https://journal.mdpip.com/index.php/oapr

Open Access Public Health and Health Administration Review

Original Article

Investigating the Prevalence and Identification of Different Tick Species in Cattle: One Health Perspective

Safi Ur Rehman[1], Muhammad Idrees[1], Muhammad Tariq[1], Dr Inayat-ur-Rehman[1], Summaia Nigar[1], Hassan Naveed[2]

[1]Department of Zoology, Government College No 1, Dera Ismail Khan, Regional Directorate of Higher Education South at Bannu, Pakistan.

[2]Institute of Biological Sciences, Gomal University, Dera Ismail Khan, Pakistan.

Corresponding author:

Dr. Inayat Ur Rehman
Department of Zoology
Government College No 1
Dera Ismail Khan
Regional Directorate of Higher Education
South at Bannu, Pakistan
Email: rehman.gandapur68@gmail.com

Received: 30 July 2026
Accepted: 06 August 2026
Published: 11 August 2026

DOI Prefix
10.59644

Quick Response Code:

ISSN (p): 2959-619X
ISSN (e): 2959-6203
Website: mdpip.com
Publisher: MDPIP

ABSTRACT

Ectoparasites, particularly Ixodid ticks, present a major constraint to livestock production and health globally by causing severe tissue damage, blood loss, reduced milk yields, and transmitting pathogenic agents. Despite the economic reliance on livestock in Khyber Pakhtunkhwa, systematic baseline data about host susceptibility and generic tick diversity remains insufficient. A cross-sectional epidemiological survey was conducted in Dera Ismail Khan. A total of 289 livestock animals were randomly selected and physically examined. Ticks were collected manually using fine-tipped forceps, preserved in 70% ethanol, and morphologically identified to the genus level under stereomicroscopy following standard taxonomic keys. An overall tick infestation prevalence of 47.40% (137/289) was recorded. Taxonomic characterization identified five tick genera: Hyalomma, Rhipicephalus, Amblyomma, Haemaphysalis, and Dermacentor. Hyalomma was the dominant genus infesting large ruminants (55.88% in cows, 50.00% in buffaloes), while Haemaphysalis predominated in goats (33.33%). Amblyomma and Dermacentor were exclusively restricted to large ruminants, while Rhipicephalus showed a ubiquitous presence across all host species. Tick infestation is endemic in Dera Ismail Khan, with large ruminants bearing the heaviest parasitic burden. The widespread dominance of Hyalomma highlights its strong physiological adaptation to the region's semi-arid microclimate. Taxon identification was restricted to the generic level based on classical morphological keys without molecular confirmation (e.g., PCR or sequencing), and sampling was limited to accessible farming localities over defined operational periods. These findings bridge a crucial geographic knowledge gap and serve as an essential baseline for local veterinary authorities to implement targeted vector control programs, improve farmer awareness of acaricide application, and establish integrated surveillance for tick-borne zoonotic pathogens in southern Khyber Pakhtunkhwa.

Keywords: Tick Infestation, Livestock, Hyalomma, Rhipicephalus, Prevalence, Ectoparasites.

How to cite this article: Ur Rehman, S., Idress, M., Tariq, M., Ur Rehman, I., Nigar, S., Naveed, H. (2006). Investigating the Prevalence and Identification of Different Tick Species in Cattle: One Health Perspective. *Open Access Public Health and Health Administration Review,* 4(2), 224-233. https://doi.org/10.59644/oaphhar.4(2).293

INTRODUCTION

Pakistan is an agricultural country where a large proportion of the population is directly or indirectly dependent on agriculture and livestock production. The livestock sector is a fundamental component of the rural economy and contributes significantly to agricultural value and national GDP (Bibi *et al*., 2020; Rehman *et al*., 2017). Livestock provides essential resources including milk, meat, energy, raw materials, and organic fertilizer for crop production. Buffaloes contribute approximately 68% of milk production in Pakistan, followed by cattle (27%), while sheep, goats, and camels contribute the remaining share (Bilal *et al*., 2017). Despite its economic importance, livestock productivity is greatly affected by parasitic infections, particularly ectoparasites, which cause significant losses in animal health and production (Anwar *et al*., 2018).

Ectoparasites, including ticks, lice, mites, and fleas, inhabit the skin or surface of their hosts and depend on animals for nourishment, development, and reproduction. They act as major constraints to livestock production by causing irritation, skin damage, blood loss, and transmitting various pathogens (Sahito *et al*., 2017). Among ectoparasites, ticks are considered one of the most important veterinary parasites due to their ability to cause severe economic losses and transmit several infectious diseases, including babesiosis, theileriosis, and anaplasmosis (Sajid *et al*., 2008). Ticks are blood-feeding arthropods that serve as vectors for a wide range of pathogens affecting both animals and humans and are considered the second most important transmitters of infectious diseases after mosquitoes (de la Fuente *et al*., 2012).

