

Prevalence of Hard Ticks Infesting Cattle and the Associated Risk Factors: A Study Conducted in Ethiopia

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ABSTRACT

Background: Ticks are widely distributed throughout the world particularly in tropical and sub-tropical countries, which cause tremendous economic importance in livestock production. This cross-sectional study was conducted to estimate the prevalence, determine the identity of *ixodid* ticks at the genus level, and their preferred sites on body parts of cattle at Itang special district of Ethiopia. Despite the fact that numerous studies were conducted on *ixodid* ticks of cattle in many parts of Ethiopia, no enough data is available on ticks infecting cattle at the study area. Data on the prevalence, type of ticks, and specific predilection site determination is essential for the development of an effective control strategy of ticks and tick-borne diseases.

Result: From the total of 384 cattle examined for *ixodid* ticks, 320 (83.3%) of the animals were found positive for one or more types ticks. A total number of 2000 adult ticks were collected from half body parts of infested cattle and identified at the genus level. From the infested cattle, 3 genera namely *Amblyomma*, *Hyalomma*, and *Rhipicephalus* and one subgenus *Boophilus* were identified with a relative infestation rate of 32.8%, 19.1%, 12.7%, and 35.5% respectively. The higher average sex ratio of 2.55:1 was observed in males than females in all genera of studied ticks. The study also found that the most infested body parts of the cattle were dewlap/brisket (20.1%) followed by genital and anal (19.7%), neck and head (19.4%), udder and scrotum (17.5%), belly (17.1%), and legs (6.2%). Age-wise ticks infestation was recorded higher in 5 years old and above at 85.5% than in younger cattle (<5 years old) at 79.6%. The infestation level of ticks in poor, medium and good body condition was found to be 86.7%, 90.9%, and 75.3% respectively.

Conclusion: The study revealed the widespread occurrence of *ixodid* tick infestation in cattle of the study area. Thus improved management practices and well-coordinated control interventions are required and further study at species-level identification and their zoonotic importance are recommended.

Keywords: Cattle; Hard ticks; *Ixodid* ticks

INTRODUCTION

Vectors and vector borne-diseases are major constraints to the development of viable livestock industries [1]. Among these, ticks and tick-borne diseases are widely distributed throughout the world particularly in tropical and sub-tropical countries, which cause a tremendous economic importance in livestock production [2]. In Ethiopia, ticks occupy the first place amongst the external parasites by the economic loss they incurred when they infest livestock particularly cattle [3] and they are common

in all agro ecological zone of the country [4,5]. Ticks are important vectors of diseases such as babesiosis, anaplasmosis and ehrlichiosis in domestic ruminants and are also known to exacerbate nonspecific disease symptoms like anemia, toxico-sis and paralysis [4].

Ticks belong to the phylum: arthropoda; class: arachnida, and subclass: acari. The families of ticks parasitizing livestock are categorized into two, *ixodidae* (hard ticks) and *argasidae* (soft ticks). Though, sharing certain basic properties they differed in

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many structures, behavioral, physiological, feeding, and reproduction pattern [6]. Hard ticks get their name from tough dorsal shield or plate called the scutum present on all mobile stage of the ticks. The scutum on the larva, nymph, and female ticks covers dorsal anterior third to half of the body. In contrast, the scutum on male ticks covers almost the entire dorsal surface and as a result engorgement during feeding not possible in male *ixodid* ticks. The scutum differs in color, shape and others characteristics among different ticks' genera that can aid in identification [7].

The lifecycle of ticks (in both *ixodidea* and *argasidae*) undergo four stages in their development; eggs, 6-legged larva, 8-legged nymph and adult [8]. According to the number of host, *ixodid* ticks are classified as one-host ticks, two-host ticks, and three-host ticks whereas *Argasids* classified as multi-host ticks. In one-host ticks, all the parasite stages (larva, nymph, and adult) are on the same hosts; in two-host ticks, larva attach to one host, feed and moult to nymphal stage and engorged, after which they detach and moult on the ground to adult; and in three host ticks the larva, nymph, and adult attach to different hosts and all detach from the host after engorging and moult on the ground [9].

