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RESEARCH ARTICLE

Knowledge, attitudes, and practices of farmers and butchers related to bovine tuberculosis and associated economic losses from ruminant organ seizures at the Koupéla abattoir, Burkina Faso: A One Health perspective

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ABSTRACT

Background and Aim: Bovine tuberculosis (bTB) is a neglected zoonotic disease in sub-Saharan Africa, with substantial implications for public health and livestock-based livelihoods. In Burkina Faso, evidence on stakeholders' knowledge, attitudes, and practices (KAP) toward bTB and its economic consequences remains limited, particularly outside major urban centers. This study aimed to assess the KAP of livestock farmers and butchers regarding bTB in Koupéla and to estimate financial losses associated with suspected bTB-related organ seizures at the local slaughter facility between 2016 and 2023.

Materials and Methods: A cross-sectional KAP survey was conducted among 115 participants (83 livestock farmers and 32 butchers) using structured questionnaires administered between October 2023 and January 2024. Knowledge and practice scores were computed using predefined scoring systems, and associations with sociodemographic variables were analyzed using chi-square or Fisher's exact tests. In parallel, a retrospective analysis of official abattoir records from January 2016 to December 2023 was performed to quantify suspected bTB lesions and estimate direct and indirect financial losses resulting from organ seizures and carcass weight reduction.

Results: Although 94.8% of participants had heard of bTB and 88.7% recognized its zoonotic nature, only 8.7% demonstrated satisfactory knowledge. Risky practices were common, including consumption of raw milk (59.1%) and meat from dead animals (29.6%), while only 44.3% of respondents exhibited practices considered protective against bTB transmission. Education level was significantly associated with knowledge ($p < 0.05$). During the eight-year period, 213 organs were seized from 271,032 slaughtered ruminants, corresponding to an overall suspicion rate of 0.08%, with cattle showing the highest species-specific rate (0.44%). Total financial losses due to bTB were estimated at 22,977,180 West African Financial Community Franc (approximately USD 36,760), largely attributable to indirect losses in cattle.

Conclusion: Substantial knowledge gaps and high-risk practices regarding bTB persist among livestock stakeholders in Koupéla, contributing to ongoing zoonotic risk and considerable economic losses. Targeted education, improved biosecurity practices, and integrated One Health interventions are essential to mitigate the public health and economic impact of bTB in similar rural and peri-urban settings.

Keywords: bovine tuberculosis, Burkina Faso, economic losses, knowledge, attitude, and practices, One Health, ruminant slaughterhouse, zoonotic disease, zoonotic tuberculosis.

INTRODUCTION

Livestock production plays a pivotal socio-cultural and economic role in Burkina Faso [1], contributing approximately 10%–20% to the national gross domestic product (GDP) [2]. However, the sector's development is constrained by multiple challenges, notably nutritional deficiencies and animal health problems, which reduce

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productivity and increase the risk of zoonotic disease transmission [1]. Bovine tuberculosis (bTB), a zoonotic and enzootic disease, exerts a dual burden on both the economy and public health systems [3]. Although cattle are the primary hosts, bTB also affects other domesticated species, including sheep and goats, as well as wildlife and humans [4]. Due to its chronic nature and the frequent absence of overt clinical signs, bTB is commonly detected during routine postmortem inspections at abattoirs. In sub-Saharan Africa, bTB remains a major yet neglected zoonosis affecting both animals and humans [5].

In Burkina Faso, despite the long-standing presence of bTB, research efforts have predominantly focused on major urban centers, namely Ouagadougou and Bobo-Dioulasso. These studies have mainly addressed the epidemiological profile of the disease, molecular characterization of Mycobacterium isolates in slaughterhouses, and tuberculin testing in cattle populations [6–8]. Only a limited number of investigations have evaluated the socio-economic implications of bTB [3, 9]. One such study, conducted in the urban commune of Koudougou, reported a bTB prevalence of 1.75% among 1,716 cattle, with infection significantly associated with the animals' geographic origin. The same study documented uncompensated financial losses of 206,950 West African Financial Community Franc (XOF) borne by butchers due to partial organ condemnations, particularly of the lungs [9]. Nevertheless, information regarding livestock stakeholders' knowledge, attitudes, and practices (KAP) toward bTB remains scarce, especially in rural and peri-urban settings.

