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# Seroprevalence and risk factors for brucellosis in cattle and rodents in Kilosa district, Morogoro, Tanzania

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## Abstract

**Background:** Brucellosis is a global zoonosis caused by gram-negative bacteria that affects a diverse array of hosts including humans, domestic animals as well as wild animals such as cattle (B. abortus), goats, and sheep (*B. melitensis*), pigs (*B. suis*), and rodents (*B. neotomae*), and results in financial setbacks in the livestock industry. This study aimed to identify risk factors and estimate the seroprevalence of brucellosis in cattle and rodents in Kilosa district, Tanzania.

**Methods:** A cross-sectional study was conducted from January 2023 to March 2023, cattle were randomly selected and rodents were trapped using Sherman, wire cages, and havahart traps. Blood samples were collected from the jugular vein and heart of the cattle and rodents, respectively. Sera were harvested from the collected blood and stored at – 20 ºC. All the sera were screened for brucella antibodies using the Rose Bengal Plate Test (RBPT) and confirmed by competitive Enzyme Linked Immuno Sorbent Assay (c-ELISA). The risk factors were captured using a structured questionnaire and analyzed by computing the Chi-square test and generalized linear model.

**Results:** The seroprevalence of brucellosis was found to be 5.31% in cattle (95% CI: 0.0286-0.089) and 0.72% in rodents (95% CI: 0.0002-0.0397). A significant association was observed between grazing style and brucellosis seropositivity in cattle, with cattle that grazed together with sheep and goats having significantly higher odds of seropositivity (OR=6.5; 95% CI: 1.74-42.17, **p < 0.01).

**Conclusion:** The detection of Brucella antibodies in both species indicates ongoing transmission and potential risk to public health. Our findings suggest that rodents may serve as reservoirs of brucellosis, contributing to its persistence and spread. Further research is essential to characterize the specific brucella species circulating among cattle and rodents and to understand the dynamics of interspecies transmission.

**Keywords:** Brucellosis Seroprevalence, Cattle, Rodents, Zoonosis, Risk Factors, Tanzania

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## Background

Brucellosis is one of the most widespread zoonoses transmitted between animals and caused by bacteria of the genus *Brucella* [1]. Genus Brucella comprises various species of facultative intracellular gram-negative bacteria such as *B. abortus, B. melitensis, B. canis, B., suis,* and *B. neotomae* [2]. Various studies have highlighted the endemic nature of brucellosis, emphasizing its global impact on both human and animal health [3,4]. Humans get infected by consuming undercooked or unpasteurized dairy products of animals, direct contact with infected animals or animals' excretions or infected products such as milk and meat, and inhaling bacteria causing brucellosis when close to infected animals or animal products [1]. Sexual and mother-to-child transmission has been rarely reported while there is a possibility of disease transmission during tissue transplantation and blood transfusion [5,6]. In spite of having public health significance, brucellosis also leads to economic losses in livestock sectors due to infertility, delayed heat, loss of calves, reduced heat and milk production, culling, and international trade bans [7,8]. The prevalence of brucellosis is high in developing countries, with notable implications for public health, especially in Mediterranean regions, western Asia, Latin America, and Africa. In Sub-Saharan Africa, for example, Brucellosis has a significant impact on livestock, with an estimated 16% of the livestock population infected [9]. Despite the wealth of knowledge available, it's crucial to understand the epidemiology, transmission pathways, and host specificity of

*Brucella* species for effective disease control and prevention. Moreover, considering the global impact of brucellosis on both animal health and human well-being, further studies into the prevalence and factors contributing to its persistence are of utmost importance, especially in pastoralist regions. In Tanzania, the first outbreak of brucellosis was reported in Arusha in 1927 [10]. However, later studies have shown the prevalence of brucellosis in cattle ranges from 0 to 60.8% [11]. In wildlife, a serosurvey carried out in Serengeti reported that 24% and 17% of buffaloes and wildebeest populations respectively were exposed to *Brucella* [12], a study carried out in Katavi reported that 7.9% of the buffaloes tested positive for brucellosis [13]. Veterinary brucellosis control and surveillance in most countries including Tanzania focuses on domestic animals, whereas systematic disease and pathogen monitoring in wildlife is rarely available. But in addition to cattle, wildlife can potentially disseminate these bacteria and present a risk [14]. Serological and bacteriological evidence of Brucella infections has been found in a wide range of wildlife animals, including rodents [15,16]. Studies have reported rodents as one of the natural reservoirs of brucellosis and play a key role in the spill-back of infections to livestock for sustainable brucellosis transmission to domestic animals as well as humans [17]. However, comprehensive and reliable data on the epizootic situation of wildlife brucellosis in Tanzania are still missing. This study is therefore aimed to determine the seroprevalence of brucellosis in cattle and rodents in the Kilosa district, the findings of the present study will provide information to livestock and public health professionals for developing mitigation measures for controlling the disease.

