% non-response rate, and these were visited. Using a questionnaire, data regarding farm and animal characteristics were collected. From each farm a total number of 20 adult animals of both sex were randomly selected for blood collection as recommended (FAO, 2003). The visited farms were subsequently classified as small-scale (20–100 cattle), medium-scale (101–500 cattle), or large-scale (501–1,780 cattle).

Collection of blood samples

Five (5) mL of blood was collected from each animal through jugular vein puncture by using a sterile vacutainer needle and plain vacutainer tube. Sterile vacutainer needles and plain vacutainer tubes were used for blood collection. Each tube was labelled and assigned identification code, including relevant deteils of animal's identification number, sampling location and date of collection to ensure proper traceability. The tubes with the samples were carefully stored in a cool box with icepacks to maintain temperature at $+4^0$C to 8^0C and transported to the laboratory.

Separation of serum and laboratory analysis

Blood samples were centrifuged at 3000 rpm for 10 minutes to separate serum, after which the serum samples obtained were transferred to sterile cryovials and stored at -20^0C ready for analysis. Laboratory analysis was carried out at Sokoine University of Agriculture (SUA) after serum being stored for three months. Prior to testing, the serum samples were thawed at room temperature and mixed thoroughly to ensure homogeneity.

Rose Bengal Plate Test (RBPT)

A total of 1080 serum samples were screened using the Rose Bengal Plate Test following manufacturer instructions. The antigen was obtained from the United State Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Dayton Avenue United States. Briefly, 30µl of RBPT antigen and 30µl of the test serum were thoroughly mixed in a single well on a glass plate. The plate was gently rocked from side to side for four minutes. Any observable clumping for each 40 samples per run including controls was considered as agglutination then interpreted as a positive result.

Competitive Enzyme-Linked Immunosorbent Assay (c-ELISA)

RBPT-positive sera were subsequently confirmed by c-ELISA (SVANOVIR Indica Sweden AB Box 1545 SE-75145 Uppsala, Sweden) following manufacturer procedures. Briefly, each well received 45µl of sample dilution buffer for serum and control samples, with duplicate wells containing 5µl of control samples and 5µl of dilution buffer. Test samples were then added at 5µl per appropriate well. Additionally, 50µl of

mAb-solution was added to all wells, and the plate was sealed and mixed on a plate shaker. After incubation and washing with PBS-tween buffer,100µl of the conjugate solution was added to each well. Following another wash, 100µl of substrate solution was added, and the plate was incubated at room temperature for 10 minutes. Subsequently, 50µl of stop solution was added to each well. Controls and samples optical densities (OD) were measured at 450nm using a microplate photometer (MICRO READ 1000 ELISA Plate Analyser) within 15 minutes after adding the stop solution to prevent OD fluctuations. Percentage inhibition values (PI) for controls and samples were calculated using the formula provided by the ELISA kit manufacturer.

$$PI = 100 - \left(\frac{OD_{sample\ or\ control}}{OD_{\ Conjugate\ Control\ Cc}} x\ 100 \right) \quad (3)$$

Serum was considered positive if the PI value was ≥ 30%, and animals were classified as *Brucella* seropositive only if both RBPT and c-ELISA tests yielded positive results. An animal was considered seropositive if tested positive on RBPT and c-ELISA test. A farm was defined as the total number of cattle from the same farm and was classified as seropositive if at least one animal tested positive on both RBPT and c-ELISA.

Data management and analysis

Results on brucellosis seropositivity were entered and cleaned in Microsoft Office Excel Version 2016 before being imported into IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp for statistical analysis. Chi-square tests and multivariable logistic regression were conducted using SPSS to assess associations between the hypothesized potential risk factors and outcome variables (Brucella seropositivity). The association of variables were considered statistically significant when the p-value was less than 0.05 at 95% confidence level.