Considering the importance of bTB in Burkina Faso, there is a clear need to generate evidence from less studied areas where livestock constitutes a central component of household livelihoods [7]. In the Center-Est region, the Koupéla slaughterhouse is among the largest facilities, having processed 271,032 ruminants between 2016 and 2023. This makes it a suitable and representative site for assessing both the prevalence and economic impact of bTB. Despite the critical role of beef production and trade in the regional economy, local stakeholders' perceptions and practices related to bTB are poorly understood. This gap raises several key questions: i) What are the levels of knowledge, attitudes, and bTB-related risk practices among farmers and butchers in Koupéla? ii) Are these perceptions influenced by sociodemographic characteristics? iii) What are the economic consequences of suspected bTB-related carcass and organ seizures recorded at the Koupéla slaughter facility from 2016 to 2023?

In response to these gaps, the present study aimed to assess the KAP of livestock farmers and butchers regarding bTB in Koupéla, Burkina Faso, and to examine the influence of sociodemographic factors on these perceptions. In addition, the study sought to estimate the economic losses associated with suspected bTB-related organ and carcass seizures recorded at the Koupéla slaughter facility over an eight-year period (2016–2023). By combining stakeholder-level KAP data with retrospective abattoir records, this study provides an integrated One Health perspective on the public health and economic burden of bTB in a less explored rural and peri-urban context.

MATERIALS AND METHODS

Ethical approval

Ethical review and approval were waived, as the survey was conducted in compliance with routine inspections conducted by veterinarians from the Directorate of Veterinary Services. However, verbal informed consent was obtained from all participants before questionnaire administration. Participation was voluntary, and confidentiality was ensured by anonymizing responses and restricting access to the dataset to the research team. Retrospective abattoir records were accessed with permission from the competent veterinary and slaughterhouse authorities and were analyzed in aggregate without personal identifiers.

Study period and location

The study was conducted between 2016 and 2023 in Kouritenga Province, located in the Center-East region of Burkina Faso (Figure 1). Four cities were included: Baskouré, Andemtenga, Koupéla, and Dialgaye. The province covers an area of 14,494 km², representing 6.7% of the national territory, and had an estimated population of 1,581,000 in 2019 [10]. The area lies within the Sudanian-North agro-climatic zone and receives an annual rainfall ranging from 750 to 1,000 mm. Livestock husbandry constitutes one of the main economic activities, involving approximately 481,000 cattle and 2,155,000 small ruminants in 2020 [11]. Production systems include intensive, semi-intensive, agropastoral, and transhumant practices. The Koupéla slaughterhouse, located at the entrance of the town, has an annual processing capacity of about 1,100 tons of meat. Slaughtering of cattle, sheep, goats, and pigs is conducted under the supervision of five veterinary officers. Kouritenga Province also serves as a major transit zone for live animals, and suspected bTB cases are frequently detected during routine meat inspections.

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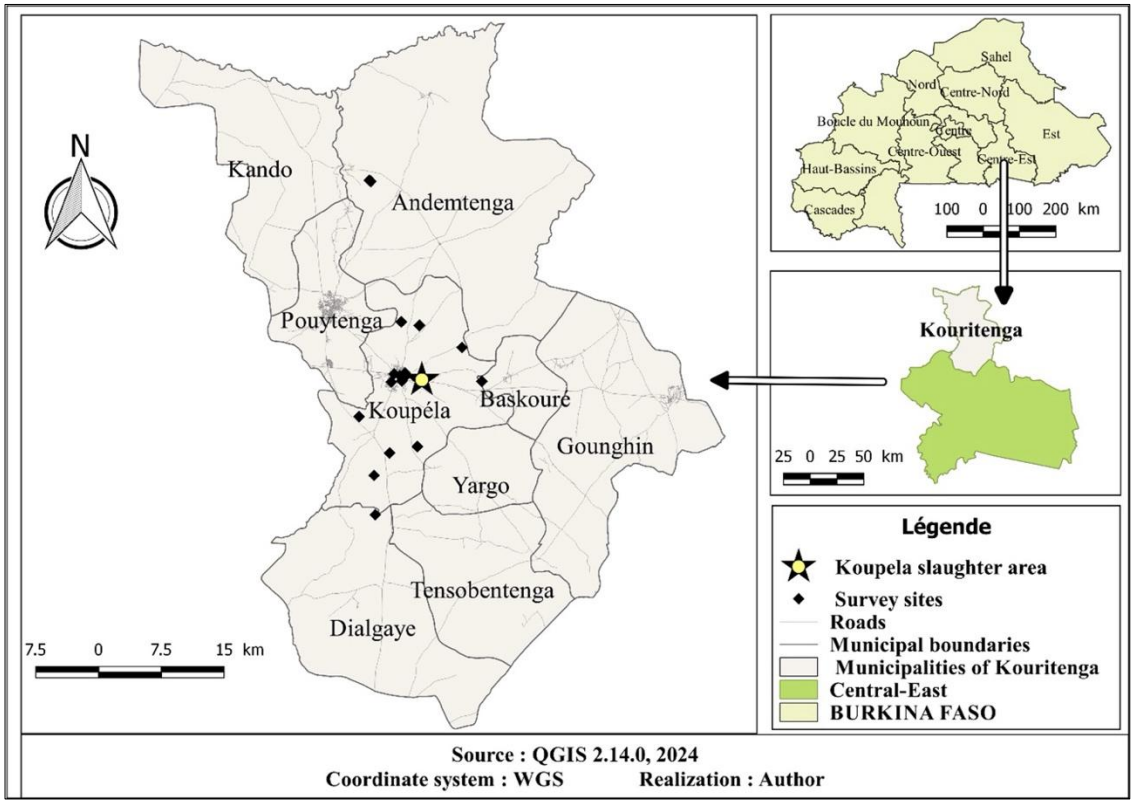