## Methods

### Study area

The study was conducted in Parakuyo and Mvumi, wards located in Kilosa district, Morogoro-Tanzania (Fig.1) between February 2023 to March 2023. Kilosa district is one of the six districts of the Morogoro Region. The district covers 14,918 square kilometers (5,760 sq. mi) and is located in the western part of Morogoro at 6° 50' 0" S, 36° 59' 0" E. It is bordered to the north by the Manyara, to the northeast by the Tanga region, to the east by Mvomero district, to the southeast by Morogoro rural district, to the south by Kilombero district, to the southwest by the Iringa Region and to the west by the Dodoma Region [18]. Kilosa district is the home of Mikumi National Park, it has two rainy seasons, from November to January and from March to June with an average rainfall of 800mm per year and temperatures ranging from 18°C to 30°C [19]. The main economic activities are crop production and livestock keeping.

### Study Design and Sampling Strategy

The study employed a cross-sectional design which used random and proportional methods of data collection. Two wards out of thirty-seven wards were purposively selected depending on the intensity of livestock and availability of rodents. One of the selected wards (Parakuyo) was engaged in the pastoral farming system and the other ward (Mvumi), was engaged in the agro-pastoral farming system, two villages (Parakuyo and Twatwatwa) were purposively selected from Parakuyo ward and four villages (Mvumi, Gongwe, Makwambe and Moe) were purposively selected from Mvumi ward depending on intensity of livestock and availability of rodents. In each of the selected villages, at least five households were selected to participate, the criterion for inclusion of the household was to keep at least one cattle. About five to ten cattle were randomly and proportionately selected for blood collection from each household. Rodents were trapped in all selected villages. In addition, livestock keepers were interviewed to obtain data on the age of cattle, sex, history of abortion, grazing practice in an area, herd size, and farming systems using a structured questionnaire.

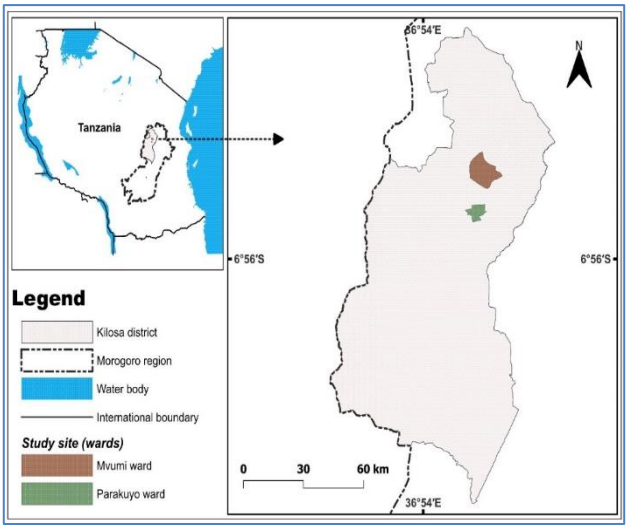


**Figure 1:** Map of Tanzania showing the study area. Map created in Quantum Geographic Information System (QGIS)

### Study population

The target populations were cattle reared in local cattle farms in agro-pastoral and pastoral systems of the Kilosa district, and rodents found near human and animal houses in an area as well as rodents found in farms that are used to graze cattle for feeding, which in this study, cattle were categorized as young (below two-year-old) and adults (two year and above). With regard to herd size, herds with less than 50 animals were considered as small; those with 50 to 100 cattle were considered as medium, whereas those with more than 100 cattle were regarded as large herds.

### Sample Size Determination

The sample size for the cattle and rodents was calculated according to study conducted by Giulieri et al. [20].

