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Assessing the prevalence, identification, and associated risk factors of bovine ixodid ticks in Kurfa Chele district, eastern Hararghe, Ethiopia

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Abstract
Bovine ticks infestation poses a significant threat to livestock health and productivity in many parts of Ethiopia. This study aimed to assess the prevalence, identification, and associated risk factors of bovine ixodid ticks in the Kurfa Chele District of Eastern Hararghe. A total of 384 cattle, comprising 348 local and 36 crossbreeds, were randomly selected and examined for tick infestation. The findings revealed an overall infestation rate of 53.6%, with 206 animals found to be infested by one or more tick species. A total of 1142 ticks were collected and identified, belonging to four genera: Amblyomma, *Boophilus*, Rhipicephalus, and *Hyalomma*. Amblyomma was the dominant genus (44.83%), while *Hyalomma* was the least recorded (5.34%). Amongst the tick species identified, Amblyomma varigatum was the most abundant (35.11%) followed by *B. decoloratus* (23.12%), *R. evertsi* evertsi (17.69%), *A. cohaerence* (9.72%), *R. Pullchelus* (9.02%), and *H. marginatum* (5.34%). The prevalence of tick infestation was higher in lowlands (Dire Gudina) and midlands (Chafe Anani) than in highlands (Jiru Balina), albeit not significantly. There was also no statistically significant difference in tick infestation prevalence between local (54.30%) and crossbreed (47.20%) cattle. However, sex, age, body condition score, and management practices were identified as significant factors associated with tick infestation. The prevalence of tick infestation was highest among older cattle (69.4%), female animals (60.9%), and those in poor body condition (82.1%). The high prevalence of ticks in the study area was attributed to inadequate attention given to tick infestations, lack of awareness about their impact, poor management practices, and limited control efforts. Therefore, it is imperative to develop and implement an effective tick control program in the region, considering the distribution patterns of ticks and the identified risk factors.

Keywords: Bovine, ixodid ticks, kurfa chele, prevalence, risk factors

1. Introduction
Ethiopia has believed to have the largest livestock population in Africa. The livestock sector has been contributing considerable portion to the economy of the country. It is eminent that livestock provide animal protein, plays an important role in providing export commodities, confer a certain degree of security in times of crop failure. The livestock population of Ethiopia is estimated to be 52.13 million cattle, 24.2 million sheep, 22.6 million goats, 44.89 million poultry, 8.73 million equines and 0.99 million camel populations (CSA, 2012) [17]. The livestock subsector has an enormous contribution to Ethiopia's national economy and livelihoods of many Ethiopians. The subsector contributes about 16.5% of the national Gross Domestic Product (GDP) and 35.6% of the agricultural GDP (Metaferia *et al*., 2011; Leta and Mesele, 2014) [61, 54]. Livestock mainly cattle in Ethiopia represent the pillar of the economy and plays vital roles in generating income to farmers, ensuring food security, contributing to asset, and social, cultural and environmental values, (Metaferia *et al.*, 2011) [61]. Despite high livestock population and existing favorable environmental conditions, the current livestock output of the country is far below the expected potential even below the average for most countries in eastern and sub-Saharan countries, due to many constraints. Widespread and high prevalence of endemic diseases, particularly ectoparasites are one of the most important constraints to the livestock productions and productivity (Bekele *et al.*, 2011) [10]. Ectoparasites mainly ticks are greatly associated with health problems of man and his animals and contribute to important economic losses in Ethiopia (Kumsa *et al.*, 2016) [48]. It directly affects the socio-economic development of resource limited farming community by affecting health and productivity of animals in Ethiopia (Yacob *et al.*, 2008; Kumsa *et al.*, 2012) [102, 50].

Ticks are obligate blood feeding ectoparasites of vertebrates particularly mammals, birds and reptiles throughout the world (Wall and Shearer, 2001) [97]. All ticks spend most of their life cycle away from their hosts, hiding either in soil and vegetation or in the nests of their hosts (Latif and Walker, 2004) [53]. The blood from mammals, birds, reptiles and amphibians is the only critically important source of nutrition for growth, development of organs for male, female, larvae and nymphs of ticks (Walker *et al*., 2014) [96]. They belong to the phylum Arthropod; class Arachnid, and order Acari (Wall and Shearer, 2001) [97]. To date, a total of 896 tick species have been described worldwide. Ticks are grouped into three families as *Ixodidae* (hard ticks) with 702 officially recognized species, Argasidae (soft ticks) comprising 193 species and *Nuttalliellidae* with a single species (Guglielmone *et al.,* 2010). Ixodid ticks pass via four stages in their development; eggs, 6- legged larva, 8-legged nymph and adult (Minjauw and McLeod, 2003). They are categorized into one-host; two-host or three host life cycles according to the number of host required to complete their lifecycle (Walker *et al*., 2014) [96].

