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Research Article

Prevalence, Burden, Distribution and Risk Factors of Bovine Tick Infestation in Bakori Local Government Area of Katsina State

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ABSTRACT
In sub-Saharan Africa, tick infestation significantly reduces livestock productivity, but there is still a dearth of localized epidemiological and ecological data. Tick prevalence, species diversity, and host-risk factors were assessed in this cross-sectional study of cattle in Bakori Local Government Area, Katsina State, Nigeria. A total of 394 systematically sampled cattle from five administrative wards underwent whole-body examinations, and recovered ticks were identified using standard taxonomic keys. The overall prevalence of infestation was 28.93% (114/394). Seven different tick species were identified. The invasive *Rhipicephalus microplus* (24.48%) was the most prevalent, followed by *Amblyomma variegatum* (20.30%), *Amblyomma hebraeum* (17.31%), *Hyalomma rufipes* (15.52%), *Hyalomma truncatum* (14.93%), *Hyalomma dromedarii* (5.37%), and *Rhipicephalus de*colour*atus* (2.09%). By ward, the spatial distribution differed significantly (χ^2 = 205.18, $p < 0.05$). Bakori B was found to be the most ecologically stable habitat by ecological diversity indices, while Barde-Kwantakwaram showed significant single-species dominance. The most heavily infested anatomical site was the trunk (37.01%). Breed, sex, and coat colour did not significantly correlate with infestation rates ($p > 0.05$), but poor herd hygiene ($p = 0.04$) and younger host age ($p = 0.0048$) did. These results highlight how herd management, spatial heterogeneity, and the dynamics of invasive species influence tick burdens in Bakori. To reduce financial losses, customized, ward-specific integrated tick management strategies are desperately needed.

Keywords: Cattle; Diversity indices; Ectoparasites; Epidemiology; Invasive species; *Rhipicephalus microplus*

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INTRODUCTION

Nigeria's agrarian economy depends heavily on livestock production, which supports rural livelihoods and the country's food security (Kemal *et al.*, 2020). Ticks are obligatory blood-feeding ectoparasites that can cause significant physiological and financial harm, and seriously jeopardize the economic viability of cattle production worldwide (Mwangi *et al.*, 2023). Through severe exsanguination, decreased weight gain, decreased milk yield, and impaired reproductive performance, ticks directly cause pathological effects in livestock (Tabor *et al.*, 2017; Bukar *et al.*, 2025). Beyond these immediate effects, they serve as the main carriers of crippling tick-borne pathogens (TBPs) that cause heartwater, anaplasmosis, theileriosis, and bovine babesiosis (Bukar *et al.*, 2025). Smallholder farmers with limited resources in developing countries are disproportionately affected by tick infestations and related vector-borne diseases, which cause annual losses of billions of dollars (Adedeji *et al.*, 2024; Kamani *et al.*, 2025).

Over 20 million cattle make up Nigeria's national herd, which is primarily run through extensive pastoral and agro-pastoral systems. These systems create microclimates that are extremely favourable to persistent tick propagation and transmission because they mainly rely on communal grazing and have few biosecurity precautions (Kyari *et al.*, 2022;

Nkiru *et al.*, 2025). Katsina State is a significant livestock hub located in the semi-arid Sudan savanna zone. Ironically, the area is under increasing pressure due to changing ecological conditions and the spread of invasive, highly competitive tick species like *Rhipicephalus microplus* (Suleiman *et al.*, 2025). In Bakori Local Government Area (LGA), livestock owners report serious, ongoing ectoparasitic problems (Musa *et al.*, 2021). Despite these vulnerabilities, this locality still lacks comprehensive empirical data on host-specific risk factors, ecological diversity indices, and spatial heterogeneity.

METHODS AND MATERIALS

Study Area

This study was carried out in Bakori in Katsina State, Nigeria (longitudes 7°30'0"E to 7°43'30"E; latitudes 11°55'30"N to 12°43'0"N). Bakori shares administrative borders with Kankara LGA to the north, Funtua LGA to the southwest, Kafur LGA to the southeast, Malumfashi LGA to the northeast, Faskari LGA to the northwest, and Danja LGA to the south. The area of Bakori is approximately 679 km² (Ladan& Sule, 2017). The area is in the semi-arid Sudan savanna ecological zone, with a long dry season (October to April) marked by dust-filled harmattan winds and a distinct wet season (May to September with mean annual rainfall between 600–800 mm) (Yusuf *et al.*, 2019). According to Yusuf *et al.* (2019), ambient temperatures peak between March and April and range from 21°C to 38°C. The region's livestock production is primarily dependent on extensive and semi-intensive pastoral management of native breeds, particularly Red Bororo (Rahaji), Sokoto Gudali, and White Fulani (Bunaji) (Suleiman *et al.*, 2025).

