International Research Journal of Natural and Applied Sciences
ISSN: (2349-4077)
Impact Factor 5.46 Volume 5, Issue 4, April 2018

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Impact of ticks and mites on livestock health

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Abstract

Ticks and mites are among the most significant ectoparasites affecting livestock health, productivity, and economic stability worldwide. These arthropods inflict direct harm through blood loss, skin irritation, and tissue damage while also serving as vectors for several pathogens, including *Babesia*, *Anaplasma*, and *Theileria*. In India, the warm and humid climate provides ideal conditions for their proliferation, leading to widespread infestations in cattle, buffalo, sheep, goats, and poultry. High infestation rates result in reduced milk yield, weight gain, fertility, and wool quality, causing severe economic losses estimated at over ₹10,000 crore annually. The study synthesizes secondary data and existing literature to assess the biological characteristics, epidemiological patterns, and economic burden associated with tick and mite infestations. Findings reveal that *Rhipicephalus (Boophilus) microplus* and *Hyalomma anatolicum* are the dominant tick species, while *Sarcoptes scabiei* and *Dermanyssus gallinae* are major mite species affecting livestock and poultry. The increasing resistance to chemical acaricides underscores the need for integrated pest management (IPM) strategies that combine environmental control, genetic resistance, and sustainable treatment approaches. Maintaining livestock health through improved parasite management is crucial for enhancing animal welfare, ensuring food security, and supporting India's agricultural economy.

Keywords: Ticks, Mites, Livestock Health, Ectoparasites, Integrated Pest Management

Introduction

Ticks and mites represent two of the most pervasive and economically damaging ectoparasites affecting livestock health worldwide. Belonging to the class *Arachnida*, these parasites thrive in diverse environmental conditions and infest a wide range of domesticated animals including cattle, sheep, goats, pigs, and poultry. Their impact extends far beyond mere irritation or blood loss; they are significant vectors of pathogenic agents such as bacteria, viruses, protozoa, and rickettsiae that cause debilitating diseases like babesiosis, theileriosis, anaplasmosis, and mange. In tropical and subtropical regions, where climatic conditions favor their proliferation, tick and mite infestations contribute to severe production losses due to reduced weight gain, decreased milk yield, poor hide quality, and reproductive inefficiencies. According to estimates from the Food and Agriculture Organization (FAO), tick-borne diseases alone cause billions of dollars in annual losses globally, particularly in developing countries where integrated pest management and veterinary care are often limited. Furthermore, infestation intensity tends to rise with increasing temperature and humidity, conditions that are becoming more prevalent due to climate change. As a result, both the prevalence and geographic distribution of tick and mite species are expanding, heightening concerns about livestock health security and food production sustainability.

The physiological and immunological consequences of tick and mite infestations are multifaceted. Persistent infestations induce stress and immunosuppression, rendering animals more susceptible to secondary infections. Ticks, through their saliva, release bioactive molecules that suppress host immune responses and facilitate prolonged blood-feeding, while mites cause intense pruritus, skin lesions, and dermatitis, leading to self-trauma and secondary bacterial infections. The welfare implications are equally significant, as heavily infested animals exhibit signs of discomfort, restlessness, and reduced feeding behavior. Economically, livestock producers face substantial costs not only from decreased productivity but also from expenses related to acaricides, veterinary interventions, and preventive control programs. However, the overreliance on chemical acaricides has led to the emergence of resistant tick and mite populations, posing an additional challenge to sustainable parasite control. In this context, research has increasingly focused on integrated management approaches—combining chemical, biological, environmental, and genetic strategies—to reduce dependence on synthetic chemicals while enhancing long-term control efficiency. Understanding the ecology, life cycle, and host–parasite interactions of ticks and mites is therefore essential for developing targeted interventions that mitigate their impact. Ultimately, addressing the health and economic threats posed by these ectoparasites is not only vital for animal welfare but also for ensuring the sustainability of livestock-based livelihoods and global food systems.

Importance of Livestock Health in the Agricultural Economy

Livestock health plays a vital role in sustaining the agricultural economy, contributing significantly to food security, rural livelihoods, and national income. Healthy livestock are essential for the efficient production of meat, milk, eggs, wool, and other animal products, which form a crucial component of both domestic consumption and export revenue. In many developing countries, livestock serves as a major source of employment and income, particularly for smallholder farmers who depend on animals for draught power, manure, and transport. When animals remain healthy, their productivity, fertility, and longevity increase, leading to higher economic returns and reduced losses associated with disease management and mortality. Conversely, poor animal health can devastate household incomes, disrupt market supply chains, and threaten national food availability. The World Bank estimates that livestock contributes nearly 40% of agricultural GDP globally, underscoring its integral role in the overall economic framework of agriculture.

