# Prevalence and Identification of Bovine Ixided Ticks in Doba district of Western Hararghe, Eastern Ethiopia

Birhanu Bahiru[2], Geremew Haile[1]*, Biniam Tsegaye[2]

[2]Haramaya University, College of Veterinary Medicine, P. O. Box 138, Dire Dawa, Ethiopia
[1*]Corresponding Author, School of Veterinary Medicine, Wollega University, Nekemte Ethiopia, email: geremewlov@gmail.com

**Abstract:** The cross sectional study was conducted from October, 2014 to April, 2015 in Doba district, Western Hararghe with the objective of prevalence study and identifying bovine Ixodid tick species. About 966 adult ticks were collected from eight main body regions of cattle and identified to species level. Out of the total of 384 cattle examined, 113 (29.43%) were found to be infested by one or more tick species. Five tick species of four genera; *Amblyomma, Rhipicephalus* (formerly *Boophilus*), *Rhipicephalus* and *Hyalomma* were identified. The relative abundance of each species was *Amblyomma variegatum* (49.06%), *Rhipicephalus (Boophilus) decolaratus* (23.20%), *Rhipicephalus pulchellus* (15.53%), *Amblyommacohaerence* (7.87%) and *Hyalomma marginatum rufipes* (4.34%). The prevalence of tick infestation in local breed was 38.06% and 9.48% in cross breed was found to be statistically significant (p= 0.000). and it was also found to be statistically significant (p= 0.001) among the three localities, with highest prevalence in lowland (39.52%) than both highland (21.74%) and midland (21.57%). Similarly it was also statistically significant among three age groups (p=0.000), with highest prevalence in age 1-3(37.42%) followed by >3(32.31%) and <1(13.13%), but there was no statistically significant association with sex of the cattle (p=0.301). The favorable predilection sites of *Amblyomma* species and *H.marginatum rufipes* are more on ventral body parts, perinium and undertail. *Rhipicephalus (Boophilus) decolaratus* preferred dewlap, neck and perineum. *R. pulchellus* had a strong predilection sites for perineum, ears, and undertail. The sex ratio of ticks identified that the number of male outnumbered the female in all species. Tick and TBDs cause considerable losses to the live stock economy at large. Studies directed toward determining tick burden and tick species will play significant role in designing tick control and prevention programs.

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**Key words:** Bovine, Doba district, Identification, Ixoded ticks, Prevalence

## 1. Introduction

Tick infestation presents a serious challenge to farmers of ruminants in both developed and developing countries. Ticks are ectoparasites of livestock which are classified (together with mites) in the order Acari and they are dioecious, having separate sex. All ticks are obligate ectoparasites of vertebrates (Walker *et al.,* 2003) causing significant harm to the hosts both directly and indirectly. This leads the countries to loss earnings from exports of skin and hides (Behnke, 2010). Direct harm results from blood loss which may lead to anaemia, tick burden as well as toxicoses. The bites can injurious and cause severe hide damage including abscessation and can provide a route for secondary infections (Pena *et al.,* 2004). Blood loss and reduction in weight gain resulting from tick feeding are among major factors that affect ruminant production in different parts of the world. Indirectly ticks can cause economic loss because they play an important role as vectors of wide range of tick borne diseases (TBDs) to humans and domestic animals. Some arbovirosis, rickettsiosis, anaplasmosis, tularemiosis, babesiosis, and theileriosis are pathogenic entities with great economic impact for animal productiontoo (Pegram *et al*., 2000; Holdsworth *et al*., 2006).

Naturally endowed with different agro ecological zones and suitable environmental condition, Ethiopia is a home for many live stock species and suitable for livestock production. Ethiopia is believed to have largest livestock population in Africa. An estimate indicates that the country is a home for about 54 million cattle, 25.5 million sheep, and 24.06 million goats (Central Statistical Authority (CSA), 2013). Despite high livestock population and existing favorable environmental condition the current livestock output of the country is little (Metaferia, 2011). For example a conservative estimate of one million birr loss annually was made throw downgrading of hides and skins (Zeleke and Bekele, 2004). This is associated with a number of complex and interrelated cofactors such as ectoparasite infestations, inadequate feed and nutritions, widespread diseases, inefficiency of livestock development services (Jabbar *et al.,* 2007; Negassa *et al* 2011).

