ADDIS ABABA UNIVERSITY
FACULTY OF VETERINARY MEDICINE

STUDIES ON IXODID CATTLE TICKS FROM SOME SELECTED SITES OF CENTRAL OROMIA REGIONAL STATE: SPECIES COMPOSITION, SEASONAL VARIATION AND CONTROL PRACTICES

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TEGAYE AYALEW

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A thesis submitted to school of Graduates studies of Addis Ababa University in partial fulfillment of the degree of Master of veterinary Science in Tropical Veterinary Parasitology

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TABLES OF CONTENTS **PAGES**

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEX

ABSTRACT

A study was conducted to determine the distribution, prevalence and seasonal variation of tick species on cattle in central Oromia regional State using cross-sectional and longitudinal study methods. During the study period a total of 10,085 adult ixodid ticks were collected from a half body regions of 918 cattle in three agro-ecological zones during wet and dry seasons .Of these collected ticks 5542 were males whereas 4543 were females. Results of the study showed that an overall prevalence of 87.1% tick infestation on cattle was recorded. In the study four genera and seven species of ixodid ticks were identified during the wet period whereas similar number of genera but six species of ixodid ticks were identified during the dry periods. *Amblyomma ,Boophilus Rhipicephalus* and *Hyalomma* tick genera were identified during the two seasons. Five different species of ticks were identified from the highland altitude. Significantly ($p<0.05$) higher proportion of *B.decoloratus* (88.2%) was identified during the wet season. But *Hy. truncatum* (1.5%) was identified with least proportion during the wet period. *Rh.e. evertsi* (50.8%) was the most abundant during the dry period whereas *Hy.marginatum rufipes* (5%) was with smallest proportion during the same season. In midland altitudes a total of six species of ticks were identified. Significantly ($p<0.05$) higher proportion of A.variegatum (75%) than the other species was recorded during the wet season. But *Rh.pulchelus* (.4%) was collected at the lowest proportion during the wet season. *Rh.e.evertsi* (49.6%) was the most abundant tick species during the dry season whereas *Hy.truncatum* (0.6%) was with lowest proportion during the dry season. In lowland altitude lower proportion of ticks were collected. A total of seven species of ticks in the wet and six in the dry season were identified. Significantly ($p<0.05$) higher proportion of *Hy.truncatum* (85.9%) was recorded during the wet season whereas *Rh.pulchelus* (1.5%) was identified with the lowest proportion .*Rh.evertsi evertsi* (68.6%) was the most abundant tick species during the dry season .But *B.decoloratus* was with the lowest proportion during the same dry season. Results of the longitudinal studies revealed that highest mean total tick burden was recorded during the early rain season than the dry season from the end of March to April. And the lowest infestation rate was recorded during early dry season and the late dry season during December and February, respectively. The overall, tick count across seasons showed significant variation at $p<0.05$ ($F=114$ & $p=0.000$). A questionnaire survey on the aspects of tick control has revealed that the majority of farmers have sufficient knowledge about the economic significance of ticks. Diazinon 60% and cypermethrin were the commonly used acaricides with a frequency of 1 to 3 times per year during the peak season of

tick infestation. *A.variegatum* and *B.decoloratus*, the most prevalent and dominant tick species in mid and highland altitudes, respectively seems more adapted than the other species to environmental factors prevailing in the areas. Thus, strategic application of acaricides especially at the beginning and end of wet months might minimize the burden of ticks on the cattle of the study areas.

Keywords: Agroecology , Cattle, Central Oromia, Prevalence, Season, Tick species

1. INTRODUCTION

Ethiopia has approximately 44.3 million cattle, 46.9 million small ruminants, more than 1 million camels and 4.5 million equines and 40 million chickens (CSA, 2004). Cattle provide meat and milk, and contribute to the economic welfare of the people by providing hide, power, and traction for agricultural purpose and fertilizer for increasing the productivity of small holdings (Minjauw and Mcleod, 2003). In addition cattle are the major sources of foreign exchange. However, poor health and productivity of animals due to diseases is considered as the major stumbling block to the potential of the cattle industry (Ayele *et al,* 2003). Skin diseases are one of the major causes of considerable economic loss from defective skin and hide export; 65% of cattle with skin diseases are detected before slaughter and are therefore rejected (Kassaye *et al,* 1998).

Ixodid ticks are one of the most common and harmful blood sucking ectoparasite of cattle worldwide. They are responsible for a wide range of livestock health problems in several countries of the world. They reduce cattle productivity, milk yield and skin and hide quality and increase susceptibility to other diseases. Approximately 80% of cattle populations of the world are at risk of tick infestation and tick born diseases. In addition to sucking large volume of blood ticks inject pathogens such as viruses, bacteria, protozoa and toxins in to their hosts (FAO, 2004). In Ethiopia, of the major parasitic diseases ticks and tick-borne diseases rank third after trypanosomiasis and endoparasitism in causing economic losses. Bekele (2002) estimated an overall loss of US$500,000 from hide and skin down grading as a result of ticks, and approximately 65.5% of major defects of hides in Eastern Ethiopia are caused by ticks. In another study conducted by Radley (1980) in western part of Ethiopia tick infestation is responsible for the estimated total cost of 1 million US$ per annum only through rejection of downgraded hides due to tick damage. McCosker (1979) estimated the global costs of control and productivity losses caused by ticks to be some US$ 700 million annually (equivalent to US$7/head/year). While De Castro (1997) estimated that the annual global cost associated with tick and tick-borne diseases in cattle range between US$ 13.9 and US$ 18.7 billion.

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 the 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 insufficient human, economic and infrastructural resources (FAO, 2004).

Acaricide application is still the main method of tick control in Ethiopia. Aresenicals and chlorinated hydrocarbons have been banned because of the treat to human health and the emergency of acaricide resistance against economically important species of tick (Regassa and deCastro, 1993). Currently organophosphates are the most widely used chemicals although evidence of resistance is emerging. Amidines and pyrethroids have recently been introduced, while plants that have acaricidal properties are widely used for tick control in rural areas (Mekonen, 1998). However, there is no effective legislation for the importation and marketing of these compounds or for monitoring their use and efficacy in the country.

Because of the growing nutritional demands for an increasing human population in Ethiopia, exotic breeds of cattle have been introduced to improve milk production. The number of dairy farms using cross-bred stock is increasing and there are an estimated 100,000 *Bos taurus/Bos indicus* crosses in the country. These animals are concentrated mainly in the central parts but small dairy farms are also scattered elsewhere in the country. These cattle are potentially at greater risk of ticks and tick-borne diseases (Mekonen,s *et al,* 2001). There is paucity of information on species composition and the associated risk factors of ixodid ticks on cattle in Ethiopia.

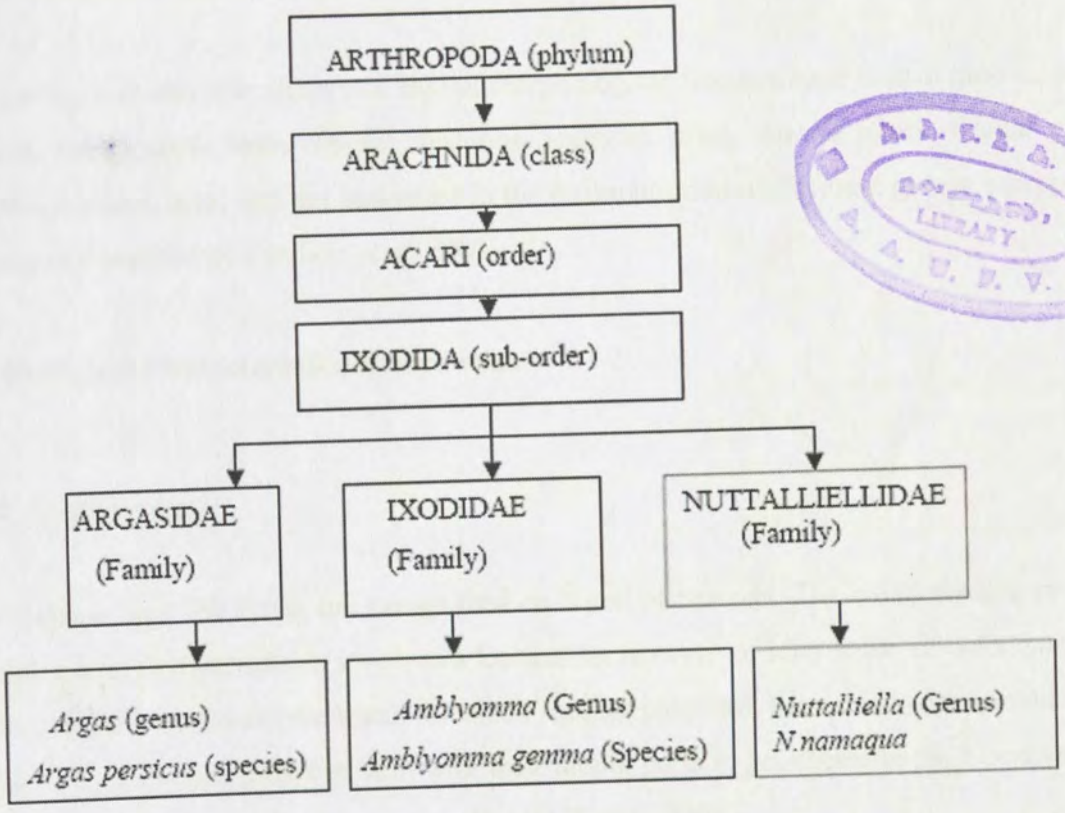
Therefore, the objectives of this study are:

- To determine species composition and the distribution of economically important ixodid ticks of cattle in selected areas of central Oromia.
- To assess the seasonal variation and tick burden of the study area.
- To assess the control practices of ticks of cattle in the study area using systematically organized questionnaire survey.

2. LITERATURE REVIEW

2.1. Classification of ticks

Ticks belong to the phylum Arthropoda and order Acarina (Latif and Walker, 2004). There are two major families of ticks called the Argasidae and the Ixodidae. Argasidae ticks are often called soft ticks, because they do not have hard scutum on their bodies whereas Ixodidae with this scutum are often called hard ticks (Walker et al, 2003). The classification of ticks according to FAO (1984) is as follows.



Barker and Murell (2004) have described about 899 tick species that infest vertebrates including Argasidae (185 species), Ixodidae (713 species) and Nuttalliellidae (1 species) The scientific nomenclature (Ixos gr= fly glue, ixodes = glued) indicates ticks are sticking and stationary parasites. They have certain characteristics that distinguish them from other

arachinids such as spiders (Morel, 1989). Ixodid ticks are characterized by the presence of a rigid chitinous scutum that covers the entire dorsal surface of the male whereas it extends only for a small area in the female, the nymph and the larval to permit the abdomen to swell after feeding (kettle, 1995)

Ticks lack a clear division between the anterior and posterior body parts that can be divided into two body components as the gnathostoma or capitulum which is the mouth parts or a fusion of head, thorax and abdomen and the idiosoma (Kaufmann, 1989). The mouth parts consist of two small retractile mandibles, a pair of short palpi and the toothed hypostome which projects forward. Engorged females can increase their weight many times and appear round and plump. This is because of the elastic cuticula of the female (Seifert, 1996).

The presence or absence, shape and size of morphological features such as anal groove, palps, scutum, mouth parts basis capituli, festoons, spiracles plate, ventral plates, adanal plates, subadanal plates, spur, and are important in the differentiation of different genera and species of ticks as described by (Walker *et al*, 2003)

2.2. Biological Characteristics of hard sticks

2.2.1. Blood feeding

To complete their life cycle, ticks must feed on blood of animals. The blood feeding process, and the events that precede it, involves a fascinating network of interaction of ticks with their hosts, and their shared environment. As blood feeding parasites, ticks must seek suitable host, attach to its body, and pierce its skin with their mouth parts to get access to the blood vessels, and get the protein rich blood they need (Dantas-Torres, 2008)

Mechanism of finding hosts

Ixodid ticks seek a host when the environmental conditions are suitable and there are several kinds of stimuli that indicate the presence of hosts. Ticks are highly sensitive to chemical

stimuli (e.g. CO_2 and ammonia), airborne vibrations, and host body temperature (Parola and Raoult, 2001).

