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TICK INFESTATION IN CATTLE IN THREE DISTRICTS OF METEKEL ZONE, BENISHANGUL-GUMUZ REGIONAL STATE ETHIOPIA: ITS PREVALENCE, CONTROL STRATEGIES AND MONETARY IMPACTS

MVSc RESEARCH THESIS

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ADDIS ABEBA UNIVERSITY
COLLEGE OF VETERINARY MEDICINE AND AGRICULTURE

DEPARTMENT OF PATHOLOGY AND PARASITOLOGY MVSc PROGRAM IN VETERINARY PARASTOLOGY

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TICK INFESTATION IN CATTLE IN THREE DISTRICTS OF METEKEL ZONE, BENISHANGUL-GUMUZ REGIONAL STATE ETHIOPIA: ITS PREVALENCE, CONTROL STRATEGIES AND MONETARY IMPACTS

MVSc Thesis

A Thesis submitted to the College of Veterinary Medicine and Agriculture of Addis Ababa University in partial fulfilment of the requirements for the degree of Master of Veterinary Science in Veterinary Parasitology

By

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June, 2019
Bishoftu, Ethiopia

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As MVSc research advisor, we hereby certify that we have read and evaluated this Thesis prepared by **Said Muhammed** entitled: **"TICK INFESTATION IN CATTLE IN THREE DISTRICTS OF METEKEL ZONE BENISHANGUL-GUMUZ REGIONAL STATE, ETHIOPIA: ITS PREVALENCE, CONTROL STRATEGIES AND MONETARY IMPACTS"** , we Approved for submittal to thesis assessment committee.

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DEDICATION

I dedicated this manuscript to my beloved father, Muhammed Hussen and my mother Alem Hussen, who sacrificed a lot to bring me up to this level, nursing me with affection and for their dedicated partnership in success of my life.

STATEMENT OF AUTHOR

First, I declare that this thesis is my work and that all sources of material used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfilment of the requirements for an advanced (MVSc) degree at Addis Ababa University, College of Veterinary Medicine and Agriculture and is deposited at the University/College library to be made available to borrowers under rules of the Library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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College of Veterinary Medicine and Agriculture, Bishoftu

Date of Submission

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ABBREVATIONS

DWAO	Dangur Woreda Agricultural Office
CSA	Central Statistics Agency
FAO	Food and Agriculture Organization
GDP	Growth Domestic product
MASL	Meter above sea level
MWAO	Mandura Woreda Agricultural Office
PWAO	Pawi Woreda Agricultural Office
TBDs	Tick Born Diseases

ABSTRACT

Ticks cause substantial losses in cattle production, in terms of diseases, reduced productivity and fertility and often death, and are economically the most important ecto-parasites of cattle. A cross-sectional study was conducted in three districts (Dangur, Mandura and Pawi) of Metekel zone, Benishangul-Gumuz regional state from November, 2018 to May, 2019 to investigate the abundance and compostion of tick species in cattle to assess control strategies and financial losses by infestation of ticks. Out of 1052 local breed of cattle randomly selected from three districts, 798 (75.9%) of them were found infested with one or more tick species. A total of 8559 adult ticks were collected from the animal body and identified to different genera and species. Six tick species were morphologically identified from four genera. Among the four genera 24.3%, 40.5%, 31.9% and 3.2% were *Amblyomma*, *Rhipicephalus, Rh. boophilus* and *Hyalomma*, respectively. The relative prevalence of each species was *Amblyomma lepidium* (6.8%), *Amblyomma variegatum* (17.5%), *Rhipicephalus* (*Boophilus*) *decoloratus* (31.9%), *Rhipicephalus evertsi evertsi* (27.5%), *Rhipicephalus pulchellus* (13%) and *Hyalomma marginatum rufipes* (3.2%). The host related risk factors such as sex, age and body conformations of cattle were statistically significant associated with tick infestation (P value = 0.05). *Amblyomma, Rhipicephalus and Hyalomma* species were abundant under tail, udder/scrotum, brisket, and ano-genital area while *Rhipicephalus boophilus decoloratus* preferred dewlap, brisket, belly, leg, and ear. In the study districts acaricide were commonly used for treatment during the time of tick infestation. Monetary losses associated with tick infestation were estimated in terms of production losses, hide losses, treatment cost and marketability reduction cost. Effective tick control program should be formulated and implemented based on the distribution pattern of ticks and factors responsible for their distribution in addition enhance skills of farmers about the effective dose and application of acaricides.

Key words: Tick Species, Control strategies, Monetary impacts, Metekel, Ethiopia.

1. INTRODUCTION

Ethiopia has an extremely diverse topography, a wide range of climatic features and a multitude of agro-ecological zones that are suitable to host a very huge animal population (Mekasha *et al*., 2014). The livestock subsector has an enormous contribution to Ethiopia's national economy and livelihoods of many Ethiopians. The subsector contributes about 16.5% of the national Gross Domestic Product (GDP) and 35.6% of the agricultural GDP (Leta and Mesele, 2014).

Poor health and productivity of animal due to disease has considerably become the major stumbling block to the potential of livestock industry (Onu and Shiferaw, 2013). Now a day's parasitism represents a major obstacle to development and utilization of animal resource. In Ethiopia ectoparasites in ruminant causes serious economic losses to small holder farmers, the tanning industry and country as a while through mortality of animals, decreased production, downgrading and rejection of skin and hide (Regasa *et al*., 2015).

Ectoparasites are responsible for decreased production and reproduction of these animals as well as leather quality deterioration, down grading and rejection of skins (Wall and Shearer, 2001). Ectoparasites mainly ticks are greatly associated with health problems of man and his animals and contribute to important economic losses in Ethiopia (Kumsa *et al*., 2016a). It directly affects the socio-economic development of resource limited farming community by affecting health and productivity of animals in Ethiopia (Yacob *et al*., 2008).

Ticks are small, wingless ectoparasitic arachnid arthropods that are cosmopolitan and prevalent in warmer climates (Olwoch *et al*., 2009). Ticks cause substantial losses in cattle production, in terms of diseases, reduced productivity and fertility and often death, and are economically the most important ecto-parasites of cattle (Eyo *et al*., 2014). According to the study conducted by Huruma *et al*. (2015a) indicates that different ticks have different predilection sites on the host's body. Ticks suck blood; damage hides and skins introduce toxins and predispose cattle to myiasis and dermatophilosis (Yiwombe, 2013and Marufu, 2008a). Furthermore, they reduce body weight gains and milk yield, in addition to creating sites for secondary invasion by pathogenic organisms (Marufu, 2008a).

Ticks are obligate blood feeding ectoparasites of vertebrates particularly mammals, birds and reptiles throughout the world (Wall and Shearer, 2001). All ticks spend most of their life cycle away from their hosts, hiding either in soil and vegetation or in the nests of their hosts (Latif and Walker, 2004). The blood from mammals, birds, reptiles and amphibians is the only critically important source of nutrition for growth, development of organs for male, female, larvae and nymphs of ticks (Walker, 2014). They belong to the phylum Arthropod; class Arachnid, and order Acari (Wall and Shearer, 2001). To date, a total of 896 tick species have been described worldwide (Walker, 2014). Ticks are grouped into three families as Ixodidae (hard ticks) with 702 officially recognized species, Argasidae (soft ticks) comprising 193 species and Nuttalliellidae with a single species (Guglielmone et al., 2010). Ixodid ticks pass via four stages in their development; eggs, 6- legged larva, 8-legged nymph and adult (Minjauw and McLeod, 2003). They are categorized into one-host; two-host or three-host life cycles according to the number of host required to complete their lifecycle (Walker, 2014).

The main genera of ticks found in Ethiopia are *Ambylomma*, *Rhipicephalus*, *Hyalomma* and *Haemaphysalis* and a subgenus *Rhipicephalus* (*Boophilus)* (Mekonnen et al., 2001). Previous studies documented the presence of more than 50 species of ticks in the country including genus *Amblyomma* (8 spp.), subgenus *Boophilus*, (2 spp.), *Haemaphysalis* (4 spp.), *Hyalomma* (9 spp.), *Rhipicephalus (*15 spp.), *Ixodes* (1 spp.), *Argas* (1 spp.) and *Ornithodoros* (2 spp.) which are reported to have great veterinary and medical importance in Ethiopia (Pegram et al., 1981). Several studies have been conducted in different parts of Ethiopia on ticks infesting cattle (Yacob *et al*., 2008; Kumsa *et al*., 2016b).

However, there is lack of precise and up-to-date comprehensive information on species compostion, control measures and financial losses of tick infestations of cattle in Dangur Mandura and Pawi districts in Metekel zone of Benishangul-Gumuz regional state of Ethiopia.

Therefore, the major objectives of this study were:

- To estimate the abundance and compostion of tick species infesting cattle.
- To assess the control strategies and financial losses of infestation of ticks in the study districts.

2. LITERATURE REVIEW

2.1. Classification and morphology of ticks

Ticks are within a member called the phylum (Arthropoda), class (Arachnida), sub class (Acari) and Order (Parasitiformes) (Torr *et al*., 2003). Within the Parasitiformes, ticks belong to the suborder Ixodida, which contains a single super family, the Ixodidae, which is divided into two major families, Argasidae (soft ticks) and Ixodidae (hard ticks), and the rare family Nuttalliellidae, with a single African species (Rodriguez-Vivas *et al*., 2004). The family Ixodidae, or hard ticks, contains some 683 species (Jongejan and Uilenberg, 2004). As adults, Ixodids exhibit prominent sexual dimorphism: the scutum covers the entire dorsum in males, but in females (and immatures) the scutum is reduced to a small podonotal shield behind the capitulum, thereby permitting great distention of the idiosomal integument during feeding (Jongejan and Uilenberg, 2004). Ixodidae ticks are relatively large and comprise thirteen genera. Seven of these genera contain species of veterinary and medical importance *Amblyomma*, sub genus *Rhipicephalus (Boophilus)*, *Rhipicephalus*, *Haemaphysalis*, *Hyalomma*, *Dermacentor* and *Ixodes* (Lora, 2001). The family Argasidae, or soft ticks, consists of about 185 species worldwide and have one important genus that infests cattle, *Ornithodoros* (Latif and Walker, 2004). Adult argasids lack a dorsal sclerotized plate or scutum, their integument is leathery and wrinkled, their mouthparts are not visible from above, and they show no obvious sexual dimorphism. Argasidae are wandering ticks, which only remain on their host while feeding (Barker and Murrell, 2004).