Study on ticks infesting livestock in their natural conditions is useful for better understanding of the host-parasite relation and the seasonal variations of tick's population [10]. The main ticks reported to be found in Ethiopia are *Amblyomma* (40%), subgenus *Boophilus* (21%), *Haemaphysalis* (0.5%), *Hayloma* (1.5%), and *Rhipicephalus* (37%) [8,11]. Among these, *A.varigatum* and *R. decoloratus* [12] *A. coherence*, *A. lepidium*, *H. rufipes*, *H. truncatum*, and *R. evertsi* are the most important and widely distributed ticks in the country [13,14].

Despite of the fact that numerous studies were conducted on species composition, prevalence and distribution of *ixodid* ticks of cattle in many parts of Ethiopia, previous study was not conducted on ticks infecting cattle at Itang special district. Data on the prevalence, type of ticks, and specific predilection site determination is essential for the development of effective control strategy of ticks and tick-borne diseases [15]. Thus, this study believed to identify the problems and forward some possible solutions in order to alleviate problems arise from hard ticks infecting cattle at Itang special district. The objectives of this study were identifying and assessing the prevalence of major hard ticks in the study area, identifying the favorable predilection sites of the ticks, and forwarding the possible solution to the problems.

MATERIALS AND METHODS

Description of the study area

The study was conducted at Itang special district, which is located 48 km from Gambella town. The district is separated by Aleworo River into different kebeles and has latitude and longitude of 8°15'N 34°35'N\8.250°N,34.583°E. It comprises arid and semi-arid agro-ecological climate zone. Its altitude ranges from 400 m1600 m above sea level. The average temperature ranges from 27°C-33°C. The maximum temperature varies from 36°C in February to 40°C from March

to mid-April. The District has a bimodal rainfall distribution with a mean annual precipitation that range from less than 961 mm-2001 mm. The extreme southern lower altitude rangeland receives most of their rainfall from April to June. There is small amount of rain from September to October. The dry season is between October and March. Livestock population in the study area was accounted about 8800 and among these cattle is estimated to be 22.92% [16].

Study design and study population

A cross-sectional study design was implemented from January 2018 to June 2018 to identify and determine the prevalence of hard ticks infesting cattle at Itang special district of Gambella regional state. In this study, cattle managed under extensive, semi intensive and intensive management system, which comprises of exotic, cross and local breeds were included. The animals were selected and sampled using random sampling technique.

Sample size determination and sampling method

The sample size was calculated using the 95% confidence interval at 5% absolute precision [17]. A total of 384 cattle were used and based on cattle population and accessible information gathered from the local clinics and cattle owners, 96 cattle from each of the 4 selected kebeles were randomly sampled.

$$\frac{n \cdot 1.96^2}{d^2} = \frac{P_{exp}(1-P_{exp})}{d^2}$$

Where: n=required sample size; P_{exp}=expected prevalence; d=desired absolute precision=0.05

Sample collection and laboratory techniques

Tick prevalence survey was carried out at Itang district in purposively selected 4 kebeles based on the cattle population and accessibility namely as Watgach, War, Bazil, and Biljakok. From each kebele, 96 cattle were included. Ticks were collected from left half body of animals using forceps from six main body sites (neck/head, belly, udder/scrotum, anal, legs and dewlap/Brisket [18]. The ticks were collected between 8:00 AM and 11:00 PM. Ticks collected from each body region were kept in a separated universal bottle containing 70% ethanol. The universal bottle was labeled with animal sex, age, area of collection, body site, date and month and body condition. The identification of ticks was done based on morphological and structural differences of the adult ticks.

Data analysis

All data recorded in this study was entered in to Microsoft excel and subsequently analyzed using SPSS 20.0 software. Chi-square test (χ^2) with computed p-value of less than 0.05 was used to determine the statistical significance association of ticks' infestation rate with sex, age groups as well as body condition score. Descriptive statistics was also used to show favorable predilection site of tick genus.

RESULTS

Prevalence of ticks in the study area

In this survey, out of the 384 local Abigar breeds of cattle examined, ticks were found on 320 animals yielding an overall prevalence of 83.33%.