Ticks belong to the phylum Arthropoda, class Arachnida, subclass Acari, and order Ixodida. They are mainly classified into two families: Ixodidae (hard ticks) and Argasidae (soft ticks). Hard ticks possess a dorsal scutum and are of major veterinary importance because of their prolonged feeding behavior and role in pathogen transmission. Their life cycle consists of egg, larva, nymph, and adult stages, and each developmental stage requires a blood meal from a suitable host. Environmental factors, climatic conditions, host availability, and livestock management practices strongly influence their survival, distribution, and abundance (Walker *et al*., 2003).

Globally, more than 800 tick species belonging to approximately 18 genera have been identified, showing wide ecological distribution (Bian *et al*., 2019). Pakistan provides favorable conditions for tick survival due to its diverse climatic zones, including plains, deserts, forests, and mountainous regions. Several tick genera have been reported from livestock in different regions of the country, including Hyalomma, Rhipicephalus, Amblyomma, Haemaphysalis, and Dermacentor. In Khyber Pakhtunkhwa, Hyalomma, Rhipicephalus, Amblyomma, and Haemaphysalis have been reported from various livestock species, with differences in prevalence according to geographical and ecological conditions (Farooqi *et al*., 2017).

Previous studies have demonstrated considerable variation in tick infestation prevalence among livestock species across Pakistan. Tick infestation rates in cattle have ranged from 10.14% to 89.9% in different regions, depending on environmental conditions, animal management, and geographical location (Rehman *et al*., 2017). Similarly, buffaloes, goats, and sheep have shown variable infestation rates across different provinces. These variations highlight the influence of ecological factors and farming systems on tick distribution.

Khyber Pakhtunkhwa faces a considerable challenge from tick infestation due to its extensive livestock population and favorable ecological conditions (Farzana *et al*., 2010). Although several studies have investigated tick prevalence in different parts of Pakistan, limited information is available regarding tick distribution and diversity in District Dera Ismail Khan. Therefore, the present study was conducted to determine the prevalence of tick infestation among cattle, buffaloes, and goats and to identify the tick genera present in selected areas of District Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan.

Research Problem

The livestock sector serves as the economic backbone of rural communities in Pakistan, with District Dera Ismail Khan representing a key region for cattle, buffalo, and goat rearing. However, the productivity and health of these animals are

severely constrained by ectoparasitic infestations, particularly Ixodid ticks, which induce substantial physical stress, blood loss, reduced milk yields, and serve as competent vectors for economically devastating pathogens such as Theileria, Babesia, and Anaplasma, as well as zoonotic agents like the Crimean-Congo Hemorrhagic Fever (CCHF) virus. Despite the high density of small and large ruminants in Dera Ismail Khan, local livestock management continues to rely heavily on traditional farming practices and empirical, untargeted acaricide applications. Without systematically documented baseline data on host-specific infestation rates and vector diversity across different livestock populations, veterinarians and livestock managers are unable to design targeted vector control programs, ultimately exacerbating animal health losses and accelerating the threat of chemical acaricide resistance in the region.

Research Gap

While numerous epidemiological studies have documented tick infestations and vector-borne diseases across various agro-ecological zones of Pakistan (e.g., Karim *et al*., 2017; Ali *et al*., 2024; Khan *et al*., 2024), a significant empirical knowledge gap remains concerning the specific baseline dynamics within District Dera Ismail Khan. Previous regional literature lacks a comprehensive, comparative assessment evaluating how tick generic distribution varies across distinct host categories—specifically comparing large ruminants (cows and buffaloes) against small ruminants (goats)—under the semi-arid, xerophilic microclimatic conditions of southern Khyber Pakhtunkhwa. Furthermore, before implementing resource-intensive molecular surveillance programs, an updated, rigorous morphological baseline establishing the identity and relative dominance of circulating tick genera (Hyalomma, Rhipicephalus, Amblyomma, Haemaphysalis, and Dermacentor) across diverse host types in DIKhan is urgently required to fill this geographical and taxonomic void.

Objectives of the Study

To address the identified problem and bridge these empirical literature gaps, the present investigation was designed with three core research objectives. The primary objective was to determine the overall and host-wise prevalence of tick infestation among cows, buffaloes, and goats across four representative localities (Jhoke Wance, Dera City, Yari Khel, and Paniala) within District Dera Ismail Khan. The second objective was to perform precise taxonomic characterizations using standard morphological diagnostic keys to identify the prevailing tick genera infesting livestock in the study area. The final objective was to evaluate host-parasite association patterns and host susceptibility across ruminant species to establish essential baseline epidemiological data for mapping vector distribution and informing targeted, strategic livestock management practices in the region.