Ixodidae ticks are relatively large, ranging between 2 and 20mm in length. Ixodidae ticks are characterized by the presence of a rigid chitinous scutum that covers the entire dorsal surface of the adult male whereas it extends only for a small area in the female (Barker and Murrell, 2004).

The mouthparts *(capitulum)* have three specialized structures called palps, chelicerae and a hypostome that are attached to a base called the basis capituli (Houseman, 2013). The body *(idiosoma)* of ticks is typically not hardened to a great extent. In hard ticks, most of the exterior cuticle is soft and has many internal folds that look like grooves on the surface of the body. The uniform, rectangular folds located on the rounded posterior end of hard ticks are called festoons (Figure 1). Unfolding and stretching of the soft cuticle along these grooves allows immature and adult female hard ticks to take enormous blood meals and swell to weigh 50 to 100 times their original weight **(**Houseman, 2013).

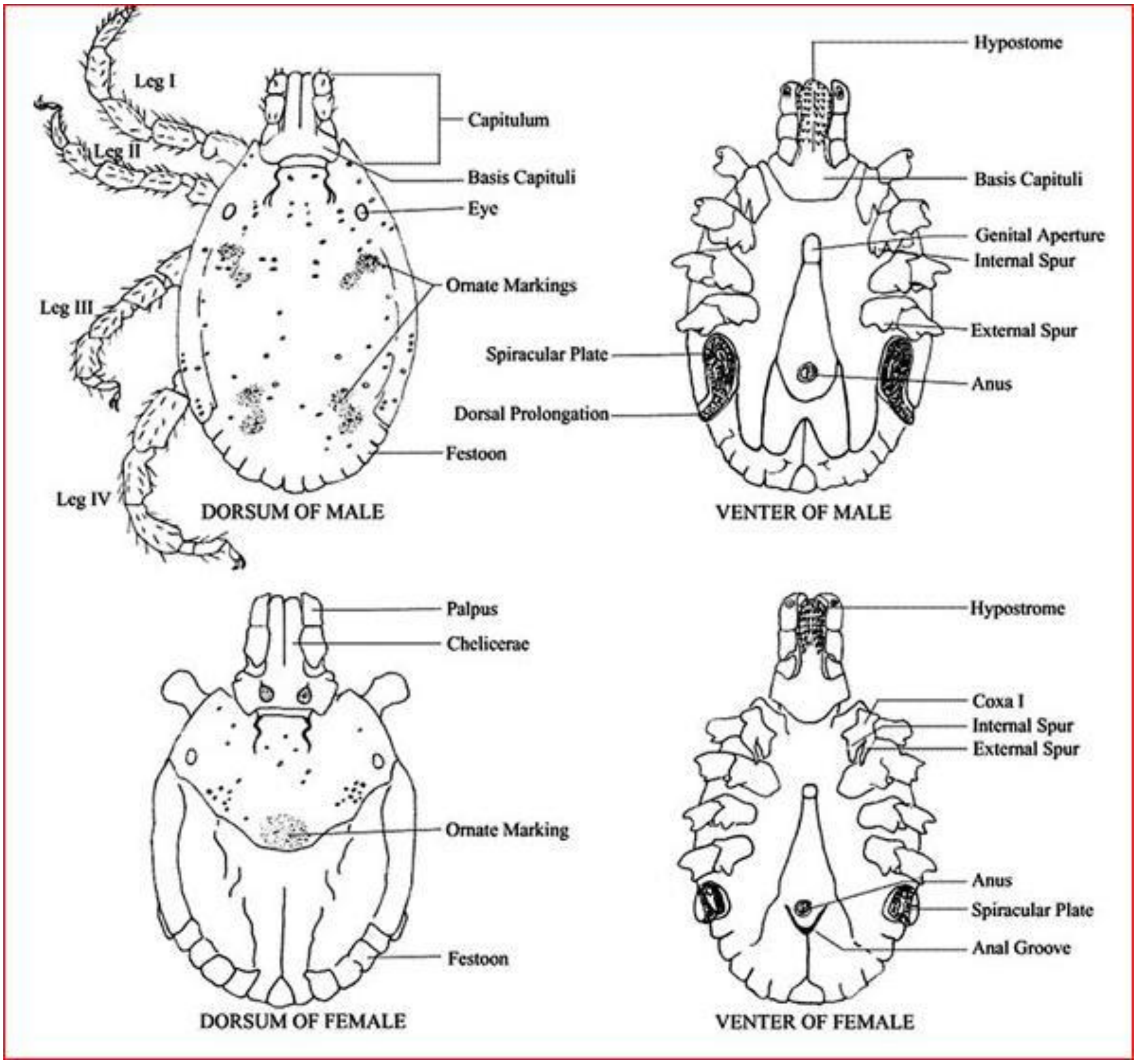

Figure 1: Key morphological features of male and female hard ticks on the top (dorsum) and bottom (ventral) of their bodies (Houseman, 2013)

2.2. Identification / general characteristics of tick genera (hard and soft ticks)

Although most people consider ticks to be either small and red or large and blue, on closer inspection many species are extremely colourful when examined under a stereoscopic microscope. Some of these features can readily be seen with the naked eye and the ticks have been given common names by farmers and researchers. Thus we have bont (brightly coloured) ticks, bont-legged ticks with ivory-coloured bands around their legs, red-legged ticks whose legs vary from light to dark orange, yellow dog ticks, and blue ticks, the last mentioned ticks acquiring their common name from the slaty blue colour of their engorged females (Walker and Bouattour, 2003). In hard ticks, most of the exterior cuticle is soft and has many internal folds that look like grooves on the surface of the body. The uniform, rectangular folds located on the rounded posterior end of hard ticks are called festoons. Unfolding and stretching of the soft cuticle along these grooves allows immature and adult female hard ticks to take enormous blood meals and swell to weigh 50 to 100 times their original weight **(**Houseman, 2013)

2.3. Epidemiology

2.3.1. Host relationship

Some ticks live in open environments and crawl onto vegetation to wait for their hosts to pass by. This is a type of ambush and the behaviour of waiting on vegetation of is called questing. Thus in genera such as *Rhipicephalus*, *Haemaphysalis* and *Ixodes* the larvae, nymphs and adults will quest on vegetation. The tick grabs onto the host using their front legs and crawl over the skin to find a suitable place to attach and feed. Adult tick of genera *Ambylomma* and *Hyalomma* are active hunters, they run across the ground after nearby hosts (Walker *et al.*, 2003). During questing, ticks may lose water, which they normally regain by descending at intervals to the litter zone (the layer of dead leaves, grass, twigs, etc. covering the soil) (Perret *et al.*, 2004).

2.3.2. Attachment site

Tick attachment site specificity is one of the populations limiting system that operate through the restriction of tick species to certain parts of the host body. They seek out places on the hosts where they are protected and have favorable conditions for their development. According to the studies of Huruma, (2015) and Jittapalapong *et al*., (2004) indicated that different ticks have different predilection sites on the host's body.

The favorable predilection sites for *B. decoloratus* was the lateral and ventral side of the animal; *A. variegatum*, teat and scrotum; *A. coherence* udder and *H. truncatum*, scrotum and brisket and *H. marginatum rufipes* udder and scrotum, *R. evertsi evertsi* under tail and anus and *R. preaxtatus* anus and under tail (Huruma, 2015). Depending on the tick, site preference on the host depends on the accessibility for attachment, to get blood and protection to overcome the environment damage that inhibits its existence and grooming activity of the host. Tick location on the host is lined to the possibility of penetration by hypostome. Genera with short hypostome for example *Rhipicephalus*, *Dermacentor* and *Haemaphysalis* species usually attach to hairless area such as under tail and anovulval area (Huruma, 2015).

2.4. Seasonal variation

The microclimate in the layers of vegetation populated by ticks is an important factor regulating the abundance of their populations. The weather also regulates the periods of the year when ticks are active (Balashov, 1972). Climate therefore has various, not yet totally quantified, effects on the mortality and development rates of the population of ticks, and also on the phenological component of the cycle may promote a rise in the mortality rates of ticks in the moulting or questing stages. Long winters or abnormally low minimum winter temperatures may induce high mortality in the population of ticks overwintering in the ground. However, it is well known that long periods of snow cover on the ground may confer a protective effect, by insulating ticks overwintering in the ground from very low temperatures (Estrada-Peña, 2015). Seasonal activity is mainly determined by the activity or inactivity of the different life cycle stages (Estrada-Peña, 2015).

2.5. Life cycle

In the 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. They transfer a sac of sperm (spermatheca) to the female. The females mate only once, before they are ready to engorge fully with blood. When they finally engorge they detach from the host and have enough sperm stored to fertilize all their eggs. Female hard ticks lay many eggs (2,000 to 20,000) in a single batch. Female argasid ticks lay repeated small batches of eggs. Eggs of all ticks are laid in the physical environment, never on the host and Members of the family Ixodidae undergo either one-host, two-host or three-host life cycles (Charles and Robinson, 2006).

2.5.1. One-host ticks life cycle

Eggs are laid on soil. Larvae hatch after several weeks of development and crawl onto 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 adults hatch and then feed on the same host. The adults will change position on the same host for mating. Thus all three feedings of any individual tick occur on the same individual host. The life cycle of one-host ticks is usually rapid, for sub genus Rhipicephalus (Boophilus) it takes three weeks for the feedings on one host and two months for egg laying and larval development. The adult is considered the diagnostic stage, as identification to the species level is best achieved with adults. Few Ixodidae of public health importance follow this pattern; an example is Rhipicephalus (Boophilus) annulatus, which can serve as a vector for Babesiosis. Vertical transmission of Babesia via transovarial transmission has been demonstrated for some species of ticks (Walker *et al*., 2003 and Kirby, 2010).