Prevalence of tick genera in relation to sex of ticks

From the total of tick collected genera, male accounts 71.85% (1437) and female 28.15 % (563) (Table 1). This shows that infestation by male tick was found to be greater than female tick. The male tick to female sex-ratio accounts subgenus *Boophilus* (4.07) *Amblyomma* (3.85), *Rhipicephalus* (1.3) and *Hyaloma* (1.15) in a decreasing order (Table 1).

Table 1: Distribution and sex ratio of adult tick genera.

Tick Genera	Total Count No.	Prevalence (%)	Sex		Ratio (M:F)
			Female	Male	
<i>Amblyomma</i>	655	32.8	135	520	3.85:1
<i>Hyaloma</i>	382	19.1	178	204	1.5:1
<i>Boophilus</i>	710	35.5	140	570	4.07:1
<i>Rhipicephalus</i>	253	12.6	110	143	1.3:1
Total	2000	100	563	1437	2.55:1

Host age wise and sex wise tick infestations

The infestation of ticks in adult cattle (>5 years of age) was 84.7% whereas in younger age of cattle (<5 years of age) was

81.0% (Table 2). The infestation of ticks in male cattle was 96.2% while in female cattle 71.8%. The infestation rate shows a statistically significant difference between male and female cattle (Table 2).

Table 2: Association of potential risks with prevalence of ticks.

Risk factors	Group	No. positive	No. negative	Total	χ^2	p-value
Sex	Male	175	7	182	0.327	0.000
	Female	145	57	202		
	Total	320	64	384		
Age (year)	<5 (young)	115	27	142	-0.048	0.346
	>5 (adult)	205	37	242		
	Total	320	64	384		
Body Condition	Good	121	33	154	-0.116	0.023
	Poor	98	12	110		
	Medium	101	19	120		
	Total	320	64	384		

p-value significant at <0.05

Identification of tick genera and their abundance

From the total of 2,000 ixodid ticks collected from half body region of 384 cattle, 3 different genera and 1 subgenus were

identified. The tick subgenus and genera identified were subgenus *Boophilus* (35.5%) and genera *Amblyomma* (32.8%), *Hyaloma* (19.1%), and *Rhipicephalus* (12.65%) in descending order of abundance (Table 3).

Table 3: Distribution of tick genera on cattle in the study area.

Kebeles	<i>Amblyomma</i>		<i>Hyaloma</i>		<i>Boophilus</i>		<i>Rhipicephalus</i>		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Watgach	205	42.3	65	13.5	175	36.1	40	8.2	485	24.25
War	120	27.3	115	26.1	135	30.7	70	15.9	440	22
Bazil	135	26.5	92	18	230	45.1	53	10.4	510	22.5
Biljakok	195	34.5	110	19.5	170	30.1	90	15.9	565	28.25
Total	655	32.8	382	19.1	710	35.5	253	12.6	2000	100

Predilection site of the identified ticks

The observed proportion of tick genera attachment site during this study was summarized and shown in Table 4. Genus of *Amblyomma* identified during the study preferred udder/scrotum, neck/head, genital/anal, legs and belly regions. The *Haylomma* preferred the attachment site in brisket, genital/anal,

neck/head, udder/scrotum, belly, and leg region in decreasing order. The *Rhipicephalus* Preferred the attachment site such as neck/head, genital/anal, belly, udder/scrotum, leg, and brisket. The subgenus *Boophilus* was encountered mainly in the belly, neck/ head, genital/anal, brisket, udder/scrotum, and leg region.

Table 4: Distribution of tick genera in different body region of cattle.

Tick genera	Neck/Head	Udder/Scrotum	Genital/Anal	Belly	Leg	Perineum/Brisket	Total
<i>Amblyomma</i>	127	260	58	37	42	131	655
<i>Haylomma</i>	17	11	143	12	10	189	382
<i>Boophilus</i>	125	72	101	266	66	80	710
<i>Rhipicephalus</i>	119	7	92	27	6	2	253
Total	388	350	394	342	124	402	2000

Status of body condition and tick infestation

In cattle, the infestation was higher in medium body conditioned with 89.1% followed by poor with 84.2 % and good with 78.6%. The result suggested that cattle with medium body conditions are more preferred by the ticks than cattle with poor and good body condition (Table 2).

