PREVALANCE OF CAMEL HARD TICKS IN EAST AND WEST HARARGHE ZONES, OROMIA REGIONAL STATE, ETHIOPIA

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SUMMARY
This study was conducted in randomly selected districts of East and West Hararghe Zones, Oromia regional state, Ethiopia. It was conducted from April 2022 to October 2022 determine the prevalence of tick infestation and identify tick genera that infesting camels. During this work, four Peasant Associations (PAs) namely Gara Gafa, Boke Wako, Milkaye and Gobele were included. Adult ticks were collected from different predilection sites on camels. From the total of 384 camels examined, the overall prevalence of tick infestation (81.7%) was recorded in the study area. Out of these, 60 of them from Gobele, 71 of them from Milkaye, 84 of them from Boke Wako and 99 Gara Gafa were infestations by different ticks with prevalence of 80%, 80.7%, 84% and 81.8%, respectively. In this study, a total of 4850 adult tick genera were collected and identified using direct stereo microscopy. The genera identified from the study were *Rhipicephalus*, *Ambylomma*, *Hyalomma* and *Boophilus*. Therefore, except in body condition of the animals ($p<0.05$), there was no statistically significant difference observed in tick infestation between origins of the animals ($p> 0.05$). The highest infestation level of ticks was observed on the Udder/Scrotum (21.3%) and the lowest (5%) was observed on the Back/side of the camel' s body region. The high prevalence of tick infestation of camels in the study areas may be due to poor level of management, favorable climates and poor awareness of farmers and poor veterinary health extension. So that, applying urgent prevention and control strategies is necessary in the areas.
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1. INTRODUCTION

Ethiopia is believed to have the largest livestock population in Africa. The livestock sector has been contributing considerable portion to the economy of the country. The camel is a multipurpose animals uniquely adapted to arid and semi arid environment which enables pastoralist people to live in difficult environment of the world (Scwartz, 2001; Tigani *et al*., 2005). Ethiopia is one of the largest camel populated countries in the world. In Africa, it ranks third next to Somalia and Sudan. About 1,102,119 of camels found in Ethiopia, distributing in Southern, Eastern, North Eastern arid and semi-arid regions of the country mainly in Ogaden, Borana and Afar regions (CSA, 2013). In Ethiopia, the one humped camel (*Camellus dromedarius*) is an important livestock species in the pastoral economy because of its extraordinary ability to perform in arid and semi-arid environments where there is scanty vegetation (Dinka *et al*., 2010). The camel's importance will increase with continuing land degradation and rapidly growing human population (Bekele, 2010).

The presence of different agro climatic zones and diversified environment makes the country suitable for different kinds of livestock disease (EARO, 2000). A wide range of various external and internal parasitic diseases have been reported to be the major problems affecting the health, productivity and performance of domestic animals. Among external parasites, ticks are definitely the most important ecto-parasites of livestock on global scale. Ticks are destructive blood sucking ecto-parasites, found in most if not all the countries of the world, but are of greater economic importance in the tropical and sub-Tropical zones (Maha *et al.*, 2010).

The importance of ticks is principally due to the ability to transmit a wide spectrum of pathogenic microorganisms, such as protozoa, rickettsial, bacterial, spirochetes and viruses. In Africa, tick-borne protozoan diseases (Theileriosis

and Babesiosis), rickettsial diseases (Anaplasmosis, Rocky Mountain spotted fever and heart water (cowdriosis), Bacterial diseases (Tularaemia), Spirochaetes (Lyme disease " tick- borne disease affecting human" and Relapsing fever) and Viral diseases (e.g. Louping ill and African Swine Fever) are the main health and management problems of livestock (Wall and Shearer, 2001). The main effect of tick infestation in one humped camel is mild to severe anaemia, loss of appetite, leading to a reduction in growth rate and decreased productivity (Mohsen *et al.,* 2013). Additionally, ticks are responsible for direct damage to the ticks through their feeding habits, damage to udders, teats and scrotum, myiasis due to infestation of damaged sites by maggots and secondary microbial infections 20(Urquhart *et al.,* 1996). Tick paralysis in camels is a syndrome that appears to be rare; it has only been reported in Sudan and is apparently caused by Hyalomma spp. adults and/or Rhipicephalus spp. adults or nymphs (Musa and Osman, 1990).

There are two major families, namely the Ixodidae or 'hard 'ticks (so called by virtue of their hard dorsal shield) and the Argasidae or 'soft 'ticks (due to their flexible leathery cuticle). The family Ixodidae comprises approximately 80% of all tick species, including the species of greatest economic importance (Jongejan and Uilenberg, 1994). Ticks which are considered to be most important to the health of livestock in Africa comprise about seven genera. Among these ticks, generally the main ticks found in Ethiopia include *Amblyomma, Boophilus, Haemaphysalis, Hyalomma* and *Rhipicephalus*. And also there are 20 species of ticks exists on livestock, all of which have damaging effect on production and productivity (Kassa, 2005; Ayele and Mohammed, 2013).

The normal distribution of the camel is in the Africa and Asian subtropical dry areas. About 1.06 million of camels found in Ethiopia, distributing in Southern, Eastern, North Eastern arid and semi arid regions of the country mainly in Borana, Ogaden and Afar region (FAO,1993; Kohler-Rollefson, 2001). However, camel production is conversely affected by the occurrence of various diseases, in-adequate veterinary services and feed besides various internal and external parasitic diseases; ticks are one of the major constraints to world livestock industry (Dabasa *et al*., 2017; Mata *et al.,* 2018). Ticks exert a major hindrance to improving animal production in the tropical and subtropical regions of the world by transmitting devastating often fatal livestock pathogens, causing blood loss, damage to hides and udder and paralysis (Sumbria *et al*., 2018).

