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Ticks and tickborne diseases in Global South countries: impact and implications of environmental changes

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Ticks and tick-borne diseases (TBDs) are escalating health and veterinary threats in the Global South, driven by environmental change, human activity, and socioeconomic vulnerability. Ticks transmit bacterial, viral, and protozoal pathogens, causing significant public health and economic burdens. Climate shifts and land-use changes have expanded tick habitats, intensifying disease transmission. This review examines the distribution of major tick species in the Global South and explores how ecological disruptions influence disease dynamics. Regional case studies from Africa, the Middle East, and South Asia highlight the impact on human health, livestock productivity, and food security. Addressing this growing threat requires integrated One Health strategies, improved public awareness, enhanced veterinary services, and investment in surveillance and vaccine development. International cooperation and strong policy frameworks are vital to mitigate the spread and impact of TBDs.

KEYWORDS

ticks, tick-borne diseases, One Health, tick ecology, climate-driven disease spread, Global South

Introduction

Ticks are blood-feeding ectoparasites that affect both humans and animals by transmitting a variety of infectious agents, including bacteria, viruses, and protozoa. These pathogens cause tick-borne diseases (TBDs), such as Lyme disease, tick-borne encephalitis, Crimean-Congo hemorrhagic fever (CCHF), babesiosis, anaplasmosis, and ehrlichiosis (1, 2). Globally, TBDs present a serious threat to public health, animal welfare, and the economy. In livestock, these diseases lead to reduced milk yield, impaired growth, reproductive losses, and mortality. It is estimated that TBDs affect approximately 80% of the 1.2 billion cattle population worldwide, contributing to economic losses of up to $7 billion annually (3). The burden is especially severe in the Global South, where limited access to diagnostic tools, veterinary services, and effective therapeutics impedes disease control. Compounding these challenges are inadequate research funding and limited pharmaceutical interest in vaccine development. These issues threaten not only animal productivity but also public health and food security in vulnerable communities. Environmental changes, particularly rising global temperatures, shifting precipitation patterns, deforestation, and land-use alterations, have further expanded the geographic range of ticks and TBDs (4–6). These drivers enable ticks to establish in previously unaffected areas, increasing human and animal exposure to pathogens.

In light of these challenges, a robust One Health approach—integrating human, animal, and environmental health—remains central to reducing the burden of TBDs in the Global South. However, additional efforts are needed to complement this approach. These include strengthening local diagnostic capacity, establishing region-specific disease surveillance systems, promoting cross-border collaborations, and integrating technological tools such as GIS for real-time monitoring. Climate-resilient agricultural practices and public-private partnerships can also help mitigate disease emergence.

This paper reviews the impact of climate and environmental changes on the prevalence and distribution of ticks and TBDs in the Global South, their implications for human and animal health, and regional economies.

Distribution and prevalence of ticks and tickborne diseases in the Global South

The Global South—which includes countries in Africa, Latin America, Asia, and Oceania—is characterized by diverse socio-economic and ecological conditions that support a wide range of tick species. Many of these ticks act as vectors for diseases affecting human and animal health, posing significant public health and veterinary challenges.

Tick-borne diseases (TBDs) remain a major constraint to livestock production in the region due to the transmission of bacterial, protozoal, and viral pathogens (7–9). Both hard ticks (Ixodidae) and soft ticks (Argasidae) are prevalent, thriving in favorable tropical and subtropical climates (7, 10). A review of literature spanning 1901 to 2020 identified 55 tick species across eight genera—Amblyomma, Dermacentor, Haemaphysalis, Hyalomma, Ixodes, Ornithodoros, Otobius, and Rhipicephalus—with Rhipicephalus being the most dominant genus (7, 11).

Common TBDs in the Global South include anaplasmosis, babesiosis, theileriosis, cowdriosis, and Lyme disease (12, 13). The most significant causative agents—Babesia, Anaplasma, Theileria, and Ehrlichia species—pose serious threats to animal productivity and human health (7, 14). Of the 116 tick species known to transmit TBDs globally, 84 belong to the Ixodidae family and 32 to Argasidae (15, 16). The highest burden of these diseases is observed in Africa and Asia, where environmental and ecological conditions support tick survival and proliferation (11).