Most ticks are active during warm periods of the year and under go hibernation or become dormant during the cold period, they hide within fissures in the ground, under rocks or in cracks and buildings (Galloway, 1974). Ixodid ticks can adopt different strategies to seek their hosts and these strategies may vary widely from species to species and from region to region. Certain tick species climb on to vegetation and wait for a host to pass, with their front legs out stretched. Then, when a host brushes against the vegetation, the tick grabs on to the host animals. Other ticks emerge from their habitat and run toward their hosts, whereas some endophilic ticks remain hidden in host's nests and burrows awaiting their arrival, some tick species display a well-defined host-seeking behavior, whereas others (e.g., R.sanguineus) can adopt different strategies (Parola and Raoult, 2001). *R.sanguineus* is considered to be a hunter tick, but its behavior may vary widely.

Attachment mechanism

To feed blood, the tick inserts its hypostome in to the hosts' skin to reach the blood vessels. Soon after wards, the tick secretes an attachment cement to more firmly anchor its mouth parts to the host's skin. The cement, which is produced in the type II and III alveoli of the salivary gland (Jaworski *et al*, 1992), is largely proteinaceous but is also, contains lipid and glycoproteins. Primitive ticks (e.g. *Amblyomma*) attach deeply; more evolved ticks (e.g. *Rhipicephalus* and *Dermacentor*) attach superficially and their mouth parts do not penetrate the dermis (Bowman *et al*, 1997). Approximately 24 hours after tick attachment there is a dermal infiltration predominantly of neutrophils.

The histopathology at the feeding site of *R.sanguineus* has revealed a cone of cement around the ticks mouth parts, epidermal hyperplasia, edema, and inflammatory cell infiltration in the dermis. Alternating periods of sucking blood and salivation with regurgitation occurring frequently, are observed during the feeding process (Parola and Raoult, 2001). The process of

intense salivation and regurgitation is of great importance for the transmission of pathogens during blood-feeding. When completely engorged, female ticks detach its mouth parts and drops off the host to complete digestion in a secured place. The duration of blood-feeding process varies according to factors such as tick developmental stage, host species, and environmental conditions (Dantas-Torres, 2008)

2.2.2. Reproduction and life cycle

High reproductive potential is an important feature in the biology of ticks (Torr *et al*, 2003). Mating in ixodid ticks usually takes place on the host, except in the case of I*xodes* where it may also occur when the ticks are still on the vegetation (Walker *et al,* 2003). The adult female tick on the host sucks up considerable amount of blood and copulates with the male while feeding (Seifert, 1996). During mating the male crawls under the female and after manipulating the female genital opening with its mouth parts, transfers the spermatheca, a sac containing the spermatozoa, in to the opening, presumably with aid of its front legs (Urquhart et al, 1996). The female mate only once before they are ready to fully engorge with blood. When they finally engorge, they detach from the host and have enough sperm to fertilize all their eggs (Walker *et al,* 2003). The engorged female drops off and deposits up to 18,000 eggs in a mass (ranges from 10,000-20,000 eggs) (Urquhart, 1996).The mean duration of the oviposition period is 16-18 days (Koch, 1982a). It occurs after a period of digestion and oogenesis takes place in natural shelter under protective cover of grasses, stone, in plant litter, etc. (Seifert; 1996 and walker *et al*, 2003). The female dies soon after wards, although males remain attached to the host (Minjauw and McLeod 2003).

The egg incubation period ranges from 6-23 days (Koch 1982a, Pegram *et al,* 1987b, Jittapalapong *et al* 2001). Under suitable conditions of hot and humid temperature, the egg hatches to yield a six-legged larva. After a period of maturation, the larva begins to seek the first host, either lying on a grass blade, or moving for hunt activity; but the later depends on the ambient temperature and humidity. Once the host is found, the blood meal lasts for 3-12 days. After this, the larval molts to nymph which is eight legged, except for lacking genital aperture, passing a period of maturation or hardening by feeding, molts to eight legged and

sexually differentiated adult (Seifert 1996). The Argasid species are characterized by multi host feeding pattern whereas the life cycle of most ixodid species typically involve a 3 host cycle (Minjauw and McLeod, 2003). Based on the number of hosts required to complete the life cycle ticks can be classified into one host, two host and three-host ticks (Walker- *et al* 2003).

Three host ticks

Feseha (1983) and Walker *et al.* (2003) stated that this is the commonest type of life cycle and is relatively considered as primitive. Host finding occurs three times and the ticks require three hosts for development, irrespective of the host species. There are three parasitic phases, separated by two phases on the ground when metamorphoses occurs (Morel, 1989). Larvae develop in the eggs until ready to hatch, usually in several weeks depending on the ambient temperature and tick species. Sudden change in temperature may kill the eggs. After hatching it begins to seek the first host, either lying in wait on a grass blade or moving to hunt actively.

Once the host is found, the blood meal lasts for 3-12 days or more depending on the species and ambient condition, then detaches from the host and falls on the ground, seek shelter and hide in sites such as soil or vegetation. The metamorphosis takes 2-8 weeks depending on microclimatic conditions and it ends with the emergence of a nymph. After a period of hardening, the activities of the instars are similar to those of the preceding larval instars in terms of movement and selected host. The feeding period is approximately the same, subsequently it undergoes a complete metamorphoses resulting in the adult female or male whose size may vary considerably depending on how favorable the conditions are for the nymph and larvae. The female feeds once and lays one huge batch of eggs. The depleted female then dies. The male may take several small feeds, mate and then die. The entire life cycle of three host ticks may take from six month to several years and thus it is slow (Walker *et al.,* 2003)

Two host ticks

In two-host ticks, the three stages develop on two different individuals that may or may not belong to the same species. In the first phase, the engorged larvae moult on the host and the nymph reattaches on the same host. At the end of the blood meal, the nymph detaches and metamorphoses on the ground. Engorgements of the adults occur during the second parasitic phase. There are only two searches for the host, which eliminates the risks linked with the need for nymphal attachment. The two-host life cycle is similar to one host life cycle but only the larvae and nymphs feed on the same individual host, and the adult will feed on another host (Morel, 1989).

One host ticks

This is less common type of life cycle but it occurs in the entire *Boophilus* genus and in some other genera. Larvae hatch after several weeks of development and crawl on to vegetation to quest for a host. When they have completed feeding, they remain attached to the host and molting occurs there. The nymphs then feed on the same host and remain attached. After another molt, the adults hatch and then feed on the same host for mating. Thus, all three feedings of any individual tick occurs on the same individual host. The life cycle of one-host ticks is usually rapid, for *Boophilus* it takes three weeks for the feedings on the host and two months for egg laying and larval development (Walker *et al.,* 2003). All the developmental stages occur on a single vertebrate attacked by the larvae. Oviposition by females, incubation and host finding by the larvae occur on the ground. The ticks leave the host at the engorged adult stage (Soulsby, 1968; Morel, 1989).

2.3. Factors affecting the epidemiology of ticks

Ixodid ticks, particularly three host ticks spend 94-97% of their life cycle off-host in the external environment (Nedham and Teel, 1991). This implies that they are exposed to and under the influence of many factors like habitat structure and climate (Randolph, 2004). The most important ecological factors that influence the occurrence of ticks in biotope include

temperature, which is dynamic factor (oogenesis activity) and relative humidity, which is a statistic factors (survival). Each species has its particular threshold temperature below that diapauses occurs in all instars (Morel, 1989).

2.3.1. Habitat

The habitat of ticks is composed of a variety of living and non-living factors (Latif and Walker, 2004). They are adapted to two extremely contrasting components of their habitat the physical environment and their host. During the time of moulting and questing in the physical environment they are in danger of drying out, starring and freezing as well as exposed to predator (walker *et al,* 2003; and Latif and Walker, 2004).

The larvae are most susceptible because they have high surface area relative to their small volume (Latif and Walker, 2004). Most ticks do not tolerate direct sunlight, dryness, or excessive rainfall. Their activity is restricted during cold period, but increases dramatically during hot and humid weather (Hendrix, 1998). But complete absence of moistures is highly destructive (Katherine, 1976). Adverse factors limit both the type of habitats and species of ticks found therein as a result knowledge of the typical physical habitat of a species aid identification of ticks.

2.3.2. Temperature

Temperature affects the proportion of the developmental stages of ticks. Progress of the rate of development is directly related to temperature (Katherene, 1976; FAO, 1984). The average survival time is determined by temperature and moisture availability (FAO, 1984; Randolph, 1997). The available estimates of *Boophilus microplus* showed that the percentage of available larval swept up by each week varied between 15-40% in trials in which stocking rates ranged from 1.5-5 beast/hectare. In summer these rates increased to 40-100% of larval finding a host during their life time (FAO, 1984)

The temperature and rainfall influences the hatchability pattern and molting period (Dipeolu, 1984). In tropical grazing area where suitable grass covers does not exist, it has been generally accepted, since temperatures are suitable for development throughout a large part of the year, that the distribution of ticks is mainly governed by rainfall (Urquart *et al*, 1996). The average weekly and monthly temperature is useful for predicting the activity threshold and optimum temperature. The various genera of ticks have different thresholds of temperature and humidity within which they are active and fed and their distribution is governed by these thresholds (Urquart, 1996).

2.3.3. Relative Humidity

Relative humidity at microclimatic level is essential for the development and survival of eggs and larvae of ticks. The success of eggs in hatching depends primarily on the availably of adequate moisture, provided that temperature are not too extreme. The wide variation in the percentage hatching is believed to largely determine the size of later tick population (FAO, 1984; Morel, 1989). Each tick species is adapted to a particular relative humidity in a biotope and it varies with the instars and its size. Immature ticks have very specific requirements, where as the adults can protect themselves better against evaporation because of their larger size and thicker tegument. Immature ticks adapt their humidity requirement by developing holes in the ground cracks in rocks, litter, the base of vegetation layer and other sheltered places (Morel, 1989). Engorged larval and nymphs particularly are less susceptible to desiccation than eggs, and their success rates in moulting are usually high in the absence of extreme temperatures or dryness (FAO, 1984). But many species of ticks are able to survive for long periods without a blood meal. Nymphs usually live longer than larvae, and adults live longer than nymphs (Katherine, 1976).

2.3.4. Plant covers (vegetation)

Vegetation is not only the rest of various elements that make up the environment, but it also determines, by its compositions the various microclimates at different level. It is the best

ecological integration which influences the biological phenomena (Morel, 1989). According to Dipeolu (1984) the molting period of larvae and nymphs kept in the open environment as well as the total duration of the life cycle was lower than those of ticks kept in the shade in addition the survival of larvae and nymphs of all tick species studied was lowest during the peak of rain and highest during the dry season. The survival was also generally higher among larvae and nymphs kept in the shade than those kept in the open environment.

2.4. Pathogenic role of cattle ticks

The local injury developed at the site of attachment may predispose to secondary bacteria infection and screwworm myiasis (Katherine 1976; Jubb et al., 1993; and Brossard, 1998).With powerful mouth parts tick damage the skin of animals and leads to reduction in the leather quality and consequently to considerable economic loss (Brossard, 1998).Deep and painful bite wound is more severe in long mouth part ticks *Amblyomma* and *Hyalomma.* Deep bite often leads to abscess formation due to infection by pyogenic bacteria and damage to udder (Jubb et al, 1993).The irritation and painful phenomenon that followed tick bite result in worry or annoyance. Hence the host expend much of its time and energy in effort to avoid this effect rather than grazing (Kaufman,1989and Morel,1989).The damage incurred by large mouthed *Amblyomma* and *Hyalomma* species results in the rejection and downgrading of skins and hides leading to an equivalent loss of one million birr annually to Ethiopian livestock industry (Fiseha,1983).

Ticks can be a direct cause of illness, toxicosis and tick paralysis (Brossard, 1988). Some species of ticks known to introduce toxin through their salivary secretions into the host bloodstream while feeding.The toxins act like neurotoxin producing ascending paralysis or responsible for tick borne toxicosis (Katherine 1976 and Morel,1989).Ticks like ixodes *Dermacentor andersoni Hemaphysalis punctata,Hyaloma aegypticum Rhipicephalus evertsi evertsi ,Rhipicephalus simus* and *Amblyoma c*ajannese reported to be responsible for tick paralysis (Katherine ,1976),while *Hyaloma truncatum* and *Rh. Appendiculatus* able to cause tick toxicosis sweating sickness that is seen in southern and east Africa (Morel,1989)

Ticks are greedy devourers of blood. Severe infestation can cause anemia, which is the product of simple hemorrhage ,bone marrow depression resulting from toxic action .The tick feeds by suction from hemorrhagic cavity alternating with injection of saliva .Engorgement is slow at first then accelerates. According to Fiseha (1983) cattle can lose 0.5 to 1 liter of blood per day through the activities of ticks .On the other hand when dealing with specific species a single adult female *Amblyomma* and *Boophilus* may extract 1-2ml of blood from a host per day (Morel,1989). Walker et al (2003) ratifies this situation by explaining that ten engorged females of *A.hebreum* per day on cattle can decrease live weight gain by 20 kg over a three month period.

