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Prevalence of Hard Tick (Ixodidae) in and Around Mizan Teferi, Ethiopia

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Abstract: A cross sectional survey aimed to determine the status of adult hard tick (Ixodidae) on cattle was done in and around MizanTeferi (Southwestern Ethiopia). Ixodid ticks were collected from cattle which were under extensive management system found at different localities of MizanTeferi and its surroundings over the period of five month (November 2010 to March 2011). During the study period, a total of 3490 adult ixodid ticks were collected from cattle in two agro ecological zones. Five tick species of two genera were identified, in which three of these belong to the genus *Amblyomma* and two belong to the genus *Rhipicephalus* constitute 83.69%, 16.26%. Except *R. decoloratus* of which more females than male were collected, the number of male ticks recovered were exceeded those of female. Out of total 384 animals examined, 365 (95.05%) were found to be infested (harboring of at least a single tick). The tick species encountered were *A. cohaerens* (40.74%), *A. lepidum* (8.3%), *A. gemma* (34.5%), *R. decoloratus* (11%), *R. evertsi evertsi* (5.27%). The burden of tick on cattle had statically significance difference ($P<0.05$) regarding season and agro ecology. The prevalence shows insignificant difference in age, sex, body condition and post treatment with acaricide. The role of ecological factors and little attention paid by livestock owners for treatment of animals against tick were suggested to result in abundance of ticks. Acaricide spraying should be strategically applied to control ticks. Finally, studies on tick-borne diseases, involvement of wildlife species as well as related facts to provide a valuable basis for design and launching national control program was recommended.

Key words: Cattle · MizanTeferi · Prevalence · Ticks (Ixodidae)

INTRODUCTION

Many of developing countries depend on natural resources for economic stability and advancement. Human and animal health requires considerable attention. Ethiopia, one of the largest African counties, covers a land area of about 1.3 million km^2[1]. Ethiopia is endowed with the largest number of livestock population estimated 35 million in Africa and animal production plays a major role in economic development of the nation [2]. Unfortunately, the contribution of this high natural resource to human nutrition and export earning is disproportionally low. The mainstay of live hood for 85-90% of people of Ethiopia is agriculture. The agriculture sector is characterized to a large extent by mixed farming system. Livestock play vital role in the farming system of the country [3].

Ticks and tick-borne diseases of livestock are of extreme importance throughout the world and the associated economic losses are immense. Different studies have shown that tick free herds can perform 25% better than those infested. The free herds have faster weight gains, have shorter calving interval, reach puberty earlier and have high quality and high milk yield [4]. The overall global costs of control and production losses due to ticks and tick-born diseases were estimated to be more than US $7 billion [5]. In Ethiopia an annual estimated loss of 1 million US$ is attributed to the down grading of hides and skins due to tick infestation. If the losses from reduced productivity death and cost of tick control are all included, the estimated total loss obviously is much greater than this [6].

Ticks compete for nutrition they suck blood, intestinal helminthes compete with the affected hosts and result in malnutrition and loss of body weight or retarded growth. They consume blood, secrete toxic substances which slow bone marrow activity and cause hemorrhage and hence anemia, that they lead to death and they transmit disease like bacterial, viral, protozoal and other diseases [3]. Heavy infestation in susceptible groups can

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also result in mortalities. Ticks usually cause trauma and favor opportunistic organism to get access and cause secondary infection. Generally they culminate in loss of production and performance of the hosts. The most important economic loss due to tick infestations is due to the damage they cause to the hides. They are responsible for downgrading the commercial value of significant proportion of hides during processing. In Ethiopia several ticks and tick-borne infectious diseases are present but East Cost Fever, caused by *Theleria parva* and its vector, *Rhipicephalus appendiculatus,* as well as *Babesia bovis* and *Theleria annulata* have not yet been detected[7].

Ticks have external sign of body segmentations and are divided in two body components [8] that is the gnathosoma or capitulum (the mouth part or a fusion of head and thorax) and the idiosoma (the abdomen). All ticks at each stage of life cycle parasitize animals, crawling on their host and attaching to the skin with their mouth part, which consist of hypostomes and palps, penetrating the epidermis while hypostome penetrate to dermis with the help of chelicerae [9].