Study design and Selection of Wards

In order to assess the prevalence, species composition, spatial distribution, and host-associated risk factors of bovine tick infestation, a cross-sectional epidemiological study was conducted between December 2024 and May 2025 (Thrusfield, 2018). To guarantee representative spatial sampling throughout the study area, five administrative wards in Bakori LGA were selected —Guga, Kurami-Yan'kwani, Dawan-Musa, Bakori B, and Barde-Kwantakwaram.

Determination of Sample Size

The standard epidemiological formula for cross-sectional prevalence surveys was used to calculate the minimum necessary sample size (N) (Thrusfield, 2018):

$$N = Z^2 \times P\,(1-P) / d^2$$

Z is the standard normal deviate at a 95% confidence interval (1.96), d is the absolute precision level (5% or 0.05), and P is the expected baseline prevalence (set at 50% or 0.50 to maximize sample size estimation due to a lack of localized data). In order to increase statistical power, a total of 394 cattle were sampled, despite the calculated minimum cohort of 384 animals.

Collection of Specimens and Preservation

With the help of their handlers, cattle were safely restrained. The ears, neck, brisket, flank, udder/scrotum, perineum, tail, and limbs were among the recognized tick predilection sites where whole-body macroscopic examination was methodically carried out. To prevent harming the capitulum, adult ticks were carefully separated from the host epidermis using blunt forceps. To avoid structural desiccation, recovered specimens were promptly preserved in labeled vials filled with a 70% ethanol and 5% glycerine solution (Mamman *et al.*, 2021).

Transportation and Morphological Identification

The specimens were preserved in cool boxes and transport to Biology Laboratory at Al-Qalam University Katsina for examination (Walker *et al.*, 2021; Mamman *et al.*, 2021). Ticks were rinsed in distilled water to remove any unnecessary organic debris before being examined under a microscope. A stereomicroscope with TopView digital imaging software was used to examine specimens in Petri dishes against alternating matte black and white backgrounds. By temporarily mounting specimens on glass slides with 70% ethanol, detailed anatomical features were resolved. Standard, internationally recognized morphological keys were used to identify species (Walker *et al.* (2021).

Assessment of Risk Factor

Every animal had a structured data sheet filled out during the sample collection process. According to Yilmer and Birhan (2016), host demographics and variables were classified as follows: sex, breed, coat colour, herd hygiene status (good, moderate, and poor), and chronological age group. Based on dental eruption and wear patterns, age cohorts were categorized as young (less than 2 years), juvenile (4–6 years), and adult (7–9 years).

Data Analysis

Data were entered into Microsoft Excel, and SPSS Version 26.0 was used for analysis. The tick prevalence values, both overall and ward-specific, were computed as percentages. Using Pearson's Chi-square (χ^2) test, associations between tick infestation and qualitative risk factors (ward, age, sex, breed, coat colour, and hygiene status) were assessed; statistical significance was determined at p = 0.05. To assess tick community dynamics throughout the sampling wards, ecological metrics such as the Shannon-Wiener diversity index (H), Simpson's dominance index (D), and Pielou's species evenness (J) were calculated (Sungirai *et al.*, 2017).

RESULTS

The overall prevalence of tick infestation was 28.93% (114/394). Seven species of ticks out of 335 were identified (Table 1). The most common species was *Rhipicephalus microplus* (24.48%, n=82), which was followed by *Amblyomma variegatum* (20.30%, n=68), *Hyalomma rufipes* (15.52%, n=52), *Amblyomma hebraeum* (17.31%, n=58), *Hyalomma truncatum* (14.93%, n=50), *Hyalomma dromedarii* (5.37%, n=18), and *Rhipicephalus de*colour*atus* (2.09%, n=7). Ward and tick distribution were significantly correlated (χ^2 = 205.18, df = 24, p < 0.05).

