Research Article

Ixodid tick fauna and infestation burden in cattle across southern districts of Tamil Nadu, India

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Abstract

Tick infestation remains a major constraint to cattle production in tropical regions owing to its effects on animal health and productivity. The present study investigated ixodid tick fauna, relative abundance and infestation patterns in cattle from four southern districts of Tamil Nadu, Tirunelveli, Tenkasi, Thoothukudi and Kanyakumari, during January 2024 to August 2025. A total of 3,463 ticks representing eight species were collected, with Rhipicephalus microplus emerging as the dominant species (67.31%), followed by Haemaphysalis bispinosa and Hyalomma marginatum. Significant district wise variation in tick species composition was observed, whereas overall infestation prevalence did not differ significantly across seasons or age and breed categories. Female cattle showed significantly higher infestation rates than males. These findings highlight the influence of geographical and host related factors on tick ecology in southern Tamil Nadu and emphasize the need for region specific tick control strategies.

Ticks (Acari: Ixodidae) constitute one of the most important ectoparasite groups affecting cattle in tropical and subtropical regions, where they impose major constraints on livestock productivity through blood loss, skin damage, stress and the transmission of a wide range of pathogens. In India, diverse agro-climatic conditions coupled with extensive grazing systems and favourable microclimates promote year-round survival and proliferation of ixodid ticks, leading to persistent infestation pressure on bovine populations. Regional surveys from southern India have documented rich tick species assemblages and considerable spatial heterogeneity in abundance across ecological zones (Balasubramanian et al., 2019; Ranganathan et al., 2021; Elango et al., 2024; Sumathi et al., 2026).

Oriental theileriosis, caused by members of the *Theileria orientalis* complex, has emerged as a major tick-borne constraint to cattle production in several parts of the world, with increasing reports of severe clinical disease, production losses and mortality. In India, molecular investigations have revealed extensive genotype diversity associated with outbreaks, including the Ikeda and N2 lineages, which are frequently linked with high pathogenicity (Aparna et al., 2011; Vinodkumar et al., 2016; Baghel et al., 2023; Jacob et al., 2024). Genotypic heterogeneity has also been

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documented across different agro-ecological zones of the country, with transmission through *Rhipicephalus microplus* demonstrated in Assam (Kakati et al., 2015), highlighting the expanding epidemiological footprint of this parasite in South Asia.

Several field investigations have emphasized that tick prevalence and species composition are shaped not only by environmental conditions but also by host-related factors such as age, sex and breed. Variations in management practices, grazing behaviour and physiological status have been implicated in differential exposure risks among cattle populations (Ponnudurai et al., 2017; Raju et al., 2025). Seasonal fluctuations linked to rainfall patterns, temperature and humidity further modulate tick population dynamics, although in humid tropical ecosystems overall infestation levels may remain relatively stable across seasons (Balasubramanian et al., 2019; Elango et al., 2024). District-wise and landscape-level differences in vegetation cover and livestock density have likewise been shown to influence tick assemblages within and between regions (Ayyavu et al., 2024).

In Tamil Nadu, statewide and district-level surveys have revealed marked variation in ixodid tick fauna across agro-climatic belts, with *Rhipicephalus microplus* consistently emerging as the dominant species parasitizing cattle, followed by several *Haemaphysalis* species (Ranganathan et al., 2021; Elango et al., 2024). Forest-fringe and coastal ecosystems have been reported to harbour particularly diverse tick communities owing to favourable microhabitats and frequent livestock–wildlife interfaces (Balasubramanian et al., 2019; Ayyavu et al., 2024). However, systematic comparative data integrating district-wise tick abundance with host demographic variables and seasonal patterns remain limited for several southern districts of the state.

In southern India, tick communities parasitizing livestock are highly diverse and frequently harbour multiple haemoprotozoan pathogens, as demonstrated in comprehensive surveys from Kerala (Nimisha et al., 2019).

