ADDIS ABABA UNIVERSITY
FACULTY OF VETERINARY MEDICINE

STUDIES ON MAJOR ECTOPARASITES AND ASSOCIATED GROSS AND MICROSCOPIC SKIN LESIONS IN SMALL RUMINANTS OF KAMBA AND BONKE DISTRICTS (SOUTHERN, ETHIOPIA).

BY

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DEBRE ZEIT, ETHIOPIA

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ABBREVIATIONS page

AAU	Addis Ababa University	41
ARPPIS	African Regional Postgraduate programme in Insect Science	41
CTA	Technical Center for Agricultural and Rural Cooperation	41
S.R.L.	Southern Range Lands	7
Ch. S. F.	Chafe State Farm	7
CSA	Central Statistical Agency	15
DVM	Doctor of Veterinary Medicine	41
DPX	Disterene, Dibutylphtatlate,Xylene	50
FVM	Faculty of Veterinary Medicine	41
ICIPE	International Center for Insect physiology and Ecology	41
UK	United Kingdom	41
USA	United States of America	39

ABSTRACT

A study was conducted to determine the prevalence of ectoparasites and associated gross and microscopic skin lesions in sheep and goats in Kamba and Bonke districts (woredas) of Gamo-Gofa Zone in Southern Nations Nationalities and Peoples Regional State. The study was conducted from October 2007 to April 2008. During the study period a total of 483 sheep and 503 goats were examined for the presence of ectoparasites and lesions caused by these parasites. Study sheep and goats were randomly selected from fifteen peasants associations of Kamba and Bonke districts. An overall prevalence of (73.53%) of ectoparasites was recorded in both host species. Out of 986animals i.e.483 sheep and 503 goats examined, 725 animals i.e. 360(74.53%) sheep and 365(72.56%) goats were infested with one or more ectoparasites. In the study lice and ticks were identified as predominant ectoparasites on sheep and goats of the study areas. The ectoparasites identified in sheep were lice (45.18%), tick (14.49%), sheep ked (13.0%), and fleas (1.45%), Demodectic mange (0.41%).Where as in goats lice (28.23%), tick species (27.04%), mange mites (16.31%), and fleas (0.99%) were identified. Lice species were *Damalinia ovis, Damalinia caprae, Linognathus ovilus*, tick species *Rhipicephalus pravus, Rhipicephalus pulchelus, Rhipicephalus sanguineous, Rhipicephalus lunulatus, Rhipicephalus muhsamae, Amblyomma variegatum, Boophilus decoloratus*, sheep ked *Melophagus ovinus*, mange mitetes *Sarcoptes scabies, Demodex ovis, Demodex caprae*,and cat flea *Ctenocephalides felisfelis* were identified. In the study the major gross skin lesions observed were red papule315 (25.44%), erythma 298(24.07%), crust formation222 (17.93%), superficial erosions 187(15.11%) scratches/excoriations 99(8.0%), loss of hair/alopecia 66(5.33%), superficial ulcers 41(3.31%), and thickening and wrinkling of the skin10 (0.81%) and were grossly characterized and recorded. Biopsy samples from 25 sheep and 25 goats were collected and tissue was processed and examined using histopathological techniques. Microscopic skin lesions were characterized and the results of the examination showed that epidermal changes include parakeratotic hyperkeratosis, acanthosis, spongiosis, and the main dermal lesions include vasodilatation, edema, and extensive infiltration by eosinophiles, macrophages, and lymphocytes.

Key words: Bonke and Kamba districts; ectoparasites, skin lesions, small ruminants, Ethiopia.

1. INTRODUCTION

Small ruminants are important contributors to food production in Ethiopia, providing 35% of meat consumption and 14% of milk consumption (Asfaw, 1997). Owing to their high fertility, short gestation interval and adaptation even in harsh environments, sheep and goats are considered as investments and insurance to provide income to purchase food during seasons of crop failure and to meet seasonal purchases such as improved seed, fertilizer and medicine for rural households. Even though small ruminants are important components of the Ethiopian farming system, their contribution to food production, rural income and export income are far below than the expected potential. This is because small ruminant production is constrained by the compound effects of diseases, poor feeding and poor mamagement (Getachew, 1995).

Hides and skins account for 12-16% of the total value of exports in Ethiopia (Asfaw, 1997. The current utilization of hides and skins in Ethiopia is estimated at 48% for cattle, 75% for goat and 97% for sheep with expected off take rate of 33, 35, and 7% for sheep, goats, and cattle, respectively. Numerous endogenous and exogenous factors cause significant alterations in the skin, an organ with a limited spectrum of responses to injury (Carlton *et al.*, 1995).

Responses to injury are manifested by changes in the epidermis, dermis, adnexia, and panniculus (Carlton *et al.*, 1995). Abnormalities of wool and hair fibers, abnormalities of sweat secretion, and abnormalities of sebaceous gland secretions, alopecia, pruritus, and dermatitis are also manifestations of skin diseases (Radostits *et al.*, 1994). The characteristic gross appearances of skin affected by skin diseases include thickened skin, encrustations, vesicles, papules, nodules, and areas of superficial erosions and ulcerations (Jones *et al.*, 1997). Histopathologically, epidermal changes of infected skin are characterized by the presence of parakeratotic hyperkeratosis, acanthosis, and spongiosis; however, such lesions vary with the specific causes (Cynthia *et al.*, 2005). The main dermal lesions consist of superficial vasodilatation, edema, and extensive infiltration by eosinophils, macrophages, mast cells and lymphocytes that are typically seen in hypersensitive reactions (Jones *et al.*, 1997).

Gross and microscopic skin lesions caused by lice, ticks, and mange mites, ked and fleas result in serious economic losses to smallholder farmers, the tanning industry and the country as a whole. They can result in mortality, decreased production and reproduction, down grading and rejection of skins. Hides and skin problems caused by ticks, lice, mange mites, keds and fleas are among the major pre-slaughter defects that cause downgrading and rejection. According to tannery reports, hide and skin problems due to external parasites cause 35% of sheepskin and 56% of goat skin rejection (Bayou, 1998).

Several previous studies conducted in different parts of the country reported the widespread occurrence and high prevalence of ectoparasites on prevalence of ectoparasites in sheep and goats in Ethiopia. According to these reports ectoparasites induced skin alterations including erythema, papules, nodules, vesicles, exudates, scab formation, crust formation, hair loss, thickeness, superficial erosions, and due to self-inflicted injuries superficial excoriations (Chane, 2007). Economic losses due to ectoparasites in Ethiopia are considerably very high. Losses due to reduced in milk and meat production, downgrading of skin quality, losses due to deaths, and due to treatment and control measures are very enormous.

In spite of the wide spread distribution and high prevalence of ectoparasites on small ruminants in many parts of Ethiopia .There is a big information gap with respect to the knowledge of distribution and effects of ectoparasites and few studies had been conducted with regard to skin lesions caused by ectoparasites in the country and particularly no such study had been conducted in Southern Nations Nationalities and Peoples Regional State. Information on major ectoparasites and associated gross and microscopic skin lesions could be used in taking appropriate prevention and control measures against ectoparasites of small ruminants. Therefore the present study was designed to achieve the following objectives:

- To characterize gross and microscopic skin lesions on sheep and goats caused by ectoparasites in the study area.
- To determine the prevalence of ectparasites and associated skin lesions in small ruminants in the study area.
- To identify the major species of ectoparasites infesting sheep and goats in the study area.

2. LITERATURE REVIEW

2.1. Skin diseases of small ruminants caused by ectoparasites

2.1.1. Tick infestation

The arthropods contain over 80% of all known animal species and occupy almost every known habitat. As a result of their activity, arthropod ectoparasites may have a variety of direct and indirect effects on their hosts (Wall and Shearer (1997).

There are more than 850 species recognized with approximately 180 in the family Argasidae (soft ticks) and the other in the family Ixodidae (hard ticks) (Wall and Shearer, 2001). Hard ticks and some of Argasidae affect small ruminants. Most species of Amblyomma, Boophilus, Rhipicephalus, Hyalomma and Haemaphysalis are frequently encountered hard ticks (Ixodidae) in Ethiopia (Sinishaw, 2000).

The infestation of ticks has always represented one of the most important problems affecting sheep and goat livestock in developed and developing countries (de Castro, 1997; Ghirotti and Maroli, 1997; Jongejan, 1999).

Ticks and tick-borne diseases affect animal and human health worldwide and are the cause of significant economic losses. Ticks and tick-transmitted infections have co-evolved with various wild animal hosts, which often live in a state of equilibrium with them and constitute reservoir hosts for ticks and tick-borne pathogens of livestock, pets and humans (Jongejan, 1999).

They have only become problems of domestic livestock when these wild hosts came into contact with them, either because man moved livestock into infested regions, or moved livestock infested with ticks into previously uninfested regions. Most ticks have preference for feeding on certain groups of wild animals, with some even being quite host specific. Consequently, the number of species pertinent to domestic animals and / or humans is limited. As a matter of fact relatively few species of ticks have successfully adapted to livestock or feed on a human subject, and these

have developed into efficient vectors of a range of pathogenic microorganisms, while virtually all human tick-borne diseases are zoonotic(Jongejan, 1999).