As presented in figure 1, *R. microplus* is concentrated in Barde, *H. truncatum* in Guga, and *H. rufipes* and *A. hebraeum* in Kurami. Barde and Guga showed low diversity with strong single-species dominance, whereas Bakori B was the most ecologically stable community according to diversity indices (Figure 1). Poor hygiene (40.43%), moderate hygiene (28.57%), and good hygiene (27.17%) were all significantly correlated with infestation (p = 0.04). Additionally, age—adults (38.46%), young (31.12%), and juveniles (22.83%)—was significant (p = 0.0048). Figure 2 shows that there were no correlations with breed (p = 0.43) or sex (p = 0.539).

Table 1: Tick species distribution and correlation with the study area

Species	Guga	Dawan Musa	Kurami	Bakori B	Barde	Total	Prevalence (%)	χ^2 (dF)	P-value
Amblyomma hebraeum	4	9	32	5	8	58	17.31	18.13	P<0.05
Amblyomma variegatum	0	22	29	10	7	68	20.30	30.76	
Hyalomma truncatum	31	7	10	2	0	50	14.93	59.03	
Hyalomma dromedarii	7	2	0	2	7	18	5.37	11.69	
Rhipicephalus microplus	20	5	6	8	43	82	24.48	57.96	
Rhipicephalus decoloratus	2	0	0	1	4	7	2.09	7.86	
Hyalomma rufipes	3	13	26	7	3	52	15.52	19.74	

