ADDIS ABABA UNIVERSITY
FACULTY OF VETERINARY MEDICINE

STUDIES ON THE COMPARATIVE PREVALENCE OF ECTOPARASITES IN SMALL RUMINATS IN THREE SELECTED AGRO-ECOLOGICAL AREAS OF NORTH WEST SHOA ZONE OF OROMIA REGION, ETHIOPIA

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A thesis submitted to the school of Graduate studies of Addis Ababa University in Partial fulfillment of the requirements for the Degree of Master of Science in Tropical Veterinary Parasitology

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AAU	Addis Ababa University
ANOVA	Analysis of Variance
CSA	Central Statistical Authority
DVM	Doctor of Veterinary Medicine
ESAP	Ethiopian Society for Animal Production
EVA	Ethiopian Veterinary Association
FAO	Food and Agricultural Organization
FVM	Faculty of Veterinary Medicine
GDP	Gross Domestic Product
ILCA	International Livestock Center for Africa
KOH	Potassium Hydroxide
MSc	Master of Social Science
OIE	Organization International de Epizootic
PAs	Peasant association
SPSS	Statistical Programme for Social Sciences
UK	United Kingdom
USA	United States of America
USD	United States Dollar

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ABSTRACT

The study was carried out from October 2007 to April 2008 in three selected agro ecological areas of North West Shoa zones of Oromia region. The objectives of this study were to determine the prevalence and intensity of ectoparasites on sheep and goats in the three agroecological zones in two seasons. Clinical examination was conducted for the presence of sheep keds, ticks, lice, fleas and mange mites from the animals. Out of 1636 sheep and 387 goats examined, 72.3% of sheep and 75.1% of goats were found to be positive with one or more ectoparasites. The major ectoparasites identified on sheep were *Mellophagus ovinus, Bovicola ovis, Rhipicephalus e.evertsi* and other species of with low prevalence. In goats, immature *Amblyomma* species, *Mellophagus ovinus, Linognathus stenopsis* are the major prevalent ectoparasites and other parasites of low prevalence. Regarding intensity of infestation, in sheep the relative abundance of *Mellophagus ovinus* was highest followed by immature *Amblyomma spp.* and *Bovicola ovis.* Other species with less intensity were *A. variegatum, B.decoloratus, R. e. evertsi, R. praetexatus, R. pravus, R. sanguineus, R. spp., H. truncatum, H. m. rufipes, L. stenopsis, L. africanus, L. pedalis* and *Ctenocephalides sp,* in decreasing order of abundance. In goats, the most abundant ectoparasite was found to be immature *Amblyomma spp.*, followed by *Mellophagus ovinus.* The prevalence of sheep ked among the agro ecologies showed significant difference between highland and lowland (OR= 0.640, P<0.01), but there was no significant difference (P> 0.05) between highland and midland agro-ecologies. Regarding lice, there was significant difference between highland and midland agro ecologies (OR= 0.589, P<0.01), but no significant difference was observed between highland and lowland areas. There was significant difference in prevalence of tick infestation in sheep between highland and lowland (OR= 1.60, P=0.001). The prevalence of flea infestation in sheep was not significantly different (P> 0.05) among the agroecologies. The prevalence of sheep ked, ticks, lice and fleas showed significant difference between late wet and early dry seasons (OR= 1.862, 0.387, 1.800 & 0.458 P< 0.05). Likewise, the effect of age on the prevalence of the ectoparasites showed that significant difference was obtained between adult and lamb in all the four ectoparasites. With respect to sex, significant difference only in prevalence of fleas infestation was shown between males and females (OR= 0.409, P<0.05). In highland and midland agroecological zones, *Mellophagus ovinus* was the dominant species in sheep and goats, followed by *Bovicola ovis* while in lowland, *Amblyomma spp.* was the dominant species both in sheep and goats, followed by *M. ovinus.*

No *B. ovis* was recorded from goats of any of the agroecological zones. *Amblyomma variegatum* was found to be of least abundance in highland sheep. In midland sheep, *Hyalomma m. rufipes* was found to be of least abundance while in midland goats, *Ctenocephalides s pp.* was the least abundant species found. *L inognathus africanus* and *Rhipicephalus sanguineus* were the least abundant species in lowland sheep. In goats *H. truncatum* and *Rhipicephalus spp.* were the least abundant ectoparasite species. During early dry season, sheep ked count in sheep was significantly higher in highland areas than midland and lowland ($P< 0.05$). Regarding tick count, midland and lowland areas had significantly ($P< 0.05$) higher number than highland but no significant difference was found between mid- and lowland ($P> 0.05$). Lice infestation was significantly higher in highland than that of midland and lowland ($P< 0.05$). No significant difference was observed in flea infestation between the three agroecological zones. The overall findings of the current study indicate the need of strategic ectoparasite control programme in the study area.

Key words: ectoparasites, prevalence, burden, Oromia region, Ethiopa, agroecology, Sheep and goats

1. INTRODUCTION

Sheep and goats are the first animals to be domesticated and have continued to provide various functions to man. Special features of small ruminants which favour their production includes their greater resistance to drought, short reproduction cycle, low unit costs and ease of handling and husbandry (Charry et al.,1992). Both sheep and goats are multipurpose animals producing meat, milk, skin, wool or hair, horns, bones and manure (Peacok, 2005, Zygoyiannis, 2006).

Statistics on sheep and goats although not always reliable, as they are frequently based on estimates rather than actual census, indicate that there were about 1024 million sheep and 768 million goats worldwide (Zygoyiannis, 2006). Sheep form a critical component of most livestock production systems in every continent.

Ethiopia is one of the African nations rich in their livestock resources. Current estimate of Ethiopian livestock population indicates that the country owns 27.6 million sheep and 23.3 million goats, which are raised in different agro-ecological regions of the country (CSA, 2004). The highlands support about 75% of sheep and 27% of goats, while the lowlands (mostly pastoral areas) are inhabited by about 25% of sheep and 73% of goats. Small ruminants are produced by farmers under extensive management system or in adjunct to crop production. In the central highlands of Ethiopia where mixed crop livestock production system is practiced, small ruminants accounted for 40% of cash income and 19% of the housed meat consumption (Zelalem and Fletcher, 1993). Although sheep and goats industry is in its infancy, most of sheep and goats kept by small holder farms were important sources of meat, milk, cash, hair wool, skin and live export animals (Kassahun and Getachew, 1996). These ruminants and their products are important export commodities contributing to the national economy in addition to supporting the livelihood of millions of pastoral people. Owing to their high fertility, short generation interval and adaptation even in harsh environments, sheep and goats are considered as investments and insurances to provide income to purchase food during seasons of crop failure and to meet seasonal purchases such as improved seed, fertilizers and medicine for rural households. Even though small ruminants are important components of Ethiopian farming system, productivity is still low and their contribution to food production are far below the

expected potential compared to other countries. This is because small ruminant production in Ethiopia is constrained by the compound effects to prevailing diseases, inadequate nutrition and poor management (Gashaw, 1986). Direct and indirect losses occur through mortalities, reduced weight gain, poor reproductive performance and condemnation of diseased organs at the abattoirs (Tembly, 1997).

Ethiopia's economy is based on agriculture that accounts for 85% of the total employment and 75% of export (Zewdu, 1995). The country's Gross Domestic Product (GDP) was US$ 6.6 billion in 2003 with an annual growth rate of 2.7% and in the same year agriculture accounted for 42% of GDP and livestock sub-sector contributed 12-16 % of the total and 30-35 % of agricultural GDP. Livestock was the second major source of earning of foreign currency through export of live animals, skins and hides (Ayele et al., 2003; FAO, 2005). In addition to their contribution to food production providing 35% of meat consumption and 14% of milk consumption (Asfaw, 1997), sheep and goat skin and live animals are the second leading export items next to coffee in Ethiopia (Gizaw, 1987). Skin from goats and sheep has been important economic products contributing for the largest share to the total and agricultural export commodities (OIE, 1997). This fact gives the advantage of earning a large foreign currency from the export of hides and skins. About one million hides and nine million skins are processed every year in more than twenty tanneries in different parts of the country. However, about 50% of the sheep skins processed are rejected because of cockle or in Amharic "Ekek" (Bayu et al.,1998) is an allergic dermatitis caused by lice and keds and is characterized by discoloration of the skin or formation of small nodules on the dermis, which are about 0.5 to 5 mm in diameter. These nodules may rupture and leaves scars when they heal. Both these scars and the discolorations formed due to the allergy do not take dyes during tanning, which cause rejection of the leather products.

Among the various types of parasites of sheep and goats, ectoparasites are known to cause animal morbidity, loss in productivity and reduction in reproductive performance. Information about ectoparasites that exist in sheep and goat flocks is always necessary. Because the presence of different types of ectoparsites in different geographical specifications, the study of small ruminant ectoparasits is important, not only for livestock but also for humans, since fleas, mites and ticks also parasitize humans, especially those who work in close contact with the affected animals (Zarif-Fard and Goudari, 2000).

External parasites are the major causes of skin diseases that hamper small ruminant production in many areas of Ethiopia. Among these, lice, keds, mange and ticks are the major causes of skin disease (Tefera, 2004). Of these *Bovicola ovis* and *Mellophagus ovinus* in sheep and goats are reported to be the most serious causes of skin diseases of small ruminants affecting their productivity and quality of skins (Habte, 1994). Skin diseases are among the major diseases of small ruminants causing serious economic loss to small holder farmers, the tanning industry and the country as a whole. Skin disease causes decreased production and reproduction and downgrading and rejection of skins. Currently skin disease caused by lice, keds and mange are affecting the tanning industry very seriously causing enormous downgrading and rejection of skin and hides. According to tanneries report, skin diseases due to external parasites cause 35% sheep skin and 56% goats skin rejection (Bayou, 1998).

The study of the parasites of sheep and goats to identify ectoparasite species and determine their prevalence in a given agro-ecological area is pertinent because the findings could be used to make objective decisions on control strategies. The findings could also help in devising strategies to meet the current shortage of meat and milk created by the rapidly increasing human population.

In view of this, the main objective of this study was to contribute to knowledge of the distribution and abundance of the most common sheep and goat ectoparasites in North West Shoa area.

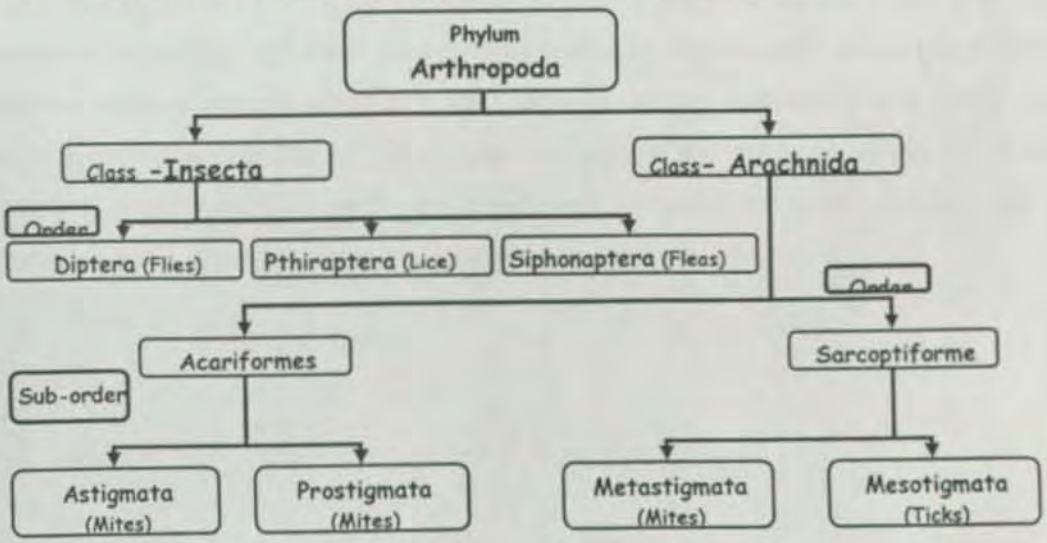
The specific objectives of this study were,

1. To determine the prevalence of ectoparsites affecting sheep and goats in three selected agro-ecological areas of North West Shoa zone of Oromia region.
2. To provide baseline data of infestation in two different seasons during late rainy season and early dry season.
3. To compare the magnitude of ectoparasites infestation between the two hosts, sexes, and ages.

2. LITERATURE REVIEW

Arthropods contain over 80% of all known animal species and occupy almost every known habitat, representing extremely diverse group that exhibit extensive morphological differences (Bay and Harris, 1988). The economically important arthropods belong to two major groups: Class Insecta that comprise flies, lice and fleas and Class Arachnida that comprise ticks and mites (Solusby, 1982). The general life cycle of insects (Flies and fleas) comprised different stages called instars. After mating , adult female flies lay eggs which hatch to larvae, such the maggots of flies, of which there may be several stages before formation of pupae from which the adult flies eventually emerge (Hunter,1994). However, flesh flies lay nearly hatched first instar larvae whereas first flies, tsetse flies and sheep keds lay larvae almost ready to puparate which larviposited. In the case of lice, the female lays eggs on the host, the nymphs hatch from the eggs and moult through 3-5 stages, eventually moulting to become asexually mature adult (Wall and Shearer, 1997). Like insects, adult ticks and mites (acarines) lay eggs that hatch to larvae, which resemble small adults except that they have only three pairs of eggs. Larvae moult to nymphs that have four pairs of legs, and these in turn moult to adults (Hunter, 1994). Arthropod ectoparasites live on, pucture, or burrow into the surface of their host's epidermis, to feed or shelter. As a result, there may be direct damage to skin and other sub-cutaneus tissues. Moreover, the presence of burrowing ectoparasites and their salivary and faecal antigens can stimulate immune responses, in some individuals leading to hypersensitivity (Berriatum et al., 2001).