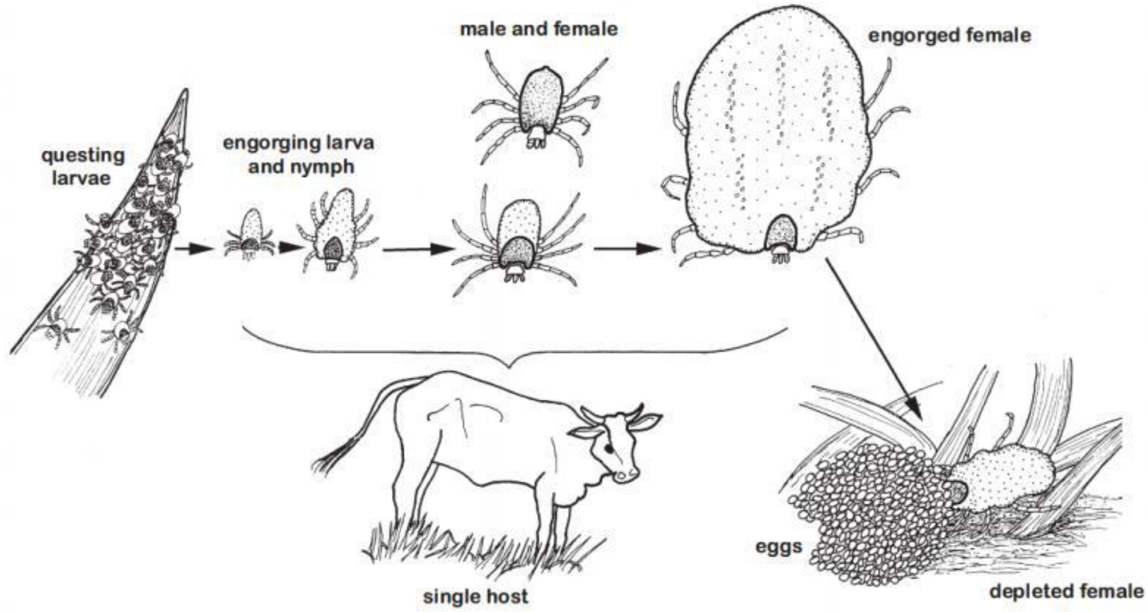

Figure 2: One-host life cycle. The example is *Rhipicephalus b. decoloratus* (Walker *et al*., 2014)

2.5.2. Two-host ticks life cycle

Larvae hatch from eggs, climb on to the first host, attach, engorge, moult on the host to nymphs, nymphs attach, engorge, detach, drop to the ground, moult to males and females in a sheltered locality, adults climb on to the second host, attach, partially engorge, mate, the females fully engorge, detach, drop to the ground, lay a single large batch of eggs in a sheltered locality and die (Walker and Bouattour, 2003). During the two-host life cycle, the tick molts from larva to nymph on the first host, but will leave the host between the nymphal and adult stages (Walker *et al*., 2003).

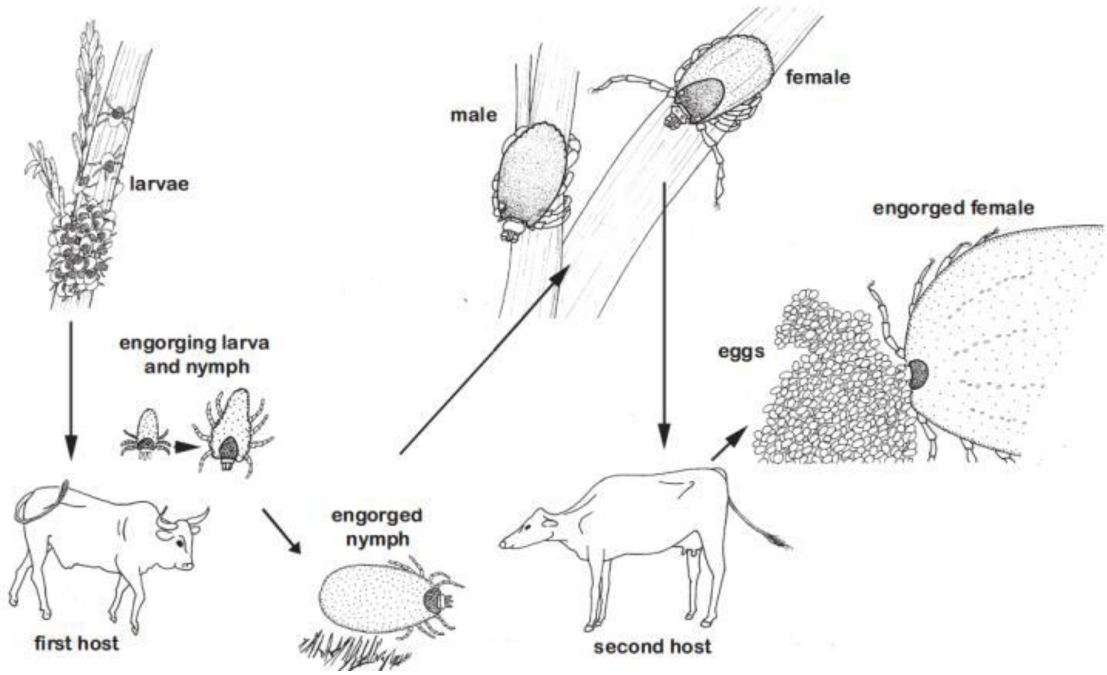

Figure 3: Two-host life cycle. The example is *Rhipicephalus bursa* (Walker *et al*., 2014)

2.5.3. Three-host ticks life cycle

This is the commonest type of life cycle. Larvae develop in the eggs until ready to hatch, usually in several weeks. Larvae feed once on a host, then detach from the host and hide in the physical environment such as soil or vegetation. They moult to nymphs. Nymphs feed once and moult in the same way as larvae. From the nymphal moult either a female or male emerges. The female feeds once and lays one huge batch of eggs. She then dies. The males may take several small feeds, mate and then die. Ticks that have recently hatched from eggs or from moulting have soft bodies and are inactive for one to two weeks whilst the external body wall hardens. The life cycle of three-host ticks is slow, from 6 months to several years to complete (Latif and Walker, 2004).

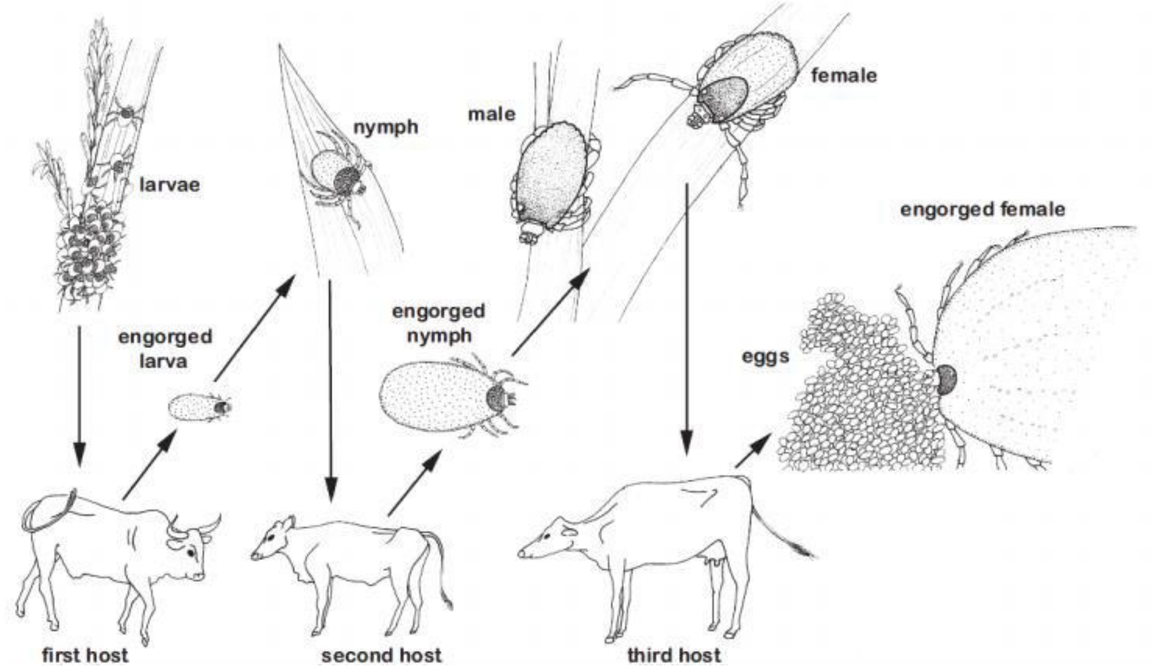

Figure 4: Three-host life cycle. The example is *Rhipicephalus appendiculatus* (Walker *et al*., 2014)

2.5.4. Life cycle of soft ticks

Soft ticks have life cycles that vary in the number of stages and feeding bouts. They are nest parasites and are likely to feed repeatedly on the same animal or the same family group of animals within the nest. Most soft ticks do not attach to the host or enlarge greatly while feeding. Those that do attach only do so during the larval stage. Nymphs and adults feed quickly on the host while it is in the nest and then return to their resting or hiding place within the nest (Houseman, 2013).

Table 1: Important Ixodidae ticks according to the number of their hosts

Tick genera	One host tick	Two host tick	Three host tick
Rhi. (Boophilus) spp.	*Rh. (B).decoloratus* *Rh. (B).annulatus* *Rh. (B).microplus*		
Amblyomma spp.			All species of *Amblyomma*
Hyalomma spp.	*Hyalomma scupense*	*Hy. m. turanicum,* *Hy. d. Dentritum*	*Hy. truncatum,* *Hy. a. anatolicum* *Hy. dromedarii,* *Hy. m. marginatum,* *Hy. Excavatum*
Rhipicephalus spp.		*Rh .e .evertsi* *Rh. Bursa*	*Rh. simus,* *Rh. pravus,* *Rh. pulchellus,* *Rh. Appendiculatus*
Haemaphysalis spp.			*Hae. Punctata*
Ixodes spp.			*I. pilosus, I. Ricinus*
Dermacentor spp.	*D. albipictus*		Most species

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

2.6. Pathogenic role of ticks

Direct effects of ticks on cattle are tick worry, blood loss, damage to hides and skins of animals and introduction of toxins (Marufu, 2008b). Hard ticks (Acari: Ixodidae) are obligate hematophaguos ectoparasites and important vectors of viruses, bacteria and protozoa. They are considered second only to mosquitoes as the most medically important group of arthropods (Hubalek, 2009).

