

Seasonal Dynamics and Prevalence of Cattle Ticks: Insight from Kolhapur District, Maharashtra

Vijay D. Jadhav and Alka K. Chougale

Department of Zoology, The Institute of Science

Dr. Homi Bhabha State University, Mumbai, Maharashtra, India

Abstract: *Ectoparasites, especially ticks, represent a significant risk to the health and productivity of livestock, impacting almost 80% of the worldwide cattle population and facilitating the transmission of various protozoan, bacterial, and viral pathogens. Tick infestations affect more than 50% of cattle. Also, cows are more susceptible than buffaloes. It results in reduction in milk quantity and decreases in hide quality. It also increases the economic burden on farmer to cure their livestock. Ticks engage in blood extraction and toxin injection, while also serving as vectors for hemoparasite diseases which further intensify mortality rates and productivity declines. This study aims to fill a significant gap by presenting the inaugural systematic dataset on tick prevalence in the Kolhapur district. It encompasses data from 30 villages across three tehsils, collected over two consecutive years and across three distinct seasons. The results revealed that during the first year of investigation of tick infestation among the three seasons, the summer of 2023 highlighted slightly higher tick infestation as compared to winter 2022 and monsoon 2023. However, during the second year of investigation of the tick infestation, the winter 2023 has slightly higher tick infestation as compared to summer and monsoon of 2024. During the current investigation, ixodid ticks viz., *Haemaphysalis* sp., and *Rhipicephalus* sp. were recorded.*

Keywords: Ticks, infestation, prevalence, seasonal dynamics, cattle, Kolhapur district, economics

I. INTRODUCTION

Ectoparasites, particularly ticks, significantly impact all species of domestic animals and present considerable health concerns, affecting approximately 80% of the global cattle population exposed to tick damage (18). Ticks spread various veterinary diseases, including protozoa, bacteria, fungi, and viruses, infecting livestock, wild animals, and humans worldwide (6,12). In India, livestock is essential for ensuring food security and supporting the livelihoods of countless rural households. India is home to over 536 million animals, representing approximately 10% of the world's livestock population, and holds the top position globally in the numbers of buffalo, cattle, and goats. In addition to its impressive figures, the sector plays a crucial role in the economy—livestock contributes nearly 30% to the Agricultural Gross Value Added (GVA) and approximately 5.5% to the national GDP. Milk, in which India holds the top position globally, has emerged as a crucial element for rural nutrition and income generation. The significance of livestock lies in its deep connection with small and marginal farmers: approximately two-thirds of rural women and more than 80% of marginal farmers rely on animal husbandry as a consistent source of supplementary income. The dual role of livestock as both an economic driver and a social safety net highlights its essential position within India's agricultural landscape (3,9).

Ticks are not merely nuisances; they significantly threaten the economic foundation of Indian agriculture. These issues impact more than half of India's cattle and almost 40% of buffalo populations each year, resulting in both immediate losses in milk production and additional expenses related to treatment and damage to hides. A recent meta-analysis has estimated the overall economic impact of tick infestations and tick-borne diseases in India to be around ₹61,076



million (USD 787.6 million)(20). Worldwide, the financial impact of tick-borne diseases ranges from US \$13.9 to 18.7 billion annually, with India accounting for approximately US \$498.7 million of this total (16,21). Ticks extract blood, introduce toxins, harm hides, weaken immunity, and transmit hemoparasite diseases like babesiosis, theileriosis, and anaplasmosis, which ultimately reduces productivity and increases treatment expenses (2,4,15). Considering that livestock accounts for nearly 5–6% of India’s GDP and approximately 30% of agricultural GVA, overlooking ticks transcends a mere veterinary concern—it represents a significant economic risk that necessitates targeted investigation and sustainable management strategies. Ticks are acknowledged as a significant group of arthropod vectors, ranking just behind mosquitoes in their influence on the health of humans and animals (17). A diverse array of pathogens is transmitted, encompassing protozoa such as Babesia and Theileria, bacteria including Anaplasma, Rickettsia, and Borrelia, as well as viruses like the Crimean–Congo haemorrhagic fever virus and tick-borne encephalitis virus, leading to serious diseases in both livestock and humans. The impact of these infections includes diminished productivity, heightened mortality rates, and significant economic losses in endemic areas(5,7,11).The significance of ticks as vectors underscores the necessity of their control, which is crucial not only for enhancing livestock production but also for alleviating the impact of zoonotic diseases (23).