DISCUSSION

The current study showed the presence of 1 subgenus and 3 different genera of ixodid ticks on cattle of the study area with the overall prevalence of 83.33%. This result was in agreement with the findings of [19] who reported a prevalence of 82% in Borena province of southern Oromia. In this study the subgenus *Boophilus* was the most abundant tick on cattle at Itang woreda (35.5%) and this is in line with the highest prevalence of *Boophilus* tick genera (35.77%) in and around Gambella town [11]. It is reported that this tick is one of the most economic importance tick species in Ethiopia. *B. decoloratus* was also identified in Bahir Dar and Humbo district, southern nations, Nationalities, and people's region (SNNPR), Ethiopia followed by *R. evertis* [20,21,22]. These ticks were also frequently encountered by different researchers such as south-western zones of Ethiopia [11]. This was the highest (most abundant)

tick identified from the study areas, which were similar in many part of east Africa [18].

Amblyomma was found to be the second most abundant (32.75%) tick genera in this study. It has a great economic importance because it is an efficient vector of heart water disease, Nairobi sheep disease and Q. fever [18]. *A. varigatum* was also frequently encountered by different researchers and it is the most abundant tick species in Bahir Dar [20]. The prevalence of the different *Amblyomma* in all age group was higher compared to the other genera in Werieleke Woreda, Tigray [23].

Hyaloma account 19.1% of the total ticks collected in the study area. This tick species is also commonly found throughout the drier Ethiopia faunal region [18] and it is found to be lower in prevalence than *Boophilus* and *Amblyomma*, which were difference from highly abundant in low land parts of the country were reported by [21]. On the other hand *Rhipicephalus* accounts the lowest prevalence rate in the study area (12.6%). This tick commonly found in many areas of east of the rift valley and prefers open grass plains in dry bush country. It can transmit the virus that causes Nairobi sheep disease [18].

The male to female sex ratio showed that male is greater than female. This is due to the fully engorged female tick drop off to

the ground to lay eggs while male tend to remain permanently attached to the host up to several months to continue feeding and mating with other female on the host before dropping off and hence males normally remains on the host longer than female [14].

This study also revealed a higher proportion of tick infestation in adult animals (84.7%) as compared to young animals (81.0%). The higher proportion may be due to outdoor management and long distant movement of adult animals to search for food and water compared to younger animals, so the chance of exposure is higher. This finding is also in agreement with the findings of [3,22,24] who stated a higher proportion in adult cattle. Regarding the predilection sites of the ticks, according to this study the most infested region of the animal was perineum/brisket showing a 20.1% followed by genital/anal with 19.7%, neck/head 19.4%, udder/scrotum 17.5%, belly 17.1%, and leg with least infestation (6.2%). Information on predilection sites of ticks is helpful in spraying individual animals since it gives a clue as to which part of the body requires more attention [5].

Furthermore, the study indicated that the infestation rate among female animals is lower when compared with male. This variation may be associated with female animals might be kept properly in the house with good management system for dairy purpose whereas male animals grazing on field all day may be exposed to tick infestation. This finding also agreed with the previous work done by other authors such as in Humbo and in Bako [25,26]. Regarding the findings related with the body condition, cattle with medium body condition score showed higher tick infestation (89.1%) when compared to the poor body condition (84.2%) and good body condition (78.6%). This may be due to the fact that medium body scored animals have reduced resistance and are exposed to any kind of disease when grazing on the field whereas poor body conditioned animals were kept at home due to their inability to walk long distant areas. However, the well-fed animals were resistant to most diseases when grazed in the field or are kept at home. This finding is in covenant with [21].

CONCLUSION

Ticks cause the greatest economic loss in livestock population either by transmitting a wide variety of tick-borne diseases or by affecting the health of animals as well as the quality of hide and skins. The important and abundant tick subgenus and genera investigated in the study area were *Boophilus*, *Amblyomma*, *Hayloma* and *Rhipicephalus* respectively. The most abundant ticks collected in this study indicated that there is high burden of ticks in the area. To sum up the distribution of ticks are not fixed but are determined by a complex interaction of factors such as climate, host density, host susceptibility, grazing habits, and pasture-herd management. Therefore, effective tick control program should be formulated and implemented based on the distribution pattern of ticks and factors responsible for their distribution.

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