Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.8, No.21, 2018

Prevalence of Tick Infestation in Cattle in Bako District, West Shoa Zone, Ormia Regional State, Ethiopia

Musa Shamo Nuna[1] Daba Gudeta Guder[2]
1.Dodola Livestock and Fishery office, West Arsi, Oromia regional State, Ethiopia
2.KL University-Department of Biotechnology, Vadesswaram post, Guntur District-52202, Andharapradesh, India

Abstract
Tick infestation is the most important parasitic disease of cattle and it remains a major burden to cattle producers as well as resulting in significant economic losses worldwide. A cross sectional study was undertaken from November 2015 to March 2015 E.C at Bako district in Oromia Regional state of Ethiopia to identify the major tick species of cattle and to determine the tick burden and as well as to asses possible risk factors that might be associated with cattle infestation. The study involved adult ticks to determine the prevalence and their predilection site in cattle at Bako district and Bako Veterinary Clinic that brought from five kebeles. A total of 400 cattle were selected by simple random sampling method. Adult ticks were collected from nine half-body regions of cattle into universal sampling bottle containing 70% ethanol, then identified by using stereomicroscope and counted to know the tick burden. As a whole 4 tick genera and 5 species were identified in the study period. The tick genera identified were Amblyoma, Boophilus, Rhipicephalus and Hylomma. During the study, a total of 645 adult ticks belonging to five species were collected. In this study, the tick species identified and their relative abundance were *Amblyomma coherence* (**36.43%),** *Amblyomma variegatum* (**29.45%),** *Boophilus decoloratus* (**20%**), *Rhipicephalus eversti eversti* **(13.17%)** and *Hylomma marginatum rufipes* (**10%).** *Amblyomma* ticks were found to be the most abundant in the study area and constituted **65.89**% of the ticks collected. Statistical comparison of the mean tick burden within age groups, breeds and sexes were not significant (**p>0.05**). The difference in the mean tick burden within body condition and physiological status group was to be statistically significant.
Keywords: Prevalence, ticks, Cattle, Bako, Ethiopia.

INTRODUCTION

Livestock constitutes an important component of agricultural and household economy in the developing world and play important role to enable the farmers move out of poverty. Ethiopia is the country with the largest number of livestock in Africa and livestock production plays a major role in the overall development of the country's agriculture. Nevertheless cattle productivity is low like developing countries (Solomon et al., 2001). The occurrence of disease and parasites are among the major contributing factors that have impeded the full exploitation of cattle potential in Ethiopia (Messele, 1989).

Ethiopian livestock contribute about 18.8% of the total GDP (FAO, 1984). Among livestock, cattle are the primary resources for people and government of Ethiopia (ILRI, 1999). Livestock production in many parts of the world is constrained by several factors among these constraints disease stands in the first line. Ecto-parasites particularly ticks have considerable impact on animals either by inflecting direct damage or by transmission of tick born diseases. Tick and tick born disease affect 90% of the world's cattle population and are widely distributed throughout the world, particularly in tropical and sub-tropical countries (Decastro, 1991). Tick infestation is of great important in the production of animal disease and can cause direct losses (Fesaha, 1983).

Vectors and vectors born diseases are major constraints to the development of viable livestock industries wherever they occur (Mekuria, 1987). Tick and tick born diseases are widely distributed throughout the world particularly in tropical and sub-tropical countries, which cause a tremendous economic important in livestock production (Kettle, 1995).

In most part of Africa, including Ethiopia tick and tick born diseases, together with tsetse and trypanosomosis are economically very important diseases (Solomon *et al*., 2001). In Ethiopia, ticks occupy the first place amongst the external parasites, and the economic loss incurred when they infest livestock, particularly cattle, is enormous (Feseha, 1983). The problem is severe in developing countries where the resources for control and eradication are very limited (FAO, 1984). Tick and tick born diseases are major constraints in the genetic improvement and up-grading of cattle breeds; especially European breeds are highly susceptible to the various tick and tick born diseases. Thus, ticks are big constraint for efficient livestock production in most of the tropical sub-tropical areas of the world (Waker, 1970).