Ticks transmit a greater variety of pathogenic microorganisms, protozoa, rickettsiae, spirochetes and viruses, than any other arthropod vector group, and are among the most important vectors of diseases affecting livestock, humans and companion animals. Moreover ticks can cause severe toxic conditions suck as paralysis and toxicosis, irritation and allergy. In general, tick-borne protozoan diseases (e.g. theilerioses and asbestoses) and rickettsial diseases (e.g. anaplasmoses and heartwater or cowdriosis) are pre-eminent health and management problems of cattle and small ruminants, as well as buffalo, affecting the livelihood of farming communities in Africa, Asia and Latin America(Jongejan, 1999).

Recently, tick-borne- diseases were again ranked high in terms of their impact on the livelihood of resource-poor farming communities in developing countries (Perry *et al.*, 2002; Minjauw& Mc Leod, 2003). Minjauw and Mc Leod (2003) have made a great effort at producing figures, tables, and maps on the importance, the distribution, the numbers of animals at risk and the cost of the various diseases in eastern and southern Africa, also to some extent in sub-Saharan Africa as a whole, and of tropical theileriosis in India. They estimated the annual cost of tropical theileriosis in India at 383.million USS, of East Coast fever in the smallholder dairy system in Kenya and Tanzania at 54.4 million USS and 4.41 million, respectively, in the traditional system in Kenya and Tanzania at 34.1 and 129.5 million, respectively.

The pathogenic effects are associated with the feeding mechanisms of the parasite, which is ideal for both penetrating the skin and transmitting microorganisms. In the feeding process the scissor-like actions of the digits at the end of chelicerae is followed by a thrusting motion of the hypostome through the lacerated skin and the locking effect of its re-curved teeth on the tissues (Urquhart *et al.*, 1996). The extent of skin lesions caused by hard ticks depends on the size of the proboscis. Ticks like Amblyomma have very long proboscis and can inflict severe lesions. Local cutaneous reactions vary in severity with the tick and its secretions and the resistance of the host. Gross lesions consist of focal erosions, erythema, and crusted ulcers with alopecia and nodules in

some individuals. Microscopic lesions include epidermal and dermal necrosis (triangular with the apex at the panniculus), and peri-vascular to diffuse inflammation at the margins of the necrotic

area, with the exudates consisting of eosinophils, macrophages, and lymphocytes. Some lesions are granulomas (arthropod-bite granuloma) in which the inflammatory cells efface the tissue architecture and are interspersed among collagenous fibers and lymphoid follicles that form within the dermis (Carlton *et al.*, 1995). The prevalence of ticks in sheep and goats in Ethiopia is given in table bellow.

Table 1: Prevalence of ticks in small ruminants in some parts of Ethiopia

Study sites	Prevalence (%)		Source
	Sheep	Goats	
Sidama Zone	10.1	15.9	Worku, 2002
Central Ethiopia	0.93	1.71	Mohamed, 2001
Kombolcha (wolo)	-	4.58	Abdulhamid, 2001
Ch.S.F (wolo)	57.4	-	Dejene, 1994
Dire Dawa	41.77	0.007	Tadesse, 1994
S.R.L. Oromia	9.54	5.27	Nura, 2002

Control of tropical tick-borne diseases, especially in more susceptible and productive exotic or upgraded breeds of livestock, still depends mainly on intensive tick control using acaricides. However, these chemical are toxic, leave residues in meat and milk and cause environmental pollution. Moreover, acaricides are costly and require expenditure in foreign currencies, thus constituting a major economic constrain on the development of the livestock industry, particularly in developing countries. The resistance of ticks to acaricides poses an increasing threat to livestock production. Consequently intensive and (and thus expensive) dipping or spraying programmers have been largely unsuccessful in eradicating ticks and tick-borne diseases. Integrated tick control strategies are therefore advocated (Young *et al.*, 1988).

2.1.2. Lice infestation

Small ruminants may become infested with the biting lice *Damalinia ovis* in sheep and *Damalinia caprae* in goats belong to order Mallophaga and sub-order Ischinocera or the sheep foot louse, *Linognathus pedalis*; the face and body louse, *Linognathus ovillus*; and the African blue louse, *Linognathus africanus*. *Linognathus stenopsis*, the goat sucking louse, is found in shorthaired and Angora breeds of goats that belong to the order Anoplura (Soulsby, 1986). The sheep body lice (*Damalinia ovis*) are found throughout sheep producing areas of Australia, on the mainland of Papua-New Guinea, and in New Zealand, South Africa, Europe and North America.

The favored sites for lice on the sheep are the mid-sides and back, irrespective of the degree of infestation. However, lice were found all over the body including the belly and the underside of the neck. *Damalinia ovis* is a small (up to 1.8 mm long) dorso-ventrally flattened insect; adults have a broad reddish head and a pale cream thorax and abdomen with reddish-brown stripes. *Damalinia ovis* apparently feed the outer stratum corneum of the epidermis as well as on the loose scruff littering the skin surface (Cynthia *et al.*, 2005).

The main method of transmission is by close contact between sheep. The population density that develops varies between sheep and heavy infestations do not develop on all sheep even when climatic conditions are most favorable. Shearing removes the bulk of the habitat apart from 6-8 mm near the skin and thus removes 30-50% of the population (Bayou, 1998). Infestation with lice cause anemia, weakness, damage to hairs and wool (ragged, pulled appearance), and discomfort. Biting lice, feeding more on epithelial cellular debris and less on blood, cause less severe systemic signs.

Infestation occurs more commonly in winter when temperatures are cooler, the wool or hair coat is longer, animals are congregated, and the plane of nutrition is lower. Spread by direct contact and the life cycle takes place entirely on the host (Carlton *et al.*, 1995). Primary lesions caused by lice are few, and most are secondary to scratching. Gross lesions consist of papules, crusts, and secondary excoriations with lice and eggs visible in the lesions (Carlton *et al.*, 1995). Histologically the epidermis of infested sheep shows moderate orthokeratosis (thickening of the

stratum corneum) (Carlton *et al.*, 1995) and a slight to moderate acanthosis due to hyperplasia of the stratum spinosum of the epidermis (Jones *et al.*, 1997). The skin is also thickened in the sudanophilic regions and the thickening is positively correlated with the level of louse infestation due to hyperplasia of the stratum spinosum of the epidermis (Carlton *et al.*, 1995).

Increased number of plasma cells, eosinophills and polymorphonuclear neutrophils may also be observed (Jones *et al.*, 1997). *Linognathus pedalis* (Foot louse) which is bluish-grey in color, about 2mm long with a short, pointed head, slightly longer than it is broad which is buried in the skin during feeding and *Linognathus ovillus* (Face louse) which is blue grey in color, with the head twice as long as it is broad the hairs on the abdomen are arranged in rows is the largest louse found on sheep (2.5 mm long). *Linognathus pedalis and Linognathus ovillus* are believed to live exclusively on blood. *Linognathus pedalis* is characteristically infesting the hairy regions of the legs of sheep, especially around the coronet and fetlock and between the fetlock and the knee or hock. *Linognathus ovillus* with heaviest populations occur on the face at the wool/ junction. Infestation with *Linognathus ovillus* mainly cause fleece discoloration and cause fleece damage (Soulsby, 1986). To control lice insecticides are used. Some reports on lice infestation in sheep and goats showed that it is common in Ethiopia (Table 2).

Table 2: Prevalence of lice infestation in small ruminants in some parts of Ethiopia

Study sites	Prevalence (%)		Source
	Sheep	Goats	
Sidama Zone	23.5	18.3	Work, 2002
Central Ethiopia	2.0	1.52	Mohamed, 2001
Kombolcha (wolo)	-	11.54	Abdulhamid, 2001
S.R.L. Oromia	-	0.53	Nura, 2002

2.1.3. Mange mites

Mites of the family Sarcoptidae are commonly referred to as sarcoptic itch or scabies mites those have a wide geographic distribution in many sheep and goat raising areas of the world (Urquhart *et al.*, 1996). *Sarcoptes scabiei var ovis* in sheep and *Sarcoptes scabiei var caprae* in goats is highly contagious mite. The pathogenesis of lesions in *sarcoptes scabiei* infestation is due to direct damage inflicted by the parasite mechanically and by the irritant effects of its secretions and excreta, and by allergic reactions developed against components of the mite or one or more of the extra-cellular products of the parasite (Jubb *et al.*, 1993). The mites burrow through the *stratum corneum* and cause intense pruritus principally due to hypersensitivity reactions, although irritation from secretions and excretions also plays a role (Carlton *et al.*, 1995). While burrowing tunnels to lay eggs, serum seeps out of the tunnels and dried on the surface of the skin to form thick scabs (Urquhart *et al.*, 1996). Lesions generally begin on thinly haired (nonwooly skin in sheep, usually starting on the external ears, head, face and neck and may be generalized).

In goats Sarcoptes scabiei var caprae is responsible for a generalized skin conditions characterized by marked hyperkeratosis, lesions usually start on the head and neck (Carlton *et al.*, 1995; Cynthia *et al.*, 2005). The condition in this species is often chronic, and may have been present simply as a 'skin disease' for many months before definitive diagnosis has been made (Urquhart *et al.*, 1996). Gross lesions include erythematous macules, papules, crusts, and excoriations. Chronic lesions are scaly, lichenified and hairless (Carlton *et al.*, 1995). Microscopically, the lesion is a hyperplastic, spongiotic, superficial peri-vascular dermatitis, with crusting and infiltration of eosinophils (Carlton *et al.*, 1995). Different studies showed that sarcoptic mange is prevalent in Ethiopia and it is more common in goats than in sheep (Table 3).