Live weight in native African cattle over one year old appears to be negatively correlated with the numbers of ticks (Pegram *et al.*, 1989). In addition ,observations made on indigenous African Sanga and Guadili cattle of similar age as used in our study found that live weight losses per tick units increases with the numbers of attaching ticks (Pegram *et al* .,1989) and with the extension of time during which tick stimuli are active (Stachurski *et al* .,1993) Furthermore a delay of 4-6 weeks age was reported between tick infestation and

2.5. Tick control methods

Control of tick infestation and the transmission of tick borne diseases remain a challenge for the cattle industry and is a priority in many countries of tropical and subtropical areas of the world (Lodos,et al.,2000). Measures recommended for tick control should have the potential to reduce parasite over successive generation and ultimately reduce or eliminate the need for regular chemical application (Honer and Gomes, 1990).Whatever the case may be ,be, integration of chemical control methods with non- chemical methods will always be expected to produce better outcomes in terms of tick control and delay of resistance than the use of chemical acaricide alone (Angus,1996).Any control strategy should be based on the knowledge of the local tick ecology which would improve the efficiency of the control programme, reduce the risk of acaricide resistance and environmental pollution (Dantas – Torres,2008).

2.5.1.Chemical control methods

There are many examples where tick have been effectively controlled or eradicated solely by the thorough application of efficient acaricides .These products will remain of paramount importance in animal production much of the world for the foreseeable future. In order to delay the emergence of acaricide resistance ,to meet consumers expectations and to prevent environmental contamination ,other control procedures must be integrated with acaricide .Acaricides can be applied b y several methods ,strategies and product formulations .The choice depends on the individual farmers ,the availability of human and monetary resources and the economic impact of ticks in the animal production system in question (FAO,2004). The recent philosophy of minimizing the use of chemical acaricide does not diminish their key role in integrated parasite control system .Indeed, there are situation, such as where market demand for tender beef has increased ,that have forced farmers to return to the use of more tick susceptible ,Bos taurus breeds of cattle(FAO,1984).

An ideal acaricide would be cheap, easily applied, with a strong knock down effect and sufficient residual effect on female ticks to prevent egg laying and to protect cattle from reinfesation by larvae .It should not select for resistance through a prolonged, gradual decay on the animal (i.e. it should have a sharp cut off in efficacy with time). In addition, it should be non toxic to livestock and humans and have no detectable residues in meat and milk (FAO, 2004).

2.5.2. Non-chemical control method

Non-chemical procedures for tick control should be considerably implemented with chemical control methods (Dantas-Torres, 2008).

Resistant breeds of animals

Genetically determined resistance of the host to ticks has been demonstrated and *Bos-indicus* breeds of cattle in general have much higher resistance than European *Bos taurus* animals

(FAO, 1989b) and (Ralph, 1989). The heritability is high and expression depends on the stimulation of an immune response by feeding ticks. There is substantial individual variation in resistance and number of external factors may affect its expression, especially season, poor nutrition and stress (Jonsson *et al.*, 2000).

The inclusion of tick resistant breeds through breeding programmes will increase the average resistance of cattle within a herd. This has been shown to result in lighter infestation and smaller populations of ticks, with a reduced requirement for treatment with acaricide. The within breed variations in resistance to ticks can be used for improvement, continuously selecting animals for breeding that are consistently infested with the smallest number of ticks. There is currently no strong evidence that resistance against ticks has a negative correlation with production trait (Jonsson *et al.*, 2000b).

Vaccines

The development of the first effective vaccine against *B. microplus* was a great advance in the fight against a serious pest that interferes with world food production. The two commercially available vaccines (Tick GARD plus, Hoechst, Australia and Gavac TM, Heber Biotech, Cuba) are now on the market in a limited number of countries. Both vaccines are based on hidden antigens from the gut of the tick that once inoculated in to cattle, induce the production of antibodies which, when ingested by the tick, result in damage to the gut, slightly reduced survival, reduced egg production and reduced hatchability of eggs. Consequently, tick population decline with time, although there is little direct mortality effect on ticks. The vaccines contain a single antigen known as BM86 (FAO, 2004).

The vaccine has advantages of reducing the frequency of acaricide treatment, and thus the risk for developing acaricide resistance is also reduced. It is possible that vaccines against ticks can reduce tick burdens but not eliminate exposure to TBDs (Fragos, *et al.*, 1998). Its application is harmless to the environment.

Rotation of crops with livestock, and pasture "spelling"

In many areas of the world, rotation between crops and livestock is a measure that reduces tick populations. Improvements in this procedure, such as introducing only clean or uninfested animals in to areas where crops have recently been harvested for instance by treating them just before introduction in to these areas, will reduce the probability of reinfestation. Rotation of sheep and cattle, with treatment of cattle just before entry in to their new paddock has also proved effective in decreasing tick populations on the pastures. In many regions where cattle and sheep are continuously pastured together cattle typically need to be treated against ticks; however, where they are pastured alone under similar circumstances, cattle carry significantly higher tick burdens. "Spelling" of pastures, which involves removal of all livestock hosts from them for periods of time that ensure death of most or all free-living ticks, has been successful in reducing or eliminating population of cattle ticks. (FAO, 1989).

The principle is that the tick habitat is modified to be less suitable for tick survival and due to the absence of the host; the parasitic life cycle is disrupted (Desquences and Vignon, 1987). Ecological studies (Quijada, *et al.*, 1997) have shown that from two months after hatching, the percentage of larvae surviving in pastures decreases significantly. This effect is most marked under adverse environmental conditions (high temperatures, dry, short pasture cover). Larval mortality is due to starvation and desiccation. Rotation or spelling periods are therefore shorter in hotter climates and in summer months.

Biological control

The biological agents, which potentially could be used for the control of ticks, include some fungi, e.g *Metarhyzium spp* and *Beauveria spp* (Rijo, 1998), bacteria, e.g *cedecea lapagei* (Verissimo, 1995),), nematode (Brum and Teixeria, 1992b) and ants (Verissimo, 1995) that attack soil living stages of the ticks. These natural pathogens and predators have not yet been subjected to sufficient field testing or validation and acquire extensive product development (Labarthe, 1994). Nevertheless, preliminary laboratory bioassay trials against *B. microplus* have shown *Metarhyzium anisophae* to have a high virulence against ticks.

It is known that a number of bird species (oxpeckers, cattle egrets, chickens) may contribute to an overall reduction in tick numbers on livestock and in the environment. Their precise effects on tick burdens need further evaluation before they can be considered as significant tick control measure (FAO 2004)

Herbal remedies

The use of some types of grass or leguminous plants with acaricidal or repellent effects needs greater assessment for possible inclusion in schemes for improving tick control. *Brachiaria brizantha, Melinis minutiflora,Stylosanthes* spp., neem oil, etc., have been shown to have some larvicidal or repellent effect against the larval (Banerjee, 1997). The feasibility of these species for feeding animals for tick control under field conditions has not yet been adequately studied (FAO.2004).

2.6. Distribution of important cattle tick species in Ethiopia

Ticks are widely distributed and usually seasonal in their activity (Galloway, 1974). The original geographical and ecological range of tick of domestic animals has been vastly extended by human and animal movements, trade, and "modernization" (FAO, 1984).

In Ethiopia ticks are common in all agroecological zones of the country (Pegram et al., 1981; Mekonen, 1998). Ticks are economically important by acting as vector of diseases like babesiosis, anaplasmosis, tropical theileriosis and dermatophilosis in cattle in Ethiopia (Morel, 1980). Previous studies on ticks in Ethiopia were done by Pavesi during 1883 to 1884, Pocock in 1900 and Neuman in 1902 and1922 as cited by Pegram *et al* (1981). Ticks common in both Ethiopia and Sudan were listed by (HoogsralHoog, 1965). Then in 1970's and beginning of 1980's tick of the country was studied by Bergeon and Balis (1974), Morel (1980) and Pegram *et al.* (1981). According to Sileshi (1994) the main genera of ticks found in Ethiopia are *Amblyomma, Boophilus, Haemaphysalis, Hyalomma* and *Rhipicephalus.* The most important and widespread tick species are *A. variegatum* (vector of *C. ruminantium* and

T. mutans) and *B. decoloratus* (vector of *A. marginale* and *B. bigemina*). There is no report of the presence of *Rh. appendiculatus* (vector of *T. parva*) in Ethiopia.

Solomon (1996) indicates that more than 50 different tick species are currently known to be present in Ethiopia, infesting all phylogenetic classes of vertebrates from amphibian to mammals; however only a few are of economic importance in terms of geographical spread, effect of feeding on the animal and/or disease transmitted. These include: *A. variegatum; B. decoloratus; Rh. pulchellus, A. cohaerens; Rh. bergeoni; Rh. e. evertsi; H. m. rufipes; H. truncatum; H. dromedarii, A. lepidium;* and *A. gemma*. The general characteristic and distribution of commonly occurring tick species in Ethiopia is described as follows:

Genus *Amblyomma*

The genus is one of the commonest ticks widely distributed all over the country. Out of the 102 species so far identified in this genus, 4 species were reported to exist in Ethiopia occupying different agro ecological zones. They are among the larger ticks and their scuta is colored ("Ornamented"). Their long mouthparts cause abscess formation, which may lead to udder damage and serious secondary infections and most of them incriminated to transmit diseases to animals (FAO, 1984 and Hall, 1985).

Amblyomma variegatum is uniformly dispersed in all regions of Ethiopia from sea level to 8500 feet elevation. It is distributed generally throughout the Ethiopian faunal region. Western parts of Ethiopia (Mekonen *et al* 1992. Abundance was found to be much lower in tropical woodlands and thorn bush vegetation habitats in the Rift valley, and in arid southeastern areas (Feseha, 1983). According to Walker *et al.* (2003), its spread southwards appear to be limited by inter specific competition with *A. hebraeum* with which it shares similar habitats, hosts and sites of attachment. Several studies done in the country have shown its widest and predominant distribution in different regions of the country. Sileshi *et al.* (2001) have found it in all administrative zones. From the Northern parts of the country it is reported by Mamo (1988), Abera (1989), Yilma *et al.*, (1995), Mesfin (1996), Sinshaw (2000) and Seyoum (2001). Haile(1987) in Illubabor, Mekuria (1987) in Nekemte, Getachew (2004)

in Jimma and Belay (2004) in Mizan Teferi are some of the reports from the western parts of the country. From the central and southern Ethiopia, Birhane (2004) in Hawassa; Mekonen ,*et al.,* (2001), Wallaga,(1997) , Fiseha and Sisay (1997) have reported in the rift valley area.

Amblyomma cohaerens is prevalent and abundant tick species on cattle in western Ethiopia, where the climate is humid for much of the year (Sileshi *et al.* 2001). De Castro, (1994) has reported it as the most abundant tick species in western zone like in Mendi (Wallega) in the north to Maji (Kefa) in the south and as far west as Itang (Ilubabor). Recent works conducted by Yitbarek, (2004) in Jimma area revealed the wide distribution of this tick species in the west zone (83% of the total collection). It is absent in the driest northeastern and southeastern ecological zones (Feseha, 1983). *Amblyomma cohaerens* is a specific parasite of the buffalo in African Savannah. It looks more particularly connected with *syncerus caffer aequinoctialis* subspecies and it seems to subsist normally on cattle where there is no initial host or when it has disappeared and very often collection of *A. cohaerens* in Ethiopia coincide in the whole, with dense formation of mountain subtropical grass land (Morel, 1980). *Amblyomma cohaerens* appears to be abundant in highlands and rare in lowland areas (Bekele, 1987 and Tedla, 1991). (FAO 1984) states that among the seven important African *Amblyomma* species, *A. cohaerens* and *A. gemma* are known to be present in Ethiopia.