General classification of Arthropod parasites (Wall and Shearer, 1997) :



2.1. Ectoparasite Host Relationship

The presense of external parasites on the host is termed as infestation. The association between arthropod ectoparasite and vertebrate hosts may take on variety of forms. In some cases the parasite may feed, only occasionally on the host, without being dependant on it (Wall and Shearer, 1997). The host provides a number of important resources for the parasite, most vitally, the host supplies a source of food, which may be blood, lymph, tear or sweat or the debris of the skin, hair of feather. The host's body also provides the environment on which ectoparasites live, generating warmth, moisture and within the skin or hair a degree of protection from the external environment. The host may also provide transportation from place to place for the parasite, a site at which to mate and, in many cases, the means of transmission from host to host (Wall and Shearer, 1997).

Despite a benefit of a close association with the host, there is a considerable variation in the amount of time spend on the host by various types of ectoparasits. Some ectoparasites such as lice live in continuous association with their host throughout their life cycle and are therefore, highly dependant on the host. The majority of ectoparsites , however, have only intermittent contact with their hosts, and are freelivig for the major portion of their lifecycles (Soulsby, 1982) . In some cases, ectoparasites, such as mites, are highly host specific; only one host species is exploited and in some instances, the parasite can exist only on one defined area of the host. Other species are able to exploit a wider range of host (Wall and Shearer, 1997).

According to Soulsby (1982), the life cycles of most of the parasites are direct. Their eggs require high humidity and warm temperatures to develop into infective larvae (third instar). Animals become infected when they are feeding or resting, particularly in a herds. The fairly common occurrence of these parasites indicate the potential means of clinical infection when conditions such as warmth and adequate moisture combine, and in particular, when animals are overcrowded in unhygienic conditions.

2.2. Occurrence and mode of spread of ectoparasites

The spread of mange, sheep ked and lice is usually by close contact between clean and infested animals. Sarcoptic mange is highly contagious thus single cases are rarly seen in groups of animals kept together. The movement of keds from ewes to lambs is an important route of infestation (Wall and shearer, 1997). Infestation with mites and lice may also occur by indirect transfer, since the mites and lice have been shown to be capable of surviving off the host. Inert materials such as bedding, blanket, grooming tool and clothing may act as carriers. The foot louse of sheep may gain infestation from the pasture (Radostitis et al., 1994).

Factors that influence the occurrence of the effect of arthropods can be classified into two groups: those controlling the prevalence of arthropods and those determining the susceptibility of the hosts (Soulsby, 1982). The prevalence of parasitic arthropods is largely influenced by season for they are adapted to definite ranges of temperature and humidity. Flies breed and are active in the warmer and humid months of the year in temperate regions, and the rainy season in tropical and sub tropical regions. Studies on myasis of sheep and goats in North Sinegal showed that sheep were more infested with wound myasis than goats. In temperate areas, the overall infestation rate of flies was high in summer, followed by spring than autumn and the least rate of infestation was in winter The incidence of blowfly strike varies widely depending largely on the climate; warm humid weather being most conductive to a high incidence. The flies are more attracted to sheep that have undergone prolonged wetting so that bacterial decomposition of the skin can occur (Radostitis et al., 1994). Local factors such as marshy areas may provide conditions suitable for flies to breed the year round (Hunter, 1994).

In the case of ticks, the relative humidity and air temperature are also main factors that influence tick activity. In temperate climate, tick activity is usually confined to the period between spring and autumn where there is sufficient rainfall and warm temperature. In tropical and sub tropical climates, tick activity and reproduction is greatest during the rainy season although different species have different microclimate requirements (Hunter, 1994). Likewise, the levels of infestation of permanent ectoparasites such as mites, lice and sheep keds show seasonal periodicity. However, in contrast to flies and ticks, heavy infestation usually occur in the moist and cool temperature of winter months and decline in the dry

and hot conditions of summer. *Psoroptic mites* take refuge in protected sites such as the axilla, eyes, ears, or even folds in the skin (Radostitis et al., 1994).

In addition to season and climate, those factors affecting the susceptibility of the host play role in determining the effect of arthropod parasites. Sheep and goats that are housed during cold, that are in poor condition, those affected with debilitating diseases, overcrowded and poorly fed, are usually affected with mites, lice and sheep keds. Long fleeced sheep breed are prone to infestation by sheep ked and lice whereas shearing reduces their population (Radostitis et al., 1994, Wall and shearer, 1997).

2.3. Importance and impact of arthropod parasites

Arthropods are important because they may serve as mechanical and biological vectors for various pathogens such as protozoa, bacteria, viruses, cestodes and nematodes that produce disease (Bay and Harris, 1988) and may produce venoms and other substances that are toxic to domesticated or wild animals, or human (Hedex, 1998). The presence of ectoparasites affect the livestock economy in terms of production, productivity, and skin quality and through labour and materials applied to minimize the direct effects (Tembly, 1997).

The direct and indirect losses due to ectoparasites include (Wall and Shearer, 1997, Nari and Hansen 1999):

Blood loss: although each individual ectoparasite only removes a small volume of blood from a host, in large numbers the blood removed by feeding may be directly debilitating and anemia is common in heavily infested hosts. In one study in USA over 90 kg of blood was estimated to have been removed by ticks from a cow over a single season.

Myiasis: the infestation of the living tissue with larvae causes direct damage to carcases or skin.

Skin inflammation and pruritus: various ectoparasite infestations cause pruritus, often accompanied by hair and wool loos (alopesia) and occasionally by skin thickening (lichenification). The presense of ectoparsite on or in burrowing in to the skin can also stimulate inflammation.

Toxic and allergic responses: caused by antigen and anticoagulant in the saliva of blood feeding arthropod.

Disturbance: the irritation caused, particularly by flies as they attempt feed or oviposit, commonly result in a variety of behaviour such as head shaking stamping skin twitching, tail switching or scratching. These activities may result in reduced growth and loss of conditions because the time spent in avoidance behaviours in lost from grazing or resting.

Self wounding: The activities of particular ectoparasites, such as warble flies, may cause dramatic avoidance responses in the intended host, known as gadding. The madly panicking animals may cause serious self-injuries following collision with fence and other objects.

Immunosuppression: due to infestation, the immune response of the animal may be weakened which further leads to increased susceptibility to other diseases

Social n uisance: large number of flies may breed in animal dung, particularly in and around intensive husbandry units. The activities of flies may cause considerable social problem. Adult flies and their feces may also decrease the esthetic appearance and values of farm facilities and produce, such as hens, eggs, and cause irritation and annoyance to employees.

2.3.1. Effect on production

Arthropods pose a threat to the rearing of small ruminants directly through their pathogenic effect and reported cause on severe morbidity. Those influencing production include lower market value due to slaughterhouse condemnations, reduced drought power, reduced dung output for fuel and fertilizer and reduced efficiency in food conversion . It is considered that sarcoptic mange adversely affects the production of the infested animals (Fthenakis et al, 2000). Barbary sheep population around Ammotragus Leria of the Seirra Espana Regional park (Murcia, Spain) suffered on outbreak of *sarcoptic mange* between 1991-1995, which contributed to a population decrease of 855 (Gonzales-Candela et al,2004).

In Ethiopia, there are few studies that indicated the importance of ectoparasites in relation with sheep and goat mortalities. Bayou (2000) reported the death of two of the treated and untreated goats of the mange in 32 experimentally infested goats. Based on a study done in shinelle zone, the morbidity and mortality rates due to mange mite and tick borne diseases in small ruminants is reported to be 58.4% and 38.7% and 28.7% and 11.6% respectively (Tafesse et al., 2003). Mange of sheep and goats was estimated to have killed about 60% of the diseased small ruminants stock (69.3% of sheep and 57.3% of goats) in one years times in Amhara region (Demisse et al., 2000).

2.3.2. Effect on productivity

A number of studies have documented that arthropod parasites of small ruminants seriously affect body weight gain, meat, milk, and wool/hair and skin production. In a study involving sheep that were infested by *Damalinia ovis* and *mellophagus ovinus* and treated with insecticides or sharing demonstrated more body weight gain (1.8 - 3.3 kg) in three months trial period than infested control group which gained only 0.9kg (Bayou et al.,1998). In another similar study involving goats infested with sarcoptic mange, most of the treated goats increased body weight gain while untreated goats that died of sarcoptic mange showed loss of body weight (Bayou, 2002). A study on lambs infested with sarcoptic mange also reported that infested lambs showed weight loss, when treated with moxidectin had up to 15% greater final weight and up to 23.7% more weight gain than infested controls (Fthenakis et al., 2000). Moreover, ewes treated with Moxidectin produced up to 24% more milk than *sarcoptic mange* infested ones (Fthenakis et al., 2000). Furthermore, ked free ewe produced 11% more wool than infested ewes (Nelson and Slen, 2004). The available information indicates that in New Zealand, the principal effect of lice is to decrease the washed yield and quality of the fleece (Heath, 1995b). Infestation with sheep ked leads to a vertical ringing of the skin (cockle).

In Ethiopia the goat skin defect known as "Ekek" is reported to be the most prevalent and responsible for huge losses incurred in tanneries. (Abddulhamid, 2001, Bayou et al., 1998, Tefera and Abebe, 2006b, Yeshak, 2000). In sheep treated with insecticides or sharing had better skin quality with skin grade of 2 - 3.3 in three months trial period and all the skins of infested group with *mellophgus ovinus* and *Damalinia ovis* were graded as rejects (skin grade of 5.5 - 6.3) because of "Ekek" (Bayou et al, 1998). Goats that died of *sarcoptic*

mange had bad skin quality while most of the treated ones had better skin quality (Bayou, 2002). The annual loss due to "Ekek" in Kombolcha and Dessie tanneries is estimated to be around 1.6 million for pickled sheeppelts and about 0.6 million for wet blue goatpelts (Tefera 2004, Yeshak, 2000). Infection by *Psoroptes ovis* also has effects on productivity. A study to determine the effect of *Psoroptes ovis* on the weight of sheep showed about 30% weight loss between control and infected lambs, which in a flock constitutes a considerable loss (Kirkwood, 1986).

2.4. Distribution and prevalence of ectoparasites of small ruminants in Ethiopia

In Ethiopia, a number of studies have reported on the distribution and prevalence of arthropod parasites of sheep and goats in different areas. In the Northern and Eastern part of the country, small ruminants were reported to be seriously affected with ectoparasites, from the ticks genera at species level *Amblyomma variegatum*, *Amblyomma cohaerans*, *Boophilus decoloratus*, *Rhipicephalus pulchellus* and *Ripicephalus evertsi evertsi* were reported to be the most abundant and widely distributed tick species (Teshome,2002, Numery,2001, Mekuria,1987 ,). The prevalence of sheep ked infestations has been reported in Northest Ethiopia (Tefera and Abebe,,2006a).It was more prevalent in the highlands of Ethiopia than in lowlands (Asegedech et al.,1999). Sarcoptes *spp.*, *psoroptes spp.* and *Demodex spp.* are common among goats. *Sarcoptes spp.* and *Psoroptes spp.* cause higher levels of infestations (Abdulhamid, 2001; Ashine 1987; Kebede, 1994; Musema, 2002; Tefera and Abebe 2006a). The studies have indicated that the occurrence and spread of skin diseases have been shown to collate with host factors, poor management ,climate factors, feed scarcity and inadequate veterinary services (Gashaw, 2002; Hafifize, 2001; Numery, 2001; Mulu, 2002; Kedir, 2002; Teshome, 2002; Tefera ,2004).

Some of the ectoparasites that are of veterinary and economic importance in small ruminants are discussed below:

2.4.1. *Mellophagus ovinus*

The sheep ked, *Mellophagus ovinus,* is a member of the parasitic Dipteran family Hippoboscidae. It is a wingless, gairly, leathery insect, 4-6mm long. The head is short, broad and not freely movable; the thorax is brown and the broad abdomen grayish-brown.

The legs are strong and armed with stout claws (Soulsby, 1982), Adult keds are permanent ectoparasites and feed on the blood of sheep which also parasitize goats (Maming and Scott, 1985).