In view of the above, the present investigation was undertaken to (i) document the species composition and relative abundance of ixodid ticks infesting cattle in selected southern districts of Tamil Nadu, (ii) determine overall and district-wise prevalence of tick infestation, and (iii) evaluate the influence of host factors (age, sex and breed), seasonal variation and geographic location on tick infestation patterns under field conditions.

Materials and methods

Study area and experimental design

The study was conducted in the southern agro-climatic belt of Tamil Nadu, India, encompassing four districts that represent distinct ecological zones: semi-arid plains (Tirunelveli), high-rainfall foothills (Tenkasi), dry coastal belts (Thoothukudi), and humid coastal–highland regions (Kanyakumari). Mean annual temperatures in the region range from 25 to 34 °C, with relative humidity frequently exceeding 70 per cent in coastal localities.

Sampling was carried out from January 2024 to August 2025. The study period was stratified into four seasons based on prevailing climatic patterns in southern Tamil Nadu: Season I (January–May 2024; late northeast monsoon–summer transition), Season II (June–November 2024; southwest monsoon), Season III (December 2024–March 2025; northeast monsoon/post-monsoon), and Season IV (April–August 2025; summer–early monsoon).

The study population comprised cattle of different breeds, including Jersey and Jersey cross, Holstein Friesian and Holstein Friesian cross, and non-descriptive animals, representing varied age groups (<1.5 years, 1.5–6 years and >6 years) and both sexes (male and female). Animals were drawn from organized dairy farms, smallholder production systems and free-grazing rural herds. These husbandry systems are typically characterized by high tick exposure, communal grazing and limited acaricide rotation, factors that increase the risk of haemoprotozoan transmission.

The sample size was calculated using power analysis at a 95 per cent confidence level and five per cent allowable error, based on an expected prevalence of 20 per cent reported in earlier Indian studies (Velusamy et al., 2014; Krishnamoorthy et al., 2021).

Tick collection and preservation

Ticks were collected manually from infested cattle during routine clinical examinations conducted across the four study districts, as reported previously. Following removal, ticks were preserved in 70 per cent ethanol and transported to the laboratory for further processing and identification.

Gross and microscopic identification of tick species

Prior to examination, preserved ticks were briefly air-dried to remove excess ethanol. Gross morphological features were recorded, and detailed microscopic examination was performed using a stereomicroscope (Lynx LM-52-3611). Species-level identification was carried out following standard ixodid tick identification keys and diagnostic characters described by Walker et al. (2003).

Statistical analysis

Tick infestation prevalence was calculated as the proportion of tick-infested cattle among the total number examined. Ninety-five per cent confidence intervals were
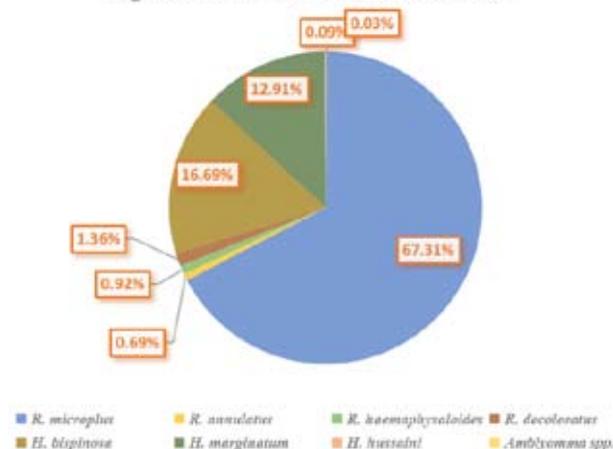
estimated using the Wilson score method implemented in OpenEpi (Version 3.01), following standard epidemiological procedures (Thrusfield, 2018). Pearson's Chi-square (χ^2) test was employed to compare overall prevalence among districts and to evaluate associations between tick infestation and host factors such as age, breed, sex and season (Ghosh et al., 2019; Yenew et al., 2025). Statistical significance was set at $p < 0.05$.

