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A cross-sectional assessment of brucellosis awareness and risk practices among sheep farmers in Telangana, India

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Abstract

Background: Brucellosis is an important zoonotic disease causing significant reproductive losses in livestock and posing serious public health concerns. Farmers' knowledge, awareness, and management practices play a critical role in the prevention and control of the disease. The present study was undertaken to assess farm management practices, identify sheep with clinical signs suggestive of brucellosis, and evaluate the knowledge, awareness, and practices (KAP) of sheep farmers regarding brucellosis in Telangana State, India.

Methods: A cross-sectional study was conducted on sheep farms established under government-subsidized livestock development schemes in Telangana. A structured and pre-tested questionnaire was administered to collect farm-level information and assess farmers' knowledge, awareness, and management practices related to brucellosis. Thirteen sheep farms were surveyed, and information on housing systems, rearing practices, reproductive disorders, and biosecurity measures was recorded. Based on questionnaire findings and clinical observations, 245 sheep exhibiting signs suggestive of brucellosis were selected from 10 farms. A KAP survey was conducted among 50 sheep farmers.

Results: Among the surveyed farms, 76.92% had earthen/concrete flooring and 76.92% followed a semi-intensive rearing system. The most frequently observed reproductive and health disorders among selected sheep were abortion (28%), retention of placenta (19%), stillbirths (16%), mastitis (12%), arthritis (10%), repeat breeding (8%), orchitis (4%), and infertility (3%). The KAP survey revealed low awareness regarding brucellosis, with 72% of respondents reporting no prior knowledge of the disease. Most farmers were unaware of its clinical signs in humans and modes of transmission, with 90% unable to identify transmission routes. The majority (94%) did not use any personal protective equipment while handling animals. Unsafe disposal practices for aborted materials were common, including disposal in open streets (38%) and water canals (10%). Although 62% of respondents sought veterinary assistance following animal abortion, 24% reported selling aborted animals in livestock markets.

Conclusion: The study revealed poor awareness and inadequate biosecurity practices among sheep farmers in Telangana, which may contribute to the persistence and transmission of brucellosis. Strengthening veterinary extension services, farmer education programs, disease surveillance, and awareness campaigns is essential to improve knowledge, promote safe husbandry practices, and reduce the risk of zoonotic transmission. The findings provide valuable baseline information for designing targeted brucellosis control and prevention strategies under a One Health framework.

Keywords: Brucellosis, sheep, Knowledge-Attitude-Practice (KAP), farmers' awareness, biosecurity, zoonosis, Telangana, small ruminants

1. Introduction

Sheep farming plays an important role in the livelihood and socio-economic development of rural communities in India, particularly among small and marginal farmers. The sector contributes significantly to household income, employment generation, and nutritional security. However, the productivity of sheep farming is often constrained by infectious diseases that adversely affect animal health, reproductive performance, and farm profitability. Among these diseases, brucellosis remains one of the most important bacterial zoonoses affecting both livestock and humans.

Brucellosis is a contagious bacterial disease caused by members of the genus *Brucella*. In sheep and goats, *Brucella melitensis* is the principal causative agent and is

responsible for considerable reproductive losses. The disease is characterized by abortion during late pregnancy, stillbirths, retention of placenta, birth of weak offspring, infertility, reduced fertility, and orchitis or epididymitis in males. These reproductive disorders result in substantial economic losses due to decreased flock productivity, reduced animal value, and increased veterinary expenditure. Brucellosis is also a major public health concern because of its zoonotic nature. Humans acquire infection primarily through direct contact with infected animals, aborted fetuses, placental materials, and contaminated secretions, or through the consumption of raw milk and unpasteurized dairy products (WHO/FAO/WOAH, 2006). Livestock farmers, shepherds, veterinarians, animal handlers, and abattoir workers are considered high-risk groups due to their

frequent exposure to potentially infected animals and animal products. Human brucellosis is often characterized by fever, weakness, sweating, joint pain, and chronic debilitating illness, leading to significant health and economic consequences (Deka *et al.* 2020) ^[6].

Despite its importance, brucellosis continues to persist in many developing countries, including India, where livestock production systems are predominantly smallholder-based and biosecurity measures are often inadequate. A recent systematic review reported that brucellosis has been documented in ruminants across almost all states of India, highlighting its widespread occurrence and continued epidemiological significance. The persistence of the disease has been associated with several risk factors, including poor biosecurity practices, improper disposal of aborted materials, unrestricted animal movement, communal grazing, inadequate disease surveillance, and limited awareness among livestock owners (Lalrinzuala *et al.* 2023 & Dadar and Godfroid 2021) ^[10, 5].

Farmer awareness and adoption of appropriate preventive measures are critical components of brucellosis control programs (Hegazy *et al.* 2016) ^[9]. Knowledge regarding disease transmission, zoonotic risks, vaccination, and safe animal-handling practices can significantly influence the effectiveness of disease prevention strategies. However, studies conducted in different parts of India and other countries have consistently reported low levels of awareness and inadequate preventive practices among livestock farmers. Poor understanding of disease transmission and risky husbandry practices often contribute to the maintenance and spread of infection within livestock populations and increase the risk of zoonotic transmission (Hegazy *et al.* 2016) ^[9].