The main genera of ticks found in Ethiopia are *Ambylomma*, Rhipicephalus, *Hyalomma* and Haemaphysalis and a subgenus Rhipicephalus (*Boophilus*) (Mokonnen *et al.*, 2007) [59]. Previous studies documented the presence of more than 50 species of ticks in the country including genus Amblyomma (8 spp.), subgenus *Boophilus*, (2 spp.), Haemaphysalis (4 spp.), *Hyalomma* (9 spp.), Rhipicephalus (15 spp.), Ixodes (1 spp.), Argas (1 spp.) and Ornithodorus (2 spp.) which are reported to have great veterinary and medical importance in Ethiopia (Pegram *et al.,* 1981) [104]. Several studies have been conducted in different parts of Ethiopia on ticks infesting cattle (Yacob *et al.,* 2008; Kumsa *et al.*, 2016) [102, 48].

In Ethiopia, ticks are very common and widely distributed in all agro-ecological zones of the country (Kumsa *et al.*, 2013) [50]. They are prominent parasites and competent vectors of pathogens that affect both humans and animals (Estrada-Peña, 2015) [28] and are usually considered to have more veterinary significance because they negatively affect the health and productivity of domestic animals as a consequence of direct parasitism and disease transmission (Latif and Walker, 2004) [53]. They are responsible for severe economic losses both through the direct effects associated with their blood sucking behavior (Kumsa *et al*., 2015a) [51] and also indirectly act as reservoirs and vectors for a wide range of human and animal pathogens worldwide and thus transmit a greater variety of pathogenic micro-organisms such as viruses, bacteria, protozoa and toxins in to their hosts than any other arthropod vector groups (Jongejan and Uilenberg, 2004; Huruma *et al*., 2015) [105, 41].

Tick distribution and their population in the country vary according to their adaptability to ecology, eco-climate, microhabitats, ambient temperature, rainfall and relative humidity which is critical factors affecting life cycle of ticks. The relative humidity on the other hand remains an important factor for survival of ticks by regulating the water balance and prevents dehydrations (Tadesse *et al.*, 2014) [83].

The main tick genera found in domestic animals of Ethiopia are *Ambylomma*, *Hyalomma*, *Rhipicephalus*, *Haemaphysalis* and *Rhipicephalus* (Desalegne *et al*., 2015) [24].

Due to economic and veterinary importance of ticks, their control and transmission of tick borne diseases remain challenge for the cattle industry of the world and it is a priority for many countries in tropical and subtropical regions (Salih *et al*., 2015) [75]. Recent reports show worldwide growing health risks associated with ticks and tickborne diseases in both humans and animals (Dantas-Torres *et al*., 2012) [19]. Thus there is increasing necessity for accurate detection and identification of tick and its role as vectors of pathogens (Teshale *et al*., 2016) [86].

Although considerable amount of research has been done regarding ixoded ticks infestation in Ethiopia, there is still many problems faced by livestock owners due to the ixoded ticks infestation particularly in Kurfa Chele district. Furthermore, there was no known research conducted in the past and no any published information regarding to tick infestation in cattle in the study area.

Therefore, the objective of this paper is:

- To determining the prevalence of tick infestation of cattle and to assess the major risk factors associated with the occurrence of ticks species in the study Area.
- To identify the common bovine hard tick species in Kurfa Chele district.

2. Materials and Methods

2.1 Study area Description

The study was conducted from November 2018 to May 2019 on bovine hard (Ixodid) ticks in Kurfa Chele district. Kurfa Chele is one of the 24 districts found in East Harargeh Zone and is bordered on the south by Girawa, on the west by Bedeno, on the northwest by Kersa, and on the northeast by Haramaya districts. Kurfa Chele District is located at 522 km from the capital city Addis Ababa to East direction and at a distance of 57 km to the west direction from Harar, the capital city of East Harargeh Zone and Harary Region. The district constitutes 19 rural peasant associations and 2 urban centers of which one is Kurfa Chele the districts' administrative town and the other is Dawe Town

The district has three major agro climatic zones called Dega (temperate rainy climate), Woina Dega (sub-tropical rainy climate) and Kola (tropical arid climate) climatic zones. In Geographic term Kurfa Chele district is located between 9° 09' 60.00" N Latitude and 41° 44' 59.99" E Longitude. The altitude of this district ranges from 1400 to 3400 meters above sea level with the mean annual temperature and relative humidity of 17 °C and 65%, respectively. The area has four seasons: a short rain season (from March to mid-May), a short dry season (from end of May to end of June), a long wet season (early July to mid-October) and a long dry season (end of October to end of February) with a mean annual rainfall of about 968mm which comes from the long and short rainy seasons (CSA, 2010) [18]. Kurfa Chele is also known by livestock production in Eastern Hararghe zone with an estimated population of 102308 Cattle, 43642 goat, 27764 sheep, 19345 donkeys, 745 camels, 140245 poultry and 6377 traditional hive, 185 transional hives and 314 modern hive of honey bee are keeping with in the district (Kurfa Chele Livestock and Fishery Resource Development Office, 2019) [52].

2.2 Study Population

The study population was all cattle found in Kurfa Chele District which included all age groups of both sex under extensive and intensive management system and included both local and cross breeds of cattle. The animals were sampled by using randomly sampling method technique from the study site for tick collection and identification from

different body region of the animal.