Sheep ked was a widespread ectoparasite of sheep that was of veterinary importance until the introduction of effective pesticides. Since then, it has become of less concern and may have become a relatively uncommon species through much of its former range. Changes in agricultural practice, both greater intensification and development of more extensive system (including organic farming and conservation grazing) may allow resurgence and a review of existing knowledge of *Mellophagus ovinus*.(Heath,1995b)

Life cycle

The female hatches its larva to the wool of the sheep by means of a sticky substance. Parturition lasts a few minutes. The larva is immobile and soon turns into a chestnut brown pupa. It is ovoid in shape with broad ends and 3-4mm long .The pupal stage lasts 19-23 days in summer to 36 days in winter, or even longer if the sheep are exposed to very cold conditions. The keds live 4-5 months on a sheep. Copulation occurs 3-4 days after emergence of the adult and each gestation lasts about 10-12 days. A female may produce ten to fifteen larvae .engorged females can live up to 8 days on the host. Pupae removed from the sheep for instance at shearing, can hatch if conditions are favorable. The entire life is spent amongst the wool of their hosts during direct contact between sheep. Such transfer is more likely during periods of higher ambient temperature when adult keds move to the fleece surface (Evans, 1950). They usually spread from sheep to sheep by contact and are most numerous in the autumn and winter (Radostitis, et al., 1994).

Geographical distribution

Mellophagus ovinus is a palearcitic parasite species that has been widely distributed through human movement of sheep. For example it has been recovered from Viking-age deposits in Greenland (Sadler, 1990). *M. ovinus* is now established in most temperate sheep rearing areas including Europe, North America South Africa and Australia but is restricted to higher altitudes in the tropics. The parasite is mainly seen in colder and wetter areas and infestation may be lost when sheep are moved to hot dry areas. keds are most active in cooler months and are common on coarse rather than fine woolen breeds. Sheep

in poor condition suffer most from infestation and goat may also be infested. Resistance is aquired in time and resistant sheep grow better and produce more wool. Keds dislodged from the host can live for up to 2 weeks in mild moist condition but most die in 3-4 days and probably do not play a part in re-infestation of sheep (Radostitis et al., 1994).

Mellophagus ovinus is the most important ectoparasite observed in sheep (Asegedech et al., 1999). The prevalence of sheep ked infestation has been reported to be 12.5% in Northeast Ethiopia (Tefera and Abebe, 2006a). It was more prevalent in the highlands of Ethiopia than in midlands and no cases has been recorded in lowlands (Asegedech et al., 1999). From fresh sheep pelt examined at Sbeta tannery showed that 32.7% had *M. ovinus* Ermias (2000).

The spread of sheep keds is mainly through contact and movement of keds from ewe to lamb is an important route of infestation (Wall and Shearer, 1997). The predilection sites of infestation are the neck, around the tail, shoulder, back and ventral part of the body (Urquart et al., 1996; White, 1998). *M. ovinus* has strong legs provided with claws and is permanent ectoparsite. The irritation caused by sheep ked result in biting and rubbing that can damage the skin The parasite lives in the wool of the sheep and suck blood. Heavy infestations can reduce the condition of the host considerably and even cause anemia. They produce intense irritation, causing the sheep to bite, rub and scratch itself, thus damaging the wool. The feces of the keds produce stains in the wool which do not wash out readily (Urquart et al., 1996).

Economic and veterinary importance

The feeding of keds cause a wide spread priorities, exacerbated by the rubbing, scraching and biting of the hosts in response to the irritation in young lambs, loss of blood to keds may be sufficient to cause a patent anemia, with consequent reduction of growth rate and production. For example Bouman,1995 recorded higher body weight in control Merino sheep compared to infested sheep, although the difference was not significant, narrow and eventually reversed.

Keds serve as the mechanical vectors of *Anaplasma ovis* and *Orbivirus,* responsible for the blue- tongue disease, a serious condition that cause 70% mortality in sheep and weight and

wool loss, abortion and congenital abnormalities in the survivors (Mathieson, 1991). Recently, some species of keds (*L. cervi* and *H. equina)* have been identified as possible of the bacterial genus *Bartonella* (Halos et al., 2004). They also are biological vectors of *Trypanosoma melophagium* which is a harmless blood parasite of the sheep (Mathieson, 1991).

2.4.2. Lice

Lice are small, wingless insects, dorsoventrally flattned, with stout legs and claws for clinging tightly to fur, hair and feathers. They spend their entire lives on their host animal and are generally highly host specific, many species even preferring specific sites on their host's body, only leaving their host to transfer to a new one. They feed on epidermal tissue debris, parts of feather, sebaceous secretions and blood (Wall and Shearer,1997).

There are two kinds of lice, represented by the suborder Anoplura, or blood sucking lice and Mallophaga, or Chewing lice (Soulsby, 1982). The Anoplura have pirercing parts consisting of three stylets that, in fixed specimens, are usually concealed with in the relatively narrow head (Urquart, 1987), which enable the lice to reach body fluids such as blood and drive nutrients they require. These processes may also involve the injection of anti-coagulant secretions which cause local irritation. The Anoplura are exclusive to mammals on the other hand, Mallophaga have mouth parts adopted specifically for chewing the epithelial debris of the skin, epidermal scales, feathers, and sebaceous secretions of birds and mammals. The Mallophaga are found in greatest variety on birds and are often called "bird lice", but some of them are very common on livestock such as sheep and cattle (Urquhart,1987).

Life cycle

Mature adult female lice generally deposit one to two eggs per day, cementing them firmly to individual hairs or feathers. Nymphs hatch from the eggs and then feed and moult through three to five stages, eventually moulting to become a sexually mature adult. The entire egg to adult life cycle can be completed in as little as 4-6 weeks. In the case of *Bovicola ovis*, the females lay eggs singly at the rate of approximately 1 year two to three days. Eggs hatch after 10 days. There are three nymphal stages and adult females

commence egg-laying 24-25 days after hatching. In suitable conditions, lice survive 30 to 60 days on sheep, and possibly some survive up to 5 months. (Urquhart, 1987).

Lice species

There are five types of lice which infest sheep and goats:

Linoghnathus africanus: This is 2.5cm long, blue-gray louse that sucks blood. It is mainly found on the face, head and neck, but in heavily infested sheep it can be seen all over the body. In summer the population decreases, and during the winter months there is an increase, with a population peak in the early spring (Asp, 1988).

Linognathus pedalis: The "Foot Louse" inhibits the lower regions of the hind limbs from the feet to below the hooves, and where there is a great fluctuations in temperature and a way from the hosts body for more than a day or two and is available on pasture for about a week (Urquhart, 1987).

Linognathus ovillus: "The face-louse" It occurs on the face and ears spreading from there to cheeks, neck and body (Soulsby, 1982; Urquhart, 1987).

Linognathus Stenopsis: "The sucking-louse" which is common in goats, is more pathogenic than the biting lice *Bovicola caprie* (Manning and Scott, 1985; Jubb et al.. 1993).

Bovicola ovis: *Bovicola ovis was* previously named *Damalinia ovis (*the biting louse; body-louse; common louse; *Trichodectes spherocephallus*). This is a white-yellow louse 1.2 cm long. It is a biting louse which feeds on exofoliated epithelium of sheep. Like the others, *B. ovis* is susceptible to high temperature, but it is also intolerant to moisture (Urquhart, 1987).

It is an obligate parasite of sheep but it can reproduce on goats which can, therefore, remain as vectors for lice from sheep to sheep. *B. ovis* cannot survive off sheep for more than a few hours unless protected from temperature extremes and light. *B. ovis* feeds on the stratum corneum as well as scurf, sebaceous secretions and skin. Bacteria irritation of the sheep is probably derived from the biting activities of the lice and possibly some immune based sensitivity. Infested sheep rub against objects like fences and posts and bite and

chew their fleeces. The fleeces therefore appear deranged and have a pulled ragged appearance, particularly the areas on the sides behind the shoulder which they can reach with their mouths (Urquhart, 1987).

Economic and veterinary importance

The effect of lice is usually a function of their density. Lice numbers build up relatively slowly on newly infested sheep and the pattern of population increase depends on the time of year the introduction occurs. A small number of lice may present no problem and may become a normal part of fauna. However, they have a potential of massive increases (Wall and Shearer, 1997). Solar radiation, temperature and rainfall all have a profound effect on lice numbers. The chief effect of lice on their hosts is due to the irritation they cause. All species cause irritation of the skin and stimulate scratching, rubbing and licking leading to restlessness, damage to the fleece and skin. The egg production of birds and the milk production of cattle fall. Moreover, the saliva and feces of the lice contains substances which are capable of causing allergies, giving rise to severe irritations followed by the skin thickening (Peter, 1995). Severe infestation with suking lice may cause "Pediculosis" which is infestation with lice and cause anemia (Jubb et al., 1993). The foot louse of sheep is found most frequently around the dew-claws, severe infestation of which produces lameness (Soulsby, 1982). According to Kettel (1985), lice might also be expected to affect fleece weights and quality could reduce the percentage yield of clean wool after sharing.

2.4.3. Ticks

Ticks are arthropods classified in the subclass Acari, order Parasitiformes of the class Arachnida. At least 840 species of ticks have been identified in three major families, namely the Ixodidae, Argasidae and Nuttallidae. The family Ixodidae is relatively large comprising thirteen genera and 650 species of which seven genera contain species of veterinary and medical importance. These are *Amblyomma*, *Boophilus* (*Rhipicephalus*), *Dermacenter*, *Haemaphysalis*, *Hyalomma* and *Ixodes* (Jongejan and Uilenberg, 1994).

Life cycle

There are four stages in the life cycle of Ixodid ticks: Egg, larva, nymph and adult. After sucking a lot of blood, the female drops off its vertebrate host and seeks sheltered locality in which it develops and lays a single large batch of eggs. After oviposition she dies while the males usually remain much longer on the host, where they may mate repeatedly. Typically, a batch of eggs contains several thousands brown globular eggs, and oviposition continues for many days and in some cases, months. Depending upon the climatic conditions, eggs hatch in two weeks to several months, giving rise to hexapod larvae. The larvae climb into a host and suck blood for several days and moult to octopod nymphs. The nymphs then feed for on the host and moult to adult male and female ticks. The process of moulting can take place either on the ground on the host depending on the pattern of lifecycle of the species. There are three types of lifecycles that the different species follow namely: one- host, two- host and three- host ticks (Arthur, 1961; Jongejan and Uilenberg, 1994).

Tick species

Some of the important tick species infesting small ruminants are discussed below:

Amblyomma variegatum: It is commonly known as tropical bont tick, and is widely distributed in Ethiopia. The preferred hosts of the adult tick are cattle, but they also infest sheep and goats. This tick requires moistures and warmth for its survival and is not found in open grassland. Activity of adult tick commences when spring rains begin between March and June. *A. variegatum* is a potential vector of *Erlichia ruminatum*, *Theileria mutans* and *T. velifera* and the virus Nairobi sheep disease. Adult of *A. variegatum* infestations were frequently associated with damages to udder causing teat losses in cow and bulls damaging scrotum leading to sterility (Pegram et al., 1981).

Boophilus decoloratus: It is indigenous to Africa and is the commonest and most widespread tick in Ethiopia, which is collected in all administrative regions except in the Afar. It was mainly found in wet highlands and sub-highlands receiving more than 800 mm rainfall annually. The distribution pattern of this tick is similar to that of *Amblyomma variegatum* (Pegram et al., 1981; Walker, 1991).

Cattle are the main hosts of *Boophilus decoloratus*, but it is also found on sheep, goats and equine. In central Ethiopia, *B. decoloratus* was more abundant on cross and exotic cattle breeds. The attachment sites are dewlap, neck, shoulder and the side of the body of an animal. The immature stages are found on the tips and upper edges of the ears and on the legs. Apart from downgrading the quality of hides and skins *B. decoloratus* also transmit *Babesia bigemina* and *Anaplasma marginale* to cattle (Walker,1991).

Rhipicephalus evertsi evertsi: All stages of *Rh. e. evertsi*, the red –legged tick frequently feed on horses, donkey and cattle. Adults are found on the hairless areas around the anus as well as the groin region of the host while the immature stages attach on the deeper parts of the inner surface of the ear and in the outer ear canal. *Rh. e. evertsi* is widely distributed and common in Ethiopia. The tick shows no apparent preference for any altitude, rainfall or season (Pegram et al., 1981). *Rh. e. evertsi* transmit *Babesia caballi* and *Theileria equi* to horses, both causing equine piroplasmosis, and *A. marginale* causing particularly in lambs, but it may also affect calves and adult sheep (Walker et al., 2003).

Rhipicephalus praetexatus: *Rhipicephalus praetexatus* Adults of this tick species are most abundant on cattle, attaching in the tail brush and around the feet. The immature stages prefer to feed on rodents. The tick is more abundant during the rainy season (Walker et al., 2003). It is found in a wide range of ecological habitats, from semi-arid areas having 250 mm annual rainfall, through tropical and subtropical savanna, to wooden highlands having 1500mm annual rainfall. The presence of this species is recorded in almost all administrative regions. *Rh. praetexatus* can transmit the virus of Nairobi sheep disease in sheep and the bacterium *Rickettsia conori* to humans causing tick typhus. The feeding of this tick species can cause toxicosis in cattle, resulting in paralysis (Walker et al., 2003). In Ethiopia there was confusion in differentiating morphologically *Rh.simus* from *Rh. praetexatus*. However, recent findings indicated that *R. simus* occurs across central and southern Africa of 6^0 South (Wallker et al., 2000). This suggests that all ticks previously recorded as *Rh. simus* should be replaced by *Rh. praetexatus* thus *Rh.simus* does not occur in Ethiopia (Pegram et al., 1987b).