Amblyomma gemma is reported to be present in the Rift Valley and eastward and appear to be adapted to arid lowland areas. It is common in the semiarid rangelands of Harar administrative region, Sidamo, far less in the Omo Valley (Morel, 1980). It is also prevalent in the rainy season from March to October and rarely occurs in areas with more than 800 mm of rainfall annually (Feseha, 1983). The distribution of *A. gemma* is between the 250 and 750 mm annual rainfall isohyets, and exclusively concerns to Eastern Africa, the Yemen, Ethiopia, Afar and Isas, Somalia, Kenya, Uganda and Tanzania (Morel, 1980 and Walker *et al.*, 2003). It was the least tick species found in Jimma area, Yitbarek, (2004). It parasitizes ungulate and carnivorous mammals available in its distributional area. Mohamed (1985), Jewaro (1986), Dejenu (1988), Sebsibe (1988), Tedla (1991), Tesfanesh (1993) and Solomon (1994) are among those who have identified and reported this tick species in different regions of Ethiopia.

Amblyomma lepidum occurs in a wide variety of climatic regions, from temperate (highland), to savannah, steppe and desert, but it inhabits most commonly arid habitats with 250-750mm rainfall, making it the second most xerophilous African species of *Amblyomma* after *A. gemma*, (Morel, 1980). It is rare in Eastern arid zones and in western wetter areas (Feseha, 1983). It is widespread in central and eastern Sudan, Ethiopia, Southern Somalia, Eastern Uganda, Kenya and Northern region of central Tanzania and is not known to occur out side East Africa (Hoogstraal, 1956). In a survey conducted in western zone of Ethiopia this species was only found in three localities of Gambella (de Castro, 1994).

Genus: *Rhipicephalus*

Some eight species of *Rhipicephalus* have been identified to occur in different parts of the country of which *Rh. pulchellus*, *Rh. e. evertsi* and *Rh. simis simus* are the dominant species. *Rhipicephalus pulchellus*, also known as "zebra tick" because of its white and black stripes and its use of zebras as a favorite host (FAO, 1984 and Walker *et al*, 2003), is highly distributed in the arid region, chiefly in the Rift Valley and eastward (Seleshi *et al*., 2001). There are only two records from the west of the Valley so far. Several previous investigators have also reported its presence in different regions of the country (Mohamed, (1985); Jewaro,(1986); Dejenu, (1988); Sebsibe, (1988); Tedla, (1991); Tesfanesh, (1993), Solomon, (1994); Surafel, (1996)and Wallaga,(1997). It occurs almost exclusively in east of the Rift valley in southeastern Ethiopia, Kenya, Somalia, and northern Tanzania, usually between 300-1800m altitudes masl, (FAO, 1984 and Walker *et al*., 2003). It infests the ungulates of the dry East Africa at all stages and sticks to the same points as *Amblyomma* or the under parts of cattle, sheep and dromedaries such as the chest, belly, genito-anal area, also in the ears (Morel, 1980).

Rhipicephalus evertsi evertsi also known as the "red-legged tick" shows no apparent preference for particular altitude or rainfall zones or seasons. Its distribution includes desert, steppe, savannah, and temperate climatic regions (Walker *et al*., 2003). It is present in the Angar Valley in western Ethiopia at 1450 masl and 1450 mm annual rainfall and at Asaita in

the eastern Danakil, below 500 m.a.s.l with 250 mm rain annually (Feseha, 1983). Sieleshi *et al.* (2001) reported its widest distribution in all administrative zones surveyed. It is a two-host tick and is widely distributed throughout the Ethiopian faunal region. It has been recorded from Eastern Ethiopia by Gulilat in (1996) and Bekele (1996), from western Ethiopia by Mekonen et al., (1992); Fiseha and Sisay (1997) at Abernosa ranch and also Seyoum (2001) reported it from Kobo Girana valley North Wollo zone. Though altitude and low temperature do not limit the distribution of red tick, rainfall bellow 10 or 15 inches per annum seems to be a limiting factor (Hoogstraal, 1956). Adults attach chiefly under the base of the tail and around the anus, less often in the groin and axillae and on the genitalia and sternum whereas the larvae and nymphs feed deep in the ears.

Feseha (1983) reported that this tick species may cause tick paralysis in animals. Bekele (1987) has found this species restricted to wetter highland and middle altitude areas infesting mainly cattle, considering it as highland ecotype. On the other hand, Jewaro (1986) has found it occupying a wide range of altitude from 610 m-1434 m.a.s.l. in semi arid to sub-humid agro ecological zones. Likewise, Mohamed (1985), Belete (1987)Eshetu (1988), Dejenu (1988),Sebsibe (1988), Tesfanesh (1993), Surafel (1996) and Solomon *et al.* (2003) have reported the existence of this species in different parts of the country, although recent finding or report made by Walker *et al.* (2003) indicates its absence from East African region.

Rihpicaphalus bergeoni is restricted to mountain areas and to the neighboring subtropical grasslands of Ethiopia (Feseha, 1983). Few reports have revealed its presence in the country (Belete, 1987; Jewaro, 1987; Bekele, 1987; Eshetu, 1988 and Tesfanesh, 1993) although Morel (1980) indicated the dominant association of the species in highland forest areas from 2000 to 3000 m.a.s.l. .

Rhipicephalus praetextatus is a member of the *Simus* group which also contains *Rhipicephalus simus* and *Rh. muhsamae*. On cattle the adults attach mainly in the tail brush and around the feet. It is a three host ticks and adults of this tick are most abundant during the rainy season and it can cause toxicosis in cattle, resulting in paralysis. This tick occurs in wide range of climatic region from temperate highland areas of Ethiopia and Kenya, through to

savanna and steppe of east Africa to the desert climate in North East Africa and the Eastern Sahara (Walker et al 2003).

Genus *Boophilus*

Boophilus decoloratus, also known as the blue tick, is the common, widespread and frequent one host cattle tick in Africa. Its distribution pattern is similar to that of *A. variegatum*. It is abundant in wetter highlands and sub-highlands of Ethiopia (Feseha, 1983. Similarly, this tick was recorded in Western Ethiopia (Mekonen et al 1992), in Abernossa ranch by Fiseha and Sisay (1997), Seyoum (2001) in KoboGirana valley, Bekele (1996) from Eastern Ethiopia, Taddesse (1994) in DireDawa; Bekele (1995) in Eastern region of Ethiopia, Mesfin (1996) in Tigray, Solomon et al (1998) in Didytuyura, Sinshaw (2000) in Metekel Ranch, Mekonen et al., (2001) in central Ethiopia, Regassa (2001) in Borana, Bekele (2002) in Alemaya, Assefa (2004) in Asela, Belay (2004) in and around Mizan Teferi, Birhane (2004) and Getachew (2004) in Hawassa are the major sites representing all agro ecological regions of Ethiopian .It predominates in broadleaved and coniferous forest but absent from drier areas Pegram et al.(1981) and de Casstro,(1984). Similarly, this tick species occurs in regions with savannah and temperate climates, typically in grasslands and woodened areas used for cattle pasture.

Boophilus annulatus is often found together with *Boophilus decoloratus*. Cattle are the main hosts of *Boophilus annulatus* but also occasionally sheep, goats, and wild ungulates can support successful completion of the life cycle. It transmits the protozoan *Babesia bigemina* and *Babesia bovis* to cattle, *Anaplasma marginale* and heavy infestations cause damage to hides and probably lead to a reduction in the rate of growth of cattle (Walker *et. al*., 2003 and Hall, 1985). Except a single record made by Bekele (1987) there is no report on the existence and distribution of this tick species in different regions. This tick is well established in the Eastern part of neighboring Sudan but not in Ethiopia, and so poses a major risk to the Ethiopian cattle population that has no immunity to *Babesia bovis* (tick modeling workshop, 1997).

Genus *Hyalomma*

Hyalomma dromedarii is common in regions with Mediterranean, steppe and desert climates that are north of the equator in Africa. It is well adapted to extreme dryness of habitat and to camel hosts. In areas where camels are now, less common it seems that cattle can support populations of this tick. In Northeast and East Africa, it occurs in Sudan, Eritrea, Northern, Eastern and Southern Ethiopia, Northern Kenya and Northern Eastern Uganda (Walker *et al.*, 2003). *Hyalomma dromedarii* can transmit the protozoan *Theileria annulata* to cattle under laboratory conditions.

Morel (1980) indicated that the distribution of *Hy. dromedarii* coincides with that of hot tropical deserts. It never extends to the cold desert of central Asia, probably it would have some biological flexibility, which would enhance its chances of survival in the difficult environment where it lives. It is most adapted to conditions of extreme drought. Dejenu (1988) and Sebsibe (1988) reported its presence in Bale and Sidamo, respectively without detail information on disease transmission

Hyalomma marginatum rufipes is also known as the hairy *Hyalomma* or the coarse legged *Hyalomma*. This is a large robust, shiny black tick. Cattle are the main hosts of adult *H. m. rufipes* in addition sheep, goats, horses and wild ungulates are infested. *H. m. rufipes* is widely distributed in much of Africa and has been recorded from every climate region from desert to rain forest. However, the distribution is patchy and it is probably commoner in the dries areas (Walker *et.al,* 2003). It has been found to be the most important vector of the virus causing CCHF in humans. It also transmits *Anaplasma marginale* to cattle. Several previous investigators in different parts of Ethiopia reported the distribution of this tick. For instance, Mohamed in Wolayita Awraja (1985), Sebsibe (1988); Dejenu in Bale province (1988); Eshetu in Gonder (1988), at Abernosa ranch by Solomon (1993) and also in North Wollo zone Kobo Girana valley by Seyoum (2001), Asrat (1987), Haile (1987) ,Mekuria (1987), Biru (1988), Abera (1989),Bekele (1996), Mesfin (1996), Solomon et al (1998), Mekonnen et al (2001), Regassa (2001), and Assefa (2004) have reported its presence although in lesser frequency and abundance compared to with the other tick species.

According to Morel (1980) *Hy. m. rufipes* was the most abundant *Hyalomma* collected in the Massai steppes and in thicket Savannahs of Ethiopia. The normal habitat of the species is found between the 150 mm and 750 mm annual rainfall isohyets.

Hyalomma truncatum, also known as the shiny *Hyalomma* because of the smooth surface of the male .The hosts of adult *Hyalomma truncatum* are large domestic and wild herbivores. The adult ticks attach to the herbivores to the tail switch around the anus on the lower perineum and on the legs, including the feet. Adults are present in the largest number in the late summer months and the immature stages in the dry autumn to spring months. Some strains of *Hy. truncatum* have a toxin in their saliva that causes the skin diseases known as sweating sickness in cattle especially in calves. This tick species is adapted to dry habitat and is commonest in desert, steppe and savanna climatic regions but is also recorded from temperate (high lands) climate Walker et al (2003). It is recorded from different ecological zones of the country by several investigators in different period of time. Bergeon and Balis (1974), Morel (1980), Pegram *et al.,(*1981), Abdo (1986), Asrat (1987), Biru (1988), Mamo (1988), Yilma *et al* (1995), Mesfin (1996), Solomon et al., (1998), Mekonnen *et al* (2001), Regassa (2001), Seyoum (2001) and Assefa (2004) have reported this tick species from different regions of the country.

3. MATERIALS AND METHODS

3.1. Study sites

Adami Tulu Jido Komolcha district is situated in the mid rift valley of East Shoa Zone of Oromia Regional state. The district has a longitude and latitude of $7^{0}52'N$ and $38^{O}42'E$, respectively (CSA, 2005). The altitude ranges from 1500 to 2300 m.a.s.l. the district has a bimodal unevenly distributed rainfall pattern .The average annual rainfall is 760.9 mm. The short rainy season is from February to April whereas the long rainy extends from July to September. The minimum temperature is 12.7^{0} c and maximum temperature is 29^{0} c. The relative humidity is 76%. Vertisol is the predominant soil type with sand, silt and clay in the proportion of 33:48:18, respectively with a PH of 7.9. The livestock population of the area is cattle 176186, sheep 30899, goats 150085, horses 1258 mules 518 donkeys 20254 and poultry 120991 (Adami Tulu Jido Kombolcha district Agriculture Office).

Adaa Liben the second site representing the midland altitude is part of the rift valley of East Shoa zone of Oromia Regional state. Its altitude is about 1850 m above sea level. It experiences bimodal patterns of rainfall with the main rainy season extending from June to September. A short rainy season occurs between March and May with an average rainfall of about 800 mm. A short rainy season occurs between March and May with an average rainfall of about 800 mm. (CSA, 2003). Highest temperatures are recorded in May. The mean relative humidity in Debre Zeit is 61.3%.