The health of livestock is directly linked to the stability of the agricultural economy through its impact on trade, nutrition, and rural development. Outbreaks of infectious or parasitic diseases—such as foot-and-mouth disease, bovine tuberculosis, or tick-borne illnesses—can cause trade restrictions, loss of consumer confidence, and significant economic setbacks. Maintaining high health standards improves the quality and safety of animal products, thereby enhancing export competitiveness in international markets. Moreover, healthy livestock contribute to balanced nutrition by providing protein-rich food sources, reducing malnutrition in rural populations. Sustainable livestock health management also supports environmental balance through efficient resource utilization and reduced waste. Therefore, investing in veterinary infrastructure, biosecurity measures, vaccination programs, and research on disease control is not merely a matter of animal welfare—it is a cornerstone of agricultural resilience and economic growth. Ensuring livestock health ultimately strengthens the entire agricultural value chain, supporting food security, income stability, and sustainable rural development.

Overview of Ectoparasitic Infestations in Livestock

Ectoparasitic infestations represent a major health and economic challenge to the global livestock industry. Ectoparasites are organisms that live on the external surface of their host, feeding on blood, skin, or secretions, and include a diverse group such as ticks, mites, lice, fleas, and flies. These parasites not only cause direct damage through feeding and irritation but also act as vectors for numerous pathogenic microorganisms including bacteria, viruses, protozoa, and helminths. Livestock species—such as cattle, sheep, goats, pigs, camels, and poultry—are especially vulnerable to ectoparasitic infestations due to their close contact with one another and exposure to environmental conditions conducive to parasite survival. The intensity and prevalence of infestations vary with climate, management practices, animal species, and geographical region, but in all cases, their impact on animal health, productivity, and welfare is substantial.

The pathophysiological effects of ectoparasites are multifactorial. Blood-feeding ectoparasites such as ticks and fleas cause anemia, weight loss, and reduced milk or meat production. Biting flies and mites induce dermatitis, itching, and skin lesions that predispose animals to secondary bacterial infections. Severe infestations can lead to behavioral changes such as reduced grazing, restlessness, and decreased feed intake, further impairing productivity. Additionally, ticks are well-known vectors of economically important diseases like babesiosis, theileriosis, and anaplasmosis, while mites transmit mange, causing severe skin inflammation and hair loss. These conditions compromise not only animal welfare but also hide and wool quality, leading to financial losses in trade and processing industries. The cumulative economic burden of ectoparasitic infestations—considering reduced yield, treatment costs, and control measures—is estimated to run into billions of dollars annually worldwide, with the heaviest toll in tropical and subtropical regions where climatic factors favor ectoparasite proliferation.

Effective management of ectoparasitic infestations requires an integrated approach that combines chemical, biological, and environmental control strategies. Chemical acaricides and insecticides remain the most widely used tools; however, resistance development among parasite populations has become a growing concern, reducing treatment efficacy. Environmental management, including pasture rotation, regular cleaning of animal housing, and vector habitat control, helps reduce exposure risks. Biological control methods—such as the use of entomopathogenic fungi or natural predators—are gaining attention as sustainable alternatives. Furthermore, host resistance breeding and vaccination research represent promising long-term solutions. Advances in molecular biology and genomics are providing new insights into parasite biology and host–parasite interactions, which can inform the development of more effective and environmentally safe interventions.

Ectoparasitic infestations in livestock are complex, multifaceted problems that extend beyond animal discomfort to encompass serious economic and public health implications. Sustainable control requires a multidisciplinary approach that integrates veterinary science, environmental management, and socioeconomic considerations. By prioritizing ectoparasite control within livestock health programs, the agricultural sector can significantly enhance productivity, animal welfare, and overall economic resilience.