Ticks are important vectors for disease like babesiosis, anaplasmosis and heart water in domestic ruminants. They also cause non specific disease symptoms like anemia, dermatitis, toxicosis and paralysis (Morel, 1980). In Ethiopia, ticks are common in all agro-ecological zones of the country (Morel, 1980; pegarm et al., 1981). Therefore, relevant data on the population dynamics of ticks is essential for the development or effective control

of tick and tick born diseases control strategies. Studying the tick on livestock under their natural conditions without any control measure is also useful for understanding the host-parasite relationship and the seasonal variation of tick population (Alekaw, 1998). In Ethiopia, extensive surveys have been carried out on the distribution of ticks on livestock in different region of the country (Pegram *et al*., 1981; Morel, 1980; Decasro, 1997). Despite extensive data available on tick distribution and abundance, a survey was conducted by Hussein on identification of tick species in Bako to know its infestation.

Therefore, the objectives of this study are:
1. To identify tick species infesting cattle in and around Bako district.
2. To identify the predilection sites of important tick species infesting cattle and
3. To assess possible risk factors for tick infestation in Bako district.

MATERIAL AND METHODS

Study Area and Study Period: The study was conducted at Bako district which is found in Western Shoa Zones of Oromia Regional State in Ethiopia. Bako is located at 251km west of Addis Ababa. The area lays $09^0$6'N latitude and 37^0E longitude at an altitude of 1650m.a.s.l. the rainfall pattern is bimodal with annual rainfall of 1243.7mm and with short rainy season in March or April and high rainy season from May to September. It has a warm humid climate and the temperature range between of 14^oc- 28^oc. A number of livestock including cattle, sheep, goat, and donkey are reared in this area and are managed extensively and semi-intensively with the exception of few farms (BARC Livestock Farm). Bako district has livestock population of 124192 cattle, 11213 sheep**,** 12666 goats, 7424 donkeys, 3221 horses, 720 mules and 184192 poultry. During the study period (November to March 2003 E.C) adult ticks were collected once from only cattle species at the selected sites. The animals were local and exotic breeds which are owned by different producers. The animals were managed under extensive and semi-intensive production system. Maize, sugarcane, and teff, are grown under rain fed condition. Natural pasture, the major feed resources of livestock, is composed of predominantly grass, Weeds and over left sugarcane with varying proportions.

Study Animals: The study was conducted among cattle in Bako district: One livestock research center (Bako Agricultural Research Center) and cattle come from 6 Kebeles of Bako district to Bako Veterinary Clinic were selected. From these six areas a total of 400 animals were selected using random sampling method.

Sample Size Determination: Since the prevalence of tick infestation of cattle in and around Bako, tick infestation has been reported, 50% expected prevalence was used. In addition, 95% confidence interval and 5% desired absolute precision also used Thrusfield [9]. Hence the sample size was calculated by using the following formula.

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

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

Therefore, the total sample size was calculated to be 384. In order to be accurate, additional 16 cattle were used. In this study, 400 cattle for adult tick samples examined, 215 (53.8%) cattle were positive for tick infestation.

Study Design and Sample Collection: A cross- sectional study was conducted to determine the prevalence of tick infestation. Adult ticks collection for identification was performed on nine half-body regions of cattle. Half body tick collection on alternative sides was made. The animals were properly casted and adult tick were collected from nine different sites of the body (udder, perineum, dewlap, sternum, abdomen, neck, scrotum, fore limb, rear limb) and placed in a separated universal bottle containing 70% ethyl alcohol as a preservative, and collection was made twice a week. The universal bottles were properly labeled with date and body sites before collections were made and then brought to the Bako Agricultural Research Center laboratory where the ticks were identified. The half body tick counts were doubled to obtain whole body tick burden according to Keiser (1987). During sampling age, breed and sex of the cattle were recorded.

Study Methodology: The animals were properly casted and adult tick were collected from nine different sites of the body (udder, perineum, dewlap, sternum, abdomen, neck, scrotum, fore limb, rear limb) and placed in a separated universal bottle containing 70% ethyl alcohol as a preservative. the sample collection was made twice a week. The universal bottles were properly labeled with date and body sites before collections were made. Petri dishes, forceps, and stereomicroscope were used for tick identification. The collection from each container was placed into a Petri dish. Then identification was carried out under stereomicroscope based on tick identification keys of Keiser (1987), Mathysee and Colbo (1987).