Research Questions

To achieve these objectives, this study was structured around three key research questions:

1. What is the overall and host-specific prevalence rate of tick infestation among cattle, buffaloes, and goats managed under current farming systems in District Dera Ismail Khan?
2. Which tick genera are predominant in the target study area based on standardized stereomicroscopic morphological features?
3. How do host susceptibility and generic tick diversity vary between large ruminants (Bos taurus / Bos indicus and Bubalus bubalis) and small ruminants (Capra hircus) within the distinct microclimatic conditions of the district?

MATERIALS AND METHODS

Study Area

The present study was conducted in different areas of District Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. The district is located in the southern part of the province on the western bank of the Indus River and covers an area of approximately 9,334 km². It consists of plain and mountainous regions with a semi-arid climate characterized by hot summers, mild winters, and limited rainfall. These environmental conditions provide suitable habitats for ectoparasites, particularly ticks. Agriculture and livestock farming are the major sources of livelihood in the district. Cattle, buffaloes, sheep, and goats are commonly reared

for milk, meat, and other agricultural purposes. Traditional management systems and limited tick control practices contribute to the occurrence and distribution of tick infestation in livestock.

Sample Size

A total of 289 animals were examined during the study, including 134 cows, 95 buffaloes, and 60 goats. Animals were randomly selected from different localities of District Dera Ismail Khan to determine tick infestation prevalence and identify the tick genera affecting livestock.

Sample Collection

Ticks were collected manually from infested animals using fine-tipped forceps. Each animal was carefully examined at common tick attachment sites, including the ears, neck, udder, tail, and groin regions. Collected ticks were placed in labeled plastic vials containing 70% ethanol for preservation (Razzaq *et al*., 2024). Each sample was labeled with information including host species, collection site, date, and sample code. The preserved specimens were transported to the laboratory for morphological examination and identification.

Protocol Followed

Ethanol Preparation

A 70% ethanol solution was prepared in the laboratory by diluting absolute ethanol with distilled water using the standard dilution formula: C1V1 = C2V2

where C1 represents the initial ethanol concentration, V1 is the required volume of stock ethanol, C2 is the desired concentration, and V2 is the final volume

Preservation

Collected tick specimens were preserved in 70% ethanol in properly labeled vials (Razzaq *et al*., 2025). This method maintained important morphological characteristics, including the capitulum, scutum, legs, and mouthparts, required for taxonomic identification. Samples were stored securely until laboratory examination.

Identification Keys

Tick specimens were identified according to the standard taxonomic keys described by Walker *et al*. (2003). Morphological features, including capitulum shape, scutum pattern, festoons, spiracular plates, mouthparts, coxae, and leg characteristics, were examined under a stereomicroscope for genus-level identification.

Data Analysis

Collected data were organized and analyzed using Microsoft Excel. Prevalence and distribution of tick genera were calculated using frequencies and percentages. Results were presented through tables, graphs, and charts to illustrate the distribution pattern of tick infestation among livestock in the study area.

RESULTS AND FINDINGS

As detailed in Table 1, overall tick infestation burdens and host susceptibility varied substantially across the three surveyed livestock species in District Dera Ismail Khan. Large ruminants bore the predominant parasitic burden, with buffaloes (Bubalus bubalis) exhibiting the highest overall infestation prevalence at 60.00% (57/95), followed closely by cows (Bos taurus / Bos indicus) at 55.22% (74/134). In stark contrast, small ruminants demonstrated a markedly lower susceptibility to ectoparasite infestation, with caprine hosts (Capra hircus) recording an overall prevalence of only 10.00% (6/60). Comparative epidemiological evaluation indicates a clear disparity across species, demonstrating that large ruminants within the district are

significantly more prone to harboring ixodid tick infestations under current regional husbandry and environmental conditions than caprine populations.

Morphological and taxonomic evaluation of the recovered tick specimens revealed distinct generic preferences and distribution profiles across the evaluated host categories. The xerophilic genus Hyalomma emerged as the primary ectoparasite infesting large ruminants, representing 55.88% (48/74) of positive cases in cows and 50.00% (38/57) in buffaloes, whereas it constituted only 10.00% (1/9) of ticks isolated from goats. Conversely, Haemaphysalis spp. served as the predominant genus recovered from goats at 33.33% (3/9), while representing secondary proportions in buffaloes (10.50%; 8/57) and cows (4.70%; 4/74). The genus Rhipicephalus maintained a steady, ubiquitous presence across all evaluated host species, accounting for 23.30% (20/74) in cows, 20.00% (2/9) in goats, and 14.50% (11/57) in buffaloes. Notably, strong host-specificity was observed with Amblyomma spp. and Dermacentor spp., both of which were exclusively restricted to large ruminants. Amblyomma spp. reached its peak occurrence in buffaloes at 18.40% (14/57), followed by cows at 14.00% (12/74), while Dermacentor spp. accounted for 6.60% (5/57) in buffaloes and 2.30% (2/74) in cows, with complete absence (0.00%) recorded in caprine samples.