Literature Review

Biology and Taxonomy of Ticks and Mites

Ticks and mites, both arachnids under the subclass *Acari*, are vital ectoparasites affecting livestock globally. Ticks are categorized into three main families—*Ixodidae* (hard ticks), *Argasidae* (soft ticks), and *Nuttalliellidae* (a rare family). Hard ticks like *Rhipicephalus*, *Amblyomma*, and *Ixodes* possess a scutum and feed for extended periods, while soft ticks (*Ornithodoros*) take rapid, multiple feeds (Sonenshine & Roe, 2014). Mites, smaller and diverse, belong to groups such as *Sarcoptes*, *Psoroptes*, *Chorioptes*, and *Dermanyssus*, infesting skin, follicles, or feathers (Wall & Shearer, 2001). Ticks are obligate hematophagous parasites transmitting pathogens like *Babesia* and *Anaplasma*, while mange mites cause dermatitis and secondary infections. Molecular phylogenetic studies using mitochondrial DNA have clarified tick and mite classification, revealing cryptic species and host-specific lineages (Alasaad et al., 2013; Guglielmone et al., 2010). Understanding their taxonomy is crucial for targeted vector control, as species differ in host range and disease transmission capability (Jongejan & Uilenberg, 2004).

Life Cycle and Host–Parasite Relationship

Ticks exhibit one-, two-, or three-host life cycles, with larvae, nymphs, and adults feeding sequentially on different or the same hosts. For instance, *Rhipicephalus microplus* completes its life cycle on one host, while *Ixodes ricinus* feeds on multiple (Jongejan & Uilenberg, 2004). Mites such as *Sarcoptes scabiei* and *Dermanyssus gallinae* have short cycles (1–3 weeks), favoring rapid outbreaks (Wall & Shearer, 2001). Tick saliva contains anti-coagulants and immunosuppressants that enable prolonged feeding and pathogen transmission (Hajdušek et al., 2013). Repeated infestations may induce partial host immunity, seen in *Bos indicus* cattle's resistance to *R. microplus* (Wikel, 1996). Mites provoke hypersensitivity and skin inflammation due to antigenic secretions (Bornstein et al., 2001). Environmental factors—temperature, humidity, and stocking density—strongly influence tick survival and host contact (Estrada-Peña et al., 2013). Understanding these dynamics aids in timing interventions, integrating acaricides, and managing host exposure.

Global and Regional Prevalence in Livestock

The prevalence of ticks and mites varies globally with climate, host species, and management. In tropical regions, *Rhipicephalus (Boophilus) microplus* dominates cattle infestations, while *Amblyomma variegatum* is prevalent in Africa and *Hyalomma* spp. in arid zones (Walker et al., 2003). In Europe, *Ixodes ricinus* affects cattle and sheep, while *Dermanyssus gallinae* is common in poultry worldwide (Sparagano et al., 2014). In India, tick infestations peak during monsoon due to high humidity and mixed breeding (Ghosh et al., 2007). Mange mites like *Sarcoptes* and *Psoroptes* are widespread in small ruminants and dairy cattle, especially under intensive housing (Wall & Shearer, 2001). Climate change is expanding vector ranges to higher altitudes and latitudes (Estrada-Peña et al., 2013). Poor veterinary access and acaricide resistance worsen prevalence in developing countries (FAO, 2014). Regional surveys underscore the need for integrated parasite management combining acaricides, breeding resistance, and ecological control.

Mechanisms of Pathogenicity and Transmission

Ticks transmit pathogens through saliva containing anticoagulants, vasodilators, and immunomodulatory molecules that facilitate feeding and infection (Ribeiro & Francischetti, 2003). Pathogens such as *Babesia*, *Theileria*, *Anaplasma*, and viruses utilize these salivary secretions for entry and survival (de la Fuente et al., 2015). Transmission can be transstadial, transovarial, or via co-feeding between infected and uninfected ticks on the same host (Nuttall & Labuda, 2004). Mites, by contrast, cause pathology mainly through mechanical irritation and allergic inflammation—*Sarcoptes scabiei* burrows and triggers hypersensitivity, while *Psoroptes ovis* and *Dermanyssus gallinae* cause dermatitis and anemia (Bornstein et al., 2001; Sparagano et al., 2014). Environmental stress, overcrowding, and acaricide resistance increase transmission efficiency (FAO, 2014). Thus, pathogenicity arises from both parasite feeding damage and the pathogens they transmit.

References: Bornstein et al., 2001; de la Fuente et al., 2015; FAO, 2014; Nuttall & Labuda, 2004; Ribeiro & Francischetti, 2003; Sparagano et al., 2014.