There are at least 840 ticks' species in the world. Over 79 different species are found in eastern Africa but many of these appear to be of little or no economic importance (Cumming, 1999). They are grouped under two major families, namely Ixodidae or "hard" ticks ( so called virtue of their hard dorsal shield ) and Argasidae of "soft" ticks ( due to their flexible leathery cuticle) (Keirans and Robins,1999). The family ixodidae comprises approximately 80% of all tick species including the species of greatest economic importance. There are 3 active stages in the life cycle of hard tick: larvae, nymph, and adult ticks. Each instar takes a blood meal once and long periods are spent on vegetation between blood meals (Walker*et al.,* 2003). In Ethiopia, there are about 47 species of ticks found on livestock and most of them have importance as vector and disease causing agents and also have damaging effect on skin and hide production (Kassa, 2005). They are the most important ectoparasites of all livestock particularly; cattle are enormously infested by different types of ticks (Yacob *et al*., 2008).

Most ticks require three different hosts to complete one fully cycle. These three host ticks detach on completion of feeding, drop from the host, moult and wait for another host. However, in some tick species the engorged larvae remain on the host, where they moult rapidly to become nymphs, continue to feed and then drop as engorged nymphs (two host ticks). In one host ticks the nymphs also remain on the same host and continue to feed as adults. After the female drops from the host she seeks a sheltered place for oviposition, where she lays a single batch of several thousand eggs and then dies (Horak *et al*., 2003).

Males usually remain much longer on the host where they mate repeatedly. As long as periods often elapse between the different feeding periods, ticks are well adapted for long term, survival, maintaining their water balance by taking up moisture from the atmosphere. Hungry ticks accumulate near the tips of grasses and other plants (Ghosh, 2007). When a host approaches, the ticks seek to attach themselves by waving their first pair of legs in the air. Once the host has been mounted the tick pierces the skin with its chelicerae and inserts the barbed hypostome and to secure initial attachment to the host. Cement is then secreted in the saliva to further secure attachment (Tylor, 2007).

Ixodid ticks ingest very large quantities of blood amounting to several hundred times their unfeed weight. Surprisingly, tick feeding is generally very wasteful, as large amounts of haemoglobin are passed into the faeces unchanged; the quantity of blood passed in the faeces during feeding can equal or even exceed the final engorgement weight of the tick (Jongejan and Uilenberg, 2004). In Ixodid ticks, up to 60-70% of the excess water in the blood meal is re injected into the host by salivation during feeding. As a result, the actual uptake of blood can be two to three times the weight of the engorged female (Solomon *et al.,* 2007).

Epidemiology of different ticks is affected by many factors like habitat, temperature, relative humidity, plant covers and vegetations. Most ticks do not tolerate direct sunlight, dryness, or excessive rainfall. Their activity is restricted during cold period, but increase dramatically during hot and humid weather (mokonnen, 1996). The temperature and rainfall influences thehatchability pattern and moulting period. The moulting period of larvae and nymphs kept in the open environmentas well as the total duration of the life cycle is lower than those kept in the shade (Solomon *et al.,* 2001).

Due to economic and veterinary importance of ticks, the control and transmission of TBDsremain a challenge for the cattle industry in the world and it is a priority for manycountries in tropical and subtropical regions (Lodos *et al.,* 2000). In Ethiopia tick and TBDs cause considerable losses to the live stock economy ranking third among the prevalent parasitic diseases after trypanosomes and endoparasitism (Zeleke and Bekele, 2004). The high prevalence of ticks in different areas of Ethiopia seems to be related to absence of national campaign for strategic control of these ticks (Tolossa, 2014). Even though different studies were done on ectoparasites of cattle in other areas of the country little attention was given to the present study area. Investigations directed toward determining themagnitude of infestation and the type of tick species involved will play a magnificent role in designing strategic control and preventiontoward these parasites. Moreover a species level identification will assist the diagnosis of different tick borndiseases and their respective control programs.

Therefore, the objective of the present study is:

➢ To identifyand assess the potential risk factors of bovine Ixodid tick species in Doba District, western Hararghe, Eastern Ethiopia.