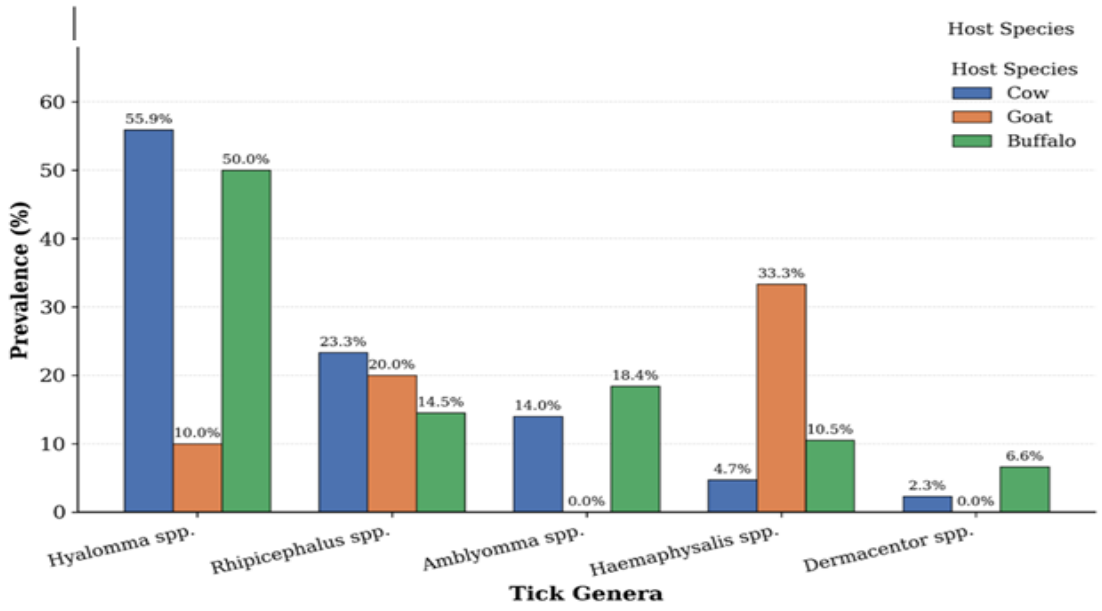
Table 1

Host-Wise Prevalence and Taxonomic Distribution of Tick Genera

Genera	COW Infested (n)	COW Prevalence (%)	Goat Infested (n)	Goat Prevalence (%)	Buffalo Infested (n)	Buffalo Prevalence (%)
Hyalomma spp.	48/74	55.88%	1/9	10.0%	38/57	50.0%
Rhipicephalus spp.	20/74	23.3%	2/9	20.0%	11/57	14.5%
Amblyomma spp.	12/74	14.0%	0/9	0.0%	14/57	18.4%
Haemaphysalis spp.	4/74	4.7%	3/9	33.33%	8/57	10.5%
Dermacentor spp.	2/74	2.3%	0/9	0.0%	5/57	6.6%
Total	74/134	55.22%	6/60	10.00%	57/95	60.00%

Figure 1

Prevalence of Tick Infesting Cattle, Goats and Buffaloes



DISCUSSION

The empirical findings of the present investigation confirm that tick infestation remains an endemic parasitological challenge among livestock populations across District Dera Ismail Khan, Khyber Pakhtunkhwa (KP), Pakistan. The observed overall prevalence of 47.40% (137/289) aligns closely with epidemiological surveys conducted across other tropical and subtropical agro-ecological zones of the world, where ixodid ticks severely constrain livestock productivity, animal health, and rural agricultural economies. In Pakistan, similar high prevalence rates have been reported across semi-arid plains, such as in Rajanpur, Punjab (41.2%–78.3%; Karim *et al*., 2017) and adjacent KP districts (35.4%–57.0%; Haider *et al*., 2022; Ali *et al*., 2024). Internationally, these findings mirror epidemiological patterns reported in tropical agro-ecosystems of India (Ghosh *et al*., 2018), Iran (Rehman et al., 2024; Vasoukolaei et al., 2020), and Sub-Saharan Africa (Bashiru and Oseni, 2025; MDPI Veterinary Sciences, 2024), where elevated ambient temperatures and relative humidity foster year-round tick survival and reproduction.

Spatial variation in infestation rates was evident across the surveyed localities within District Dera Ismail Khan. Spatial heterogeneity in tick distribution is heavily mediated by microclimatic conditions, vegetation cover, and regional husbandry practices. Elevated infestation levels in rural and peri-urban zones are linked to extensive grazing regimes, communal pasture utilization, and continuous exposure to infested vegetation and soil. Conversely, lower localized prevalence in urban centers such as Dera City reflects intensified farm management, tethered feeding systems, reduced animal movement, and improved access to veterinary care and acaricidal treatments. This spatial disparity is corroborated by regional observations in KP (Rehman *et al*., 2017) as well as broader tropical livestock surveys in East Africa (Hooria *et al*., 2025; Gebre *et al*., 2021), which consistently demonstrate that extensive, free-ranging pastoralism significantly elevates vector exposure compared to intensive zero-grazing urban or peri-urban farm management systems.