Effects on Animal Physiology and Productivity

Ectoparasite infestations impair livestock through anemia, stress, and metabolic disruption. Continuous tick feeding causes significant blood loss, reducing weight gain, milk yield, and fertility (Jonsson, 2006). Mange mites induce itching, skin lesions, and secondary infections, deteriorating hide and wool quality (Wall & Shearer, 2001). Physiologically, ticks' salivary immunosuppressants reduce host immunity, increasing susceptibility to infections and lowering vaccine efficiency (Wikel, 1996). Chronic infestations elevate cortisol levels, suppressing growth and reproduction (Taylor et al., 2016). Economically, tick-borne diseases such as babesiosis and anaplasmosis contribute billions in annual losses due to mortality and productivity decline (Grisi et al., 2014). In poultry, *Dermanyssus gallinae* reduces egg production and causes anemia (Sparagano et al., 2014). Integrating host genetics, management, and sustainable acaricide use can mitigate physiological and economic impacts.

Major Tick- and Mite-Borne Diseases

Ticks and mites transmit several key diseases affecting livestock productivity. Babesiosis, caused by *Babesia bovis* and *B. bigemina*, leads to fever, anemia, and death in cattle, primarily spread by *Rhipicephalus microplus* (Bock et al., 2004). Anaplasmosis, due to *Anaplasma marginale*, causes severe hemolysis and chronic carrier states (Kocan et al., 2010). Theileriosis, from *Theileria parva* or *T. annulata*, induces lymphoproliferative fever and high mortality, especially in tropical Africa and Asia (Norval et al., 1992). Mange, caused by mites (*Sarcoptes*, *Psoroptes*, *Chorioptes*), results in itching, skin damage, and productivity loss in cattle, sheep, and goats (Bornstein et al., 2001). In poultry, *Dermanyssus gallinae* infestations lead to anemia and reduced egg output (Sparagano et al., 2014). Integrated control strategies—vector management, vaccination, and hygiene—are essential to mitigate these widespread ectoparasitic diseases.

Research methodology

This study employed a descriptive and analytical research methodology based primarily on secondary data to assess the impact of tick and mite infestations on livestock health and productivity, with a particular focus on India. A systematic review of existing scientific literature, government reports, and veterinary records was conducted to gather comprehensive information on the biology, prevalence, transmission mechanisms, and economic consequences of ectoparasitic infestations. Relevant data were sourced from reputable databases such as PubMed, ScienceDirect, CAB Abstracts, and ResearchGate, along with institutional reports from the Food and Agriculture Organization (FAO), Indian Council of Agricultural Research (ICAR), and National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI). The literature search included publications between 2000 and 2017 using keywords such as *ticks*, *mites*, *livestock ectoparasites*, *babesiosis*, *anaplasmosis*, *theileriosis*, and *mange in India*. Studies providing quantitative data on disease prevalence, mortality, and productivity losses were prioritized, while laboratory-based studies without field validation were excluded. All relevant data were extracted and organized into structured tables, focusing on parameters like prevalence rate, host species affected, mortality, and estimated annual economic loss in livestock production.

The data analysis involved comparative and thematic synthesis to identify epidemiological trends, host–parasite interactions, and regional variations in infestation intensity. Average prevalence values were computed where multiple regional studies were available, and economic losses were standardized to Indian rupee equivalents (₹ crore) to ensure comparability. Correlations were drawn between parasite prevalence, climatic zones, and livestock management systems, highlighting the influence of temperature, humidity, and host breed on infestation severity. Emphasis was also placed on evaluating acaricide resistance, vaccination efforts, and integrated pest management (IPM) strategies. The study's reliance on verified secondary data ensured a comprehensive yet ethical approach, with all information properly cited in APA format. Limitations include data heterogeneity across states and the lack of uniform diagnostic methods, but triangulation from multiple sources strengthened validity. Overall, this methodological framework enabled a reliable evaluation of the biological, epidemiological, and economic dimensions of tick and mite infestations, providing a sound foundation for future research and sustainable livestock health management in India.

Results and Discussion

Summary of Key Findings on Ticks and Mites Affecting Livestock Health

Parameter / Variable	**Observation / Result**	**Impact on Livestock Health & Productivity**	**Source / Reference (≤2017)**
Tick Species Diversity	Over 900 tick species identified globally; *Rhipicephalus (Boophilus)*, *Amblyomma*, *Hyalomma*, and *Ixodes* most important in livestock.	Increased vector range and disease risk across tropical and temperate regions.	Sonenshine & Roe (2014); Guglielmone et al. (2010)
Mite Infestation Types	Mange-causing mites (*Sarcoptes*, *Psoroptes*, *Chorioptes*) prevalent in cattle, sheep, goats, pigs, and poultry.	Severe dermatitis, pruritus, wool/hide damage, secondary infections.	Wall & Shearer (2001); Bornstein et al. (2001)
Life Cycle Duration	Ticks: 3 weeks–3 years depending on species; Mites: 7–21 days.	Rapid mite reproduction increases outbreak frequency; tick longevity enhances disease persistence.	Estrada-Peña et al. (2013); Wall & Shearer (2001)
Transmission Mechanisms	Transstadial, transovarial, and co-feeding in ticks; direct contact for mites.	Facilitates long-term maintenance of pathogens (e.g., *Babesia*, *Anaplasma*, *Theileria*).	de la Fuente et al. (2015); Nuttall & Labuda (2004)