The families of ticks parasitizing livestock are categorizing in to two, Argasidae ("soft ticks") and Ixodidae ("hard tick"). Although both share certain basic properties, Argasids and Ixodids differ in many structural, behavioral, physiological, ecological, feeding and reproductive patterns [10]. Most ticks are active during warm period of the year and undergo hibernation or become dormant during the cold period, they hide within fissures in the ground, under rocks or in cracks and buildings.

Hard ticks (Ixodidae) have mostly four life stages: egg, six-legged larvae, eight-legged nymph and adult. After the egg hatches the tiny larvae sometimes called "a seed tick" feed on appropriate host. The larvae then molts in to larger nymph. The nymph then feed on host and molt into larger adult [11]. According the number of host they require during their life cycle Ixodids species are classified as one-host ticks, all the parasitic stages i.e. larvae, nymph and adult on the same host; two-host ticks, larvae attach to one host feed and molt to nymphal stage and engorged after which they detach and molt on the ground to adult and three host ticks, the larvae, nymph and adult attach to different hosts and all detach from the host after engorging and molt on the ground and multi-host ticks (Argasids) a large number of hosts are involved and it is common to have five month, each completed after engorging and detaching from the host [12].

Both female and male adult of hard tick feed on host, then the female lay eggs sometimes after feeding. They wait for host animal from the tip of the grass and shrubs (not from trees). When brushed by moving animal or person, they quickly let go of vegetation and climb on the host [13]. Within the Ixodidae genera of tick are economically important: *Amblyomma*, *Hyalomma* and *Rhipicephalus*[14]. Ixodidae are the efficient carries of diseases because they attach firmly when sucking blood, feed slowly and may go unnoticed for considerable time while they feed. They take several days to complete the feed [4].

The successful implementation of rational and sustainable tick control programs in grazing animals is dependent upon a sound knowledge of the epidemiology of the parasite due to interaction with the host in specific climate, management and production environments. In some countries substantial ecological and epidemiological knowledge bases have been established through extensive studies and field trials. On the contrary, developing countries including Ethiopia lack such information due to sufficient human, economic and infrastructural recourses [13].

Acaricide application is still the main method of tick control in Ethiopia. Arsenicals and chlorinated hydrocarbons have been banned because of the threat to human health and the emergence of acaricide resistance against economically important species of tick [15]. Currently organophosphate is the most widely used chemicals although evidence of resistance is emerging. Amides and pyrethroids have recently been introduced, while plants that have acaricide properties are widely used for tick control in rural areas [16]. However, there is no effective legislation for the importation and marketing of these compounds or for monitoring their use and efficacy in the country.

Information of tick species prevalent in the area, relative seasonal abundance of the species and the predilection site of these ticks on the host are prerequisite in controlling ticks and tick borne diseases [2]. Therefore, the objectives of the study were (i) to estimate the prevalence of hard tick or Ixodidae in bovine in and around Mizan Teferi.

MATERIALS AND METHODS

Study Area: The study was conducted in MizanTeferi, which is located in the Southern Nations Nationality and People's regional state. Mizan Teferi is 565 km far from

Addis Ababa. The climate conforms to the Ethiopian woynadega. Geographically Mizan Teferi zone is located between 5°33` to 7°21`N latitude and 34^0 88` to 36°14`E longitudes and has an altitude ranging from 500-2500 meter above sea level. The main occupation of the rural population is mixed farming system. The livestock species include cattle, sheep, goats, horse, donkey and poultry. The vegetation in the area is mainly wet savanna grass land type of vegetation. It has an area of 1996.80 km^2 and about 475,902 human populations of which 89.8% live in the rural part of the region. The livestock population of the zone is 778,056 cattle, 112,793 sheep, 91,939 goats, 528,249 chickens, 12,559 horses and 1,035 donkeys. Agro ecologically, the zone is divided into lowland (50%), midland (45%) and highland (5%). The average annual rainfall ranges between 400 and 2,000 mm and the mean temperature ranges between 15^0C and 27^0C, respectively. The rainfall is with short rainy season from March to May and long rainy season from June to November followed by the dry season from January to February [17].

Study Animals: The study was conducted on a total of 384 cattle. The animals were selected and sampled using random sampling technique from the study area for tick collection and identification from different body region of the cattle in and around MizanTeferi. For each animal, body condition were determined based on Nicholson and Butterworth [18].

Study Design: Cross sectional survey was conducted to address up to date information on the prevalence of common adult hard tick (Ixodidae), favorable predilection site and the relative tick burden and to assess possible risk factors that affect tick infestation in cattle in and around Mizan Teferi.