Species-wise epidemiological analysis demonstrated distinct disparities in host susceptibility. Large ruminants bore the predominant parasitic burden, with buffaloes exhibiting the highest overall infestation prevalence (60.00%; 57/95), followed closely by cattle (55.22%; 74/134). In contrast, goats exhibited a significantly lower infestation rate of 10.00% (6/60). While some tropical literature highlights higher relative susceptibility in crossbred cattle due to thinner epidermis and lack of wallowing behaviors (Karim *et al*., 2017; Strydom *et al*., 2023), the elevated burden in bubaline hosts observed in DIKhan aligns directly with local surveys by Khalil *et al*. (2021) and broader tropical studies in South Asia (Ghosh et al., 2018), where dense wallowing mud-margins frequently act as micro-habitats for questing adult ticks. On the other hand, the markedly lower susceptibility observed in caprine hosts compared to bovines and bubaline aligns with established parasitological literature across both Pakistan (Farooqi *et al*., 2022) and international tropical regions, e.g., South Africa (Strydom *et al*., 2023). This caprine resistance is widely attributed to active self-grooming habits, selective top-canopy browsing behaviors that minimize contact with ground-dwelling questing ticks, and distinct skin morphology less conducive to tick attachment.

Taxonomic identification revealed a diverse tick fauna comprising five genera: Hyalomma, Rhipicephalus, Amblyomma, Haemaphysalis, and Dermacentor. Hyalomma was identified as the predominant genus in cattle (55.88%; 48/74) and buffaloes (50.00%; 38/57). This finding agrees with previous reports identifying Hyalomma as the principal ectoparasite of large ruminants in semi-arid and arid agro-ecological environments across Pakistan (Karim *et al*., 2017; Ali *et al*., 2024), North Africa, and the Middle East (de la Fuente *et al*., 2023). Its widespread dominance is largely governed by its high physiological tolerance to thermal stress, xerophilic nature, and survival capability in desiccating microclimates. Interestingly, Haemaphysalis constituted the primary genus recovered from goats (33.33%; 3/9), followed by Rhipicephalus (20.00%; 2/9) and Hyalomma (10.00%; 1/9), mirroring small-ruminant tick distributions in both regional KP studies (Farooqi *et al*., 2022) and tropical Asian ecosystems (Ghosh *et al*., 2018). Furthermore, Amblyomma (18.40% in buffaloes, 14.00% in cattle) and Dermacentor (6.60% in buffaloes, 2.30% in cattle) were exclusively restricted to large ruminants, indicating strong host-size and habitat affinities, which is consistent with tropical vector distribution models (Bashiru & Oseni, 2025).

The high prevalence of these specific genera carries serious veterinary and public health implications. Hyalomma species serve as primary vectors for Theileria annulata (tropical theileriosis), Babesia spp., and the Crimean-Congo Hemorrhagic Fever

(CCHF) virus, posing severe risks to both animal productivity and human public health in endemic pastoral regions throughout South Asia, the Middle East, and Sub-Saharan Africa (Razzaq *et al*., 2025; Sajid *et al*., 2017; de la Fuente *et al*., 2023). Similarly, the presence of Rhipicephalus is epidemiologically critical given its established role in transmitting bovine babesiosis and anaplasmosis worldwide (Iqbal *et al*., 2025; Ali *et al*., 2024). Although recorded in lower numbers, Amblyomma, Haemaphysalis, and Dermacentor represent competent vectors for diverse bacterial, protozoal, and viral pathogens, emphasizing the necessity for continuous, integrated surveillance and targeted vector management strategies in District Dera Ismail Khan.

CONCLUSION

The present study demonstrates a high prevalence of tick infestation (47.40%; 137/289) among livestock populations within District Dera Ismail Khan, highlighting a significant and persistent veterinary health challenge in the region. The spatial distribution of these ectoparasites is strongly influenced by geographic locality and animal husbandry practices, with rural and peri-urban areas exhibiting markedly higher infestation rates than urban centers like Dera City due to the widespread utilization of extensive grazing systems. Furthermore, a distinct pattern of host susceptibility was observed; large ruminants bore the primary tick burden—with buffaloes exhibiting the highest prevalence (60.00%; 57/95), followed by cows (55.22%; 74/134)—while goats demonstrated a significantly lower infestation rate (10.00%; 6/60) across the surveyed localities. This differential susceptibility is likely mediated by a combination of efficient self-grooming, selective browsing habits that minimize contact with ground-dwelling vectors, and specific skin and hair coat characteristics less favorable for prolonged attachment. At the generic level, the identification of five distinct tick genera—with Hyalomma overwhelmingly dominating the tick fauna in large ruminants (55.88% in cows, 50.0% in buffaloes), alongside Rhipicephalus, Amblyomma, Haemaphysalis (which predominated in goats at 33.33%), and Dermacentor—underscores a complex and epidemiologically dangerous vector landscape. Because these dominant genera are notorious vectors for highly pathogenic agents, including the Crimean-Congo Hemorrhagic Fever (CCHF) virus, Theileria annulata, and Babesia species, the substantial infestation rates documented in this study pose a severe, dual threat to agricultural economic productivity and public health safety in Khyber Pakhtunkhwa.