An expected prevalence of 20% and 10% were chosen in cattle and rodents, respectively (21)

n= (Z^2 PQ)/L^2

Where n=sample size Z=statistics corresponding to the level of confidence=1.96, P=expected prevalence, Q= 1-Pand L is desired precision 5%

Cattle= (1.96)2 x 0.2(1- 0.2)/ (0.05)2 = 245

Rodents= 1.96)2 x 0.1(1- 0.1)/ (0.05)2 = 138

Based on the above formula, a total of 245 cattle and 138 rodents were sampled.

### Blood sample collection from cattle

Blood samples were collected aseptically from the jugular vein using both syringes and plain vacutainer tubes. The collected blood was centrifuged at 4000 rounds per minute (rpm) for 10 min to get serum. Serum was then harvested into micro vials using a micropipette and stored in a -20◦C freezer until the

completion of the field study. Samples were then shipped to a laboratory at Sokoine University of Agriculture (SUA) in a cool box (4ºC) for further laboratory analysis. In the laboratory, the samples were stored at -20oC until when they were analyzed.

### Trapping of rodents

Rodents were trapped from farms, fallow land, indoors, and around peri domestic areas in all selected villages using Sherman, Havahart, and wire cages baited with peanut butter and maize bran. All the captured rodents were taken to the Kilosa hospital laboratory; Age and sex were determined and identified to species level according to a study conducted by Mengele et al. [10].

### Blood sample collection from rodents

Rodents were anesthetized in a basin using halothane and were then placed on a dissecting board in a dorsal position. Blood was drawn through heart puncture, and the collected blood was centrifuged at 4000 rounds per minute (rpm) for 10 min to get serum which was then transferred to sterile micro vial tubes and stored in -20◦C freezer at Kilosa hospital laboratory until the completion of the field study. Samples were then shipped to SUA in a cool box (4oC) for further laboratory analysis. The remains of rodents were disposed of in the decomposition pit available at Kilosa district hospital.

### Serological tests

Serum samples from cattle and rodents were examined for antibodies specific to Brucella. The Rose Bengal Plate Test (RBPT) was used as a screening test, and the Competitive-Enzyme Linked Immunosorbent Assay (c-ELISA) was used as a confirmatory test for positive reactors following the screening test. Both tests were carried out at the SUA laboratory. Serum samples that tested positive for both the RBT and the c-ELISA were regarded as positive.

### (a)Rose Bengal test

All the harvested sera were screened for Brucella antibodies by using RBPT. Before the test started, the test serum samples and Rose-Bengal antigen were brought to room temperature for one hour. The test was performed according to the protocol by [22] using Rose-Bengal antigen from the National Veterinary Services Laboratories (NVSL) Diagnostic, Bioanalytical, and Reagent Laboratory, United States of America (USA). A glass plate was placed on a white background, a Rose Bengal antigen vial was gently swirled, then using a pipette, the same volume (25-30 µl) of neat serum and antigen side by side was placed on a plate, thereafter using a clean wooden stick, antigen, and serum was mixed, the stick was changed during mixing every spot and then spots were further mixed by rotating the slide in slanted orbital motion, Appearance of agglutinating clumps indicated positive reaction and absence of the clumps denoted negative reaction [22].

### (b) Competitive ELISA

The SVANOVIR® Brucella c-ELISA kit (SVANOVA Biotech AB, Uppsala, Sweden) was used to confirm all the positive samples from RBPT. Before the test started, the test serum samples and Brucella c-ELISA kit reagents were equilibrated to room temperature for two hours except for 20× Antibody concentrate and 100× Conjugate. Kit reagents were then prepared ready for ready-for-use solutions. The test was performed according to the manufacturer's guidelines [23]. All positive serum samples by RBPT from cattle and rodents were tested for Brucella-specific antibodies. Samples and controls were pre-diluted in a 1:1 ratio with antibodies using the uncoated plate, and then 100µl of pre-diluted controls and samples were pipetted into Brucella LPS coated plate test wells. The plate was covered and incubated at room temperature. The Plate was washed and 100µl of conjugate was added into each well and again incubated for 30 minutes at room temperature. The plate was washed again and 100µl of the substrate was added into each well and thereafter incubated for 15 minutes at room temperature. Stop solution was added and then Using a microplate photometer (Universal Microplate Reader, Bio-Tek Instruments, Inc.) at 450 nm, the optical density (OD) values of the serum samples in the wells and each of the controls included in the kit were determined. Percent inhibition (PI) values were calculated. The results were reported as either positive (PI >30%) or negative (PI <30%) for Brucella antibodies [23].