Knowledge, Attitude, and Practices (KAP) studies provide valuable information on farmers' perceptions, awareness levels, and management behaviors related to disease prevention and control. Such information is essential for designing effective veterinary extension programs, targeted awareness campaigns, and evidence-based disease control strategies. Although several studies have assessed brucellosis awareness among dairy farmers, information regarding sheep farmers in Telangana remains limited (Zhang *et al.* 2019) ^[13].

Therefore, the present study was undertaken to assess farm management practices, identify reproductive and health disorders suggestive of brucellosis in sheep farms established under government-supported livestock development schemes, and evaluate the knowledge, awareness, and management practices of sheep farmers regarding brucellosis in Telangana State, India. The findings are expected to provide baseline information for strengthening veterinary extension services, improving farmer awareness, and supporting effective brucellosis prevention and control programs.

Materials and Methods

Questionnaire

A structured questionnaire was developed to obtain preliminary information for the identification of sheep farms and selection of suspected animals for brucellosis screening. The survey involved direct interviews with sheep farm owners and workers to assess their knowledge, attitudes,

and practices (KAP) regarding the prevention and control of brucellosis.

The questionnaire was designed using simple, clear, and unambiguous language to ensure accurate understanding by respondents. All questions were aligned with the study objectives and formulated to avoid leading or biased responses. The questionnaire was arranged in a logical sequence, progressing from general farm information to specific questions related to animal health and disease awareness.

The questionnaire comprised two sections. The first section collected farm-level and animal-level information, including herd management practices, history of abortion, stillbirth, retained placenta, arthritis, epididymitis, testicular swelling, vaccination status, and other clinical signs suggestive of brucellosis. Information regarding sheep farms established under government-supported livestock development schemes was also recorded.

The second section focused on assessing farmers' knowledge, attitudes, awareness, and management practices related to brucellosis, including disease transmission, zoonotic significance, preventive measures, biosecurity practices, and vaccination. Prior to field implementation, the questionnaire was pre-tested on a small group of respondents to identify and correct any ambiguities and ensure its suitability for large-scale administration.

Results

Information on sheep farms established under government-subsidized livestock development schemes was obtained from the Veterinary and Animal Husbandry Department, Telangana. A total of 13 sheep farms distributed across different districts of the state were identified for the study (Table 1). These farms had procured sheep through government-supported schemes aimed at promoting small-ruminant production.

Baseline data were collected from each farm regarding housing conditions, flooring type, rearing system, and the occurrence of reproductive and clinical signs suggestive of brucellosis as reported by farm owners or workers. Data collection was carried out with the support of officials from the Veterinary and Animal Husbandry Department. The information obtained served as the basis for identifying farms with suspected brucellosis and selecting animals for subsequent serological investigation.

Table 1: Sheep farms selected from districts of Telangana State

Sl. No.	Sheep farm	District
1	Farm 1	Mancherial
2	Farm 2	Mahabubabad
3	Farm 3	Nalgonda
4	Farm 4	Bhongiri
5	Farm 5	Jogulamba-Gadwal
6	Farm 6	Khammam
7	Farm 7	Janagoan
8	Farm 8	Hanamkonda
9	Farm 9	Warangal
10	Farm 10	Medchal-Malkajigiri
11	Farm 11	Vikarabad
12	Farm 12	Ranga Reddy
13	Farm 13	Hyderabad

Various types of information were gathered from the farms, including farm management practices, the health status of the sheep, and farmers' knowledge and understanding of brucellosis. The details collected were systematically represented and analyzed to gain insights into the occurrence and management of the disease, as follows.

Type of Floor

Information regarding flooring systems was collected from 13 sheep farms included in the study (Table 2). Among these, 10 farms (76.92%) had earthen/concrete floors, whereas only 3 farms (23.08%) maintained elevated flooring systems. The predominance of earthen/concrete flooring indicates that traditional housing systems are widely practised in the study area. The distribution of flooring types is presented in Figure 1.

Table 2: Floor types in sheep farms

Sl. No.	Type of floor	Number of farms	Percentage (%)
1	Earthen/ Concrete	10	76.92
2	Elevated	3	23.08
Total		13	100

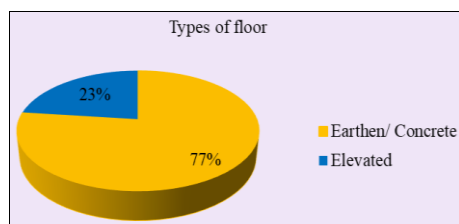


Fig 1: Distribution of floor types in sheep farms

Rearing System

The management systems followed by the surveyed farms are presented in Table 3. Of the 13 farms investigated, 10 (76.92%) practised a semi-intensive rearing system, while 3 (23.08%) adopted an intensive system. Semi-intensive sheep rearing was therefore the predominant production system among the surveyed farms. The distribution of rearing systems is illustrated in Figure 2.