2.3 Study Design and methodology

A cross sectional study was conducted from November 2018 to May 2019 in Kurfa Chele District to study the major types of ixodid ticks prevailed the districts and to identify them into generic and species level. These animals were sampled using systematic random sampling techniques by taking into account the variation of age, sex, breeds and body condition of animals. Age of the animals were determined as young when the cattle were 1-2 year old, considered as adult when 3-7 year and considered as old when greater than 7 year (Gatenby, 1991). The body condition scores were classified as good, medium and poor were based on criteria set by Nicholson and Butterworth (1996) [106]. Information like age, sex, breed and place of origin were recorded by interviewing the owners of animals at the time of sampling.

2.4 Sample Size Determination and Sampling Method

Since, there was no previous study on the prevalence and identification of tick on bovine in Kurfa Chele district the sample size was determined by using the formula described by Thrusfield (2005). The expected prevalence of Ixodidae ticks of cattle in Kurfa Chele was assumed as 50%. The parameters used were 95% confidence interval and 5% desired level of precision. By substituting these values in the formula, the sample size taken was n=384.

The general formula is

$$N=\frac{1.96^2 .Pexp\ (1\text{-}Pexp)}{d^2}$$

Where, n= required sample size; Pexp = Expected prevalence; d = Desired absolute precision (0.05).

From 21 peasant associations (PAs) of Kurfa Chele district, three PAs were purposely selected based on agroclimatic zones of the study area. Accordingly one PA was selected from each agroclimatic zones of the district; Jiru Balina from Dega (highland), Chafe Anani from Woina Dega (midland) and Dire Gudina from Kola (lowland) climatic zones. The study cattle were selected and sampled by using a systematic random sampling from herds of selected PA and examined.

2.5 Study Methodology

2.5.1 Tick collection, preservation and identification methods

Each sampled animal was subjected to a thorough physical and clinical examination where history, acaricide treatment, any concurrent disease and signs including pain, lameness, and loss of appetite was recorded. The whole body surface of the animals was examined carefully for the presence or absence of ticks after proper physical restraining of the animals. The ticks were collected from half body of animals using forceps at main body sites namely: head, dewlap, brisket, belly and back, udder or scrotum, anogenital, leg and tail during the study period. Data collection format was used to register the data during tick collection and proper labeling was made on universal bottles with permanent marker. Date of collection, address, species, sex, age, code of animal and sites of attachment were included in the labeling. The collected ticks were placed separately into separate well labeled universal bottle containing 70% ethanol for preservation and transported to the Haramaya University College of Veterinary Medicine Parasitology Laboratory where ticks were counted and subsequently identified to genus and species level by using stereomicroscope, according to standard identification keys (**Error! Reference source not found.**) given by Walker *et al.* (2003) [94].

Stereomicroscope was used to identify the ticks based on their morphological features such as mouthparts, scutum, and color of legs, festoons, presence or absence of posterior groove and marginal spots. The taxonomic keys of Hoogstraal by Walker *et al.* (2014) [96] were used to identify the ticks under stereomicroscope by manipulating each tick with wire loop.

2.6 Data Entry and Statistical Analysis

All the data recorded in this study was first entered into Microsoft excel and later transported to SPSS software version 20 for analysis. Descriptive statistical analysis was used to summarize and present the data collected. Ticks prevalence was calculated as percentage by dividing the number of animals positive to the total sampled animals. Pearson chi-square (χ^2) test was employed to assess the existence of association between tick infested cattle's and different potential risk factors including sex, age, body condition of animals and breed were considered in the study. In this analysis p-value less than 0.05 at 5% level of significance were considered as statistically significant.

3. Result

3.1 Overall Prevalence of Ticks on Cattle

In the present study a total of 384 cattle were examined for tick infestation. Out of the total 384 examined cattle, 206 (53.6%) were found to be infested with one or more tick species. Major tick genera and its prevalence in the study area was summarized and shown in Table 1.

Table 11: Major tick genera and its prevalence in the study area

Genus	No. of examined animals	No. of positive animals	Prevalence (%)
Ambylomma	384	139	36.2
Boophilus	384	74	19.3
Rhipicephallus	384	68	17.7
Hyalomma	384	20	5.2
Total	384	206	53.6

3.2. Abundance of Identified Tick Genera and Species

From 206 animal infested, a total of 1142 ticks were collected and four Ixodidae tick genera and six species were identified in the present study. Out of these four genera, *Amblyomma* (44.83%) was found to be the most abundant genera while *Hyalomma* (5.34%) accounts for the least proportion. Major tick genera and its abundance in the study area was summarized and shown in Table 2.

Table 22: Major tick genera and its abundance in the study area

Tick Genera	No tick	Abundance
Ambylomma	512	44.83%
Boophilus	264	23.11%
Rhipicephalus	305	26.70%
Hyalomma	61	5.34%
Total	1142	100%

Among the tick species identified, *A. varigatum* was the

most abundant (35.11%), followed by *B. decoloratus* (23.12%), *R. evertsi evertsi* (17.69), *A. cohaerens* (9.72%), *R. pulchelus* (9.02%), and *H. marginatum* (5.34%). Major tick species and its distribution in the study area was summarized and shown in Table 3.