Table 3: Prevalence of sarcoptic mange of small ruminants in some parts of Ethiopia.

Study sites	Prevalence (%)		Source
	Sheep	Goats	
Tigray	30.32	31.77	Mussema, 2000
S.R.L. Oromia	0.22	0.20	Nura, 2002
Dire Dawa	22.7	43.10	Tadesse, 1994
Harrarge	2.33	4.66	Tekle, 1986
Kombolcha (Wolo)	-	33.27	Abduhamid, 2001
Sidama Zone	-	0.47	Worku, 2002
Wolaita	-	0.44	Ngusie, 2001

Psoroptic mange (sheep scab) is caused by *Psoroptes ovis* and is a notifiable disease (Cynthia *et al.*, 2005). *Psoroptes ovis*, though it is non-burrowing mite, unlike most non-burrowing mites, it has piercing mouth parts which can severely damage the skin (Urquhart *et al.*, 1996). The distribution of mites on animals varies according to season, the infestation being in a quiescent state in reservoir sites such as the axilia, groin, infra-orbital fossa, and inner surface of the pinna and auditory canal during spring, summer, and early autumn, and spreading rapidly over the rest of the in the colder months as the fleece thickens (Urquhart *et al.*, 1996). It is very active in the keratin layer, and cause direct damage to the skin by pricking with its mouth to feed on lymph and tissue fluids (Cynthia *et al.*, 1998).

The earliest phase of infection occurs as a zone of inflammation with small vesicles and serous exudates, but as the lesion spreads, the centre becomes dry and covered by a yellow crust while the borders, in which the mites are multiplying, are moist. The first visible sign is usually a patch of lighter wool, but as the area of damage enlarges the sheep responds to the intense itching associated with mite activity by rubbing and scratching against fence posts and other objects, so that the wool becomes ragged and stained, and is shed from large areas (Urquhart *et al.*, 1996). Lesions develop on the withers and sides. The woolen areas are chiefly involved with crusts that

adhere to the matted fleece and, in time, expand and coalesce. Damage is due to self-inflicted trauma, resulting from local irritation and hypersensitivity reactions.

Microscopically, the epidermis of the infected skin is variably acanthotic, hyperkeratotic, parakeratotic, and contains the characteristic mites in the stratum corneum beneath the thickened layer of the superficial keratin. The dermal lesions consist of superficial vasodilatation, edema, and extensive infiltration by eosinophils, macrophages, mast cells, and lymphocytes, typically those cells seen in type I and type IV hypersensitivity reactions (Jones *et al.*, 1997). Psoroptic mange (ear mange) in goats, caused by psoroptes cuniculi, usually affects the ears but can spread to the head, neck, and body and cause sever irritation. This occurs particularly in the angora goats, in which the mohair is considerably damaged (Cynthia *et al.*, 1998). The prevalence of Psoroptic mange is more common in sheep than in goats (Table 4).

Table 4: Prevalence of Psoroptic mange of small ruminants in some parts of Ethiopia

Study sites	Prevalence (%)		Source
	Sheep	Goats	
Sidama Zone	1.63	0.95	Worku, 2002
Central Ethiopia	1.80	2.25	Mohamed, 2001
Ch. S.F.(Wolo)	42.9	-	Dejene,1992
Robe(Bale)	20	-	Ashine,1987
Addis Ababa	32.87	-	Nigatu,1992
Harrarge	4.67	6.15	Tekle, 1994
Mekele	1.15	-	Gaim,1994
S.R.L. Oromia	0.15	0.37	Nura,2002

Demodectic mange in sheep is caused by *Demodex ovis* and is of little economic importance, being confined to the face region and being mild in character (Urquhart *et al.*, 1996). In goats it is

caused by *Demodex caprae*, in which it causes lesions similar to those in cattle. Demodicosis is worldwide in distribution. It is of greatest economic importance in warm countries (Urquhart *et al.*, 1996). In goats non-pruritic papules and nodules develop, especially over the face, neck, shoulders, and sides. The nodules contain a thick, waxy, grayish material that can be easily expressed; mites can be found in these exudates (Cynthia *et al.*, 2005).

Localized demodicosis consist of one or more scaly, erythematous, alopectic macular areas on the face and legs. Generalized lesions consist of large coalescing patches of erythema, alopecia, scales, and crusts (Carlton *et al.*, 1995). Microscopically perifolliculitis and follicular hyperkeratosis may be associated with follicular plugging, bacterial proliferation, and bacterial neutrophilic folliculitis. The follicular plugging and mites may result in follicular rupture, a secondary foreign body furunculosisis and sometimes, cellulitis with lymphadenitis and septicemia (Carlton *et al.*, 1995). Demodectic mange is more prevalent in goats than in sheep in Ethiopia (Table5).

Table 5: Prevalence of demodectic mange of small ruminants in some parts of Ethiopia

Study sites	Prevalence%		Source
	Sheep	goats	
Wolaita	-	6.13	Nigusie,2001
Kombolcha(wolo)	-	1.36	Abdulhamid,2001
Ch.S.F.(Wolo)	3.2	-	Dejene,1992
Harrarge	0.84	0.99	Tekle,1986
S.R.L. Oromia	0.88	3.50	Nura,2002
Ch.S.F.(Wolo)	3.2	-	Dejene,1992

2.1.4. Sheep ked infestation

The sheep ked *Melophagus ovinus* is a member of the parasitic Dipteran family Hipoboscidae. *Melophagus ovinus* is a dark brown or grayish, hairy insect varying in length from 3-7 mm. It

was frequently, but incorrectly, called the sheep tick, it is a palaearctic species that has been widely distributed through human movement of sheep. *Melophagus ovinus* is now established in most temperate sheep raising areas, including Europe, North America, South Africa and Australia but is restricted to the higher altitudes in the tropics (Kettle, 1984). Sheep ked was a widespread ectoparasite of sheep and it 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.

Although with less veterinary importance in Europe since the introduction of pesticides, the sheep ked is reported to cause inflammation and, wool loss and skin damage can be caused (Soulsby, 1986). The latter in turn may lead to secondary infections and, particularly, expose the animal to cutaneous myiasis. Without statutory requirement to dip sheep in the UK, and the other changes in European and world wide agriculture noted by Colebrook and Wall (2004), it is impossible that *Melophagus ovinus* will be come more prevalent. Although sheep are generally considered to be the only definitive host, *Melopaghus ovinus* has been reported from a range of domesticated and wild animals including goat, bison *Bison bonasus* (Linn. 1758) Smith 1827 (Izdebska,2001), rabbit *Oryctolagus cuniculi* (Linn.1758) Liljeborg 1874, and red fox *Vulpes vulpes* (Linn. 1758) Frisch 1775 (Lassing *et al.*,1998). Wool type seems to be important determinant of infection rates. Urquhart *et al* (1996) stated that long- woolen breads appeared to be particularly susceptible.

To feed, sheep keds pierce the skin with their mouthparts and suck blood. They usually feed on the neck, breast, shoulder, flanks, and rump but not on the back where dust and other debris collected in the wool (Cynthia *et al.*, 1998). The feeding activity of keds causes a widespread pruritus, excoriated by the rubbing, scratching and biting of the hosts in response to the irritation (Urquhart, 1996). The fleece become thin ragged and dirty. The excrement of the keds causes permanent discoloration, which is likely to reduce the value of the wool. Keds also cause a defect in the skin called cockle, which affects the grade and value of the sheep skin (Cynthia *et al.*, 2005). Lesions induced by bites of flies are due to local irritation and include wheals and papules formed around a puncture wound that may bleed. Such lesions may persist with hair loss, scales, hemorrhagic crusts, erythema, and secondary excoriations due to self-inflicted trauma.

Microscopic lesions include superficial perivascular dermatitis. Eosinophilic folliculitis and furunculosis may also occur. Intraepidermal pustules, filled with eosinophils and foci of necrosis ("nibble marks") may be seen (Carlton *et al.*, 1995).

The economic losses result from the effects of feeding and scratching on the skin with the formation of hard nodules (cockle) reducing the value of the hide (Legg *et al.*, 1991); however cockle can also be caused by biting lice *Bovicola ovis* (Heath *et al.*, 1995). Bayou et al. (1999) demonstrated both an improvement in mean quality of hides and an increased weight gain in Ethiopian hairy sheep treated against lice and keds.

Keds are the intermediate hosts of the sheep parasite *Trypanosoma melophagium*; although considered non-pathogenic Nelson (1988) linked skin lesions on sheep to the presence of *Trypanosoma melophagium*. More significantly, it was reported that keds transmitted the Orbivirus responsible for blue-tongue disease, a serious condition that can cause 70% mortality in sheep, with survivors suffering weight and wool loss, abortions and congenital abnormalities (Mathieson, 1991). Bayou et al(1999) showed that a single shearing was as effective as effective in controlling keds as two sprays (1 week apart) with either diazinon or amitraz; 90 days after treatment mean weight gain was greatest in the shorn group, although not statistically significant from that of insecticide treated groups.