Results

Farming practices and management

The majority of farms (94.4%, n=51) practice an outdoor farming system (free range), with most of these farms (63.0%, n=34) utilizing their own fields or paddocks. Notably, 61.1% (n=33) of these farms are medium-scale farms. In terms of breeding practices, all farms uses natural breeding system, among them more than three quarters 83.3% (n=45) of the farms do not share bulls, and a larger proportion (85.2%, n=46) have never vaccinated their cattle against brucellosis. Abortion were reported on all farms included in study, with the majority (61.1%) showing that the most recent abortion occurred less than six months before the study visit. A considerable number of these abortions (42.6% n=23) were reported to have occurred during the third trimester of gestation. Furthermore, majority (68.5%) of the surveyed farms kept cattle for beef production. More than half of the selected farms 57.4% n= 31) kept cattle with goats and sheep in same farm (Table 1)

Table 1

Characteristics of Commercial Farms of Lake Zone

Variable	N=54 n (%)
Farming system	
Outdoor	51 (94.4)
Indoor	3 (5.6)
Grazing area	
Communal pasture	6 (11.1)
Own pasture	34 (63.0)
Communal/own pasture	14 (25.9)
Farm size	
Small scale	14 (25.9)
Medium scale	33 (61.1)
Large scale	7 (13.0)
Sharing bulls	
No	45 (83.3)
Yes	9 (16.7)
Vaccination against brucellosis	
No	46 (85.2)
Yes	8 (14.8)
Last abortion	
≤ 6 month	33 (61.1)
7 – 12 months	7 (13.0)
> 12 months	14 (26.0)
Gestation stage of the last abortion	
First trimester	9 (16.7)
Second trimester	22 (40.7)
Third trimester	23 (42.6)
Other animal in the farm	
None	10 (18.5)
Goats	11 (20.4)
Goats and sheep	31 (57.4)
Goats, sheep and pigs	2 (3.7)
Purpose of keeping cattle	
Dairy	17 (31.5)
Beef	37 (68.5)

Seroprevalence of Brucella infection associated with farm characteristics

Seroprevalence of 6.9% was recorded at the animal level and 51.9% at the farm level. Chi-square test did not show any significant difference on the seropositivity and farm characteristics. Notably, the highest seroprevalence (63.6%) was observed in farms where cattle grazed on both communal areas and privately owned fields. Seropositivity was also higher in medium-sized farms (60.6% n=20) than the large-scale and small-scale farms. Further farms that share bulls for reproduction have higher level of seropositivity (55.6%, n=5) compared to those which uses their own bulls for reproduction. In addition farms that are not vaccinated had higher positivity 52.2% (n=24) than those which practice vaccination against brucellosis, and farms that had other animals showed higher seropositivity (54.8%) than those which had cattle only (Table 2)

Table 2

Seroprevalence of Brucellosis and associated risk factors in based on farm and animal level in Lake Zone of Tanzania

Variable	**Farm level**			**Animal level**		
Farming system	Positive n (%)	Negative n (%)	P –value*	Positive n (%)	Negativen(%)	P –value*
Outdoor	27 (52.9)	24 (47.1)	0.509	73 (7.2)	947 (92.8)	0.102
Indoor	1 (33.3)	2 (66.7)		1 (1.7)	59 (98.3)	
Grazing area						
Communal/own pasture	7 (63.6)	4 (36.4)	0.601	17 (7.7)	203 (92.3)	0.122
Communal pasture	2 (33.3)	4 (66.7)		4 (3.3)	116 (96.7)	
Own pasture	19 (51.4)	18 (48.6)		53 (7.2)	687 (92.8)	
Scale of production						
Small scale	6 (42.9)	8 (57.1)	0.225	13 (4.6)	267 (95.4)	0.195
Medium scale	20 (60.6)	13 (39.4)		52 (7.9)	608 (92.1)	
Large scale	2 (28.6)	5 (71.4)		9 (6.4)	131 (93.6)	
Sharing bulls						
No	23 (51.1)	22 (48.9)	0.808	61 (6.8)	839 (93.2)	0.829
Yes	5 (55.6)	4 (44.4)		13 (7.2)	167 (92.8)	
Vaccination against brucellosis						
No	24 (52.2)	22 (47.8)	0.910	66 (7.2)	854 (92.8)	0.315
Yes	4 (50.0)	4 (50.0)		8 (5.0)	152 (95.0)	
Other animal in the farm						
None	4 (40.0)	6 (60.0)	0.871	9 (4.5)	191 (95.5)	0.117
Goats	6 (54.5)	5 (45.5)		12 (5.5)	208 (94.5)	
Goats and sheep	17 (54.8)	14 (45.2)		52 (8.4)	568 (91.6)	
Goats, sheep and pigs	1 (50.0)	1 (50.0)		1 (2.5)	39 (97.5)	
Purpose of keeping cattle						
Dairy	7 (41.2)	10 (58.8)	0.287	15 (4.4)	325 (95.6)	0.031
Beef	21 (56.8)	16 (43.2)		59 (8.0)	681 (92.0)	
Sex						
Male				3 (3.9)	74 (96.1)	0.287
Female				71 (7.1)	932 (92.9)	