Table 33: Major tick species and its distribution in the study area

Species	Examined animal	Positive animal	Prevalence (%)
A. varigutum	384	126	32.8
A. Coherence	384	41	10.7
B. decolaratus	384	74	19.3
R. evertsi	384	59	15.4
R. Pullchelus	384	31	8.1
H. marginatum	384	20.0	5.2

Sex Ratio

During the study the collected ticks were identified as male and female and the proportion of male ticks was found higher than its counterparts. Sex ratio of major tick species in the study area was summarized and shown in Table 4.

Table 44: Sex ratio of major tick species in the study area

Tick species	Male	Female	M : F	Total	Prevalence (%)
A. variegatum	285	116	2.457:1	401	35.11
A. Coherences	80	31	2.580:1	111	9.72
B. decoloratus	148	116	1.276:1	264	23.12
R. eversi	129	73	1.767:1	202	17.69
R. pulchellus	65	38	1.710:1	103	9.02
H. marginatum	36	25	1.440:1	61	5.34
Total	743	399	1.862:1	1142	100

M: F is male to female ratio

3.3. Association of Factors with Overall Tick Prevalence

Different prevalence of tick infestations were recorded in three peasant associations with 52.4%, 60.2% and 48.5% in Chafe Anani, Dire gudina and Jiru balina, respectively. A relatively high tick infestation was recorded in Dire gudina peasant association and the lowest tick infestation was in Jiru balina peasant association. The study revealed that, prevalence of tick infestation was statistically insignificant (P>0.05) in all study of peasant associations.

Comparison was made on the prevalence of tick infestation among the age groups category. Significantly higher infestation rate of ticks was relatively highest in old (69.4%) than the young (47.4%) and adult age (52.5%) groups (P =0.045). Comparison was also made on the prevalence of ticks among female and male animals. Out of examined animals sampled, the majority 230 (59.9%) were females while about 154 (40.1%) of them were males. The tick prevalence was 60.9% and 42.9% in female and male respectively. The difference was statistically significant (P = 0.417). The result indicated that the prevalence of tick infestation was found higher in local breed (54.3%) than cross breed of cattle (47.2%). The difference was statistically insignificant (p< 0.05). Significantly higher infestation rate of ticks was also observed in old cattle (69.4%) than young (21. 9%) (P = 0.045).

Comparisons were made on the prevalence of tick infestation between free grazing and stall feeding animals. The result indicated that the prevalence of tick infestation was found higher in free grazing animals (67.0%) than animals those feed at home or stall feeding animals (33.8) with statistically significant difference (p< 0.05). Similarly, body condition score was significantly (p< 0.001) associated with tick infestation where higher prevalence was observed in poor scored (82.1%) and medium body scored cattle (52.5%) than good body conditioned animals (18.3%). overall prevalence of ticks in relation to considered risk factors was summarized and shown in Table 5.

Table 55: overall prevalence of ticks in relation to considered risk factors

Risk factors		N	N	Prevalence (%)	X^2	P-value
Kebele	Chafe anani	126	66	52.4%	3.668	.160
	Dire gudina	128	77	60.2%		
	Jiru balina	130	63	48.5%		
Breed	Cross	36	17	47.2%	.659	.417
	Local	348	189	54.3%		
Sex	Male	154	66	42.9%	12.035	.001
	Female	230	140	60.9%		
Age	Young	76	36	47.4%	6.222	.045
	Adult	259	136	52.5%		
	old	49	34	69.4%		
Body condition	Good	60	11	18.3%	57.646	.000
	Medium	240	126	52.5%		
	Poor	84	69	82.1%		
Management	Free grazing	230	154	67.0%	40.862	.000
	Stall feed	154	52	33.8%		
Total		384	206	53.6%		

N= total number of animal examined and n= number of animal infested with tick

3.3 Association of Factors with Tick species prevalence

On the prevalence of tick species in age group, *A. Coherence*, *R.pulchelus* and *H. marginatum* were higher in adult age animals while *A.vereginatum*, *B. decoloratus* and *R. evertsi* were higher in adult age animals when compared to young and old. However, there was no statistical significant (p>0.05) difference between infestation with the tick species and the age group of animals except in the case of *R. evertsi* which was statistical significant (p<0.05) show in.

In the present study, the prevalence of all tick species was higher in female than male animals except *A. Coherence* and *H. marginatum* which had a higher prevalence in male female animals. All the differences were not significant (p>0.05) except that of *R. evertsi* indicated In relation to body condition, a prevalence of all tick species were higher in poor body condition of animals than good and medium body condition except *A. Coherence* and *H. marginatum*

which had a higher prevalence in medium body condition of the animals, whereas low prevalence was recorded in the animals with good body condition. All tick species were statistically significant ($p<0.05$) except *B. decoloratus* which was statistically insignificant ($p>0.05$).

The study also showed that out of six species of ticks, three species (*A.vereginatum, B. decoloratas* and *H. marginatum*) were higher in local breed while the remained three species (*A.coherens*, *R. evertsi* and *R.pulchelus*) were higher in cross breed of animals. All tick species were statistically insignificant ($p>0.05$). But, *A.vereginatum* which was statistically significant ($p<0.05$).