2.1.5. Flea infestation

Fleas are wingless insects with laterally compressed bodies, about 1.5-4 mm long. *Ctenocephlides felis felis* the cat flea and *Ctenocephalides canis* are cosmopolitan in distribution (Soulsby, 1982). Fleas are a rare cause of dermatitis in sheep and goats; however, infestation with *Ctenocephlides felis felis* has been reported. A popular rash with pruritus and self-inflicted excoriations occur in sheep and papules, crusts, pruritus and excoriations are clinical signs in goats (Wall and Shearer, 1997). Flea infestation is principally the problem of dogs and cats. Lesions occur over the dorsal lumbo-sacral region, caudo-medial thighs, ventral abdomen, and flanks. Gross lesions are multiple red papules and secondary excoriations (Carlton *et al.*, 1995).

3. MATERIALS AND METHODS

3.1. Study area

The study was conducted in Bonke and Kamba districts (woredas) of Gamo-Gofa Zone in Southern Nations Nationalities and Peoples Regional State, Ethiopia. These two woredas were selected because the life of the people is highly dependent on the small ruminant production. Bonke district: The total area of this district is in hectares 79,782. The climate is characterized by a mean rainfall of 1650 mm, and mean temperature ranging from 17-25C°. The agro-ecology comprises 46% highland, 30% midland, and 24% lowland with altitude ranging from 1200-3500 m.a.s.l. Recent number of peasants associations (PA) is 33 with 163,813 total human population and livestock population of cattle 96179, sheep 92183, goats 16349, equines23964, poultry 77432, Camels 24(CSA, 2002). Main food crops produced are: barley, wheat, sorghum, maize, teff, beans, peas, inset (famous food crop of southern Ethiopia), and potatoes. Major wild lives in the area are antelopes, warthog, apes, monkeys, and porcupines. The study was conducted in Dambile, Deshkele, Bulla, Gorate, Zaziae, and Gazeso PAs.

Kamba district: The size of this district is 118054 hectares. The climate is characterized by the annual minimum of 14 C^0 and maximum of 37 C^0 temperatures with 1400, 900, and 400 mm of rainfall. The human population of Kamba district comprises 39 Peasants Associations (PAs) with human population of 141312 and livestock population: Cattle 103975, Sheep78370, Goats 52067, Equines 13202, and Poultry 239990. The altitude ranges from 750 to 2900 m.a.s.l. Major food crops: Maize, Barley, Wheat, Sorghum, Teff, Peas, Beans, Different spices, Potatoes, Inset, and Cane Sugar, and Coffee, Bananna. Major wild animals in the district are Antelopes (Bushbucks, Greater and lesser kudus), Warthogs, Monkeys, Foxes, Lions and Pythons. The study was carried out in Fudale, Osamerche, Boko, Lae, Dombesale, Meroshile, Garda, Malewude, and Marta PAs.

3.2. Study animals

The study was carried out on the indigenous sheep and goats owned by farmers and agro-pastoralists under extensive and traditional management system.

3.3. Study design

A cross section type of study was used to asses ectoparasites and their associated gross and microscopic skin lesions on small ruminants of Bonke and Kamba districts. PAs from high, mid, and low altitudes were selected from these two districts. Age, sex, and body condition of each study small ruminant was determined during the study. In positive animals the extent of skin lesions was categorized into three classes as light if lesions are localized, moderate if lesions are regionalized type, and severe if lesions are of generalized type.

Study districts and PAs were selected purposively considering the high population of small ruminants compared to other districts in Gamo-Gofa zone. Study Sheep and goats from each PA were randomly selected for clinical examination for ectoparasites and gross skin lesions. Skin biopsy samples were collected from 25 sheep and 25 goats.

3.4. Sample size

The sample size of the current study was determined as per the method described by Thrusfield, (1995). The following points were considered for this purpose: 50% prevalence, 5% desired absolute precision and 2% accepted error at 95% confidence level. With the simple random technique the following formula (Thrusfield, 1995) was applied in sample size calculation:

$$n = \frac{1.962\ P_{exp}\ (1- P_{exp})}{d^2}$$

Where, n = Sample size

P_{exp} = expected prevalence

d = desired absolute precision

Since the disease was studied in two hosts (sheep and goats) the sample obtained was multiplied by two. So that 493x2 = 986 sheep and goats were examined in both woredas.

The sample size calculated was proportionally distributed for each agro-ecological zone according to the number of sheep and goats found in the study areas. Therefore, a total of 483 sheep and 503 goats were used in this study.

3.5. Clinical examination and sample collection

A total of 986animals (483 sheep and 503 goats) were randomly selected from 15 PAs located in three agro-ecological zones were clinically examined for presence of ectoparasites and gross skin lesions. The species, sex, age, and body condition of each selected animal was recorded during clinical examination. Body condition score was determined by modifying the scoring system described in Gatenby (1991) for sheep and goats. Poor body condition score was given to sheep and goats that were extremely thin with smooth and less prominent spinous process, transverse processes in which finger can be pushed and those having moderate depth of loin muscle. Good body condition score was given for sheep and goats in which the spinous process only stickup very slightly, smooth, rounded and well covered transverse process and those having full loin muscle and very fat.

Clinical examination of each study animal was performed by multiple fleece parting in the direction opposite to that in which hair or wool normally rests followed by and close visual inspection by naked eye and also using magnifying glass and by palpation of the skin for parasites and /or gross skin lesions across all parts of the animals including the ears and digits. Ectoparasites such as ticks, lice, sheep ked, and fleas were collected by hand from their attachment sites and predilection areas, placed in labeled containers with 70% alcohol as described in Urquhart *et al.*, (1996).

Skin scraping samples for mange mite examination were collected using scalpel blade by scraping the edges of the lesions until capillary bleeding was seen as described by Soulsby (1982) and preserved in 70% in ethyl alcohol. The operation sites on the animals were dressed in order to prevent secondary bacterial infection. The skin biopsy samples were collected from 50 animals (25 sheep and 25 goats) which were clinically affected with ectoparasites induced skin lesions and preserved in 10% neutral buffered formalin ten times greater volume than the volume of the specimen. The hairs from the operation sites were clipped using scissors; using 70% alcohol the areas were cleaned by soaking the sterile gauze, local anesthesia (2% lidocain) was applied to infiltrate the sapling sites. Incision biopsy method was used using scalpel blade and forceps. All collected sample were properly labeled with all relevant and required information.

The gross characteristics of skin and skin lesions including papules, nodules, exudates, scab formation, crust formation, superficial erosions and ulcers, excoriations (scratches), alopecia(hair loss), thickening and wrinkling of the skin were recorded .

3.6. Laboratory examination for parasites

Parasite species identification was carried out at the laboratory of pathology and parasitology department of FVM, Debre Zeit whereas histopathological examination of biopsy samples was performed at the National Animal Health Diagnostic and Investigation Center based at Sebeta town. The collected samples of ticks, lice, sheep keds, and fleas were examined under stereomicroscope and identification was performed according to the identification key given by Walker *et al.* (1999) and Okello-Onen *et al.* (1999) for ticks and Wall and Shearer (1997) and Urquhart *et al.* (1996) for lice, keds, mange mites and fleas (Annexes). Skin scrapings for mange mites were processed according to the method described by Cole. (1986). Mites were identified to the species level under compound microscope according to their morphological key structures.

3.7. Histopathological techniques for skin biopsy samples

The skin specimens previously collected from live animals were properly preserved in10% neutral buffered formalin for 48 hours and were subjected to tissue processing.
The samples were processed using histopathological techniques (samples were trimmed to the appropriate size, dehydrated in different concentrations of graded alcohol from lower grade to the absolute alcohol, cleared in xylene, impregnated and embedded in paraffin, sectioned using microtome, stained using routine Hematoxylin and Eosin stains, examined under low magnification) according to the procedures given in Bancroft *et al.*,(1994).

3.8. Data analysis

Collected raw data was carefully recorded and stored in Microsoft Excel database system used for data management. Statistical software package called SPSS for windows version 15 was used for data analysis. Descriptive statistics, percentages and 95% confidence intervals were used to

summarize the proportion of infected and non-infected animals. The effects of different environmental and host risk factors were analyzed by one way ANOVA test. Statistical significance was set at $P< 0.05$.

4. RESULTS

4.1. Prevalence of ectoparasites

Out of the total 483 sheep and 503 goats examined for ectoparasites 368(76.2%) sheep and 286(56.9) goats were infested with one or more ectoparasites (Table 6). The major ectoparasite identified in sheep were *Damalinia ovis* 334(69.15%) and *Melophagus ovinus* 63(13.04) followed by *Boophilus decoloratus* 42(8.7%), *Amblyomma variegatum*38 (7.87%), *Rhipicephalus pravus* 21(4.55%), *Rhipicephalus pulchellus* 17 (3.52%), *Ctenocephalides felis felis*15 (3.11%), *Rhipicephalus sanguineus* 14(2.9%), *Linognathus ovilus* 3(0.62%), *Demodex ovis* 2 (0.41%), and *Rhipicephalus muhsamae* 1(0.21%). In goats tick infestation with *Rhipicephalus* species comprising *R. pravus* 103(20.48%), *Sarcoptes scabiei* 78(15.51%), *R. pulchellus* 71(14.12%), *R.sanguineus* 56(11.13%), *Linognathus stenopsis* 55(10.93%), *Amblyomma variegatum* 48(9.54%), *Damalinia caprae* 35(6.96%), *Boophilus decoloratus* 34 (6.76%), *Ctenocephalides felis felis* 10(1.99%), *Rhipicephalus lunulatus* 7(1.39%), *Rhpicephalus muhsamae* 6(1.19%), and *Demodex caprae* 3(0.6%). In addition to adult ticks immature stages of *Amblyomma* nymph and larvae, *Rhipicephalus* and *Boophilus* nymphs were also identified.

