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Abundance and Diversity of Ticks Infestation Among Three Selected Areas of Cattle in Bauchi State, Nigeria

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Abstract

Ticks and tick-borne diseases are a major constraint to good livestock productivity in sub-Saharan Africa, including Nigeria. This study aimed at determining the abundance and diversity of tick infestations on cattle in Bauchi metropolis, Bauchi State, Nigeria. Ticks were collected from 150 randomly selected cattle of four breeds. Morphological identification of ticks was done using a hand lens, dissecting microscope, and standard identification keys. A total of 174 ticks were collected from 75 (50%) infested cattle, which spread across 26 bulls and 49 cows. Although the majority of the infestation was caused by the Red and White Fulani breeds (80.0% and 48.9%, respectively), there was no significant difference in tick infestation (P = 0.448). Compared to female cattle (44.6%), male cattle showed a considerably (P = 0.027) greater infection rate (65.0%). There were three different species of ticks. *Rhi*. (*Boophilus*) spp. 10 (6%), *Rhipicephalus* (*Boophilus*) *evertsi evertsi* 79 (45%), and *Amblyomma variegatum* 85 (49%) were the most prevalent (P <0.001). Male ticks made up 79.3% of the total ticks found (P <0.001). The udder/scrotum (32.2%), thighs (21.8%), and tail (15.5%) were the ticks' most favored preference locations (P<0.001). With a total tick abundance of 51% (P = 0.357), the majority of the affected animals (48.0%) came from livestock herders in the Bauchi metropolitan area (P = 0.301). This study reveals a significant abundance of tick infestation among indigenous cattle in Bauchi metropolis, especially those raised by pastoralists, and if they are diseased, they could spread diseases through ticks.

Keywords: Ticks, Cattle, Cattle breeds, Infestation, Abundance and diversity, Predilection sites

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INTRODUCTION

Important livestock, cattle are raised for their meat, milk, hides, skins, and other commercial uses. They can produce meat, fiber, skins, and milk from domestic waste and fodder crops (Lawal-Adebolawale, 2012; Owhoeli *et al*., 2014; Leal *et al*., 2020; Ola-Fadunsin *et al*., 2020). Tick infestation is one of the limitations that hinder cow rearing despite these advantages. According to Yu *et al*. (2015) and Rochlin and Teldo (2020), ticks are important carriers of pathogens, which include bacteria, viruses, and protozoa, that cause illnesses like Lyme

disease, anaplasmosis, babesiosis, and tick-borne encephalitis. The primary obstacle to cattle rearing that causes financial losses globally is tick infestations (Squire *et al*., 2019).

The Fulani ethnic group, who comprise the majority of traditional pastoralists in Nigeria, possess 90% of the country's cattle and small ruminants, such as sheep and goats (Awogbade, 1979; Opara *et al*., 2016; Lorusso *et al*., 2013). Two-thirds of the country's cattle and other ruminant population are concentrated in the north-central region, from whence they migrate to other areas in search of pasture and water for their animals. This group of people are primarily found in arid and semi-arid regions (Umar, 2006). Although these migrations are based on a variety of factors, they are primarily influenced by the seasonal distribution of water and pasture, avoiding dangerous flies (such as tsetse and tabanids), bad weather, livestock rustlers, tax assessors, and unfriendly social settings (Welburn, 2014). The pastoralists' nationwide migrations expose them and their animals to a variety of arthropod vectors, including flies, mites, and ticks, which can spread harmful and zoonotic pathogens, including Rickettsia, *Babesia*, *Borrelia*, *Anaplasma*, and the Crimean Congo Haemorrhagic Fever Virus (Ogo *et al*., 2023).

One of the major setbacks for stabilizing and improving profits from the livestock industry is the effects of ticks or tick-borne diseases. Ticks have a way of damaging not just the meat we get from the cattle but also the products derived from their skin as well. The global impact of ticks and associated tick-borne diseases is very high (Pfäffle *et al*., 2013). The average yearly loss resulting from tick infestation on Nigerian livestock is 360 million Naira, according to Oguntomole *et al*. (2018). However, the direct effects of tick infestation include anemia, reduced productivity, tick toxicosis, and depreciation of hide value (Peter *et al.,* 2005; Yadav *et al.,* 2024).