### Statistical analysis

Data were entered and cleaned in MS Excel 2019. R statistic software version 4.2.2 was used for analysis. Frequencies were computed to determine the prevalence of brucellosis in cattle and rodents. The prevalence of brucellosis in cattle and rodents was calculated as:

$$\text{Prevalence} = \frac{\text{Number of Positive Samples}}{\text{Total Number of Samples}} \times 100$$

The chi-square test was used to determine the difference in brucellosis prevalence in cattle between locations, sex, age, grazing practice, herd size, and farming systems but also Chi-square test was also used to determine the difference in brucellosis prevalence in rodents between sex, age, species, locations as well as habitats. The Chi-square test was used to determine the difference in brucellosis prevalence among different categories. The test statistic is given by:

$$x^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

where $O_i$ is the observed frequency and $E_i$ is the expected frequency.

A generalized linear regression model was then used to determine the association between brucellosis seropositivity and significant variables from the chi-squared test. As such, to determine the association between brucellosis seropositivity and significant variables, a GLM was employed. The model can be expressed as:

$$\text{logit}(P) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n$$

where $P$ is the probability of sero-positivity, $\beta_0$ is the intercept, $\beta_1, \beta_2, \ldots, \beta_n$ are the coefficients, and $X_1, X_2, \ldots, X_n$ are the predictor variables.

Specifically, the Odds Ratio (OR) for grazing style in cattle was calculated as:

$$OR = \frac{\text{Probability of Brucellosis in Grazing Cattle}}{\text{Probability of Brucellosis in Non-Grazing Cattle}}$$

## Results

### Demographic information of cattle sampled

A total of 245 cattle were sampled for serum collection with 50.2% (123/245) of cattle from the pastoral farming system community and 49.8% (122/245) of cattle from agro-pastoral farming system community. About 69.39% (170/245) of cattle sampled were female while 30.61% (75/245) of cattle sampled were male and 81.22% (199/245) of the cattle sampled aged above two years and 18.78% (46/245) of the cattle sampled aged less than two years (Table 1).

### Cattle level seroprevalence and risk factors of brucellosis in cattle

The seroprevalence of brucellosis in individual cattle was 5.31%. (n=13/245, 95% CI: 0.0286-0.089). The Chi-squared test indicated a significant difference in brucellosis seroprevalence in cattle between different farming systems (*p<0.05) and different herd sizes (*p<0.05). A significant difference was also observed between female cattle with a previous history of abortion and those without a previous history of abortion (**p= 0.01). However, there was no significant difference in seroprevalence between villages (p-value=0.24), sexes (p-value =0.76), and age groups (p =0.96). The results on the seroprevalence of brucellosis in cattle are summarized in Table 2. Results on the Generalized model showed that the odds of brucellosis seropositivity were significantly higher (OR=6.5; 95% CI: 1.74-42.17**p< 0.01,) for cattle from herds that grazed cattle, sheep, and goats together, as compared to cattle from herds which did not graze the different livestock species together.

### Herd-level seroprevalence of brucellosis in cattle

A total of 47 herds were sampled for the present study. The herd level overall seroprevalence of brucellosis was 27.66% (n=13/47, 95% CI: 0.1562-0.4264) Table 3. The Chi-squared test indicated a significant difference in brucellosis seroprevalence in cattle herds between different farming systems (**p <0.01). Herds that kept cattle, goats, and sheep together showed significant differences from herds that did not keep cattle, goats, and sheep together. However, there was no significant difference in herd level seroprevalence between villages (p=0.154) or herd sizes (p=0.06).

### Demographic data of rodents sampled

A total of 138 rodents were caught, out of which 82.61% (114/138) were *Mastomys natalensis*, 12.32% (17/138) *Rattus rattus*, 2.9% *Mus musculus* (4/138) and 2.17% (3/138) were *Gerbilliscus leuocogaster*. Females were dominant representing 62.32% (86/138) of the rodents sampled while 31.88% (52/138) were males. About 77.54% (107/138) of rodents were caught from the ward with agro-pastoral farming system and 22.46% (31/138) were from pastoral farming system community. Furthermore, 85.5% (118/138) of the rodents were caught from farms while 14.5% (20/138) of the rodents were caught from inside the houses where humans live.