In Ethiopia, reports on camel ticks is scanty, despite the vital role that camels play in livelihood of Ethiopian pastoral society and the likely impact of tick on their productivity. In East and West Hararghe Zones camels are always under the risk of tick infestation and tick born disease challenges. There are different methods for controlling of ticks infestation in the area. But the challenge of tick on animals is still observed because the control methods practiced in the area have not covered wide area of the households. Moreover, there was not specific study conducted on status of hard tick infestation on camels in the West and East Hararghe Zones. Hence, this study was attempted with the objectives to determine the prevalence of hard ticks on camels and to identify the genera of tick distributed in selected PAs of East and West Hararghe Zones.

2. CAMEL HARD TICKS

2.1.General Characteristics of Ticks

Ticks are closely related insects and spider, which are all without spine. They belong to the phylum Arthropoda, the class Arachnida and order Acari (Latif and Walker, 2004). Since they belong to the acarine, any infestation of domestic animals by tick is referred as acariasis (Hendrix, 1998). There are two main families of tick' s species called the Argasidae and the Ixodidae. Argasidae ticks are often called soft ticks, because they do not have hard scutum on their bodies. It has one important genus that infests cattle, Ornithordores. Argasidae ticks remain permanently on their host while feeding (Latif and Walker, 2004). The Ixodidae ticks often called hard ticks. They act most often as disease vector. The following genera belong to this family: *Boophilu*s, *Amblyomma, Rhipicephalus, Haemphysalis,* D*ermcentoer, Ixodes* and *Margaropu*s which are popularly feed cattle (Walker *et al*., 2003).

Both families have in common the developmental form the six-legged larvae and eight-legged nymph and then after renewed moulting to imago. In order to locate the host, both families of tick posses a number of chemoreceptor, haller' s organ that is located on the tarsus of the first pair of legs (Kettle, 1995 and Walker, *et al*., 2003).

2.1.1 Morphology of ixodid ticks

Camel can infected with a range of different genera of ticks. The most economically important and widely prevalent ticks are the family *Ixodida*e genus; *Amblyomma, Hyalomma, Boophilus, and Rhipicephalus.* Ixodid ticks are characterized by the presence of a rigid chitinous scutum that covers the entire dorsal surface of the adult male where as it extends only for a small area in the female, the nymph and the larvae to permit the abdomen to swell after feeding (Kettle, 1995). They have rounded body, lack a clear boundary between the anterior and posterior body parts and are divided in to two body components that is gnathostoma or capitulum, the mouthparts or a fusion of head, thorax and the ideosoma (Kaufmann, 1989).

The Mouth part consists of two small retractile mandibles, a pair of short palpi and the toothed probe or hypostome, which projects forward. When engorged, females may increase their weight many times, 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, mouthparts, basis capituli, festoons, spiracles plates, ventral plates, adanal plates, subadanal plates, spur, and others are important in the differentiation of different genera and species of ticks (Walker *et al.*, 2003).

2.1.2. Biology of ixodid ticks

Based on the number of hosts required to complete the development during their life cycle ticks can be classified as one-host, two-host and three-host ticks (Urquhart *et al.*, 1996). One -host tick: the larvae, which emerge from the eggs 3-4 weeks after s deposition at the earliest, attach themselves to a host animal where they complete their entire development on the host they develop from larvae to nymph imago. Then copulate after maturation period and following engorgement female drops off and deposit egg on the ground. The entire development cycle takes mostly 19-21 days, but depending on the environmental condition can be range from 15-40 days (Morel, 1980). All species of *Boophilis* are example of one-host tick (Walker *et al.*, 2003).

Two-host ticks: The egg hatch to give larva ,which can attaches to host animal and feed on blood ,then develops to nymph stages, after maxima of 14 days its drops off onto the ground where it reach the imago stage 20-30 days time. The adult took for another host feeds for 6-11 days, then female drops to ground and deposit eggs which will develop in larvae (Morel, 1980). Some example two -host tick are: *Rhipicephalus*, *hyalomma (*Walker, *et al.*, 2003).

Three host ticks:-the larval merges from the eggs deposited on the ground, looks for host, feed on it for 3-6 days, drops off and molt after 3-4 weeks on the ground. Then nymph climbs to the second host in order to feed on it 3-7 days. Leave it and molt in to imago on the ground after 2-3 weeks. Then the adult tick look for a third lost to feed on, and for copulation with male which takes 1-3 weeks, finally it drop off and completes the cycle with Oviposition on the ground to continue another cycle (Latif and walker, 2004). Species *Amblyomma*, *Dermacentor*, *Ixodes* and *Rhipicephalus* most species and *hyalomma* (except few species) arethree host ticks (Okello-onen, *et al*., 1999). The entire development of one cycle may lose up to one year since the different length and time spent in each stage on the ground (Latif and Walker, 2004).

2.1.3Attachment sites

Site specificity is one of the populations limiting system that operates through the restriction of tick species to certain part host body. The host or aspect of environment and tick behaviour enforce it (Tatchell, 1987). The tick' s grad on hosts using their front legs and then crawl over the skin to find a suitable place to attach feed (Walker, 2003). They seek out place on host where they are protected and have favourable condition for their developments and prefer to bite on part of skin (Okello-onen, 1999).