In Sudan, several tick species—including *Hyalomma*, *Rhipicephalus*, and *Amblyomma*—are known to transmit babesiosis, anaplasmosis, and theileriosis, all of which contribute to substantial veterinary and economic losses (7). Similarly, in Egypt, *Hyalomma* and *Rhipicephalus* species are primary vectors of Crimean-Congo hemorrhagic fever (CCHF) and babesiosis (17, 18). In Mauritania, *Hyalomma rufipes* and *Rhipicephalus evertsi* dominate the tick population and are associated with multiple TBDs (19).

In the Middle East, *Hyalomma dromedarii* has been reported as the major vector of CCHF in camel-rearing regions of Saudi Arabia and the United Arab Emirates (20). Further east, countries such as Yemen, Jordan, and Oman continue to contribute to the regional TBD burden. In these areas, *Hyalomma impeltatum*, *Rhipicephalus sanguineus*, and *Hyalomma anatolicum* are among the key species implicated in the transmission of babesiosis and theileriosis (7).

The epidemiology of TBDs in the Global South is shaped by distinct ecological, climatic, and socio-environmental factors that vary widely across regions. In Southeast Asia (SEA), a tropical region comprising 11 countries and over 620 million people, at least 97 tick species have been identified—*Haemaphysalis* being the most diverse genus (3). A broad spectrum of pathogens, including *Anaplasma*, *Borrelia*, *Babesia*, *Coxiella*, *Ehrlichia*, *Rickettsia*, and *Theileria*, circulate in the region (21). Despite its high ecological suitability for vector-borne diseases, limited surveillance systems and diagnostic infrastructure, particularly in rural areas, contribute to underreporting and misdiagnosis (3). The relationship between tick species, pathogens, and hosts varies across regions of the Global South and is summarized in Table 1.

As shown in Figure 1, In Sub-Saharan Africa (SSA), nine tick genera—including *Amblyomma*, *Hyalomma*, and *Rhipicephalus*—play critical roles in transmitting both zoonotic and non-zoonotic diseases, such as babesiosis, ehrlichiosis, rickettsiosis, borreliosis, and anaplasmosis, as well as viral infections like Crimean-Congo hemorrhagic fever, Dugbe virus, and Bhanja virus (22). In South Africa, *Rickettsia*, *Anaplasma*, *Ehrlichia* (formerly *Cowdria*), *Babesia*, and *Theileria* have been found at high prevalence in cattle across multiple provinces (23), reflecting strong endemic transmission cycles in livestock.

Regional case studies further illustrate the variation in vector–host-pathogen dynamics. In East Africa, for example, *Hyalomma*

TABLE 1 Summary of tick-borne diseases (TBDs) by region, tick species, pathogens, diseases, and hosts.

Region	Tick Species / Genus	Pathogens	Disease(s)	Primary Host(s)	References
Southeast Asia	*Haemaphysalis* spp., *Ixodes* spp.	*Anaplasma*, *Borrelia*, *Babesia*, *Coxiella*, *Ehrlichia*, *Rickettsia*, *Theileria*	Multiple febrile illnesses (e.g., rickettsiosis, babesiosis)	Livestock, wildlife, humans	(3, 21)
South Asia (India)	*Hyalomma anatolicum*, *H. marginatum*	Kyasanur Forest Disease Virus (KFDV)	Kyasanur Forest Disease (KFD)	Monkeys, small mammals, humans	(24)
East Africa	*Hyalomma* spp.	Rift Valley Fever Virus (RVFV)	Rift Valley Fever (RVF)	Cattle, goats, sheep, humans	(25)
Sub-Saharan Africa	*Amblyomma* spp., *Hyalomma* spp., *Rhipicephalus* spp.	*Rickettsia*, *Anaplasma*, *Ehrlichia*, *Babesia*, *Theileria*, Dugbe virus, Bhanja virus, CCHFV	Ehrlichiosis, babesiosis, theileriosis, CCHF	Livestock (cattle, goats), wildlife, humans	(22)
Southern Africa (South Africa)	*Rhipicephalus* spp., *Amblyomma* spp.	*Rickettsia*, *Anaplasma*, *Ehrlichia*, *Babesia*, *Theileria*	Tick-borne bacterial and protozoal diseases	Cattle, small ruminants	(23)