Statistical Analysis: Computation of descriptive statistics was conducted using SPSS FO windows (version 16)

and stata for windows (version 8) statistical software. Descriptive statistics such as percentages, proportions and frequency distributions were applied to compute some of the data. The data collected from the study sites were entered into Excel Spreadsheet (windows) and analyzed with SPSS FO Windows (version 16) and stata for windows (version 8) statistical software. The point prevalence for the parasites was calculated for all data as the number of infested individuals divided by the number of individual's sampled X 100. Categorical data were analyzed first with the Chi-square (2) test for independence as a screening process. ANOVA was used to compare means of three or more groups. A P value <0.05 was required for significance.

Result and discussion

Out of 400 cattle for adult tick samples examined, 215(53.8%) cattle were positive for tick infestation. The tick prevalence in cattle based on age was young 24(11.2%) and adult 191 (88.8%), based on sex, female 138(64.2%) and male 77(35.8%), based on body conditions poor 48(22.3%), medium 83(38.6) and good 84(39.1%), based on physiological status lactating 63(29.3%), dried off 50 (23.3%), fattening 25(11.6%), pregnant 16(7.4%) and other 61(28.4%) and with breed of cattle, local zebu 208(96.7%) and cross breed 7(3.8%).

With regard to identification of species of ticks, a total of five species were identified with *Amlyomma coherens* (36.43%) was the most prevalent species followed by *Amlyomma varigatum* (29.45%), *Boophilus decoloratus* (20%) and *Rhipicephalus evertsi evertsi* (13.17%), and *Hyalomma marginatum refipes* (10%) was the least prevalent species found (table 1).

In this study a total of 645 adult ticks were collected from 400 cattle that comprising four genera and five species. The genera recorded were Amlyomma, Boophilus, Rhipicephalus and Hyalomma with relative infestation prevalence of 65.89%, 20%, 13.17% and 10%, respectively. Among the five tick species identified two species (*A. coherens and A. varigatum*) were from the genus Amblyomma, one species (*B. decoloratus*) from the genus Boophilus, one species (*Rh. Evertsi evertsi*) from the genus Rhipicephalus, and one species (*H. marginatum rufipes*) from the genus Hyalomma.

Table 1: Distribution of adult tick species in and around Bako district, Ethiopia

Types of tick species	Number of ticks	Tick prevalence
Amblyomma coherens	235	36.43%
Amblyomma varigatum	190	29.45%
Boophilus decoloratus	129	20%
Rhipicephalus evertsi evertsi	85	13.17%
Hylommaa marginatum rufipes	6	10%
Total	645	100%

In the present study, the relative infestation of tick species on cattle sampled showed *A. coherens* was the most abundant tick species found with prevalence of 36.43%. The examined animals carried significantly more ticks of this species than other ticks throughout four months study period. *A. varigatum* was the second most abundant tick species found with relative abundance of 29.45%. *B.decoloratus* has also found throughout the study period with a relative percentage of 20%. *Rh. Evertsi evertsi* was the fourth abundant tick species found throughout the study period with relative infestation rate of 13.17%. *H. marginatum rufipes* was the fifth abundant ticks with relatively low number 10%.

About 53.8% of the examined animals were found to be infested by ticks. The infestation level of ticks was not a statistical significant difference (P=0.305, X^2=1.053, df=1) and there was statistically significant between body conditions (P=0.022, X^2= 7.60, df=2) the prevalence was higher in the poor body condition than in the good body condition. The infestation level based on sex and age were not statistically significant (P=0.100, X^2= 2.702, df=1) and (P=0.000, X^2=1.053, df=1) respectively, and the physiological status of the animals were statistically significant (P=0.000, X^2=83.604) and breed of cattle was not statistically significant (P=0.575, X^2=0.315, df=1). (Table 2).