Hyalomma truncatum: It occurs throughout Ethiopia in different ecological zones from 300 to 3500 m altitude and between 250 and 1500 mm rainfall. The tick is adapted to dry habitat and is common in desert and savanna climatic regions (Walker et al., 2003). de Castro (1994) recorded the tick on cattle in Anger Gutin in East Wollega, and Mekonnen et

al (2001) in East Shoa, West Shoa, North shoa, Gurage, Kembata – Alaba Timbaro and Afar. Morel (1980) Collected this tick species from camels and goats in Diredewa and from cattle in Bale, Yabello, Moyalle and Dollo areas. The adults prefer cattle followed by sheep, goats and horses.

The predilection sites of this tick are the switches of tail, around the anus, on the lower perineum and the legs (Walker et al., 2003). *Hyalomma truncatum* have a toxin in their saliva that causes the skin disease known as waiting sickness in cattle, particularly calves. Due to the long mouth parts, secondary infections may lead to abscess and lameness in lambs (Walker et al., 2003).

Economic and veterinary importance

Ticks are blood- sucking ectoparasites that feed on mammals, birds and reptiles. The medical and economic importance of ticks had long been recognized due to their ability to transmit diseases to humans and animal in several ways and parasitize a wide range of vertebrate hosts, and transmit a wide variety of pathogenic agents than any other group of arthropods (Oliver, 1989). They play a major role of vector in spreading different diseases of livestock and humans such as babesiosis, thileriosis, anaplasmosis and many rickettsial viral diseases (Gary and Potgieter, 1982). In addition, direct losses due to their being ectoparasites include blood loss, irritations that result in "tick worry" and interrupt the grazing habits of the host. Damage and loss of udders are also caused by the attachment and feeding activities of ticks, which provide portals of entry for secondary bacterial infections and induce myiasis and tick paralysis due to the toxins they secrete into the blood. The secreted toxins may even disseminate to the respiratory organs and cause death of the animal (Sere, 1997; Soulsby, 1982). Their attachment and feeding also down grade hides and skins and reduce milk and wool production. Reduce productivity and increase susceptibility to the other diseases (de Castro, 1997).

The estimated global costs of control and productivity losses to be around USD 7000 million annually and de Castro (1997) estimated that the annual global cost associated with tick and tick borne disease in cattle ranges between USD 13.9 to USD 18.7 billion.

Frans (2000) indicated that the economically most important *Ixodidea* ticks of livestock in tropical regions belong to the genera of *Hyalomma, Boophilus* and *Amblyomma*. Species belonging to these genera most economically important in Ethiopia are: *Amblyomma cohaerans* on cattle sheep, goat, camel and equine; *A. variegatum* on cattle, sheep, goat and camel; *A. gemma* on cattle, sheep, goat and camel; *A. lepideum* on cattle, sheep, goat and camel; *Boophilus decoloratus* on cattle, sheep, goat, camel and equine; *Rhipicephalus pulchellus* on cattle, camel and equine; *Hyalomma truncatum* on sheep, and goat; *H. marginatum rufipes* on cattle, sheep, goat and camel and *H. dromedary* on camel. (Mekonnen, 1996).

2.3.4. Fleas

The *Siphonaptera* or fleas are wingless ectoparasites of mammals and birds. Fleas are unique in being laterally flattened compared with lice, which are dorso-ventrally flattened. Fleas generally parasitize a range of hosts and it is this ability to transfer from one host species to another that makes them of medical importance by transmitting disease from animals, mostly rats, to man. All fleas have basically the same structure and their identification is a matter for the specialist. Holland states that 1,800 species and subspecies of fleas have been described and that the probable total number of species is approximately 3,000. The adult female is a 1-6 mm long, female being larger than males of the same species, and readily recognized by their mahogany brown color, and the habit of jumping when disturbed (Yeruhan et al., 1989).

Fleas are generally not considered to be important ectoparasites of livestock. However, this may not be the case in a number of countries in the Mediteranean region, particularly where livestock live in close association with farm cats and dogs. For example, in Israel, Cat fleas, *Ctenocephalides felis* may be amongst the most important ectoparasites of ruminants. Heavy infestation of calves, lambs and kids may be affected more severe than calves. Flea infestation may be more widespread in summer and autumn than in winter and spring (Yeruhan et al., 1989).

Life cycle

The flea has 4 life stages, egg, larva, pupa, and adult. Under favorable conditions a generation can be completed in 2 to 3 weeks. Mating takes place on the host and eggs are laid on the host. Since they are not attached, the eggs drop to the ground and hatch in from two days to several weeks. Development occurs most commonly in the bedding of the resting areas of the host. The larvae are very small worm-lice legless insects with chewing mouthparts. In several weeks they pass through 3 larval stages, feeding on organic debris. The pupal stage lasts approximately one week, and then the newly emerged adult flea is readily to feed on blood within 24 hours (Lioyd 2002).

Economic and veterinary Importance

The stick tight flea is the most common flea in sheep and goats. Large population of this flea may cause ulcers on the head and ears. Flea infestations often spread to other animal including humans (Lioyd 2002).

2.4.5. Mites

Mange mites are common in sheep and goats and are reported from several geographic areas (FAO 1995). The most important mange mites known to cause skin disease in sheep and goats belong to the family Sarcoptidae, Psoroptidae, Choroptidae and Demodicidae (Gashaw, 1986).

Life cycle

The entire lifecycle of mite takes place on the host. Adult female create permanent tunnels, of up to one centimeter in length parallel to the skin surface, in which they feed and lay eggs. Female mites produce relatively large eggs, from which a small, six- legged larva hatch. A few species are ovoviviparous, producing live offspring. The larva moult to become an eight- legged nymph. There may be between one and three nymphal stages, known as protonymph, deutonymph and triotonymph. At least one of these nymphal stages is usually inactive and development proceeds without feedings. The nymph then moult to become adult (Wall and Shearer, 1997). The number of egg produced per female

is highly variable but lifetime reproduction output may be as low as 16 eggs per female. Nevertheless, the lifecycle of many parasitic species may be completed in less than four weeks and in some species may be as short as eight days thus having the potential for tremendous increase in their population size (Wall and Shearer, 1997).

Mite species

***Demodex* spp.**: Mites of *Demodex* species infest hair follicles of domestic animals. Demodex live as commensals, in sebaceous glands of the skin where they spend their entire lives. For the most part they are non- pathogenic. Species of *Demodex* are unable to survive off the hosts. The disease causes little concern but in cattle it has significant damage in hides and rarely death due to secondary bacterial invasion. The disease may be severe in goats but rare in sheep (Jackson 1991; Urquhart et al., 1992). Skin is the favored site for demodicosis lesions. On histological examination of caprine and bovine foetal skins it was found that they are infected as early as during their pre-natal stage and during post natal and subjected growth phases of the animals. Such congenitally infected skins are constantly subjected to variations in environmental factors such as relative humidity, temperature and rain fall which in turn influence the skin surface humidity and temperature are not only controlled by the environment and metabolism but also by other factors.

***Sarcoptes* spp.**: It is a species of obligate, burrowing mite. Host adapted varieties of this species cause *sarcoptic mange* in cattle, sheep, goats, dogs, and humans, plus a wide range of wild animals. It has been particularly well studied in pigs, but is relatively rare in cats or horses. It is usually more common in housed animals or those in poor condition, usually at the end of winter or early spring (Radostits et al., 1994).

***Psoroptes* spp.**: Are obligate ectoparasites of mammals but in this case they are a non-burrowing species. They are generally larger than the burrowing sarcoptid mites but they also infest a wide variety of hosts including sheep, cattle, goats, horses, mules, camels and rabbits (Bates, 1999). The disease caused by *P. ovis* is a of considerable economic and welfare importance, particularly in sheep flocks in many areas of the world (O'Brien, 1999). While *P. ovis* in sheep is prevalent worldwide, the infestation of cattle by this species is less common, although when present it may cause a more severe dermatitis, characterized by more extensive lesions and secondary bacterial infestation commonly

seen in sheep (Kirkwood, 1986). *Psoroptes* infested skin will have a grain surface that is totally distributed on the area where the parasites has been proliferating on the skin is thicker than normal on that whole area. The central part is rough and in the periphery Cleary distributed tunnels and pits are seen (Asp, 1988).

***Choreoptes* spp.**: *Choreoptes bovis* is the most widespread species in sheep, cattle goats, and horses (Health, 1978; Heath et al., 1983). It causes an allergic, exudative dermatitis and is seen most frequently on the scrotum of rams. When ewes become infested, they transmit the mites to their lambs during sucking (Heath et al., 1983). The main concern in rams is that the lesion forming on the scrotum can seriously impair semen quality (Heath, 1978). The extent of the body affected by lesions is categorized into three classifications: localized lesions were found only on one part of the body, regional lesions were found in multiple parts of the body, and generalized lesions were found all over the body. The severity of infection appears to be inversely related to temperature and to lesser extent with total rainfall. Relative humidity also has a highly significant positive correlation with the intensity of infestation (Jakson et al., 1983).

Economic and veterinary importance

Mites have chewing rather than blood-sucking mouth parts, and appear to feed on skin debris and secretions, Any host reactions are therefore likely to be due to mere presence of the mites, their "products" on the skin surface and the secondary bacterial invasion they lead to, and not to injection of saliva.

There are five genera of mites responsible for mange in sheep and goats. These are Demodectic (follicular mange), Sarcoptic (head scab or mange), Psoroptic (common mange or sheep scab), and Chroptic (foot scabs or mange) (Soulsby, 1982; Asp, 1988).

3. MATERIALS AND METHODS

3.1. Study area

The study was conducted in Fiche area, North West of Shoa zone (Fig. 1) of Oromia regional state, which is located about 190 km from Addis Ababa. This area is part of the central highlands of the country. Geographically, the zone is located between latitude 9^0-10^0 24'N and longitude 37^0 57- $39^0$33'East (NSDAD, 2001). The total area coverage of the zone is 11,607 km^2 while the altitude of the zone is ranging from 1000 – 3500 meter above sea level (CSA,2003). The highland, mid land and lowland covers 54%, 28% and 18% of the total land mass, respectively (EASE, 2003). The mean annual rainfall of the zone is 1026 mm and the daily mean maximum and minimum temperature are 20.68 ^{0}C and 11.23 ^{0}C, respectively. The maximum and minimum temperature, rainfall and relative humidity of the areas during the study period were collected from the National Meteorology Agency weather station located at Fiche and Kuyyu sites (Fig.2). The human population of the zone was estimated to be 1,420,571 with crude population density of 124 persons per household. The specific study sites were four peasant associations of Fiche (Girar Jars), Kuyyu (Gebre Gurach) and Hidabu Abote (Ejere) woreda. The woredas were selected based on their representativeness of the highland, midland and lowland agro-ecologies. From each woreda 16 Peasant associations were randomly selected.