Results and discussion

Tick abundance and infestation burden

A total of eight ixodid tick species, *Rhipicephalus microplus*, *R. annulatus, R. haemaphysaloides, Rhipicephalus decoloratus, Haemaphysalis bispinosa*, *Hyalomma marginatum*, *Hyalomma hussaini* and *Amblyomma spp.* were identified in the study area. During the entire period of study, 3463 ticks were collected. Among these 2331 (67.31%), 578 (16.69%), 447 (12.91%), 47 (1.36%), 32 (0.92%), 24 (0.69%), 3 (0.09) and 1 (0.03%) were *Rhipicephalus microplus, Haemaphysalis bispinosa*, *Hyalomma marginatum*, *Rhipicephalus decoloratus*, *Rhipicephalus haemaphysaloides*, *Rhipicephalus annulatus, Hyalomma hussaini* and *Amblyomma* species, respectively. *Rhipicephalus microplus* species was the most dominant tick species, whereas the second and third most abundant tick species were *H. bispinosa* and *H. marginatum* respectively. *Amblyomma species* was the least abundant tick species in the study areas (Fig. 1).

Figure 1. Overall relative abundance of ticks

Legend: ■ *R. microplus*   ■ *R. annulatus*   ■ *R. haemaphysaloides*   ■ *R. decoloratus*
■ *H. bispinosa*   ■ *H. marginatum*   ■ *H. hussaini*   ■ *Amblyomma spp.*

The predominance of *Rhipicephalus microplus* on cattle in the present study closely agrees with the findings of Elango et al. (2024), who, in a large-scale survey across seven agro-climatic zones of Tamil Nadu, reported *R. (Boophilus) microplus* as the most prevalent tick species infesting cattle (25.41%), thereby confirming its wide distribution and strong host preference for bovines in the state.

Comparable dominance of *R. microplus* has been documented across humid tropical ecosystems

of southern India. In the Sirumalai foothill region of Tamil Nadu, Ayyavu et al. (2024) collected 2,851 ticks and identified *Haemaphysalis intermedia* (72.6%) and *R. (B.) microplus* (15.2%) as the two predominant species, with cattle exhibiting a tick infestation rate of 42.6 per cent. Supporting evidence from Madurai district was provided by Ranganathan et al. (2021), who recorded *R. (B.) microplus* constituting 24.12 per cent of the total ticks collected, ranking among the three most common species infesting domestic animals.

Under forest-fringe ecological conditions of the Western Ghats of Kerala, Balasubramanian *et al*. (2019) reported that 86.15 per cent of domestic animals were infested with ticks, with 3,633 specimens collected. In that study, *R. microplus* constituted 52.71 per cent of all ticks, followed by *Haemaphysalis bispinosa* (16.90%) and *R. decoloratus* (15.77%), with mean tick loads of 11.39 *R. microplus* and 3.65 *H. bispinosa* per animal. The close similarity in species composition and infestation magnitude between the Western Ghats and the present Tamil Nadu study indicates that comparable humid tropical ecosystems across southern peninsular India support stable enzootic tick populations dominated by *R. microplus* and *H. bispinosa*.

Likewise, Raju et al. (2025), surveying 2,877 domestic animals across five states of the Western Ghats, reported an overall tick prevalence of 44.91 per cent, with cattle showing 45.97 per cent infestation. *R. (B.) microplus* was the most abundant species (39.63% of all ticks), with a mean abundance of 2.53 ± 0.66 ticks per host and a mean intensity of 5.74 ± 2.47 ticks per infested animal, followed by *H. bispinosa* (27.39%; mean abundance 1.75 ± 0.27 ticks per host). The concordance in species dominance between the Western Ghats survey and the present investigation reinforces that *R. microplus* and *H. bispinosa* together constitute the core tick fauna of cattle across southern Indian tropical ecosystems (Raju et al., 2025; Sumathi et al., 2026).