Table 3: Types of rearing systems in sheep farms

Sl. No.	Type of Rearing System	Number of Farms	Percentage (%)
1	Semi-Intensive	10	76.92
2	Intensive	3	23.08
Total		13	100

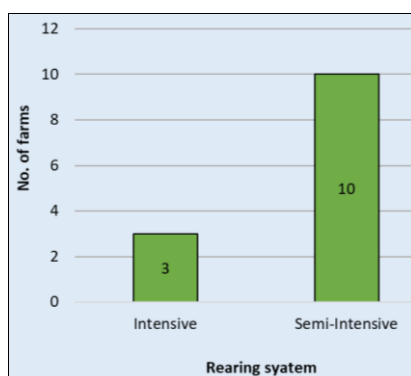


Fig 2: Distribution of rearing systems in sheep farms

Selection of Sheep Using Questionnaire Information

Based on questionnaire responses and farm-level observations, sheep exhibiting reproductive and clinical disorders suggestive of brucellosis were identified across the surveyed farms. Although suspected cases were observed in both intensive and semi-intensive systems, a higher occurrence of clinical signs was recorded in sheep maintained under semi-intensive management. Consequently, 10 of the 13 farms were selected for detailed investigation.

A total of 245 sheep showing reproductive and health disorders compatible with brucellosis were randomly selected from the identified farms for serological screening. The frequency of recorded clinical manifestations is presented in Table 4 and Figure 3. Abortion was the most frequently observed condition, accounting for 28% (69/245) of cases, followed by retention of placenta (19%; 47/245), stillbirths (16%; 39/245), mastitis (12%; 29/245), arthritis (10%; 25/245), repeat breeding (8%; 20/245), orchitis (4%; 10/245), and infertility (3%; 7/245).

Table 4: Incidence of reproductive and health Disorders in sheep

Sr. No.	Symptom	Number of Cases	Percentage (%)
1	Abortion	69	28%
2	Retention of placenta	47	19%
3	Stillbirths	39	16%
4	Repeat breeding	20	8%
5	Infertility	7	3%
6	Arthritis	25	10%
7	Mastitis	29	12%
8	Orchitis (males)	10	4%
Total		245	100%

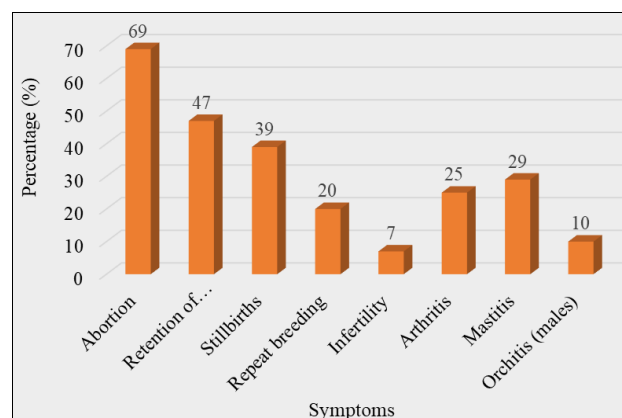


Fig 3: Frequency and Percentage of symptoms of brucellosis in sheep

Farmers' Knowledge, Awareness and Practices of Brucellosis

A cross-sectional Knowledge, Attitude, and Practices (KAP) survey was conducted among 50 sheep farmers to assess their awareness and management practices related to brucellosis.

Socio-demographic Characteristics

The socio-demographic characteristics of the respondents are presented in Table 5. The age of respondents ranged from 23 to 65 years. The majority belonged to the 23–35-year age group (58%; n=29), followed by 36–45 years (22%; n=11), 46–55 years (16%; n=8), and 55–65 years

(4%; n=2) (Figure 4).

Most respondents were male (82%; n=41), whereas females accounted for 18% (n=9) (Figure 5). Regarding educational status, more than half of the respondents (56%; n=28) were

illiterate, while 18% (n=9) had primary-level education and 30% (n=15) had secondary-level education or above (Figure 6). Among the surveyed participants, 66% (n=33) owned livestock, while 34% (n=17) did not.

Table 5: Data concerning the farmers

Variables	Category	Number	Percentage (%)
Age (years)	23-35	29	58
	36-45	11	22
	46-55	8	16
	55-65	2	4
Gender	Males	41	82
	Females	9	18
Education level	Illiterate	28	56
	Primary education (1-5 th standard)	9	18
	Higher education (5 th -12 standard)	15	30
Do you have farm animals	I don't have	17	34
	I have farm animals.	33	66
Precautionary measures and protective gear details	I don't use	47	94
	Using interchangeable protective clothing and gloves.	3	6
	Disinfection is done by professional experts	0	0