LIMITATIONS

Several limitations of the present study warrant consideration. First, ectoparasite identification was confined to the generic level based on classical morphological keys, without species-level identification. Second, molecular diagnostic techniques such as PCR amplification or sequence analysis were not performed to confirm taxonomic status or identify potential cryptic species. Finally, sampling was limited to accessible farming areas and livestock hubs within Dera Ismail Khan over defined operational periods, which may not capture subtle micro-regional variations or multi-year seasonal shifts in tick dynamics.

FUTURE RESEARCH DIRECTIONS

Based on these findings, several future directions are recommended. Community-level educational programs are needed to improve farmer awareness regarding tick management and responsible acaricide use. Upgrading livestock housing structures and farm hygiene will help eliminate critical off-host tick micro-habitats. Future studies should integrate molecular diagnostics such as PCR and DNA sequencing alongside longitudinal sampling to achieve species-level taxonomic resolution and monitor long-term population dynamics. Lastly, active interdisciplinary surveillance combining veterinary and public health frameworks is essential to track tick-borne zoonotic pathogens in the region.

DECLARATIONS

Ethics Approval and Consent to Participate: All handling and sampling of livestock animals were conducted strictly accordingly with institutional guidelines for veterinary ethical research, with full verbal consent obtained from local animal owners before sample collection.

Authors' Contributions: Muhammed Idrees Khan, Muhammad Tariq Khan, and Syed Safi Ur Rehman Shah served as the primary researchers, carrying out field sample collection, laboratory processing, and morphological identification. Summaia

Nigar and Syed Hassan Naveed Shah assisted with fieldwork and data management. Prof. Dr. Inayat Ur Rehman provided overall scientific supervision, study design direction, and manuscript review.

Funding: This research received no specific grant or external funding from public, commercial, or non-profit funding agencies.

Competing Interests: The authors declare that they have no competing or financial conflicts of interest relevant to the content of this article.

Consent for Publication: All authors have reviewed the manuscript and granted their explicit consent for its publication.

Acknowledgments: The authors sincerely thank the local livestock farmers, community members of District Dera Ismail Khan, and all our friends for their cooperation and assistance during field sampling and data collection.

Use of Artificial Intelligence: No AI tools were used for data extraction, statistical analysis, data processing, or scientific results generation. The authors conducted all analyses, and they take full responsibility for all content and analytical findings.

Similarity Index/Plagiarism: The similarity index was checked, and it is well below the threshold of 19%, with each source at < 5%.

REFERENCES

Abdel-Shafy, S., El Namaky, A.H., Zeina, H.A.A., & Ghazy, A.A. (2015). Description of immature stages of the brown dog tick Rhipicephalus Sanguineus (Acari: Ixodidae) using scanning electron microscopy. *Int. J. Vet. Sci. Res. 1*, 12–30.

Abdu, A., Mohammed, A., & Hailu, Y. (2024). Longitudinal trends in cattle tick infestation rates and evaluation of risk factors under changing climate conditions. *Preventive Veterinary Medicine, 223*, 106110.

Ahmed S, Numan, M., Manzoor AW, Ali FA. (2012). Investigations into Ixodidae ticks in cattle in Lahore, Pakistan. *Vet Italiana,* 48:185–91.

Ali, Z., Rehman, A., & Ahmad, I. (2022). Prevalence, morphological identification, and economic burden of tick infestation in cattle populations of Pakistan. *Journal of King Saud University – Science, 34*(5), 102062.

Amrutha, B.M., Kumar, K.G.A., Kurbet, P.S., Varghese, A., Deepa, C.K., Pradeep, R.K., Nimisha, M., Asaf, M., Juliet, S., Ravindran, R. *et al*. (2023). Morphological and molecular characterization of Rhipicephalus microplus and Rhipicephalus annulatus from selected states of southern India. *Ticks Tick. Borne Dis. 14*, 102086.

Anwar, K. (2018). Epidemiology of tick-borne infection in ruminants in Peshawar. *Adv Parasitol, 5*, 1–7.

Bashiru, G., & Oseni, S. O. (2025). Global distributions and economic burdens of ixodid ticks in tropical livestock systems. *Veterinary Parasitology: Regional Studies and Reports, 48*, 100982.

Bian, C., Liu, C.Y., Zhang, C.Y., Wang, K., & Li, X.D. (2019). *Analysis of multiple infections of tick-borne diseases such as forest encephalitis, Lyme disease and spotted fever*. World Latest Med. Inf.