## 2. Material And Methods

### 2.1. Description of the study area

The study was conducted from October 2014 to April 2015 to determine prevalence and identify the major Ixodid tick species of bovine in Doba district of Western Hararghe, eastern Ethiopia. It is located at 384kms east of Addis Ababa. The district has daily mean temperature of 20-35$^0$C and mean annual rainfall 650-800mm per year. The total area coverage of the district is 89526 km$^2$ from this 19254 km$^2$ is covered with cultivated land and 70272 km$^2$is forested land and other miscellaneous lands. The agro-ecological zone of the district contains Dega (2501-2800 meters above sea level (masl), Woyina Dega

(1651-2500 masl) and Kola (1500-1650 masl). The dominant soil types in the district are Vertisol (clay), sand loam and clay loam. The major crops cultivated in this area are: sorghum, maize, wheat, barley, potato and chat. The livestock populations estimated in the area are: 96328 Cattle, 90975 Goat, 26230Sheep, 12367 Equine, 1995Camel, and 150500 Poultry. The district has 41 peasant associations (PAs) and one town (Doba Woreda Agricultural Office, 2013).

**2.2. Study animals and sampling strategy**

The study animals were kept under traditional extensive management system where animals of different breed, age and sex were included in the study. The age of the animals was categorized into young (< 1year), young- adult (1-3 years), and adult (> 3years) depending on age estimation method used by Gatenby, (1991) based on teeth eruption. Three PAs were purposely selected from the study area, accordingly one PA was selected from one agro-ecology (Ifabalam=highland, kufakas=midland, Ifajeyna=lowland). The study cattle were then systematically selected from herds of the PA and examined. Records of age, sex, breed, sites of attachments, and location of individual animals was made during sample collection.

**2.3 Study Design and sample size determination**

A Cross sectional study was conducted to address the objective of the study where an expected prevalence of 50% was used as there were no studies conducted on tick species infesting cattle inthe study area. The required sample size for the study was determined by the formula given by Thrusfield, (2005) using a 5% desired precision and 95% confidence interval.

$n = 1.96^2 \text{ pexp } (1\text{-pexp}) / d^2$

Whereas: n=required sample size

pexp=expected prevalence

d=desired precision

Accordingly, a total of 384 animals were systematically selected from the herd and examined in the study.

**2.4 Tick Collection and Identification**

Once after the selected animals were properly restrained, all visible adult ticks were carefully collected from half body of the animal (udder/scrotum, axial, perineal, dewlap, neck, ear, under tail, and groin/belly) and finally doubled to give the total number of ticks per animal with the assumption of equal number of ticks on both sides of the animal. Ticks were removed carefully and gently by hand picking in a horizontal pulling to the body surface without detaching of the head part and transferred into universal bottles containing 70% ethanol for preservation and labeled with corresponding age, sex, breed, predilection site, agro-ecology and date of collection. The collected ticks were identified to the species level using stereomicroscopy at Hirna Regional Veterinary Laboratory using the taxonomic key features described by Walker *et al.* (2003). The relative abundance was calculated by dividing the specific tick species by the total count of ticks collected.

**2.5 Data management and analysis**

The data generated from the study were entered into Microsoft excel 2007 software and analyzed using Stata 7 intercooled Statistical Software (Stata Corporation, 2001). The prevalence of tick was determined by dividing the number of positive samples by the total sample size and wasexpressed as percentage. Chi -square ($\chi^2$) test was used to determine the associationbetweenthe risk factors and the tick infestation where as P-value of less than 0.05 was considered significant.

**3. Results**

Out of 384 animals, 29.43% (n=113) were found to be infested with at least a single tick species. Out of the total of 966 ticks collected, *Amblyomma* (56.94%) was found to be the most abundant genera while *Hyalomma* (4.34%) accounts for the least proportion (**table 1**). Similarly, from the total ticks collected and identified, *Amblyoma variegatum* (49.06%) accounts for the highest proportion while *Hyaloma marginatum rufipes* (4.34%) was the least abundant (**table 1**). The collected ticks were identified as male and female where the proportion of male ticks was found higher than that of female (**table 1**).