Figure 1: Map of the study area showing the survey sites [Source: The map was generated using QGIS version 2.14.0].

Study design

This study adopted a combined cross-sectional and descriptive design. The cross-sectional component involved a KAP survey administered to livestock farmers and butchers using a structured questionnaire. The descriptive component consisted of a retrospective analysis of official records from the Koupéla abattoir. The field KAP survey was conducted between October 2023 and January 2024. The retrospective component covered the period from January 1, 2016, to December 31, 2023, and focused on carcass and organ seizures with macroscopic lesions suggestive of bTB, thereby enabling a longitudinal assessment of economic losses.

Sampling strategy and inclusion criteria

A simple random sampling approach was used to select participants for the KAP survey, including livestock farmers and butchers. All butchers present at the abattoir during the study period were systematically approached and invited to participate. Upon providing consent, each butcher was asked to identify farmers who supplied animals to them. From these lists, two to three farmers were randomly selected for inclusion. The minimum sample size was calculated using the Thrusfield formula:

$$n = (Z^2 \times p(1 - p)) / d^2$$

Where n represents the required sample size, Z is the 95% confidence level (1.96), p is the assumed awareness level of 98.2% reported by Hamid et al. [12], and d is the margin of error (0.05). This yielded a minimum sample size of 27 participants. To improve robustness, 115 participants were included, comprising 83 farmers and 32 butchers. All butchers were male, and none identified female farmers as their suppliers.

Data collection

Primary KAP data were collected using an electronic questionnaire administered via KoboCollect version 2023.2.4 9 (https://kc.kobotoolbox.org). Information on sociodemographic characteristics, awareness of bTB, and related attitudes and practices was obtained through open interviews. The questionnaire was developed in French and translated orally into Mooré to ensure clarity and cultural appropriateness. It was pretested among five farmers and five butchers who were not included in the final sample, and feedback from this pretest was used to refine the wording and sequencing of questions. The questionnaire was further reviewed by the Veterinary Directorate and two university professors to ensure content validity and alignment with the study objectives. Each interview lasted approximately 30–45 minutes, and routine data backup and quality control procedures were applied throughout the data collection process.

Secondary data were extracted from official monthly abattoir records and meat inspection forms at the Koupéla slaughter facility. These records documented the number of animals slaughtered by species, the type and number of seized organs or carcasses, reasons for seizure, and characteristics of the condemned organs. A suspected bTB lesion was defined as the presence of typical tuberculous granulomas in the lungs or lymph nodes observed during postmortem inspection. All ruminant species, including cattle, sheep, and goats, were considered, and a total of 96 monthly records were reviewed. Data verification and cross-checking were performed using veterinary officers' reports to ensure consistency with diagnostic criteria for suspected bTB lesions. These data were subsequently used to estimate bTB-related economic losses.

Assessment of the financial impact of bTB (2016–2023)

The economic impact of bTB was estimated using abattoir data from the Koupéla slaughter facility by calculating both direct and indirect losses.

Direct loss calculation

Direct losses were attributed to the condemnation of organs and carcasses. Organs considered in the analysis included the liver, lungs, kidneys, mammary glands, and whole carcasses. The market prices used in the calculations were derived from a field survey of local butchers conducted during the study period (2016–2023), with an average meat price of 3,000 West African Financial Community Franc (XOF) per kilogram. Prices were applied uniformly, and no inflation adjustments or currency conversions were made, as all analyses were conducted in XOF. Direct losses (PD) were calculated using the formula:

$$PD = \Sigma (nXi \times P + (nCi \times Pm \times p)),$$

where nXi denotes the number of seized organs, nCi the number of seized carcasses, Pm the mean carcass weight, and P the market price per organ or per kilogram of meat.