species are involved in the complex ecology of Rift Valley fever (RVF), where 67 outbreaks were recorded between 2010 and 2024 across Uganda, Rwanda, Kenya, Tanzania, Burundi, and South Sudan (25). These outbreaks are closely linked to climatic conditions such as heavy rainfall and flooding, which create ideal breeding environments for RVF-transmitting mosquitoes and promote interactions between infected livestock and humans. Conversely, in the dry forested regions of southern India, *Hyalomma anatolicum* and *H. marginatum* are primary vectors of Kyasanur Forest Disease (KFD), a viral hemorrhagic fever maintained in a sylvatic cycle involving monkeys and small mammals. A case-control study in Thirthahalli, Shivamogga, identified residences near recent monkey deaths and household tick exposure as significant risk factors for human infection (24). The limited awareness among residents further exacerbates the spread of the disease, emphasizing the importance of community education and localized vector surveillance. These show that there is ecological heterogeneity of TBDs in the Global South and the need for geographically tailored prevention strategies. While tropical zones support a high diversity of vectors and pathogens, arid and forested environments can also sustain unique transmission cycles that pose severe public health risks.

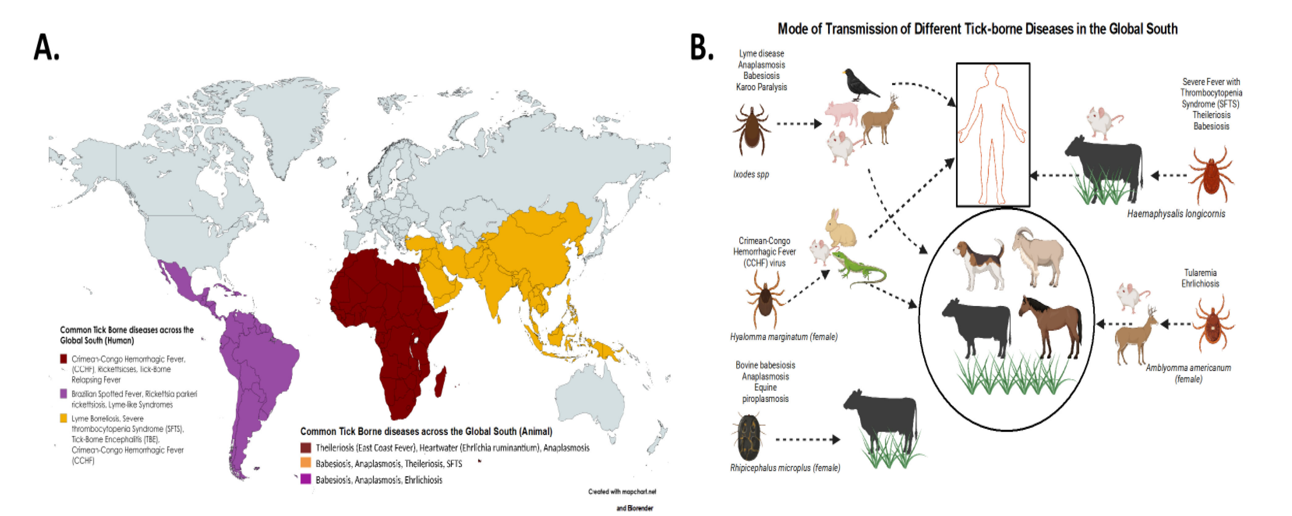

FIGURE 1
Geographic distribution of medically important tick species and tick-borne diseases (TBDs) in selected countries of the Global South **(A)**. The map highlights regions with documented tick diversity, vector–host-pathogen interactions, and reported TBD outbreaks, including Rift Valley Fever (RVF), Kyasanur Forest Disease (KFD), and Crimean-Congo Hemorrhagic Fever (CCHF). Countries represented include: Uganda, Kenya, Tanzania, Rwanda, Burundi, South Sudan, Nigeria, South Africa, Sudan, Egypt, Mauritania, Saudi Arabia, India, Pakistan, Bangladesh, Sri Lanka, Malaysia, Thailand, Vietnam, Myanmar, Cambodia, Laos, and Indonesia. Ixodes spp. Uses birds, ungulates, small rodents, and Suidae as intermediate hosts to infect humans and domestic animals with Lyme disease, anaplasmosis, babesiosis, and Karo paralysis. *Hyalomma marginatum* females use leporids, members of Lacertidae, and rodents as intermediate hosts to infect humans and domestic animals with Crimean-Congo Hemorrhagic Fever (CCHF) virus. *Rhipicephalus microplus* female ticks infect domestic animals with bovine babesiosis, anaplasmosis, and equine piroplasmosis. *Amblyomma americanum* female ticks use rodents and ungulates to infect domestic animals with tularemia and ehrlichiosis. *Haemaphysalis longicornis* causes babesiosis, theileriosis in domestic animals **(B)**.