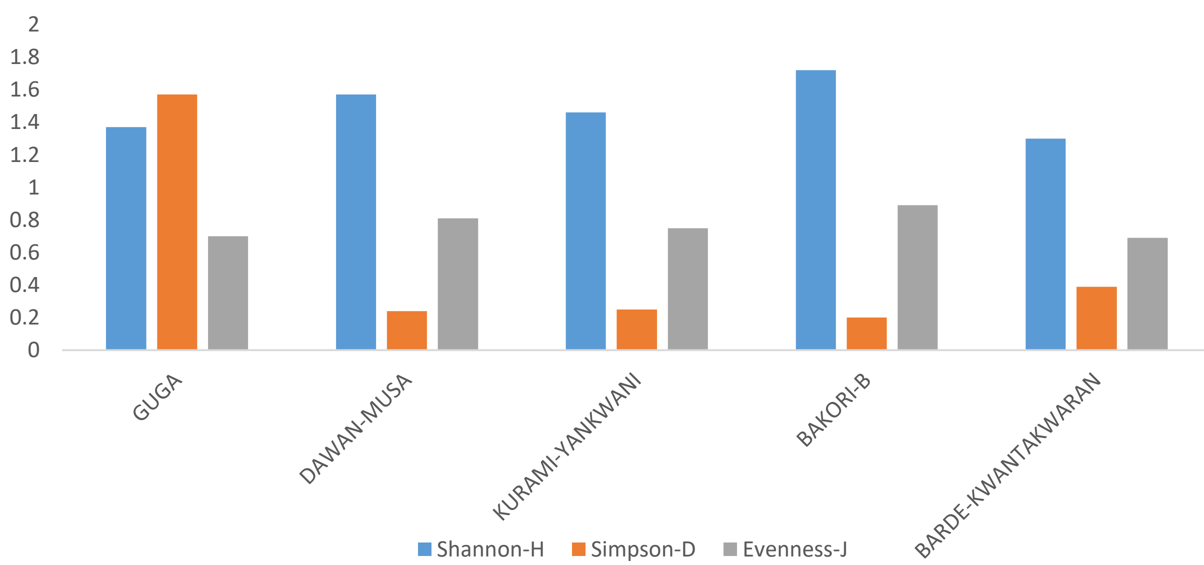

Figure 1: Diversity indices of Tick species in the study area

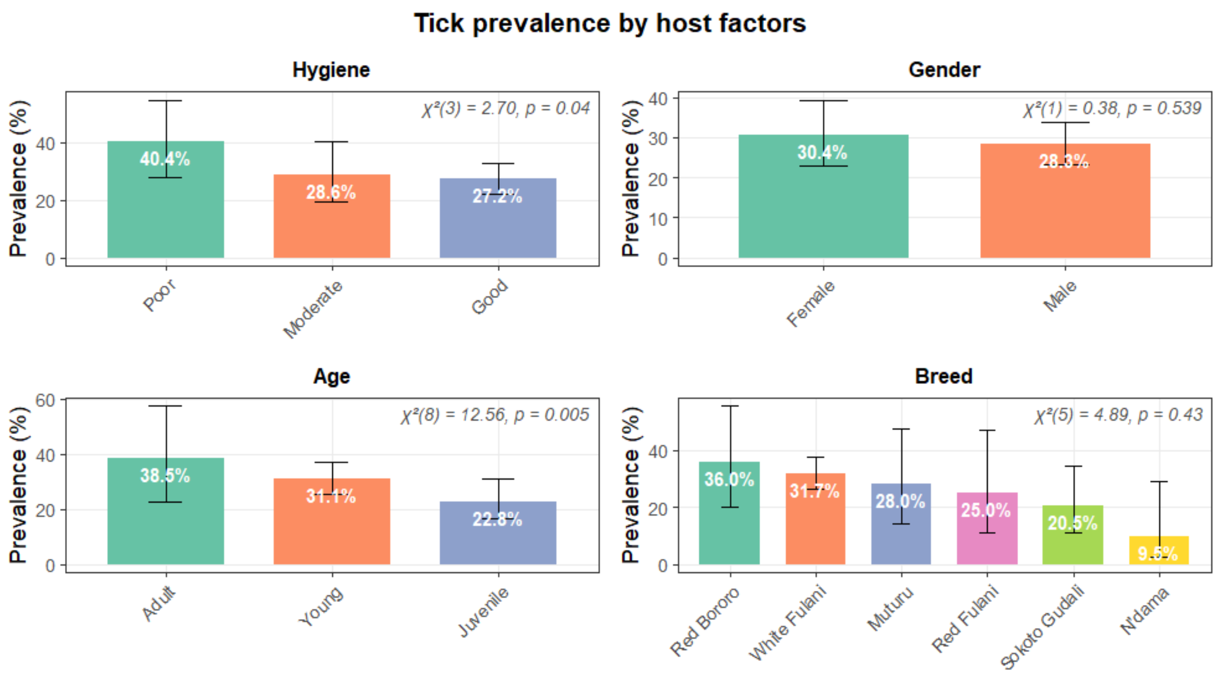

Figure 2: Tick prevalence by Hygiene, Gender, Age and Breed

Figure 3 summarizes the lack of a significant correlation between the coat colour of the cattle and the prevalence of tick parasites. However brown-coloured red cattle are the most common (42.9%), followed by black and white-coloured cattle (40%). Four cattle that were examined had no infestation of brown or black. Figure 4 shows that the most infested site was the trunk (37.01%), followed by the tail (25.67%), head (21.49%), and legs (15.82%).

In table 2, Kurami had the highest prevalence at the ward level (39.24%), followed by Barde (32.91%), Bakori B (31.65%), Guga (24.36%), and Dawan M (16.46%), 46%.

Figure 4 revealed that, the tick infestation in cattle varies by body part, with the highest infestation on the trunk (37%), followed by the tail region (25.7%), head (21.5%), and legs (15.8%). This distribution suggests that ticks prefer larger, less groomed areas like the trunk and tail, highlighting these regions as key targets for effective tick control measures.