### Brucella seroprevalence in rodents

The seroprevalence of brucellosis in rodents was 0.72%. (n=1/138, 95% CI: 0.0002-0.0397) Only Mastomys natalensis species were infected with Brucella recording a seroprevalence of 0.87% (1/114). Only Twatwatwa village was infected recording a seroprevalence of 7.69% (1/13). Only Female rodents were infected recording a seroprevalence of 1.16% (1/86). Brucellosis seropositive was only detected in rodents from farm habitats with a seroprevalence of 0.85% (1/118). No, factor was found to be significantly associated with brucellosis seropositivity in rodents in the Kilosa district.

**Table 1.** Demographic information of cattle used in the present study.

| Village | Sex | | | | Farming System | | | | Age | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Female | | Male | | Pastoral farming system | | Agro pastoral farming system | | Adult | | Young | |
| | No. | (%) | No. | (%) | No. | (%) | No. | (%) | No. | (%) | No. | (%) |
| Parakuyo | 34 | 54.84 | 28 | 45.16 | 62 | 100 | 0 | 0 | 45 | 72.58 | 17 | 27.42 |
| Twatwatwa | 47 | 77.05 | 14 | 22.95 | 61 | 100 | 0 | 0 | 56 | 91.80 | 5 | 8.20 |
| Mvumi | 26 | 83.87 | 5 | 16.13 | 0 | 0 | 31 | 100 | 26 | 83.87 | 5 | 16.13 |
| Gongwe | 24 | 77.42 | 7 | 22.58 | 0 | 0 | 31 | 100 | 25 | 80.65 | 6 | 19.35 |
| Makwambe | 18 | 60.00 | 12 | 40.00 | 0 | 0 | 30 | 100 | 22 | 73.33 | 8 | 26.67 |
| Moe | 16 | 53.33 | 14 | 46.67 | 0 | 0 | 30 | 100 | 25 | 83.33 | 5 | 16.67 |
| **Total** | 165 | | 80 | | 123 | | 122 | | 199 | | 46 | |

## Discussion

This study described the prevalence of brucellosis in cattle and rodents in the Kilosa district. The detection of Brucella antibodies in cattle from the Kilosa district suggests either past or present exposure to Brucella bacteria because vaccination against brucellosis has not been done in the area for the past 10 years. The present results on animal-level seroprevalence align with that of Chitupila et al. [24] which reported overall bovine brucellosis seroprevalence of 5.6% in Kibondo and Kakonko districts, however, the results are lower compared to Swai et al. [25] in Tanzania, Muma et al. [26] in Zambia and Tasiame et al. [27] in Ghana. Our results on animal-level seroprevalence are higher than 2.4% and 1.0% which were reported by Chota et al. [28] in the Eastern and Northern zones of Tanzania. The differences in results between studies can likely be ascribed to several things, including sample sizes, diagnostic test types or assay used, sampling strategies, and strategies for interpretations and consideration of results. In this study, about 27.66% of the herds had at least one seropositive animal, suggesting that in the absence of any control measures to prevent the spread of disease in an area, the inter and intra-herd transmission of disease is predicted to increase with time [29]. Female cattle recorded higher seroprevalence compared to male cattle, therefore this study agrees with other studies such as the study conducted by Assenga et al. [13] and Chitupila et al. [24]. The higher seroprevalence of brucellosis in female animals could be

attributed to the fact that females have a larger risk of exposure because they are kept in the breeding herd for a longer period than males [30]. Furthermore, the serological response of male animals to *Brucella* infection is limited, therefore male animals with infections typically have low antibody titers [31].

**Table 2:** Cattle level seroprevalence based on cELISA and risk factors of brucellosis

| Variable | Categories | No. of cattle examined | No. of positive cattle | Prevalence (%) | Chi-squared P-value |
|---|---|---|---|---|---|
| Villages | Parakuyo | 62 | 5 | 8.06 | 0.24 |
| | Twatwatwa | 61 | 6 | 9.84 | |
| | Mvumi | 31 | 0 | 0 | |
| | Gongwe | 31 | 0 | 0 | |
| | Moe | 30 | 1 | 3.33 | |
| | Makwambe | 30 | 1 | 3.33 | |
| Farming system | Pastoral | 123 | 11 | 8.94 | 0.02 |
| | Agropastoral | 122 | 2 | 1.64 | |
| Age | Adult | 199 | 10 | 5.03 | 0.96 |
| | Young | 46 | 3 | 6.52 | |
| Sex | Male | 80 | 4 | 5.00 | 0.76 |
| | Female | 165 | 9 | 5.45 | |
| Herd size | Large | 127 | 11 | 8.66 | 0.03 |
| | Small | 118 | 2 | 1.69 | |
| History of abortion for female cattle | With a history of abortion | 12 | 7 | 58.33 | 0.00 |
| | Without a history of abortion | 153 | 2 | 1.30 | |