Bauchi metropolis contains Cattle of different breeds, kept for fattening and breeding for food (Butswat & Bello, 2002). This study was undertaken to generate information on tick species infesting cattle on the mustering areas and at the point of slaughter in Bauchi metropolis and to determine the prevalence of tick species parasitizing these animals

MATERIALS AND METHODS

Study Area

The investigation was carried out in the city of Bauchi. Located in northeastern Nigeria, the capital of Bauchi State is the Bauchi Local Government Area (LGA), which spans two different vegetation zones: the Sahel and Sudan savannahs (Tijjani *et al*., 2023; Alhaji, 2025). According to the 2006 National Population Census, there were 493,810 people living in the 3,687 km2 LGA

(National Population Commission, 2009). Between latitudes 10°19′55″N and 10°20′58″N and longitudes 9°50′50″E and 9°51′29″E is where Bauchi LGA is located. There are two distinct seasons in Bauchi State: the wet season is oppressive and cloudy, while the dry season is hot and partly cloudy throughout the year. In Bauchi State, the average yearly temperature fluctuates between 13.9°C and 37.8°C. Temperatures can occasionally climb beyond 104°F (40°C) or drop below 51°F (10.6°C). The primary productive animals raised in the region are cattle, sheep, and goats; the estimated numbers of these animals are 1.8 million cattle, 2.8 million sheep, and 3.4 million goats (Agricultural and Rural Development Bureau of Bauchi state, 2007 Annual Report).

Collection of Tick Samples

A total of 150 cattle were selected randomly and examined for tick infestation from Inkil abattoir market, Between April and July 2024, 40, 30, and 80 cattle from the Yelwan Lebra abattoir market and the nomadic cattle herders in Sabon Kaura were inspected, accordingly. The animal's body parts examined were thigh, ear, groin, head, udder, neck, dewlap, belly, leg, tail, and the anal area (Adejoh *et al.,* 2019; Rwang *et al.,* 2019). Using blunt steel forceps and hand gloves, ticks that were clearly attached to these regions were gathered and placed into sample vials with labels. Precautionary steps were followed during the tick removal process to prevent harm to the host cattle's skin and mouth parts.

Tick specimens collected were counted and stored in vials of 25mm in diameter and 75mm in length, containing 20% formalin for preservation, and carefully labeled. The date of collection, the breed of the cattle, the tick's preferred location on the animal's body and its sex, and the sex of the cattle were additional information gathered at the sampling location. The samples collected were transported to the Biological Sciences Laboratory of Abubakar Tafawa Balewa University, Bauchi, for proper identification.

Morphological Identification

Ticks collected were placed in a petri dish containing a drop of 20% formalin and studied under a dissecting microscope. Ticks were identified by the size and length of the capitulum, the colour of the body, and predilection site collected from. Additionally, the tick samples were identified morphologically using the Walker (2003) and Makwarela *et al*. (2023) identification keys.

Statistical Analysis

For statistical analysis, the data's obtained from the study was cleaned in Excel and then imported into Stata software, version 17.0. Both the abundance of ticks collected across locations and the percentage of afflicted animals relative to the total number of cattle under investigation were calculated using simple percentages. The infestation rates on the collected animals were compared using

Pearson's Chi-square test according to preference sites, tick species, sex, cow breeds, and abundance across regions. Fisher's exact test, however, was applied in cases when the expected count was fewer than 5. The Wilcoxon Rank-sum test was used to compare the abundance of each tick species by sex. $P < 0.05$ was established as the study's level of significance

RESULTS AND DISCUSSION

This study revealed that half (n=75, 50%) of the 150 cattle examined were infested by ticks, as shown in Table 1. The high prevalence of tick infestation observed among cattle in Bauchi State may be influenced by seasonality, given the study's focus on the change from the late dry to the wet season. Furthermore, considering the state's different management practices and extensive geographic spread, the study's analysis of cattle from two abattoirs and a herd of nomadic herders may only be a partial representative of the state's cow population. The current finding in this study agrees with the finding of Rwang *et al.* (2019), whose research cut across the early dry season (November) and wet season (July) period and found that almost 50% of the indigenous cattle reared in Qua'an-Pan LGA of Plateau State, Nigeria, were infested with ticks.