Table 2: Results of chi-square analysis of different risk factors for tick spp. Infestation in cattle

Risk factors	No exam	No positive	prevalence	X^2	Df	P value
Body condition						
Poor	70	48	68%			
Medium	167	83	49.7%	7.609	2	0.022
Good	163	84	51.5%			
Physiological status						
Lactating	83	63	75.9			
Dried off	159	50	31.4	83.604	4	0.000
Fattening	25	25	100			
Pregnant	16	16	100			
Other	117	61	52			
Ages						
Young	51	24	47	1.053	1	
Adult	349	191	54			
Sexes						
Female	271	138	50.9	2.702	1	
Male	129	77	59.9			
Breeds						
Local zebu	385	208	54	0.315	1	
Cross breed	15	7	46.6			

Each species of tick in the study prefer a site of attachment on the animal body as shown below, the preferred sites for *Amblyomma coherens* was udder+scrotum (47.29%) and perineum (15.35%); the preferred sites for *A. varigatum* udder +scrotum(47.29%), perineum(15.35%), dewlap(6.05%); the preferred predilection site for *Rh. evertsi evertsi* was Perineum(15.35%), dewlap(6.05%) and udder+scrotum (47.29%). As well as *B. decoloratus* usually infests the udder +scrotum(47.29%), perineum(15.35%), dewlap(6.05%), abdomen(2.48%), forelimb(6.36%) and rearlimb(12.09%). *H. marginatum rufipes* was mainly found on the neck. Generally, the overall tick distribution is observed mainly on udder+scrotum (47.29%), perineum(15.35%) and rearlimb(12.09%). (table 3).

Table 3: percent of ticks with host body attachments or sites

Attachment sites	Number of ticks	Prevalence of site
Neck	49	7.60
Scrotum	176	27.29
Udder	129	20.00
Perineum	99	15.35
Sternum	18	2.79
Dewlap	39	6.05
Abdomen	16	2.48
Fore limb	41	6.36
Rear limb	78	12.09
Total	645	100.00

The highest tick burden on cattle at Bako district during the four month study period was recorded in November; this is relatively a wetter month. The total tick burden generally decreased from November to March that means from relatively wetter month to drier month.

DISCUSSIONS

The present study revealed that the total prevalence of ticks were 53.8% among cattle which studied in Bako and around Bako district. This high prevalence might be attributed to risk factors (age, sex, breed and physiological status), absence of the intervention and lack of management as well as high wet and humidity weather condition. In this study *A. coherens* was the most abundant tick species (36.43%). The high number was probably due to favourable geographic location for this tick. The prevalence of this study was disagrees to other report in western shoa (Solomon *et al*., 2001) and in Bako (Hussein, 2009) with the prevalence of (2%). The result of this study was agrees with tick survey conducted in south western Ethiopia in MizanTeferi (Seid, 2004) and in Jimma (Yitbarek, 2004) were found to be the most prevalent in those areas with a prevalence of 50.5% and 83.1% respectively. This may due to the same weather condition throughout the year. In western Ethiopia, where the climate is humid much of the year, A. coherens is the most prevalent and abundant tick on cattle (Pegram *et al*., 1981).

A.varigatum was found to be the second abundant tick species in the area (29.45%). The high prevalence

was might be condussive geographic location for this tick species, and due to its being relatively active throughout the year. Likewise, several researches, which had been conducted in different part of Ethiopia, indicated that *Amblyomma varigatum* is the abundant tick species with highest prevalence as present study such as North Omo (Tesfanesh, 1993), Bahir Dar (Mesele, 1989) and Bako (Hussein, 2009) with prevalence of 59%, 75.91% and 54.3%) respectively. *A. varigatum* is the most widely distributed cattle tick in Ethiopia (Morel, 1980; Pegram *et al.,* 1981) and has a great economic importance, because it is an efficient vector of Cowderia ruminantum. This parasite also causes the greatest damage to hide and skin because of its long mouth parts which render the commodity value less on world market if the ticks are large in number (Solomon *et al.,* 2001). Furthermore, more ulcers caused by this tick species become favorable sites for secondary bacterial infection like Dermatophilus congolensis (Kaufman, 1989).