The Global South comprises countries primarily in Africa, Latin America, Asia, and Oceania, characterized by diverse socio-economic and ecological conditions. This region is home to numerous tick species, many of which are vectors for human and animal diseases, posing significant public health and veterinary challenges.

Environmental changes and tick ecology

Environmental and climate changes significantly influence tick ecology and the transmission of tick-borne diseases (TBDs). Rising temperatures, shifts in rainfall, and humidity changes affect tick survival, reproduction, and geographic distribution (26–30). Warmer climates accelerate tick development and expand their range into higher altitudes and latitudes, as seen with Ixodes scapularis establishing in southern Canada (27). However, extreme heat and prolonged drought may hinder tick survival due to desiccation stress (31). Moisture levels, particularly high humidity, support tick activity by enhancing host-seeking behavior (32). In addition, land-use changes such as deforestation alter tick-host dynamics by bringing wildlife reservoirs (e.g., deer, rodents) into closer proximity with humans, thereby increasing TBD transmission risk (33, 34). These interconnected environmental shifts highlight the complex drivers of TBD emergence and spread. Urbanization fragments habitats and creates ecotones where ticks and their hosts can thrive. Similarly, agricultural expansion increases the availability of livestock hosts, promoting the persistence of pathogens such as Babesia and Anaplasma (33). Additionally, globalization and human mobility contribute to the spread of ticks and TBDs. International trade and cross-border livestock movement have introduced ticks like *Rhipicephalus microplus* to new regions, while *Hyalomma marginatum* has been transported via agricultural goods (35, 36). Companion animals such as dogs also play a role, as ticks like *Rhipicephalus sanguineus* can be transported over long distances when pets travel with their owners (7).

Implications of ticks and tick-borne diseases on human health

Tick-borne diseases (TBDs) pose a significant public health challenge in the Global South due to the interplay of environmental, biological, human, and socioeconomic factors (37–40). Limited healthcare infrastructure, high levels of tick exposure, and poor public awareness contribute to higher morbidity and mortality compared to high-income regions.

The region's biodiversity creates a complex web of interactions between humans, domestic animals, and wildlife. Wildlife species serve as natural reservoirs for tick-borne pathogens, while domestic animals often act as bridges for transmission between wildlife and human populations (41). In many parts of Africa, extensive agriculture and transhumance—where farmers move with their livestock—facilitate frequent contact with ticks, increasing disease transmission risk (36). These practices also contribute to the cross-border spread of emerging pathogens, complicating regional disease control efforts (42).

Clinically, TBDs often present with nonspecific symptoms such as fever, chills, fatigue, and body pain (43). Some infections, like Lyme disease, may be associated with rashes, while others, such as Crimean-Congo hemorrhagic fever (CCHF), can lead to rapid deterioration involving hemorrhaging and organ failure (44). Beyond acute symptoms, patients may suffer from long-term effects such as joint pain, neurological complications, and cardiovascular issues, which can evolve into life-threatening conditions like meningoencephalitis, myocarditis, and acute respiratory distress syndrome (45). These chronic sequelae contribute to sustained public health burdens (46).

These burdens disproportionately affect vulnerable groups. Rural populations, which depend heavily on livestock for food and income, are at heightened risk due to close contact with potentially infected animals (23). Children are also more susceptible, as their developing immune systems offer less protection and they spend more time outdoors. In countries like South Africa, smallholder farmers experience high infection rates worsened by limited access to preventive resources and health information.

Implications of ticks and tick-borne diseases on animal health

Ticks are among the most significant ectoparasites affecting livestock in tropical and subtropical regions, particularly in the Global South. They cause substantial economic losses both through direct effects such as blood-feeding and through their role as vectors of debilitating pathogens (47). These impacts reduce livestock productivity and threaten food security, especially in communities that heavily rely on animal products for sustenance and income.

Tick-borne diseases (TBDs) impair livestock performance by decreasing growth rates, reducing milk yield and quality, lowering reproductive efficiency, and, in severe cases, causing mortality (48, 49). Additionally, tick infestations lead to conditions such as "tick worry," where repeated bites and irritation cause stress and reduced feed intake. Other effects include toxin injection, hide damage, blood loss, and increased susceptibility to secondary infections (47, 50). Collectively, these effects result in reduced animal productivity and poor-quality animal products.

Socioeconomic factors such as poverty, weak healthcare systems, and limited public health education increase vulnerability to tick-borne diseases (TBDs) (51). Many individuals are unaware of exposure risks during activities like farming, hunting, and mining (52). Inadequate veterinary care worsens the situation, as untreated livestock can harbor pathogens and serve as sources of infection (36). These challenges place significant pressure on both public health systems and household economies.