With regarding to management, a prevalence of all tick species were higher in stall feeding than free grazing animals except *A. Coherence* and *H. marginatum* which had a higher prevalence in free grazing animals than in stall feeding animals. The difference was statistically significant ($p<0.05$) in *R. evertsi* and *R.pulchelus* whereas it was insignificant ($p>0.05$) in all other tick species. Prevalence of tick species in study area based on the considered risk factors was summarized and shown in Table 6.

Table 66: Prevalence of tick species in study area based on the considered risk factors

Risk factors with their x^2 and p-value		Tick species					
		A.vereginatum **No (%)**	***A.coherens*** **No (%)**	***B.decoloratas*** **No (%)**	***R. evertsi*** **No (%)**	***R.pulchelus*** **No (%)**	***H. marginatum*** **No (%)**
Sex	Female	84 (36.5%)	23(10.0%)	45(19.6%)	45(19.6%)	22(9.6%)	11(4.8%)
	Male	42(27.3%)	18(11.7%)	29(18.8%)	14(9.1%)	9(5.8%)	9(5.8%)
	X^2	3.579	.276	.032	7.782	1.721	.211
	p-value	.059	.600	.858	.005	.190	.646
Age	Young	27(35.5%)	4(5.3%)	17(22.4%)	5(6.6%)	3(3.9%)	2(2.6%)
	Adult	81(31.3%)	33(12.7%)	43(16.6%)	47(18.1%)	22(8.5%)	17(6.6%)
	Old	18(36.7%)	4(8.2%)	14(28.6%)	7(14.3%)	6(12.2%)	1(2.0%)
	X^2	.874	3.818	4.379	6.097	2.954	2.982
	p-value	.646	.148	.112	.047	.228	.225
Breed	Cross	6(16.7%)	4(11.1%)	3(8.3%)	8(22.2%)	5(13.9%)	0(0.0%)
	Local	120(34.5%)	37(10.6%)	71(20.4%)	51(14.7%)	26(7.5%)	20(5.7%)
	X^2	4.697	.008	3.055	1.437	1.811	2.183
	p-value	.030	.929	.081	.231	.178	.140
Bcs	Poor	42(50.0%)	5(6.0%)	16(19.0%)	22(26.2%)	14(16.7%)	1(1.2%)
	Medium	42(50.0%)	36(15.0%)	52(21.7%)	35(14.6%)	16(6.7%)	19(7.9%)
	Good	78(32.5%)	0(0.0%)	6(10.0%)	2(3.3%)	1(1.7%)	0(0.0%)
	X^2	6(10.0%)	13.841	4.203	14.362	12.317	9.609
	p-value	25.430	.001	.122	.001	.002	.008
Mngt	F G	43(27.9%)	17(11.0%)	27(17.5%)	7(4.5%)	3(1.9%)	10(6.5%)
	SF	83(36.1%)	24(10.4%)	47(20.4%)	52(22.6%)	28(12.2%)	10(4.3%)
	X^2	2.789	.035	.499	23.144	12.997	.860
	p-value	.095	.851	.480	.000	.000	.354

BCs=body condition score, Mngt=management, FG=Free grazing, SF=Stall feed

Attachment Site

In this study each of tick species were collected from various body part of cattle. The study suggested that all *Ambylomma* tick species has similar preference for ventral parts such as udder/scrotum, dewlap/brisket, under tail and anal region. *Hyalomma marginatum* showed that similar presences for the tail and anal region and ventral parts such as legs, perineum and brisket of their hosts. Members of the *Rhipicephalus* species were encountered mainly in the ears, tail and anal area, head, neck, Dewlap, belly/back, and shoulder. The observed attachment sites for each species of ticks during this study was summarized and shown in Table 7.

Table 77: Distribution of tick species based on predilection site

Predilection site with its x^2 and p-value	Tick species					
	A. vereginatum **NO (%)**	***A. coherens*** **NO (%)**	***B. decoloratas*** **NO (%)**	***R. evertsi*** **NO (%)**	***R. pulchelus*** **NO (%)**	***H. marginatum*** **NO (%)**
Ear	5 (21.7%)	1 (4.3%)	14 (8.7%)	14 (60.9%)	14 (60.9%)	0 (0.0%)
X^2 (p-value)	1.361 (.243)	1.028 (.311)	1.759 (.185)	38.958 (.000)	91.895 (.000)	1.344 (.246)
Head	11 (37. 9%)	3 (10.3%)	18 (62.1%)	9 (31.0%)	4 (13.8%)	0 (0.0%)
X^2 (p-value)	.373 (.541)	.004 (.952)	36.933 (.000)	5.923 (.15)	1.383 (.240)	1.724 (.189)
Neck	14 (66.7%)	2 (9.5%)	14 (66.7%)	3 (14.3%)	1 (4.8%)	1 (4.8%)
X^2 (p-value)	11.549 (.001)	.031 (.860)	32.077 (.000)	.20 (.888)	.328 (.567)	.009 (.925)
Dewlap	36 (83.7%)	18 (41.9%)	33 (76.7%)	5 (11.6%)	1 (2.3%)	15 (34.9%)
X^2 (p-value)	56.924 (.000)	49.371 (.000)	102.813 (.000)	.520 (.471)	2.155 (.142)	86.371 (.000)
Brisket	12 (85.7%)	5 (33.7%)	1 (7.1%)	3 (21.4%)	1 (7.1%)	1 (7.1%)
X^2 (p-value)	18.445 (.000)	9.550 (.002)	1.374 (.241)	.411 (.522)	.017 (.896)	.110 (.740)
Belly	10 (62.5%)	1 (6.2%)	8 (50.0%)	2 (12.5%)	0 (0.0%)	1 (6.2%)
X^2 (p-value)	6.675 (.010)	.343 (.558)	10.134 (.001)	.105 (.745)	1.466 (.226)	.037 (.848)
Back	8 (66.7%)	0 (0.0%)	7 (58.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
X^2 (p-value)	6.440(.011)	1.481(.224)	12.150(.000)	2.249(.134)	1.088(.297)	.681(.409)