Research on ticks in India has underscored their extensive distribution, variety of hosts, and crucial role in the transmission of pathogens that impact livestock productivity. Research indicates that there are over 106 tick species present nationwide, with genera like *Rhipicephalus*, *Haemaphysalis*, *Hyalomma*, and *Ixodes* recognized for their significant veterinary relevance (1,10,14).In Maharashtra, the prevalence of ticks can be attributed to the conducive tropical climate and the significant density of cattle and buffalo populations. Surveys conducted across various districts, such as Satara, Pune, and Nagpur, have recorded seasonal fluctuations in tick populations, with the monsoon and post-monsoon periods exhibiting the highest levels of infestation (1,13). Although they are crucial, comprehensive studies on district-level distribution in Maharashtra are scarce, highlighting the necessity for targeted investigations into local tick ecology and its effects on livestock productivity. Ticks are acknowledged as a significant group of arthropod vectors, ranking just behind mosquitoes in their influence on the health of humans and animals. A diverse array of pathogens is transmitted, encompassing protozoa such as Babesia and Theileria, bacteria including Anaplasma, Rickettsia, and Borrelia, as well as viruses like the Crimean–Congo haemorrhagic fever virus and tick-borne encephalitis virus, leading to significant diseases in both livestock and humans. Infections of this nature result in diminished productivity, heightened mortality rates, and significant economic detriment in areas where they are prevalent (5,11). Consequently, the function of ticks as vectors underscores the necessity of their management, which is crucial for enhancing livestock output and alleviating the impact of zoonotic diseases.

There have been no thorough investigations into tick infestation and its seasonal distribution in Kolhapur district, resulting in a lack of foundational epidemiological data. This study was conducted to survey three geographically distinct tehsils of Kolhapur. In each tehsil, a selection of 10 villages was made, and from each village, five farmer cattle sheds/sites were examined, resulting in a comprehensive coverage of 30 villages and 150 sites. Data were meticulously documented over three distinct seasons (winter, summer, and monsoon) for two consecutive years, facilitating a comprehensive evaluation of the spatial and seasonal dynamics of tick infestation. This study presents the inaugural district-level dataset on tick prevalence in Kolhapur, delivering essential insights for the development of integrated tick management strategies and livestock health planning in the area.

II. MATERIAL AND METHODS

Study area

The investigation took place in the Kolhapur district of Maharashtra, situated in the western part of India (16°40’–17°40’ N latitude and 73°40’–74°40’ E longitude). The area experiences a tropical monsoon climate characterized by three distinct seasons: summer from February to May, monsoon from Jun to September, and winter from October to January. Kolhapur stands out as a significant district for livestock rearing, where cattle and buffaloes constitute the majority of the population.



Site selection

Three tehsils in the Kolhapur district were chosen according to their geographical distribution and the density of livestock present. A total of 30 villages were selected, with 10 representative villages chosen from each tehsil. In every village, a total of five cattle sheds or farm sites were examined, encompassing 150 farmer sheds. Data on tick infestations were gathered over a span of two consecutive years (2022–2024) throughout the three primary seasons: summer, monsoon, and winter. This stratified sampling facilitated the evaluation of spatial and seasonal variations in tick occurrence.

Collection of Ticks

Ticks were meticulously gathered from various body areas of cattle and buffaloes with the use of blunt forceps, prioritizing the comfort of the host animals. The gathered ticks were preserved in 70% ethanol and transported to the laboratory for additional analysis. Morphological identification was conducted using a stereomicroscope in accordance with established taxonomic keys (8,22). Ticks were classified through the examination of morphological features including scutum shape, mouthparts, and leg ornamentation.