The economic impact of TBDs is considerable. Direct costs—including diagnostics, treatment, and hospitalizations—strain already limited healthcare resources, while indirect costs such as lost productivity, long-term disability, and premature death further burden national economies (53). For example, Uganda loses an estimated USD 1.1 billion annually due to TBDs, and Lyme disease cost the United States approximately USD 968 million in 2016 alone (54, 55). Globally, the economic burden of TBDs in developing countries is estimated at USD 14–19 billion each year (22, 56). Rhipicephalus microplus alone accounts for significant annual losses—USD 32.4 million in Brazil, USD 573 million in Mexico, and USD 168 million in Colombia (57–59). Comparable figures are reported in Australia (USD 26 million) and India (USD 499 million) (47, 57). These statistics highlight the global scope of the issue, with more severe consequences in the Global South due to limited veterinary infrastructure and restricted access to control measures.

Beyond production losses, the financial burden includes treatment, prevention, and replacement of animals lost to disease. In regions with poor veterinary services and few food alternatives, outbreaks can drastically reduce livestock populations, worsening poverty and malnutrition, and impeding agricultural and economic development (60).

The control of animal diseases, including TBDs, is essential for livestock development in Latin America, Asia, the Caribbean, and Africa. Alongside optimal nutrition, management, and market access, disease prevention remains a cornerstone of agricultural sustainability (56). TBDs also directly impact food security by reducing the availability of meat, milk, and other animal-derived foods. Infected animals may lose 10–15% of their body weight annually (47), while dairy cows can produce up to 20% less milk than their healthy counterparts (58).

The financial burden includes not only production losses but also the cost of treatment, preventive measures, and the replacement of animals lost to disease. In regions with limited access to veterinary care and alternative food sources, outbreaks of TBDs can drastically reduce animal populations. This in turn worsens poverty and malnutrition, trapping communities in a cycle that hinders agricultural growth and economic development.

Role of animals in maintaining tick populations and tick-borne disease transmission

Ticks are obligate blood-feeding ectoparasites that rely entirely on vertebrate hosts to complete their life cycle. Globally, they are the most significant arthropod vectors of pathogens affecting animals (61). These hosts not only provide necessary blood meals but also serve as reservoirs and amplifiers of tick-borne pathogens (TBPs), thereby playing a vital role in sustaining endemic transmission cycles (39).

Because ticks have limited independent movement, their distribution is largely influenced by host behavior and mobility. Migratory and wide-ranging animal species, especially birds, are instrumental in dispersing ticks across long distances and introducing them into new geographical regions. For example, migratory birds are estimated to carry between 50 and 175 million *Ixodes scapularis* ticks each spring, demonstrating their critical role in tick population expansion and TBP transmission (62). Increased interactions between wildlife, migratory birds, livestock, and domestic animals elevate the risk of human exposure to infected ticks. Wildlife species in urban and peri-urban settings often act as both maintenance hosts and pathogen reservoirs. Their movement within these environments sustains local tick populations and enhances the likelihood of contact between infected ticks and human populations.

The ecological relationships among ticks, their hosts, and the environment are fundamental to the persistence and spread of TBPs. Factors such as host density, migratory patterns, and interactions between domestic and wild animals contribute to a complex network that facilitates tick survival and disease transmission. Understanding these dynamics is essential for designing effective mitigation strategies, especially in both endemic and emerging regions (63). TBDs also pose serious threats to animal health. In livestock and companion animals, diseases such as babesiosis and ehrlichiosis can cause significant morbidity and mortality. In dogs, these infections often result in severe clinical symptoms. Many TBPs are zoonotic, including Lyme disease, Rocky Mountain spotted fever, and Crimean-Congo hemorrhagic fever (CCHF), which are transmitted from animal reservoirs to humans through tick bites. As a result, the global incidence of TBDs is rising, posing increasing challenges to both public health and veterinary medicine (64).

Ticks also transmit the widest variety of zoonotic pathogens among all arthropod vectors, and while these pathogens often primarily affect animals, their zoonotic potential complicates disease control efforts (47). Moreover, ticks can maintain TBPs across generations via transovarial and transstadial transmission, ensuring pathogen persistence in the environment. Effective tick and TBD control demands integrated strategies. These include promoting host resistance, applying targeted acaricide treatments, and implementing strategic interventions that consider the seasonal dynamics of tick activity. A multifaceted, sustainable approach is necessary to reduce the overall burden of TBDs in both animals and humans (13).