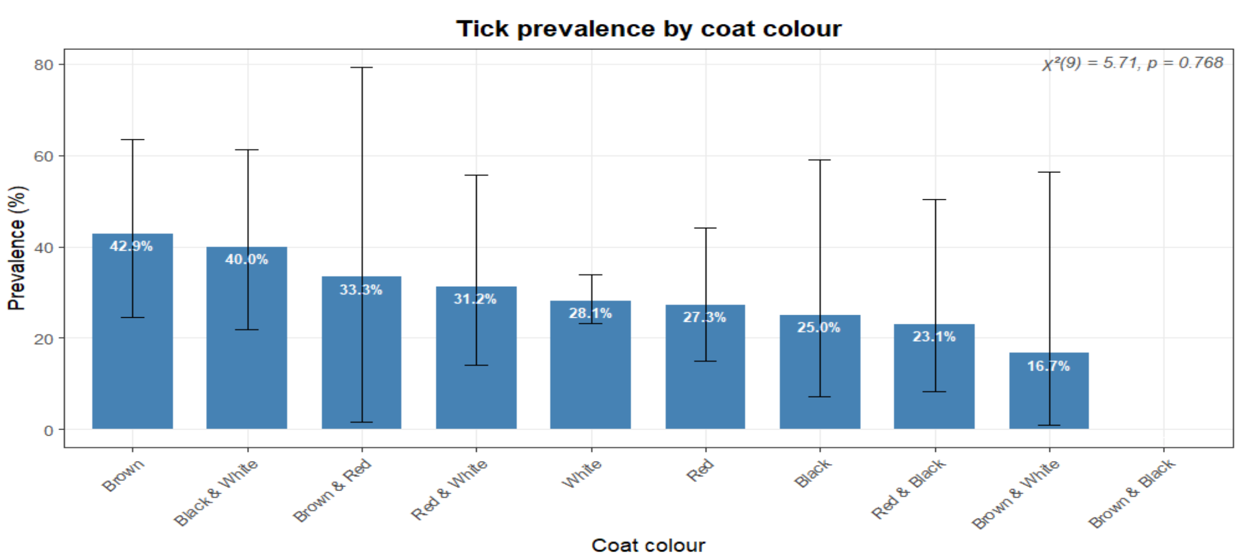

Figure 3: Tick prevalence by coat colour

Table 2: Prevalence of tick parasites in the study areas

Geographic Location	Examined	Infested	Prevalence (%)
Kurami	79	31	39.24
Barde	79	26	32.91
Bakori B	79	25	31.65
Guga Ward	78	19	24.36
Dawan Musa	79	13	16.46

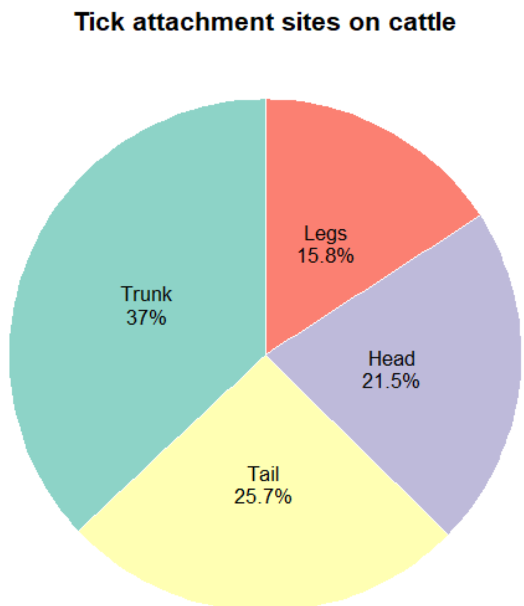

Figure 4: Tick body region distribution

DISCUSSION

The striking dominance of the invasive tick *Rhipicephalus microplus* (24.48%) concurrent with the competitive suppression of the native *Rhipicephalus decolouratus* (2.09%) is a crucial finding of this study that emphasizes its ecological novelty. The Sudan savanna zone's persistent competitive exclusion and ecological displacement of native boophilid ticks by R. microplus are strongly implied by this striking asymmetric distribution. The macro-ecological changes observed throughout sub-Saharan West Africa are reflected in this local trend (Yessinou *et al.*, 2022; Zannou *et al.*, 2025). High reproductive plasticity of *R. microplus*, its short generation cycles, and high resistance to common chemical acaricides all contribute to its successful proliferation. This displacement has significant veterinary and economic ramifications because *R. microplus* is a highly skilled vector of hyper-virulent tick-borne pathogens, particularly Babesia bovis and Anaplasma marginale, which cause catastrophic outbreaks of anaplasmosis and bovine babesiosis in unsuspecting herds (Byaruhanga *et al.*, 2021; Kamani *et al.*, 2022).

Bakori Local Government Area (LGA) has a moderate but enzootically stable ectoparasitic burden, as evidenced by the observed overall tick infestation prevalence of 28.93% among cattle. Compared to the 75.0% infestation rate recorded at the Katsina Central Abattoir by Suleiman *et al.* (2025), this prevalence is much lower. This discrepancy is probably caused by sampling design; this cross-sectional farm-gate survey captured local herd realities, while abattoir-based studies selectively sample market-ready, frequently stressed, or older animals drawn from larger geographic areas. The present results, however, are in close agreement with epidemiological data from comparable semi-arid ecological zones in Sokoto and Zamfara States, where prevalence rates differ according to herd management intensities, veterinary extension access, and seasonal microclimates (Mamman *et al.*, 2021).

Localized vector dynamics are not captured by macroclimatic generalizations, as evidenced by the highly significant spatial variation in tick distribution across administrative wards ($p < 0.05$). Rather, tick assemblages are largely determined by microclimatic variations and livestock handling practices at the community level. This finding was corroborated by ecological diversity metrics, which showed that Bakori B was the most biodiverse and ecologically stable tick community, suggesting a mature, unaltered multi-species equilibrium.