Indirect loss calculation

Indirect losses were estimated based on carcass weight reduction associated with bTB infection. According to Kwaghe et al. [13], infected animals experience an average carcass weight loss of 33.6%. Indirect losses (PI) were calculated using the formula:

$$PI = N \times Pm \times 0.336 \times Prm$$

Where N represents the number of bTB cases, Pm the average carcass weight, and Prm the market price per kilogram of meat. Mean carcass weights applied were 113 kg for cattle, 9 kg for sheep, and 8 kg for goats [14]. Indirect losses were estimated uniformly across species, without weighting by prevalence, for analytical simplicity. Total financial losses over the study period were obtained by summing direct and indirect losses.

Data management and statistical analysis

Survey data were stored in Kobo Toolbox and subsequently exported to Microsoft Excel 2016 for data cleaning and preliminary analysis. Knowledge scores were calculated from nine questions, with individual question scores ranging from 0 to 3 based on response accuracy and completeness. The maximum achievable knowledge score was 23, and a threshold of ≥14 (≥60%) was used to classify participants as having satisfactory knowledge, following the Likert-type scoring approach described by Hamid et al. [12]. Practice scores were derived from 7 questions, with a maximum score of 7; participants who scored at least 4 were classified as having good practices. Based on these criteria, respondents were categorized as having satisfactory or unsatisfactory knowledge and positive or negative practices. Statistical analyses were conducted using R software (version 4.4.0). Associations between variables were assessed using the chi-square test of independence or Fisher's exact test when appropriate, and statistical significance was set at $p < 0.05$.

RESULTS

Sociodemographic characteristics of the participants

A total of 115 participants were enrolled in the study, comprising 83 livestock farmers (72.2%) and 32 butchers (27.8%) (Table 1). All respondents were male, with the largest proportion (45.2%) aged 31–50 years. Most participants had no formal education (67.8%), and the majority were married (93.9%). Livestock farming or butchery constituted the principal occupation for 91.3% of the respondents. Among livestock farmers, extensive production systems predominated, with 98.8% practicing extensive livestock husbandry.

Table 1: Sociodemographic characteristics of the participants (n = 115).

Variable	Category	Frequency	Percentage (%)
Age group (years)	18–30	11	9.6
	31–50	52	45.2
	>51	52	45.2
Marital status	Married	108	93.9
	Single	7	6.1
Education level	No formal education	78	67.8
	Primary	24	20.9
	Secondary	12	10.4
	University	1	0.9
Profession	Farmer	83	72.2
	Butcher	32	27.8
Main activity	Primary	105	91.3
	Secondary	10	8.7
Farming type (farmers only)	Extensive	82	98.8
	Semi-intensive	1	1.2

Percentages are calculated based on the total number of participants (n = 115), except for farming type, which applies only to farmers.

Knowledge of bTB among participants

Most respondents (94.8%) reported having heard of bTB, and 88.7% were aware that the disease could be transmitted from animals to humans. The main sources of information on bTB were personal experience (32.2%), veterinary officers (31.3%), and health workers (12.2%).

Regarding clinical signs of bTB in animals, only 26.1% of respondents identified at least 2 symptoms. The most frequently cited signs were cough (79.1%), anorexia (20.9%), and weight loss (18.3%). Concerning human tuberculosis symptoms, 31.3% of participants identified at least two signs, most commonly cough (70%), followed by weight loss (18.3%) and anorexia (13%).

Knowledge of transmission and prevention of bTB

Regarding transmission pathways in animals, consumption of contaminated feed, water, or milk was the most frequently reported route (44.3%), followed by aerosol inhalation (9.6%). For humans, consumption of raw or undercooked meat (71.1%) and raw milk (35.6%) were the most commonly cited modes of transmission, whereas 23.5% of respondents were unable to identify any transmission routes.