The third study site the highland altitude (Sebeta Waso) located in south west Shoa zone of Oromia Regional state .The area is located at 8^{0} 55'N latitude and 38^{0} 37'E longitude. The district has an altitude of maximum 3385 and minimum 1800 m.a.s.l. This study site has annual rainfall of maximum1200 and minimum 866 .The minimum temperatures of 3^{0}c and 28^{0}c prevail in the area) .The proportion of soil type in the area is as follows: black clay soil (61%),red soil (34%) and brown soil (5%).The farmers in the area follow mixed crop livestock farming system .The livestock population of the area : 132743 cattle,17405 sheep ,

2006 goats, 4519 horses, 3691mules, 24000 donkeys, 52740 poultry and 19373 bee colonies (Sebeta District Agriculture and Rural development office2001).

3. 2. Study animals

3.2.1. Longitudinal study

For longitudinal study twenty indigenous cattle breed randomly selected were sampled from each agro ecological zones of the study areas. All the animals were not treated with any acaricides prior to the study period of tick burden counting.

3.2.2. Cross sectional study

For cross sectional study one hundred and fifty three cattle randomly selected were subjected to standard tick collection and identification techniques. During the study period ticks were collected from eight half body regions of cattle namely: head, dewlap, brisket, belly and back, udder or scrotum, anogenital, leg and tail during the wet period. Similar sample size of cattle was used for similar purpose during the dry season.

3.3. Study design and methodology

The study comprises longitudinal type to asses the bi-monthly seasonal total tick burden in the three different agro ecological zones on selected cattle .The second type of the study was cross sectional study, which is to assess the adult tick species present in the area during the wet and dry periods. For the study of tick control practices in the study sites a questionnaire format was designed and delivered for 50 respondents in all the three study sites .The formats includes the following concepts: type of acaricides used ,frequency of acaricide application ,method of application ,rotational use of acaricide ,use of ethinoveterinary practices and their knowledge about ticks and ectoparasites .

3.3.1. Tick collections and identification

Adult ticks were collected from half –body region of cattle from the three agroecologicl zone during wet and dry periods into the universal bottle containing 70% ethanol (Walker et al 2003). Ticks were removed from the host while retaining their good conditions for collection using good quality forceps .The collected adult from each body regions were kept separately for identification in separate sample bottles .The ticks then taken to the parasitology laboratory of Faculty of veterinary medicine, AAU and also to the National Animal Disease Investigation Laboratory,Sebeta. Ticks were identified using stereomicroscope following the standard identification procedures described by Walker et *al*., (2003).

3.3.2. Tick burden counting

In each of the three agro ecological zones half body regions of total tick burden of twenty indigenous cattle counted every two months starting from October 2008 up to April 2009 representing : late rainy season ,early dry season ,late dry season and early rainy season. All tick species and any developmental stages of total ticks; present in the animal on either side of the animal was counted every two month by dividing the animal body in to: head, Dewlap, Brisket, Belly and Back, Udder or scrotum, Anogenital, Leg and .Tail (Modified from Kaiser *et al* and Okello-Onen, 1999a).

3.3. Sampling and sample size

The study sites were selected by purposive sampling technique .But the study cattle ,twenty indigenous breeds from each agroecological zone were sampled by systematic random sampling technique .To assess tick species present in the three agro-ecological zones in wet and dry periods ,cattle selected from each study sites by systematic random sampling technique during each period .The sample size for the cross-sectional study was determined using the formula indicated by (Pfeiffer,2002), to determine or estimate the level of disease occurrence taking an estimated prevalence of tick infestation of 88.2% indicated by Bekele (1987),accepted error of 5% and 95% confidence interval.

Formula used to calculate sample size or detect disease occurrence

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

n=required sample size

Pexp=expected prevalence

d= desired absolute precision

Therefore from each agroecological zone and each season 153 cattle were sampled by systematic random sampling technique .The adult ticks were collected from half-body regions of eight different body parts of cattle during dry period's .Also during wet periods 153 cattle sampled by similar sampling technique. Every tenth animal was taken while they move for watering or gathering for vaccination .After that adult ixodid ticks were collected from eight half-body region of the animal body in to separate sample bottle all the collected adult ticks were identified to species level using stereomicroscope at the parasitology laboratory of Faculty of veterinary Medicine, AAU and National Animal Disease Investigation Laboratory, Sebeta.

3.4. Data analysis

After entry of the collected data in to the Microsoft Excel sheet, it was summarized by descriptive statitistics like mean and percentage and displayed by graphs and tables..Analysis of variance, t-test, and x^2 were used to test the prevalence, the seasonal and agroecologicl differences of species identified, and the burden difference between seasons. For these analyses Micro soft Excel and SPSS 14.5 were used.

4. RESULTS

4.1. Tick species identified

During the study period total of 10,085 adult ixodid ticks were collected from a half –body regions of 918 cattle that were sampled from the three agro ecological zones during the wet and dry season .Of these collected ticks (5542) were males (4543) were females (*Table.1.*) .As a whole in the study areas four adult ixodid tick genera and seven species were identified in wet period ,and similar number of genera and six species of adult ixodid ticks were identified during dry periods .During the two season the genera of ticks identified were *Amblyoa ,Boophilus Rhipicephalus and Hyalomma. Fig.1.*

Table 1: Tick species identified in different altitudes during the wet and dry season

Tick spp	agroeocolgy						sex		**total**
	highland		midland		lowland				
	wet	dry	wet	dry	wet	dry	male	female	
A.variegatum	48	116	2760	192	440	88	2226	1418	3644
B.decoloratus	1920	224	120	56	110	78	906	1604	2510
Rh.e.evertsi	66	484	240	720	110	190	1040	770	1810
Rh.paetextatus	-	-			330	104	258	176	434
Rh.pulchelus	-	-	15	-	20	-	29	6	35
Hy.m.rufipes	108	48	280	512	60	130	558	328	880
Hy.truncatum	34	80	24	72	380	176	528	238	760
Total	2176	952	3644	1452	1450	766	5542	4543	10085

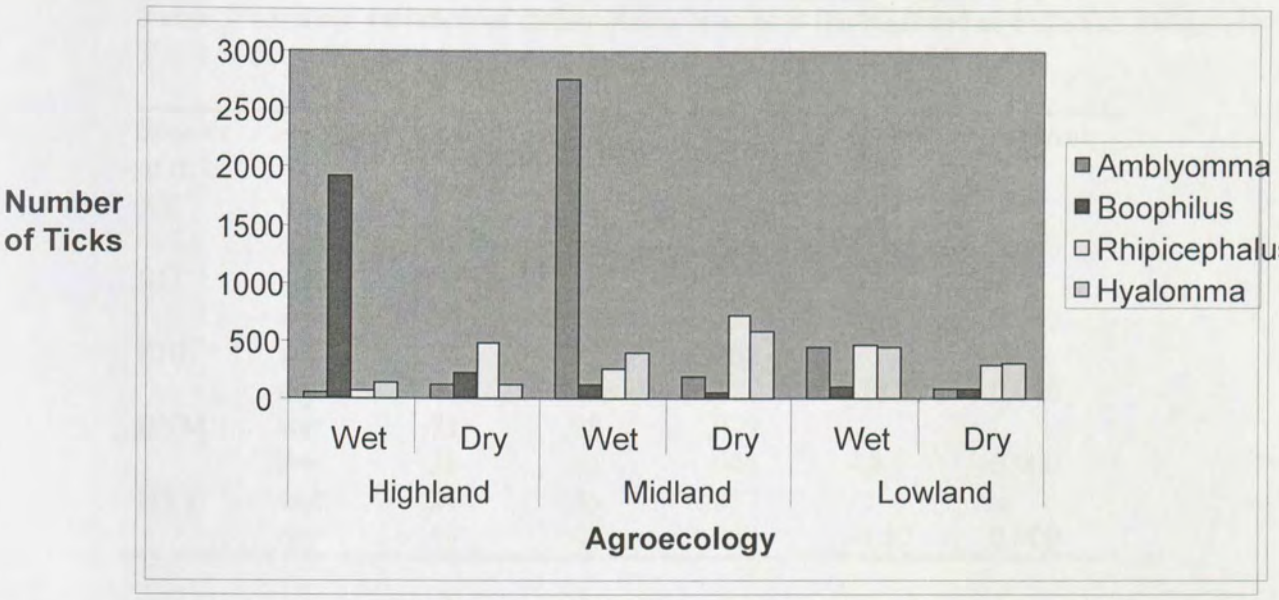


Figure 1: Genera of ticks identified in three different agro ecological zones during the dry and wet seasons

A total of 2176 and 952 adult ixodid ticks were collected from half body regions in the wet and 153 cattle in the dry season, respectively. A total of five species of ticks were identified (Fig 3) from this study .Significantly ($p<0.05$) higher proportion of *B.decoloratus* 88.2% were identified during the wet season .But *Hy. truncatum* (1.5%) was identified with least proportion during the wet period. *Rh.e. evertsi* (50.8%) was the most abundant during the dry period whereas *Hy.marginatum rufipes* (5%) was with smallest proportion during season (Fig3)

Table 2: seasonal variation of different tick species at the highland as tested by independent T-test with equal variances

Species of ticks	*season*	*mean*	*SD*	*SD Error*	*t-test*	***p-value***
AV	wet	.34	.58	.48		
	dry	.92	1.46	.118	-3.60	0.000
BD	wet	13.39	6.46	.52		
	dry	1.5	1.8	.15	21.93	0.000
RHE	wet	.48	.77	.062		
	dry	2.97	2.18	.17	-13.33	0.000
HYM	wet	.73	.98	.079		
	dry	.28	.56	.046	4.84	0.000
HYT	wet	.24	.45	.037		
	dry	.59	.84	.068	-4.57	0.000

AV = *A.variegatum* BD= *B.decoloratus* RHE = *Rh.evertsi evertsi*

RHPR =*Rh.praetextatus* HYM = *Hy.marginatum rufipes* HYT = *Hy.truncatum*

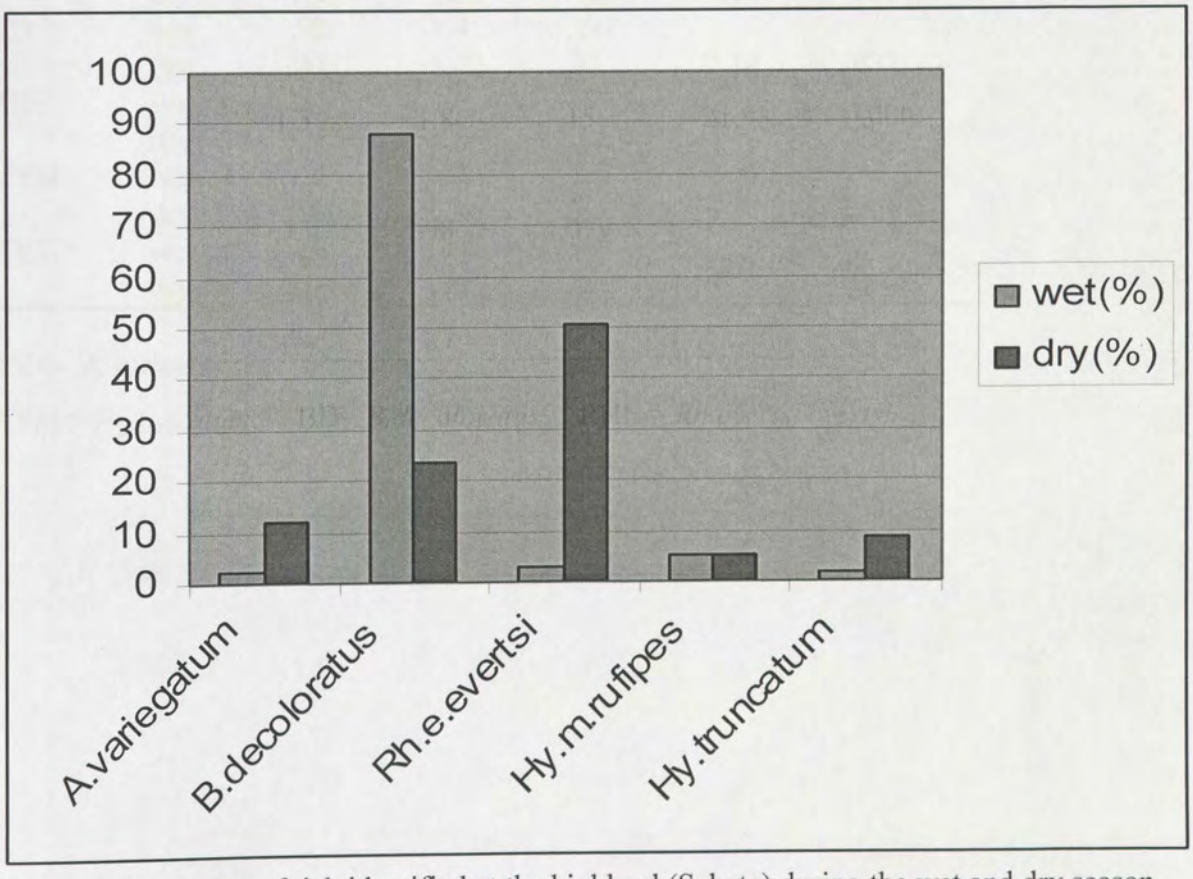


Figure 2: Proportion of tick identified at the highland (Sebeta) during the wet and dry season