2.6.1. Tick worry

Tick worry is a generalized state of unease and irritability of cattle severely infested with ticks, often leading to serious loss of energy and weight. This negative effect on the growth of animals and their production is thought to be due to the effects of a toxin in the saliva of ticks (Marufu, 2008b).

2.6.2. Anaemia

Anaemia is an inevitable consequence of heavy infestation by any blood-feeding parasite, and cattle deaths attributable to anaemia as a result of tick infestation are common (Jonsson, 2006). Engorging Ixodidae females will increase their weight by 100–200 times but the actual amount of blood ingested is much greater than this, as blood meal is concentrated and fluid excreted in saliva. Estimates of the amount of blood removed vary according to the species under consideration (Marufu, 2008b). The anaemia caused by heavy tick infestation results in loss of condition in cattle causing a reduction in meat production and milk yield (Marufu, 2008b).

2.6.3. Wounds and myiasis

Ticks with longer mouthparts such as *Amblyomma* and *Hyalomma* cause more extensive damage than those with shorter mouthparts such as *Rhipicephalus* (*Boophilus*) and *Rhipicephalus*. The involvement of host reactions leading to tissue damage may be dependent upon recruitment of inflammatory responses characterized by dermal cell infiltrates which form the lesions (Mattioli *et al*., 2000). Tick wounds may become infested by screwworms or other agents of myiasis, and are also associated with the spread of bovine dermatophilosis caused by *Dermatophilus congolensis* (Kahn *et al*., 2005).

2.6.4. Toxicoses

Tick saliva contains toxins which have a specific pathogenic effect. The toxins affect not only the attachment site but also the entire organs of the host. Some ticks produce neurotropic toxins which induce tick paralysis that is characterized by an acute ascending flaccid motor paralysis (Kahn *et al*., 2005). Females of the species *Hyalomma truncatum* produce a dermotropic (epitheliotropic) toxin which causes sweating sickness in calves and some adult cattle (Kahn *et al*., 2005).

2.7. Distribution of ticks in Ethiopia

The distribution and abundance of tick species infesting domestic ruminants in Ethiopia vary greatly from one area to another area (Desalegn, 2015). In Ethiopia, studies on tick fauna have begun early in the 19th century. Since then, different researchers from abroad and country determine the pattern of ticks and the tick-borne diseases; and ticks are common in all agro-ecological zones of the country (Pegram *et al*., 1981). The main tick genera found in domestic animals of Ethiopia are *Amblyomma*, *Hyalomma*, *Rhipicephalus*, *Haemaphysalis* and *Rhipicephalus* (Morel, 1989).

Table 2: Distribution of the most predominant and economically important tick species of cattle in different parts of Ethiopia

Tick Species	District/Study area	Prev.%	Reference
Amblyomma variegatum	Somalia	4.2	Abebe *et al.*, 2010
	Northwest, Ethiopia	13.4	Alemu, 2014
	Western Ethiopia	17.2	Kumsa et al., 2013
	Southren, Ethiopia	20.82	Shifarew, 2005
Amblyomma cohaerens	Central Oromia	90	Pegram, 1981
	Borana Province	1	Regassa, 2001
	Western Ethiopia	66.3	Kumsa et al., 2013
Amblyomma gemma	Somali Ethiopia	9.4	Tomassone *et al*., 2012
	Borana zone	5	Regassa, 2001
Rhipicephalus (*Boophilus*) *decoloratus*	Western Ethiopia	38.2	Kumsa *et al*., 2013
	Northern Ethiopia	23.9	Yacob *et al*., 2008
	Southern Ethiopia	46.57	Wogayehu *et al*., 2016
Rhipicephalus evertsi evertsi	Western Ethiopia	25.8	Kumsa *et al*., 2013
	North shewa	20.6	Tadesse and Sultan, 2014
	Northwest Ethiopia	11.51	Alemu *et al*., 2014
Rhipicephalus pulchellus	Somali Ethiopia	40.1	Tomassone *et al.*, 2012
	Adami Tulu	0.9	Ayalew *et al*., 2014
Rhipicephalus praetextatus	Adami Tulu	19.6	Ayalew *et al*., 2014
	Western Ethiopia	0.4	Kumsa *et al*., 2013
Hyalomma rufipes	Ada‟a	17.8	Ayalew *et al*., 2014
	Somali Ethiopia	13.3	Tomassone *et al.*, 2012
Hyalomma truncatum	Adami Tulu	25.1	Ayalew *et al*., 2014

2.8. Tick control methods

The aim of tick control campaign is not to control all ticks simultaneously, but a definite species because of its particular role (FAO, 2004). The successful implementation of rational and sustainable tick control programmes in grazing animals is dependent upon a sound knowledge of the ecology or epidemiology of the tick as it interacts with the host in specific climatic, management and production environments. In most situations, however, efficient and reliable methods for the control of cattle ticks and TBD are based on the use of a chemical treatment (acaricide application), often without a local understanding of appropriate ecology or epidemiology (FAO, 2004).

It is now generally understood that tick control should not only be based on acaricide use, despite the fact that this remains the most efficient and reliable single method. The most common tick control methods used are briefly described as follows:

2.8.1. Ecological tick control

Ecological control method is used for habitat and host linked treatment. Pasture management, including spelling and seasonal changes in cattle grazing areas in Australia and in Zambia respectively has been used as a tick control strategy and are believed to be responsible for a decrease its burden (Walker *et al*., 2003).

2.8.2. Biological tick control

A first attempt at tick biocontrol was made with the introduction of tick parasitic wasps from France to the USA and Russia. During the past decades, interest in developing antitick biocontrol agents such as birds, parasitoides, entomopathogenic nematodes, entomopathogenic fungi and bacteria have gained momentum (George *et al.*, 2008). In biological tick control the activities of the hyperparasites chalcid flies Hunterellus are probably important in nature, but they are difficult to evaluate and it is still more difficult to manipulate or reproduce them for practical use. The biological agents, which potentially include predators like rodents, birds, ants, spiders, lizards and beetles as well as Prasitoids (destroy the host: the wasp lay the eggs in the engorged ticks and larvae eats the tick and emerges as adult to attack another tick) and parasites (Nematodes and fungus) are attack soil living stages of the ticks are effective and depending on the conditions, these predators can consume a large number of ticks (Latif and Walker, 2004). Yet, having such effective importance the development of a biological tick control methods has been neglected as compared to the control of plant pests or dipterous insects harmful to men and animals (Samish and Alekseev, 2001).

2.8.3. Chemical tick control

Acaricide treatments are commonly used and would be cheap, easily applied, with a strong knock down effect and sufficient residual effect on female ticks to prevent egg lying and to protect cattle from reinfestation 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. Unfortunately, such an ideal acaricide has not yet been produced. Generally, although the use of acaricides for the control of ticks has limitations and tick resistance to acaricides is an increasing problem and real economic threat to the livestock worldwide, most livestock holders depend completely on acaricides to control ticks, but do not have access to guidelines on how to make a profit from their tick control program or how to detect and resolve problems with resistance to acaricides (George *et al.*, 2008).

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2.8.4. Genetic tick control

The application of acaricides is the most common method used to control cattle ticks. However, the improper use of these chemicals compounds has been causing the development of tick resistance to various pesticides available in the market, reducing these products’ useful lifetimes. Besides this, problems generated by the presence of chemical residues in meat, milk and the environment have prompted reflection on the need for better monitoring of their application (Castro-Janer *et al*., 2010). Therefore, the study of the genetic resistance to ticks among different breeds of cattle can contribute to the development of alternative control methods (Ibelli *et al*., 2012). It is widely known that *Bos indicus* cattle are more resistant to ectoparasites than are *Bos taurus* animals. There are great differences between these two breeds of cattle in regard to their susceptibility to parasitism by cattle ticks (Bianchin *et al*., 2007). Studies are intensifying the crossing of these two groups, aiming to obtain animals that are more resistant to the conditions found in tropical countries and are also good meat producers (Graf *et al*., 2004). Tick resistance among cattle is influenced by a number of factors. The most important are increased levels of histamine at the early stages of the infestation, self-cleaning behaviour Ibelli *et al*. (2012), increased levels of eosinophils, basophiles and mast cells, the presence of specific immunoglobulin patterns, and genes related to the expression of keratins and lipocalins (Kongsuwan *et al*., 2010).

2.8.5. Tick vaccine

A vaccine by contrast has the potential to be a non-contaminating, sustainable and cheap technology, potentially applicable to a wide variety of hosts. There are potential limitations as well first and foremost whether vaccines can be produced which achieve the desired level of efficacy under field conditions (Willadsen, 2004). The Australian experience has shown that integrated control, involving a combination of strategies, is necessary because of the development of tick to acaricides. Integrated control has led to the widespread use of tick-resistant zebu cattle and vaccines against TBDs (Santana, 2000). A tick-vaccine named "TICK GUARD" is on the market mainly in Australia and Latin America for the control of *Rhipicephalus (Boophilus) microplus,* which is prepared from antigens of tick gut multiplied with genetically engineered *Escherichia coli*. It acts essentially by damaging the tick gut thereby reducing tick fertility. The vaccine has been evaluated during the last 10 years and has demonstrated its safety as part of an integrated tick control programs. Unfortunately this vaccine is developed specifically for *Rhi (Boophilus) microplus*, which is the only major tick species of that country (Xu *et al*., 2005).