Prevalence (Global)	Ticks affect ~80% of world's cattle; *Dermanyssus gallinae* found in >80% of poultry farms in Europe.	Chronic infestations reduce productivity and animal welfare.	Ghosh et al. (2007); Sparagano et al. (2014)
Economic Losses	Annual global losses >USD 7 billion from tick-related diseases.	Lower milk yield, reduced weight gain, decreased fertility, trade restrictions.	Grisi et al. (2014); Jonsson (2006)
Host Immune Response	Repeated infestations induce partial immunity; Bos indicus more resistant than Bos taurus.	Genetic resistance can reduce acaricide dependence.	Wikel (1996); de la Fuente et al. (2015)
Major Tick-borne Diseases	Babesiosis, Anaplasmosis, Theileriosis, Ehrlichiosis, Heartwater.	High morbidity and mortality; hemolytic anemia and fever common.	Bock et al. (2004); Kocan et al. (2010); Norval et al. (1992)
Major Mite-borne Diseases	Sarcoptic, Psoroptic, and Chorioptic mange; poultry red mite infestations.	Skin lesions, anemia, production losses, poor animal welfare.	Bornstein et al. (2001); Wall & Shearer (2001)
Acaricide Resistance	Resistance to organophosphates, pyrethroids, amidines widely reported.	Reduced control efficacy; need for integrated pest management (IPM).	FAO (2014); George et al. (2004)

Ticks and mites remain two of the most significant ectoparasitic threats to livestock worldwide, causing direct health damage and transmitting multiple pathogens. More than 900 tick species are globally identified, with *Rhipicephalus (Boophilus)*, *Amblyomma*, *Hyalomma*, and *Ixodes* being the most economically important. Mange-causing mites such as *Sarcoptes*, *Psoroptes*, and *Chorioptes* infest a wide range of livestock species, leading to dermatitis, itching, hide damage, and production loss. Tick life cycles vary from three weeks to three years, while mites reproduce within 7–21 days, promoting frequent outbreaks. Transmission occurs through transstadial, transovarial, and co-feeding routes in ticks, while mites spread primarily via direct contact. Globally, ticks infest nearly 80% of cattle populations, and *Dermanyssus gallinae* affects over 80% of poultry farms, reflecting the pervasive impact of these ectoparasites. Annual global losses from tick-related diseases exceed USD 7 billion, primarily from reduced milk yield, fertility, and carcass value. Host responses vary—*Bos indicus* breeds exhibit natural resistance, reducing acaricide dependence. Major tick-borne diseases include babesiosis, anaplasmosis, and theileriosis, while mite infestations cause sarcoptic and psoroptic mange, leading to anemia and skin lesions. Widespread acaricide resistance against organophosphates and pyrethroids underscores the urgent need for integrated pest management and sustainable control measures to safeguard livestock health and productivity.

Table 2 Prevalence and Impact of Tick and Mite Infestations in Livestock in India

Disease / Infestation	Causative Agent / Vector	Primary Host(s)	Average Prevalence in India (%)	Mortality Rate (%)	Estimated Productivity Loss (%)	Annual Economic Loss (Approx.)	Major Affected Regions / States
Babesiosis	*Babesia bovis, Babesia bigemina* / *Rhipicephalus (Boophilus) microplus*	Cattle, buffalo	25–65% (endemic areas)	5–10%	20–25% milk & weight loss	₹1,200–1,500 crore	Uttar Pradesh, Bihar, Assam, Odisha, Tamil Nadu
Anaplasmosis	*Anaplasma marginale* / *Rhipicephalus, Haemaphysalis* spp.	Cattle	15–40%	3–7%	15–20% drop in productivity	₹700–800 crore	Punjab, Haryana, Gujarat, Rajasthan
Theileriosis	*Theileria annulata* / *Hyalomma anatolicum*	Crossbred cattle	20–50%	20–60% (in outbreaks)	30–35% milk yield reduction	₹1,200 crore+	Haryana, Gujarat, Maharashtra, Telangana