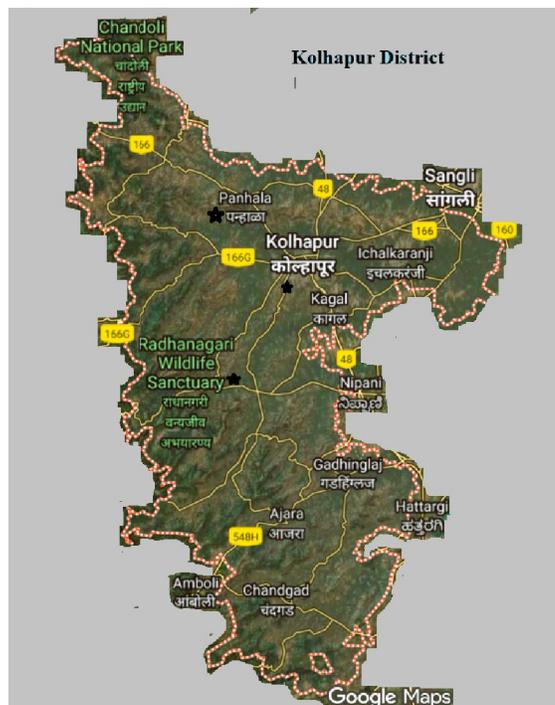


Figure 2

Data analysis

At each site, we documented the total number of animals examined, the quantity of ticks collected, and the season during which the collection took place. All the data were collected and compiled in prescribed format using Excel. ANOVA and t-test were also performed.

III. RESULT AND DISCUSSION

During the winter season (2022), the mean percent infestation of ticks recorded across the three tehsils disclosed noticeable variation. The tick infestation was found to be highest in Radhanagari (59.20%), followed by Panhala (57.25%) and Karvir (51.88%). The analysis of variance (ANOVA) indicated a statistically significant difference



among the three regions ($P = 0.0316$), suggesting that geographical location and associated ecological conditions influenced the infestation intensity. Pairwise t-test comparisons further revealed that the difference between Karvir and Radhanagari was statistically significant ($P \geq 0.01$) representing that Radhanagari experienced significantly higher infestation levels. In contrast, differences between Radhanagari and Panhala ($P \leq 0.081$) and between Karvir and Panhala ($P \leq 0.4585$) were statistically non-significant, implying that infestation levels in these regions were comparable. The tick infestation percentages during summer season(2023) varied significantly. The maximum mean infestation was recorded in Karvir (57.84%), followed by Radhanagari (54.22%). However, the lowest infestation was noticed in Panhala (44.96%). Statistical analysis using ANOVA revealed a highly significant difference ($P = 0.00000396$) among the tehsils, confirming that geographical and environmental conditions had a marked impact on infestation levels. Pairwise t-test analysis indicated that the difference between Karvir and Radhanagari ($P \leq 0.11778$) was not significant, suggesting similar infestation patterns in these areas. However, infestation levels in Karvir and Radhanagari were significantly higher than in Panhala ($P \geq 0.0000134$ and $P \geq 0.0001614$, respectively). This indicates that Panhala experienced substantially lower infestation during the summer months.