2.8.6. Ethno-veterinary in control of tick

Despite the major role in control of Acari, synthetic acaricides suffer from a large limitation. Because of the hard delayed degradation, their residues usually remain in agricultural environment where they adversely affect the life of living organisms in natural ecosystem. Likewise, they are able to induce the production of resistant strains of ticks (Habeeb, 2010). Ethno-veterinary medicine covers people's knowledge, skills, methods, practices and beliefs about the care of their animals (Moyo and Masika, 2009). In Kenya ethno-veterinary remedies are used among pastoral and farming communities in marginal areas (Njoroge and Bussmann, 2006). They are locally available and affordable to the farming communities (Moyo and Masika, 2009). Ethno-veterinary medicine provides valuable alternatives to and compliments the conventional acaricides especially where the later is unavailable, unaffordable or inappropriate. Some of the ethno veterinary remedies have been documented and some have been validated for their acaricidal properties. For example, certain plants have been found to possess strong acaricidal and/ or tick repellent properties. These include: *Nicotiana tabacum, Vernonia amygdalina*, *Tephrosiavogelii*, *Chrysanthemum cinerariaefolium* (Hlatshwayo and Mbati, 2005). The ethno-veterinary remedies of tick control practiced in western Ethiopia have been examined by a survey of farmers, followed by *in vitro* and *in vivo* testing of treatments that appeared to have potential to control ticks (Regassa, 2000). Some plants with acaricidal properties have some side effects on animals for example application of latexes of *Euphorbiaobovalifolia* caused alopecia in areas of skin smeared with the latex (Regassa, 2000). In Ethiopia in north Gondar the use of some plants to control tick in animal using some plants such as Birbira (*Milletia ferruginea*), Zikita (*Calpurnia auera*), endod (*Phytolacca dodecandra*) and others was reported (Melaku, 2013). Uses of ethno-veterinary remedies probably reduce tick-burdens while maintaining endemic stability to tick-borne diseases. However little work has been done to document and validate these ethno-veterinary remedies in Ethiopia (Regassa, 2000).

2.9. Monetary impacts of tick infestation

2.9.1. Tick infestation impacts on hide and skin

Ticks can affect skin and hide quality through penetration of skin by piercing mouth parts makes holes which are defects in processed skin. When feeding, ticks can allow bacteria to pass through the skin leading to the development of local abscessed which damage skin quality more expensively than the hole caused by feeding (Taylor *et al*., 2007).

Hide and skin accounts for 12-16% of the value of export in Ethiopia. More than 60 species of ticks infesting both domestic and wild animals have been recorded in Ethiopia. However, hide and skin which is emanating from East and Central African countries including Ethiopia have low value in the international market which is mainly associated with tick marks (Abunna *et al*., 2012).

2.9.2. Tick infestation impacts on production (milk)

Ticks can reduce potential yield, which mean that significant infestations of *Boophilus microplus* reduce the cattle's ability to reach its full weight potential (Stewart and De Vos, 1984). When animals infested with an average of 40 ticks /day could lose weight equivalent to 20 kg/year and when infested with more than 200 ticks for a period of six weeks could die if not treated (Frisch *et al*., 2000).

Each tick bite causes stress and weakens the host's immune responses which affect the performance of the animals. The economic losses due to ticks can be expressed either in terms of body weight or milk production lost per engorged tick or in terms of average financial loss (production loss plus cost of control) per animal per year (Jonsson, 2006).

2.10. Tick borne diseases

The term vector-borne disease refers to any of a broad array of infectious diseases caused by pathogens that are transmitted by arthropods or other biologic intermediaries. Although transmission usually occurs on blood feeding by an infected insect or acarine parasite, infection can also result when a vertebrate host ingests a vector or on contamination of a wound by infectious organisms in the feces of the arthropod intermediary. Regardless of the means of transmission, the vector, a critical component in disease transmission, engages in a lifestyle that is at least partially parasitic and that somehow contributes to its ability to both acquire and serve as a source of infection to animals (Bowman, 2009).

2.10.1. Babesiosis

Bovine babesiosis is a hemoparasitic disease caused by protozoa of the genus *Babesi*a (Phylum: Apicomplexa), which infects mainly ruminants (Melendez, 2000). In cattle the disease also is known by such names as bovine babesiosis, piroplasmosis, Texas fever, red-water, tick fever, and tristeza (Zaugg, 2009). It is associated with *B. bigemina* and *B. bovis* are the most important disease of tropical and subtropical. Both species are transmitted transovarially by *Boophilus* ticks, but only tick larvae transmit *B. bovis*, whereas nymphs and adults transmit *B. bigemina* (Radostits *et al*., 2006). Several studies have been conducted in different region in Ethiopia, including abundance, distribution and prevalence of bovine Babesiosis with over all prevalence of 1.5% in Benishangul Gumuz Regional State, Western Ethiopia out of which two species of *Babesia* comprising of *B. bovis* (1.24%) and *B. bigemina* (0.248%) were identified (Bihonegn *et al*., 2015).

2.10.2. Theileriosis

Theileriosis is a hemoparasitic disease caused by protozoa of the genus *Theileria* (Apicomplexa) (Allison and Meinkoth, 2010). Theileriosis is caused by *Theileria* spp. in cattle, goats, sheep and wild and captive ungulates (Radostits *et al*., 2006). The parasites are transmitted by tick such as *Rhipeciphalus* and *Hyalomma* species.

These parasites undergo repeated merogony in the lymphocytes ultimately releasing small merozoites, which invade the red cells to become piroplasms. Theileriosis have a variety of tick vectors which cause infections ranged from clinically inapparent to rapidly fatal (Taylor *et al*., 2007). Recently *Theileria* **(***T. velifera, T. mutans, T. ovis, T. separata, T. annulata)* infection in domestic ruminants is reported in northern Ethiopia (Gebrekidan *et al*., 2014).

2.10.3. Cowdriosis (Heartwater)

Bovine ehrlichiosis (also known as heartwater or cowdriosis) is an infectious and tick-borne disease of ruminants caused by the rickettsial organism, *Ehrlichia ruminantium* (formerly *Cowdria ruminantium*) and transmitted by ticks of the genus *Amblyomma* through stage to stage transmission, particularly *Am. variegatum* which is widespread in Ethiopia (Mekonnen *et al.,* 2001). The disease is endemic in sub-Saharan African countries and it has a serious negative impact on livestock productivity, with high morbidity and mortality rates (up to 90%) in susceptible ruminants. European breeds are generally more susceptible than more susceptible than indigenous African breeds (OIE, 2011).

2.10.4. Anaplasmosis (gall sickness)

Anaplasmosis is a vector-borne infectious blood disease in cattle caused by the bacterial parasites, *Anaplasma marginale* and *A. centraele*. It occurs primarily in warm tropical and subtropical areas. Anaplasmosis is not contagious; numerous species of tick vectors (*Boophilus, Rhipicephalus and Hyalomma*) can transmit Anaplasma species (Taylor *et al*., 2007). It can also be transmitted via contaminated surgical instruments, biting flies and mosquitoes. The intracellular parasites destroy the red blood cells. It causes anaemia, fever, weight loss, breathlessness, uncoordinated movements, abortion and death. It is transmitted by the tick through transovarial and stage to stage transmission (de la Fuente *et al.,* 2005)

3. MATERIALS AND METHODS

3.1. Description of study area

The study was conducted in Metekel zone of Benishangul Gumuz Regional State, Northwest Ethiopia. About 80% of the zone was characterized by having sub-humid and humid tropical climate. The topography of the zone presents undulating hills slightly sloping down to low land Plateaus having an altitude range from 600-2800 meters above sea level. According to (Engda, 2000) the surrounding of Metekel zone were a wide climatic range varied from hot to warm moist lowlands and hot to warm sub humid lowlands agro-ecological zone.

Dangur district, located 563 kms west of Addis Ababa in the Benishangul- Gumuz administrative region. Mixed agriculture was the mainstay of the livelihood of the society where crop and livestock production play integral roles. The district was situated at 11°18’ N and 36°14’ E with a total area of 838,700 hectares. It had an elevation that varies from 800 to 2000 meters above sea levels (masl) and has 70% plains, 8% valley and 22% mountainous topographic feature. The average annual low and high temperatures are 30°C and 38°C respectively and the mean annual rainfall ranges from 900 to 1400 ml (ARDODW, 2011).

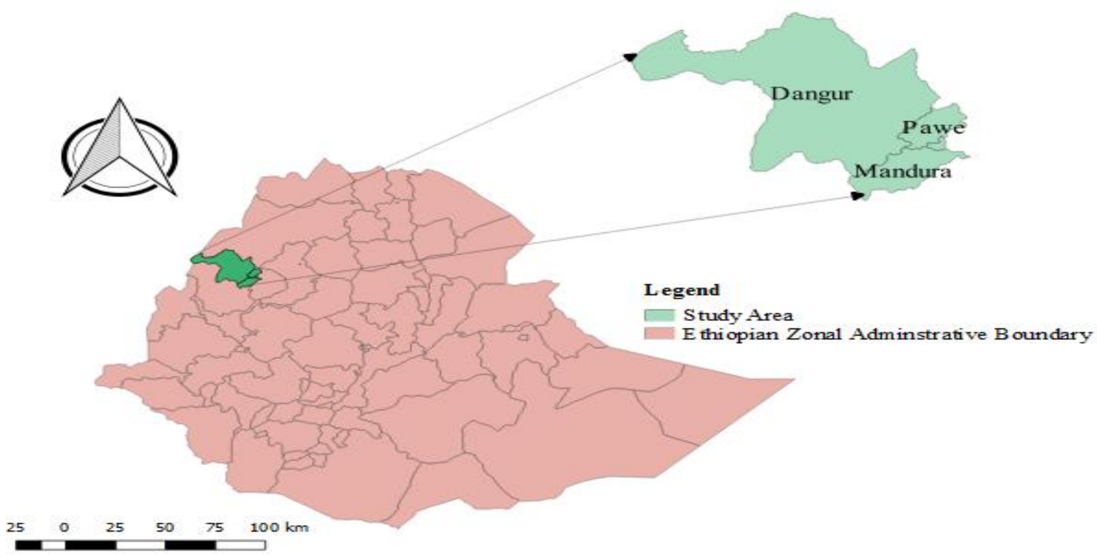
In Dangur district the study population was constituted of indigenous zebu cattle managed under smallholder mixed crop-livestock farming system. The animals were kept under traditional extensive husbandry system with communal grazing and watering points when in my supervisions. Animal population of the district consists of 25,715 cattle, 8,453 sheep, 17,993 goats, 19 horses, 78 mules, 6305 donkeys and 43,855 poultry (DWAO, 2018).