Regarding prevention in animals, more than half of the respondents (56.5%) were unaware of any biosecurity measures and relied primarily on veterinary services. Isolation of sick animals was mentioned by only 28.7% of participants, and slaughter of affected animals by 9.6%. For human prevention, respondents suggested consumption of well-cooked meat by 54.8%, milk pasteurization by 7.8%, and hygiene measures such as repeated cleaning and disinfection of equipment by 20%. Overall, only 8.7% of participants demonstrated a satisfactory level of knowledge on bTB. Although butchers showed a higher proportion of satisfactory knowledge (13%) compared with livestock farmers (6%), this difference was not statistically significant ($p > 0.05$). The distribution of knowledge scores is presented in Table 2.

Table 2. Knowledge scores of participants on bovine tuberculosis (bTB) (n = 115).

Knowledge component	Score / Response	Frequency	Percentage (%)
Awareness of bTB	Yes	109	94.8
	No	6	5.2
Awareness of human transmission	Yes	102	88.7
	No	13	11.3
Animal species affected by TB infection	0	10	8.7
	1	12	10.4
	2	14	12.2
	3	79	68.7
Knowledge of animal-to-human transmission	0	34	29.6
	1	59	51.3
	2	21	18.3
	3	1	0.9
Knowledge of animal-to-animal transmission	0	46	40.0
	1	24	20.9
	2	43	37.4
	3	2	1.7

Knowledge component	Score / Response	Frequency	Percentage (%)
Clinical signs in animals	0	11	9.6
	1	74	64.3
	2	18	15.7
	3	12	10.4
Clinical signs in humans	0	34	29.6
	1	45	39.1
	2	24	20.9
	3	12	10.4
Protective measures for animals	0	68	59.1
	1	39	33.9
	2	8	7.0
Awareness of effective human treatment	Yes	17	14.8
	No	98	85.2
Prevention measures for humans	0	23	20.0
	1	75	65.2
	2	16	13.9
	3	1	0.9
Overall knowledge level	Satisfactory	10	8.7
	Unsatisfactory	105	91.3

Scores represent the number of correct responses for each knowledge component.

Factors associated with knowledge level on bTB

Several sociodemographic and occupational factors were evaluated for their association with knowledge levels on bTB among livestock farmers and butchers at the Koupéla slaughter facility (Table 3). A statistically significant association was observed between knowledge level and educational status ($p < 0.05$). Participants with secondary or university education were significantly more likely to have satisfactory knowledge compared with those without formal education ($p < 0.0001$).

Table 3: Factors associated with knowledge level on bovine tuberculosis among participants (n = 115).

Variable	Category	Total (n)	Satisfactory knowledge, n (%)	p-value
Age group (years)	18–30	11	2 (18.2)	0.5
	31–50	52	4 (7.7)	
	>51	52	4 (7.7)	
Education level	No formal education	78	2 (2.6)	0.00016
	Primary	24	4 (16.7)	
	Secondary	12	3 (25.0)	
	University	1	1 (100.0)	
Profession	Butcher	32	5 (15.6)	0.2
	Livestock farmer	83	5 (6.0)	
Main activity	Primary	105	9 (10.0)	1.0
	Secondary	10	1 (8.6)	

Percentages are calculated within each category. Statistical significance was assessed at $p < 0.05$.

In contrast, no significant associations were found between knowledge level and age group ($p = 0.5$), occupation (farmer versus butcher, $p = 0.2$), or whether livestock farming or butchery was the respondent's main occupation ($p = 1.0$).

Attitudes and practices toward bTB

The survey identified several behaviors that may increase or reduce the risk of bTB transmission (Table 4). More than half of the participants (59.1%) reported consuming raw milk, and 29.6% admitted to eating meat from dead animals. Conversely, 94.8% preferred well-cooked meat. Regarding protective practices, only 14.8% of respondents reported wearing gloves, and 32.2% reported wearing masks when handling sick animals. Among butchers specifically, only 6.3% reported using gloves during meat handling.

In addition, 12.2% of participants reported having experienced symptoms suggestive of tuberculosis at some point in their lives. Overall, only 44.3% of respondents practiced appropriate measures to prevent bTB transmission.

Occurrence of suspected bTB lesions at the abattoir

Between January 2016 and December 2023, a total of 271,032 ruminants were slaughtered at the Koupéla slaughter facility, including 44,037 cattle, 40,163 sheep, and 186,832 goats. During this period, 213 organs were

condemned due to suspicion of bTB, comprising 194 from cattle, 11 from sheep, and 8 from goats (Figure 2). No whole carcass condemnations were recorded. The overall suspicion rate was 0.08%, with species-specific rates of 0.44% in cattle, 0.03% in sheep, and 0.004% in goats.

Table 4: Attitudes and practices of livestock farmers and butchers toward bovine tuberculosis (n = 115).