The host grooming response to the irritation level at tick attachment site man influence the distribution of tick on host body. With short haired host exposed to the full sun, insulation can prevent successful attachment and engorgement on the dorsum of animal certain species have well know adult tick predilection sites (Tatchell, 1987). Depending on the tick, site preference on the host depends on the accessibility for attachment, to the get blood and protection to overcome the environment damage that inhibits their existence. Tick location on the host is lined to the possibility of

penetration by hypostome. Species with short hypostome for example, *Rhipicephalus* species, *Dermacentor* species and *Haemphyslis* species usually attachments to head (in ear, eye, cantus, around neck) margin of anus, udder and the tail. Long hypostome species such as *Ambylomma* and *hyalomma* species attach to lower part of the body where the skin is thicker (like dewlap, axilla, groin, udder, perineum and margin of anus (Potency *et al*., 1987). Smaller tick likes *Bophilis* have not marked preference can be found all over the body (Morel, 1989).

2.2. Epidemiology of Ticks

Ticks occur in the temperate as well as in the tropical region of the world. There are about 825 described species of ticks in the world parasitizing domestic and wild animals as well as human (Walker *et al.*, 2003). The family *Ixodidae* has 13 genera and 671(or more) species of ticks. The most important situation to be considered in the epidemiology of ticks categorized in to free living developmental phase, host finding phase and parasitic phase. When ticks occur freely in the environmental external, factors like temperature and humidity are the major determinant of their development and growth (FAO, 1984).

*2.2.1.*Factors influencing the distribution of ticks

Intrinsic factors: Ticks have characteristic species of hosts to which they are adapted. Hosts are usually in a group of similar species. All stages feed well on camel and similar hosts in the family Camel idea and many wild species such as buffalo (Walker *et al*., 2003).

Hyalomma and *Rhipicephalus* of plains and savannas, *H. marginatum* and *R.bursa* are only two searches for a host, which eliminates the risks linked the need for nymph attachment. There are also many one host species in important of veterinary point of view, example *Boophilus*. The degree of host specificity ixodid ticks varies from genera to genera within certain sub-groups of varies genera. Earlier; ticks have characteristic species of hosts to which they are adapted. At present, camel & cattle constitute the only available host for ticks in an environment transformed by modern Agriculture and livestock production technique. Ticks are not specific but selective towards a group of vertebrates based on their size and mobility (Morel, 1989).

The ticks' location on the host is linked to the possibility of penetration by the hypos tome .On ungulates or camel species with a short hypos tome (*Rhipicephalus, Dermacentor* and Haema physalis) usually attach to the head (within the ear, nape of neck), margin of the anus and under the tail. Long hypos tome species (*Hyalomma, Amblyomma*) attach to the lower part of the body where the skin is ticker, such as the dew lap, axial, groin, udder, testes, perineum and margin of the anus. Small ticks (all instars of *Boophilus* and larvae and nymphs of *Amblyomma*) have no marked preference, and can be found all over the body (Shah-fisher and Say, 1989).

Extrinsic (ecological) Factors: the previous studies in south-western Ethiopia by Morel (1980); peg ram *et al.* (1981); De Castro (1994), were classified the area in to different altitude, rain fall, rain type and climax vegetation which affect the distribution of tick species in this area. Humid rather than wet conditions are essential for development and survival of eggs and pupae, and the survival of unfed hatched ticks. Depending on the climatic characteristics of a season and region, ticks may be active during the day, morning and evening (Morel, 1989).

2.3 Life Cycle of Ticks

In hard ticks mating takes place on the host, except with *Ixodes* where it may also occur when the ticks are still on the vegetation .Male ticks remain on the host and will attempt to mate with many females whilst they are feeding. The females mate only ones, before they are ready to fully engorge with blood. When they finally engorge they death from the host and have enough sperm stored to fertilize all their eggs. Female hard ticks lay many eggs (2,000-20,000) in single batch (Walker *et al*., 2003).

The life cycle of Ixodid ticks involves four instars: egg, six-legged larvae, eight legged – nymph and adult. Most hard ticks are relatively immobile and rather than actively hunting for their hosts, the majority adapts a' sit and wait' strategy (Wall and Shearer, 2001). According to the number of host they require during their life cycle, ticks can be classified in to three groups one, two and three-host ticks (Soulsby, 1982).

In one- host ticks all the three instars feed on the same hosts. This is a less common type of life cycle but it occurs in the entire *Boophilus sub-genus* of the *Rhipicephalus* and in other genera (Soulsby, 1982). Egg is laid on the soil. 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 moulting occurs there. The Nymphs then feed on the same host and also remain attached. After another moult the adult hatch and then feed on the same host. The entire development cycle takes mostly 19-21 days (Walker *et al*., 2003).

In two- host ticks, the larvae and nymphs feed on the same individual host, and the adult will feed on another host. *Hyalomma detriyum* and *Rhipicephalus everts* have two host life cycle. The entire cycle depends on the time the nymph need on the ground to find a new host (Taylor *et al*., 2007). Three- host ticks require different host for every instar they drop off each time after having engorged and moult on the ground (Soulsby, 1982). This is the commonest type of life cycle. The life cycle of three host ticks is slow, from six months to several years (Shah-Fischer and Say, 1989 and Walker *et al*., 2003).

2.4. Pathogenic Role of Ticks

Apart from the mechanical cytolytic effect and blood loss, ticks have a specific pathogenic effect due to the presents of toxin in the saliva. The toxin affects not only the attachment site but also act certain host tissue. Neurotropic toxin cause tick paralysis while dermo tropic toxin cause sweating sickness (Shah-Fischer and Say, 1989). Ticks cause damage to hides and loss of production, Anaemia and death, when they are present in large numbers. They also cause greater morbidity and mortality during the period of drought, as well as delays on fattening resulting in animals held longer before they can be sold. Ticks are also important transmitter of diseases (Radostits *et al*., 2007).

2.4.1 Direct effect

Ticks paralysis is a disease of man and animals characterized by an acute ascending flaccid motor paralysis. The condition may terminate fatally unless the ticks are removed before respiratory paralysis occurs. This paralysis is common in young domestic Animals which are heavily infested with ticks. In general the degree of paralysis is proportional to the length of time the ticks has been feeding and on the number of ticks attached (Soulsby, 1982).