Mandura district located in Metekel zone of Benishangul Gumuz regional sate situated at 547 Kilometres North West of Addis Ababa. The mean annual rain fall in Mandura district ranges from 900- 1400 ml. The annual temperature ranges from 28-30oC. The district has altitudes ranging from 1000-1400 m. a. s.1 (Kumela, 2015).

The cattle in the Mandura district were local breeds that were kept under traditional extensive husbandry systems with communal herding. Agriculture was the main stay of the livelihood of the society with mixed farming system and livestock play an integral role for agriculture. The animal population of the district was estimated to be 24,102 cattle, 11,320 sheep, 18,212 goats, 28 mules, and 1,596 donkeys (MWAO, 2018).

The Pawe district had 20 kebeles covering an area of 64,300 hectare with human population of 42,000. It is located at latitude of 110 and 15’ 24.7’’N and, longitude of 360 and 23’10’’E. It has an altitude of 1064m above sea level. Its annual average temperature is 32^{o}C and its rainfall range is 900-1400 ml (NMSA, 2007).

In Pawi district were the livelihood of the society largely depends on mixed livestock and crop production having livestock population of 59,112 Cattle, 5502 Goat, 5613 Sheep, 964 Equines, 29,445 Poultry and 3119 beehives (PWAO, 2018).



Spatial location of study districts (Source: QGIS)

Figure 5: Map of the study districts in Metekel zone (Dangur, Mandura and Pawi) of Benishangul-Gumuz regional state Ethiopia

3.2. Study population

The study was conducted on cattle populations that were present in rural and urban area of Dangur, Mandura and Pawi districts. All the cattle sampled were local breeds kept under extensive production system.

3.3. Sample size determination

The study kebeles (peasant association) were selected by based on animal population size, whereas the study cattle were select by simple random sampling technique. The sample size for the cross sectional study was determined using the formula indicated by Thrusfield (2005) to determine the level of occurrence of ticks.

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

Where;

n= sample size

Pexp= Expected prevalence (50%)

d^2= Expected precision which is usually 5% (0.05).

$$n = \frac{(1.96)^2 \, (0.50)\,(1-0.50)}{(0.05)^2}$$

n=384 * 3 districts = 1152

Since: From 1152 sample size 1052 were examined in the cause of zone peace and security problem.

3.4. Study design and methodology

The cross-sectional study type was used to assess the adult tick species present in each of the three districts under metekel zone in Benishangul-Gumuz region during the study periods. The study Kebeles of the districts were selected based on the population size of the cattle kept in the Kebeles. From each selected Kebeles, the animals were selected by simple random sampling method. For the assessment of tick control strategies and estimation of financial losses of tick infestation study, well-organized questionnaires were delivered to 150 respondents in the three study districts. The questionnaires respondent size was determined by using mathematical model of Arsham (2005). The questionnaire size, N, can then be expressed as largest integer less than or equal to 0.325/SE2. (N=0.32/SE2), SE is standard error (considering SE of 0.0472 with 95 % coefficient interval).

3.5. Tick collection and identification

Ticks were collected from different body regions after proper physical restraining of the animals. During collection, ticks were removed manually from different attachment sites of the animal body by a rotating manner to retain their body parts for identification (Wall and Shearer, 2001).

Ticks were collected into universal bottle containing 70% ethanol from body region of each study cattle from the three study districts during study periods (Walker *et al*., 2003). Ticks were removed from the body of the cattle by using forceps. Ticks from each body regions were collected into separated, labelled sampling bottles for identification.

The ticks were taken to the Pawi Agricultural Research Centre at Pawi town then examined and identified in genera and at species level. Stereomicroscope was used to identify the ticks based on their morphological features such as mouth parts, scutum, and colour of legs, festoons, interstitial punctuations, presence or absence of adanal shields, posterior groove and marginal spots based on the taxonomic keys of (Walker *et al.,* 2003).

3.6. Data Analysis

First, collected data will enter in to the Microsoft Excel sheet, and then descriptive statistics like percentages and tables employed to summarize the data. Analysis of obtained data was done by logistic regression were used to test the association between tick infestation with different risk factors (sex, age and body condition score). For this analysis, R software was used.

4. RESULT

4.1. Prevalence and Distribution of Ticks

In the present study a total of 1052 cattle were examined for tick infestation. Out of the total, 798 were infested for one or more genera or species of tick and the overall prevalence was 75.9%. A total of 8559 adult Ixodidae ticks were collected from different body region of infested cattle. In general, four Ixodidae tick genera were identified from the study area. From identified genera's; *Rhipicephalus* (40.5%) was the most abundant and widely distributed genus followed by genus *Rh. boophilus* (31.9%) and genus *Ambylomma* (24.3%). However, *Hyalomma* (3.2%) was found to be the least abundant genera (Table 3).

Table 3: Prevalence of tick genera in the study area

Prevalence of tick genera in the study area		
Genus	**Total tick count**	**Prevalence (%)**
Ambylomma	2081	24.31
Rhipicephalus	3469	40.53
Rh. Boophilus	2734	31.94
Hyalomma	275	3.21
Total	8559	100

4.2. Tick species prevalence

Out of the four genera investigated six species of ticks were identified; the higher prevalence and the lower percentage was seen respectively i.e. *Rh. boophilus decoloratus* (31.9%), *Rhipicephalus evertsi evertsi* (27.5%), *Ambylomma variegatum* (17.5%) in *Rhipicephalus pulchellus* (12.9%), *Ambylomma lepidium* (6.7%) and *Hyalomma marginatum rufipes* (3.2%). From the three districts in Dangur *Rhipicephalus evertsi evertsi* (49.8%) and *Hyalomma marginatum rufipes* (1.7%); in Mandura *Ambylomma variegatum* (47.3%) and *Rhipicephalus pulchellus* (2.7%); in Pawi *Rh. boophilus decoloratus* (50.3%) and *Ambylomma lepidium* (2.6%) registered the higher and the lower prevalence respectively (Table 4).

Table 4: Prevalence of tick species (in three study districts)

District	*Ambylomma lepidium*	*Ambylomma variegatum*	*Rhipicephalus evertsi evertsi*	*Rhipicephalus pulchellus*	*Boophilus decoloratus*	*Hyalomma marigatum rufipes*	Total
Dangur	68 (2.3%)	102 (3.5%)	1417 (49.8%)	507 (17.8%)	699 (24.5%)	50 (1.7%)	2843
Mandura	433 (15.9%)	1289 (47.3%)	287 (10.5%)	76 (2.7%)	527 (19.3%)	111 (4%)	2723
Pawi	78 (2.6%)	111 (3.7%)	654 (21.8%)	528 (17.6%)	1508 (50.3%)	114 (3.8%)	2993
Total	579 (6.7%)	1502 (17.5%)	2358 (27.5%)	1111 (12.9%)	2734 (31.9%)	275 (3.2%)	8559 (100%)

4.3. Tick species sex compostion

Among the four genera examined six species of ticks the male ticks were more abundant than the female ticks as shown below (Table 5).

Table 5: Prevalence and sex ratio of tick species

Tick species	Total count	Male	Female	M:F ratio	Prevalence (%)
Ambylomma lepidium	579	371	208	1.78:1	6.76
Ambylomma variegatum	1502	1049	453	2.31:1	17.54
Boophilus decoloratus	2734	1899	835	2.27:1	31.94
Rhipicephalus evertsi evertsi	2358	1618	740	2.18:1	27.54
Rhipicephalus pulchellus	1111	791	320	2.47:1	12.98
Hyalomma marginatum rufipes	275	188	87	2.16:1	3.21
Total	8559	5916	2643	2.23:1	100

4.4. Distribution of tick species among predilection site

Each tick species tended to prefer a site of attachment on the animal's body. The most and the list favorable predilection site for each species was *Am. lepidium* (31.1%) brisket and (0.2%) head; *Am. Variegatum* (36.7%) udder/scrotum and (0.3%) head; *Rh. evertsi evertsi* (33.1%) udder/scrotum and (0.04%) ear; *Rh. pulchellus* (35.8%) under tail and (3.4%) dewlap; *B. decoloratus* (32.5%) dewlap and (1.8%) leg; *H. mar. rufipes* (36.7%) udder/scrotum and (0.4%) head preferred respectively (Table 6).

Table 6: Tick species distribution on different body region

Predilection site	*Am. Lepidium*	*Am. variegatum*	*Rh. evertsi evertsi*	*Rh. pulchellus*	*Bo. decoloratus*	*H. mar. Rufipes*
Head	1 (0.17%)	5 (0.32%)	-	-	-	1 (0.36%)
Ear	-	-	1 (0.04%)	-	156 (5.65%)	-
Dewlap	37 (6.43%)	55 (3.59%)	32 (1.39%)	38 (3.37%)	895 (32.45%)	25 (9.09%)
Brisket	179 (31.13%)	539 (35.25%)	-	40 (3.55%)	597 (21.64%)	54 (19.63%)
Leg		-	-	-	50 (1.81%)	-
Udder / Scrotum	135 (23.47%)	565 (36.95%)	760 (33.10%)	388 (34.45%)	-	101 (36.72%)
Ano-genital	-	-	735 (32.01%)	257 (22.82%)	-	34 (12.36%)
Under tail	171 (29.73%)	305 (19.94%)	569 (24.78%)	403 (35.79%)	471 (17.07%)	60 (21.81%)
Belly	52 (9.04%)	60 (3.92%)	199 (8.66%)	-	589 (21.35%)	-
Total	575 (100%)	1529 (100%)	2296 (100%)	1126 (100%)	2758 (100%)	275 (100%)

4.5. Prevalence of ticks in relation to host risk factors (sex, age and body condition)

From a total of 1052 cattle examined, 391(72.9%) and 407(78.9%) male and female was infested with tick, respectively. Different age groups of animals were observed for tick's infestation, highest numbers were found on old animals 551 (81.1%) while 171 (70.4%) and 76 (58.5%) were identified on adult and young, respectively. Relatively highest prevalence was recorded in good body conditioned were 327 (86.5%), medium (81%) and poor (58.3%) as shown below (Table 7).