Tick Collection, Count and Identification: Removal of adult tick was carried out from November 2010 to March 2011. During sampling each animal was either restrained in crash, casted and laid down or restrained with rope and half-body collection on alternative body sides of the cattle was made. All visible attached adult ticks of all species were collected from seven body regions (ear, head, dewlap, brisket, udder, tail, scrotum) of each animal. Ticks were removed carefully and gently in a horizontal pull to the body surface by hands. The collected adult ticks were kept for identification in pre-labeled bottles containing 70% ethanol [19, 20].

Petri-dishes and stereomicroscope were used for identification. The collected ticks from each container were placed into a Petri-dish then identification was carried out under stereomicroscope based on standard identification procedure described by using taxonomy of African tick identification manual [21].

Sample Size Determination and Sampling Technique: The sampling procedure was conducted using systematic random sampling techniques, which ensure the sample is evenly distributed across the study population. The sample size was calculated according to Thrusfield [22]. Since there was no priveous study in the area, 50% expected prevalence was taken with 95% confidence interval (95% CI) and 5% desired absolute precision (d=0.05).

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

were
n= required sample size
Pexp= expected prevalence
d= desired absolute precision

Therefore, a total number of 384 cattle were sampled in the study.

Data Analysis: The data collected were entered into Microsoft Excel spreadsheet and analyzed using pronounced jump (JMP**)** 5.0 software. The determinants of tick prevalence were investigated using present values and Pearson's chi-square (x^2). A statically significant association between variables was said to exist if the calculated P<0.05 at confidence level.

RESULTS

A total of 384 cattle were considered for the survey. A total of 3490 adult ticks were collected from 384 cattle comprising two genera and five species (Table 1). The genera *Amblyomma* and *Rhipicephalus* with relative infestation rate 83.69% and 16.27% were recorded respectively (Fig. 1).

The animals were infested significantly more by *A. cohaerans* than others with a relative abundance of 40.74% and male to female ratio was (1.71:1). *A. gemma* was the second most abundant tick species found with a

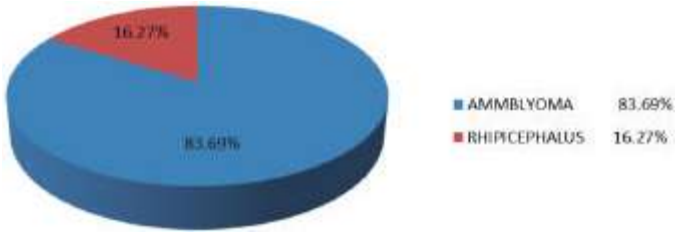

Fig. 1: Infestation rate of tick genera on cattle.

Table 1: Tick genera and their distribution in study area

Location (PA)	Number of animals examined	Amblyomma No. (%)	Rhipicephalus No. (%)	Total No. (%)
Balt	70	376(10.77)	38(1.1)	414(11.86)
Gariken	63	318(9.11)	0(0)	318(9.11)
Gacheb	67	366(10.49)	0(0)	366(10.49)
Kubt	61	296(8.46)	40(1.15)	336(9.63)
Tum	66	716(20.5)	490(14.04)	1206(34.55)
Yale	57	850(24.35)	0(0)	850(24.35)
Total	384	2922(83.72)	568(100)	3490(100)

Table 2: Tick species and their distribution at study area

		A.cohaerens			*A.gemma*			*A.lepidum*		
Location (PA)	No. of animals examined	Male	Female	Total (%)	Male	Female	Total (%)	Male	Female	Total (%)
Tum	66	212	78	290(20.39)	218	86	304(25.25)	94	28	122(41.12)
Balt	70	152	48	200(14.06)	110	48	158(13.12)	14	4	18(6.08)
Kubt	61	94	78	172(12.09)	70	30	100(8.3)	18	6	24(8.1)
Gariken	63	84	86	170(11.95)	92	56	148(12.3)	0	0	0(0)
Gacheb	67	106	78	184(12.93)	106	58	164(13.62)	16	2	18(6.08)
Yale	57	250	156	406(28.5)	256	74	330(27.4)	94	20	114(38.51)
Total	384	898	524	1422(100)	852	352	1204(100)	236	60	296(100)