During the monsoon season (2023), the highest mean infestation was recorded in Radhanagari (48.34%), followed by Panhala (43.06%) and Karvir (40.70%). The ANOVA test revealed a significant difference ($P = 0.024532$) among the tehsils, indicating that local environmental and climatic factors influenced the distribution of infestations. Pairwise t-test results showed a significant difference between Karvir and Radhanagari ($P \geq 0.006$), suggesting that the Radhanagari region experienced more favourable conditions for parasite survival and spread. However, the differences between Radhanagari and Panhala ($P \leq 0.3982$) and between Karvir and Panhala ($P \leq 0.07$) were statistically non-significant, implying broadly similar infestation levels between these regions. During the next year investigation, in the winter season (2023), the mean infestation of ticks was maximum in Radhanagari (70.16%), followed by Karvir (63.50%) and Panhala (62.22%). ANOVA results indicated a significant difference ($P = 0.001053$) among the tehsils, confirming that local environmental and climatic factors had a substantial influence on infestation prevalence. Pairwise t-test analysis revealed that the difference between Karvir and Radhanagari ($P \geq 0.022635$) and between Karvir and Panhala ($P \geq 0.0146$) were statistically significant, suggesting a clear spatial variation in infestation levels. However, the difference between Radhanagari and Panhala ($P \leq 0.2821$) was non-significant, indicating similar infestation intensities in these two tehsils. The tick infestation levels during the summer season of 2024, showed a clear variation among the three tehsils. The highest mean infestation was observed in Radhanagari (66.20%), followed by Karvir (63.50%). In contrast, Panhala tehsil (53.50%) recorded the lowest infestation. ANOVA results revealed a highly significant difference ($P = 0.000359$) among the tehsils, suggesting that the variation in infestation was strongly influenced by local climatic and ecological conditions. Pairwise t-test analysis indicated no significant difference between Karvir and Radhanagari ($P \leq 0.3725$), implying similar infestation patterns in both regions. However, infestation levels in Karvir and Radhanagari were significantly higher than in Panhala ($P \geq 0.00095$ and $P \geq 0.00077$, respectively), indicating a consistent trend of lower infestation in the hilly and cooler environment of Panhala.

During the monsoon season of 2024, the highest mean infestation of ticks was recorded in Radhanagari (55.54%), while Karvir (50.45%) and Panhala (50.71%) exhibited almost comparable infestation levels. The ANOVA test revealed a highly significant difference ($P = 0.000298$) among the three tehsils, confirming that infestation was influenced by locational and ecological differences. Pairwise t-test results indicated a significant difference between Karvir and Radhanagari ($P \leq 0.052083$) and between Radhanagari and Panhala ($P \geq 0.011757$), showing that Radhanagari had consistently higher infestation. A highly significant difference between Karvir and Panhala ($P \geq 0.000458$) also suggested variation between these regions, possibly due to differences in altitude, temperature, and humidity. The seasonal data across both years clearly validate the ecological adaptability of ticks to local climatic variations. The Radhanagari tehsils consistently showed the highest overall infestation, confirming that forest ecosystems with high humidity and dense vegetation favour tick survival and transmission. In contrast, Panhala's high-altitude, cooler environment exhibited moderate infestation during most seasons, while Karvir showed fluctuating but significant infestation linked to intensive livestock movement and grazing. Seasonal variation in tick infestation across



the study area was closely linked to local environmental conditions. Karvir showed high summer infestation due to irrigated agriculture, which maintained soil moisture and humidity, favouring tick survival. In contrast, Radhanagari and Panhala exhibited peak infestation during winter, associated with dense forest cover, high humidity, and the presence of wildlife reservoirs such as bison and deer, which support continuous tick transmission. A clear monsoon decline was observed across all regions, as heavy rainfall and waterlogging disrupted tick life cycles; however, forested areas sustained moderate populations due to sheltered, humid microhabitats. These findings highlight the strong influence of microclimate, vegetation, and host availability on seasonal tick dynamics. According to the findings, peak tick activity occurred between November and February, whereas the lowest infestation was recorded in May and June (19). Infestation of ticks to the animals were throughout the year (13,14). Tick infestation is a serious parasite issue that affects cattle in Maharashtra. The frequency varies significantly depending on the region, time of year, and breed (16). As in previous findings from the districts of Kolhapur, Marathwada, and Nagpur, the most common tick species was *Rhipicephalus (Boophilus) microplus*, which was followed by *Hyalomma anatolicum* and *Haemaphysalis bispinosa*. The monsoon and post-monsoon seasons, which offer ideal humidity and temperature conditions for tick reproduction, were shown to have the highest infection intensity. Because they have thinner skin and less natural resistance, crossbred and exotic cattle were more vulnerable than native varieties. These results align with the molecular identified several tick-borne pathogens in Maharashtra cattle, including *Babesia bigemina*, *Anaplasma marginale*, and *Theileria annulata*. Reduced body condition and milk yield were linked to high infection levels, underscoring the financial significance of efficient tick treatment. The necessity for integrated tick management tactics that incorporate chemical, biological, and environmental approaches is highlighted by the emergence of resistance brought about by farmers' regular use of chemical acaricides. Tick populations in the area may be sustainably controlled by implementing routine monitoring, acaricide rotation, and the application of botanical or herbal formulations.