Brucellosis seroprevalence in cattle in individual villages was higher in Twatwatwa and Parakuyo villages as compared to the other villages, this can be attributed to the fact that Parakuyo and Twatwatwa employ pastoral farming systems while others employ agro-pastoral farming system. It has been shown in this study that areas performing pastoral farming system had higher prevalence compared to areas performing agro-pastoral farming system which concurs with [32] which reported brucellosis seroprevalence in Arusha and Manyara regions of Tanzania to be higher in Pastoral farming system (13.2%) compared to 5.3% prevalence in agropastoral farming system, disparities among systems can be observed because the majority of agropastoral herds have smaller herd sizes and graze their animals less communally than pastoral herds do.

**Table 3:** Herd level seroprevalence of brucellosis in cattle.

| Variable | Categories | No. of herds examined | No. of positive herds | Prevalence (%) | P-value at p<0.05 |
|---|---|---|---|---|---|
| Overall | | 47 | 13 | 27.66 | |
| Villages | Parakuyo | 13 | 6 | 46.15 | 0.154 |
| | Twatwatwa | 10 | 4 | 40.00 | |
| | Mvumi | 6 | 0 | 0.00 | |
| | Gongwe | 6 | 0 | 0.00 | |
| | Moe | 6 | 1 | 16.67 | |
| | Makwambe | 6 | 2 | 33.33 | |
| Farming system | Pastoral | 23 | 10 | 43.48 | 0.040 |
| | Agropastoral | 24 | 3 | 12.50 | |
| Grazing style | Graze cattle, goats, and sheep together | 24 | 11 | 45.83 | 0.010 |
| | Graze cattle only | 23 | 2 | 8.70 | |
| Herd size | Large (>200 cattle) | 24 | 10 | 41.67 | 0.060 |
| | Small (1-50 cattle) | 23 | 3 | 13.04 | |

This study reported a higher seroprevalence in cattle aged less than two years compared to cattle above two years. This study concurs with that of Al-Majali et al. [34] which reported a higher prevalence in younger compared to adult cattle. This can be attributed to the fact that younger, naïve animals in endemic locations are likely to be more at risk of Brucella infection and subsequent seroconversion than older cattle, some of which may not show measurable antibody titers due to latency, which is typical in chronic brucellosis [35]. However, the results are contrary to various reports such as Muma et al. [26] and Mellau et al. [33] who reported a higher prevalence in adult cattle compared to young cattle. This study agrees with the findings of previously published studies [34–36] where the seroprevalence of brucellosis in cattle from large-sized herds was higher compared to smaller herds. This could be attributed to the reason that as the number of animals goes up the likelihood of transmission of the disease by contact between them increases as well therefore infected individuals have a higher chance of contact with uninfected individuals and increase the possibility of infecting them, but also large-sized herds have a higher chance of contact with other herds and therefore acquire infection, especially during shared grazing [34–36]. Our results showed a

higher percentage of seropositive cattle had a previous history of abortion, this suggests that previous abortion cases may be associated with brucellosis as reported by Ntirandekura et al. [37] and Teresa et al. [38], that brucellosis is associated with abortion cases as this is the main clinical sign of the disease. Rodents are well known for harboring a plethora of zoonotic pathogens of public health concern [39]. Given their known susceptibility to Brucella infections, rodents may play a role in the disease's spread to domestic animals and humans [5,14,28]. This study reported lower brucellosis seroprevalence in rodents compared to other studies [17] that found a 14.2% prevalence in Germany. The lower brucellosis seroprevalence in the present study could be attributed to a number of factors, including sample sizes, diagnostic test types or assay used, and sampling strategies, but ecological differences between the two areas could also account for differences in seroprevalence seen. Prior research has shown that in experimentally infected animals, antibodies are not present at measurable levels during the first 12–16 days following infection. Therefore, the stage of infection at which a sample is taken may be a key factor in the diagnosis of Brucella. As a result, in the early stages of infection, RBPT and c-ELISA may not be the best diagnostic technique. For these reasons, early infection detection of Brucella may benefit greatly from the use of Polymerase Chain Reaction (PCR) [40] which was not used in the present study. The occurrence of brucellosis in rodents was only detected in Mastomys natalensis species, this could probably be attributed to the fact that Mastomys natalensis were the majority (82.61%) compared to other species but also an ability of Mastomys natalensis species to occupy different habitats and interact with different wild and domestic animals increases the possibility of species to contract different zoonoses including brucellosis.