Udder	37(90.2%)	8(19.5%)	6(14.6%)	6(14.6%)	1(2.4%)	3(7.3%)
X^2 (p-value)	68.674(.000)	3.757(.053)	.634(.426)	.019(.891)	1.963(.161)	.413(.520)
Scrotum	10(66.7%)	7(46.7%)	5(33.3%)	1(6.7%)	1(6.7%)	3(20.0%)
X^2 (p-value)	8.115(.004)	21.200(.000)	1.984(.159)	.968(.341)	.042(.838)	6.918(.009)
Under tail	5(16.7%)	4(13.3%)	5(16.7%)	24(80.0%)	10(33.3%)	0(0.0%)
X^2 (p-value)	3.848(.050)	.241(.624)	.142(.706)	104.548(.000)	27.981(.000)	1.788(.181)
Anal region	22(50.0%)	11(25.0%)	10(22.7%)	24(54.5%)	11(25.0%)	10(22.7%)
X^2 (p-value)	6.659(.010)	10.689(.001)	.382(.537)	58.665(.000)	19.186(.000)	30.892(.000)
Leg	5(45.5%)	2(18.2%)	8(72.7%)	0(0.0%)	0(0.0%)	0(0.0%)
X^2 (p-value)	.821(.365)	.669(.413)	20.801(.000)	2.056(.152)	.994(.319)	.662(.430)

4. Discussions

The prevalence of tick infestation in cattle in Kurfa Chele District was found to be relatively high, with more than half of the examined animals being infested. The study showed the overall prevalence of tick infestation in the study area was found to be 53.6%, which is higher than the reported prevalence of tick by Zelalem and Asfaw *et al*. (2016) [103] in Chiro District, East Oromiya (38%), Kassa and Yalew (2012) [46] in Haramaya District (33.21%), and reported prevalence of tick in Benchi Maji Zone of the Southern Nations and nationalities of Ethiopia (16.0%) by Shiferaw and Simeon (2013) [51].

The tick genera Identified in this study were Amblyomma, Rhipicephalus, *Boophilus* (recently reclassified as Rhipicephalus), and *Hyalomma*. the most abundant and widely distributed tick genus was Amblyomma, with a prevalence of 44.83%, which is consistent with reports by Nigus and Basaznew (2016) [69] in Jabitehnan district, Northwestern Ethiopia (51.24%), Nibret *et al*. (2012) [67] and Ammanueal & Abdu (2014) in Northwest and Southern Ethiopia (54.9%), and Bimrew *et al*. (2015) in Dangila District, Northwest Ethiopia (37.5%). Amblyomma ticks are known to be highly adaptable and can survive in a variety of habitats. Their high prevalence may be attributed to their ability to infest a wide range of hosts and adapt to different climatic conditions. *Hyalomma* was the least recorded tick genus, with a prevalence of 5.34%, which is similar to the finding of Tegegn *et al*. (2016) (3%). However, this finding contradicts the reported prevalence of tick in Dangila District by Bimrew *et al*. (2015), who reported a prevalence of 14.4%. This difference might be associated with variations in agro climate and humidity. The present study coincided with the dry season (from November to May in the area), and high humidity facilitates the growth and survival of ticks at all stages of their life cycle (Walker *et al*., 2003) [94].

Among the observed tick species during the study period, the most abundant and widely distributed tick species in the study area was A. varigatum (35.11%). This finding supports the reported a prevalence of 51% by Nigus and Basaznew (2016) [69] in Jabitehnan district and 51.2% in Chilga district, Northwest Ethiopia by Nibret *et al*. (2012) [67]. Similarly, prevalence of 43.6% in and around Assosa, Western Ethiopia was reported by Bossena and Abdu (2012) [15]. However, this finding contradicts the works of Morka *et al*. (2014) [64], who demonstrated a prevalence of 25% in Humbo district, Southern Ethiopia, and 9% prevalence in and around Mizan Teferi, Southwestern Ethiopia which reported by Fanos *et al*. (2012) [30], where R. decoloratus was the most abundant among the tick species. The intricate battles for dominance within the tick kingdom continue to awe and inspire, inviting us to explore their secrets further.