Table 1: Tick that cause paralysis

Animal	Tick Species	Country
Camel Foals	*D. andersoni*	Australia
Foals	*Rhipicephalus everts*	South Africa
Adult Camel	*Rhipicephalus everts*	Africa

Source: Radiostits *et al*., (2007)

Blood Loss: Tick feed only on the blood of their host (Walker *et al*, 2003). High engorgement species therefore ingest about three times the volume of blood found at the end of the meal (Shah-Fischer and Say, 1989).
Bite injury (wound): at the site of tick bite focal necrosis and haemorrhage occurs, followed by an inflammatory response, often involving eosinophils. Ticks bite wounds can become infected with *staphylococcus* bacteria, causing local cutaneous abscesses or pyaemia (Wall and Shearer, 2001).
Tick Toxicosis: certain toxins may not have a localized pathogenic effect, but weaken the animals and occasionally encourage the emergence of protozoa that chronically infect the host. It is an aggravation of the specific toxin effect of the parasite' s saliva (Shah-Fischer and Say, 1989).

2.4.2 Disease transmission

Through their blood feeding habits ticks are important as vector of animal disease, transmitting a wide range of pathogenic virus, rickettsia, bacteria and protozoa. May of the major diseases transmitted by ticks babesiosis, anaplasmosis, theileriosis, Q-fever, cowdriosis, African swine fever and etc (Wall and Shearer, 2001)

2.5 Treatment and Control

The aim of tick control campaign is not to control all ticks simultaneously but a definite species because of its particular role. The strategy should therefore be based on the biological characteristics of the target species; moreover, there is no perfect acaricide. The efficacy of these acaricides depends on rational and methodical use (Shah-Fischer and Say, 1989). The knowledge of the behaviour of the tick on the host animal is prerequisite for any measures of control and eradication (Seifert, 1996). Three and recently four methods have been used to control ticks (Radostits *et al*., 2007 and George, 1990).

2.5.1. Acaricides

Acaricide application on the ground or host (dip, powder, ointment, pour-on preparations) requires data on the location and necessary treatment pattern (Shah-Fischer and Say, 1989). The choice of acaricides largely depend on three factors: the persistence of the compound on the skin and hair coat, the likelihood of residues toxic to man appearing in the milk or meat and whether or not the ticks in the area have developed resistance to the particular acaricide (Radostits *et al*., 2007).

The commonly used acaricides include arsenic, Amitraz, cyhalothrion, dixathion, ethion, diazinon and ivermectin which is given sub subcutaneously, gives satisfactory control of ticks (Radostits *et al*., 2007). Treatment every 21 days during the tick season showed good control. But, since nymphal stages appear to be less susceptible to most acaricides a12 day interval is often necessary between treatments at the beginning of the tick season (Urquhart *et al*., 1996).

2.5.2.Pasture spelling

Traditional control methods such as burning of pasture, removal of native fauna, pillowing of field and rotational grazing are still most important techniques in extensive range condition (Radostits *et al.*, 2007 and Taylor *et al.*, 2007).

2.5.3. Use resistant breeds

It is possible to reduce the impact of ticks and tick borne disease by the introduction of *Bos indicus* breeds of cattle than *Bos Taurus*. The resistance has been shown to be largely acquired and is mainly expressed against the larvae in the first 24 hours after attachment (Taylor *et al.*, 2007 and Radostits *et al.*, 2007). Reports from eastern and southern Africa indicated that European cattle breeds tend to carry more tick species than do zebu types (Mohammed and De Castro, 1993; Solomon *et al.*, 2007).

2.5.4. Vaccination

Crude vaccine made from extracts of semi-engorged adult female *B. micropus* give an effective immunity. Antibody destroys cells lining the ticks gut and allows blood to escape in to the hemocoelom, some ticks die and the fertility of those remaining is reduced by up to 70%. The fertility of male also reduced (Radostits *et al*., 2007 and Urquhart *et al*., 1996). A recombinant vaccine based on a membrane bound glycoprotein Bm 86 has been isolated and shown to be as effective as the native antigen and to be effective agent acaricidal resistant ticks (Radostits *et al*., 2007).

2.6. Tick Species Prevalent in Ethiopia

Extensive surveys have been carried out on the distribution of tick species on livestock in different regions of the country. In Gamo Gofa (Jewaro, 1986), Bale (Dejenu, 1988), Shewa Zone (Gebre *et al.*, 2001), Jimma zone (Abebaw, 2004), Wolayta, Southern Ethiopia (Desie, 2005), two district of Somali regional state (Rahmeto *et al.*, 2010), Asella (Tamiru and Abebaw, 2010), Holeta Town (Belew and Mekonnen, 2011), Chilga, North West Ethiopia (Nibret *et al.*, 2012), in Mekelle (Hilina, 2012), the highland area of Harar and Dire Dawa (Ayele and Mohammed, 2013), in Borana (Ayana *et al.*, 2013) and Haramaya town (Bedasso *et al.*, 2014). The distribution limits of ticks are not fixed and constant, but are determined by a complex interaction of factors such as climate, host density and host susceptibility (Solomon, 2003). Such responsible factors are essential for effective tick and tick borne diseases (TBDs) control strategies (Alanr, 2011). It is important to know the geographical distribution and prevalence of the tick species for the control of ticks and TBDs (Zelalem, 1994).

The study conducted in Ethiopia by Mokonnen (1995) showed a prevalence of *Amblyomma* (40%), *Boophilus* (20%), *Haemaphysalis* (0.5%), *Hyalomma* (1.5%) and *Rhipicephalus* (37%). However, over 60 species are known to exist in the country. The distribution of *A. varigutum* is similar to that of *B.decoloratus* (Pegram *et al*., 1981).