Table 7: Prevalence of ticks in relation to host risk factors (logistic regression)

Risk factors	Category	No. of examined	No. of infested	Prevalence (%)	OR	SE	CI	P-value
Sex	Male	536	391	72.9	1.39	0.42	1.03 - 1.86	0.024
	Female	516	407	78.9				
Age	Young (<1)	130	76	58.5	1.05	0.23	1.69 – 2.69	0.000
	Adult (1-3)	243	171	70.4				
	Old (>3)	679	551	81.1				
Body condition	Good	378	327	86.5	4.64	0.22	2.97 – 7.30	0.001
	Medium	343	278	81				
	Poor	331	193	58.3				
Total		1052	798	75.9				

SE =Standard error, OR= Odds ratio, CI= Confidence interval

4.6. Prevalence of tick infestation in selected kebeles of the study districts

During the study period prevalence of tick infestation were measured in selected kebeles of the study districts. The kebeles of districts had showed statistically significant. In Dangur district Azarti Kebele (88.6%) and Gublak Kebele (59.4%), in Mandura district Genete Mariam Kebele (100%) and Daho Gubash Kebele (56.5%) and in Pawi district Kebele 30 (95.7%) and Kebele 26 (58.6%) identified higher and lower prevalence rate respectively as shown below (Table 8).

Table 8: Prevalence of tick infestation in selected kebeles of the study districts

Districts	Kebeles	Total examined	No. of infested	No. of non infested	Prevalence (%)	X^2	P – value
Dangur	Manbuk	70	59	11	84.3	23.51	0.00
	Azarti	70	62	8	88.6		
	Gitsi	70	50	20	71.4		
	Aysika	70	44	26	62.9		
	Gublak	69	41	28	59.4		
Mandura	G/Beles	70	63	7	90	58.98	0.00
	G/mariam	75	75	0	100		
	Danz Baguna	70	50	20	71.4		
	Asitsa	70	40	30	57.1		
	Daho Gubash	69	39	30	56.5		
Pawi	Almu	70	64	6	91.4	44.12	0.00
	Kebele 30	70	67	3	95.7		
	Kebele 23	70	58	12	82.9		
	Kebele 26	70	41	29	58.6		
	Kebele 49	69	45	24	65.2		

4.7. Monetary impacts of tick infestation

Monetary impacts of tick infestation were surveyed and assessed in three districts as questionnaire interview from 150 respondents in the factors as shown below (Table 9).

Table 9: Monetary impacts followed by tick infestation

Monetary/financial lost factors	**Number of respondents affected (n=150)**	**Total cost in ETB**	**Percent from the respondents were affected (%)**
Treatment cost	150	24.4	100
Production (milk) lost	81	147.5	54
Control/ Prevention cost	138	102.3	92
Marketability reduction cost	95	439	63.3
Hide lost	77	20.6	48.7

4.8. Control strategies

In the study districts there has no exercised ecological control method and less attention on the minimization of ticks on the environment rather than given treatment on the host after the tick infestation were emerged.

In my observational assessment in the study districts were acaricide treatment was commonly used in the time were tick infestation occurred. But it had limitations on the utilization of acaricide hence tick resistance to acaricides was an increasing problem and real economic threat to the livestock in the study districts.

Most livestock owners depended completely on acaricides to control ticks, but do not had access to guidelines for the application of acaricide and slow awareness to ask technicians.

5. DISCUSSION

This study revealed that ixodid ticks are widespread and most significant external parasites of cattle in the district with an overall prevalence 75.9%. The animals were infested with at least a single tick. This finding is in line with previous result reported by Meaza *et al*. (2014) with prevalence of 74% at Bahir Dar. Our results were not in agreement with lower prevalence reported by Asrate and Yalew (2012) 33.2% in and around Haramaya district eastern Ethiopia. However, higher prevalence was reported by Kemal *et al*. (2016) 93.8% in Babille district eastern Ethiopia. This variation could be due to the difference in the agro climatic condition of the study areas. Tick activity influenced by rainfall, temperature, altitude and atmospheric relative humidity and the use of acaricide and other preventive measures (Pegram *et al*., 1981).

Among the Four genera of ticks *Amblyomma*, *Rhipicephalus*, *Rh. boophilus* and *Hyalomma* identified during the study period, with a total prevalence of 24.3%, 40.5%, 31.9% and 3.2%, respectively. The genera *Rhipicephalus* and *Rh. boophilus* ticks were higher in abundance in this study (40.5% and 31.9%) than Admassu *et al*. (2015) (23.1% and 25%) respectively and according to Tamiru and Abebaw (2010) in Asella (*Rhipicephalus* 22%, *Rh. boophilus* 15.4%). *Amblyomma* tick infestation was indicated higher in study of Tamiru and Abebaw (2010) which was 60.1%.

Among the tick species, *Rh. B. decoloratus* is one of the most important cattle ticks in Ethiopia for its parasitic effect (Morel, 1980). Accordingly, it was the most abundant (31.9%) tick species that were identified in the study area. The result of the current research was also in line with Asrate and Yalew (2012) (31.5%). The higher abundance of the species reported by Kemal *et al*. (2017) in Borecha district southern Ethiopia, Alemu *et al*. (2014) in northwest Dembia district and Bossena and Abdu (2012) in and around Assosa town they reported 60.5%, 40.9% and 45% tick infestation prevalence respectively. Tick activity influenced by rainfall, temperature, altitude and atmospheric relative humidity and the use of acaricide and other preventive measures (Pegram *et al*., 1981).

Rh. evertsi evertsi was the second most abundant tick species in the present study with prevalence of (27.5%). The result of the current research was also slightly in line with that of Tadesse and Sultan (2014) 20.6% in Fitche Salale. The lower abundance reported by Alemu *et al*. (2014) 11.5% in northwest Dembia district and Hussein *et al*. (2018) 11.2% in Hetosa district east Arsi zone. The higher infestation was reported by Bossena and Abdu (2012) 45% in and around Asossa. The reason for wide distribution of this species of ticks in different parts of the country could be related with the non apparent preference for particular altitude, rainfall zones or seasons (Pegram *et al*., 1981).

Rh. pulchellus tick species was identified with the prevalence of (13%) in the study area. The Result of *Rh. pulchellus* in this study districts higher than reported by Asrate and Yalew (2012) 6.6% which could be due to the nature of this tick species that can have an ability to confine to semi arid and low land areas (Pegram *et al*., 1981).

A. variegatum was the prevalent tick species of cattle in the study area (17.5%). Similar to the study of Alemu *et al*. (2014) (13.6) northwest of Ethiopia. However, reports from different parts of Ethiopia such as Hussein *et al*. (2018) (39.3%) in Hetosa east Arsi, Nuna and Guder (2018) (29.4%) in Bako, Huruma *et al*. (2015b) (22.9%) in Sebeta indicated that *A. variegatum* as the most abundant tick species in the respective study areas. The difference in abundance could be due to the geographical location as *A. variegatum* was reported to be the highest in number in the highland and high rainfall areas. Solomon *et al*. (2001) stated that *A. variegatum* causes the greatest damage to hides and skins because of its long mouth part, which renders the commodity valueless on world market if the infestation was high. The abundance of *A. variegatum* in study area may be associated with massive damage to hides and skin.

Am. lepidum species of tick encountered during this study period (6.7%). This result in agreement with reported by Pawlos and Derese (2013) in Arbegona district southern Ethiopia with prevalence of (6.6%). In the present study, the prevalence of *A. lepidum* was high in comparison to the reports of Alemu *et al*. (2014) in northwest Ethiopia with prevalence (1.9%) and Ayana *et al*. (2013) in Borena Pastoral area with the prevalence of (1.7%). This may be associated with the differences in agro ecological factors. According to Pegram *et al*. (1981) found *A. lepidum* throughout the 500 to 2000 m altitude zone and the 250 to 1000 mm rainfall zone and rare in wetter areas. However, the present study area agro ecology was with altitude of 2060 m.a.s.l and receive 1800 to 2050 mm rain fall. Due to the agro ecology of the study area the occurrence of this species was lowered.

H. marginatum rufipes was the least abundant tick species with the prevalence of 3.2%. This result is in line with Tamiru and Abebaw (2010) 2.5% in Borena province; Hussein *et al*. (2018) 2.6% in east Arsi and lower prevalence reported by Huruma *et al*. (2015b) 0.8% in Sebeta town. The higher abundance also reported by Tadesse and Sultan (2014); Alemu *et al*. (2014) and Nuna and Guder (2018) which was 12.4%, 12.9% and 10% respectively. The low prevalence of this tick species in this study area could be due to the fact that *H. marginatum rufipes* is mostly found in arid part of tropical Africa that receive about 250 to 650 mm annual rainfall and rare in western and Central Highland of the Country. In Ethiopia altitude is often between 1000-2500 m above sea level and this makes the prevalence of this parasite to be very rare (Pegram *et al.*, 1981).

Risk factors (sex, age and body condition scores) were also involved in the variations of the prevalence of ticks in the study area. The difference in prevalence was found statistically significant ($P < 0.05$) between sex of cattle. Female animals were found more affected than males (in female 78.9% and in male it was 72.9%) with statistical significance (P-value < 0.05). This result was in agreement with Alemu *et al*., (2014) in female 81.8 and in male 80.84 in addition Asrate and Yalew (2012) in female 35.2% and in male 31.1% in contrast to those researches were not found statistically significant between sex groups. This might be due to equal opportunities of oxen and cows to tick infestation in their production as well as in their management condition or cattle rearing ways in the study area.

Age also affected the prevalence of ticks in cattle in the study area. In those age categories, young (<1) it was 58.5% while in adult (1 up to 3) 70.4% and old (>3) were 81.1%. They had statistically significance between the age groups (P-value < 0.05). Similar findings reported by Kassa and Yalew (2012) and Asrate and Yalew (2012) young (32.6%), adult (30.3%) and old (35.4%). However, Kemal *et al*. (2017) old 82%, adult 62.5% and young 55.9% reported that exist statistical significance difference in the age group. In contrast to this, study findings reported by Hussein *et al*. (2018) in young (100%), adult (71.2%)

and old (59.4%). In general, the prevalence of ticks in most of the authors indicated that very young animals are affected less than adult and old animals. This could be due to the less exposure to field grazing with other animals in the field and adults and olds are exposed due to the communal grazing habit under extensively managed.