* Chi-square test

Regression analysis of risk factors associated with Brucellosis

The multivariable logistic regression performed to determine the factors associated with increased risk of *Brucella* seropositivity (Table 3). The overall model was not significant (p = 0.130), however three factors showed significance values and the variation in the model was explained by 31.1%. At 95% confidence level, both medium scale farms (OR = 11.304; CI:1.140 – 112.108; p = 0.038) and mall scale farms (OR = 37.170; CI:1.119 – 1235.006; p = 0.043 demonstrated a significantly higher likelihood of seropositivity to brucellosiss than large scale farms. Furthermore, dairy cattle farms were less likely to be seropositive (OR = 0.046; CI:0.003 – 0.728; p = 0.029) than beef cattle farms.

Table 3

Statistical inference of associations between risk factors and Brucella seropositivity using Multivariable Logistic Regression Model

Variable	n (%)	Brucella positive n (%)	Adjusted OR	95%CI	P -value
Scale of production					
Small scale	14 (25.9)	6 (42.9)	37.170	1.119 – 1235.006	0.043
Medium scale	33 (61.1)	20 (60.6)	11.304	1.140 – 112.108	0.038
Large scale			Reference		
Grazing system					
Communal pasture	6 (11.1)	2 (33.3)	0.086	0.005 – 1.618	0.101
Own pasture	34 (63.0)	18 (52.9)	1.067	0.085 – 13.328	0.960
Communal/Own pasture			Reference		
Action taken to aborted foetus					
Give raw to dogs	18 (33.3)	9 (50.0)	0.426	0.072 - 2.528	0.347
Thrown into the bush	6 (11.1)	2 (33.3)	0.876	0.048 - 16.097	0.929
Buried	13 (24.1)	7 (53.8)	6.160	0.545 - 69.570	0.142
Left in a grazing area			Reference		
Other animal in the farm					
Goats	11 (20.4)	6 (54.5)	2.000	0.136 – 29.440	0.613
Sheep and goats	31 (57.4)	17 (54.8)	0.682	0.072 – 6.439	0.738
None			reference		
Gestation stage of abortion					
First trimester	9 (16.7)	4 (44.4)	0.771	0.127 – 4.6881	0.777
Second trimester	22 (40.7)	12 (54.5)	2.317	0.497 – 10.798	0.285
Third trimester			Reference		
Farming system					
Outdoor	51(94.4)	27 (52.9)	0.000	0.000 - …….	1.000
Indoor	3 (5.6)	1 (33.3)	Reference		
Purpose of keeping animal					
Dairy	17 (31.5)	7 (41.2)	0.046	0.003 – 0.728	0.029
Beef	37 (68.5)	21 (56.8)	Reference		
Region					
Kagera	37 (68.5)	19 (51.4)		0.000	1.000
Mara	11 (20.4)	7 (63.6)		0.000	1.000
Mwanza			Reference		