A total of 3644and 1452 ixodid tick species were collected from Ada Liben amidland study site from half- body regions of 153 cattle in the wet and 153 cattle in the dry season, respectively. A total of six species of ticks were identified from this study .Significantly ($p<0.05$) higher proportion of A.variegatum (75%) than the other species was collected during the wet season. But Rh.pulchelus (.4%) was collected at the lowest during the wet season. Rh.e.evertsi (49.6%) was the most abundant tick species during the dry season whereas Hy.truncatum (0.6%) was with lowest proportion during the dry season (Fig 4)

Table 3 : seasonal variation of different tick species at the midland as tested by independent T-test with equal variances

Tick species	season	mean	SD	SD error	t -value	**p-value**
AV	wet	16.16	10.67	.86		
	dry	1.29	1.52	.12	9.65	.000
BD	wet	.92	1.4	.11		
	dry	.41	1.02	.83	2.14	.032
RHE	wet	1.58	1.4	.11		
	dry	4.61	4.8	.39	3.4	.001
HYM	wet	.22	.44	.04		
	dry	2.92	2.65	.21	3.5	.001
HYT	wet	.18	.39.	.03		
	dry	.49	.95	.077	6.5	.000

AV = A.variegatum BD= B.decoloratus RHE = Rh.evertsi evertsi

HYM = Hy.marginatum rufipes HYT = Hy.truncatum

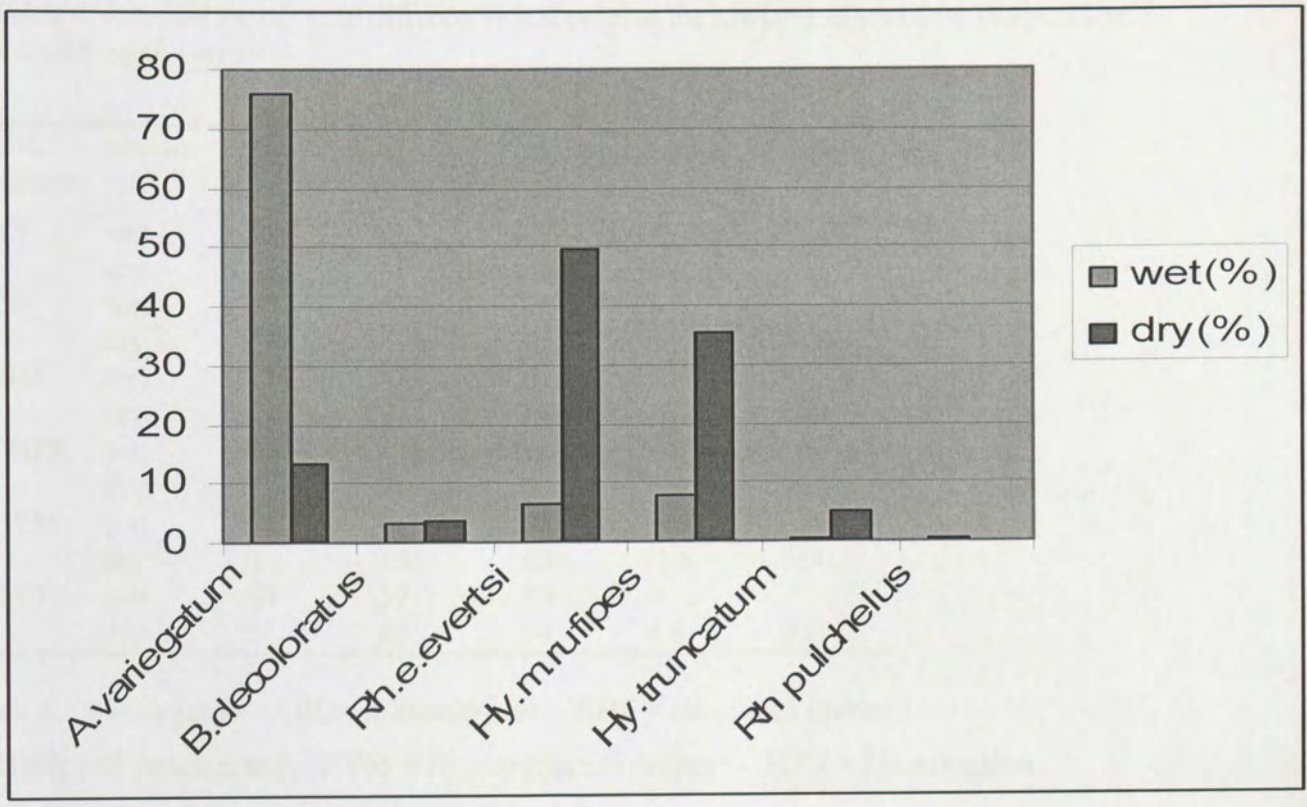


Figure 3: Tick species identified in the midland (Adaa Liben) during the wet and dry season

A total of 1450 ticks from the half-body regions of 153 cattle in the wet and 766 ticks from the half-body regions of 153 cattle in the dry season were collected and identified from Adami Tulu Jido Kombolcha district a low land study site. A total of seven species of ticks in the wet and six in the dry season were identified (Fig.4).Significantly ($p<0.05$) higher proportion of *Hy.truncatum* (85.9%) was recorded during the wet season whereas *Rh.pulchelus* (1.5%) was identified with the lowest proportion .*Rh.evertsi evertsi* (68.6%) was the most abundant tick species during the dry season .But *B.decoloratus* was with the lowest proportion during the same dry season (Fig5)

Table 4: seasonal variation of different tick species at the lowland as tested by independent T-test with equal variances

Tick species	season	mean	Sd deviation	Sd error	t-test	**p-value**
AV	wet	.69	.46	.037		
	dry	.34	.47	.38	6.6	.000
BD	wet	.37	.48	.04		
	dry	.39	.49	.04	-.47	.64
RHE	wet	.37	.48	.039		
	dry	.67	.47	.038	-5.6	.000
RHPR	wet	2.3	1.78	.14		
	dry	.72	.9	.07	9.8	.000
HYM	wet	.26	44	.036		
	dry	.3	.48	.039	-1.8	.064
HYT	wet	.84	.37	.03		
	dry	.61	.49	.04	4.6	.000

AV = *A.variegatum* BD= *B.decoloratus* RHE = *Rh.evertsi evertsi*

RHPR =*Rh.praetextatus* HYM = *Hy.marginatum rufipes* HYT = *Hy.truncatum*

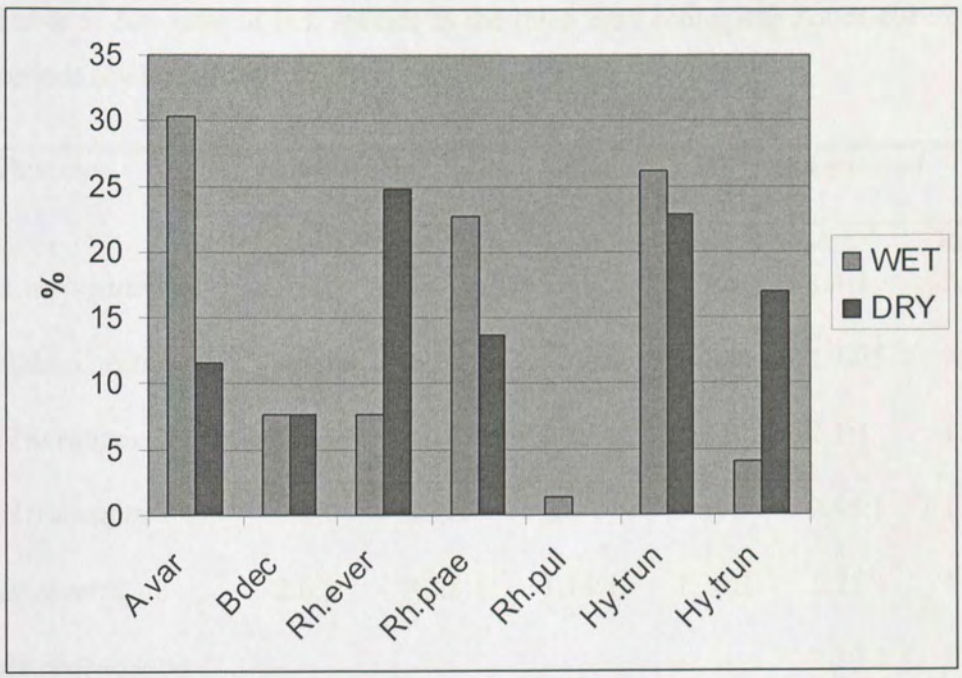


Figure 4: proportion of tick species identified in the lowland area (Adami Tulu Jido Kombolcha district) during the wet and dry season

4.2. Sex ratio

During the study period in all study sites the number of male ticks were significantly higher than the number of females in *Amblyoma* , *Rhipicephalus* and *Hyalomma* genera of ticks .On the other hand the number of females were significantly higher than the males in *Boophilus* (Table 4).

Table 5: Sex ratio of tick species in the three agro ecological Zones during the wet and dry periods (male: female).

Tick spp	*highland*		*midland*		*Low land*		**Overall**
	wet	dry	wet	dry	wet	dry	
A.variegatum	1.7:1	1.4:1	1.6:1	1.5:1	1.4:1	1.4:1	1.56:1
B.decoloratus	1:1.73	1:2.1	1:2.56	1:2.85	1:1.75	1:1.78	1:1.77
H.m.rufipes	1:1.45	1.18:1	2.5:1	1:781	2.1:1	1.6:1	1.7:1
H.truncatum	2.4:1	2.2:1	2.0:1	1.57:1	2.45:1	1.67:1	2.2:1
Rh..evertsi	2.0:1	1.28:1	1.14:1	1.36:1	1.75:1	1.37:1	1.25:1
Rh.praetextatus	-	-	-	-	2.13:1	2.05:1	2.2:1
Rh.pulchelus	-	-	4.0:1	-	2.33:1	-	2.8:1

4.3 .Attachment sites

In the study each species of ticks were collected from various body regions of cattle. But attachment site preference were stronger in some species than the others .The observed proportion of attachment sites for each species of ticks during this study was summarized and shown in Table 5.The most preferred predilection site of *A,variegatum* in decreasing order were scrotum/udder ,brisket, inside parts of legs and belly. For *B.decoloratus* the preferred attachment sites in decreasing order were dewlap, belly, leg, and head. *Hyalomma* tick species had a preference of attachment for scrotum/udder, tail and anogenital regions.