Boophilus decoloratus (28%) was the most abundant ticks found and heavy infestations by this species were observed on cross breed cattle. *Boophilus annulata* is restricted to Gambella and South West Ethiopia. *A. cohaerens* predominant in west Ethiopia (De Castro, 1994) and *R. pulchllus* was mostly found in south eastern Ethiopia among the rift Valley. *R. e. everts* occupies wider range climatic and ecological zones. *A. gemma* and *R. pulchellus* are confined to semi-arid areas (Peg ram *et al*., 1981).

A study done in Mekele showed the foundation of *Boophilus* (53.6%), *Amblyomma* (23.9%) and *Rhepicepulus* (22.5%). In this study ticks infestation was significantly higher in cattle keep under extensive than intensive production system (Yakob *et al*., 2008).

The study conducted on cattle at Gibe valley in central Ethiopia revealed *B. decoloratus* (34.2%), *A. varigatum* (29.8%), *R. e. everts* (21.1%), *R. praetexatus* (9.03%), *A. cohaerens* (4.59%), *R. camicasi* (0.59%), *H. m. rufipes* (0.14%) and *H. trunctum* (0.02%). The dewlap and vertical parts of the cattle were found to be the most favorable feeding site for most of the ticks collected (Solomon *et al*., 2007).

3. MATERIALS AND METHODS

3.1.Study Area

The study was conducted in West and East Hararghe Zones of Oromiya Regional State of Ethiopia. **East Hararghe** is a zone in the Oromia Region of Ethiopia. It is bordered on the southwest by Bale, on the west by West Hararghe Zone, on the north by Dire Dawa and on the north and east by the Somali Region. The Harari Region is an enclave inside this zone. The Administrative center of this zone is Harar.

West Hararghe is one of the Zones in the Ethiopian Region of Oromia. It is bordered on the south by the Shebelle River which separates it from Bale, on the southwest by Arsi, on the northwest by the Afar Region, on the north by the Somali Region and on the east by East Hararghe. The Administrative center of this zone is Chiro. The average altitude is 1000-1750 m.a.s.l. The area receives annual rain fall of 410-820 mm of the long rain season occurring from July to October while the short one occurs in months of March to May. The climatic condition is semi-arid and the mean maximum temperature ranges from 19^0c-30^oc. The farming system of the area includes pastoral, agro- pastoral and urban livelihood system. The livestock populations of the districts are: west hararghe (35,403 Camels, 1,117,575 Cattle, 135,963 Sheep, 1,112,238 Goat and 281,157, Equine and east hararghe (395, 231 Camels, 1,241,557 Cattle, 314,134 Sheep, 1,151,462 Goat and 300,707, Equine (CSA, 2020).

3.2.Study Animals

The study was conducted on one humped camels (Camelus dromedarius) found in randomly selected districts of East and West Hararghe Zones. Camels of young and adult age and sex groups were included in this study. Based on the owner' s information and De Lauta and Habel (1986) the sampled animals classified into two age groups, young (<3 years) and adult (≥3 years). Following the recommendation of Okello- Onen *et al.*, (1999) nine predilection sites (ear, head, neck/brisket, foreleg, belly, rear legs, escutcheon, tail and shoulder) back side of tick tics were carefully examined by restraining the animals. Purposively selected Peasant Associations (PAs) like Gara Gafa, Boke Wako, Milkaye and Gobele of the four districts such as Gola Oda, Burqa dhintu, Daro labu and Haramaya, respectively from East and West Hararghe Zones in oromiya Regional State of Ethiopia were included in the study. This purposive selection of PAs was based on the Camel population in the study areas.

3.3.Study Design

A cross-sectional study was conducted from November, 2014 to April, 2015 E.C to determine the prevalence of tick infestation and to identify tick' s genus infesting on one humped camels (*Camelus dromedarius*) found in randomly

selected districts of East and West Hararghe Zones. Moreover, favourable predilection sites of the tick genus on the animal body, the relative tick burden and a possible risk factor such as age, sex, origin and body conditions of the animal was measured.

3.4.Sample Size Determination

The total number of camel required for study **(**sample size) were calculated based on the formula given by Thrusfield (2005) using simple random sampling method by taking 95% confidence interval and 5% desired absolute precision. Since there was no previous work done on this area, a 50% expected prevalence was used to calculate the required sample size. Therefore, the sample size in this study was calculated using the following formula.

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

Where: **n** = required sample size, $\mathbf{P_{exp}}$ = expected prevalence and **d** = desired absolute precision. Accordingly, the estimated sample size was 384 animals.

3.5.Study Methodology

3.5.1. Sample collection

Camels were examined carefully for ticks with the help of the camel owners or their assistants. Predilection sites for ticks, such as the head, neck, sternum, under tail, ventral, scrotum/udder and back/side surface of the body of the camels were carefully examined by visual inspection and palpation of skin. All visible adult ticks attached on these areas of camel bodies were collected carefully and gently removed. Then the collected ticks were preserved in properly labelled tick collection bottle containing 70% alcohol. The bottles were labelled with date of collection, place, sex, age and site of the body and then transported to Hirna Regional Veterinary Diagnostic and Research Laboratory for storage and tick' s identification according to Okello-Onen *et al.,* (1999) and Walker *et al.,* (2003).

3.5.2. Hard tick identification

The collected hard ticks from each bottle were placed onto Petri dishes and examined under stereo microscope to identify the genus using tick identification keys described by Walker *et al.,* (2003). Briefly, the main identification features of the ticks were scutum, anal groove, festoon (ornamentation), colour, size, shape of mouthparts, and legs color.