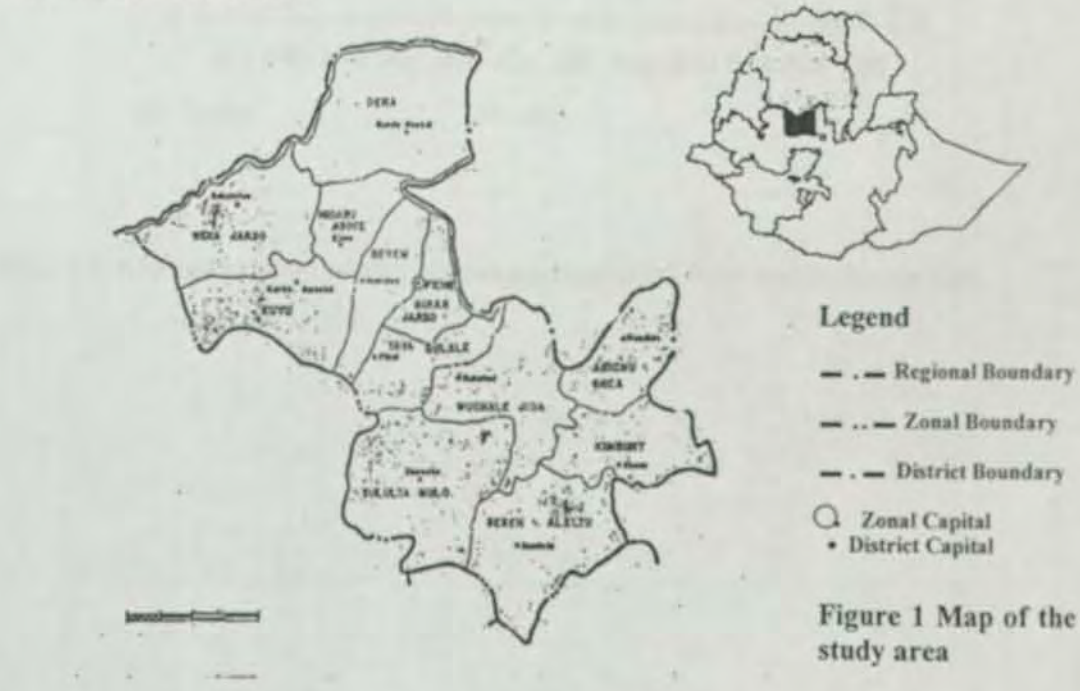


Figure 1 Map of the study area

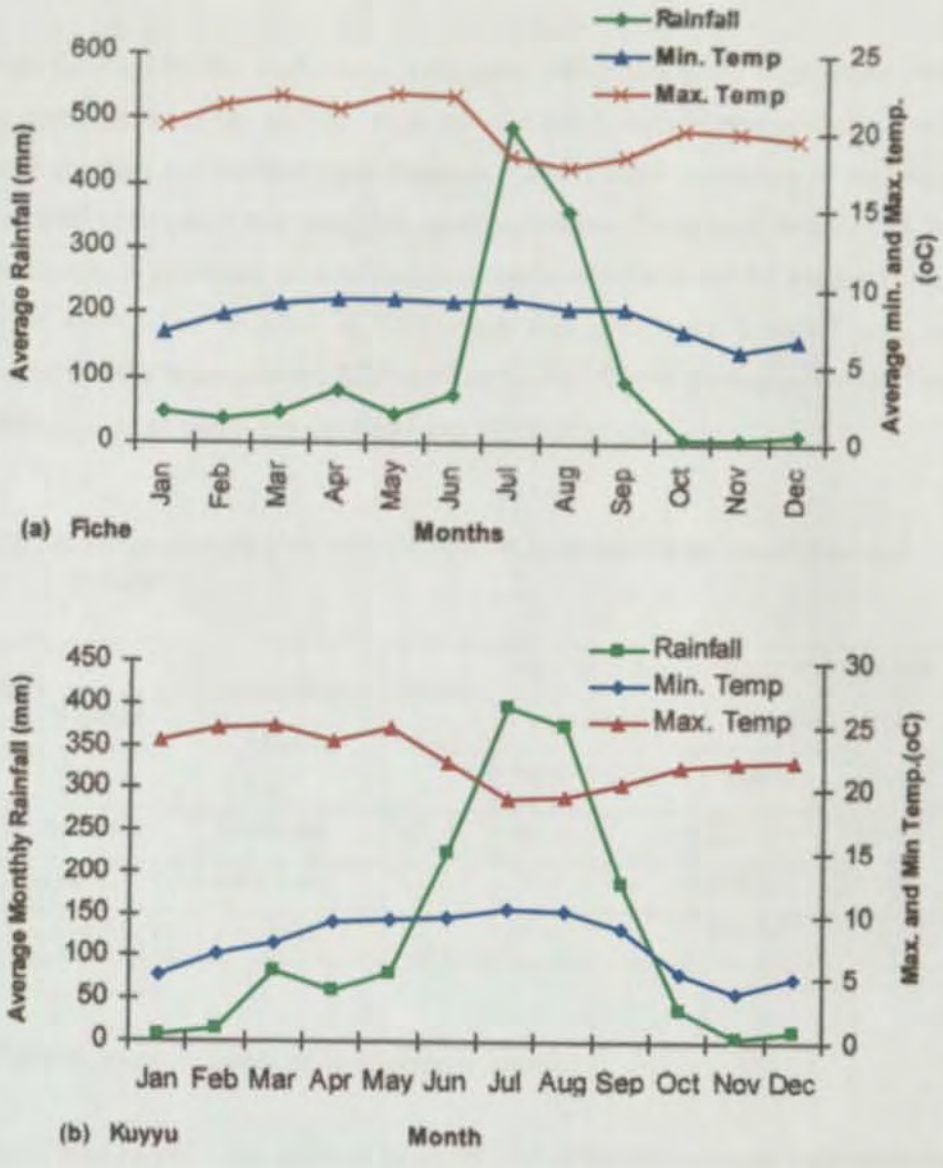


Figure 2. Average monthly rainfall and temperature of (a) Fiche and (b) Kuyyu sites

3.2. Study animals

Animals included in the study were indigenous sheep and goats kept under extensive management system. The woredas were selected based on their representativeness of the highland, midland and lowland agro- climates. Table 1 shows summary of the study sites with peasant association and small ruminant population. From each woredas 16 Peasant associations were randomly selected and goats and sheep that come for routine vaccination programs were taken. A total of 2023 sheep and goats were sampled in a random systematic manner from October 2007 to March 2008. Out of the total number of animals sampled, 1636 were sheep and the remaining 387 were goats.

Table 1. Summary of study sites with the Peasant Associations and small ruminant populations.

Woreda	Study Agro-climate	Total PAs	PAs with the selected Agro-ecology	Sheep and Goats in the study area	
				Sheep	Goats
Girar Jarso	Highland	17	16	32119	15809
Kuyyu	Mid-Land	23	16	50,853	20,904
Hidabu Abote	Lowland	19	16	59070	–

3.3. Collection and Identification of ectoparasites

During clinical examination external parasites and all immature stages were collected and kept in 70% alcohol and identification was made with the help of an identification key according to Soulsby (1982). To observe the predilection sites of the parasites and to facilitate the parasite collection, the body of the animal were divided in to ear, head, shoulder, back, ventral sites, hoof, ano-vula area and tail (Kaiser, 1987).

3.3.1. Ticks, Lice, Keds and Fleas

Hard ticks, lice, keds and fleas were collected from the full body of the examined animals in the eight mentioned predilection sites. Each ectoparasite was placed in separate universal bottles containing 70% ethanol that had been pre- labeled with date, region, zone,

wereda and locality as well as animal species. Each bottle was tightly closed for further examination in the laboratory (National Animal Health Diagnostic and Investigation Center Sebeta (NAHDIC). Identification of each of the ectoparasites was done using light stereomicroscope according to the standard taxonomic keys described by Wall and Shearer (1997), Urquart et al.,(1996), Soulsby (1986), Orlov (1963) for lice, keds and fleas and Hoogstraal (1956), Matthysse and Colobo (1987) and Morel (1980) for ticks. During collection, care was taken to ensure that the mouth parts of ticks were not left behind during the traction with thumb forceps. Identified ticks were then counted and species, sex and instars were recorded. Confirmatory identification was done for some specimens using the expertise available at the National Animal Health Diagnostic and Investigation Center, Sebeta.

3.3.2. Skin scraping examination

Examination of skin scraping in the diagnosis of mange was made at different sites where lesions were visible on each animal and approximately 1cm^2 area were scraped for superficial skin scraping (epidermal surface examination) and 6 to 8 cm^2 for deep skin scraping. After removing hair by gentle clipping were used to identify surface mites while deep skin scraping (deep epidermal examination) until capillary blood oozes is useful in the diagnosis of borrowing and follicular mites (Wall and Shearer, 1997). Skin scraping from each animal were transferred into a Petridish and samples were examined within 6hrs of collection. After adding 10% KOH, the sample was heated until hair and epithelial scales were dissolved. Mites were then removed from the top of the solution and examined under light microscope at 40X magnification and the species were determined according to the method described by Bowman (1995) and Urquhart et al., (1996).

3.4. Data management and analysis

Microsoft Excel was used for data entry. SPSS (Version 13) statistical software was used for data analysis. Descriptive statistics such as percentages were used to summarize the prevalence of the different kinds of identified ectoparasites from the animal. Logistic regression was used to see effect of risk factors on prevalence of ectoparasite infestation while analysis of variance (ANOVA) was used to compare the mean count of the different ectoparasite encountered to different epidemiological factors. Level of rejection was set at $p>0.05$.

4. RESULTS

4.1. Identification and prevalence of ectoparasites in sheep and goats

Out of 1636 sheep and 387 goats examined for ectoparasites, 1184 (72.3%) sheep and 291 (75.1%) goats were infested with one or more ectoparasites. The major ectoparasites identified on sheep and goats and their prevalence is shown in (Table 2.)

Table 2. Prevalence of different ectoparasites in sheep and goats

Ectoparasites		Sheep		Goats	
		(No. examined =1636)		(No. examined =387)	
		No. Infested	Percent	No. Infested	Percent
Sheep ked	*Mellophagus ovinus*	636	38.5	15	3.88
Tick	*Amblyomma* spp (Imm)	95	5.8	184	42.2
	R.e.evertsi	112	6.84	37	9.58
	R. praetexatus	42	2.56	11	2.84
	R. pravus	4	0.24	3	0.77
	R. sanguineus	4	0.24	-	-
	R. spp	6	0.36	-	-
	Hy.m. rufipes	2	0.12	1	0.25
	Hy.truncatum	16	0.97	-	-
	A.variegatum	32	1.95	16	4.14
	B.decoloratus	32	1.95	12	3.10
Louse	*Bovicola ovis*	169	10.32	-	-
	L. stenopsis	-	-	12	3.10
	L. africanus	9	0.55	-	-
	L. pedalis	1	0.25	-	-
Flea	*Ctenocephalides spp*	30	1.88	11	2.84
Total		1184		291	

4.2. Intensity of infestation with ectoparasites

The overall intensity of infestation by ectoparasites was found to be 6.66/infested animal. The result regarding different ectoparasites revealed that parasite burden with *Mellophagus ovinus* (2.735/animal) was highest followed by immature *Amblyomma spp.* (1.86 animal) and *Bovicola ovis* (1.3/animal). Other species with less intensity in decreasing order were *A. variegatum, B.decoloratus, R. e. evertsi, R. praetexatus, R. pravus, R. sanguineus, R. spp.,Hy.truncatum, Hy. m. rufipes, L.stenopsis, L.africanus, L.pedalis* and *Ctenocephalides spp* (Table 3).

Table 3: Intensity of ectoparasites on infested animals in northwest Shoa zone, Ethiopia

Ectoparasites	Species	Number of ectoparasites	Intensity (No. parasite/animal)
Sheep ked	*Mellophagus ovinus*	4032	2.735
Ticks	*Amblyomma species* (Immature)	2744	1.861
	Amblyomma. variegatum	102	0.069
	Boophilus decoloratus	152	0.103
	Rhipicephalus evertsi evertsi	327	0.221
	Rhipicephalus. praetexatus	114	0.077
	Rhipicephalus. pravus	9	0.006
	Rhipicephalus. sanguineus	18	0.012
	Rhipicephalus species	25	0.017
	Hyalomma truncatum	41	0.028
	Hy. marginatum rufipes	6	0.004
Lice	*Bovicola ovis*	1920	1.302
	Linognathus stenopsis	134	0.091
	L. africanus	47	0.032
	L. pedalis	10	0.007
Fleas	*Ctenocephalides spp.*	128	0.087
Total		9809	6.655

In sheep, the relative abundance of each ectoparasite species showed *Mellophagus ovinus* to be the most abundant species (49.33 %) followed by *Bovicola ovis* (24.5 %), while in goats, the major ectoparasite was found to be immature *Amblyomma spp.* (74.12 %), followed by *Mellophagus ovinus* (8.45 %) (Table 4).

Table 4. Relative abundance of ectoparasites from sheep and goats in northwest Shoa zone, Ethiopia

Ectoparasites	Species	Sheep		Goat	
		No. parasite	Abundance (%)	No. parasite	Abundance (%)
Sheep ked	*Mellophagus ovinus*	3865	49.33	167	8.45
Ticks	*Amblyomma species*	1280	16.33	1464	74.12
	A. variegatum	70	0.89	32	1.62
	B. decoloratus	134	1.71	18	0.91
	R. e. evertsi	265	3.38	62	3.13
	R. praetexatus	73	0.93	41	2.07
	R. pravus	5	0.06	4	0.20
	R. sanguineus	18	0.22	18	-
	R. species	24	0.30	1	0.05
	Hy. truncatum	40	0.51	1	0.05
	Hy. m. rufipes	6	0.07	6	-
Lice	*Bovicola ovis*	1920	24.5	-	-
	L. stenopsis	-	-	134	6.78
	L. africanus	47	0.59	47	-
	L. pedalis	-	-	10	0.50
Flea	*Ctenocephalides spp*	87	1.11	41	2.07
	Total	**7834**		**1975**	

4.3. Prevalence of ectoparasites in relation to different factors

4.3.1. Prevalence and abundance of ectoparasites in different agroecology

In highland and midland agro-ecological zones, *Mellophagus ovinus* was the dominant species in sheep and goats, followed by *Bovicola ovis* while in lowland, *Amblyomma spp.* was the dominant species both in sheep and goats, followed by *M. ovinus*. No *B. ovis* was recorded from goats of any of the agroecological zones. *Amblyomma variegatum* was found to be of least abundance in highland sheep. In midland sheep, *Hyalomma m. rufipes* was found to be of least abundance while in midland goats, *Ctenocephalides spp.* was the least abundant species found. *Linognathus africanus* and *Rhipicephalus sanguineus* were the least abundant species in lowland sheep. In goats *H. truncatum* and *Rhipicephalus spp.* were the least abundant ectoparasite species (Table 5).