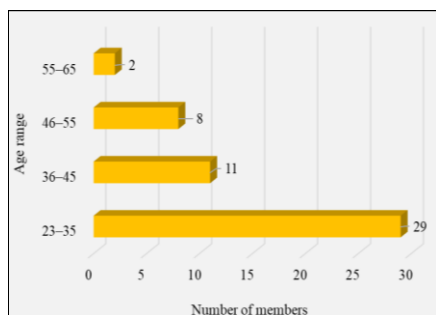


Fig 4: Age-wise Distribution of Sampled Farmers in the Study Area

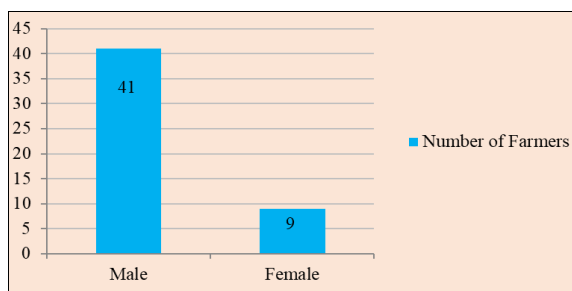


Fig 5: Gender wise distribution of farmers involved in survey

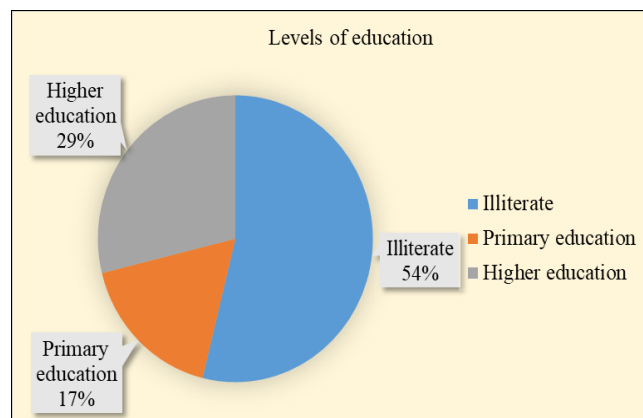


Fig 6: Distribution of farmers according to their level of education

Adoption of Biosecurity and Protective Measures

The use of personal protective measures during animal handling was generally poor among respondents (Table 5). A large majority of farmers (94%; n=47) reported not using any protective equipment while handling animals or animal products. Only 6% (n=3) reported using protective clothing and gloves, and none of the respondents reported employing professional disinfection practices (Figure 7).

Table 5: Farmers' knowledge, awareness and practices about brucellosis

Variables	Category	Frequency (%)	Mean±SD
Are you aware of Brucellosis	No	36 (72)	0.28±0.45
	Yes	14 (28)	
Symptoms of brucellosis in humans	Don't know	36 (72)	0.01±0.30
	Fever	5 (10)	
	Chills	0	
	Night sweat	0	0.14±0.35
	Painful scrotum in men	7 (14)	
	Miscarriage in women	2 (4)	
Anybody having Brucellosis? How is it treated?	No	50 (100)	
	Yes, self-treatment with the help of traditional healers.	0	
	Yes, treatment under medical supervision.	0	
Is brucellosis transmitted through	I don't know	45 (90)	0.04±0.20
	Consumption of raw milk and unpasteurized dairy products	2 (4)	

	Contact with the fetus and fetal membranes of infected animals	3 (6)	0.06±0.24
	Consumption of meat from infected animals	0	
	Contact with a sick person only	0	
Handling of aborted material	I don't involve.	2 (4)	0.10±0.30
	Throwing in water canals	5 (10)	0.38±0.49
	Throwing away in the streets	19 (38)	0.16±0.37
	Burning	8 (1)	0.26±0.44
	Burying	13 (26)	0.06±0.24
	Consulting a veterinarian for proper disposal	3 (6)	
Practices followed when an animal is aborted	Separation of the aborted animal from the herd	5 (10)	0.10±0.30
	Treating an aborted animal with the help of a veterinarian	31 (62)	0.62±0.49
	Selling aborted animals in the market	12 (24)	0.24±0.43
	Selling an aborted animal to the butcher	2 (4)	0.04±0.20
	Slaughtering the infected animal in the house	0	

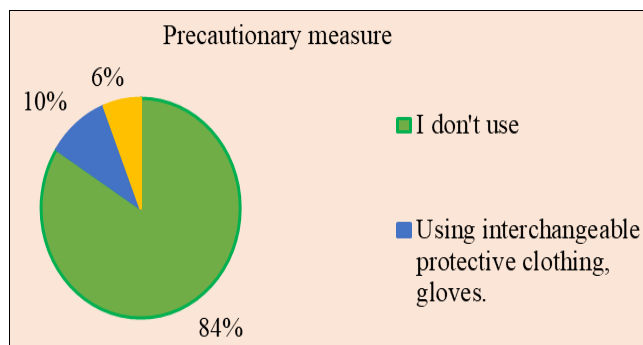


Fig 7: Trends in safety measures adopted by the farmers

Awareness of Brucellosis

The survey revealed a low level of awareness regarding brucellosis among sheep farmers. Of the 50 respondents, 36 (72%) had never heard of brucellosis, whereas only 14 (28%) were aware of the disease (Table 5; Figure 8). The overall awareness score was low (Mean $\pm$ SD: 0.28 $\pm$ 0.45).