Discussion

The present study aimed to determine the seroprevalence of bovine brucellosis in commercial cattle farms in the Lake Zone regions of Tanzania (Kagera, Mara and Mwanza). Our study pinpointed only evidence of animal exposure to *Brucella* pathogen in the study area. Persitence of the disease may be associated with lack of vaccination of cattle against brucellosis and bacteria remain to be perpetuated in the same farm for the long time (Assenga *et al.,* 2015). The prevalence observed in this study however is similar to a study conducted in agro-pastoral areas of Morogoro (Asakura *et al.*, 2018), and in pastoralist region(Id *et al.,* 2023) in northern Kenya but lower than what was reported in Zambia (Chimana *et al.*, 2010) where 70.0% seroprevalence was reported in commercial and mixed dairy cattle. The lower prevalence in commercial farms of Lake Zone could be explained by the minimum interaction of the animals between farms due to private ownership of the farms in an identified boundaries. Each study was conducted in different setting and geographical location, which may provide valuable insights for developing region- specific

control strategies region.

The current study underscore the existence of brucellosis at animal level to be 6.8%. This result may be partly associated with limitation of resources which could support effective surveillance, timely diagnosis and other control measures, a challenge also reported in Arusha and Manyara regions by Shirima (2005). The prevalence of this findings however is similar to study conducted in domestic ruminants in Kagera (Ntirandekura *et al*., 2021), but lower compared to 9.3% and 9.9% study done in commercial farms in Mbarari Mbeya and in communal cattle in Zimbabwe respectively (Gomo *et al.,* 201, Sagamiko *et al*., 2018). The lower prevalence in commercial cattle than in communal cattle farms may be attributed by lack of controlled movement in communal cattle.Variation in animal level prevalence across studies may result from differences in sample size and diagnostic tests.Using a stsndardized serological test in endemic areas could improve consistency in prevalence estimates.

In our study findings showed that medium scale farms demonstrated a significantly higher likelihood to be brucellosis seropositive compared to large scale farms. The higher likelihood of infection may be attributed to the larger number of animals in medium scale farms, which increases the risk of brucellosis transmission through close contact. A similar observation were reported by Tulu (2022). This findings is in line with the previous study by (Vinueza *et al*., 2023), that show medium farms had 3.7 more odds to be infected than small farms in Equador.The variation in seroprevalence across studies may be due to difference in the diagnostic test employed. The test such as CFT which is very specific and I-ELISA are known to have higher sensitivity and specificity compared to RBPT and C-ELISA used in the current study, which possibly causing the higher detection rate (Mcdermott and Arimi, 2002). In contrast, study conducted in pastoral areas of Kenya (Id *et al*., 2023) reported higher seropositivity in large scale farms. This discrepancy may also be explained by difference in the classification of production scale. In the current study many farms were medium scale farms and scale classification based on herd size which may differ from other studies. Moreover, differences in production settings commercial vs pastoral system could contributed to the observed variation.

Findings from this study demonstrated that small scale farms had significantly higher likelihood to be *Brucella* seropositive than large scale farms. This could be associated with adherence of proper care in large cattle farms and considerations of biosecurity issues, additionally they afford to consult veterinary officers for animal health management regulary. The study by Deka *et al.* (2021) in dairy farm in India indicated the higher *Brucella* seropositive farms are those of large size. The higher likelihood for *Brucella* seropositive in small farms than large scale farms could be explained by resource-poor farm holders who improperly manage their farms for example, borrowing bulls for reproduction purpose and during the dry season sharing of water points might contributed to the increase in prevalence of the disease. Contrary, to the study performed in commercial farms (Warioba *et al*., 2023), that there was no difference in odds between small and large scale farms, of East Cost Zone of Tanzania (ECZT) the lack of difference of odds between small and large farms might be due prevalence rate reported based into animal level seroprevalence, but the current study reported the prevalence at farm level.