Table 5. Percentage abundance of different ectoparasites in sheep and goat in three agro-ecological zones

Ectoparasites	Highland			Midland			Lowland		
	Sheep	Goat	Total	Sheep	Goat	Total	Sheep	Goat	Total
Mellophagus ovinus	2447 (69.48)	-	2447	1269 (38.44)	149 (4.51)	1419	149 (5.06)	18 (0.61)	167
Amblyomma.spp (Immature)	-	-	-	299 (9.06)	82 (2.48)	381	980 (33.29)	1383 (46.99)	2363
Bovicola..ovis	970 (27.54)	-	970	847 (25.66)	-	847	103 (3.49)	-	103
Rh.e.evertsi	43 (1.22)	-	-	200 (6.06)	29 (0.88)	229	22 (0.75)	33 (1.12)	55
Ctenocephalides spp	21 (0.60)	-	21	13 (0.39)	2 (0.06)	15	53 (1.80)	39 (1.33)	92
A.variegatum	3 (0.09)	-	3	58 (1.76)	9 (0.27)	67	9 (0.31)	23 (0.78)	32
B.decoloratus	10 (0.28)	-	10	116 (3.51)	7 (0.21)	123	8 (0.27)	11 (0.37)	19
Hy.truncatum	24 (0.68)	-	24	16 (0.48)	-	16	-	1 (0.03)	1
Linognathus stenopsis	-	-	-		62 (1.88)	62	-	72 (2.45)	72
Rh.pratexatus	-	-	-	65 (1.97)	34 (1.03)	99	8 (0.27)	7 (0.24)	15
Rh.pravus	-	-	-	-	-	-	5(0.17)	4(0.14)	9
Rh.spp	14(0.40)		14	10(0.30)	-	10	-	1(0.03)	1
Linognathus pedalis	-	-	-	-	-	-	-	10 (0.34)	10
Hy.m.rufipes	5(0.14)	-	5	1(0.03)	-	1	-	-	-
L. africanus	13 (0.37)	-	13	32 (0.97)	-	32	2 (0.07)	-	2
Rh.sanguineus	15 (0.43)	-	15	-	-	-	2(0.07)	-	2
Total		-	3522			3301			2943

The overall prevalence of ectoparasites in highland, midland and lowland were 36.7%, 51.2% and 11.9%, respectively in sheep and 0%, 25.3% and 74.8%, respectively in goats. The prevalence of different ectoparasites of sheep and goats in different agro-ecology are shown in (Figures 2 and 3), respectively..

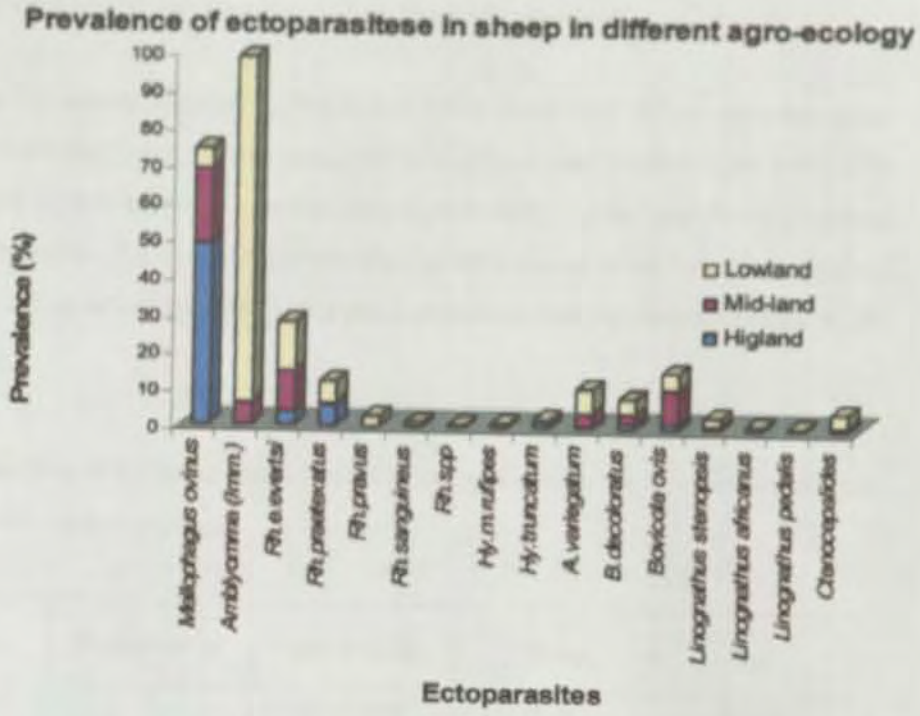


Figure 3. Prevalence of different ectoparasites of sheep in different agro-ecology in northwest Shoa zone , Ethiopia

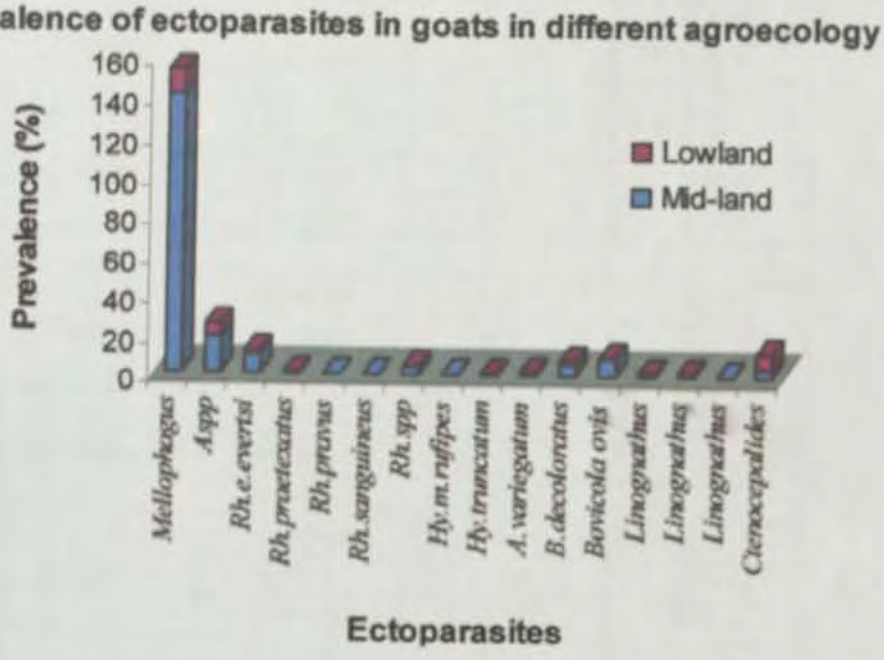


Figure 4. Prevalence of different ectoparasites of goats in different agro-ecology in northwest Shoa zone , Ethiopia

4.3.2. Seasonal variation in prevalence and abundance of ectoparasites

During the late wet season (October to December 2007) in lowland sheep, the mean count of sheep ked was significantly lower than that of highland and midland ($P< 0.05$). The mean ticks count in this season in lowland was significantly higher than that of highland and midland ($P< 0.05$). Lice infestation was significantly higher in midland than highland and lowland and fleas were significantly the more abundant than highland and midland ($P< 0.05$) .(Table 6).

Table 6. Mean counts of the major ectoparasites of sheep found in the three agro ecological zones during two seasons

Seasons	Ectoparasite	Agro-ecology	Mean	S.E
Late rainy season	Sheep ked	Highland	4.94	0.255
		Midland	4.38	0.266
		Lowland	0.73*	0.235
	Ticks	Highland	2.31	0.261
		Midland	2.59	0.305
		Lowland	7.25*	0.618
	Lice	Highland	2.67	0.335
		Midland	4.65*	0.447
		Lowland	1.64	0.501
	Fleas	Highland	0.34	0.137
		Midland	0.25	0.126
		Lowland	1.91*	0.584
Early dry season	Sheep ked	Highland	6.55*	0.456
		Midland	0.31	0.115
		Lowland	0.05	0.146
	Ticks	Highland	0.72*	0.270
		Midland	8.14	0.465
		Lowland	9.30	0.385
	Lice	Highland	2.34*	0.573
		Midland	0.33	0.216
		Lowland	0.39	0.193
	Fleas	Highland	0.18	0.184
		Midland	0.21	0.147
		Lowland	0.88	0.306

*The difference in mean values is significant ($P< 0.05$)

During early dry season (February and March 2008), sheep ked count in sheep was significantly higher in highland areas than midland and lowland ($P< 0.05$). Regarding tick count, midland and lowland areas had significantly ($P< 0.05$) higher number than highland but no significant difference was found between mid- and lowland ($P> 0.05$). Lice infestation was significantly higher in highland than that of midland and lowland ($P< 0.05$). No significant difference was observed in flea infestation between the three agro ecological zones (Table 6).

During late wet season in sheep, *Mellophagus ovinus* count was significantly higher in the highland area, followed by midland and lowland zones. Highest abundance of immature *Amblyomma spp.* was recorded in lowland than the other agro-ecological zones ($P< 0.05$). No significant difference between the three agro-ecological zones was found with respect to *Bovicolla ovis* infestation (Table 7).

Table 7. Mean counts of *M. ovinus, B. ovis* and *Amblyomma spp.* in sheep found in the three agro ecological zones during two seasons

Seasons	Ectoparasite Species	Agroecology	Mean	S.E
Late wet season	*M. ovinus*	Highland	3.90*[a]	0.386
		Midland	2.18*[b]	0.187
		Lowland	0.47*[c]	0.206
	B. ovis	Highland	1.61	0.389
		Midland	1.41	0.204
		Lowland	0.42	0.195
	Amblyomma spp. (Immature)	Highland	0.00	0.000
		Midland	0.14	0.060
		Lowland	12.55*	2.827
Early dry season	*M. ovinus*	Highland	4.03*	0.370
		Midland	0.10	0.043
		Lowland	0.08	0.076
	B. ovis	Highland	1.64*	0.414
		Midland	0.26	0.128
		Lowland	0.00	0.000
	Amblyomma spp. (Immature)	Highland	0.03	0.028
		Midland	0.85	0.287
		Lowland	2.67*	0.277

* [a, b, c] within variable group, the difference in mean values is significant ($P< 0.05$)

During early dry season in sheep, significantly higher count of *M. ovinus* and *B. ovis* was found in highland agro ecology while highest *Amblyomma spp.* was found in lowland area (Table 7).

The mean count of sheep ked, ticks, lice and fleas in goats was found to have no significant difference between the agro-ecological zones in both late wet and early dry seasons.

4.3.3. Prevalence of ectoparasite in different sexes of the animals

The overall prevalence of ectoparasites in male and female sheep was found to be 25.46 and 48.59%, respectively. Likewise, the prevalence in male and female goats was 16.02 and 55.56%, respectively, showing that the ectoparasites were more prevalent in females than in males. In sheep, the prevalence of infestation by *Mellophagus ovinus, Amblyomma spp.* and *Bovicola ovis* was twice as high as that of the males while in goats, higher prevalence in males was recorded in *Mellophagus ovinus* infestation (Table.8)

Table 8. Prevalence of ectoparasites in different sexes of sheep and goat in the study area.

Type of Ectoparasite	Sheep				Goat			
	Male n=448	%	Female n=1178	%	Male n=176	%	Female n=211	%
Mellophagus ovinus	133	8.18	339	20.85	39	10.08	134	34.63
Amblyomma spp.(Imma)	99	6.09	133	8.18	9	2.33	28	7.24
Bovicola ovis	51	3.14	105	6.46	3	0.78	10	2.58
R. e. evertsi	53	3.26	85	5.23	2	0.52	10	2.58
Ctenocephalides spp.	6	0.37	25	1.54	4	1.03	5	1.29
A.variegatum	15	0.92	30	1.85	-	0	3	0.78
B.decoloratus	13	0.79	23	1.41	1	0.26	6	1.55
Hy.truncatum	11	0.68	5	0.31	-	0	-	0
Linognatus stenopsis	-	0	-	0	2	0.52	10	2.58
R. praetexatus	18	1.11	31	1.91	1	0.26	3	0.78
R. pravus	4	0.25	1	0.06	-	0	2	0.52
Rhipicephalus spp.	1	0.06	1	0.06	1	0.26	3	0.78
L. pedalis	-	0	1	0.06	-	0	-	0
Hy. m. rufipes	6	0.37	3	0.18	-	0	-	0
L. africanus	1	0.06	7	0.43	-	0	1	0.26
R. sanguineus	3	0.18	1	0.06	-	0	-	0
Total	414	25.46	790	48.59	62	16.02	215	55.56

4.3.4. Prevalence of ectoparasites in different age groups of study animal

The overall prevalence of ectoparasites in adult, young and lambs sheep was 53.4%,49%,75.7% and in goats adult,Young and kid 21.24%,13.9%,25% respectively (Table.9)

Table 9. Prevalence of different ectoparasites in different age groups of study animals