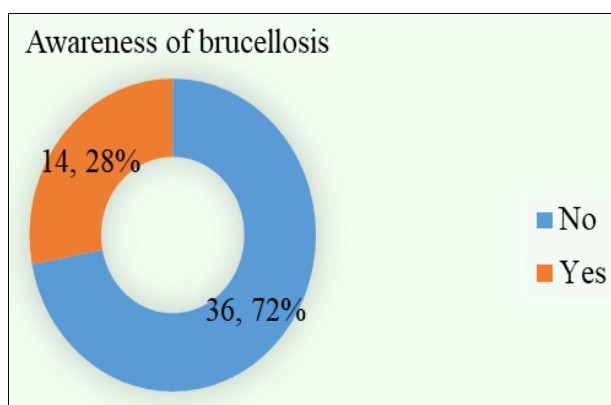


Fig 8: Awareness of brucellosis among farmers

Knowledge of Human Brucellosis

Knowledge regarding the clinical manifestations of brucellosis in humans was limited. The majority of respondents (72%; n=36) were unable to identify any symptoms associated with the disease. Fever was recognized by 10% (n=5) of respondents, painful scrotum in men by 14% (n=7), and miscarriage in women by 4% (n=2). None of the respondents identified chills or night sweats as symptoms of human brucellosis (Figure 9).

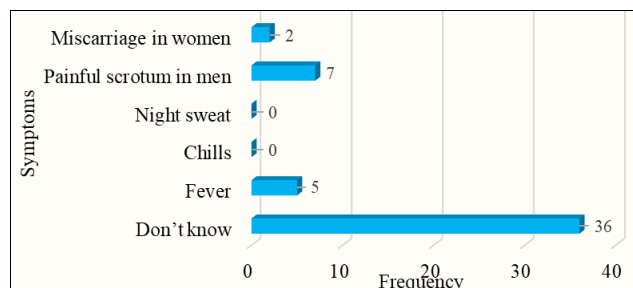


Fig 9: Knowledge on symptoms of brucellosis in humans

Knowledge of Disease Occurrence and Treatment

All respondents (100%; n=50) reported that they had never encountered a confirmed case of brucellosis in their community. Consequently, none reported any experience regarding treatment of the disease through traditional healers or formal medical services (Figure 10).

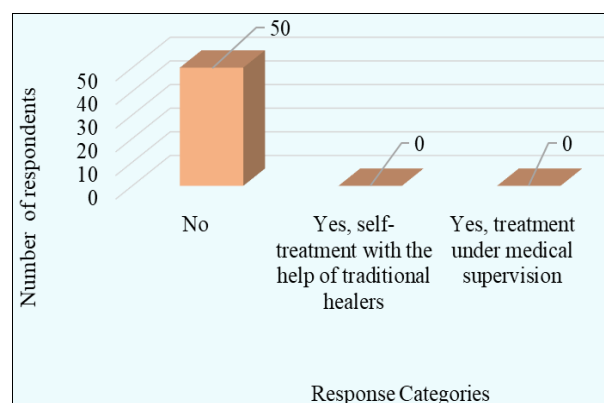


Fig 10: Occurrence and treatment of brucellosis among respondents

Knowledge of Brucellosis Transmission

Knowledge of disease transmission was found to be inadequate. Most respondents (90%; n=45) did not know how brucellosis is transmitted. Only 4% (n=2) identified consumption of raw milk or unpasteurized dairy products as a transmission route, while 6% (n=3) recognized contact with aborted fetuses and fetal membranes as a potential source of infection. None of the respondents identified consumption of infected meat or direct contact with infected individuals as possible transmission pathways (Figure 11).

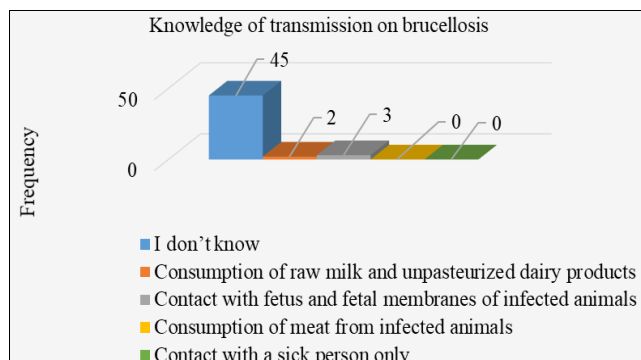


Fig 11: Knowledge of farmers regarding transmission of brucellosis

Disposal of Aborted Materials

The disposal practices adopted by farmers for aborted fetuses and associated materials varied considerably. Throwing aborted materials into open streets was the most commonly reported practice (38%; n=19), followed by burial (26%; n=13), burning (16%; n=8), and disposal into water canals (10%; n=5). Only 6% (n=3) consulted veterinarians regarding appropriate disposal procedures, while 4% (n=2) reported no involvement in disposal activities (Figure 4.12).

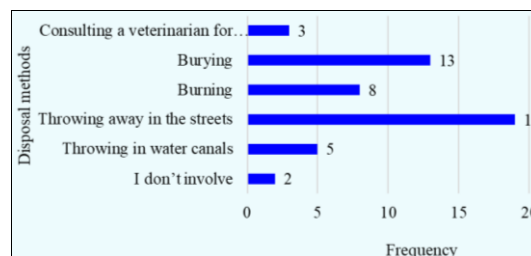


Fig 12: practices followed for disposal of aborted animal material

Management of Animals Following Abortion

Management practices following abortion are presented in Table 4.6 and Figure 13. The majority of respondents (62%; n=31) sought veterinary assistance for treatment of aborted animals. However, only 10% (n=5) reported isolating aborted animals from the flock. Risky practices were also observed, with 24% (n=12) reporting the sale of aborted animals in livestock markets and 4% (n=2) selling such animals directly to butchers. None of the respondents reported slaughtering affected animals at home.