B.decolratus, is the third abundant tick species (20%) in this study has also been reported as prevalent in many other parts of the country such as Rift vally (Pegram *et al.,* 1981; Solomon and Kaya, 1996) and in high land areas of Harer and Dire Dawa district (Mannueri and Tilahun, 1991). The result of this study disagrees with the finding of Alekaw (1998) at Metekel Ranch, Ethiopia showing a prevalence of 5.7% and slightly agrees Hussein (2009) at Bako with a prevalence of 18%. This may be due to the different in geographical location and altitude factor. This tick species is abundant in wetter highlands and sub-highlands receiving more than 800mm rainfall annually (Pegram *et al.,* 1981). The regional distribution of *B. decoloratus* is similar to *A. varigatum* (Feseha, 1981). *B. decoloratus* transmit Babesia begmina and Anaplasma marginale to cattle and severe sick infestation can lead to tick worry and anemia (Mokonnen *et al.,* 2001).

Rh. evertsi evertsi was the fourth abundant (13.17%) tick species in this study. This tick species was reported to be prevalent by other authors such as in Bahir Dar (Mesele, 1989), (Bahailu, 2004) and (Tammiru, 2008) in Assela. Morel (1980) mentioned that the native distribution of *Rh. evertsi evertsi* in Ethiopia seems to be connected with middle highland, dry savannas and ateppes in association with Zebra and ruminant and it is widely distributed throughout Ethiopia. This tick species shows no apparent preference for particular altitude, rainfall zones and seasons (Pegram *et al.,* 1981). *Rh. evertsi evertsi* is the possible vector of babesia, Rickettsia coronary, thiearia and East Cost Fever (Morel, 1980).

H. marginatum rufipes was the least abundant tick species collected this prevalence was 10% of the total collections. This study was disagree with Hussein (2009) in Bako with a prevalence of 1.2%. This is might be due to absences of intervention and proper management.

In this study, the most infested sites of the animal was scrotum(27.29%), udder(20%), perineum(15.35%), and rearlimb(12.09%). The predilection sites mentioned in the results corroborated with those reported by other author (Solomo *et al*., 2001) and (Mesele, 1989). A variety of factors such as density (Kettele et al., 1995), time and season (Evans, 1952), inaccessibility for grooming (Chandler and Read, 1961) have also been reported to determine the attachment sites of ticks. Information on predilection sites of ticks is helpful in spraying individual animals since it gives clue as to which part of the body requires more attention (Zelleke, 1980).

The study also shows that the infestation level of ticks were higher in the poor body condition than good body condition as prevalence with body conditions (P=0,022, X^2=7.60, df=2) in cattle. This may due to the immune compromised of poor body condition cattle. This present study also agrees with previous reports at MizanTeferi (Seid, 2004) and Asella (Tamiru, 2008). The prevalence of ticks based on age and sex on the burden of tick were not statistically significant (P=0.305, x^2=1.053, DF=1 and (p=0.100, X^2=2.702, df=1) respectively.

Even though, this study was conducted for a short period of time (November to March) it is possible to indicate the trend of seasonality of tick population by comparing the number of tick collected every month. There was a tendency of tick population that shows seasonal variation. That is decreasing from November to February, probably due to the change from slightly wetter month to the drier month. Similarly it has been reported by Feseha (1983), Alekaw (1998) and Solomon *et al*(2001) and that infestation by ticks during the dry months reaches very low level and during the rainy season the activity of adult tick become high.

CONCLUSSION

In this study ticks are highly prevalence in cattle at Bako district. This study result illustrate that ticks are still the most important parasitic diseases of cattle, and those ticks species remain the major burden to cattle producers and dairy farms. The species of tick circulating in the cattle survey was presumed to be a total of five species were identified of which *A. coherns* was the most prevalent followed by *A. varigatum* *B.decoloratus* and *Rh. evertsi evertsi,* and the *Hy. marginatum rufipes* was found the least prevalent species in the study. In spite of the fact that most of the cattle sampled were found to be infested with species, no clinical tick infestation was observed in cattle. Therefore, it is concluded that most tick infestations in cattle at Bako district, even infested ith *A. coherens* and *A. varigatum*, result in subclinical infestations. Taking into account the high proportion of the tick infesting species, *A.coherens, A. varigatum* and as well as *B. decoloratus* in infested cattle; however, the subclinical infestations they cause should not be underestimated as these infestations can still negatively influence animal productivity and cause economic losses due to, weight loss, failure of the cattle to grow to their

full potential and increased susceptibility to other diseases. In the final analysis, this study made it possible to identify some factors that were significantly associated with the risk of infestation with tick species. The body conditions and physiological status of the cattle were the most important risk factors that strongly influenced the detection of tick in the cattle. The present observations indicate that infestations in cattle due tick species infestations are more important in cattle in old age.