Overall infestation prevalence patterns reported from Tamil Nadu further align with the present observations. Ranganathan et al. (2021) recorded an overall tick infestation rate of 21.90 per cent (tick index 0.92), with cattle showing 27.34 per cent infestation (tick index 1.12), while Elango et al. (2024), in their statewide survey of 1,252 cattle, reported a prevalence of 38.65 per cent, demonstrating widespread tick exposure across agro-climatic zones.

The present study demonstrated that tick species composition differed significantly among districts ($p < 0.01$), with Tirunelveli and Kanyakumari showing higher representation of *H. bispinosa* and *H. marginatum*, whereas *R. microplus* predominated across all districts. Similar spatial heterogeneity was documented by Ranganathan et al. (2021), who observed significant

differences in tick distribution between rural, semi-urban and urban localities, and by Elango et al. (2024), who attributed regional variation in tick diversity to vegetation type, grazing practices and microclimatic conditions.

Interestingly, despite pronounced geographic variation in tick species composition, the overall infestation burden did not differ significantly by district or season in the present study. Comparable observations were reported by Raju et al. (2025), who found no statistically significant differences in overall tick prevalence among Western Ghats states despite differences in species assemblages. Likewise, Ponnudurai et al. (2017) noted that although tick fauna varied across agro-climatic zones of Tamil Nadu, overall infestation levels remained comparable, suggesting ecological replacement of tick species that maintains relatively stable infestation pressure. The high tick diversity reported from forest-fringe villages of the Eastern Ghats by Ayyavu et al. (2024), attributed to dense vegetation and favourable microclimatic conditions, further parallels the present finding that local environmental factors sustain enzootic tick populations in southern Tamil Nadu.

Relative abundance of ticks in southern districts of Tamil Nadu

The district wise relative abundance of tick species collected from cattle is presented in Table 1. A total of 3,463 ticks were recorded across the four districts, with the highest numbers observed in Tirunelveli (1,318), followed by Tenkasi (917), Kanyakumari (747) and Thoothukudi (481). *Rhipicephalus microplus* was the predominant species overall (2,331/3,463), contributing the largest share in all districts, particularly in Tirunelveli and Tenkasi. Other commonly encountered species included *Haemaphysalis bispinosa* (578) and *H. marginatum* (447), the former being especially abundant in Kanyakumari, whereas *H. marginatum* occurred mainly in Tirunelveli, Tenkasi and Thoothukudi but was absent in Kanyakumari. Minor species such as *R. decoloratus* (47),

R. haemaphysaloides (32), *R. annulatus* (24), *H. hussaini* (3) and *Amblyomma* spp. (1) were detected sporadically across districts. Statistical analysis demonstrated that the distribution of tick species differed significantly among districts (χ^2 = 1245.6; p < 0.001), indicating marked geographic heterogeneity in tick species composition in the southern agro-climatic zones of Tamil Nadu.

The predominance of *Rhipicephalus microplus* across all four districts and the substantial contribution of *Haemaphysalis bispinosa* and *H. marginatum* observed in the present study are consistent with earlier surveys from Tamil Nadu and the Western Ghats region, which have repeatedly identified these species as the dominant components of cattle-associated tick fauna (Balasubramanian et al., 2019; Ranganathan et al., 2021; Elango et al., 2024; Raju et al., 2025). District-wise heterogeneity in tick abundance observed in the present investigation mirrors patterns reported by Ayyavu et al. (2024) and Elango et al. (2024), who attributed spatial variation in tick assemblages to ecological gradients, vegetation cover and livestock management practices. Similarly, Ranganathan et al. (2021) recorded significant differences in tick species composition among agro-ecological settings within Tamil Nadu, reinforcing that local environmental conditions strongly influence tick community structure.

Prevalence of ticks in respect to age group of cattle

The prevalence of tick infestation among different age groups of cattle is summarized in Table 2. Of the 108 animals aged <1.5 years examined, 84 were infested, yielding a prevalence of 77.78 per cent. Among cattle aged 1.5–6.0 years, 160 of 199 animals were positive for ticks (80.40%), whereas 166 of 218 cattle aged >6 years were infested, corresponding to a prevalence of 76.15 per cent. Statistical analysis indicated that differences in infestation rates among age groups were not significant (χ^2 = 1.11; p = 0.574), suggesting that age did not exert a measurable influence on tick infestation in the study population.