3.6.Data Management and Analysis

Data obtained in the assessment was entered in MS Excel work sheet and analyzed using STATA® version 11, for windows software. Descriptive statistical analysis was used to analyze prevalence of tick species and its attachment site. Chi-square test (X^2) was applied to compare the infestation rate with regard to age, sex, origin, and body conditions. A 95% confidence interval and a 5% absolute precision level were used to determine whether there was significant difference between measured parameters.

4. RESULTS

4.1.Prevalence of Tick Infestation Based Origin of Animals

The current study was conducted on camels found in four Peasant Associations (PAs) namely: Gara Gafa, Boke Wako, Milkaye and Gobele of randomly selected districts of East and West Hararghe Zones. From the total of 384 camels examined, 314 (81.7%) were found to be infested by different genera of ticks. Out of these, 60 of them from Gobele, 71 of them from Milkaye, 84 of them from Boke Wako and 99 Gara Gafa were infestations by different ticks with prevalence of 80%, 80.7%, 84% and 81.8%, respectively. Therefore, there was no statistically significant difference observed in tick infestation between origins of the animals ($p> 0.05$) (Table 1).

Table 2: Prevalence of tick infestation based on place of sampling27

Zones	Districts	PAs	Nº. of examined	Nº. of Positive (%)	X^2	P value
West Hararghe	Daro Labu	Milkaye	88	71 (80.7)		
	Burka Dhintu	Boke Wako	100	84 (84)		
Total			188	155 (82.4)	0.0853	0.982
East Hararghe	Gola Oda	Gara Gafa	121	99 (81.81)		
	Haramaya	Gobele	75	60(80)		
Total			**196**			
G/Total			**384**	**314 (81.7)**		

4.2.Prevalence of Tick Infestation Based on Sex, Age, Body Condition Categories

Regarding sex, 224 females and 160 male camels were examined, out of which 188 (83.9%) and 126 (78.5%) were infested by different ticks species, respectively (X^2=3.47 and p= 0.062). The difference in tick infestation rate between sex groups was not statistically significant (p> 0.05). The prevalence of tick infestation in adult is found to be 84.9% and that of the young is 76.3%. There was no statistically significant variation detected between age groups (p> 0.05) and rate of tick infestation.

According to body condition scoring (BCS), camels were grouped into three namely: good, medium and poor, with infestation rate of 49.1%, 75.8% and 95.8 %, respectively. There was statistically significant difference (p=0.000) in infestation rate among camels that have different body conditions (Table 3).

Table 3: Prevalence of tick infestation based on sex categories27

Variables	Categories	Nº. of Examined	Nº. of infested (%)	X^2	P-value
Sex	Male	160	126 (78.5)	3.46	0.061
	Female	224	188 (83.9)		
Age	Young	245	208 (84.9)	1.27	0.246
	Adult	139	106(76.3)		
Body Condition	Good	59	29 (49.1)	-	0.000
	Medium	132	100 (75.8)		
	Poor	193	185 (95.8)		
Total	**384**	**314 (81.7)**			

4.3.Distribution of Camel Ticks Genera

In the study, a total of 4850 adult ticks were collected from body region of 384 examined camels. Eight tick species that belongs to four genera were identified in the districts. The abundant tick genera were *Rhipicephalus* (38%) followed by *Hyalomma* (35.2%), *Amblyomma* (21.6%) and *Boophilus* (5%).

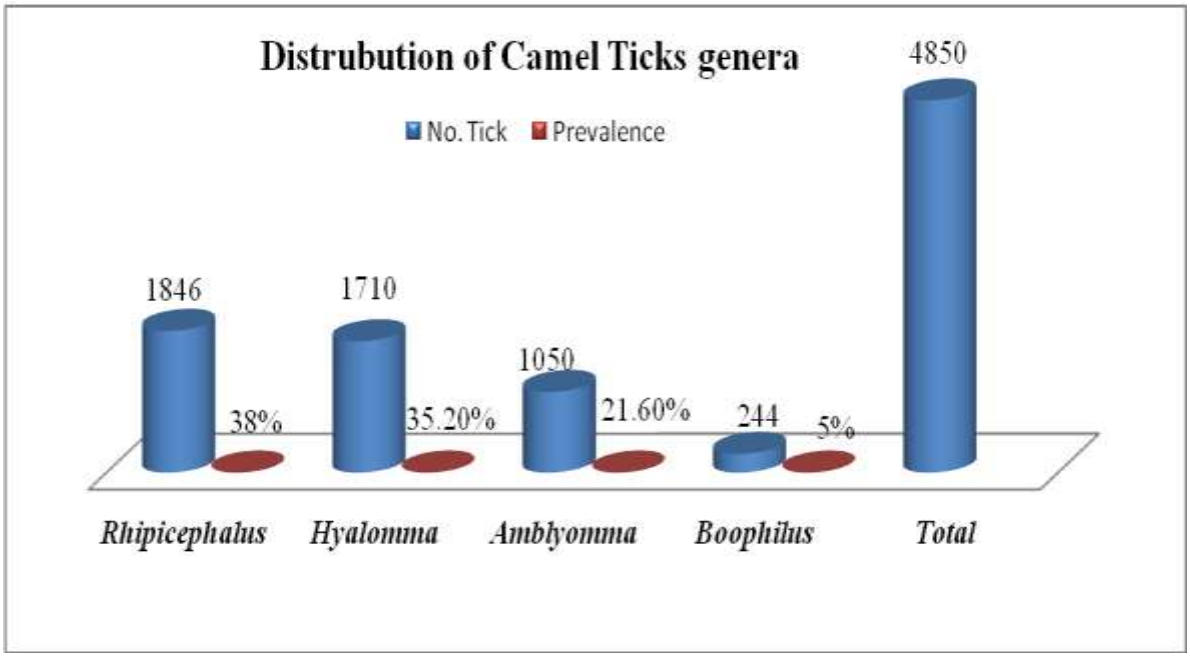

Figure 1: Distribution of camel ticks genera in the study area

4.4. Identified Ticks Genera and Their Attachment Sites

During this study, major tick genera such as *Hyalomma, Amblyomma, Boophilus* and *Rhipicephalus* were the identified.