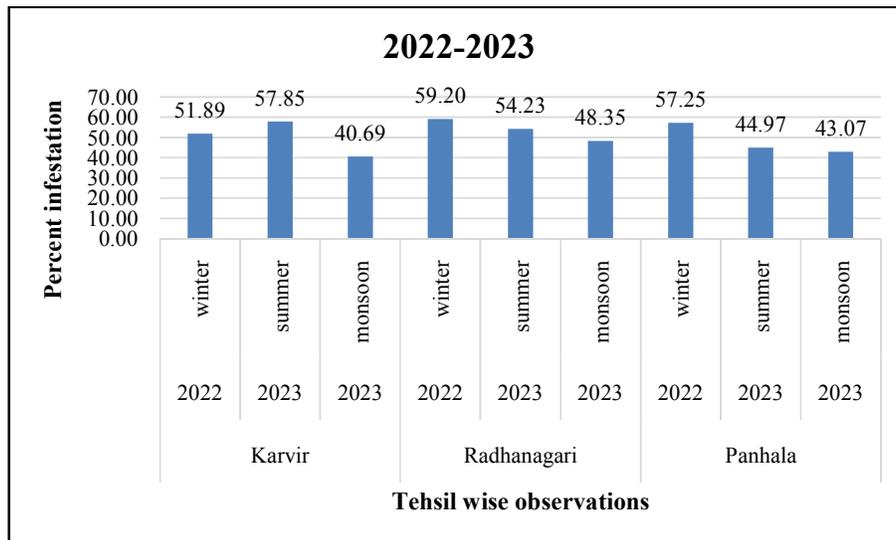


Fig. 1. Graphical representation of tick's infestation in selected tehsil of Kolhapur across various seasons during 2022-23.



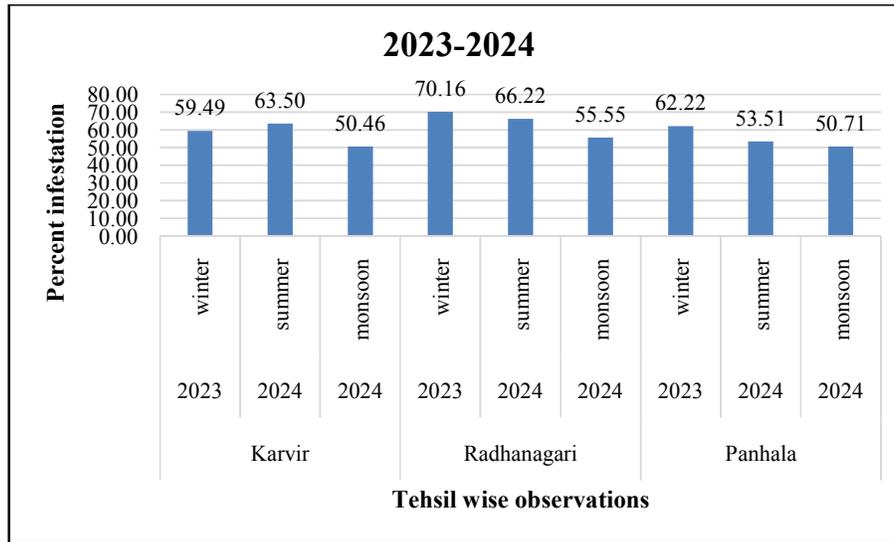


Fig. 2. Graphical representation of tick's infestation in selected tehsil of Kolhapur across various seasons during 2023-24.

IV. CONCLUSION

The study concludes that tick infestation among cattle in Kolhapur district follows a distinct seasonal rhythm, with summer being the peak season for tick infestation and Radhanagari tehsils showing the highest prevalence across both years. Regular monitoring and strategic tick control before the summer onset can effectively minimize economic losses and vector-borne disease's transmission in the region.