Table 1. District wise relative abundance of ticks

	Tirunelveli	Tenkasi	Thoothukudi	Kanyakumari	Total Tick
R. microplus	873	689	339	430	2331
R. annulatus	0	8	0	16	24
R. haemaphysaloides	10	22	0	0	32
R. decoloratus	20	14	5	8	47
H. bispinosa	173	54	58	293	578
H. marginatum	242	126	79	0	447
H. hussaini	0	3	0	0	3
Amblyoma spp.	0	1	0	0	1
Total Tick	1318	917	481	747	3463
χ^2 value	1245.6**				
p	< 0.001				

NS - Non significant (p>0.05), * Significant at 5% (p<0.05), ** Highly significant at 1% (p<0.01)

Table 2. Prevalence of ticks in respect to age group of cattle

Sl.No.	Age	No. of cattle examined	No. of cattle infested	Prevalence %	χ^2 value	p value
1	< 1.5 Y	108	84	77.78		
2	1.5 to 6.0Y	199	160	80.40	1.11[NS]	0.574
3	>6.0Y	218	166	76.15		

NS- Non-significant, * - Significant at 5% (p<0.05), ** - Significant at 1% (p<0.01)

Table 3. Prevalence of ticks in respect to gender of cattle

Sl. No.	Sex	No. of cattle examined	No. of cattle infested	Prevalence %	χ^2 value	p value
1	Male	76	23	30.26	115.60 **	<0.001
2	Female	449	387	86.19		

NS- Non-significant, * - Significant at 5% (p<0.05), ** - Significant at 1% (p<0.01)

The absence of a significant association between cattle age and tick infestation in the present study accords with observations by Ranganathan et al. (2021) and Raju et al. (2025), who likewise reported relatively uniform infestation levels across age categories in endemic areas. Balasubramanian et al. (2019) suggested that continuous exposure to infested grazing environments and shared housing conditions can override age-related resistance under enzootic situations, thereby maintaining comparable infestation burdens among young and adult animals. The present findings thus support the view that in long-established endemic zones, ecological exposure and management factors may play a more decisive role than host age in shaping tick infestation patterns.

Prevalence of ticks in respect to gender of cattle

The prevalence of tick infestation in relation to the sex of cattle is presented in Table 3. Of the 76 male cattle examined, 23 were infested, giving a prevalence of 30.26 per cent, whereas among 449 female cattle, 387 were positive for ticks, corresponding to a markedly higher prevalence of 86.19 per cent. Statistical analysis revealed a highly significant association between sex and tick infestation (χ^2 = 115.60; p < 0.001), indicating that female cattle were significantly more prone to tick infestation than males under the prevailing management and ecological conditions in the study area.

The significantly higher infestation rate recorded among female cattle in the present investigation agrees with previous reports from southern India, where females were found to harbour heavier tick burdens than males (Ranganathan et al., 2021; Raju et al., 2025). Such sex-associated differences have been attributed to physiological stress linked to lactation and reproduction, longer retention within herds, and greater exposure to communal grazing environments (Balasubramanian et al., 2019; Ponnudurai et al., 2017). Elango et al. (2024) similarly noted that production-related management practices can influence tick exposure patterns, lending support to the present observation that host sex constitutes an important determinant of infestation risk in field conditions.

Prevalence of ticks in respect to breed of cattle

The prevalence of tick infestation in relation to breed of cattle is presented in Table 4. Among Jersey and Jersey crossbred cattle, 236 of 295 animals were infested, yielding a prevalence of 80.00 per cent. Holstein Friesian and Holstein Friesian crossbred cattle showed a comparable prevalence of 76.16 per cent (131/172), while non-descriptive cattle exhibited a prevalence of 74.14 per cent (43/58). Statistical analysis indicated that differences in infestation rates among breeds were not significant (χ^2 = 1.53; p = 0.465), suggesting that breed did not exert a measurable influence on tick infestation under the prevailing management and ecological conditions in the study area.