In this study, male and female cattle from four distinct breeds were analyzed. Overall, the tick infection rates of the various cattle breeds under investigation did not differ significantly ($P = 0.448$). Infestation was highest among the Red Fulani breed (n = 4, 80%), Black Fulani (n = 5, 63%), and White Fulani (n = 64, 49%). The Bokolo breed had the lowest infestation rate (n = 2, 33%). In contrast to this study, Usman and Malann (2020) in Bauchi discovered that White Fulani had a greater tick prevalence than Sokoto Gudali and Red Bororo breeds, but these differences were not statistically significant. Tick infestation did not differ significantly between breeds, according to a comparable study by Ogbuefi *et al*. (2025), however the White Fulani breed in Anambra state had a higher frequency than the Red Fulani type. Thus, regardless of the breed raised, this study demonstrates that all cattle breeds are susceptible to tick infection and that management practices may significantly impact the burden of tick infestation. Additionally, according to a recent study by Paguem *et al*. (2020), a variety of factors, such as genetic susceptibility, coat color, and environmental conditions, contribute to the Red Fulani cattle's variable levels of tick infection as compared to other breeds. Additionally, in some circumstances, their crimson coat may render them more vulnerable to tick infestation.

Overall, the prevalence of ticks was substantially ($P = 0.027$) greater in bulls (n = 26, 65.0%) than in cows (n = 49, 44.5%). The similar finding was observed for the White

Fulani breed among the other cattle breeds, with the bull registering a prevalence of 67.7% compared to the cow's 42.3% (P = 0.011). In the Black Fulani breed, the cow (66.7%) had a greater prevalence of tick infestation than the bull (50.0%), however the difference was not statistically significant (P = 1.000). Only one male Red Fulani was found to be infested, however 75% of the female Red Fulani breeds that were investigated were also infested, despite the fact that Bokolo reported similar occurrences in both male and female cattle, with each having a prevalence of 33.3%. Malgwi *et al*. (2025) found that female cattle in Borno State had more ticks than male cattle. However, Bulus *et al*. (2025) discovered that male cattle appeared to harbor more ticks than female cattle in a study done on free-grazing cattle in Kaduna. Given that male cattle graze farther from the field and are employed for field work, which may increase their exposure to questing ticks, it is likely that the higher number of ticks observed in these animals is caused by their increased exposure to tick infestations (Bulus *et al*., 2025).

Table 1: Ticks Infestation in Relation to Cattle Breeds and Sex

Breed	Bulls		Cows		Total No. Examined	Total No. Infested (%)	χ^2	df	P - value
	No. Examined	No. Infested (%)	No. Examined	No. Infested (%)					
White Fulani	34	23 (67.65)	97	41 (42.27)	131	64 (48.85)	6.490	1	0.011*
Black Fulani	2	1 (50.00)	6	4 (66.67)	8	5 (62.50)			1.000
Red Fulani	1	1 (100)	4	3 (75.00)	5	4 (80.00)			
Bokolo	3	1 (33.33)	3	1 (33.33)	6	2 (33.33)			
Total	**40**	**26 (65.00)**	**110**	**49 (44.55)**	**150**	**75 (50.00)**	4.909	1	0.027*
χ^2		0.658		0.410		0.448			

* = Significant

The number and sexes of ticks found during this study are displayed in Table 2. Throughout the study, 174 tick samples of both sexes from three distinct species were found (Plate I-VII). *Amblyoma variegatum* (49.0%), *Rhipicephalus* (*Boophilus*) spp. (6.0%), and *Rhipicephalus* (*Boophilus*) *evertsi evertsi* (45.0%) were the three tick species that were found; *Amblyoma variegatum* had a significantly ($p<0.05$) higher relative abundance than *Rhipicephalus* (*Boophilus*) spp. The tick

species seen in this investigation are consistent with earlier findings by Rwang et al. (2019), who discovered six tick species in their investigations, including all three species described in this investigation. Nonetheless, they found that the most prevalent tick species in their investigation was *Hyalomma ruficipes*. Another study by Lynen *et al*. (2008) found no evidence of *Rhipicephalus evertsi evertsi* in the Katagum Local Government Area of Bauchi state, only the presence of *Amblyoma variegatum* and *Boophilus* spp. However, *Rhipicephalus evertsi evertsi* was found in a study done in Yola by James-Rugu and Sale (2011). Because of their active host-seeking behavior, their luminous color that makes them visible during tick harvest, their hardiness that prevents them from being easily plucked or falling off, and, thirdly, the number of hosts they use in their life cycle as a three-host tick, *Amblyomma* ticks have been reported to be more common than other tick groups in tick surveys over the years (Martins *et al*., 2020; De Paula *et al.,* 2022; Gomes *et al.,* 2024).