Table 2: Continued. Tick species and its distribution at study area

		R. decolaratus			*R. evertsievetsi*		
Location (PA)	No. of animal examined	Male	Female	Total (%)	Male	Female	Total (%)
Tum	66	72	234	306(79.68)	130	54	184(100)
Balt	70	34	4	38(9.89)	0	0	0(0)
Kubt	61	30	10	40(10.41)	0	0	0(0)
Gariken	63	0	0	0(0)	0	0	0(0)
Gacheb	67	0	0	0(0)	0	0	0(0)
Yale	57	0	0	0(0)	0	0	0(0)
Total	384	136	248	384(100)	130	54	184(100)

relative abundance of 34.5% and its male to female sex ratio was (2.42:1). *Rhipicephalus decularatus* was the third most abundant tick species found with the relative abundance of 11% and its male to female ratio was (1.82:1). During study period *A. lepidum* was found with a relative percentage of 8.48% and its male to female ratio was (3.93:1). *R. evertsi evertsi* was also found with a relative percentage of 5.27% and its male to female ratio was (2.4:1) (Table 2).

This study indicated that the most preferable site of attachment of ticks is udder and scrotem (41.6%), brisket and dewlap comes next with 29% and 24%, respectively (Fig. 2).

The prevalence and significance of currently identified tick species in body condition and agro ecology of animal are assessed. The burden of tick on cattle had statically difference ($P<0.005$) between cattle found in lowland and midland, which was higher in low land. Although significant difference ($P<0.005$) in *A. gemma* infestation level on body condition, insignificant ($P>0.005$) were recorded for the other observed tick species (Table 3).

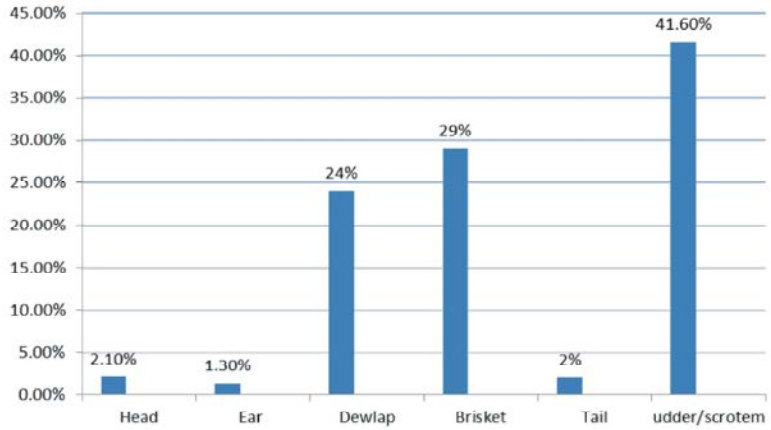

Fig. 2: Distribution of ticks in relation to body part of the animal

Table 3: Prevalence of different tick species in relation to Body condition and Agro-ecology

Risk factor	Total number of animal examined	*A. cohaerens*	*A.gemma*	*A.gemma*	*B.docolaratus*	*R. evertsievertsi*
Body condition		Positive (%)	Positive (%)	Positive (%)	Positive (%)	Positive (%)
Poor	50	15.85	15.49	14.49	22.35	19.61
Medium	303	77.24	6.57	0	74.12	76.74
Good	31	6.91	77.93	85.51	3.5374.12	3.92
Chi square 5.6 3.6 7.4 10.4 3.26						
P-value 0.06 0.16 0.02 0.005 0.196						
Agro-ecology						
Low land	242	70.24	62.30	25	29.76	20.24
Mid land	132	52.27	42.42	4.55	7.58	0
Chi square 12.14 13.86 24.58 24.23 30.8						
P-value 0.0005 0.0002 0.0001 0.0001 0.0001						

Table 4: Prevalence of different tick species in relation to post treatment with accaricide, sex, age and season