Practice and attitude	Response	Frequency	Percentage (%)
Consult a veterinarian when necessary	Yes	109	94.8
	No	6	5.2
Consumption of meat from dead animals	Yes	34	29.6
	No	81	70.4
Consumption of raw milk	Yes	68	59.1
	No	47	40.9
Preference for well-cooked meat	Yes	109	94.8
	No	6	5.2
Use of gloves when handling sick animals	Yes	17	14.8
	No	98	85.2
Mask use when handling sick animals	Yes	37	32.2
	No	78	67.8
Use of gloves when handling meat *(butchers only, n = 32)*	Yes	2	6.3
	No	30	93.7
Experienced TB-like symptoms	Yes	14	12.2
	No	101	87.8

Percentages are calculated based on the total number of participants (n = 115), except where otherwise indicated.

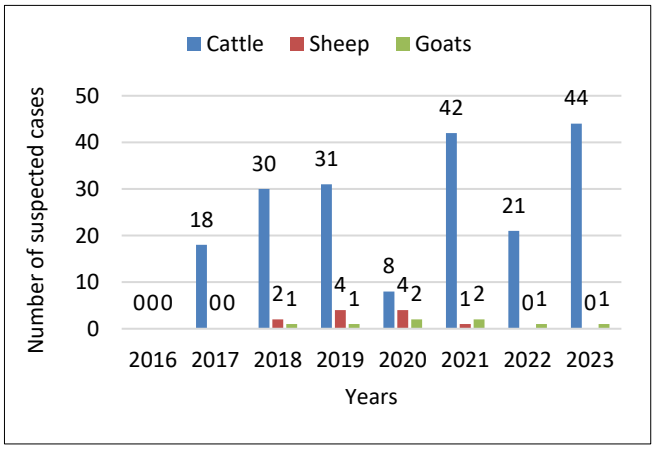

Figure 2: Evolution of suspected cases of bovine tuberculosis in ruminants (Cattle, Sheep, and Goats) at the Koupéla slaughter plant from 2016 to 2023.

Direct financial losses associated with bTB

Over the same period, direct financial losses from organ condemnations due to suspected bTB at the Koupéla slaughterhouse amounted to 715,500 XOF. These losses resulted from the seizure of lungs, udders, livers, kidneys, and hearts from cattle, sheep, and goats. Cattle accounted for the majority of the losses (696,500 XOF), mainly due to the condemnation of 120 lungs (360,000 XOF), 50 udders (150,000 XOF), 14 livers (182,000 XOF), one kidney (3,000 XOF), and one heart (1,500 XOF). In sheep, five livers and five lungs were condemned, resulting in losses of 10,000 XOF, while in goats, condemnation of four livers and five lungs led to losses of 9,000 XOF. No complete carcasses were condemned during the study period (Table 5).

Table 5: Direct financial losses associated with tuberculosis in ruminants at the Koupéla slaughter facility.

Seizure indicators and economic losses	Carcass (kg)	Liver	Lungs	Udder	Kidney	Heart	Total (XOF)
Number of seizures (cattle)	0	14	120	50	1	1	
Average price (XOF)	3,000	13,000	3,000	3,000	3,000	1,500	
Direct losses—cattle (XOF)	0	182,000	360,000	150,000	3,000	1,500	696,500
Number of seizures (sheep)	0	5	5	0	0	0	
Average price (XOF)	3,000	1,000	1,000	0	300	500	
Direct losses—sheep (XOF)	0	5,000	5,000	0	0	0	10,000
Number of seizures (goats)	0	4	5	0	0	0	
Average price (XOF)	3,000	1,000	1,000	0	300	500	
Direct losses—goats (XOF)	0	4,000	5,000	0	0	0	9,000
Total losses (XOF)	0	192,000	370,000	150,000	3,000	1,500	715,500

XOF = West African Financial Community Franc.

Indirect and total financial losses due to bTB

Indirect financial losses associated with bTB at the Koupéla abattoir between 2016 and 2023 were estimated at 22,261,680 XOF. Cattle accounted for the highest proportion of indirect losses (22,097,376 XOF), followed by sheep (99,792 XOF) and goats (64,512 XOF). These estimates were based on an assumed mean carcass weight loss of 33.6% attributable to bTB and the average market price of meat per kilogram (Table 6).

Overall, the cumulative financial losses due to bTB during the study period, including both direct and indirect losses, were estimated at 22,977,180 XOF. The largest share of these losses was borne by cattle producers (22,793,876 XOF), with comparatively lower losses recorded for sheep (109,792 XOF) and goats (73,512 XOF) (Table 6).