In the current study, dairy cattle were less likely to be seropositive compared to beef cattle. More seropositivity in beef cattle could be due to large number of beef cattle sampled than dairy cattle in the study area. Similar findings in dairy cattle were also reported reported by Bayemi *et al*. (2015) in Cameroon. Notably, studies conducted in smallholder farmers in urban and peri-urban areas of Uganda showed no significant difference between beef and dairy cattle (Mugizi *et al*., 2015; Nguna *et al*., 2019). On the other hand, contrary report indicated that dairy cattle have great possibility of contracting disease and spreading it more rapidly compared to beef cattle in Ethiopia (Tulu, 2022). This is primarily due to their confinement in small spaces, which increases the contact during feeding and milking as well as the stress associated with these conditions. This findings suggests other studies in commercial cattle farms should collect adequate number of sample from dairy cattle farms.

Furthermore, current study showed that farms

that practices communal grazing are more likely to have cattle which are seropositive than those which practice both communal and own pasture grazing however the result were insignificant. The more seropositivity in communal farm might be due to multiple heard sharing the pasture and water sources this condition facilitate *Brucella* transmission. On the other hand,farms practicing both farming systems, may sometimes graze their cattle separately in private pastures, which can reduce continuous exposure to infected animals and as a result lowering transmission rate. The results is in agreement with finding from semi-intensive and extensive managed cattle in Cameroon (Bayemi *et al.*, 2015) which found that the cattle raised in extensive management had high prevalence of 6.5% as compared to semi extensive system. Moreover the study of cattle in pastoral system show seroprevalence of 46.1% higher than 35.9% unit seroprevalence in dairy herds kept under intensive husbandry system in Eritrea (Omer *et al.*, 2000). In order to reach the statistical significance clearer association might be through collection of sufficient sample size from the commercial farms.

Unlike prior studies, presence of other animals in the farm, farming system, and action taken to aborted foetus did not significantly influence the positivity in this study. The effect of presence of goats and sheep on seropositivity was insignificant in this findings, however, the positivity in those mixed farms was seen to be higher compared with the farms without shoats, this impalys that the presence of goats and sheep is a risk factor of disseminating Brucellosis this results is in agreement with study done in commercial farms in Mbeya that show less seropositivity in farms with cattle only (Sagamiko *et al*., 2018). Therefore, the proper disposal of aborted materials and adherence to hygienic practices are important steps for effective brucellosis control program (Al-Majali *et al.*, 2009). In addition separating shouts from cattle in commercial farms could help to decrease the risk of disease spread.

Conclusion and recommendations

In the present study results showed that more than half of the farms were positive to *Brucella* antibodies establishing prevalence of 51.9% at farm level. The findings indicated that potential risk factors for the occurrence of brucellosis in commercial cattle farms in the Lake Zone of Tanzania were keeping beef cattle and farm size. In order to reduce the spread of disease and lowering prevalence, the surveillance system in commercial farms to be improved and implementing target interventions for the control strategies including vaccination of the Brucellosis.

Acknowledgment

The authors acknowledge the Sokoine University of Agriculture for issuing a research permit which enabled the successful execution of this study. Appreciation also goes to Dr. Joseph Maro Genchwere, Manager, Tanzania Veterinary Laboratory Agency (TVLA) Mwanza for his support during sample collection, including logistical guidance that contributed significantly to the success of field work. Further appreciation to Dr. Charles Ngassa Mayenga, Manager, Tanzania Vaccine Institute (TVI), for providing materials that facilitated laboratory analysis. The author also acknowledge the support from local authorities who arranges field visits for smooth engagement with livestock keepers. Lastly, deep gratitude is expressed to the livestock keepers for their willingness to participate, sharing valuable information and providing samples from their cattle which was crucial in accomplishing the objective of this study.

Ethical clearance

Blood collection from cattle was carried out after obtaining ethical clearance from the institutional board of Sokoine University of Agriculture (DPRTC/R/186 VOL IV). Sampling was done with verbal consent obtained from the owners of the herd after we explained to them the purpose of the study and confidentiality of the data.

Conflict of interest

The authors declare no conflict of interest on the stud

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