Risk factor	Total number animal examined	*A. cohaerens*	*A.gemma*	*A.lepidum*	*B.decolaratus*	*R. evertsievertsi*
Posttreatment		Positive (%)	Positive (%)	Positive (%)	Positive (%)	Positive (%)
Treated	103	27.24	22.97	23.19	22.35	10.68
Non-treated	281	72.76	77.93	76.81	77.65	21.25
Chi square 0.06 5.51 0.56 1.11 0.82						
P-value 0.8 0.019 0.45 0.290.36						
SEX						
Male	167	61.08	20.36	59.28	26.35	85.03
Female	217	66.36	16.13	52.53	18.89	11.98
Chi square 1.143 1.1461.7393.042 0.732						
P-value 0.2849 0.2844 0.18720.08120.3923						
Age						
Calf	53	62.26	15.09	39.62	22.64	13.21
Young	115	64.35	24.35	52.17	24.35	14.78
Adult	216	64.35	15.28	61.11	20.83	12.50
Chi square 0.0864.533 8.677 0.547 0.340						
P-value 0.95770.1037 0.01310.76070.8438						
Season						
Dry	259	54.47	47.89	18.84	22.35	0
Wet	125	45.53	52.11	81.16	77.65	100
Chi square 59.36 92.78 86.60 97.24 131.79						
P-value 0.0001 0.0001 0.0001 0.0001 0.0001						

The prevalence of tick species were also studied by considering the animal age, sex of ticks, post treatment with acaricide before one week ago and season of study area.A significance difference (P<0.005) was only observed for the season for tick species. For the age of the animal a significance difference was observered for *A. gemma* only, regarding the treatment only for *A. lepidu* (Table 4).

DISCUSSION

The overall prevalence of cattle tick infestation in the area was 95.05%. From 384 samples of cattle,365 were harboring at least by one species of tick. These indicate that significant numbers of cattle were infested. Different factor may facilitate for getting of ticks and infestation of animal like few intensive animal production systems; little attention of the owner to the cattle, seasonal factor may increase the infestation level in the area. The common widely used animal production system in the area is an extensive type of production system in which animals are mixed on grazing and watering site.

The tick species identified in the area through the study period from November 2010 to March2011 are *A. cohaerans, A. lepidum, A. gemma, R. decolaratus, R. evertsi evertsi* were identified in the area. *Amblyomma* was the most abundant tick genus in the area accounts (83.69%) from 3490 ticks collected during study period and followed by *Boophilus* by *Rhipicephalus* 16.27%.

Amlyomma cohaerans was the most abundant tick species in the area accounts 40.74%% which agreed with Seleshi*et al*.[23] has reported it is the most abundant tick species in Majii (Kefa) in South Ethiopia. This tick species found in very high number was probably due to geographic location. The distribution of *A. cohaerans* is generally between at altitude of about 1200-1500 m with annual rainfall of about 625-1500 mm p.a. The prevalence of ixodid ticks in this study disagrees with other reports in Western Shoa [24]. The result disagrees with tick survey conducted in southwestern Ethiopian region, Jimma [25] which was found to be the most prevalence of ixodid in area with the prevalence of 83.1% may be due to the climate much of the year around this area. The result was somewhat less than previous report with tick prevalence rate 50.15% by Seid [26] this may be due to the improvement of management system. The result showed a significant difference (P<0.05) of the tick load in the rainy and dry season with *A. cohaerans* being mostly collected around months of November and December, which were period immediately after rainy season in the area and decrease from collection around the month of January, February and early March which was dry period. Similarly it has reported by Feseha [27], Bekele [28] and Solomon *et al*. [29]. Prevalence was also significantly different in the present study as well as in the above mentioned previous studies regarding the agro-ecology with a higher prevalence in the lowland than in the midland.

The 2nd abundant tick species in study area was *A. gemma* with the prevalence of 34.5%. The distribution of *A. gemma* is generally between the 250 and 750 mm annual rainfall [27]. The prevalence of disagrees with other reports conducted in Southwestern Ethiopia, Jimma,that reports low prevalence of this tick which may be due to geographic location and weather condition Yitbark [25]. *Amlyomma gemma* is statically significant (P<0.05) in case of season and agro-ecology with higher numbers during wet season than dry season. No significant difference in prevalence of *A. gemma* could be found regarding treatment or body condition of the animals.

Rhipicephalus decolaratus is the third common tick species in the study area during the period of study conducted with the prevalence rate accounts 11% and it has reported as prevalent in many other parts of the country such as Rift Valley [30]. The prevalence of this study disagrees with finding of Tameru[31] at Assela showing with the prevalence of 18% and Teshome [32] reported the highest counts 80%. This may be due to geographical and altitudinal factors which are a 1500 to 1600 above sea level at Metekel ranch. According to Hoogstral[19] *R. decolaratus* was present at all altitude from seas level to high mountains which occur mainly in humid area [33]. The prevalence of *R. decolaratus* was significantly different (P<0.005) in case of season and agro ecology. *Rhipicephalus decolaratus* (Blue tick) was common in the present study around the months of November and December, which were a period immediately after rainy season in the area and decrease from collection around the month of January, February and early March which was dry period. This is in accordance with the other authors mentioned previously butit contradicts with Shiferaw [34] in Wolayta area reported highest frequency observed during dry season. *Rhipicephalus decolaratus* transmit *Babesia bigemina* and *Anaplasma marginale* to cattle and severe tick infestation level can cause tick worry and anemia [3].