Table 6: Summary of the financial losses associated with tuberculosis in ruminants at the Koupéla slaughter facility.

Species	Number of suspected cases	Average carcass weight (kg)	Total weight loss (kg)	Average price per kilogram (XOF)	Indirect losses (XOF)	Direct losses (XOF)	Total losses (XOF)
Cattle	194	113	7,365.792	3,000	22,097,376	696,500	22,793,876
Sheep	11	9	33.264	3,000	99,792	10,000	109,792
Goats	8	8	21.504	3,000	64,512	9,000	73,512
Total	213	NA	NA	3,000	22,261,680	715,500	22,977,180

XOF = West African Financial Community Franc, NA = Not applicable.

DISCUSSION

Overview of study objectives and key findings

This study assessed livestock farmers' and butchers' KAP regarding bTB and estimated the associated economic losses at the Koupéla slaughter plant in Burkina Faso. The findings provide comprehensive insight into the epidemiological burden of bTB and its socio-economic implications for key stakeholders along the livestock value chain.

Awareness and knowledge of bTB

The majority of participants (94.8%) reported having heard of bTB, and 88.7% recognized its zoonotic nature, indicating a high level of general awareness. Comparable levels of awareness have been reported in Sénégal, where 98.2% of respondents had heard of bTB and 97.8% were aware of its zoonotic potential [12]. Similarly, in Cameroon, 81.9% of livestock handlers were aware of bTB, with 67.9% recognizing its zoonotic risk [15]. In contrast, substantially lower awareness levels have been documented in Ethiopia, with only 22.9% and 24.1% of livestock owners being aware of bTB or its zoonotic implications, respectively [16, 17]. The relatively high awareness observed in the present study may be attributed to participants' long-standing involvement in livestock-related activities and repeated exposure to the disease through routine husbandry and slaughter practices.

Despite this high level of awareness, only 8.7% of respondents demonstrated satisfactory knowledge. Knowledge gaps were particularly evident regarding transmission routes and clinical manifestations in both animals and humans. Cough was the most frequently cited symptom across species, a finding consistent with reports from Sénégal [12], Cameroon [18], Nigeria [19], and South Africa [20]. The consistent identification of cough as a key clinical sign represents a potential entry point for early disease recognition and reporting by livestock owners, facilitating timely veterinary intervention. Notably, the consumption of animal products, especially unpasteurized milk and undercooked meat, was perceived as the main route of transmission to humans.

Knowledge gaps related to transmission and prevention

Limited awareness of hygiene-related transmission routes and aerosol inhalation highlights the need for targeted health education. Poor understanding of transmission pathways likely contributed to risky behaviors, including the consumption of raw milk and meat from dead animals, thereby increasing the risk of zoonotic spillover. Similar findings have been reported in Ethiopia, where 41.1% of respondents cited aerosol inhalation and 42.9% reported raw meat or milk consumption as transmission routes [17]. In Nigeria, 43.2% of respondents identified meat products and 41.8% identified raw milk as potential sources of infection [19], while in Cameroon, milk (53.8%) and meat (46.2%) were the most commonly cited sources [15]. These consistently low levels of awareness across settings underscore the public health risks associated with bTB and emphasize the need for sustained sensitization campaigns on disease transmission.

Educational attainment was strongly associated with knowledge level, with participants who had received formal education demonstrating significantly better understanding of bTB. This finding aligns with previous reports confirming the critical role of education in shaping disease awareness and risk perception [17].

Attitudes and practices related to bTB

Preventive practices were generally inadequate, with only 44.3% of respondents exhibiting protective behaviors against bTB transmission. Although most participants reported consuming well-cooked meat and seeking veterinary services when necessary, unsafe practices such as raw milk consumption (59.1%) and consumption of meat from dead animals (29.6%) remained common. Similar patterns have been reported in other West African contexts, where cultural dietary habits and limited access to milk processing infrastructure contribute to the persistence of these practices [12, 21].

The use of personal protective equipment (PPE) was notably low: only 14.8% of farmers and butchers reported using gloves, and 32.2% reported using masks when handling diseased animals. These findings are consistent with those of Hamid *et al.* [12], who reported low PPE utilization and heightened occupational health risks among livestock handlers.