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Table 6: Overall prevalence of ectoparasites in sheep and goats in Bonke and Kamba districts.

Ectoparasite species	Sheep n=483		Goats n=503		Total sheep and goats	
	No of positives	Prevalence (%)	No of positives	Prevalence (%)	No of positives	Prevalence (%)
D.ovis	334	69.15	-	-	334	31.6
D.caprae	-	-	35	6.90	35	3.31
L.ovillus	3	0.55	-	-	3	0.28
L.stenopsis	-	-	55	10.84	55	5.2
R.pravus	21	3.82	103	20.31	124	11.73
R.pulchellus	17	3.09	71	14.00	88	8.33
R.sanguineus	14	2.55	56	11.04	70	6.62
R.lunulatus	-	-	7	1.38	7	0.66
R.muhsamae	1	0. 18	6	1.18	7	0.66
Rhipicephalus nymph	2	0.4	20	4	22	2.23
A.variegatum	38	6.91	48	9.46	86	8.14
Amblyomma nymph	10	2.1	24	4.8	34	3.5
B.decoloratus	42	7.64	34	6.76	76	7.19
B.decoloratus nymph	1	0.2	11	2.2	12	1.2
M.ovinus	63	11.45	-	-	63	5.96
S.scabiei	-	-	78	15.38	78	7.01
C.felis felts	15	2.73	10	1.97	25	2.37
Dem.ovis	2	0.36	1	0.19	3	0.28
Dem.caprae	-	-	3	0.59	3	0.28

The prevalence of *D.ovis* in sheep was the highest of all prevalence recorded 159(64.63%) p=0.000 in Bonke district followed by *M.ovinus* 43 (17.48%), *B.decoloratus* 17(6.91%) *A.variegatum* 17(6.91%), *R.pravus* 21(4.4%) in sheep. In goats the highest prevalence was recorded with *L. stenopsis* 52 (21.05%), followed by *D. caprae* 33(13.36%), *R.pravus* 19 (7.69%), *R.sanguineus* 4 (1.63%), *A.variegatum* 17(6.91%), and *B.decoloratus 5* (2.02%) (table 7).

Table 7: Overall prevalence of ectoparasites in sheep and goats in Bonke district

Ectoparasites species	Sheep n = 246		Goats n = 247		Total sheep and goats n= 493	
	No of positives	Prevalence (%)	No of positives	Prevalence (%)	No of positives	Prevalence (%)
D.ovis	159	64.63	-	-	159	32.25
D.caprae	-	-	33	13.36	33	6.69
L.ovillus	-	-	-	-	-	-
L.stenopsis	-	-	52	21.05	52	10.55
R.pravus	8	3.25	19	7.69	27	5.48
R.pulchellus	4	1.63	-	-	4	0.81
R.sanguineus	4	1.63	-	-	4	0.81
R.lunulatus	-	-	2		2	1.01
R.muhsamae	1	0.41	-		1	0.2
Rhipicephalus nymph	1	0.39	1	0.4	1	-
A.variegatum	17	6.91	9	3.64	26	5.27
Amblyomma nymph	3	1.2	3	1.2	6	0.8
Amblyomma larvae	-	-	-	-	-	-
B.decoloratus	17	6.91	5	2.02	22	4.46
M.ovinus	43	17.48	-	-	43	8.72
S.scabiei	-	-	2	0.81	2	0.41
C.felis felis	2	0.82	2	1.6	4	0.82
Dem.ovis	1	0.41	-	0.4	1	0.2
Dem.caprae	-	-	-	-	-	-

In Kamba district *D.ovis* was observed with the highest prevalence175 (71.13%) of all ectoparasite prevalence in sheep with significant difference to the other ectoparasite prevalence in sheep and goats not only in this district but also in comparison to overall prevalence of ectoparasites in both study districts. *B.decoloratus*25 (10.16%) was the second ectoparasite with high prevalence in comparison to the other ectoparasites followed by *A.variegatum* 21(8.54%), *M.ovinus 20* (8.4%), *R.pravus* (5.55%), *R.pulchellus*(5.5%),*R.sanguineus*(3%) in sheep. In goats *R. pravus* (32.8%) was significantly with highest prevalence followed by *S.scabiei* (29.7%), *R.pulchellus* (24.2%), R. *sanguineus* (17.6%), *A. variegatum* (16%), and *B.decoloratus* (11.3%) (Table 8).

Table 8: Overall prevalence of ectoparasites in sheep and goats in Kamba district.

Ectoparasites species	Sheep n = 246		Goats n = 247		Total n=493	
	No of positives	prevalence (%)	No of positives	prevalence (%)	No of positives	Prevalence (%)
D.ovis	175	71.13	-	-	175	35.5
D.caprae	-	-	2	0.8	2	0.41
L.0villus	3	1.22	-	-	3	0.61
L.stenopsis	-	-	3	1.21	3	0.61
R.pravus	13	5.28	84	32.8	97	19.68
R.pulchellus	13	5.28	71	24.2	84	17.04
R.sanguineus	10	4.07	56	17.6	66	13.39
R.lunulatus	-	-	6	1.9	6	1.22
R.muhsamae	-	-	6	2.3	6	1.22
Rhipicephalus nymph	1	0.4	20	7.8	21	4.26
A.variegatum	21	8.54	41	16.0	62	12.58
Amblyomma nymph	15	3.0	22	8.6	37	7.51
Amblyomma larvae	1	0.4	3	1.2	4	0.81
B.decoloratus	25	10.16	29	11.3	54	10.95
Boophilus nymph	1	0.4	11	4.3	12	2.43
M.ovinus	20	8.14	-	-	20	4.06
S.scabiei	-	-	76	15.42	76	15.42
C.felis felis	11	4.47	16	3.25	27	5.48
Dem.ovis	1	0.41	-	-	1	0.2
Dem.caprae	-	-	3	1.21	3	0.61

The overall prevalence of ectoparasites in lowlands, highlands and midlands were 95.9% 72.8%, 65.4% in sheep and goats (Table 9). In sheep, the prevalence of *D. ovis* and *M. ovinus* was significantly higher in highlands than in midlands. The prevalence of *D.caprae* was significantly higher in midlands than in highlands and in lowlands which are almost similar. The prevalence of tick species was higher in lowlands than in the highlands and midlands. *R.pravus* was the most prevalent tick species of all prevalence due to tick species investigated. The prevalence of *A. variegatum* and *B. decoloratus* was significantly higher in lowlands than in midlands and it was slightly higher in lowlands than in the highlands. Higher prevalence of sarcoptic mange was recorded in lowlands than in highlands and midlands which were almost similar. In sheep, the prevalence of *D. ovis* and *Melophagus ovinus* was significantly higher in the highlands than both lowlands and midlands, which were almost similar.

Table 9: Prevalence of ectoparasites in sheep and goats by agro-ecology

Ectoparasites species	Highland		Midland		Lowland		Total	
	No. Posit	Prev.(%)	No Posit.	Prev. (%)	No Posit.	Prev. (%)	No. Posit.	%
D.ovis	228	47.2	106	22.0	-	-	334	34.0
D.caprae	2	0.4	32	6.6	1	0.2	35	3.6
L.ovillus	3	0.6	-	-	-	-	3	0.3
L.stenopsis	2	0.4	51	10.6	2	0.4	55	5.6
R.pravus	7	1.5	10	2.1	107	22.2	124	12.6
R.pulchellus	5	1.0	3	0.6	81	16.8	89	9.0
R.sanguineus	4	0.8	7	1.5	58	12.0	69	7.0
R.lunulatus	1	0.2	2	0.4	2	0.4	5	0.5
R.muhsamae	-	-	1	0.2	6	1.2	7	0.7
Rhipicephalus nymph	-	-	1	0.2	20	4.1	21	2.1
A.variegatum	28	5.8	10	2.1	48	9.9	86	8.7
Amblyomma nymph	6	1.2	3	0.6	25	5.2	34	3.5
B.decoloratus	31	6.4	10	2.1	35	7.3	76	7.7
Boophilus nymph	1	0.2	11	2.2	12	1.2		
M.ovinus	35	7.3	28	5.8	-	-	63	6.4
S.scabiei	-	-	-	-	78	16.2	78	7.9

To determine the prevalence of ectoparasites in sheep and goats by sex 762 female (77.3%) and 224(22.7%) male animals were examined. There were slight differences in sexes where the prevalence of *A.variegatum, B. decoloratus, S. scabiei*, and *L.stenopsis* was slightly higher in male animals than in females but the prevalence of other ectoparasites investigated was almost similar in both sexes (table 10).

Table 10: Prevalence of ectoparasites in sheep and goats by sex.