Therefore, based on the above conclusion the following recommendations are forwarded

- ✓ The cattle producers should have manage their animals separately because the older animals can serve as source of infestation for the younger ones.
- ✓ The owners should be watched their cattle regularly and provide appropriate treatment.
- ✓ To overcome the problems owner, using pasture management, acaricides application and rearing resistance breeds should be practiced.
- ✓ Government should provide intervention and research to develop long lasting prevention and control strategies to get rid of the ticks.

REFERENCES

Abebaw, G. (2004); Seasonal dynamics and host preference of *Boophilus decoloratus* Koch, 1944) on naturally infested cattle in Jimma zones, south western Ethiopia. Ethiopia Veterinary Journal, **18**(1):19-28.

Alekaw, S. (1998): Distribution of tick and tick-borne diseases at Metekel Ranch. Ethiopia Veterinary Journal, **vol. IV**, No.1, pp. 30.

Bahilu, A. (2004): A survey of ticks and tick borne blood protistia in cattle at AsselaArsi zone, DVM Thesis, faculty of veterinary medicine, Addis Ababa University Debrezeit, Ethiopia.

Bekele, H. (1987): Study of the geographic distribution of ticks on economically important Domestic animals in Illubabor, DVM thesis, faculty of veterinary medicine, Addis Ababa University, Debrezeit, Ethiopia

Bellete, M. (1987): A preliminary survey of ticks on four species of domestic animals in NekemteAwraja, DVM thesis Faculty of veterinary medicine, Addis Ababa University, Debrezeit, Ethiopia.

BirkhauserVerlag, Switzerland vaccination with in vitro attenuated rickettsiae. Infection and Immunity 59**:** pp. 729-731.

Branangan, D. (1970): The development and survey of *Rhipicephalus appendiculatus.* Neuman, in laboratory and field PHD thesis, Edinburgh University.

Brossard, M. (1998): The use of vaccine and genetically resistant animals in tick control: in genetic resistance to animal diseases. Rev.Sci. tech. off.IntEpiz. **17**(1): 88-99.

Chandeler, C. and Read, P. (1961): Introduction to parasitological, 10th ed., Jhon Wiley and sons Inc. pp. 882.

De castro. J.J. (1994): A survey of the tick species in western Ethiopia including the previous finding and recommandtion, for further tick survey in Ethiopia.Technical report AG DP/ETH/83/023. FAO, Rome. Pp. 1-83.

Dejenu, G. (1988): A preliminary survey of tick on domestic animals in Bale administral Region, DVM thesis Faculty of Veterinary Medicine, Addis Ababa University, Debrezeit, Ethiopia.

Etsay, K. (1985): Seasonal tick population survey at Bedele, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debrezeit, Ethiopia.

Evans, G.O. (1952): The distribution of Ixodesricines (L) on the body of cattle and sheep Bull. Ent Res. **41**: pp 709-723.

FAO (1984): Ticks and tick borne diseases control. A practical field manual. Vol.1. tick control. FAO, Rome. Pp 1-299.

Feseha, G. (1983): Notes on tick species and tick borne diseases of domestic animal in Ethiopia, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debrezeit , Ethiopia.

Gashaw, A. (2004): Seasonal dynamics and host preference of *Boophilus decoloratus* Koch,1944) on naturally infested cattle in Jimma zone, south western Ethiopia. Ethiopia Veterinary Journal, **18**(1): 19-28.

George. (1990): J. Agric, Entomology, Helmenths, Arthropods and Protozoa of domestic animals. 6th ed. Lea and Fibiger, Phlladelphia.Pp. 809.

Hogstral,H. (1956): African Ixodidae, (I) Risk of Sudan (with special to equatorial, province and with preliminary reviews of the genera Boophilus, Margaropus, Hyalomma). Res. Rep.N.M.005050.29-07.U.S government Department of Navy,Bur. Med. Surg, Washington, D.C. PP. 200-1101.