Abattoir surveillance and economic losses due to bTB

The overall lesion suspicion rate recorded in this study was 0.08%, with species-specific rates of 0.44% in cattle, 0.03% in sheep, and 0.004% in goats. These values are comparable to those reported in Niger [22] but lower than figures from Cameroon, Algeria, and Egypt [15, 23, 24]. The relatively low suspicion rate may reflect underdetection due to reliance on macroscopic lesions during postmortem inspection, which may fail to identify early or subclinical infections commonly associated with bTB.

The total economic losses attributable to bTB between 2016 and 2023 were estimated at 22,977,180 XOF (approximately 36,752 USD), primarily borne by cattle producers due to the higher economic value of cattle and the greater frequency of organ seizures in this species. These findings are consistent with those of Ouedraogo *et al.* [9], who reported uncompensated losses of 206,950 XOF incurred by butchers due to partial organ condemnations, mainly involving lungs, in the Northern Sudan region of Burkina Faso. While both studies highlight the economic burden of bTB, the present study provides a broader temporal scope and includes losses incurred by farmers, whereas Ouedraogo *et al.* [9] focused on butchers over a shorter period. Comparable economic patterns have been reported elsewhere in Africa, although the magnitude of losses varies widely depending on slaughter volume, diagnostic sensitivity, and market prices [3, 25–27].

Implications for One Health interventions

The findings underscore the need for integrated One Health strategies that link animal, human, and environmental health sectors. Targeted public health education, improved biosecurity practices, and strengthened abattoir surveillance are essential to enhance awareness, reduce risky behaviors, and mitigate zoonotic transmission of bTB.

CONCLUSION

This study provides a comprehensive assessment of bTB among livestock farmers and butchers in Koupéla, Burkina Faso, by integrating KAP data with long-term abattoir surveillance and economic analysis. Although general awareness of bTB was high, with most participants recognizing its zoonotic nature, only a small proportion demonstrated satisfactory knowledge. Risky behaviors, particularly the consumption of raw milk and meat from dead animals, and the limited use of PPE, were common. Abattoir records revealed a low overall bTB lesion suspicion rate (0.08%), with cattle accounting for the majority of suspected cases. Importantly, the cumulative economic losses associated with organ seizures and reduced carcass productivity were substantial, amounting to approximately 22.98 million XOF over an eight-year period, with cattle producers bearing the greatest burden.

The findings highlight critical gaps between awareness and effective disease prevention practices, underscoring the need for targeted, context-specific interventions. Strengthening farmer and butcher education on bTB transmission routes, biosecurity, and safe handling of animal products is essential to reduce zoonotic risk. Improved use of PPE during animal handling and slaughter, coupled with enhanced hygiene practices, should be prioritized. From an economic perspective, the absence of compensation mechanisms for condemned organs and carcasses exacerbates financial losses and may undermine compliance with meat inspection regulations. Integrating compensation schemes and reinforcing routine abattoir surveillance within a One Health framework could improve disease control while safeguarding livelihoods.

A key strength of this study lies in its integrated approach, combining stakeholder-level KAP assessment with retrospective abattoir data spanning eight years. This design allowed for a nuanced understanding of both behavioral drivers of bTB risk and the cumulative economic impact of the disease. The focus on a less explored

rural and peri-urban setting further enhances the relevance of the findings for similar livestock-dependent regions in sub-Saharan Africa.

Despite its strengths, the study has limitations. The reliance on self-reported KAP data may have introduced recall or social desirability bias. Diagnosis of bTB was based on macroscopic postmortem lesions without laboratory confirmation, which may have resulted in underestimation of true disease prevalence. Additionally, economic loss calculations were based on fixed mean market prices and did not account for inflation or temporal price fluctuations. The findings are also context-specific and may not be directly generalizable to other regions of Burkina Faso.

Future studies should incorporate laboratory-based diagnostic confirmation, such as culture or molecular methods, to improve the accuracy of bTB detection at abattoirs. Expanding similar integrated assessments to other regions would provide a national perspective on the burden of bTB. Longitudinal studies evaluating the effectiveness of targeted education programs, biosecurity interventions, and compensation schemes are also warranted. Moreover, incorporating environmental and wildlife components would further strengthen One Health-oriented bTB surveillance and control strategies.

DATA AVAILABILITY

All the generated data are included in the manuscript.

AUTHORS' CONTRIBUTIONS

MCK, AS, and LDD: Designed the study and provided overall academic support and guidance during the study. DWB and KS: Collected the data and analyzed and interpreted the results. YK and TRH: Interpreted the results and edited and revised the manuscript. EO: Analyzed the data and drafted, edited, and revised the manuscript. All authors have read, reviewed, and approved the final version of the manuscript.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

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