Ectoparasites species	Female n =762		Male n = 224	
	No of Positives	Prevalence (%)	No of Positives	Prevalence (%)
D.ovis	264	34.6	70	31.3
D.caprae	27	3.5	8	3.6
L.0villus	2	0.3	1	0.4
L.stenopsis	40	5.2	15	6.7
R.pravus	100	13.1	24	10.7
R.pulchellus	70	9.2	19	8.5
R.sanguineus	58	7.6	12	1.6
R.lunulatus	5	0.7	2	0.9
R.muhsamae	6	0.8	1	0.4
Rhipicephalus nymph	17	2.2	5	2.2
A.variegatum	57	7.5	29	13.0
Amblyomma nymph	25	3.3	9	4.0
B.decoloratus	58	7.6	18	8.0
M.ovinus	54	7.1	9	4.0
S.scabiei	57	7.5	21	9.4

There were 260(26.4) young and 726(73.6) adult animals in the study of ectoparasite prevalence in sheep and goats by age-group in both study districts. The result of this study showed that there was significantly high prevalence of *D.ovis* in young animals than in adults. The prevalence of *R. pravus, R.pulchellus, R.sanguineus*, and that of *S. scabiei* was significantly higher in adults than in young animals (table 11).

Table 11: Prevalence of ectoparasites in sheep and goats by age group

Ectoparasites species	Young n = 260		Adults n = 726	
	No of Positives	Prevalence (%)	No of positives	Prevalence (%)
D.ovis	118	45.4	216	29.8
D.caprae	12	4.6	23	3.2
L.0villus	2	0.8	1	0.1
L.stenopsis	18	6.9	37	5.1
R.pravus	20	7.7	104	14.3
R.pulchellus	20	7.7	69	9.5
R.sanguineus	13	5.0	57	7.9
R.lunulatus	3	1.2	4	0.5
R.muhsamae	2	0.8	5	0.7
Rhipicephalus nymph	7	2.7	15	2.1
A.variegatum	26	10.0	60	8.3
Amblyomma nymph	7	2.7	27	3.7
B.decoloratus	27	10.4	49	6.8
M.ovinus	22	8.5	41	5.7
S.scabiei	19	7.3	59	8.1

To determine the prevalence of ectoparasites in sheep and goats by body condition 814(82.6%) animals with poor body condition and 172(17.4%) animals with good body condition were subjected to examination. The prevalence of *D.ovis* was significantly higher in animals with poor body condition than in those with good body condition. With slight variation for *D. caprae*, the prevalence of all other investigated ectoparasites was almost significantly higher in animals with poor body condition than in animals with good body condition (table 12).

Table 12: Prevalence of ectoparasites in sheep and goats by body condition.

	Poor n = 814		Good n = 172	
ectoparasites	Positives	Prevalence (%)	Positives	Prevalence (%)
D.ovis	327	40.2	7	4.1
D.caprae	26	3.2	9	5.2
L.0villus	3	0.4	-	-
L.stenopsis	52	6.4	3	1.7
R.pravus	109	13.4	15	8.7
R.pulchellus	78	9.6	11	6.4
R.sanguineus	59	7.3	11	6.4
R.lunulatus	7	0.9	-	-
R.muhsamae	7	0.9	-	-
Rhipicephalus nymph	22	2.7	-	-
A.variegatum	78	9.6	8	4.7
Amblyomma nymph	30	3.7	4	2.3
B.decoloratus	71	8.7	5	2.9
M.ovinus	62	7.6	1	0.6
S.scabiei	76	9.3	2	1.2

4.2. Prevalence of gross skin lesions.

In the study gross skin lesions observed to be characteristic to ectoparasite infestation were red papules, small vesicles, nodules, superficial erosions and ulcers, scratches (excoriations), crust formation, thickening and wrinkling of the skin, loss of hair(alopecia),and scaling of the skin over different sites(body regions).

The tail, head, the fore and rear legs, and belly were the major attachment sites for ticks representing higher prevalence of the total tick infestations. The common sites for *D.ovis* infestation were the skin of shoulder, sides, neck, flank, belly, and back with proportion of. For *Melophagus ovinus infested* sheep, the sites commonly parasitized were the neck, sides, shoulder and flank, in order of importance. The major tick attachment sites on sheep were head/ ears, lips and eye lids. In goats infestations with Sarcoptic mange were recorded as localized, regionalized, and generalized forms. There was localized infestation with Demodectic mange in sheep and goats.

Head, mainly ears and the groin areas were the major sites infested by narcotic mange in goats. For Linognathus species shoulder, neck, and sides were the main infestation sites. Sternum and belly were the infestation sites in both sheep and goats with *Ctenocephalides felis felis*. Demodex caprae and *demodex ovis* were found to infest the face/ head in both sheep and goats

The highest prevalence of lice was recorded on shoulder (22.87%%) of the sheep skin. neck, sides, flank, belly, head, back, legs, and tail, were the infestation sites for lice with proportions(20.37), (18.5%), (13.3%), (12.89%),(4.0%), (3.1%), (2.9%),(1.87%) respectively. In goats the highest prevalence was recorded on the neck (32.0%), followed by shoulder (24.0%), sides (18%), flank (8.0%), belly (8.0), back (6%), (4.0%) (Table 13). The findings of this study has strong agreement with that in different reference literatures it was described that the major predilection sites for lice are shoulder,neck,flank, sides ,belly, and back even though the parasite is actively moving and can be found on the entire body.

Table 13: Prevalence of skin lesions associated with lice infestation (*D.ovis, D.caprae, L.ovilus, and L.stenopsis).*

Species	Body region	Type of lesions				Total lesions	Prevalence (%)
		papules	excoriation	crust	alopecia		
Sheep	Flank	32	12	16	5	65	13.5
	Shoulder	63	17	21	9	110	22.87
	Neck	51	14	25	8	98	20.37
	Sides	49	16	20	4	89	18.5
	Belly	29	11	21	1	62	12.89
	Back	12	-	3	-	15	3.1
	Legs	7	-	5	2	14	2.9
	Tail	5	-	3	1	9	1.87
	Head	11	3	5	-	19	4.0
	subtotal	259	73	119	30	481	100
Goats	Flank	2	-	2	-	4	8.0
	Shoulder	5	2	5	-	12	24.0
	Neck	6	2	8	-	16	32.0
	Sides	4	1	4	-	9	18.0
	Belly	2	-	2	-	4	8.0
	Back	2	-	1	-	3	6.0
	Legs	-	-	2	-	2	4.0
	Tail	-	-	-	-	-	-
	Head	-	-	-	-	-	-
	subtotal	21	5	24	-	50	100
	Grand total	280	78	143	30	531	53.85

Head (48.3%) recorded was with the highest prevalence of lesions, on tails (21.77%), legs (15.65%), belly (8.84%), neck (5.44%) were the prevalence of lesions on respective sites in sheep and in goats head(43.64%),tail(22.6%),legs(21.56%), belly(6.75%).and neck(5.45%) were with their corresponding prevalence of lesion in order of importance (table 14).

Table14: Prevalence of skin lesions associated with the infestations of tick spp. on different body regions of sheep and goats.

Species	Body regions	Erythema	Erosions	Crusted ulcers	alopecia	Total lesions	Prevalence (%)
Sheep	Flank	-	-	-	-	-	-
	Shoulder	-	-	-	-	-	-
	Neck	5	3	-	-	8	5.44
	Sides	-	-	-	-	-	-
	Belly	8	5	-	-	13	8.84
	Back	-	-	-	-	-	-
	Legs	7	8	8	-	23	15.65
	Tail	18	7	5	2	32	21.77
	Head	35	33	-	3	71	48.3
	subtotal	73	56	13	5	147	100
Goats	Flank	-	-	-	-	-	-
	Shoulder	-	-	-	-	-	-
	Neck	15	3	-	3	21	5.45
	Sides	-	-	-	-	-	-
	Belly	19	5	-	2	26	6.75
	Back	-	-	-	-	-	-
	Legs	35	31	17	-	83	21.56
	Tail	53	30	-	4	87	22.6
	Head	85	62	11	10	168	43.64
	subtotal	207	131	28	19	385	100
	Overall	280	187	41	24	532	53.96

Sheep ked caused skin lesions with the highest prevalence on neck region (31.75%). The other body regions damaged by this parasite were shoulder (15.87%), Shoulder (14.27%), Flank (11.11%), and belly (11.11%) in order of importance (table 15).

Table 15: Prevalence of skin lesions associated with infestation of *Melophagus ovinus* in sheep

Spp.	Body region	papules	Erythema	Hemorrhagic crusts	Excoriations	alopecia	Total lesions	Prevalence (%)
Sheep	Flank	3	2	-	2	-	7	11.11
	Shoulder	4	1	2	-	1	10	15.87
	Neck	6	7	3	4	-	20	31.75
	Sides	4	2	1	1	1	9	14.27
	Belly	2	3	-	-	1	7	11.11
	Back	-	-	-	-	-	-	-
	Legs	-	-	-	-	-	-	-
	Tail area	2	3	1	3	-	10	
	Head	-	-	-	-	-	-	-
	Total	21	18	7	10	3	63	

Sarcoptic mange in goats was observed with high prevalence on head (face, ears) with proportion of (35.1%) than on any other body regions. Neck (19.23 %%), groin (16.67 %), Back (12.86 %), shoulder (10.26 %) and legs (8.97%) were preferred sites observed with stated prevalence in order of importance (table 16).