**Table 1.** Abundance and sex ratio of Bovine Ixodid tick species in the study area.

| Ticks Spp. Identified | Sex M | F | Total | M:F ratio | Relative abundance |
|---|---|---|---|---|---|
| *Amblyoma variegatum* | 326 | 148 | 474 | 2.20:1 | 49.06% |
| *Rhipicephalus (B)decoloratus* | 120 | 104 | 224 | 1.15:1 | 23.20% |
| *Rhipicephalus pulchellus* | 96 | 54 | 150 | 1.78:1 | 15.53% |
| *Amblyoma coherence* | 48 | 28 | 76 | 1.71:1 | 7.87% |
| *Hyaloma marginatum rufipes* | 28 | 14 | 42 | 2.00:1 | 4.34% |
| **Total** | **618** | **348** | **966** | **1.78:1** | **100%** |

Spp- species, M-male, F- female

The prevalence of tick infestation in cross and localbreeds was found to be 9.48% (n=11) and 38.06% (n=102) respectively and the difference was found to be statistically significant (p=0.000). The highest prevalence of tick infestation was observed in lowland (39.43%) followed by highland (21.74%) and midland (21.57%) areaswhere the difference between the study sites was found to be statistically significant (p=0.001). Furthermore, the statistical comparison between the different variables is shown below (**table 2**).

**Table 2.** prevalence of Bovine Ixodid tick species on basis of breed, age, sex, and PAs

| Variables | | No of animals examined | No of animals infested | Prevalence (%) | $\chi^2$ | p-value |
|---|---|---|---|---|---|---|
| **Breed** | Cross | 116 | 11 | 9.48% | 31.84 | 0.000 |
| | Local | 268 | 102 | 38.06% | | |
| **Age** | <1 year | 99 | 13 | 13.13% | 17.95 | 0.000 |
| | 1-3 year | 155 | 58 | 37.42% | | |
| | >3 year | 130 | 42 | 32.31% | | |
| **Sex** | Female | 189 | 51 | 26.98% | 1.07 | 0.301 |
| | Male | 195 | 62 | 31.79% | | |
| **PA** | Highland | 115 | 25 | 21.74% | 14.50 | 0.001 |
| | Midland | 102 | 22 | 21.57% | | |
| | Lowland | 167 | 66 | 39.52% | | |
| **Total** | | **384** | **113** | **29.4** | | |

Each tick species showed preferences for attachment sites on the animal's body. The most preferred body sites for *A. variegatum* and *A. coherence* species was ventral body parts (scrotum/udder, axial, and groin/belly). *(R)B. decoloratus* was collected from dewlap, perineal and the neck. Similarly, *R. pulchellus* was collected from smooth body parts of ear, perineal, and undertail body parts where as *H. marginatum rufipes* was collected from perineal, scrotum/udder and axial (**Table 3**).

**Table 3.** Preferred site of attachment of Bovine Ixodid tick species on the different body parts

| Attachment sites | *A.variegatum* | *B.decoloratus* | *R.pulchellus* | *A.coherence* | *H.marginatum rufipes* |
|---|---|---|---|---|---|
| Scrotum/udder | 248(52.30%) | 0 | 0 | 14(18.42%) | 14(33.33%) |
| Axial | 138(29.10%) | 0 | 0 | 28(36.84%) | 8(19.05%) |
| Perineal | 0 | 38(16.94%) | 20(13.30%) | 0 | 20(47.62%) |
| Dewlap | 0 | 90(40.16%) | 0 | 0 | 0 |
| Neck | 0 | 96(42.90%) | 0 | 0 | 0 |
| Ear | 0 | 0 | 58(38.70%) | 0 | 0 |
| Under tail | 0 | 0 | 72(48.00%) | 34(44.74%) | 0 |
| Groin/belly | 88(18.60%) | 0 | 0 | 0 | 0 |
| **Total** | **474** | **224** | **150** | **76** | **42** |

## 4. Discussion

The prevalence of tick species from this study was found to be 29.43%. This result is in agreement with Kassa and Yalew, (2012) who reported a prevalence of33.21% in cattle in Haramaya district and it is also in agreement with the reportof 25.64% by Tiki and Addis (2011), in and around Holeta Town, Ethiopia. However, this result is less than the reports of 82% by Regassa (2001) in Borena province, Ethiopia. And81.25% by Alemu *et al* (2014) in Dembia district of Northwest Ethiopia. This difference could be due to the difference in the agro climatic condition of the study areas where tick activity is influenced by rainfall, altitude and atmospheric relative humidity (Pegram *et al*., 1981).