Bibi, S., Rafique, N., Kareem, A., Taj, M.K., Iqbal, K., Bibi, A. *et al*. (2020). Prevalence and taxonomic identification of hard ticks (Ixodidae) found in livestock of Harnai District, Balochistan, Pakistan. *J Pure Appl Biol. 9*, 2330– 8.

Bilal, M.Q., Suleman, M., & Raziq, A. 920060. Buffalo: black gold of Pakistan. *Livest Res Rural Dev. 18*, 140–51.

de la Fuente, J., Estrada-Peña, A., Cabezas-Cruz, A., & Brey, R. (2023). Tropical theileriosis and tick vector dynamics in endemic regions: A global perspective. *Acta Tropica, 239*, 106810.

de la Fuente, J., Estrada-Pena, A., Venzal, J.M., Kocan, K.M., & Sonenshine, D.E. (2012). Overview: Ticks as vectors of pathogens that cause disease in humans and animals. *Front. Biosci. 13*, 6938–6946.

Farooqi, S. H., Khan, M. A., Khan, A., Rehman, A., & Ali, Z. (2022). Prevalence of cattle ticks in various agro-ecological zones of Khyber Pakhtunkhwa, Pakistan. *Journal of King Saud University – Science, 34*(5), 102062.

Fentahun, T., Worku, Y., & Mamo, G. (2023). Morphological characterization and host-related risk factors of ixodid ticks infesting cattle in tropical agro-ecological zones. *Journal of Veterinary Medical Science, 85*(4), 412–421.

Gebre, S., Niguse, A., & Yimer, M. (2021). Epidemiological survey of tick infestation in ruminants under different husbandry systems in tropical East Africa. *Veterinary World, 14*(8), 2105–2112.

Ghosh, S., Nagar, G., Sharma, A. K., & Kumar, S. (2018). Status of tick infestations and tick-borne pathogens in livestock populations of South Asia. *Tropical Animal Health and Production, 50*(7), 1421–1430.

Ghosh, S., Sharma, A. K., & Kumar, S. (2023). Modern trends and sustainable approaches in integrated tick management (ITM)

for livestock production: A review. *Veterinary Sciences, 10*(6), 389.

Girma, M., Tesfaye, A., & Kebede, N. (2024). Prevalence and generic diversity of ixodid ticks infesting cattle in Ethiopia: A systematic review and meta-analysis. *Veterinary Parasitology: Regional Studies and Reports, 49,* 100985.

Haider, A., Ayaz, S., Rafaaqat, A., & Fatima, G. (2022). Prevalence of tick species infesting domesticated animals in Pakistan. *Indian Journal of Pure & Applied Biosciences, 10*(6), 17–22.

Hooria, Rehman, I.U., Khan, I.U., Eman, Y., & Razzaq, M.S. (2025). Prevalence and identification of Lernaea cyprincea infesting major carps (labeo rohita, catla, catla, and Cirrhinus mrigala) of the River Indus Dera Ismail Khan. *Health Sciences Journal*, 9-15.

Iqbal, S., Rehman, I. U., Khan, I. U., Razzaq, M. S., & Kamal, M. K. (2025). Optimization and comparative analysis of phenol-chloroform vs salting-out DNA extraction methods from human blood and saliva tissues: Assessing yield, purity, and suitability for downstream molecular applications. *Open Access Public Health and Health Administration Review, 1*(1), 59–68.

Karim, S., Kasi, K. K., Rehman, A., & Kakar, E. (2017). Distribution of ticks infesting ruminants and risk factors associated with high tick prevalence in livestock farms in the semi-arid and arid agro-ecological zones of Pakistan. *Parasites & Vectors, 10*(1), 190.

Khalil, B., Kundi, A., Kundi, F., Najam-un-Nisa, & Ullah, I. (2021). Prevalence of ticks and mites' infestation in livestock and drugs' efficacy against them in district Dera Ismail Khan, KPK, Pakistan. *Journal of Entomology and Zoology Studies, 9*(5), 08–13.

Khan, M. A., Ali, Z., Rehman, A., & Ahmad, I. (2024). Prevalence, species diversity, and risk factors of tick infestation in cattle from District Peshawar, Pakistan. *Veterinary Medicine and Science, 11*(6), e70642.

Khan, M.S., Bhutto, M.B., Khan, S.A., Awan, K., Shah, S.R.A., & Shah, S.K.A. (2019). Epidemiological study on tick infestation in indigenous and cross-breed cattle in Hyderabad, Pakistan. *Pak J Sci. 71*, 63.

Kumar, R., Singh, A. P., & Rawat, S. S. (2022). Epidemiological investigation and risk factor analysis of tick infestation in cattle across varied agro-climatic zones of India. *Indian Journal of Animal Sciences, 92*(8), 945–952.

Kumar, S., Paul, A., & Sharma, D. (2017). Seasonal dynamics of tick infestation in cattle in North India. International *Journal of Current Microbiology and Applied Sciences, 6*(6), 1234–1240.