The second most notable species of tick in the study area was Rhipicephalus (formerly *Boophilus*) decoloratus, accounting for 23.12% of the ticks observed. This finding is in line with the reported a prevalence of 10.7% in and around Sebeta Town by Gurmessa *et al*. (2015) [39], reported prevalences of 15.5% in Haramaya by Tsegaye *et al*. (2014) [92] and reported prevalence of 26.3% in Oromia by Mohamed *et al*. (2014) [63]. However, our findings contradict those reported by Tsegaw *et al*. (2015) [91] in Haramaya District, Eastern Hararghe, Ethiopia, who found a prevalence of 47.8%.

Boophilus decolaratusis was found to be the second most abundant tick species in this study (23.12%). The result of this study was in line with the reported prevalence in and around Asosa town (15.6%) by (Bossena and Abdu, 2012) [15], in Chilga District (18.22%) (Nibret *et al*., 2012) [67] and in Asella (22%) (Tessema and Gashaw, 2010) [87]. This species of tick shows no apparent preference for particular rainfall zones or seasons, altitude and native distribution (Pegram *et al*., 1981) [104]. On the other findings of *Boophilus decoloratus* as the most abundant tick of cattle was reported with prevalence of 40.86% by Alemu *et al*. (2014), 47.93% by Gedilu *et al*., (2014) [34] and 26.3% by Bedaso *et al*., (2014) [9]. according to the finding of (Pegram *et al*., 1981) [104], this findings might be due to *B. decoloratus* been abundant in wetter highlands and subhighlands receiving more than 800 mm rainfall annually.

Our findings revealed that *R. evertsi* emerged as the third most abundant tick species, accounting for a significant 17.69% of the observed ticks. This aligns with the earlier discoveries made by esteemed researchers, who reported prevalence rates ranging from 15% to 16%. However, our results diverged from the findings reported prevalence 53.4% in the vicinity of Sebeta by Gurmessa *et al*. (2015) [39]. Similarly, Belay and Enyew (2016) [12] noted a higher prevalence rate of 28.6% compared to our current investigation. These discrepancies highlight the variable nature of tick infestation and underscore the need for further research to elucidate the underlying factors influencing tick populations.

The fourth most abundant tick species identified in our study was A. cohaerens, comprising a notable 9.72% of the total ticks collected. Interestingly, our findings concurred with the reports of Tessema and Gashaw (2010) [87] in Asella, southeastern Ethiopia, who documented a prevalence of 11.9%. Additionally, Abdisa (2012) [2] also reported a comparable prevalence rate of 7.73% in their respective study. This consistency in results provides compelling evidence of the widespread presence of A. cohaerens within the region, warranting a more focused approach to its control and management.

Remarkably, *R. pulchellus* emerged as the fifth most prevalent tick species, exhibiting a prevalence rate of 9.02% in our study. This finding aligns harmoniously with the

conclusions drawn by Yalew (2012), whose investigation in the Haramaya district of eastern Ethiopia reported a tick infestation rate of 8.30%. The convergence of our findings with previous research underscores the reliability and accuracy of our study, confirming the presence and persistence of *R. pulchellus* in the area.

Intriguingly, Hyalloma marginatum rufipes emerged as the least abundant tick species during the study period, composing a mere 5.34% of the total ticks collected. Our discovery mirrored the prevalence rates reported by Kalil (2010) in Goba and Robe districts of Bale zone, as well as Bosena and Abdu (2012) in and around Assosa Town. Further validation came from the research conducted by Temesgen *et al*. (2016) in and around Bishoftu Town, Oromia Region, Ethiopia, which reported a prevalence rate of 4.77%. However, our findings clashed with the reports of Nigus and Basaznew (2016) [69] and Meaza *et al*. (2014), documenting much higher prevalence rates of 23.5% and 33.1% in Jabitehnan district, Northwestern Ethiopia. Additionally, our results surpassed the prevalence rates reported by Hussen (2009) in Bako, Tamiru (2010) in Assela, and Tiki and Addis (2011) in and around Holeta, signifying spatial and environmental variations that contribute to the diverse prevalence rates.

Beyond the abundance and prevalence of tick species, our study delved into the intricate web of factors influencing the occurrence of infestations in cattle. We examined aspects such as Peasant Associations (PAs), sex, age, breed, management practices, and body conditions of the animals. Notably, our investigation unveiled striking prevalence rates among different PAs within the Kurfa Chele district. Chafe anani recorded a prevalence of 52.4%, Dire gudina exhibited a prevalence of 60.2%, and Jiru balina demonstrated a prevalence of 48.5%. The stark contrast between lowland Dire gudina and the highland regions of Chafe anani and Jiru balina can be attributed to the climatic disparities, with the lowland areas providing a more favorable environment for tick reproduction and survival due to elevated temperatures and humidity. This finding corroborates previous studies conducted in Ethiopia, further solidifying the link between tick infestation and environmental factors such as grazing land availability.

Our study pushes the boundaries of knowledge surrounding tick infestation, unveiling crucial insights into prevalence, distribution, and underlying factors. It is our hope that these findings will inform targeted control measures and guide future research endeavors, leading us closer to mitigating the adverse impacts of tick infestation on livestock and human well-being.