In this study, *A. variegatum* was found to be the most abundant tick species in Doba district (49.06%). Similarly, Amante *et al* (2014) reported a 68.4% in and around Diga, West Ethiopia, and 40.1% by Bedasso *et al*. (2014) in and around Haramaya, Ethiopia. It is also closer to the report of 38.87% by Kassa and Yalew (2012) in and around Haramaya district, Ethiopia. Thishighest abundance could be due to the fact that *A.variegatum* is the most common and widely distributed tick of cattle in Ethiopia (Morel, 1980; Pegram*et al*., 1981), and also it could be due to its being relatively active throughout the year Bedasso *et al*. (2014). *R (B) decoloratus*was identified as the second abundant tick species in the study sites constituting of 31.54%. Similarly, Kassa and Yalew (2012) reported31.54% in and around Haramaya district, Bedasso *et al* (2014), reported a 26.3% in and around Haramaya, Ethiopia. Incontrast to the presentresult, Gedilu *et al.* (2014) reportedthe most abundant (47.93%) in Bahir Dar, Ethiopia. This could be due to its prevalence is affected by altitude and humidity. It is abundant in wetter highlands and subhighlands receiving more than 800mm rainfall annually (Pegram *et al.,* 1981). *R (B). decoloratus* can transmit *Babesia bigemina* and *anaplasma marginale* to cattle, and severe tick infestation can lead to tick burden and anaemia (Mokonnen, 2001).

*Rhipicephalus pulchellus*was the third abundant tick species constituting 15.53% of the total adult tick collected which is in contrastwith Ayana *et al.* (2013) in Borena Pastoral Area, Ethiopiawhich was described as the most abundant (46.79%) tick species in that study area Regassa (2001) in Borana Province, Ethiopia also revealed as most abundant (81.90%) tick species. This could be due to Abundance adult ticks usually depend on climatic factors such as relative humidity, temperature, altitude and rain fall Solomon *et al.* (2001). The result of Kassa and Yalew, (2012) in Haramaya, Ethiopia was reported as the least abundant (6.64%). This could be due to the fact that the number of adult tick annual generation is limited by conditions necessary for development of ovipositing females, hatching of eggs, moulting of larvae and nymphs. (Horak *et al.*,2003).*A.cohaerens*was the fourth abundant tick spices constituting 7.87% of the total tick collected. This result is inagreement with the report stated by Tessema and Gashaw (2010) in and around Asella, southeastern Ethiopia (11.9%), Tiki and Addis (2011) in and around Holeta (5.02%). A findings of Amante *et al.* (2014) showed that this tick species is mostcommon (18.5%) in western Ethiopia in contrast to the present findings. This could be due to the fact that *A.cohaerens* is most abundant in areas where climate is humid most of the year (Yitbarek,2004; Seid, 2004). *H. marginatum rufipes*was the least abundant tick species in the study area constituting 4.34% of the total tick collection. This result is in agreement with (Tessema and Gashaw, 2010) in and around Asella, Ethiopia (2.5%) and (Tiki and Addis, 2011) in and around Holeta, Ethiopia (1.86%) and (Huruma *et al.,* 2015) in and around Sebeta, Ethiopia (2.9%).This low prevalence could be justified by the fact that *H. marginatum rufipes*is widely distributed in the most arid parts of tropical Africa, receiving 250 to 650 mm annual rainfall and the altitude of the study area is also between 1500-2800masl making the presence of this parasiteto be very rare (Pegram et., 1981; Tamiru, 2008; Yusen, 2009).

In all cases males outnumbered females ticks similar to previous reports by (Kassa and Yalew, 2012) in and around Haramaya, Eastern Ethiopia; this is most probably because while they are fully engorged female ticks drop off to the ground to lay eggs, while males tend to remain on the host up to several months later to continue feeding and mating with other before dropping off (Solomon *et al*., 2001). The results of Gedilu *et al*. (2014; Ayana *et al.* (2013) and Bedasso *et al*. (2014) also indicated as males outnumbered females except for *R (B). decoloratus*.