Overall, the findings indicate limited awareness of brucellosis and inadequate adoption of recommended biosecurity measures among sheep farmers, despite the frequent occurrence of reproductive disorders suggestive of the disease.

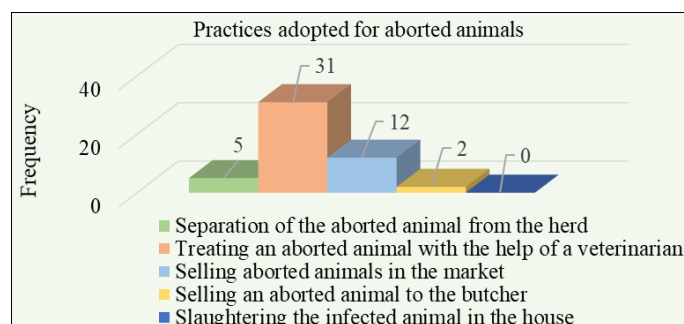


Fig 13: Farmers' handling of aborted animals

Discussion

Assessment of Knowledge, Attitude and Practices Relating to Brucellosis

The present study evaluates farm management practices, reproductive disorders suggestive of brucellosis, and the level of knowledge, awareness, and preventive practices among sheep farmers in Telangana State.

In the present study, earthen/concrete flooring was observed in 76.92% of the sheep farms, whereas only 23.08% maintained elevated flooring systems. The predominance of earthen or inadequately managed floors indicates that traditional and low-cost housing practices continue to be widely adopted in sheep farming systems of Telangana. Such flooring conditions may contribute to poor sanitation by accumulating faecal matter, urine, and moisture, thereby creating an environment conducive to the survival and transmission of infectious agents, including *Brucella* spp.

These findings are consistent with those of Sibhat *et al.* (2024) [17], who reported that pastoral livestock enclosures in northeastern Ethiopia predominantly had earthen floors with inadequate drainage and infrequent cleaning, leading to unhygienic conditions that may facilitate the persistence and spread of brucellosis. Similarly, Leahy *et al.* (2020) [11]

observed a notable association between earthen-floored housing systems and brucellosis seropositivity among small ruminants in eastern India.

However, the present observations differ from those reported by Deka *et al.* (2021) [7], who found a higher seroprevalence of brucellosis among dairy animals maintained on concrete floors compared to those housed on earthen floors in Bihar and Assam. This variation may be attributed to differences in animal species, production systems, farm management practices, hygiene standards, stocking density, waste disposal methods, and prevailing climatic conditions. Furthermore, the condition and maintenance of the flooring system, rather than the flooring material alone, may play a crucial role in influencing the risk of brucellosis transmission within livestock farms.

The present study revealed that semi-intensive rearing systems were predominant, accounting for 76.92% of the sheep farms surveyed, whereas only 23.08% followed intensive management practices. Sheep maintained under semi-intensive systems exhibited a higher frequency of reproductive and clinical signs suggestive of brucellosis compared to those reared under intensive systems. Semi-intensive production systems typically involve regular

grazing, movement of animals across communal pastures, and frequent contact with neighboring flocks and other livestock species. These practices increase opportunities for direct and indirect transmission of infectious diseases, including brucellosis, through exposure to contaminated environments, aborted materials, and infected animals.

The present findings are consistent with those reported by Leahy *et al.* (2020) ^[11], who identified the mixing of small ruminants with other livestock species as a potential risk factor for the transmission of brucellosis. Likewise, Sibhat *et al.* (2024) ^[17] documented several high-risk husbandry and livestock management practices among pastoral communities in northeastern Ethiopia, which were associated with increased transmission of *Brucella* spp. among animals and between animals and humans. These observations highlight the importance of adopting improved biosecurity measures, controlled grazing practices, and proper flock management to reduce the risk of disease spread.

Among the 245 sheep selected from farms suspected of brucellosis, abortion was the most frequently observed reproductive disorder, accounting for 28% of cases, followed by retention of placenta (19%), stillbirths (16%), mastitis (12%), arthritis (10%), repeat breeding (8%), orchitis (4%), and infertility (3%). The predominance of abortion among the affected animals is particularly significant, as abortion is widely recognized as the hallmark clinical manifestation of ovine brucellosis and is responsible for substantial economic losses due to reduced reproductive efficiency and lamb mortality.