Table 16: Prevalence of skin lesions associated with *Sarcoptes scabiei* infestation in sheep and goats

Spp.	Body region	papules	crust	excoriation	alopecia	lichnification	T6otal lesions	Prevalence (%)
Goats	Flank	-	-	-	-	-	-	-
	Shoulder	2	5	-	-	1	8	10.26
	Neck	4	6	2	-	3	15	19.23
	Sides	-	-	-	-	-	-	-
	Belly	-	-	-	-	-	-	-
	Back	-	5	-	4	1	10	12.82
	Legs	2	3	2	-	-	7	8.97
	groin	3	5	3	-	2	13	16.67
	Head	6	7	4	5	3	25	32.05
	Total	17	31	11	9	10	78	100

4.3. Microscopic skin lesions

Grossly animals were examined for skin lesions caused by ectoparasites and from 25 sheep and 25 goats totally from 50 clinically affected animals skin biopsy samples were collected .The samples were subjected to histopathological examination after they had been processed and stained by routine staining method known as Haematoxylin-Eosin stain. From clinically examined animals, 21 sheep and 23 goats totally 44 animals became positive for lesions caused by ectoparasites.

The following microscopic lesions were observed in sheep: histopathological examination of skin biopsy samples revealed that circulatory disturbances originated in and confined to the stroma (dermis), there were extravascular erythrocytes in the sweat glands and the papillae of the hair follicles. Though congestion and edema are not common in the epidermis (cutis), it was evident in

some samples. Breakage of hair fibers due to pressure atrophy and in some cases due to hypertrophy of the cells was observed in almost all samples that might caused alopecia.

In many samples there was exfoliation of the epidermis accompanied by proliferation of fibroblasts and fibrocytes. There was severe dystrophy and atrophy of hairs. Superficial dermal blood and lymph vessels were moderately dilated and surrounded by numerous mononuclear cells (plasma cells, lymphocytes) and eosinophils giving an impression of postinfectious alopecia. At the same time degenerated keratinocytes with pyknotic nuclei were observed. In the dermis and sub-cutis several areas were optically empty due to accumulation of edema fluid.

In goats the findings of histopathological examination showed that in the epidermis the major component cells were keratinocytes with nuclei evidently karyorrhectic. Stratum spinosum was thickened due to increase in basal layer in some examined samples. Generally, there was excessive keratinocytes proliferation in the epidermis that was evidence of hyperkeratosis. Various portions of numerous hair follicles and the inner root sheath were embedded in the thickened superficial layer of the dermis. There was atrophy of hair roots. Furthermore, the cells of the hair follicles were pyknotic, and the hair center and cuticles were sloughed off. Holocrine sebaceous glands were with small, flat, peripheral stem cells, vacuolated cytoplasm, with inner degenerating cells with pyknotic nuclei . These glands showed atrophy. The sweat glands were few in number and in some samples, almost none. In the dermal layer, there were marked inflammatory reactions, with randomly excessive agglomeration of inflammatory cells (neutrophils and macrophages) and scattered eosinophils were also encountered.

5. DISCUSSION

The results of the present study add data to obtain information on ectoparasite infestation of small ruminants kept in different agro-ecology and management systems in southern Ethiopia. The problem of ectoparasites in small ruminants of the study area seems to be very important as they are widely distributed with high prevalence in all agro-ecological zones affecting all age groups. This observation is in consistence with many previous works of Sertse and Wossene (2006), Dejene (1994), Mussema (2000), Abdulhamid (2001), and Worku (2002) all of which reported high prevalence of ectoparasites from different parts of Ethiopia suggesting the study area is conducive for survival and development of different stages of ectoparasites of small ruminants.

In the study lice infestations due to *D. ovis* was identified as the most prevalent ectoparasite of the study sheep in the areas. This observation may be attributed to the fact that Damalinia is susceptible to high temperature (Urquhart *et al.*, 1996). Lice infestations due to *D. ovis* was identified the most prevalent ectoparasite in the highland and midland in sheep (P = 0.000). Lice infestation may indicate some other underlying problems such as malnutrition and chronic diseases (Wall and Shearer, 1997). Irritation caused by even moderate population of lice due to scratching and rubbing, causes damage to the skin (Kettl, 1984) and severe infestation with Linognathus species may cause anemia (Wall and Shearer, 1997). *D. ovis* is mobile and can be spread over the entire body causing considerable irritation, restlessness, interrupted feeding and loss of condition and is responsible for development of nodular hypersensitivity reaction lesions (Cockle or"ekek") in pickled pelts (Heath *et al.*, 1995; and Wall and Shearerer, 1997). Significantly higher difference in prevalence of *D. ovis* was recorded in young than in adults sheep (P = 0.000), and also significantly higher prevalence was observed in highland sheep than other agro-ecologies. This finding is in agreement with the reports of Sertse and Wossene (2006) in Amhara Region. According to Kettle (1984) *D.ovis* requires suitable temperature (33-39C$^{o)}$, and fiber of appropriate diameters to which eggs can be attached.

Likewise, the prevalence of *Linognathus* in midland goats is significantly higher than goats in both highlands and lowlands (p=0.000). This observation is also inline with the findings of Sertse and Wossene (2006).This may be attributed to narrow temperature range required for lice breeding, when temperature is higher than optimum, eggs do not develop while hot temperature prevent egg laying

and kill the lice as described by Radostitis et al. (1994). In sheep and goats with poor body condition the prevalence of ectoparasites is significantly higher than those animals with good body condition (p=0.000). This finding corroborates with reports of Sertse(2004).Worku(2002).and Mohamed(2001) This is most probably due to feed that are improperly feed and exposed to cold and debilitating diseases carried the heaviest infestations of lice since debilitated animals do not groom themselves and leave the lice undisturbed (Urquhart et al.,1996). In this study there was no significant (P>0.05) variations in prevalence of lice species between female and male sheep and goats. This finding is in agreement with Sertse (2004), Worku (2002), and Mohamed (2001).

In the study *Melophagus ovinus* was identified as most prevalent ectoparasite in sheep accounting 6.4% in the overall prevalence of all ectoparasites in the study area. Significantly higher prevalence of *M.ovinus* in highlands than both in midlands and lowlands recorded in sheep. According to Radostitis (194) and Kett (1984), in the hot and humid climate, the parasite is restricted to cooler highlands and infestations may be lost when sheep are moved to hot dry areas. The irritation caused by ked results in biting and rubbing with resultant damage to the fleece and development of vertical riding on the skin called cockle (Kettle, 1984; Urquhart et al., 1996; Wall and Shearer, 1997). The prevalence of *M. ovinus* was also significantly (p=0.002) higher in Bonke district than Kamba district. Similarly, the prevalence was significantly higher in sheep with poor body condition than in those with good body condition (p=0.001). Since this parasite is known to suck too much blood, debility of the animals may be due to direct effect of the parasite as described by Urquhart et al. (1996) and Soulsby (1982).

Three genera of ticks namely *Rhipicephalus*, *Amblyomma*, and *Boophilus* were identified from both sheep and goats with overall prevalence of 20.3% in sheep and 53.9% in goats. *R.pravus* (12.6%) was identified as the most predominant tick species on small ruminants of the study areas (p=0.000). Rhipicephalus genus consisting a total of species with prevalence of 94.9% was recorded as the most prevalent in both Bonke and Kamba districts in both sheep and goats hosts with prevalence of *R. pravus*(12.6%), *R.pulchelus* (9.3%), *R.sanguineus* (7.0%), *R. muhsamae* (0.7%, *R. lunulatus* (0.5%)and nymphs of *Rhipicephalus* spp(2.2%). The genus *Amblyomma* (12.7%), encountered as the second most common tick spp in the study area constituting *A. variegatum* (8.7%, nymphs (3.5%) and larvae (0.5%) prevalence in both districts in sheep and goats where as Boophilus species (9.9%)

with *B. decoloratus* (7.7%) and nymph (1.2%) identified as least abundant in the study areas. Ticks were common in Kamba district than in Bonke district. This observation is most probably due to the fact that there are more lowland areas in Kamba than in district Bonke and also in lowlands there is greater number of goats in Kamba district than in Bonke. Ticks were common in lowland areas than both midland and highland areas Sertse (2004). The prevalence of ticks in young and adults, females and males never showed significant variation but the prevalence was significantly higher on animals with poor body condition than in animals with good body condition. This suggests that high tick infestation leads to emaciation of the host animals as described by Sertse (2004), Worku (2002), and Mohamed (2001).

The prevalence of *R.pravus* was significantly higher in Kamba district than in Bonke district and also higher in both highlands and midlands (P=0.000). There was significantly higher prevalence in goats in Kamba district than in goat in Bonke district (p=0.000). *R. pulchellus* was identified as the second most common species of ticks and was significantly higher in Kamba than in Bonke (p=0.000) district. It was significantly more prevalent on goats than on sheep at the study area. Similarly the prevalence of R.pulchelus significantly also higher in goats in Kamba than in goats in Bonke district. It was significantly higher in lowlands than in highlands in poor body condition than in animals with good body condition. Rhipicephalus sanguineus (7%) was common in Kamba than in Bonke district. The prevalence of R.sanguineus was not significantly varied between animals with poor and good body condition and also with higher prevalence in lowlands than in highlands. The prevalence of *A.variegatum* was higher in Kamba than in Bonke (p=0.000) district and also significantly higher in lowlands than in midland areas. Animals with poor body condition were with significantly higher prevalence of A. variegatum than animals with good body condition (p=0.037). *B.decoloratus* was recorded with significantly higher prevalence in Kamba than in Bonke district (p=0.000). It was with significantly higher prevalence in goats and sheep in Kamba than in goats in Bonke. In lowlands the prevalence of *B.decoloratus* was significantly higher than in midlands (p=0.003) but variation in prevalence between midlands and lowlands was not statistically important.