Ectoparasites	Sheep						Goat					
	Adult n=1221	%	Young n=312	%	Lamb n=103	%	Adult n=306	%	Young n=314	%	Kid n=4	%
Mellophagus ovinus	245	20.1	51	16.3	15	14.6	132	43.1	33	13.7	0	0
Amb .spp	132	10.8	38	12.2	11	10.7	28	9.1	3	2.9	0	0
Bovicola ovis	90	7.4	19	6.1	23	22.3	0	0	0	0	0	0
Rh.e.evertsi	75	6.1	17	5.4	10	9.7	10	3.3	1	1.1	0	0
Ctenocephalides spp	16	1.3	4	1.3	5	4.8	5	1.6	1	0.5	0	0
A.varigatum	29	2.4	6	1.9	3	2.9	2	0.7	0	0.2	0	0
B.decoloratus	19	1.5	9	2.9	3	2.9	5	1.6	2	0.5	0	0
Hy.truncatum	1	0.08	3	1.0	0	0	0	0	0	0	0	0
Linognathus stenopsis	0	0	0	0	0	0	7	2.3	2	0.7	0	0
Rh.pratexatus	28	2.3	4	1.3	5	4.8	2	0.7	1	0.2	0	0
Rh.pravus	5	0.4	0	0	0	0	1	0.3	0	0.1	1	25.0
Rh.spp	1	0.08	1	0.3	0	0	4	1.3	0	0.4	0	0
Linognathus pedalis	1	0.08	0	0	0	0	0	0	0	0	0	0
Hy.m.rufipes	1	0.08	1	0.3	3	2.9	0	0	0	0	0	0
Linognathus africanus	6	0.49	0	0	0	0	1	0.3	0	0.1	0	0
Rh.sanguineus	4	0.3	0	0	0	0	0	0		0	0	0
Total	653		153		78		65		43		1	

4.4. The association of ectoparasitic infestation with age and sex of host animal, agro-ecology and season

The effect of agroecology on the prevalence of ectoparasites identified was analyzed using multiple logistic regressions to see the association between ectoparasites and their association to agroecologies. The prevalence of sheep ked among the agroecologies showed significant difference between highland and lowland agro ecologies (OR= 0.640, P< 0.01), but there was no significant difference (P> 0.05) between highland and midland agro-ecologies. A similar method of analysis was performed on lice prevalence among the three agro ecological zones which indicated significant difference between highland and

midland agro ecologies (OR= 0.589, P< 0.01), but no significant difference was observed between highland and lowland areas. There was significant difference in prevalence of tick infestation in sheep between highland and lowland (OR= 1.60, P= 0.001). The prevalence of flea infestation in sheep was not significant (P> 0.05) among the different agro-ecologies.

The effect of season on the prevalence of ectoparasites identified was analyzed using similar analysis to see the association between ectoparasites and their association to the two seasons. The prevalence of sheep ked, ticks, lice and fleas showed significant difference between late wet and early dry seasons (OR= 1.862, 0.387, 1.800 & 0.458 P< 0.05). Likewise, the effect of age on the prevalence of the ectoparasites showed that significant difference was obtained between adult and lamb in all the four ectoparasites (Table 10). With respect to sex, significant difference only in prevalence of fleas infestation was shown between males and females (OR= 0.409, P<0.05).

Table 10. Multivariate logistic regression, odds ratio and p-values of agro-ecology, season, sex and age for ectoparasites of sheep

	Risk Factor	Sheep ked		Ticks		Lice		Fleas	
		P-value	OR	P-value	OR	P- value	OR	P-value	OR
Agro ecology	Highland		1		1		1		1
	Midland*	0.555	1.075	0.726	1.04	0.005	0.588	0.105	0.506
	Lowland	0.004	0.640	0.001	1.60	0.720	0.931	0.983	1.0089
	Midland**	0.001	1.679	0.002	0.653	0.031	0.632	0.983	1.009
Season	Late Wet	0.000	1.862	0.000	0.387	0.001	1.800	0.024	0.458
	Early Dry		1		1		1		1
Sex	Male	0.399	0.906	0.096	1.204	0.800	1.042	0.048	0.409
	Female		1		1		1		1
Age	Adult		1		1		1		1
	Young[A]	0.766	1.042	0.320	0.873	0.951	0.986	0.141	0.336
	Lamb	0.000	0.168	0.000	0.099	0.000	8.078	0.000	5.601
	Young[B]	0.000	6.187	0.000	8.843	0.000	0.122	0.000	0.060

*Reference highland; ** Reference lowland; [A] Reference adult; [B] Reference lamb;

In goats, the effect of agro-ecology on the prevalence of ectoparasites identified was analyzed to see the association between ectoparasites and agro-ecologies. The prevalence of sheep ked among the agro ecologies showed significant difference between midland and lowland (OR= 2.268, P= 0.01). Regarding lice and fleas, prevalence in the two agro-ecological zones indicated no significant difference between midland and lowland agro ecologies. In contrast, there was significant difference in prevalence tick infestation of goat between midland and lowland areas (OR= 0.305, P= 0.000).

The effect of age on the prevalence of the ectoparasites showed significant difference between young and kids in lice and fleas and not in ticks and keds. With respect to sex, no significant difference in the prevalence of all the ectoparasites was shown between males and females (Table 11).

Table 11. Multivariate logistic regression, odds ratio and p- values of agro ecology, season, sex and age for ectoparasites of goats

Variables	Risk Factor	Sheep ked		Ticks		Lice		Fleas	
		P- value	OR	P- value	OR	P- value	OR	P- value	OR
Agro ecology	Midland	0.001	2.268	0.000	0.305	0.854	0.893	0.186	0.196
	Lowland		1		1		1		1
Sex	Male	0.770	1.073	0.790	1.081	0.201	0.262	0.692	1.628
	Female		1		1		1		1
Age	Adult		1		1		1		1
	Young*	0.294	1.322	0.596	0.836	0.389	0.404	0.284	4.588
	Kid	0.465	0.428	0.999	0.000	0.064	9.152	0.002	104.0
	Young**	0.339	3.088	0.999	3.8E+08	0.0042	0.044	0.042	0.044

*Reference adult

** Reference kid

4.5. Predilection sites of ectoparasites

The common predilection sites of *Mellophagus ovinus* on sheep were the back, shoulder and ventral sides with the proportion of 18.8%, 17.3% and 4.3%, respectively. *Rhipicephalus. e. evertsi* was commonly found in the ano-vulva area. Immature

Amblyomma spp. was found to be very common in the ear (47.1%) and also distributed in most parts of the body.

In *Boophilus decoloratus* infested sheep the sites commonly parasitized were the shoulder, ventral sides, hoof and ano-vulva area and for *Amblyomma variegatum* the sites were ventral sides, hoof and ano- vulva area (Fig.5).

In goats the sites commonly parasitized by immature *Amblyomma spp*, were ear, head, back and the hoof areas. *Boophilus decoloratus* and *Ctenocephalids spp.* were commonly found shoulder and back areas of the goats. All infestation of ticks on the ear was due to immature *Amblyomma* species (Fig. 6).

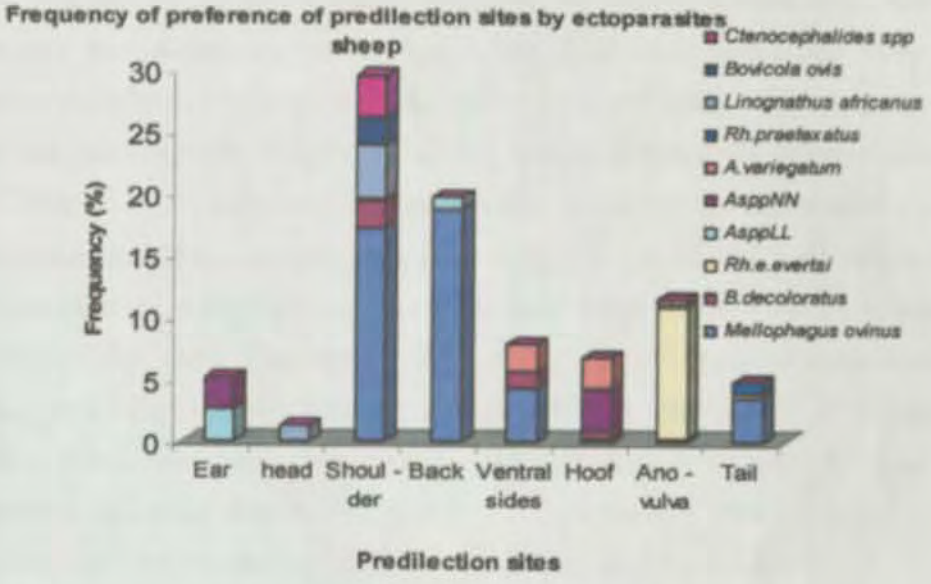


Figure 5. Preferred feeding sites of the major ectoparasites infesting sheep

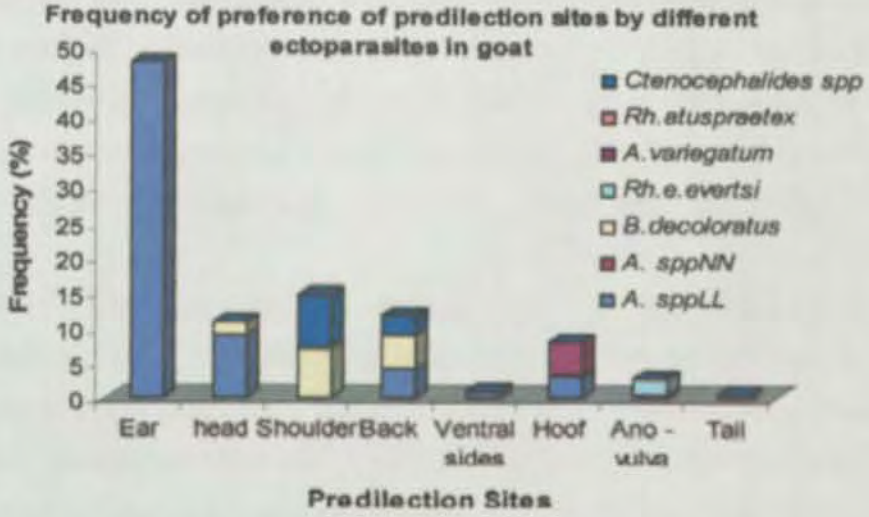


Figure 6. Preferred feeding sites of the major ectoparasites infesting goats

5. DISCUSSION

From a total of 1636 Sheep and 387 Goats examined for ectoparasites, 72.3% sheep and 75.1% goats respectively were infested with one or more types of ectoparasites. Sheep keds, ticks, lice and fleas are the major ectoparasites affecting sheep and goats in the study area. Previous studies have indicated the wide spread nature of these ectoparasies in many areas of Amhara region (Tefera and Abebe, 2006a; Mersha, 2007). In an investigation to determine the major ectoparasites infestation in small ruminants in selected farms in Nsukka, Nigeria, the species identified in goats included *Ctenocephalide canis, Boophilus decoloratus and Amblyomma variegatum,* while those from parasitized sheep were *Ctenocephalides canis* and *Damalina ovis* (Ugochnukwu and Apeh,1985). In another study of external parasites in the Egypt indicated two species of biting lice infesting sheep and goats (*Bovicola caprie* and *Bovicola ovis* respectively) and two species of sucking lice on goats (*Linognathus africanus* and *Linognathus stenopsis*). In addition, *Mellophagus ovinus* was collected from goats and sheep, and goats were infested with two *Rhipicephalus spp* (El-Bakey, 2001). Sheep and goats from Atlantic and littoral areas of south Benin and Senegal were examined and found to be infested with nine species of ectoparasites including *Damalinia caprie* (*Bovicola caprae*) and *Damalinia ovis* (*Bovicola ovis*), *Linognathus stenopsis, Linognathus pedalis, Ctenocephalides felis, sarcoptes scabies, Psoroptes ovis , Amblyomma spp and Rhipicephalus spp* (Salifou et al.,2004)

Large numbers of sheep were infested with *Mellophagus ovinus* in the highlands. Sheep keds were common in highlands than in midlands and lowlands of the study area. Previously *Mellophagus ovinus* was reported in sheep from north Shoa and south Wollo and one of northwest Shoa zones of Oromia region (Bayou et al., 1998; Assegedech et al., 1999; Numery, 2001; Tefera and Abebe 2006a; Asela regional laboratory, 2007).

Larger number of goats than sheep were infested with different *Amblyomma spp,* and lice were the other common ectoparasites found in the study. There were three species of lice were recognized in this study infested sheep and goats which are *Bovicola ovis, Linognatus stenopsis* and *Linognathus africanus*. Several authors previously have identified these species of Lice in sheep and goats (Asegedech et al.,1999; Ermias, 2000; Numery,2001 ;Bayou,2005; Tefera and Abebe 2006a). *L. africanus* was recorded on Turkish goats and

sheep (Tasci and Topcu,1989a,b). This species was also identified in northern Greece along with *Bovicola caprae* and *Linignathus stenopsis*. Of the sheep, 1.9% (252) were infested with lice ,predominantly *Bovicola ovis* ,*Linognathus pedalis* , *L. africanus* and *L. ovillus*. The 11% (533) of infested goats carried *L.stenopsis*, *L.africanus* and *B. caprie* (Gabaja et al., 1992) which is in agreement with our study.