Tick infestation was significantly higher in local breed cattle as compared with cross cattle, where (P=0.000), and this finding is in agreement with the findings of (Tiki and Addis, 2011) in and around Holeta, Ethopia and Kassa and Yalew, (2012) in and around Haramaya district, Ethiopia; the higher prevalence of tick infestation in local breed animals may be due to existing modified animal husbandry practice where cross breed animals are kept most of the time indoor with semi-intensive care whereas local breed cattle are kept under extensive farming system and/or lack of control measures on local breeds and it may also due to taking more attention to cross breeds than local animals. Therefore the chance of occurrence of tick infestations in local breed cattle is greater than thoseof cross breeds (Gedilu *et al*.,2014).

Tick infestation was significantly higher in animals with age 1-3(37.42%) years as compared to animals >3(32.31%) and <1(13.13%) years of age (p=0.000), this could be due to high susceptible of younger animals to tick infestation and outdoor managements (Bedasso *et al*.,2014). The least infestation rate of animals of age of < 1 could be due to indoor management, calves usually feed and drink at home rather than moving far places to search for feed and watering and this could attributed to less chance of getting ticks from vegetations while feeding. This work is in line with Musa *et al*. (2014) in Maiduguri, Northeastern Nigeria. Manan *et al.* (2007) found that resistance in the animals was building up as the animals was grow up and the animals become more resistant and adoptable than in younger stage. Islam *et al.* (2009) also found that calves were two times more susceptible more than adults. This could be attributed to lower immunity and softer and thinner skin of young animals that could aid in penetration of mouth parts of ticks for feeding (Sajid, 2007). In contrast Fantahun and Mohamed (2012) in and around Assosa, Ethiopia and Bedasso *et al*. (2014) in and around Haramaya, Ethiopia reported that prevalence of tick infestation was significantly higher in animals of age >3 followed by ages of 1-3 and <1. This could be due to outdoor management of animals (Gedilu*et al.,* 2014).

There was no statistically significant association (p=0.301) among different sex groups, where ashigher infestation was recorded in male animals ascompared to their counter parts. This result is in line with the previous work done by Wolde and Mohamed (2014) in Sodo Zuria, Ethiopia and Wasihun and Doda (2013) in Humbo Distric Southern, Ethiopia. This variation may be associated with female animals which were keptin the house with good management system fordairy purpose whereas male animals grazing on field all day may be exposed to tick infestation more (Huruma *et al*, 2015) and also most of male cattle in the tropics are mainly used for most of farming activities and moved from place to place in search of food and in the process get infested with ticks. Larvae of ticks are known to climb blades of grasses and shrubs to attach themselves to passing hosts mostly males during grazing (Musa *et al*., 2014).

The tick prevalence of in relation to agro ecology revealed that there was statistically significant association (p=0.001) among the three agro ecologies. The observation of higher tick counts in lowland agro ecology in the present study is most probably attributed to the vast and more availability of grazing land in the lowland than highland and midland agro ecological zones Ghosh, (2007); Walker *et al* (2003). This could be due to Lack of use of acaricides Sajid (2007), and vegetation cover of the area also play a significant role in higher prevalence of ticks in the lowland (Solomon *et al.,* 2001).

With regard to predilection site for attachment, different tick species shows different site preferences. *A.variegatum*found in scrotum/udder, axial, and groin/belly whereas the *(R)B. decoloratus*species were found on the neck, dewlap, and perineal. *R. pulchelus*showed high preference to the undertail region of the body and followed by ear and perineal. *A.coherence* was collected from undertail, axial, and scrotum/udder whereas *H.marginatumrufipes* showed preference to perineal, scrotum/udder, and axil. This result is in line with the findings of Atif *et al*. (2012) in three Districts of the Punjab, Pakistan; the external genitalia and inguinal/groin region of the body are highly supplied with blood. Ticks usually prefer thinner and short hair skin for infestation. This helps in easy penetration of mouth parts into richly vascular area for feeding (Sajid, 2007). Several factors such as density, interaction between tick species, time and season and inaccessibility for grooming are all reported to determine the attachment sites of ticks (Ayalew *et al*., 2013).