Table 4: Identified ticks Genera and their attachment sites on Study animals

Predilection site	Under tail	Head	Neck	Sternum	Ventral	Udder/Scrotum	Back/side	Total
Hyaloma	443	301	597	226	143	-	-	1710
Amblyoma.	543	-	-	121	-	386	-	1050
Boophilus	-	-	-	-	-	-	244	244
Rhpicephalus	-	416	-	388	395	647	-	1846
Total	**986**	**717**	**597**	**735**	**538**	**1033**	**244**	**4850**

5. DISCUSSIONS

Camels play a significant multi-purpose role in the dry lands of Ethiopia. The commonest uses of camels by the pastoralists are for transporting different goods as well as for milk and meat production. 384 examined camels are examined, from that 314 (81.7%) were found infested by hard ticks. The ticks' distribution between camels' origins were studied and the prevalence of hard tick infestation between areas were almost similar, 80% Gobele, 80.7% Milkaye, 84% Boke Wako and 81.81% Gara Gafa. The finding indicated that there is no statistically significant association between rates of camel infestation by hard ticks and their living area (PAs).

This finding agreed with the report of Ahmed and Abebe (2018) in Jijiga district and Dinka (2010) in Dire Dawa and disagreed with the report of Rahmeto *et al*., (2010) from Jijiga Zone and Ayele and Mohammed (2013) from Dire Dawa which indicates that tick infestation rates have an association with camels living area. This is because of the effect of climate on tick survival. As Morel (1989) stated the most important ecological factors influencing the occurrence of ticks in a biotope include temperature and relative humidity. The absence of this association in the current study may be due to the climatic condition similarities of the PAs.

There was no statistically significant difference (p>0.05) in hard tick infestation rates between host sexes. However, the proportion of tick species in female camels 188 (83.9%) was slightly higher than that of males 126 (78.5%) and this finding agreed with previous finding of Ayele29and Mohammed (2013) in Ethiopia; Mohsen *et al*., (2013) in Iran and Maha *et al*., (2010) in Sudan. This may be due to high female camels mostly dwelling around home for milk production and grazing areas (shrubs) that create easy access for ticks whereas male camels mainly used for transportation so that they are unstable in one area and in close supervision by their owner for the tick infestation.

The result of this study indicates that there is statistically significant association (p<0.05) between hard tick infestation rate and body condition of the camels. The tick infestation rate is higher in camels with poor body condition score (BCS) (95.8%) (p=0.000) followed by camels with medium BCS (75.8%) (p=0.000) than in camels that have good BCS (49.1%). The higher prevalence in poor body conditioned camels may be due to ruffled hair coat that allows ticks to penetrate hair and attach the skin of camel easily. The overall prevalence of tick burden between adult and young camels showed no significant difference (p> 0.05) and the prevalence of tick infestation in adult (≤3 year) 208 (84.9%) was similar to that of the young (< 3 year) 106 (76.3) camels. This finding agreed with finding of Ayele and Mohammed (2013) and Eyeruselam (2008).

In this study, 4850 hard ticks were collected which belongs to four genera of ticks (*Rhipicephalus, Hyalomma, Ambylomma* and *Boophilus*). This result agrees with finding of Ahmed and Abebe (2018) on the study of camel ticks in Jijiga district, Eastern Ethiopia and Ayele and Mohammed (2013) on a study of camels' ticks in and around Dire Dawa, Eastern Ethiopia. The presence of similar hard tick genera in the districts because of unrestricted camel movement from area to area, which is a common these neighboring areas.

In this study *Rhipicephalus* was the most abundant tick species recorded on camel with relative prevalence of 38%, which is slightly lower to the finding of (Abebe, 2001; Ayele and Mohammed, 2013; and Ayana, 2013) who reported a prevalence of 50%, 46.8% and 46.8%, respectively. This difference may be due to climatic condition and different management practice in the pastoral areas. The higher in number of this species may be due to the fact, as Walker *et al*., (2003) stated that *Rhipicephalus* is a tick of savanna, steppe and desert climatic regions. It is one of the commonest ticks present in North East Africa, the Rift Valley and also east of the Rift Valley from Eritrea in the north to north-eastern Tanzania in the south.

Hyalomma was the second predominant species infesting on camel in the current study District, With relative prevalence of 20.2%, this result was in agreement with the finding of Abeba (2001) 20.4% and there is slight difference with the finding of Ayele and Mohammed (2013); Dinka *et al.*, (2010) and Eyeruselam (2008), which reported 26.8% 15.36% and 15.4% respectively. The finding contradicts the study of Bekele (2010) and Zeleke and Bekele (2004), who reported 1.2% and 3.87% respectively from Ethiopia. This difference might be due to management, agro-ecological and geographical difference. Camels are the preferred hosts of *Hyalomma* (Walker *et al.,* 2003).