ACKNOWLEDGEMENTS

The Author is thankful to the Department of Zoology, The Institute of Science, Dr. Homi Bhabha State University, Mumbai for providing technical support.

Conflict of Interest

Authors declare no conflict of interest.

REFERENCES

- [1]. Ajith Kumar, K. G., Ravindran, R., Johns, J., Chandy, G., Rajagopal, K., Chandrasekhar, L., Jacob George, A., & Ghosh, S. (2018). Ixodid Tick Vectors of Wild Mammals and Reptiles of Southern India. *Journal of Arthropod-Borne Diseases*. <https://doi.org/10.18502/jad.v12i3.79>
- [2]. Ayyavu, V., Nallan, K., Ayyanar, E., Thirupathi, B., Kumar, A., & Rajaiah, P. (2024). Distribution of ixodid tick species parasitizing livestock in Sirumalai, The Eastern Ghats of Tamil Nadu, South India and its implications for public health. *Acarological Studies*, 6(1), 1–8. <https://doi.org/10.47121/acarolstud.1352496>
- [3]. Balasubramanian, R., Yadav, P. D., Sahina, S., & Arathy Nadh, V. (2019). Distribution and prevalence of ticks on livestock population in endemic area of Kyasanur forest disease in Western Ghats of Kerala, South India. *Journal of Parasitic Diseases*, 43(2), 256–262. <https://doi.org/10.1007/s12639-019-01086-7>
- [4]. Bhangale, G. N., & Narladkar, B. W. (2023). Study of distribution of Rhipicephalus microplus ticks in India based on Worldclim temperature and rainfall data through an ecological niche modeling approach. *Journal of Applied and Natural Science*, 15(2), 777–782. <https://doi.org/10.31018/jans.v15i2.4561>