## Conclusion

This study highlights the prevalence and risk factors associated with brucellosis in cattle and rodents in Kilosa District, Morogoro-Tanzania. The findings indicate a seroprevalence of 5.31% in individual cattle and 0.72% in rodents. Significant differences in seroprevalence were observed among different farming systems, herd sizes, and cattle with a history of abortion. Specifically, cattle grazing with sheep and goats showed higher odds of brucellosis seropositivity. The herd-level seroprevalence was 27.66%, with pastoral farming systems exhibiting higher prevalence compared to agro-pastoral systems. The study also reported lower brucellosis seroprevalence in rodents, with Mastomys natalensis being the only species infected. These results underscore the complexity and widespread nature of brucellosis, affecting both livestock and wildlife and suggest potential interspecies transmission. Therefore, enhanced surveillance and monitoring of brucellosis in cattle and rodents should be implemented to track the disease's prevalence and spread effectively. Improved farming practices are essential, including promoting agro-pastoral systems over pastoral ones due to their lower brucellosis prevalence. Additionally, discouraging communal grazing of cattle, sheep, and goats can reduce transmission risks. Targeted control measures for cattle with a history of abortion, which showed higher seroprevalence, should be implemented, including isolation and treatment of affected animals. Public awareness and education programs are crucial to inform farmers and the community about brucellosis transmission, symptoms, and prevention strategies, emphasizing the importance of reporting and managing cases of animal abortion. Further research is needed to characterize Brucella species circulating in cattle and rodents and explore the potential role of rodents as reservoirs of brucellosis. Advanced diagnostic techniques like Polymerase Chain Reaction (PCR) should be considered for early detection of Brucella infections.

### Abbreviation

c-ELISA: Competitive –Enzyme-Linked Immunosorbent Assay; RBPT; Rose Bengal Plate Test; OR: Odds ratio; CI: Confidence Interval; Fig.1: Figure 1; QGIS: Quantum Geographic Information System; rpm: round per minute; SUA: Sokoine University of Agriculture; USA: United States of America; LPS: lipopolysaccharides; OD: optical density; National Veterinary Services Laboratories: NVSL; PI: Percent inhibition; PCR: Polymerase Chain Reaction; ACE: African Center of Excellence; ACE(IRPM and BTD): African center of excellence for Rodent pest management and Biosensor Technology Development; TZ: Tanzania.

### Declaration

#### Acknowledgment

We extend our heartfelt appreciation to the Ministry of Education, Morogoro Region, and Kilosa District Council for granting permission to conduct this study. We wish to express our sincere gratitude to livestock officers from the Mvumi and Parakuyo wards for their high level of cooperation during data collection. Deep appreciation also goes to cattle owners in the Kilosa district for allowing us to use their animals in this study.

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#### Availability of data and materials

Data will be available by emailing mwamengelega3@gmail.com

#### Authors' contributions

Gilbert Mwamengele (GM) is the primary investigator (PI) who contributed to the conceptualization, data curation, formal analysis, and drafting of the manuscript. Coletha Mathew (CM) contributed to the conceptualization of the project; supervision of the field and laboratory work; and reviewing, editing, and re-writing of the manuscript. Christopher Sabuni (CS) contributed to the supervision of the fieldwork, reviewing, editing, and re-writing of the manuscript. All authors have read and accepted to be published final version of the manuscript.

#### Ethics approval and consent to participate

We conducted the research following the declaration of Helsinki. The study followed appropriate research clearance and ethical protocols to ensure the protection of participants' rights and compliance with regulations. The research clearance was approved by SUA under reference number SUA/DPRTC/R/186 /25.

#### Consent for publication

Not applicable

#### Competing interest

The authors declare that they have no competing interests.

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