High prevalence of tick infestation was observed in the study area. The overall prevalence in sheep was 14.04% while in goats 17.7%. The most important tick species identified from sheep in the three agroecological areas were *Amblyomma spp*, *Rhpicephalus e.vertsi*, *Rhipicepalus praetexatus*, *Boophilus decoloratus*, *Amblyomma variegatum*, *Hyalomma truncatum* and tick species identified from goats were *Amblyomma spp*, *Rhipicephalus e.evertsi* and *Boophilus decoloratus*, showing the presence of economically important ticks in the study area. Several tick genera are widely distributed in Ethiopia, such as *Amblyomma*, *Boophilus*, *Rhpicephalus* and *Hyalomma* that are the main parasites of livestock. The remaining species occur in limited number and have little practical significance to livestock production (Mekonnen, 1996).

Accordingly, the major tick infestation was found to be significantly higher in goats than in sheep. This may indicate a relative host preference of these tick species. *Amblyomma variegatum* is widely distributed in Ethiopia, and the preferred hosts of the adult tick are cattle, but they also infest sheep and goats. This tick requires moisture and warmth for its survival and is not found in open grassland (Pegram et al.,1981).

The species of ectoparasites identified from sheep and goats were the same as for cattle, however prevalence and density of infestation is differed, probably due to pasture differences (Encinas Grandes,1986). ticks attacked both kinds of animal, those with their bodies fully protected by wool and those without wool. Two categories did not differ significantly, suggesting that whether wool covered the body completely or left parts of the body uncovered, did not affect infestation.

It has been reported that ectoparasites are the major constraints in the production of good quality skins from sheep and goats (Asegedech et al.,1999; Ermias,2000; Numery,2001; Bayu,2005). In the present study, the skin scraping test for the presence of mange mites did not show any positive result. Despite the differences in study area and environment,

0% prevalence of demodectic mange in sheep was reported from Sidama zone south Ethiopia (Teshome, 2002). The current result is comparable with the report from Wolaita Sodo (0.98%) (Yalew, 2007), from the same area of study by Chalachew (2001) (1.3%) and from Sidama zone Southern Ethiopia (0.95%) (Teshome, 2002). The absence of mange mite infestation in sheep and goat in the study area (North weast shoa Zone of Oromia region) is similar to the finding of (Chalachew, 2001).

It is an established fact that higher humidity and skin wetting known to favour the survival of ectoparasites, and the penetration and colonization of the skin by various etiological agents (Paangui, 1994).

The current study shows the dependence of ectoparasite prevalences in sheep on the two seasons studied. The early dry season has higher prevalence with respect to keds, ticks, lice and fleas than the late wet season. (Milines and Green,1999) reported that the prevalence of louse infestation varied widely throughout the year, but peaked in winter with nearly 90% of sheep skin examined.

Mellophagus ovinus tend to be most common on lambs, which become infested by direct contact with the ewes. Young animals are generally more susceptible to ectoparasites because of higher ratio of accessible surface to the body volume and poor grooming behaviour (Lehmann, 1993)

The relatively lower prevalence of multiple infestation observed for ectoparasites may reflect the similarity of the life cycle pattern of most of the parasites.

In a certain study, lambs in March along with older sheep have similar densities of ked numbers in the following summer and autumn as older ewes. Two factors contribute to this, temperature and the development of resistance in individual sheep (Nelson 1956) ceased at lambing, which was attributed to the development of resistance through nutritional factor, especially vitamin A (Nelson and Hironak, 1966)

Sheep keds were found commonly on shoulder, back, venter and tail. Most pupareal and adult sheep ked were frequently detected on the chest, forequarter and ribs region with few on the back of abdomen, although all parts of the body support keds. Some authors have

indicated that the neck and the body of sheep are the preferred sites of sheep keds (Legg *et al*., 1991; Jubb et al., 1993) .Others indicated that the preferred sites are the neck, tail and the ventral parts of the body (Asp and Taunni,1988; Legg *et al*., 1991). Macleod (1948) recorded that sheep keds increased on the back, lower sides and abdomen in summer. (Muma *et al*.,1952) suggested that higher ked population and/or poorer nutrition may influence growth rate.

The finding of (Milines and Green ,1999) that the neck and shoulder were most affected (68%) followed by the forelimbs and dewlap (39.1%) corresponds well with the reported predilection sites for lice (Nafsta and Gronstol,2001b).

The preferential sites of attachment of ticks were the axilla, inguinal region, face, ears and under tail. Ticks bits initially caused papule and wheals, which may latter develop in to crusts, erosions, ulcers and local alopecia. Skin lesion is caused by ticks are described by various authors (Wall and shearer, 1997, Mac Gavin et al.,2001) . On subcutaneous sides of the skin tick bites are known to leave bleeding points and edema in which the mouth parts of the ticks are attached (Asp and Taunni ,1988) In the present study, lowland goats were most affected by the tick infestation. Lice were observed to infest the neck ,shoulder and flank areas. These areas are observed to be the most preferred sites for *Linognathus stenopsis*. These areas are commonly having long hair, and those providing a good habitat which is readily colonized by Lice (Urquart et al., 1987) . Excessive use of acaricides, especially on small ruminants, for tick control is the probable reason for the low level of lice infestation (Molu, 2002).

Higher prevalence rate of tick infestation was observed in female than in male sheep. this findings is supported by (Hoskins,1991) some vigorous healthy animals do react and repeal any attempt of ticks to attach to them. Lactating and pregnant animals could be weak and prone to the attacks of ticks.

6. CONCLUSION AND RECOMMENDATIONS

Generally, the results of this study clearly reveal that ectoparasites such as sheep keds, lice and ticks are prevalent in the study areas. The presence of these parasites in small ruminant has great economic value for downgrading the quality of skin of animals, and hence reducing the foreign currency earning of the country. Heavy economic losses of the skin of small ruminants at foreign trade are caused due to management, storing, skin disease, external parasites etc. The Ethiopian Government currently is undertaking a control program against ectoparasites and skin diseases (mangemite) of small ruminants in Afar, Tigray and Amhara Administrative region by dipping and spraying using acaricidal chemical called Diazinon. Therefore, unless other relevant administrative regions take part in the campaign, the program could not be effective as untreated animals transmit the disease and the parasites to the treated ones. Though the study sites are in the Oromia Administrative region, it is adjacent and neighbour to Northern Shoa zone of Amhara region which currently are undertaking control campaign against ectoparasites and skin diseases. So the finding of this study will definitely contribute to the National effort for the control of external parasites and skin diseases of small ruminants, hence in improving the quality of the commodities and increase national foreign currency earning.

As the study area prevails different types of ectoparasites of small ruminants, considering the importance of skin as a main source of foreign currency the following recommendations may be forwarded:

- Control of ecto-parasite using effective insecticides and acaricides should be practiced to minimize the impact of parasitism on health and productivity of animals.
- Education of the owners with regard to parasitic diseases and appropriate husbandry systems will facilitate the applicability of the control measure.
- The control programme run by the Ethiopian government can be asked to be extended to the study site as well as to other regions of the country affected with the ectoparasitic diseases of small ruminants.
- All stakeholders: farmers, tanners and the government should participate in and implement effective ectoparasite control programme.

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8. ANNEXES

ANNEX I: Photographs taken during the study period

Plate 1. Infestation of *Mellophagus ovinus* on sheep.

Plate 2. Examination of goat for ectoparasites at Hidabu Abote

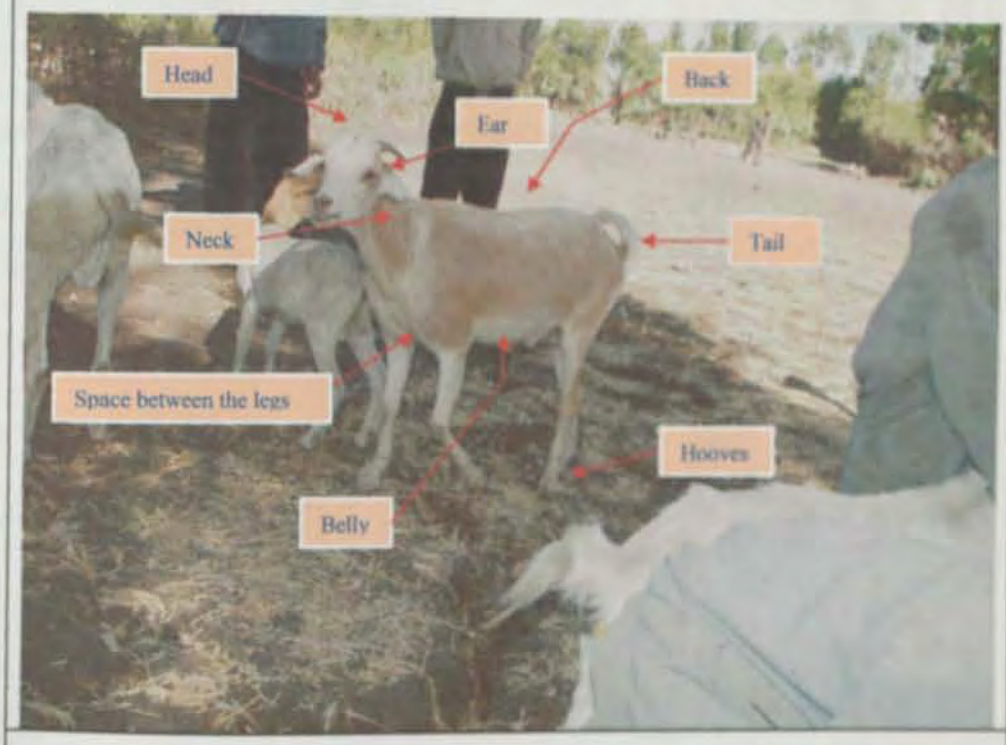

Plate 3. Predilection sites of ectoparasites on goat

ANNEX II: Ectoprasites of small ruminants

a

b

Plate 4. *

a. Amblyomma spp.

b. Mellophagus ovinus

c. Bovicola ovis

c

***Source:** Soulsby (1982) , Matthysse,J.G.& Colobo,M.H.(1987).

9. CURRICULUM VITAE

1. PERSONAL DETAILS

Name	:	NIGIST MEKONNEN SIMGHEN
Sex	:	Female
Date of Birth	:	August 05/1970
Nationality	:	Ethiopian
Marital Status	:	Single
Address	:	National Animal Health Diagnostic and Investigation Center. P.O Box 04, Sebeta , ETHIOPIA Mobile: 09 11 67 44 28 E-mail: nigistmekon@yahoo.com
Profession	:	Associate Researcher

2. EDUCATION

1975- 1980	Hibret Frae Elementary School (Addis Ababa)
1981- 1984	Sene 21 High School (CUBA.)
1985- 1986	Mengistu Haile Mariam High School (CUBA)
1987- 1991	DVM, Granma University, Bayamo (CUBA)

3. LANGUAGE

	SPEAKING	READING	WRITING
Amharic	Excellent	Excellent	Excellent
English	Good	Good	Good
Spanish	Excellent	Excellent	Excellent

4. WORK EXPERIENCE

1992 – 1996	Veterinary officer (field Veterinarian). Sodo woreda ,(BUEE) South Ethiopia Peoples Nation & Nationalities Regional government state
1997- to date	Associate Researcher, Parasitology Department, Acarology and Entomology Section, National Animal Health Diagnostic and Investigation Center (NAHDIC).

5. COMPUTER SKILL

Microsoft Excel	Microsoft Word
Microsoft Access	Microsoft Power point

6. PUBLICATIONS.

1. Ibrahim Hussen, Sileshi Mekonnen, Nigist Mekonnen, Preliminary Entomological survey (1999). Ethiopian Veterinary Association proceeding of the 12th Conference 1999.

2. Solomon Gebre, Nigist Mekonnen and Kassa Bayu 2003, Seasonal Variation of Ticks on Calves at Sebeta in Western Shoa Zone, Ethiopia, in Ethiopian Veterinary Journal Vol.7 Number 1&2 ISSN 168-6324 Page 17.

3. Nigist Mekonnen2004, A case of gynandromorphism in Amblyomma variegatum at Sebeta, Ethiopia, in Ethiopian Veterinary Association Short CommunicationVol.8 Number 1 ISSN 1683-6334 Page 89-92

7. PARTICIPATION

- Member ship of Ethiopian Veterinary Association (EVA)
- Member of Organizacion profesional de listas veterinarias, Malaga, Spain

8. TRAINING

- CERTIFICATE : for participation in the training workshop on planning Monitoring and Evaluation organized by Ethiopian Agricultural Research Organization (EARO) from 24 to 29 September 2001 Addis Ababa.

- CERTIFICATE : for participation in the training workshop on SAS program at the year 2000 in Addis Ababa.

- CERTIFICATE: for participating in the training workshop on Biometrics Using Genstat for Windows organized by International Livestock Research Institute(ILRI) from 13 to 17 December 2004

The information I have provided above is true and correct

Name NIGIST MEKONNEN (DR)

Signature _____

Date 25/June/2000

10. STATEMETNT OF DECLARATION

This Thesis, my original work, has not been presented for a degree in any other University and that all source material used for the thesis have been duly acknowledged.

Name ..... Nigist Mekonnen .....

Signature .....

Date of submit ion ..... 25/June/2008 .....

This thesis has been submitted for examination with my approval as an advisor.

1. Dr. Basu. A.K .....
2. Dr. Yacob.H .....