Overall, according to the Wilcoxon rank-sum test, there were considerably more male ticks (n = 138, 79.3%) than females (n = 36, 20.7) ($P < 0.05$). Only female *Rhipicephalus* (*Boophilus*) spp. (10) were found in the study, although both *Amblyoma variegatum* and *Rhipicephalus* (*Boophilus*) *evertsi* had considerably ($P < 0.05$) more male ticks collected (66 and 72, respectively) than female (19 and 7 respectively). Perhaps because fully engorged female ticks descend to the ground to lay eggs, while male ticks typically stay on the host for weeks or months to mate with as many females as possible before falling off to die (Solomon *et al*., 2001), Gumel *et al*. (2015) also documented a similar tendency. As previously reported by Okwuonu *et al*. (2021) and Addo *et al*. (2024), male *Amblyomma variegatum* ticks vary in their distribution on cattle due to a combination of host factors like age and color and tick-related factors like attachment preferences and pheromone communication. This suggests that the higher abundance of male ticks compared to females may also be caused by season and ecological zone, as well as tick-related factors like pheromone communication and attachment preferences.

Additionally, with only 10 female ticks gathered for this study, *Rhipicepalus* (*Boophilus*) spp. was the least common tick species found. Sex-specific variations in feeding and host-association behavior may be the cause of this species' lack of males. While mature males roam actively in quest of mates and feed seldom or not at all, adult females stay connected and enlarge, making them easy to spot during host checks. Because of this, males are less noticeable and frequently go unnoticed by sample techniques that concentrate on attached, eating ticks (Kahl & Gray, 2023).

Table 2: Checklist of Tick Species among Cattle in Bauchi Metropolis

Species	Male	Female	Total (%)	z	P - value
Amblyoma variegatum	66	19	85 (49.0)	-9.17	<0.001*
Rhipicephalus (*Boophilus*)spp.	0	10	10 (6.0)		
Rhipicephalus (*Boophilus*)e*vertsievertsi*	72	7	79 (45.0)	-8.832	<0.001*
Total (%)	**138 (79.3)**	**36 (20.7)**	**174 (100)**	-13.153	0.001*
P – value			<0.001*		

* = Significant

Among the several preference areas analyzed (Table 3), the udder/scrotal region accounted for a larger percentage of the ticks collected (32%), followed by the thighs (21%), and the tail (16%). There were no ticks on the skull (0%), while the ears had the fewest (3%) ticks. *Rhi*. (*Boophilus*) *evertsi evertsi* on the tail (n = 22), *Rhipicephalus* (*Boophilus*) spp. (n = 5) in the ears, and *Amblyomma variegatum* in the udder/scrotal region (n = 40) were more common. The distribution of ticks gathered in connection to the several preference locations varied significantly, according to the statistical analysis's findings.

Muhammed and Tibesso (2018) found a substantial correlation between tick infestation and several preference sites, which is similar to our finding. The udder and scrotum were the ticks' most preferred preference sites, according to the current study. This may be because of the areas' thin skin and high blood flow, which make them perfect for feeding, particularly for *Amblyomma variegatum* (Muhammed & Tibesso, 2018). Additionally, the animal frequently shields the udder and scrotum from grooming, and the hair is usually thinner there, which promotes attachment (Addo *et al*., 2024). Similar to the report of Musa *et al*. (2014), the thigh was another significant tick predilection region found in this investigation. Curiously, no ticks were discovered on the skull, defying the findings of Musa *et al*. (2014). Targeted tick control strategies may benefit from an understanding of the ticks' preferred locations, particularly with regard to the udder, thighs, and tail, where the majority of ticks adhere.

Table 3: Ticks Predilection Sites Preference on Cattle

Preferred site	***Amblyomma variegatum***	***Rhi. (Boophilus)* spp.**	***Rhi. (Boophilus) evertsi*** *evertsi*	**Total (%)**
Head	0	0	0	0 (0.0)
Ears	0	5	0	5 (3.0)
Dewlap/neck	7	1	8	16 (9.0)
Udder/Scrotum	40	0	16	56 (32.0)
Tail	5	0	22	27 (16.0)
Legs	5	0	5	10 (6.0)
Thighs	19	3	16	38 (21.0)
Anus	9	1	12	22 (13.0)
Total	**85**	**10**	**79**	**174 (100.0)**

Fisher's exact test: P< 0.001

The prevalence of tick infection on cattle in the various areas where samples were taken, as well as the tick abundance observed in each location, are displayed in Table 4. The findings showed that more livestock from herders in the Bauchi metropolitan area (48%) and the Inkil Abattoir market (32%) had infestations than those from the Yelwan Lebra Abattoir market (20%). The livestock sampled from herders in the Bauchi metropolitan area also had a greater percentage of ticks (51%) and Inkil Abattoir market (25%) than the Yelwan Lebra Abattoir market (24%). Additionally, the study found that cattle sampled from the herders had higher abundances of all tick species encountered. The number of cattle afflicted with ticks and the number of ticks recovered from the various research locations, however, did not differ significantly ($p = 0.301$ and $p = 0.357$, respectively).