Among the associated risk factors that were assessed in the present study, the prevalence of tick infestation varies with the body condition of the animals. The prevalence of tick infestation in the study area was significantly (P-value < 0.05) higher prevalence was seen in animals with good (86.5%), medium (81%) and poor (58.3%) body condition. According to the study by Tadesse and Sultan (2014) have reported that the proportion of tick infestation was higher in medium body conditioned 44.5% as compared to poor body conditioned 9.8% and good body conditioned animals 4.9%. This might be due to the fact that medium and good body scored animals are exposed to any kind of diseases when grazing on the field, and poor body conditioned animals were kept at home due to their inability to walk long distant areas, so they become less infested than good and medium sized animals but, the well fed animals were very resistant to any kind of diseases when they grazed in the field or are kept at home (Tadesse and Sultan, 2014).

In the current study, predilection site for attachment of different tick species show different site preferences. *Am. variegatum* (36.9%) found udder/scrotum, this result were agreed with Hussein *et al.* (2018) 60.9%; Nuna and Guder (2018) 47.2%. *Am. lepidium* found (33.1%) under tail and brisket whereas the *Rh. B. decoloratus* species were found on the dewlap (32.4%), brisket and belly and similar with Alemu *et al.* (2014) and *Rh. evertsi evertsi* (33.1%) on udder/scrotum agreed the study with Nuna and Guder (2018) (47.2%). *Rh. pulchellus* showed high preference (35.7%) to the under tail and ano-genital similar the study with Kassa and Yalew (2012) (28.7%) under tail region of the body, the mostly preferred sites were investigated in the study area.

In the study districts, there has no exercised ecological control method and less attention on the minimization of ticks on the environment rather than given treatment on the host after the tick infestation was emerged. The aim of tick control campaign is not to control all ticks simultaneously, but a definite species because of its particular role (FAO, 2004). The successful implementation of rational and sustainable tick control programmes in grazing animals is dependent upon a sound knowledge of the ecology or epidemiology of the tick as it interacts with the host in specific climatic, management and production environments (FAO, 2004).

In my observational assessment in the study districts also acaricide treatment was commonly used in the time were tick infestation occurred. But it had limitations on the utilization of acaricide hence tick resistance to acaricides was an increasing problem and real economic threat to the livestock in the study districts. Most livestock holders has depended completely on acaricides to control ticks, but do not have access to guidelines on how to make a profit from their tick control program or how to detect and resolve problems with resistance to acaricides.

In one local area of Mandura district of the study area the so called Daho Gubash used medicinal plant the so called “endod” by grinding of its leaves and attached to tick infested area of the animal’s body. According to the study of Radostits *et a*l. (2006) for the control of ticks at present is the use of chemical acaricides Individual animals can be effectively treated by the application of any one of a number of acaricides applied either as a spray or by dipping.

The amount of money that the farmer or stock holder annually losses for the purchase of chemicals and treating animals in veterinary clinics were from 150 respondents all was affected by financial losses especially in rainy season annually loosed an average of 24.4 ETB. Price or value of cattle infested with ticks in market also mattered on normal prices or reduced acceptance by buyers; the farmer loosed annually an average of 439 ETB or 63.3% of the respondent affected by the reduction especially in rainy season.

Hide losses also another losses that occurred were owners slaughtered their animals infested with ticks and the hide could be damaged with tick were sold reduced annually an average prices of 20.6 ETB or 51.3% of the respondents affected by this losses.According to the study by Abunna *et al*. (2012), hide and skin accounts for 12-16% of the value of export in Ethiopia. However, hide and skin which is emanating from East and Central African countries including Ethiopia have low value in the international market which is mainly associated with tick marks. Ticks can affect skin and hide quality through penetration of skin by piercing mouth parts makes holes which are defects in processed skin. When feeding, ticks can allow bacteria to pass through the skin leading to the development of local abscessed which damage skin quality more expensively than the hole caused by feeding (Taylor *et al*., 2007).

Ectoparasites significantly affect the quality of hide there by affecting the economy of Ethiopian farmers as well as international market. However, poor health and productivity of animal due to disease has considerably become the major stumbling block to the potential of livestock industry (Bekele *et al.,* 2011). Now a day parasitism represents a major obstacle to development and utilization of animal resource among ectoparasites which are significantly affect the quality of skins and hides (Rony *et al.,* 2010).

In the study area were decrease in production (milk) estimated annual financial losses also surveyed and annually loosed an average of 147.5 ETB or 54% of the respondents were declined their milk production since estimations done by 1 litre milk equivalent with 10 ETB in rural areas; 1 cow infested with ticks declined its milk production by half litre gap and half litre calculated with 5 ETB so days of declined milk times 5 ETB gives the result of reduction. N.B. cows with other cases of diseases were excluded. The impact of ticks on cattle milk production includes a decrease both in quantity and quality. Different reports has revealed that ticks are causing huge loss to cattle milk production conjugated with nutritional status, and poor management pattern (Duguma *et al.*, 2012). According to the study conducted Jonsson *et al*. (1998) female tick is capable of ingesting 1.0 ml blood from the cow during its parasite phase which cause the loss weight about 1 gram and thus reducing and affecting the product of milk by about 8.9 ml.

The most widely used method for the effective control of ticks is the direct application of acaricides to host animals (Sudhakar *et al*., 2013). For control and prevention of tick infestation financial losses were registered. Stock holders bought acaricide on the beginning of rainy season withstand infestation were ticks occurred and 92% of the respondents faced this lose with annually an average of 102.3 ETB. According to the study of Minjauw and McLeod (2003) most tick borne diseases, early treatment is essential. However, this is seldom possible because the first signs of infection are often rarely perceptible and farmers rarely undertake a thorough daily examination of their animals.

Generally tick infestation in farmers (stock holders) was a matter financial loosed through treatment price, prices for control and prevention, reduced the power of drafting oxen next to declined production and productivity and marketability in the study districts.

6. CONCLUTION AND RECOMMENDATION

This study showed high burden of ticks in the area with an overall prevalence of 75.9%. The most important and abundant tick species were *Rh. B. decoloratus, A. lepidium, A. variegatum, Rh. evertsi evertsi.* The predilection sites identified for the tick species will help in designing tick control methods.

The study indicated that there was high burden of ticks in the area. However, the attention given to control the infestation had not been sufficient. Acaricide application is the main method of tick control in the study area.

The present study revealed high prevalence of ixodid tick infestation in the study area. These pose huge economical and health constraint to the farmers and the animals in the study area.

Tick should be managed at an economically (financially) acceptable level by a combination of techniques and this requires knowledge of the tick species prevalence and an understanding of their epidemiology. Because there is no single method that would guarantee completes control of ticks.

This encompasses the selection of tick resistant cattle, acaricide treatment, appropriate livestock management, evaluation and incorporation of traditional practices or remedies that appear to be of value.

Effective tick control program should be formulated and implemented based on the distribution pattern of ticks and factors responsible for their distribution. In light of the above conclusion the following recommendations are forwarded:

- The owners should be supervise their cattle especially in the beginning and in the time of rainy season and provide appropriate treatment.
- To overcome the problems owner should be using pasture management, the right dosage and application of acaricides and rearing resistance breeds should be practiced in the combination with agricultural research institutions.
- The study areas were very large and will need future studies especially in each district to know the burden of ticks and tick borne disease.
- Government should provide intervention and research to develop long lasting prevention and control strategies to get rid of the ticks.

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8. ANNEX

Annex 1: Identified tick species in the study area

Tick species	Examined Species
Rhipicephalus pulchellus	 
Rhipicephalus evertsi evertsi	 
Hyalomma marginatum rufipes	 
Amblyomma variegatum	 
Boophilus decoloratus	 
Amblyomma lepidium	

Annex 2: Questionnaire format

ADDIS ABABA UNIVERSITY
COLLEGE OF VETERINARY MEDICINE AND AGRICULTURE
SCHOOL OF POSTGRADUATE STUDIES

Questionnaire survey on infestation of tick on cattle and the consequences of economic impacts

I. Back ground information

Name of the respondent ___________________________Family size________

District __________ Kebele ___________

Date of the interview______________________________

II. Specific information

1. Are you a livestock farmer?

A. Yes B. No

2. If yes, please specify how many animals do you have under the following groups of cattle?

Group of animals	Oxen	Lactating cows	Dry cows	Bull	Heifer	Calves
Flock/herd size						

3. Is there any problem related to tick infestation of cattle in your locality?

A. Yes A. No

4. In which groups of cattle the problem is more serious?

A. Calves C. Male

B. Adults D. Female

5. In which season of the year the problem is more sever?

A. Summer C. Autumn

B. Winter D. Spring

6. Would you please tell us the amount of money that you annually lose for the purchase of chemicals and treating the animals at veterinary clinics; to control and prevent the problem of tick in cattle? ___________________(in ETB)
7. Are the chemicals used in the form of spraying or treatment given at veterinary clinics effective in treating cattle infested with tick?
   A. Yes B. No
8. Do you know any medicinal plant used in the treatment of tick infestation in your area?
   A. Yes B. No
9. If yes, please specify? ____
   ____
10. Do you know any disease of cattle transmitted by ticks?
   A. Yes B. No
11. If yes, please specify?
   ____
   ____
12. Price/value of cattle infested with ticks:

12.1. Marketability (annually) _____________________________ ETB

13. Financial loss associated with tick infestation

13.1. Hide loss (annually)___________________________ ETB

13.2. Loss due to death of cattle with tick paralysis (annually)____________ ETB

13.3. Financial loss due to control and prevention of disease transmitted with tick (annual)_________________ ETB

13.4. Decrease in production and productivity (estimated annual financial loss) ______________ ETB

Thank you for your time and patience!

Annex 3: Data collection and identification format

3.1. Sample collection format

S/No.	Date	District	Kebele	Breed	Sex	Age	BCS	ID
1								
2								
3								

3.2. Tick predilection site format

S/No	Date	District	Kebele	ID	Body regions							
					Head	Ear	Dewlap	Brisket	Leg	Udder / Scrotum	Ano-genital	Under tail
1												
2												
3												

3.3. Morphological features during identification

Tick ID	Mouth part	Bases capituli	Ornamentation	Festoons	Eyes	Scutum	Anal groove	Ventral shield
1								
2								
3								

Annex 4: Pictures taken during sample collection