- [5]. De La Fuente, J., Estrada-Peña, A., Rafael, M., Almazán, C., Bermúdez, S., Abdelbaset, A. E., Kasajja, P. D., Kabi, F., Akande, F. A., Ajagbe, D. O., Bamgbose, T., Ghosh, S., Palavesam, A., Hamid, P. H., Oskam, C. L., Egan, S. L., Duarte-Barbosa, A., Hekimoğlu, O., Szabó, M. P. J., ... Dahal, A. (2023). Perception of Ticks and Tick-Borne Diseases Worldwide. *Pathogens*, 12(10), 1258. <https://doi.org/10.3390/pathogens12101258>
- [6]. Fentahun, G., Bizuayehu, F., & Dubie, T. (2023). Study on Identification and Prevalence of Ixodid Ticks Genera Infestation in Cattle in the Case of Areka District, Wolaita Zone, and Southern Ethiopia. *Journal of Parasitology Research*, 2023, 1–6. <https://doi.org/10.1155/2023/6389473>
- [7]. Frean, J., Blumberg, L., & Ogunbanjo, G. (2008). Tick bite fever in South Africa. *South African Family Practice*, 50(2), 33–35. <https://doi.org/10.1080/20786204.2008.10873689>
- [8]. Geevarghese, G., & Dhanda, V. (n.d.). *Ixodid ticks of Maharashtra State, India*.
- [9]. Ghosh, S., Azhahianambi, P., & De La Fuente, J. (2006). Control of ticks of ruminants, with special emphasis on livestock farming systems in India: Present and future possibilities for integrated control—a review. *Experimental & Applied Acarology*, 40(1), 49–66. <https://doi.org/10.1007/s10493-006-9022-5>
- [10]. Ghosh, S., Bansal, G. C., Gupta, S. C., Ray, D., Khan, M. Q., Irshad, H., Shahiduzzaman, Md., Seitzer, U., & Ahmed, J. S. (2007). Status of tick distribution in Bangladesh, India and Pakistan. *Parasitology Research*, 101(S2), 207–216. <https://doi.org/10.1007/s00436-007-0684-7>
- [11]. Jongejan, F., & Uilenberg, G. (2004). The global importance of ticks. *Parasitology*, 129(S1), S3–S14. <https://doi.org/10.1017/s0031182004005967>
- [12]. Kaba, T. (2022). Geographical distribution of ixodid ticks and tick-borne pathogens of domestic animals in Ethiopia: A systematic review. *Parasites & Vectors*, 15(1), 108. <https://doi.org/10.1186/s13071-022-05221-x>
- [13]. Kumar, K., Balakrishnan, N., & Sharma, A. K. (2014). Studies on the Vertical Distribution of Ticks of Domestic Animals and Their Public Health Importance in Nilgiri Hills and Adjoining Areas of Tamil Nadu State (India). *International Journal of Zoology*, 2014, 1–6. <https://doi.org/10.1155/2014/359812>
- [14]. Kumar, S., Singh, A., Cossio-Bayugar, R., Moradi-Asl, E., Singh, D., & Chaubey, A. K. (2023). Diversity and Seasonal Distribution of Hard Ticks in Livestock Animal Population from Western part of Uttar Pradesh in India. *Acta Scientifica Veterinaria Sciences*, 5(4), 73–84. <https://doi.org/10.31080/ASVS.2023.05.0633>
- [15]. Ma, R., Li, C., Gao, A., Jiang, N., Li, J., Hu, W., & Feng, X. (2024). Tick species diversity and potential distribution alternation of dominant ticks under different climate scenarios in Xinjiang, China. *PLOS Neglected Tropical Diseases*, 18(4), e0012108. <https://doi.org/10.1371/journal.pntd.0012108>
- [16]. Narantsatsral, S., Myagmarsuren, P., Davaasuren, P., Enkhtaivan, B., Battsetseg, B., & Battur, B. (2015). Molecular biological detection of emerging tick-borne zoonotic pathogens in Ixodid tick species. *Mongolian Journal of Agricultural Sciences*, 13(2), 37–41.
- [17]. Pages, F., Dautel, H., Duvallet, G., Kahl, O., De Gentile, L., & Boulanger, N. (2014). Tick Repellents for Human Use: Prevention of Tick Bites and Tick-Borne Diseases. *Vector-Borne and Zoonotic Diseases*, 14(2), 85–93. <https://doi.org/10.1089/vbz.2013.1410>
- [18]. Pandit, P., Bandivdekar, R., Geevarghese, G., Pande, S., & Mandke, O. (2011). Tick Infestation on Wild Snakes in Northern Part of Western Ghats of India. *Journal of Medical Entomology*, 48(3), 504–507. <https://doi.org/10.1603/me10164>
- [19]. Patel, G., Shanker, D., Jaiswal, A. K., Sudan, V., & Verma, S. K. (2013). Prevalence and seasonal variation in ixodid ticks on cattle of Mathura district, Uttar Pradesh. *Journal of Parasitic Diseases*, 37(2), 173–176. <https://doi.org/10.1007/s12639-012-0154-8>
- [20]. Petros, A., Befekadu, U. W., Mulisa, M., & Teka, F. (2015). In vitro and in vivo acaricidal efficacy study of amitraz and diazinon against some tick species infesting *Camelus dromedarius* around Jigjiga, Eastern Ethiopia. *African Journal of Pharmacy and Pharmacology*, 9(34), 850–855. <https://doi.org/10.5897/ajpp2015.4425>



- [21]. Singh, C. B., Renkema, J. A., & Dhaka, J. P. (n.d.). Income And Employment Potential Of Dairy, Crop And Mixed Farming Systems On Small Farms.
- [22]. Singh, N. K., & Rath, S. S. (2013). Epidemiology of ixodid ticks in cattle population of various agro-climatic zones of Punjab, India. *Asian Pacific Journal of Tropical Medicine*, 6(12), 947–951. [https://doi.org/10.1016/s1995-7645\(13\)60169-8](https://doi.org/10.1016/s1995-7645(13)60169-8)
- [23]. Walker, A. R. (2011). Eradication and control of livestock ticks: Biological, economic and social perspectives. *Parasitology*, 138(8), 945–959. <https://doi.org/10.1017/s0031182011000709>