Conversely, Barde and Guga Wards showed strong R. microplus single-species dominance and low diversity metrics. Such low-diversity dominance profiles in tick ecology are a sign of severe habitat disturbance or intense, single-chemical acaricide pressure that allows invasive, resistant lines to spread unchecked while selectively eliminating vulnerable native species (Muvhuringi *et al.*, 2024; Tabor & Ali, 2024).

Ticks' anatomical preference for the host's trunk (37.01%) and tail (25.67%) is consistent with the specialized feeding habits of tropical ixodids (Elelu *et al.*, 2022; Walker, 2023). These protected, vascularized anatomical zones offer direct insights that can be utilized to create focused, economical spot applications of acaricides. Additionally, they offer defense against harsh sunlight and host grooming techniques. The important role of farm biosecurity is further highlighted by the significant correlation ($p = 0.040$) between high infestation rates and poor herd hygiene; neglected communal corrals and accumulated organic bedding provide detached, engorged ticks with perfect pupation shelters (Bukar *et al.*, 2025). In contrast to typical trends where immunologically naive juveniles carry higher loads, the age-dependent susceptibility pattern ($p = 0.0048$) is characterized by peak burdens in mature adult cattle (38.46%). This is most likely the result of exposure brought on by management; calves are kept within secure, constrained boundaries, but adult cattle graze widely over sizable communal pastures every day, maximizing contact with questing tick vectors (Kamani *et al.*, 2022). Finally, under conventional extensive production systems, high environmental vector density and communal grazing pressures effectively override any innate genetic or physiological resistance factors of individual hosts, as evidenced by the lack of significant statistical association with host breed, sex, or coat colour ($p > 0.05$) (Sajid *et al.*, 2017). From a broader One Health perspective, the documented tick community profile carries extensive veterinary and public health risk implications. The identified genera (Amblyomma, Hyalomma, and Rhipicephalus) serve as primary vectors for debilitating livestock pathogens, including *Theileria spp.*, *Babesia spp.*, and *Anaplasma spp.*, which severely depress milk yields and livestock value across Nigeria. Concurrently, species such as *Amblyomma variegatum* and Hyalomma spp. pose significant zoonotic risks as recognized vectors of Rickettsia africae (the causative agent of African tick-bite fever) and *Coxiella burnetii* (Q fever) (Ogo *et al.*, 2012; Djiman *et al.*, 2024). These findings suggest that tick management in Bakori LGA must transition away from blanket regional programs toward ward-specific, integrated interventions that prioritize invasive species monitoring, biosecurity education, and rural public health awareness.

CONCLUSION

This study reveals that bovine tick infestation in Bakori, Katsina State, Nigeria, poses significant economic and clinical challenges, dominated by the invasive *Rhipicephalus microplus* displacing the native *Rhipicephalus decoloratus*. Tick distribution varies widely due to local microclimates and herd management, with poor hygiene and older cattle increasing tick burdens, while breed, sex, and coat color have no effect. Ticks prefer attaching to the trunk and tail, and their presence threatens both animal and human health, highlighting the need for localized, ecology-based tick control rather than broad regional policies.

Based on the empirical insights established in this study, the following integrated management actions are recommended for sustainable tick suppression in Bakori LGA: Deployment of Ward-Specific, Integrated Tick Control Protocols: Vector management programs must abandon blanket regional chemical applications in favor of tailored interventions. In high-dominance, invasive-heavy regions like Barde and Guga, immediate veterinary surveillance must be deployed to monitor and mitigate chemical acaricide resistance within R. microplus lines. Conversely, integrated strategies combining rotated pasture management with targeted spot-applications of acaricides to anatomical predilection sites (the trunk and tail) should be prioritized.

Enhancement of Farm-Level Biosecurity and Extension Services: Smallholder livestock keepers must be educated on the direct correlation between herd hygiene and ectoparasitic amplification. Rural extension programs should actively promote routine structural sanitization and the clearance of organic waste from communal cattle corrals to interrupt the environmental pupation cycles of detached ticks. Furthermore, community-level training should be provided to demystify tick biology, transmit safety protocols regarding chemical applications, and raise awareness of zoonotic disease transmissions.

Institutional Adoption of One Health Surveillance Frameworks: Given the documented presence of zoonotic vectors (*Amblyomma variegatum* and Hyalomma spp.), local agricultural and public health sectors must establish a unified One Health monitoring framework. Future research architectures should prioritize the deployment of advanced molecular tools (such as Polymerase Chain Reaction) to characterize the true carriage rates of underlying tick-borne pathogens and systematically profile the molecular mechanisms driving acaricide resistance in regional vector pools.

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