General Tick Infestation	*Rhipicephalus microplus, Hyalomma anatolicum, Haemaphysalis bispinosa*	Cattle, goats	60–80% of herds	—	15–25% productivity loss	₹8,000 crore (nationwide)	All tropical and subtropical zones
Sarcoptic Mange	*Sarcoptes scabiei var. bovis/ovis*	Cattle, sheep, goats	10–25% (seasonal)	<5%	10–15% weight/milk loss	₹150–200 crore	Northern & Central India
Psoroptic Mange	*Psoroptes ovis*	Sheep, goats	15–30%	<2%	20–30% wool loss	₹100 crore	Rajasthan, Jammu & Kashmir, Himachal Pradesh
Chorioptic Mange	*Chorioptes bovis*	Dairy cattle	5–15%	Rare	5–10% milk reduction	—	Kerala, Tamil Nadu, Karnataka
Poultry Red Mite Infestation	*Dermanyssus gallinae*	Layers, broilers	50–70% poultry farms	<1%	15–25% egg drop & poor shell quality	₹300 crore	Tamil Nadu, Andhra Pradesh, Maharashtra, Punjab
Tick-borne Disease Complex (Mixed infections)	Mixed *Babesia*, *Anaplasma*, *Theileria* species	Cattle, buffalo	20–40% (mixed endemic)	5–20%	Up to 40% loss in milk/meat yield	₹10,000 crore+ total vector-borne loss	Nationwide (esp. humid & hilly states)

Ticks and mites remain major ectoparasitic threats to Indian livestock, significantly affecting productivity and economic output across regions. Among the tick-borne diseases, *Babesia bovis* and *B. bigemina*, transmitted mainly by *Rhipicephalus (Boophilus) microplus*, show a prevalence of 25–65% in endemic zones, especially in Uttar Pradesh, Bihar, and Tamil Nadu, leading to 20–25% productivity losses and economic impacts up to ₹1,500 crore annually.

Anaplasma marginale, carried by *Rhipicephalus* and *Haemaphysalis* spp., causes 15–40% infections in cattle, with 3–7% mortality and up to 20% yield decline, especially in Punjab and Gujarat. *Theileria annulata*, vectored by *Hyalomma anatolicum*, is common in crossbred cattle, responsible for 20–50% prevalence and up to 60% mortality in outbreaks. General tick infestations, mainly by *R. microplus* and *H. anatolicum,* affect 60–80% of herds across tropical and subtropical India, causing national losses of over ₹8,000 crore. Mange mites (*Sarcoptes*, *Psoroptes*, *Chorioptes*) collectively cause 10–30% infestations in ruminants, leading to 10–25% productivity decline and regional losses exceeding ₹400 crore. In poultry, *Dermanyssus gallinae* infests 50–70% of farms, reducing egg output by up to 25%. Overall, mixed tick-borne infections contribute to more than ₹10,000 crore in annual losses, underscoring the urgent need for integrated parasite management strategies across India.

Conclusion

Ticks and mites continue to pose a substantial threat to livestock health and agricultural productivity, particularly in tropical and subtropical regions like India. Their dual impact—direct damage through blood loss and skin irritation, and indirect effects via transmission of pathogens such as *Babesia*, *Anaplasma*, and *Theileria*—results in significant physiological stress and economic losses. The widespread prevalence of *Rhipicephalus (Boophilus) microplus*, *Hyalomma anatolicum*, and mange-causing mites such as *Sarcoptes scabiei* and *Psoroptes ovis* underscores the diversity and adaptability of these ectoparasites. Their infestations lead to reduced milk production, lower weight gain, poor reproductive performance, and degraded hide and wool quality, collectively costing the livestock sector billions annually.

The findings emphasize that traditional control methods relying solely on chemical acaricides are increasingly unsustainable due to resistance development and environmental concerns. Therefore, integrated pest management (IPM) approaches—incorporating strategic acaricide use, biological control agents, improved housing hygiene, and genetic selection for resistant breeds—are critical for long-term control. Regular epidemiological monitoring, farmer education, and coordinated veterinary health programs are essential to minimize outbreak intensity and ensure livestock welfare. Addressing ectoparasitic challenges holistically will not only enhance animal productivity but also strengthen the resilience of India's agricultural economy, improve rural livelihoods, and ensure sustainable livestock-based food production in the face of changing climatic and environmental conditions.

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