Control and prevention strategies

A variety of strategies have been employed to control ticks and tick-borne diseases (TBDs), including Integrated Pest Management (IPM), acaricides, biological control, public health education, and veterinary interventions. IPM offers an eco-friendly framework that is particularly suitable for regions with limited resources and infrastructure (65).

Acaricides remain the most widely used method for tick control and are effective when applied appropriately. However, concerns about resistance and environmental impact necessitate the development of complementary strategies (66). Biological control, which utilizes natural entomopathogenic fungi such as *Metarhizium* *anisopliae* and *Beauveria bassiana*, has shown promise as a sustainable alternative to synthetic chemicals (67).

Public health education is critical in raising awareness about tick biology, disease transmission, and prevention practices. In the Global South, where TBD prevalence is increasing, educating both the public and healthcare professionals can facilitate early detection and prompt treatment. Veterinary interventions, especially anti-tick vaccines, play a vital role in reducing tick populations and disease transmission in livestock. For example, the BM86 vaccine, derived from *Rhipicephalus microplus*, has demonstrated moderate efficacy in reducing tick infestations and the transmission of associated TBDs in cattle (68). However, its effectiveness can vary depending on the tick species and regional genetic diversity (69, 70) and it offers limited protection against non-*Rhipicephalus* species, highlighting the need for broader-spectrum or species-specific vaccine development.

Recommendations for future research

Future research should focus on a deeper investigation of tick ecology and the transmission dynamics of TBDs—similar to advances made in other vector-borne disease systems (71, 72). This includes examining how environmental changes, host availability, and pathogen interactions drive the emergence and spread of TBDs. Moreover, targeted actions are required to address the growing burden of TBDs through improved surveillance, research, and policy implementation.

Robust and responsive surveillance systems are vital for early detection and control of tick and TBD outbreaks. Real-time monitoring using advanced technologies such as GIS and remote sensing can enhance preparedness and inform rapid interventions of TBDs and other vector-borne diseases (73). Additionally, strengthening laboratory capacity for accurate and timely diagnosis is essential, especially in under-resourced settings. Cross-border and regional collaboration in disease monitoring will support more effective data sharing, risk assessment, and coordinated response in the Global South.

Further research is needed to advance our understanding of tick ecology and disease transmission dynamics, particularly in the face of climate and environmental changes. Studies should explore the interactions among hosts, vectors, and pathogens, and how these are influenced by factors such as habitat change and host density. Moreover, investigating the genetic and molecular mechanisms that contribute to tick survival, resistance to acaricides, and vector competence is crucial for developing innovative interventions (74). Research should also prioritize investigating the genetic and molecular mechanisms that enable tick survival, adaptation, and resistance to control measures. Exploring these pathways could inform the development of novel, more effective interventions. Research should also examine the roles of wildlife and livestock in maintaining tick populations and spreading TBDs across rural, urban, and peri-urban interfaces. Additionally, investment in the development of sustainable control measures—such as anti-tick vaccines, biological control agents, and genetic approaches—should be prioritized to reduce reliance on chemical acaricides.

Furthermore, effective control of TBDs requires supportive policy frameworks that integrate One Health principles and promote collaboration across human, animal, and environmental health sectors. Governments and non-governmental organizations should work together to expand access to tick control tools, strengthen veterinary and public health services, and fund research and innovation. Policies should also support public education campaigns, workforce training, and incentives for the adoption of integrated control strategies. International cooperation will be critical in facilitating technology transfer, knowledge exchange, and the development of regional research hubs. A long-term commitment to evidence-based policy implementation will be instrumental in reducing the burden of TBDs and safeguarding health, food security, and economic development in the Global South.

Conclusion

Climate change, human activities, and socioeconomic factors are key drivers exacerbating the burden of TBDs in the Global South. These factors threaten both human and animal health by undermining public health systems, reducing livestock productivity, and straining national and regional economies.

Challenges such as inadequate veterinary infrastructure, limited public awareness, and gaps in disease surveillance hinder effective TBD prevention and control. Addressing these challenges requires a comprehensive One Health approach that integrates human, animal, and environmental health. Global collaboration is essential to mitigate the impact of TBDs. Governments and non-governmental organizations must work together to implement effective tick control measures, strengthen disease surveillance, and invest in vaccine development research.

Author contributions

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