These findings are in accordance with the established clinical presentation of brucellosis in small ruminants. Singh *et al.* (2023) ^[18] reported that although abortion is one of the most important indicators of brucellosis, awareness of its association with the disease was limited among livestock keepers. Similarly, Xu *et al.* (2025) ^[19] found that the majority of sheep and goat farmers in China recognized abortion as the principal clinical sign of brucellosis in infected animals. Furthermore, the occurrence of orchitis, infertility, repeat breeding, and retained placenta in the present study supports the likelihood of *Brucella* infection, as these reproductive disorders are commonly associated with brucellosis in both male and female animals. The presence of mastitis and arthritis among the affected sheep further corroborates the systemic nature of the disease and its ability to impair both reproductive performance and overall animal health. Together, these findings emphasize the importance of considering reproductive disorders, particularly abortion, as key indicators for brucellosis surveillance and diagnostic investigations in sheep flocks.

The present study demonstrated a low level of awareness regarding brucellosis among sheep farmers, indicating significant gaps in knowledge about this important zoonotic disease. Approximately 72% of the respondents had never heard of brucellosis, while only 28% reported being aware of the disease. These findings are consistent with those reported by Deka *et al.* (2020) ^[6], who found that 91.9% of dairy farmers in Bihar and Assam were unaware of brucellosis. Similarly, Singh *et al.* (2023) ^[18] reported that 94.6% of cattle keepers in Uttar Pradesh had never heard of the disease. Ghughey *et al.* (2022) ^[8] also documented extremely low baseline awareness among rural

communities, where only 4.7% of participants had prior knowledge of brucellosis before educational intervention. The poor awareness observed in the present study may be attributed to factors such as limited literacy, inadequate veterinary extension services, insufficient public health education, and restricted access to information on zoonotic diseases in rural farming communities.

The educational profile of the respondents further supports these observations. More than half of the farmers (56%) were illiterate, while only 30% had attained higher levels of education. Educational status is widely recognized as an important determinant of disease awareness, health-seeking behaviour, and adoption of preventive measures. Abbasi-Ghahramanloo *et al.* (2024) ^[1] reported that individuals with higher educational attainment possessed significantly better knowledge and more positive attitudes toward brucellosis prevention and control. Similar findings were reported by Xu *et al.* (2025) ^[19] and Reddy *et al.* (2024) ^[15], who observed a strong association between educational level and awareness of zoonotic diseases. Therefore, the high proportion of illiterate respondents in the present study may have contributed substantially to the limited understanding of brucellosis, its transmission, clinical manifestations, and preventive strategies.

Knowledge regarding the clinical symptoms of brucellosis in humans was also found to be inadequate. Nearly 72% of the respondents were unable to identify any symptoms associated with the disease. Among those who were aware, only a small proportion recognized signs such as fever, painful swelling of the scrotum in men, and miscarriage in women. These findings are comparable with those of Madzingira *et al.* (2023) ^[12], who reported limited awareness of human brucellosis symptoms among communal livestock farmers. Likewise, Deka *et al.* (2020) ^[6] found that only a few farmers were aware that prolonged or recurrent fever could be a symptom of brucellosis in humans. In contrast, studies conducted in Saudi Arabia and China reported relatively higher levels of knowledge. Al-Homayani *et al.* (2023) ^[3] and Alhazmi *et al.* (2022) ^[2] observed that a majority of participants were aware of the zoonotic nature and clinical manifestations of brucellosis, while Xu *et al.* (2025) ^[19] reported satisfactory knowledge regarding symptoms such as undulant fever and reproductive disorders. These differences may be due to variations in literacy rates, public health education programs, disease control initiatives, and accessibility of veterinary and healthcare services across different regions.

The present study also revealed poor understanding of the modes of transmission of brucellosis. Approximately 90% of the respondents were unaware of the disease transmission pathways, while only a small number identified consumption of raw milk and contact with aborted fetuses or reproductive discharges as potential risk factors. Similar findings were reported by Banu *et al.* (2023) ^[4], who observed that many livestock owners were unable to identify the routes through which brucellosis is transmitted from animals to humans. Singh *et al.* (2023) ^[18] likewise reported that nearly 91% of respondents lacked knowledge regarding disease transmission pathways. Furthermore, Deka *et al.* (2020) ^[6] highlighted the extremely limited awareness of zoonotic transmission among dairy farmers in India. In contrast, studies involving more educated or

previously sensitized populations reported better knowledge of transmission routes. Njenga *et al.* (2020) ^[14] found that mixed livestock farmers in Kenya were relatively well informed about transmission through consumption of raw dairy products and undercooked animal products. Similarly, Xu *et al.* (2025) ^[19] reported that most participants correctly identified contact with aborted materials, raw milk, and raw meat as important risk factors for brucellosis transmission. The poor knowledge regarding disease transmission observed in the present study underscores the urgent need for targeted awareness programs, farmer education campaigns, and community-based extension activities to improve understanding of zoonotic risks and promote the adoption of preventive practices among sheep farmers.

The present study revealed widespread adoption of unsafe practices for the handling and disposal of aborted materials among sheep farmers. Approximately 38% of the respondents disposed of aborted fetuses and placental materials in open streets, while 10% discarded them into water canals. Only 26% of the farmers reported burying the materials, and very few sought veterinary guidance regarding their safe disposal. Improper disposal of potentially infectious reproductive waste can lead to environmental contamination and serve as a significant source of infection for susceptible animals and humans. Similar observations were reported by Leahy *et al.* (2020) ^[11], who found that placental and fetal materials were frequently discarded in open fields or drainage systems. Likewise, Al-Homayani *et al.* (2023) ^[3] documented the disposal of aborted fetuses in open areas, while Ghugey *et al.* (2021) ^[8] reported open dumping of fetal waste among migratory livestock handlers in Maharashtra. Such practices facilitate the persistence and dissemination of *Brucella* spp. within livestock populations and increase the risk of zoonotic transmission.