Table 6: Body regions showing site of attachment of the identified tick species in (%)

Tick species	**Body regions**							
	Head/ Ear	dewlap	brisket	Belly/back	leg	Scrotum / udder	tail	anogenital
A.variegatum	1.6	13	22.8*	10	3.2	53.4*	-	7
B.decoloratus	5.8	48*	11.6	28*	6.2	1.4	-	3
Rh.evertsi evertsi	30.1*	4	-	-	-	-	-	65.9*
Rh.pulchelus	75.8*	-	-	-	-	-	-	24.2*
Rh.praetextatus	-	-	-	-	7.6		92.4*	-
H.m.rufipes	-	2.4	13.5	-	3.7	48*	-	33.4*
H.truncatm	-	-	3	-	4	7.6	68.4*	17

* indicates significantly higher preference

4.4. Prevalence of ticks on cattle

The prevalence of each species of tick was determined as the number of cattle infested by the respective species divided by the total of cattle. During the study period a total of 918 cattle were examined for presence of tick infestation (Table 6).Results of the study showed that an overall prevalence of 88.1% was recorded .Different peaks of prevalence that is from the midland and during the wet 99.3% and 9.8% from the lowland area and during the dry season was recorded for *A.variegatum* and *Rh.pulchelus* ,respectively .The prevalence of the least common tick species recorded were *Rh.pulchelus* and *B.decoloratus* (18.9%) during the dry season in midland *Hy.truncatum* (24.2%) during the wet season and *Hy.marginatum rufipes* (23.5%) during the dry season in highland area and *Rh.pulchelus* (13.1%) in the wet and *A .variegatum* (33.3 %) during the dry season in low land area. When all the study area considered together the infestation rate of *Rh.evertsi evertsi* was signifificantlly higher during the dry season than the wet season (x^2=94.000 & p=0.000,x^2 =12.49 & p=0.000,x^2=28.92 & p=0.000 for the high ,mid and lowland altitudes ,respectively).On the contrary infestation rate of *A.variegatum* was higher during the wet season than the dry season

(x^2=11.64&p=0.001,x^2=77.53 & p=0.000,x^2 =38.167& p=0.000 for the high ,mid and low altitudes areas, respectively). When

Table 7: Prevalence of the different tick species during the dry and wet season in different altitudes

Altitudes	*Season*		**Tick species**				
High land	Wet	No +ve	*A.variegatum* 44	*B.decoloratus* 149	*Rh.e.evertsi* 54	*Hy.truncatum* 37	*Hy.m.rufipes* 62
		%	28.7	97.4	35.3	24.2	40.5
	Dry	No +ve	72	93	137	61	36
		%	47	60.7	89.5	39.8	23.5
	X^2		11.64	66.46	94.00	12.56	11.13
	p-value		0.001	0.000	0.000	0.000	0.001
Midland	Wet	No +ve	152	88	108	24	31
		%	99.3	57.5	70.6	15.7	20.3
	Dry	No +ve	88	29	133	44	118
		%	57.3	18.9	86.9	28.6	77.5
	X^2		77.53	19.67	12.49	105.887	6.001
	p-value		0.000	0.000	0.000	0.000	0.14
Lowland	Wet	No +ve	108	55	57	131	41
		%	70.5	36	57.3	85.6	26.8
	Dry	No +ve	51	88	108	94	54
		%	33.5	57.5	68.6	61.4	35.3
	X^2		38.158	.227	28.92	3.435	19.955
	p-value		.000	.637	0.000	.064	0.000

4.5. Tick burden

The highest mean total tick burden was recorded during the early rain season that is the short rainy season from the end of March to April (Table7). The lowest infestation rate was recorded during early dry season and the late dry season which is the month of December and February, respectively. The minimum and maximum total tick count recorded on half–body regions of cattle was 4 at lowland and 138 at midland during February and April, respectively.

The overall, tick count across season showed significant variation at $p<0.05$ ($F=114$ & $p=0.000$).

Table 8: Overall tick counts on cattle of the study areas across season

Tick count in season	*Mean*	*standard deviation*	*Standard error*	*95% CI*		**Range**	
				lower	Upper	min	max
LR	54.2	23.43	3,025	48.15	60.25	22	112
ED	27.3	12.34	1.593	24.11	30.49	12	64
LD	16.43	15.55	2.007	12.42	20.45	4	98
ER	74.88	22.9	2.957	68.97	80.8	38	138
total	43.2	29.79	1.824	39.47	46.99	4	138

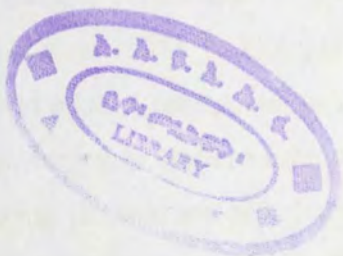
LR=late rainy season ED=early dry season LD=late dry season

ER=early rainy season

4.6. Questionnaire survey

Over 92% of the livestock owners that were interviewed have knowledge about the effect of tick on animal productivity .similarly, 88% of owners expressed their knowledge as to the effect of tick in inflicting direct damage on the host .However lesser response rate was recorded as to their knowledge on tick as a vector of diseases that accounted for 46% in all study area. In all study area livestock owners used to practice some form of tick control measure .And thus during the past five years limited variety of accaricides were available in the market as well as in the veterinary clinics of the respective study sites .Among which organophosphate compounds like : Diazinon 60% E.C.and chlorfenvinphos based acaricide (steladohe^{R});from the synthetic pyrethriod group such as cypermethrin (Ectopor^{R}) and delthametrin ; Amidine group is represented by amitrz 12.5 % and ivermectin from the macrolactones group were used .From the above mentioned acaricide ,Diazinon 60% E.C, was used by 90% of the respondents and that of cypermethrin accounted for 57.3%.Otherwise, the other mentioned acaricides were used in a very minimal rate . These acaricides were most of the time available from the district veterinary clinics that accounted for (68%) and the rest (38%) was bought from private veterinary drug retailer that is to be reconstituted at home.

The frequency of application in one year was classified in ranges of time .Accordingly, (72%) of the respondents in all the study area applied 1-3 times per year during the peak season of the year .On the other hand (23%) of the farmers applied 4-5 times per year and very few (6%)of the respondents used to apply 6-8 times.In all the study area the method of application of acaricide was hand spray using Knapsack sprayer at the respective district veterinary clinics that is accounted for (62%) and (38%) of the respondents used hand dressing by immersing a piece of garment in to a solution of acaricide.Asfar as the application of acaricide rotation in one year is concerned ,there was no any regular shifting of one acaricide by the other .That is determined by the accessibility and availability of the acaricide both in the market as well as in the district veterinary clinics. Ethinovetrinary practice of the study area revealed little information that needs detailed study with the livestock owners that have better perception and acceptance from the respective locality .Anyhow some application of plant juices, plant juice mixed with gasoline, plant juice mixed with butter and gasoline and burning with hot iron were some of the practices responded by very few live stock owners.



5. DISCUSSION

In this study a total of 10085 adult ticks were collected from half-body regions of cattle from the three agro ecological zones of central Oromia region. *A.variegatum,B.decoloratus ,Rh.evertsi.evetsi H.marginatum rufipes* and *H.truncatum are the* five most commonly encountered tick species in the study sites .The study showed that the proportion and /or frequency of occurrence varied very significantly over the season and across the different agroecologies .In the study *Rh.praetextatus* and *Rh.pulchelus* were recorded only in very small numbers across all the agro ecologies and in both wet and dry seasons .These findings are in agreement with the previous works of Pegram *et al.*,(1981).

Results of the current study identified A,variegatum as the most abundant of all tick species comprising 36.1% of the collected ticks in all the study sites .This tick species collected in a very large number from Adaa Liben (Midland) accounting (75%) and in Adami Tulu Jido Kombolcha (Lowland) accounted for 12% .This finding is in agreement with the previous work of Solomon *et al* (1995) at Sebeta and Abernosa ,respectively who recorded highest counts of *A,variegatum* in July and April during the rainy month of the area .Yehualashet *et al* ., (1995) also reported the presence of this species during wet period at Alemaya Agricultural University Campus .The adults of *A,variegatum* are usually found on their host during the rainy season (Kaiser 1988). In Ethiopia Pegram *et al.,* (1981) observed that the onset of feeding activity of adult *A,variegatum* ticks coincide with the start of wet season .de Castro (1994) also in his survey in western Ethiopia revealed that females of *A,variegatum* were usually present during the rain season collections .Also ,Assefa (2004) reported highest counts during and shortly after the rainy season at Assela ,but very small counts during the dry season in February and March .Similar to the previous reports , the number of *A,variegatum is* significantly ($p<0.05$) higher in wet than the dry season

Results of the current study also agrees with the previous works from other African countries, for instance the seasonal prevalence of A,variegatum was peaked during the rainy season in traditionally managed N'Dama cattle in Gambia (Mattioli *et al.,* 1997).Adult A,variegatum on Malawi cattle herds that were kept under traditional management systems occurred mainly

during the rainy season. *Petney et al., (1987)* also reported that the adult stage of *A,variegatum* is abundant in high number during the rainy season. But larvae and nymphs gradually become more numerous in the dry season (Morel, 1980).This is thought to be attributed to the fact that activation of quiescent adult is initiated by rainfall and due to xerophilic nature of *A.variegatum.* Salih *et al* (2008) from the southern Sudan and Walker.and Koney (1999) from Ghana observed that *A.variegatum* was common on cattle sheep and goats mainly during the rain season. *A.variegatum* is considered as the most economically important tick in Ethiopia for several reasons including the major vector of *C.ruminantum,* trnsmision of *D,conglensis* ,severe tissue damage and destruction of teats and hides .

During the study period other species of *Amblyomma* that were reported from other parts of the country were never encountered .This may suggest the study areas are not optimum climatic conditions for these tick species (Osman *et al.*, 1982). Furthermore, the distribution of ticks are determined by interactions of several factors such as climate, host susceptibility, host density, vegetation cover, host resistance, grazing habitat and type of animal husbandry

In the present study *B.decoloratus* was identified as the second most abundant tick in the study sites .However, highest counts were recorded from the highland area (Sebeta) during the short rainy season that accounted for 75% of all collection of this species This finding is consistent with the earliest work of Yismashewa (2005) who reported high counts mainly in low and highland areas during early rainy season (March to April) .Teshome *et al.,* (1995) also reported comparable results where *B.decoloratus* comprised 80% of counts at Holleta .Solomon *et al.*, (2000) also indicated that *B.decoloratus* was the most common and abundant tick species in Sebeta Westen Shoa.The distribution of this tick species is by far lower in mid and low altitudes during both seasons ($t = 12.52$ and $p = 0.000$). Gashaw (2004) showed that when the monthly rainfall is greater than 250mm ,there was a reduction in *B.decoloratus* numbers and prevalence. The number and distribution of *B.decoloratus increases* during wet season's .On the contrary, Shiferaw (2005) in Wolayta area reported highest frequency of *B.decoloratus* during the dry season from the high and midland areas. This variation is mostly probably attributed to the variations in weather and agro ecology among the study areas.

This finding is consistent with the observation of (Solomon 1993) at Abernosa, (Bazarusanga 2007) in Rwanda and (Mattioli *et al.,* 1997) in Gambia who reported *B.decoloratus as* the second most abundant tick. This species is reported to be widely distributed in the central rift valley parts Ethiopia Pegram *et al.,* (981) and Dhuffera (1987). Etsay (1985), recorded higher number of Boophilus in areas with high rainfall pattern. In the present study, females *B.decoloratus were* found in greater number than males in all study sites and in both seasons with a significantly higher counts during rainy season from March to April .This finding agrees with the earliest work of de Castro (1994).This is probably due to the small size of male *B.decoloratus* that can be overlooked during counting and identification.

Rh.evertsi evertsi was recorded as the third most abundant tick species. This finding is in line with (Solomon *et al.,* 2007) in Ghibe Tolay who recorded highest count in January at the middle of the dry season .This observation is consistent with the present study .This species was significantly higher in a dry period in all the study sites (t =11.746 and p=0.000) which is in agreement with report of MacLeod (1970) in Zambia who recorded higher counts during post rainy and hot dry season. This tick species can survive and reproduce with in the range of 350-3500 m.a.s.l. in various habitats throughout Ethiopia (Pegram *et al.*, 1981). Bekele (2002) also reported that this species never showed specific preference for a particular environment.

Hy.marginatum rufipes was recorded as the fourth abundant tick in the study areas. Highest counts of this tick was recorded at mid and lowland areas during the dry season (t=-8.617 and p=0.000) .This finding is consistent with Rahbari *et al.*, (2007) who recorded high counts in all study areas specially in the desert boundary areas. This observation was also in-agreement with that of Walker and Koneky (1999) and Mattioli *et al* ., (1997) both of which recorded this species as the fourth tick species identified in Ghana and Gambia ,respectively .*Hy.m.rufipes* is one of the most widely distributed tick species and has been reported in many parts of Ethiopia such as the rift valley (Pegram *et al* .,1981,Solomon and Kaya ,1996),Wollo (Seuyoum 2001),Borena (Solomon *et al.*, 1998) central Ethiopia (Mekonen *et al* ., 2001) .It is usually incriminated as one of the causative factors of udder and teat damage particularly in cattle in pastoral and agro-pastoral areas.