In contrast to the abattoirs sampled, cattle sampled from herders in the Bauchi metropolitan area had the highest prevalence (48%) and abundance (51%) of tick infestation. This suggests that lengthy exposure to tick habitats typical of pastoral herds and extensive grazing may increase contact with questing ticks, resulting in higher infestation rates than cattle in market settings. This result is consistent with Maidala's (2015) previous study, which found that high tick infestation in cattle is

linked to both environmental exposure and intensive management strategies. They highlighted the endemic nature of ticks in the area by reporting that several tick genera affected livestock with high overall incidence in their study carried out in Katagum Local Government Area, Bauchi State (Maidala, 2015). The prevalence and abundance of tick infestation varied throughout this study, although there was no discernible statistically significant difference between the samples collected from the various locations. This lack of relevance might be due to the sampling sites' generally similar ecological and climatic circumstances, which sustain steady tick populations and abundant host availability. Ticks continue to be a major hindrance to cattle production under conventional grazing systems, as evidenced by the findings of Bulus et al. (2025) and Akande *et al*. (2017), who observed that tick infestation can be prevalent throughout regions with no significant differences across any risk factors.

Table 4: Location-wise Abundance of Ticks on Cattle in Bauchi Metropolis

Location	**No. of Cattle Examined**	**No. of Cattle Infested**	**Species**			**Total (%)**
			Amblyoma variegatum	***Boophilus*spp.**	***Rhipicephalus*** e*vertsi*e*vertsi*	
Inkil Abattoir market	40	24 (32.0)	23	0	21	**44 (25.0)**
Yelwan Lebra Abattoir market	30	15 (20.0)	18	4	20	**42 (24.0)**
Cattle herders around the Bauchi metropolis	80	36 (48.0)	44	6	38	**88 (51.0)**
Total (%)	**150**	**75(50)**	**85(49)**	**10(6)**	**79(45)**	**174**

Cattle: Chi-square = 2.4000, df = 2, P < 0.301; Ticks: Chi-square = 4.378, df = 4, P = 0.357

Dorsal View

Ventral View

Plate I: Engorged Adult Female *Rhi.* (*Boophilus*) spp.

Dorsal View

Ventral View

Plate II: Engorged Adult Male *Amblyomma variegatum*

Dorsal View

Ventral View

Plate III: Engorged Adult Female *Amblyomma variegatum*

Plate IV: Adult Male (left hand side) and Female (right hand side) *Amblyomma variegatum*

Dorsal View

Ventral View

Plate V: Engorged Adult Male *Rhi.* (*Boophilus*) *evertsi evertsi*

Dorsal View

Ventral View

Plate VI: Engorged Adult Female *Rhi.* (*Boophilus*) *evertsi evertsi*

Plate VII: Adult Male (Left hand side) and Female (Right hand side) *Rhi.* (*Boophilus*) *evertsi evertsi*

CONCLUSION

Ticks in particular have had a part in the widespread prevalence of vector-borne illnesses in livestock, especially cattle. Considering the importance of meat, skin, and hide as a source of income, the growing prevalence of tick infestation that is observed in this study deserves immediate attention to minimize the spread of infestation and improve the health of the animals. This survey confirms the endemicity of ticks on cattle in the city of Bauchi, and suggests that one significant element that may make the animals more susceptible to tick infestation is pastoralism. Therefore, the control of these tick species is paramount if the productivity of livestock is to be enhanced in the Bauchi metropolis. For sustainable and profitable livestock production, it is recommended that the handlers be trained on strategic tick control methods, such as good grazing management practices. Vaccination of cattle should be done at the beginning of the rainy season to ensure adequate protection. This would help reduce production losses caused by tick-borne diseases.

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Competing interest

The authors declare that they have no competing interests and that the manuscript has not been previously published and are not under consideration by any other journals.

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