Ambylomma (11.5%) was the third most abundant tick genera found in the study area. This finding agreed with the report of Ayele and Mohammed (2013) 11.35%, Eyeruselam (2008) 13.6% and Bekele (2010) 15.0% and is quite the opposite with the finding of Zeleke and Bekele (2004), Abeba (2001), and Zelalem (1994) who reported 4.10%, 5.79%, and 7.1% respectively. This difference may be due to application of acaricides and management practice used in different areas. It has long mouth parts are more significant in inflicting udder damage and is of a risk factor for mastitis in camels (Bekele, 2010; Ayele and Mohammed, 2013). Hyalomma fourth abundant tick genera with a prevalence of 8.3% in the study area, followed by *Hyalomma marginatum rufipes* and *Ambylomma variegatum* which was found slightly similar infestation rate that were 6.7% and 5.2% respectively. This agreed with finding of Ayele and Mohammed (2013) in Ethiopia and that of Maha *et al*., (2010) in Sudan. The smaller infestation rate of these tick species may be requirement of moisture and warm for their survival (Mekonnen, 2007). *Ambylomma variegatum* has a great economic importance, because it is an efficient vector of *Cowdria ruminantum*, the organism causing cowdrosis or heart water (Morel, 1980). Furthermore, ulcer caused by this tick species becomes favorable site for secondary bacterial infection like *Dermatophilus congolensis* (Tamiru and Abebaw, 2010).

Boophilus decoloratus was the second least abundant ticks in the study areas that account 5%. This lower number may be associated as (Morel, 1980) stated *Boophilus decoloratus* is often collected in Ethiopia and does not seems abundant anywhere. This tick species is abundant in wetter highlands and sub-highlands receiving more than 800 mm rainfall annually (Belew and Mekonnen, 2011). *Boophilus decoloratus* transmits Babesiosis and Anaplasmosis. *Ambylomma lepidium* was the least abundant thick in the study area, with relative prevalance of 4.9%. Little abundance of these

species might be associated with availability of suitable hosts since it prefers a cattle or the climatic factor in the study area. This tick transmits the *Cowdria ruminantium*, which causes heartwater and the protozoans *Theileria mutans* and *Theileria velifera* which cause benign bovine theilerioses (Walker *et al.*, 2003).

During the study each species of hard ticks were collected from various body regions of camels. But the30attachment site preference was higher in some species than the other species. The proportion of attachment sites for each species of tick during this study was: *Rhipicephalus pulchellus*, *Ambylomma lepidium* and *Boophilus decoloratus* (Head, Sternum, Ventral and Udder/scrotum), *Hyalomma dromedarii* (Under tail, Head and Neck), *Hyalomma truncatum* (Neck and Sternum), *Hyalomma marginatum rufipes* (Under tail, Neck and Ventral), *Ambylomma gemma* (Under tail and Udder/Scrotum), *Ambylomma variegatum*, (Under tail and Sternum), *Ambylomma lepidium* (Udder/Scrotum) and *Boophilus decoloratus* (Back/Side).

In the attachment site Back/side was least preference site. This is because of the presence of thick skin and long hair on the back/side. A verity of factors such as host density, interaction between tick species and inaccessibility for grooming determine the attachment site of ticks (Gebre etal., 2001). With regarding of sex of ticks males higher in number than females except for *Boophilus decoloratus*. This is most probably because of 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 on the host before dropping off (Abebaw, 2004). Host grooming easily removes semi-engorged or engorged females as compared to males. The females of *Boophilus decoloratus* outnumbered males in this study probably due to the small size of the male which could not be seen and this might be one of the contributory factors for missing of males. Similar report was indicated in the country by (Ahmed and Abebe 2018, Ayele and Mohammed, 2013; Ayana, 2013; Solomon *et al.*, 2003 and Desie, 2005).

6. CONCLUSION AND RECOMMENDATIONS

It is known that hard ticks cause severe economic losses either by transmitting of diseases, product and productivity of livestock. The result of this study indicates there is high prevalence (81.7%) of camel hard tick infestation in the study. The factors such as sex, age, origin and body condition score were studied and only body condition score has statistically significant in association. The camel ticks found in randomly selected districts of East and West Hararghe Zones belongs to four genera. The most abundant tick genera *Rhipicephalus*, while the least one was *Ambylomma*. Most of hard ticks were found on the udder/scrotum and under tail of the camel' s body and the least preferred site is the back/side of the camels.

Based on the finding this study the following recommendations are forwarded:

- ♣ Appropriate tick control strategy should be implemented in the area;
- ♣ There should be creation of awareness of the livestock owners as to the impact of ticks and other ecto-parasites on the health and productivity of their camels;
- ♣ Further detailed investigation on the distribution of ticks in different climatic conditions (seasons) and diseases they transmit should studied.

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8. ANNEXES

Annex 1. Age determination based on dental formula

Age	Characteristic change
1.5-2	I_1 erupt
2-2.5	I_2 erupt
3	I_3 erupt
3.5-4	*I_4 erupt
5	All incisor and canine are in wear
6	I_1 is level and the neck has emerged from the body
7	I_2 is level and the neck is visible
8	I_3 is level and the neck is visible, I_4 may be level
9	I_4 is level and the neck is visible
10	The dental star is squire in I_1 and in all teeth by 1_2 years
15	The teeth that are not fallen out are reduce (small round pegs)

Note: Canine of ruminant is usually considered as fourth incisor I – Incisor
Source: (De Lauta and Habel, 1986).

ANNEX 2. Identification certain for different types of tick

Characteristics	***Amblyomma***	***Hyalomma***	***Boophilus***	***Rhipicephalus***
Gnatosoma	Long	Long	Short	Short
Basis captulali	Rectangular dorsally	Rectangular dorsally	Hexagon	Hexagon
Coxa I	Twospurs	Bfield	Bifield	Twospurs
festoon	Present	Present/Absent	Absent	Present
Ornamentation	Yes	Yes / No	No	No

Sources: Walker *et al.*, (2003) and Matthysse and Colbo, (1987)