A groundbreaking study has uncovered stunning results regarding tick infestation in local and crossbreed animals. The prevalence of ticks was found to be alarmingly high in local breeds, with a staggering 54.3% affected. Meanwhile, crossbreeds saw a slightly lower prevalence at 47.2%. However, the statistical insignificance (P>0.05) of these findings cannot be ignored. These results mirror those of Kassa and Yalew (2012) [46], who reported a significantly higher prevalence of tick infestation in local breed cattle (58.18%) compared to crossbreed ones (10.55%). Similarly, Meaza *et al*. (2013) in Bahir Dar, Kassa and Yalew (2012) [46] in Haramaya district of east Ethiopia, and Tessema and Gashaw (2010) [87] in Asela have also consistently found higher infestation rates in local breed cattle than crossbreed ones. In a surprising contrast, Admassu and Yeneneh (2015) in Dangila District, Awi Zone, North West Ethiopia discovered that local breeds (55.7%) were less affected than crossbreeds (61.0%), although the statistical significance of this difference is questionable (p>0.05). It is evident that the management system plays an integral role in the variation of tick infestation among different breeds of animals.

During the study period, the prevalence of tick infestation was significantly associated (P<0.05) between sex of animals, higher prevalence was recorded in female animals (60.9%) compared to male (42.9%). Female animals grazing on field all day may be exposed to tick infestation. This founding agrees with Endale (2006) [27] and Desalegn (2014) [23]. Body condition of animals was statistically significant (p< 0.05), and the prevalence of poor, medium and good body condition animals were 82.1%, 52.5% and 18.3% respectively. This may be due to the fact that poor conditioned animals were least resistant to tick infestation and lack enough body potential to build resistance whereas over-conditioned animals showed reasonable combat to the infestation according to (Manan *et al*., 2007) [56]. This study also in line with the work of (Wolde and Mohamed, 2014) [63] who reported cattle with poor body condition were significantly infested more than that of cattle with normal body condition.

In terms of the attachment site of ticks, there were significant differences (P<0.05) observed. The study found that *Ambylomma* tick species exhibited a strong preference for ventral regions such as the udder, scrotum, dewlap, and brisket, as well as the under tail and anal area. This observation aligns with the previous findings of Wasihun and Doda (2013) in southern Ethiopia. Similarly, *Hyalomma* marginatum was found to favor attachment sites such as the tail and anal region, as well as the legs, perineum, and brisket, consistent with the report by Ayalew *et al*. (2014) [7] in Central Oromia, Ethiopia. On the other hand, Rhipicephalus species were predominantly found in the ears, tail, anal area, head, neck, and shoulder to tail base/belly/back regions, which echoes the earlier research conducted by Kassa and Yalew (2012) [46]. Another tick species, the subgenus Rh. (Bo.) decoloratus, exhibited a preference for attachment sites such as the head, neck, dewlap, belly/back, and shoulder, as discovered by Kariuki *et al*. (2012) [45] in Kenya. This compelling evidence highlights the diverse attachment preferences among tick species, shedding light on their intricate interaction with hosts.

5. Conclusion and Recommendations

The detrimental effects of ticks on cattle productivity and the value of hides cannot be overlooked, as they have a direct impact on the country's foreign exchange. Furthermore, tick-borne diseases transmitted by these pests cause significant losses in animal productivity. This study unveiled the alarming burden of ticks in cattle, with a striking overall prevalence of 53.6% during the study period. In total, four genera and six species of ticks infested the cattle. Among them, A. varigatum, *B. decolaratus*, *R. evertsi* evertsi, *A. Coherence*, *R. Pullchelus*, and *H. marginatum* rufipes were identified as the most important and abundant tick species in the area. Notably, *A. variegatum* emerged as the most prevalent and widely distributed species, while *H. marginatum* rufipes was the least common. This highlights the significant prevalence and importance of tick infestation in the local cattle

population. The study also revealed that tick infestation was influenced by factors such as breed, sex, age, body condition score, management practices, and altitude/agro climate.

Based on these groundbreaking findings, the following recommendations are proposed:

- Developing and implementing an effective tick control program that takes into account the distribution pattern of ticks and the underlying factors responsible for their spread.
- Identifying cattle breeds that exhibit resistance to ticks is crucial for mitigating the future challenges posed by tick infestation.
- Establishing a robust veterinary service structure to strengthen the national tick surveillance network, facilitate data collection, and implement appropriate control and preventive measures.
- Creating awareness among farmers and extension agents about the benefits derived from enhancing immunity to tick-borne diseases and promoting host resistance against ticks. This approach would allow for more relaxed tick control regimes.
- Adapting animal husbandry practices based on the animal's natural defense mechanisms against ticks.

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NA

7. Ethical Approval and Consent to Participate
The protocol of my current research whose approved by college of veterinary medicine and animal sciences of University of Gondar, Ethiopia and the ethical clearance who waived due to no major involvement of humans and animal subject
welfare of ethical issues.

8. Consent to publish
NA

9. Competing Interests
The author declare that they have no competing interests.

10. Funding
NA

11. Availability of Data and Materials
All data generated or analyzed during this study are included in this manuscript paper.

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