Hussein, Y. (2009): A preliminary survey of tick species and burden in cattle in and around Bako district, DVM thesis, Jimma University, school of Veterinary Medicine, Jimma, Ethiopia. Pp. 32.

ILRI (1998): preliminary result of the market-oriented smallholder dairy research project from a study carried out in Tanzania, Draft report. International Livestock Research Institute, Nairobi, Kenya.

ILRI (1999): Making the livestock work for poor, annual report ILRI. Nairobi, Kenya. Pp. 1-32.

Jewaro, A. (1986): A survey of tick and tick borne disease in Gamo Gofa administrative Region, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debreziet, Ethiopia.

Jongejan, F. (1991): Protective immunity to heart water infection in acquired system in the tropics, 2nd ed. UK, PP. 231.

Jongejan, F. and Uilenberg, G. (1989): Tick and control methods Ectoparasites of animals and control methods Rev. Sci. tech.off. Int. Epiz., **13**(4), pp. 1201-1226.

Jubb, K.V; Kennedy, P.C. and Palmer, N (1993): Pathology of domestic animals volume 1, 4th ed. Acadamic press, Inc. pp. 691.

Kathrine, M.K. (1976): Ticks of veterinary importance animal and plant health inspection service United States Department of Agriculture hand book number **487**. Pp. 1-122.

Kaufman, J. (1996): Parasitic Infestation of Domestic Animals: A Diagnostic Manual.

Kaufman, W.R. (1989): Tick host interaction a synthesis of current concepts arapsychologyToday, **5**(2): 47-55.

Keiser, M.N. (1987): Ethiopia, Report on tick taxonomy and biology, AG: DP/ETH/83/23 consultant report. Food and Agriculture Organization of the United Nations: pp. 92.

Kettle, D.S. (1995): Medical and Veterinary Entomology second edition, CAB International,Wallingford, Oxon, UK. PP. 440-485.

Latif, A.A. and Walker, A.R (2004): An introduction to the biology and control of ticks in Africa. ICTTD-2 Project. Pp. 1-29.

Mannueri, K. and Tilahun J. (1991): A survey of ectoparasites of cattle in Hareri and Dire Dawa districts, Harerge administrative region of Ethiopia. Bull. Anim.

Mathysee, J.E and Colbo,M.H. (1987): Ixodid ticks of Uganda. Entomological, Soc. Am Collage Parad MD.

Mehari, B. (2004): Distribution of livestock tick species in Awassa area, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debreziet, Ethiopia.

Mekennen , S. Hussein, I. and Bedhane, B. (2001): The distribution of Ixodid ticks in central Ethiopia On Dersteport Journal of Veterinary Research, **68**(4): pp. 243-251.

Mekuria, B. (1989): A preliminary survey of ticks on four species domestic animals in NekemteAwraja, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debreziet, Ethiopia. Pp. 1-35.

Mesele, A. (1989): Bovine tick survey in Bahir Dar Awraja, DVM thesis, Faculty of Veterinary Medicine, Addis ababa University, Debreziet, Ethiopia.

Mijauw, B. and Decastro, J.J (2000): Host resistance to tick and tick borne diseases: its role in integrated control breeding for disease resistance in farm animals, CAB International, pp. 153-169.

Morel, p. (1980): Study on Ethiopian ticks (Acaridea, Ixodida) Republic of France, Ministry of Foreign affairs,French Vet Mission, Addis, C.J.E.M.V.T. PP. 7-32.

Morel, P. (1989): Of tropical veterinary parasitological tick borne diseases of livestock in Africa. CAB International, UK. PP. 299-460.

Nicholonson, M.J., and Butterworth, M.H. (1986): A guide to condition scoring of zebu cattle International Livestock Center for Africa, Addis Ababa, Ethiopia. Pp. 29.

Okello-onen, J., Hassan,S.M and Essuman, S. (1999): Toxonomy of African tick, an identification manual. International center for insect physiology and ecology press, Nairobi, Kenya, pp. 1-124.

Pegram, G., Hoogstral, H. and Wassef, H.p. (1981): Ticks acrid Ixodes) of Ethiopia distribution, Ecology and Host relationship of species infesting livestock Bulletin of entamologyReseasrch, **71**: pp. 339-359.