The lack of a statistically significant association between breed and tick infestation observed in the present study parallels earlier findings from Tamil Nadu and neighbouring regions, where crossbred and non-descriptive cattle showed comparable infestation levels under similar management systems (Ranganathan et al., 2021; Elango et al., 2024; Raju et al., 2025). Ponnudurai et al. (2017) also reported that regional ecology and husbandry practices exert stronger influences on tick burden than host genotype alone. These observations collectively suggest that in endemic settings characterized by high tick challenge, environmental exposure and acaricide usage patterns may overshadow any inherent breed-related resistance.

Prevalence of ticks in respect to seasonal changes in southern Tamil Nadu

Season-wise prevalence of tick infestation among cattle in southern Tamil Nadu is presented in Table 5. Infestation rates ranged from 74.71 to 80.54 per cent across the four study seasons. The highest prevalence was recorded during Season I (January–May 2024; 80.54%), followed by Season II (June–November 2024; 78.76%), Season IV (April–August 2025; 76.04%) and Season III (December 2024–March 2025; 74.71%). Statistical analysis revealed no significant association between season and

Table 4. Prevalence of ticks in respect to breed of cattle

Sl. No.	Breed	No. of cattle examined	No. of cattle infested	Prevalence %	χ^2 value	p value
1	Jersey and Jersey cross	295	236	80.00		
2	Holstein Friesian and Holstein Friesian cross	172	131	76.16	1.53 [NS]	0.465
3	Non-descriptive cattle	58	43	74.14		

NS- Non-significant, * - Significant at 5% (p<0.05), ** - Significant at 1% (p<0.01)

Table 5. Prevalence of ticks in respect to seasonal changes in southern Tamil Nadu

Sl.No.	Season	No. of cattle examined	No. of cattle infested	Prevalence %	χ^2 value	p value
1	I	149	120	80.54	1.39 [NS]	0.709
2	II	193	152	78.76		
3	III	87	65	74.71		
4	IV	96	73	76.04		

NS- Non-significant, * - Significant at 5% (p<0.05), ** - Significant at 1% (p<0.01), Season I – January 2024 to May 2024; II-June 2024 to November 2024; III-December 2024 to March 2025; IV-April 2025 to August 2025

tick infestation (χ^2 = 1.39; p = 0.709), indicating that tick occurrence remained relatively consistent throughout the year under the agro-climatic conditions prevailing in the study region.

The relatively uniform tick infestation rates recorded across seasons in the present study are comparable to observations made in other tropical regions of southern India, where tick populations persist year-round owing to favourable temperature and humidity regimes (Balasubramanian et al., 2019; Raju et al., 2025). Ranganathan et al. (2021) and Elango et al. (2024) similarly documented sustained tick activity across seasons in Tamil Nadu, although shifts in species composition were sometimes evident. Ponnudurai et al. (2017) proposed that stable enzootic transmission cycles maintained by continuous host availability and microclimatic suitability can minimize pronounced seasonal fluctuations in overall infestation levels, an interpretation that is strongly supported by the present findings.

Conclusion

The present investigation demonstrates that cattle in southern Tamil Nadu harbour a diverse ixodid tick fauna dominated by *Rhipicephalus microplus*, with substantial contributions from *Haemaphysalis* and *Hyalomma* species and marked geographic heterogeneity among districts. Although species composition differed significantly between locations, overall infestation prevalence remained relatively uniform across seasons, age groups and breeds, indicating stable enzootic tick pressure under prevailing agro-climatic conditions, while female cattle were significantly more affected than males. Collectively, these results underscore the role of ecological setting and host factors in shaping tick infestation dynamics and provide baseline epidemiological information essential for designing district-specific, integrated tick management programmes in southern India.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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