Lashari, M.H., Akhtar, M.S., Ayaz, M., Tasawar, Z., Aziz, F., Farooq, A.S. *et al*. (2016). A preliminary report on prevalence of mange infestation in dumbi sheep in and around Fort Munru, Dera Ghazi Khan, Punjab, Pakistan. *Wayamba J Animal Sci. (2016)* 1402–5.

Lew-Tabor, A. E., & Rodriguez Valle, M. (2016). A review of reverse vaccinology approaches for the control of ticks. *Ticks and Tick-borne Diseases, 7*(4), 573–585.

Mohamed, H. A., Hassan, M. M., & Abdel-Rahman, E. H. (2023). Seasonal population dynamics of ixodid ticks and their role as vectors of bovine blood parasites. *Acta Parasitologica, 68*(2), 295–304.

Razzaq, M. S., Hassan, M. S. U., Ullah, W., & Arif, S. (2025). Solvent-dependent bioefficacy of Azadirachta indica leaf extracts against Heterotermes indicola (Blattodea: Rhinotermitidae). *National Journal of Biological Sciences, 6*(2), 16-29.

Razzaq, M.S., Rehman, I.U., Rehman, F.U., Khan, I.U., Shah, K.H., & Ali, M.Z. (2024). In silico analysis of identified most frequent mutations in exon 10, codon 618 of the human ret gene. *Health Sciences Journal, 3*(1):70-78.

Rehman, A., Nijhof, A. M., Staubach, C., Schauer, B., & Clausen, P. H. (2017). Tick infestation rate in cattle and buffalo in different areas of Khyber Pakhtunkhwa, Pakistan. *Journal of Agricultural and Biological Science, 12*(1), 12–18.

Rehman, A., Nijhof, A.M., Sauter-Louis, C., Schauer, B., Staubach, C., & Conraths, F.J. (2017). Distribution of ticks infesting ruminants and risk factors associated with high tick prevalence in livestock farms in the semiarid and arid agro-ecological zones of Pakistan. *Parasite Vectors. 10*, 190.

Rehman, I. U., Muzammal, M., Siraj, S., & Khan, J. (2024). Molecular characterization of thyroid cancer in Pashtun ethnic families of Khyber Pakhtunkhwa, Pakistan. *Journal of Population Therapeutics and Clinical Pharmacology, 31*(7), 1809–1820.

Sahito, H.A., Kousar, T., Mughal, M.A., Mangrio, W.M., Shah, Z.H., Ghumro, B.D. *et al*. (2017). Prevalence of cattle lice;

Haematopinus tuberculastus and Ticks; Haemaphysalis bispinosa on cattle at region Sukkur, Sindh - Pakistan. *Int J Res Studies Biosci. 5*, 1–5.

Sajid, M. S., Iqbal, Z., Khan, M. N., & Muhammad, G. (2017). Point prevalence, clinical aspect and economic impact of tick infestation in ruminants. *Pakistan Veterinary Journal, 37*(2), 174–178.

Sajid, M.S., Iqbal, Z., Khan, M.N., Muhammad, G., & Khan, M.K. (2009). Prevalence and associated risk factors for bovine tick infestation in two districts of lower Punjab, Pakistan. *Prevent Vet Med. 92*, 386–91.

Strydom, T., Oosthuizen, M. C., & Schoeman, J. P. (2023). Comparative tick infestation patterns and host vulnerability in tropical ruminants. *Veterinary Sciences, 10*(4), 254.

Tesfaye, S., Desta, B., & Regassa, F. (2023). Efficacy assessment of chemical acaricides and management practices against tick infestation in cattle. *Tropical Animal Health and Production, 55*(3), 182.

Vasoukolaei, N. H., Telmadarrehiy, Z., & Oshaghi, M. A. (2020). Tick infestation dynamics on domestic ruminants in subtropical agro-ecological environments. *Asian Pacific Journal of Tropical Medicine, 13*(3), 115–122.

Walker, A., Bouattour, A., Camicas, J.L., Estrada-Peña, A., Horak, I., Latif, A., Pegram, R.G., & Preston, P.M. (2003). *Ticks of Domestic Animals in Africa: A Guide to Identification of Species*. Bioscience Reports: Edinburgh, UK, pp. 1–227.

Note: Open Access Public Health and Health Administration Review is recognized by the Higher Education Commission of Pakistan in the Y category in 2024-2025. The journal is under evaluation by the Pakistan Medical and Dental Council (PM&DC) and ISI Web of Science.

Disclaimer/ Publisher's Note: The statements, opinions, and data contained in all publications in this journal are solely those of the individual author(s) and not of the Multidisciplinary Publishing Institute (SMC-Private) Limited and/ or the editor(s). Multidisciplinary Publishing Institute (SMC-Private) Limited and the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions, or products referred to in the content.