The present study also demonstrated poor adoption of personal protective measures during animal handling and management of reproductive disorders. Nearly 94% of the respondents reported that they did not use gloves, masks, or any other protective equipment while assisting parturition, handling aborted materials, or managing sick animals. These findings are consistent with those of Ghugey *et al.* (2021) ^[8], who observed that none of the migratory livestock handlers used protective clothing during routine animal management activities. Similarly, Al-Homayani *et al.* (2023) ^[3] and Alhazmi *et al.* (2022) ^[2] reported low levels of personal protective equipment usage among livestock owners and animal handlers. The absence of appropriate protective measures substantially increases occupational exposure to *Brucella* organisms, particularly among farmers, shepherds, veterinarians, and individuals involved in animal husbandry practices.

Despite the generally poor awareness regarding brucellosis, a majority of respondents (62%) reported seeking veterinary assistance following the occurrence of abortion in their animals. This finding suggests that farmers recognize abortion as an important reproductive health problem requiring professional intervention, even though they may not be aware of its potential association with brucellosis. However, several high-risk practices were also identified. Approximately 24% of farmers reported selling aborted animals in livestock markets, while 4% sold such animals

directly to butchers. Similar observations were made by Reddy *et al.* (2024) ^[15], who reported that farmers with limited knowledge of zoonotic diseases often sold diseased animals without proper diagnosis or treatment. Singh *et al.* (2023) ^[18] also noted that the sale of infected or sick animals contributed to the continued spread of brucellosis within livestock populations. These practices may facilitate disease transmission through the movement of infected animals and pose challenges to effective disease control.

The demographic profile of the respondents was largely comparable with findings from previous studies. The majority of participants were male (82%) and belonged to young and middle-aged groups actively engaged in livestock farming. Similar demographic patterns have been reported by Banu *et al.* (2023) ^[4], Xu *et al.* (2025) ^[19], Ghugey *et al.* (2022) ^[8], and Reddy *et al.* (2024) ^[15], where livestock husbandry activities were predominantly managed by men. The greater participation of younger and middle-aged individuals may be attributed to the labour-intensive and physically demanding nature of sheep farming operations.

Overall, the findings of the present study indicate substantial deficiencies in awareness, knowledge, and preventive practices related to brucellosis among sheep farmers in Telangana. The high proportion of illiterate farmers, limited access to awareness and extension programs, inadequate understanding of disease transmission, unsafe disposal of infectious materials, poor use of personal protective equipment, and risky animal management practices collectively create favourable conditions for the persistence and spread of brucellosis within sheep flocks. Furthermore, the frequent occurrence of reproductive disorders, including abortion, retained placenta, stillbirths, mastitis, orchitis, and infertility, highlights the potential burden of brucellosis in the study area. These findings emphasize the urgent need for comprehensive farmer education programs, strengthened veterinary extension services, regular disease surveillance, improved biosecurity measures, safe disposal of infectious reproductive waste, and promotion of personal protective practices during animal handling. Implementation of such interventions will be critical for reducing the prevalence of brucellosis, minimizing economic losses, and preventing zoonotic transmission to humans.

Conclusion

The present study demonstrated that sheep farms established under government-supported livestock development schemes in Telangana continue to exhibit management conditions and reproductive health problems suggestive of brucellosis. The predominance of semi-intensive rearing systems and traditional housing practices, coupled with a high occurrence of abortion, retained placenta, stillbirths, mastitis, arthritis, orchitis, and infertility, indicates the potential presence and continued circulation of *Brucella* infection in the study area.

The Knowledge, Attitude, and Practices (KAP) assessment revealed substantial deficiencies in farmers' awareness and understanding of brucellosis. Most respondents lacked knowledge regarding the disease, its zoonotic significance, clinical manifestations, transmission pathways, and preventive measures. Unsafe disposal of aborted materials, inadequate use of personal protective equipment, and the marketing of animals with reproductive disorders were

common practices that may contribute to disease transmission and increase public health risks.

These findings underscore the critical need for comprehensive agricultural extension and veterinary outreach programs aimed at improving farmers' knowledge and adoption of recommended biosecurity measures. Regular awareness campaigns, farmer education initiatives, strengthened disease surveillance, promotion of vaccination programs, and improved veterinary advisory services are essential for effective brucellosis prevention and control.

A multidisciplinary One Health approach involving veterinary, public health, and agricultural extension sectors is recommended to enhance disease awareness, reduce zoonotic transmission risks, and improve the sustainability and productivity of sheep farming systems in Telangana. The outcomes of this study provide valuable baseline information for policymakers, extension professionals, and animal health authorities to design evidence-based interventions for brucellosis control among small-ruminant farming communities.

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