Pegram, R.G., hoogstral, H.H, andWasself, H.V, (1982): Ticks of Ethiopia distribution, ecologyand host relationship of tick spp. Infesting livestock. Bull, Entomology, pp. 342-343.

Sebsibe, B. (1988). A preliminary survey of tick distribution in southern Sidamo, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debreziet, Ethiopia.

Sefert, H.S.H. (1996): Tropical animal health Klwer Academic Publisher Boston LK/ London. Pp.151-160

Seid, B. (2004): A survey of cattle tick species in and around MizanTeferi, Bench Majizone, and SNNPRS, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debreziet, Ethiopia. Pp. 121

Solomon, G. and Kaya, G.P. (1996): Study on the development and survival of *Rhipicephalus pulchellus* and *Amblyomma gemma* under field condition. Ethiopian Veterinary Association.Vol. **V**, No. 1

Solomon, G., Nigist, M., and Kassa, B. (2001): Seasonal variation of tick on calves at Sebeta in western shoa zone. Ethiopian Veterinary Journal, **7** (1&2): pp. 17-30

Soulsby, E. J. L. (1982): Helmenths, Arthropods and Protozoa of domestic animals 7th ed. Lea and Fibiger Philadelpia. Pp. 809.

Southerst, R. W. (1983): Tick ecology: the importance of population dynamics in developing national tick control and eradication program: the eradication of ticks, proceeding of the expert consultation on the eradication of ticks with special reference to Latin America, Mexico, 22-26 June 1987. Pp. 196-210.

Tamiru, T. (2008): A survey of bovine tick species in and around Assela Town, DVM thesis, School of Veterinary Medicine, Jimma University, Jimma, Ethiopia.

Tesfanesh, G.M. (1993): Tick and tick borne disease of cattle in North Omo administrative zone, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debreziet, Ethiopia.

Thrusfield, M. (1995): Veterinary Epidemiology, Second edition. U.K. Black well science Ltd. Pp. 182-198.
Urquhart, G.M; Armour J.D; Duntun J.L; Dunn A.M and Jennings, F.W. (1988): Veterinary parasitological, low priced ed. English language book Society Long man, Blackwell.
Walker, A.R., Bouattour, A., Camicas, J.J.,Estrda-pena, A., Horak, I.g., Latif AA., Pegram R.G and Preston, P.M. (2003): Ticks of domestic animals in Africa: a guide to identification of species Bioscience report, pp. 1-1221.
Walker, J.B. (1970): Notes on common tick species of East Africa, 3rd ed. Cooper, Kenya. Ltd. Nairobi, Kenya.
Yitbarek, G. (2004): Tick species infesting livestock in Jimma area, south west Ethiopia, DVM thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debreziet, Ethiopia.
Zeleke, D. (1980): Major cattle tick and their distribution in Ethiopia Vet. Bullentin **Vol**. IV, No. 2.

8. ANNEXES

Annex 1. **Data collection formats**

a. General format

ID	origin	breed	Sex	age	Body condition	Physiological status	Management	ID

b. Sites or regions on the cattle

Scrotum	Udder	perineum	sternum	dewlap	neck	abdomen	Fore limb	Rear limb

Annex 2. **Sampling and laboratory record sheet**

Cattle name	Date of sampling	Cattle ID	Breed	sex	Ages	Tick genera	Tick species

Annex 3. **Bases or clues during identification**

Tick *spp*	Bases capituli	Mouth part	festoons	Eyes	Ventral shield	Anal groove	Scutum
B.decoloratus	hexagonal	Short	absent	Present	2 pairs	Posterior	Entirely
A.varigatum	Rectangular	Long	Present	Present	Absent	Posterior	Entirely
Rh. e.evertsi	Hexagonal	Short	Present	Present	2 pairs	Posterior	Entirely
A.coherens	Rectangular	Long	Present	Present	2 pairs	Posterior	Entirely
H. marg.rufipes	Rectangular	large	Present	Present	3 pairs	posterior	Entirely

Annex 4. **Thrusfield formula**

$$n = \frac{1.96^2 p_{exp}(1-p_{exp})}{d2}$$

Where:
n=required sampling size
p_{exp}=expected prevalence
d= desired absolute precision

Annex 5. Descriptions of body condition scores