Amplyomma lepidum was the fourth most prevalent tick species in the area with the prevalence rate 8.48%. It occurs in a wide variety of climatic regions, from

temperate highland to savannah, steppe and desert, but it inhabits most commonly arid habitats with 250-750 mm rainfall, Morel [33]. The study area receives an annual average rainfall of 400-2000 mm and is thus mostly above the preferred range of this tick species which could explain the relatively low prevalence. It is the suspected vector of heartwater, *Thieleria mutans*, *Thieleria velifera, Coxiella burnetii* and *Rickettsia conori* Onen*et al*. [21] The result of this study is somewhat greater than the survey done in, Jimma Yitbark [25] which was found with the prevalence of 1.2%. This may be due to the geographical location of the area.

The study revealed that *R. evertsi evertsi* was least abundant tick species in the area with the prevalence rate 5.27%. This finding contradicts Solomon *et al*. [7] in Ghibe who recorded highest count. This tick species can survive and reproduce within the range of 350-3500 m.a.s.l in various habitats throughout Ethiopia [35]. Prevalence of *R. evertsi evertsi* was statically significant (P<0.005) in case of season and agro ecology in which found high in number during wet season and in lowland. This geographical distribution is different from the findings of Morel [36] who mentioned that the native distribution of *R. evertsi evertsi* in Ethiopia seems to be connected with middle highland, dry savannas and steppes in association with zebra and ruminant. *R. evertsi evertsi* is widely distributed throughout Ethiopia, but found less in very dry areas.

This study showed that except *R. decolaratus* the number of male is greater than female which agree with previous report (Solomon *et al.* [7] and Mesele[37]. This is due to the fact that the period of female attach on the host relatively lesser than male. After engorged drop to the ground to lay egg, but male remain attach on the host. Regarding *R. decolaratus* the male very small in size than female that make difficult to collect during collection.

This study showed that the most body part of the animal to be most likely infested is the udder/scrotum (41.6%), followed by brisket (29.0%), dewlap (24.0%), head (2.1%), tail (2.0%) and ear (1.3%). The attachment site is determined by variety factor such as density of the animal (Kettle, 1995) [38], time and season [39], inaccessibility of grooming [40]. This is important in order to know which body parts of the animal require more attention during spraying.

Generally the density of tick population showed seasonal variation that decrease from November to January and February. Similarly it has been reported by Feseha [27], Solomon *et al*. [7] that the infestation level of tick is low during dry season and increase during rainy season. Even though, this study was only conducted for short period of time (November 2010 to March 2011) it is possible to indicate seasonal variation of tick population by comparing the number of ticks collected during dry and rainy season.

Main tick control method in the area of study conducted is acaricide application. The type of acaricide commonly used in the area was diazinone 60% with the frequency of 1 to 3 times per year during the peak season of tick infestation, but according to Sutherst *et al*. [41] suggested that effective acaricide concentration must be applied every 21 days, so that all ticks that attach to animals are exposed to lethal dose that are true during the wet season. The application method of acaricide in the area mostly hand spraying using Kapsack sprayer and hand dressing. Although dipping is the preferable and more effective method of application it is still not the used in the area, because it is technically more difficult, for example requiringthe construction of dipping facilities.

CONCLUSION AND RECOMMENDATIONS

The most important and abundant tick species belongs to *A. cohaerans, A. gemma R. decularatus*, *R. evertsi evertsi* and *A. lepidum*. Of these *A. cohaerans, A. gemma* and *R. decularatus* are the most abundantly distributed tick through the period of study due to conducive environmental factor prevailing in the area. *Amlyomma cohaerans* is the most abundantly distributed tick species in study area..

In light of the aforementioned conclusion, the following recommendations were forwarded;

- Encourage communities to practice safe and economic traditional tick control methods as part of integrated tick management.
- Tick control program (application of acaricide) should be continued with an increasing frequency of application in wet months.
- Detection of acaricide resistance tick species which are economically important since limited types of acaricids were used in the area.

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