Hy.truncatum: was recorded as the fifth tick species and significantly higher counts were encountered in low land area during the wet season ($p<0.05$). Walker and Koney (1999) in Ghana also reported this tick as the fifth isolates which is in agreement with this finding.

The results of this study showed the predilection sites of ticks over the body of cattle was in general similar to that observed by Kaiser *et al* (1982) in southern Uganda , Kaiser *et al* (1991) in northern Uganda , Howell *et al* (1978) in south Africa ,and Matthee *et al* (1997) on impala at Letabara in south Africa .The study showed that *A.variegatum* was found mainly attached to scrotum/udder brisket and inside parts of the legs .Okello-Onen *et al* (1999[a]) reported that the most preferred site of attachment for *A.variegatum* are brisket ,ventral surface of cattle flanks and lower dewlap. Likewise, the four most predilection site during for *B .decoloratus* were dewlap, belly and back, leg and head in decreasing order .*Rh.evertsi evertsi* and *Rh .pulchelus* showed high preference to the anogenital region of the body and then followed by inside of the ear .On the other hand *Rh. praetextatus* showed a highest preference of attachment on the tail switch .The findings of this current study agrees with the earlier report of Walker *et al* (2003) who indicated that the site of attachment of adult *Rh.evertsi evertsi* and *Rh .pulchelus* have been described as and that of *Rh praetextatus* the tail brush & around the feet. *Hy.marginatum* rufipes has showed similar preference of site of attachment with *A.variegatum* and also the anogenital region the other preferred site. *Hy.truncatum* prefers anogenital region, the tail switch and udder/scrotum region of the body .These findings are in agreement with report of Walker *et al* (2003).

Several factors such as density (Andrews & petney 1981), interaction between tick species (Andrews *et al*., 1972), time and season (Evans 1952), and inaccessibility for grooming (Wilkinson 1972) have also been reported to determine the attachment site of ticks. Apart from its use in increasing the efficacy of control methods information on predilection site of ticks, is also useful during sampling.

The male to female sex ratios recorded in the present study for *B .decoloratus*, *A.variegatum, Rh.evertsi evertsi, Rh .pulchelus, Rh praetextatus Hy.marginatum rufipes* and *Hy.truncatum* were similar to the earlier work of Solomon *et al* (2007), Mohamed (1977) and Kaiser *et al* (1982). Except for *B .decoloratus* the number of males is significantly higher than females. This is most probably attributed to the fact that 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 females as has been observed by Solomon *et a*l (1998).

The over all prevalence of 87 % recorded in the present study is in agreement with observation of Bekele (2001) who reported prevalence of 88.2 % in western part of Ethiopian .In another study made by (G/Michael, T.1993 and Naser, M.1985) similar high prevalence of 90% was reported from the SNNPRS that concord with the present study .In the present study significantly higher prevalence of infestation of 99.3% and with ticks of 36.1% of tick count were recorded in early rainy season from March to April . This finding is consistent with observation of Yismashewa (2005) who reported highest prevalence of 98.16% and 35.5% of the whole count during the rainy season. According to Abebaw (2004) high humidity and temperature are crucial factor that influence the seasonal variation of ticks. Solomon *et al* (2003) showed that the prevalence and intensity of infestation of ticks were generally low during the dry season but higher during the rainy season. The variation in tick prevalence in different areas is attributed to a variety of factors like: geoclimatic conditions, association and life cycle of different species of animals, awareness/education of the farmers, and farm management practices. (Bangladesh)

The present study revealed that tick count was significantly higher in the wet season than the dry season ($F = 114.1$, $P = 0.000$). Solomon *et al* (2007) reported that ticks were found on cattle through out the study period, although higher loads of ticks were observed during rainy than .This finding supports observations of the present study. (Bekele 2002) also reported significantly highest total tick burden during wet period than the dry season. December .In the present study lower counts of ticks on indigenous cattle were observed in lowland altitude zone. This is most probably attributed to the nature of the grazing area which is wide open

and more availability of grazing land than the mid and high altitude areas. Additionally possible reason could be the predominance of Arsi breed cattle in the study area known to support lower tick load than the other indigenous cattle breed .

In the present study tick collections were higher in forests than in open grass land areas. This agrees with previous observations of Pegram *et al* (1981) Gray (1991) who reported that woodlands better provide the necessary host density and high humidity than more exposed open fields. Ticks were found on cattle through out the study period, although higher loads of ticks were observed during short rainy season than during the dry months. The monthly environmental temperature appears to affect the tick loads. The higher load of ticks during the rainy season might be due to the high humidity and lower temperature range, that is conducive for growth and survival of all different life stages of ticks (Walker *et al* .,2003). The study clearly indicated that only a few species of ticks are commonly found on cattle of the study sites with a marked seasonality in abundance .This suggests that efficient tick control measures for cattle in the study area should focus on the dominant economically important tick species.

As part of the study a preliminary questionnaire survey on the aspects of tick control was carried out in the three agro-ecological zones of central Oromia regional state have revealed majority of farmers have sufficient knowledge on the economic aspect of ticks .This finding corroborates with previous works(Jonnson,1998). However, the study showed that majority of farmers in the area do not have sufficient knowledge about tick-borne diseases .This may be attributed to cattle breed effect (indigenous) that are found to be relatively resistant to hempoparasitic diseases. The types of acaricide commonly used in the area were Diazinon 60% E.C. and cypermethrin with a frequency of 1 to 3 times per year during the peak season of tick infestation. As a result of this higher prevalence of tick infestation (87.1%) was recorded. Sutherst *et al* (1979) suggested that effective acaricides concentration must be applied to all animals every 21 days, so that all ticks that attach to animals are exposed to lethal doses that are true during the peak season of tick.

The method of application mostly used was hand spray that was provided in the respective district of veterinary clinic using Knapsack sprayer .And fewer instances hand dressing was also used after purchasing acaricides from private veterinary drug retailers that is to be reconstituted at home and this may cause under or over dilution of the acaricides because of literacy problem (Ogden *et al.*, 2005). In all study sites there was no any dipping vat .Because in both hand spraying and hand dressing methods of application ,it is not possible to maintain appropriate acaricide concentration that is lethal to the tick under check .In addition this sub lethal dose of chemical may select resistant tick species (FAO,2004).

6. CONCLUSION AND RECOMMENDATIONS

The present study on the distribution and seasonal pattern of tick load is considered primarily as an aid in improving tick control in the study areas. It is also useful in planning for the introduction of different improved breeds .Additionally, the study clearly indicated that only a few species of ticks are commonly found on cattle, with a marked seasonality in abundance .This suggests that, to be effective, tick control measures for cattle in the study area should concentrate on the dominant tick species .The study also indicated low level of control measures as evidenced from the questionnaire survey and highest prevalence rate of tick infestation *.A.variegatum* and *B.decoloratus* ,the most prevalent and dominant tick species were identified in excess mainly in mid and highland altitudes ,respectively that is due to conducive environmental factors prevailing in the areas. Therefore, the following recommendations are forwarded so as to benefit the livestock owners by overcoming the problems arising from tick infestation.

- Strategic application of acaricides especially at the beginning of wet months might minimize the burden of ticks on the cattle.

- The effect of dominant species on the productivity of cattle and determination of the minimum load that affect productivity, are warranted

- Encourage community to practice safe and economical traditional control methods as part of integrated tick management.

- As limited types of acaricides were commonly used in all study areas, detection of acaricide resistance for those economically important tick species should be carried out.

- Animal health services need to be strengthened through infrastructure and man power.

- Use of tick resistance breeds of cattle can be used with short interval of pasture rotation and with limited level of acaricide usage.

- A more detailed and year round epidemiological study and a constant surveillance of ticks and tick borne diseases are required using more sensitive diagnostic techniques such as serology.

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8. ANNEXES

Annex 1: The means count of different tick species in different agro ecology as tested by ANOVA

Tick species	altitude	mean	Std deviation	Std error	F-value	p-value	CI 95%		Range	
							LB	UB	min	max
AV	High	.67	1.4	.078			.52	.82	0	13
	Mid	8.69	10.65	.61			7.49	9.8	0	52
	Low	1.54	2.0	.12			1.32	1.77	0	8
	Total	3.64	7.3	.24	147.6	.000	3.17	4.11	0	33
BD	High	7.4	7.6	.44			6.6	8.3	0	33
	Mid	.65	1.3	.07			.51	.79	0	6
	Low	.65	1.03	.06			.53	.76	0	6
	Total	2.9	5.5	.18	156.9	.000	2.6	3.3	0	33
RHE	High	1.7	2.1	.12			1.5	1.9	0	9
	Mid	3.1	3.8	.22			2.6	3.5	0	23
	Low	1.0	1.3	.07			.87	1.2	0	5
	Total	1.9	2.7	.09	137.9	.000	1.7	2.1	0	23
HYM	High	.5	.8	.05			.41	.6	0	3
	Mid	1.6	2.3	.13			1.3	1.8	0	13
	Low	.6	1.3	.07			.49	.79	0	11
	Total	.9	1.7	.06	74.25	.000	.79	1.01	0	13
HYT	High	.4	.7	.04			.34	.49	0	4
	Mid	.3	.7	.04			.24	.41	0	4
	Low	1.8	1.6	.95			1.57	1.94	0	7
	Total	.8	1.3	.04	1.84	.83	.75	.91	0	7

Annex 2: The prevalence associationin different tick species in different agro ecology

altitude	Tick species									
	a.variegatum		b.decoloratus		Hy.m.rufipes		Rh.e.evertsi		Hy.truncatum	
High	Positive	%	Positive	%	Positive	%	Positive	%	Positive	%
	115	37.6	242	79.1	99	32.4	192	62.7	95	31
Mid	240	78.4	96	31.4	152	49.7	241	78.8	69	22.5
Low	160	52.5	116	37.9	94	30.7	161	52.6	223	72.9
X^2	106.37		163		46.56		28.78		18215	
p-value	.000		.000		.000		.000		.000	

Annex 3: Questionnaires format on tick control practices

1. Name of owner_____2. Address_____3. Number of cattle_____

1. Types of acaricides used in the last five years

2. Freqency of applications in one year

   a. Never and 1-3 times b. 4-5 times c. 6-8 times

3. Methods of application

   a. spray races b. hand spray c. others _____

4. Is there any rotational use of acaricides? a. Yes b. No

   If yes at what interval in one year

5. Is there any medicinal plants used in your area?

   a. yes b. No

   If yes mention the practices

6. Knowledge about ticks and ecto- parasites

   a. effect on animal productivity a. yes b. no

   b. as vectors of diseases a. yes b. No

   c. inflect direct damage on the host a. yes b. No

7. Basis of dosage determination

a. body weight b. number of animals c. others

9. CURRICULUM VITAE

Personal profile

Full name: Tsegaye Ayalew Woldeyesus

Place of birth: North Wollo

Date of birth: 1969

Marital status:single

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Present address: Alagae Agricultural Technical Vocational Educational Training College

Occupation: instructor in the above college

Educational back ground

DVM: Faculty of Veterinary Medicine, Addis Ababa University Debrezeit from 1993-1998

Diploma: Institute for higher education for Animal Health Assistants in Debrezeit from 1986-1987.

Secondary school: Medhanealem comprehensive senior secondary school from 1982 -1985

Junior elementary school: Yemanebirhane elementary school in aAddis Ababa from 1976-1881.

Work experience

From 1999-2005: field practitioner under ministry of Agriculture and Rural development office.

From 2005-2008: instructor in Alagae ATVET College

From1988-1992: meat inspector in Jimma Municipality Abattoir

Research papers

DVM Thsis: Bovine mastitis in and around Holetta

10. SIGNED DECELARATION SHEET

I undersigned, declare that the thesis is my original work and has not been presented for a degree in any other University and that all sources of materials used for the thesis have been acknowledged

Name: Tsegaye Ayalew

Signature .....

Date of submission: June 26, 2009

This thesis has been submitted for examination with our approval as University advisors

Dr Yakob Hailu (DVM,MVSc,PhD,associate professor) .....

Dr Bersisa Kumsa(DVM, MSc ,associate professor) .....