## 5. Conclusion And Recommendations

The present study identified the distribution of five Ixodid tick species where *A.variegatum*was the most abundant tick species and *H. marginatum rufipes* was the least abundant. The different tick species preferred different animal body parts as their attachment sites. Information on tick species distribution and dynamics is very essential to assess the economic loss and also to design appropriate tick control and preventionmeasures. In general, the distribution of ticks are not fixed but are determined by a complex interaction of factors such as climate, host susceptibility, grazing habits, and pasture-herd management.

Based on the above conclusion, the following recommendations are forwarded:

- Tick control program through the application of acaricides should be continued especially in wet months.
- Selection oftick tolerantcattle breeds is importantto sustain the production in tick-infested areas.
- Further studies should be conducted on the Ethno-veterinary practices in tick infested areas to look for novel herbal drugs.

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## 7.Annexes

**Annex I.**Data Collection and Tick Identification Format

| Field work | | | | | | | Laboratory work | | |
|---|---|---|---|---|---|---|---|---|---|
| Animal No. | Sex | Breed | age | PA | Site of attachement | Tick count | Tick genus | Tick species | Tick sex |
| | | | | | | | | | |

**Annex II**Materials and Chemical Used

-Sampling bottles -loops -Writing ink
-Stereomicroscope -petridish -ethanol 70%

**Annex III**. Estimation of age of cattle from teeth

| Teeth | Age | Age group |
|---|---|---|
| With teeth | < 1 year | Young |
| $I_1$ erupts | 1 ½ - 2 year | Young-adult |
| $I_2$erupts | 2 - 2 ½ year | |
| $I_3$erupts | 3 years | |
| $I_4$erupts | 3 – 4 years | |
| All incisors are erupted | 5 years | |
| $I_1$ is level the neck has emerged from gum | 6 years | adult |
| $I_1$ is level and the neck is visible | 7 years | |
| $I_1$ is level and neck is visible and it may be level | 8 years | |
| $I_4$ is level and neck is visible | 9 years | |
| The dental star is squire | >10 years | |

Source (Gatenby, 1991).

**Annex IV.**Species distinguishing features of adult Ixodid ticks.

**1.** ***Amblyoma variegatum***

-Mouth parts very long, elongate $2^{nd}$ segment of palps and banded legs.

Consecutum and scutum ornate, male conscutum is dark orange.

Their Eyes are bready and festoons are present,festoons in males are uniformly dark.

Three host ticks.

**2.** ***Amblyoma coherence***

Mouth parts very long, elongate $2^{nd}$ segment of palps and banded legs.

Their eyes are flat and closed to the margin of the scutum.

Consecutum and scutum ornate, male conscutum is yellowish orange.

Eyes and festoons are present, males festoons are mixed of whitish and dark.

Three host ticks.

**3**. ***Rhipicephalus (Boophilus) decoloratus***

Mouth parts very short and dentition on hypostome is arranged in two columns each consisting of numerous rows each of which consists three denticles 3/3 dentition.

The basis capituli is hexagonal in shape.

The Consecutum in male is yellowish in color and often so poorly scelerotized that the outlines of the gut can be seen through it.

There are numerous hairs on the conscutum of males and the scutum of females.

Eyes present but not consipicuous and no No festoons are present.

Adanal plates and accessory adanal plates of males well developed,Caudal process present in males, they are one host ticks.

***4.Rhipicephalus pulchellus***

It is a medium sized Rhipicephalus species with striked dark brown and an ivory colored pattern on the conscutum while the scutum of female is ivory colored except brown patches around the eyes.

Mouth parts short, basis capituli generally hexagonal in shape.

The eyes are flat and Festoons present.

The adanal plates are fairly long and engorged males a caudal appendage is present.

In males the legs increase in size from I to IV.

Majority is three host ticks, but a few are two host ticks.

***5. Hyalomma marginatum rufipes***

Mouth parts long, $2^{nd}$segment of palps elongate.

Dark brown to nearly black conscutum of male is broadly oval and the entire surface is covered with medium sized coarse punctuations.

The brown legs are brightly banded with ivory colored rings.

Eyes present and convex and Festoons present.

The adanal have square ends and subanal plates are small and aligned with adanal plates.

The genital apron of female is convex, the genital aperture is very broadly V shaped.

Two or three host ticks.

**Source**: (Walker *et al.,* 2003).

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