The prevalence of Sarcoptic mange was significantly higher in goats in Kamba than in Goats in Bonke district. temperature range required for lice breeding, when temperature is higher than optimum, eggs do not develop while hot temperature prevent egg lying and kill the lice Radostits et

al., 1994). In Goats with poor body condition the prevalence was higher than in goats with good body condition (P = 0.016). Sheep with high infestation of lice were found to be with poor body conditions and have high prevalence of lice. In *D.ovis* infested young sheep the prevalence was observed significantly higher than in the adults (P = 0.000) and significantly higher in animals with poor body conditions than in animals with good body condition (P = 0.000). Animals in poor body condition and that are improperly feed and exposed to cold and debilitating diseases carried the heaviest infestations of lice since debilitated animals do not groom themselves and leave the lice undisturbed (Urquhart *et al.*,1996).

In this study, variations in prevalence with *D.ovis* between females and males were not observed (P = 0.345). There was variation in the prevalence of *D.ovis* between two study districts. In Kamba district the prevalence of *D. ovis* was higher than in Bonke district but this was not statistically significant (P = 0.324). This is may be due to differences in ecological and management factors. On the other hand there were no variations observed with prevalence of *L. ovillus* between the two districts (P = 0.084). The prevalence of *L. stenopsis* was significantly higher in Bonke district than in Kamba (P = 0.000). This shows that goats in district Bonke are at higher risk for this species of parasite. The prevalence of *D.caprae* was significantly higher in district Bonke than in Kamba (P = 0.000).

Melophagus ovinus was the second most important ectoparasite observed in sheep accounting 6.4% in the overall prevalence of all ectoparasites identified. *M. ovinus* was with higher prevalence in highlands than in the midlands and lowlands was significantly higher prevalence than lowlands and midlands respectively. According to Radostitis *et al.*, (1994) and kett (1984), in the hot and humid climate, the parasite is restricted to cooler highlands and infestations may be lost when when sheep are moved to hot dry areas. The irritations caused by ked results in animal biting and rubbing with resultant damage to the fleece and development of vertical riding on the skin called 'cockle' (Kettle,1984; Urquhart *et al.*,1997; Wall and Shearer,1997). The prevalence of *M. ovinus* was 2 times (significantly) higher in Bonke district than in Kamba (P = 0.002). The prevalence of *M.ovinus* was significantly higher in female sheep than in males but this was not statistically significant and 1.5 times higher in the young sheep than in the adults, but this was not statistically significant. The prevalence of *M.ovinus* was also significantly higher in sheep with poor body condition than in those

with good body condition (P = 0.001). Since this parasite is known to suck too much blood, debility of the animals may be due to direct effect of the parasite.

The prevalence of ticks in Kamba district was significantly higher in goats than in sheep and in Bonke it was also significantly higher in goats than in sheep. There was significantly higher prevalence of ticks in sheep in Kamba district than that of in Bonke district and it was significantly higher in goats in Kamba than in goats in Bonke district. Most probably this was due to that there are more lowland areas in Kamba district than in district Bonke and also in lowlands there is greater number of goats in Kamba district than in Bonke. The prevalence of ticks in lowlands was 6.8 times higher than in high lands and significantly higher in midlands in Kamba. It was recorded that the prevalence of ticks in young and adults, females and males was almost similar in both districts. There was significantly higher prevalence in animals with poor body condition than in animals with good body condition. This suggests that high tick infestation leads to emaciation of the host animals.

R.pravus was recorded significantly with higher prevalence in Kamba district than in Bonke and it was significantly higher in lowlands than in highlands and significantly higher in lowlands than in midlands(P = 0.000). In Kamba district in sheep the prevalence was significantly higher than the prevalence of this parasite in sheep in Bonke and it was significantly higher in goats in Kamba than in goats in Bonke district (P = 0.000). There was no significant variation in prevalence of R.pravus between female and male animals, young (P = 0.006). Also the prevalence of this parasite species was significantly higher in animals with poor body conditions than in animals with good body conditions, but this was not statistically significant (P>0.05). *R.pulchellus* species was the second to *R.pravus* in the genus Rhipicephalus in this study and it was with significantly higher prevalence in Kamba than in Bonke (P =0.000) and accounted 9.3% of all prevalence of the identified ectoparasites in both study districts. *R.pulchellus* was 4.3 times prevalent in goats than in sheep in general and with 4.4 times higher prevalence in goats in Kamba district than in sheep and also it was significantly higher in goats in Bonke than in sheep(P = 0.000). Similarly, the prevalence of *R.pulchellus* was 4.4 times (significantly) higher in goats in Kamba than in goats in Bonke. *R.pulchellus* was recorded with 16.8 times higher prevalence in lowlands than in highlands and 28 times higher in lowlands than in midlands (P = 0.000) and also it was 1.5 times higher in animals with poor body condition than in animals with good body condition, but this was not statistically

significant(P>0.05). From genus *Rhipicephalu. R.sanguineus* was with 7% prevalence in general and 3.5 times prevalent in Kamba district than in Bonke (p= 0.000) and it was with significantly higher prevalence in goats in Kamba than in goats in Bonke as well as with significantly higher prevalence in sheep in Kamba than in sheep in Bonke and also significantly higher prevalence in sheep in Kamba than in sheep in Bonke (p = 0.000). The prevalence of *R.sanguineus* was almost similar in animals with poor and good body conditions. Significantly higher prevalence was recorded with *R. Sanguineus* in lowlands than in highlands and it was with 8times (significantly) higher prevalence in lowlands than in midlands (P = 0.000). The prevalence of *A. variegatum* was significantly higher in Kamba than in Bonke (p = 0.000) and was significantly higher in goats in Kamba than in goats in Bonke as well as 1.4 times higher in sheep in Kamba than in sheep in Bonke, but this was not statistically significant (P>0.05) and also significantly higher in lowlands than in highlands and significantly higher in lowlands than in midlands (P = 0.000). Animals with poor body condition showed significantly higher prevalence of *A.vareigatum* than animals with good body condition (P=0.037) *Boophilus decoloratus* was recorded.

Significantly higher prevalence in Kamba than in Bonke district (P = 0.000). It had significantly higher prevalence in goats in Kamba than in goats in Bonke, and also with 2 times higher prevalence in sheep in Kamba than in sheep in Bonke (P = 0.05). In lowlands the record of *B.decoloratus* was significantly with higher prevalence than in midlands (P = 0.03), but variation in prevalence between lowlands and midlands was not significantly observed. It was observed that the prevalence of *B.decoloratus* was significantly higher in animals with poor body condition than in animals with good body condition (P = 0.009). The prevalence of *Melophagus ovinus* was higher in sheep in Bonke than in sheep in Kamba (P = 0.001) and significantly higher in highlands than in midlands and was not recorded from lowlands (P = 0.000). It was more prevalent in animals with poor body condition than in animals with good body conditions (P = 0.001). Sarcoptic mange in goats in Kamba district was significantly with higher prevalence than in goats in Bonke district and it was not recorded in sheep in both districts(P = 0.000). This may be due to that in lowlands mainly goats only were reared so that there is little chance of getting contact for these two species of animals. The prevalence of *Ctenocephalides felis felis* was significantly higher in sheep than in goats and was significantly higher in Kamba than in Bonke. The prevalence of Demodectic mange in goats in Kamba district was 2 times higher in goats than in sheep in both Kamba and Bonke districts, but the

prevalence of this parasite in sheep in both districts was similar. From Bonke district *Demodex caprae* was not recorded.

In this study it was observed that gross skin lesions associated with infesta6tions of *Damalinia ovis* were more frequent on sides, shoulder, neck, flank, belly, and back and this agreement with that stated in Wall and Shearer (1997). The prevalence of skin lesion caused by *D.ovis* on sides, shoulder, neck, and flank were (2.9), (2.3), (2.2), and (1.9) times higher than skin lesions on the back of the affected animal respectively. Similarly the prevalence of skin lesions caused by *D.caprae* were most frequent on the neck followed by shoulder, sides, belly, and back, that has an agreement with that stated in Wall and Shearer(1997). Gross skin lesions caused by *R.pravus* was most frequrnt on tails, fillowed by head, legs, belly and neck. Skin lesions caused by *A. variegatum* were more sever than those induced by other tick species since the attaching mouth parts of A.variegutum being longer and embedded in the skin causing erosions. Gross skin lesions caused by *Melophagus ovinus* were with higher prevalence on equal base on flank and sides followed by neck, shoulder, and belly.

In general, gross skin lesions observed during the time of clinical examinations were: red papules, nodules, pustules, erosions, excoriations (scratches), crust formation, scales, thickened and wrinkled skin, loss of hair (alopecia), superficial ulcers on the intedigital spaces caused by tick infestations. Goats with generalized skin lesions were with poor body condition and showed thickened and wrinkled as well as cracked and bleeding wounds on the skin especially on both for and rear legs and at the groin areas. Localized form of sarcoptic mange infestation was mainly observed on the head, on some cases the ear canal was occluded by yellowish-white colored powder like mass that left eroded and red underlying tissue after removal of this mass.

6. CONCLUSION AND RECOMMENDATIONS

The current study showed very high prevalence of ectoparasites in sheep and goats of both sexes, all age groups and body conditions scores in the study areas. Ectoparasites were observed to be major problems of small ruminants in all agroecologies of the study area. These ectoparasites were found to be associated and responsible in causing a variety of gross and microscopic skin lesions like papules, erythema, erosions, excoriations, and ulcers on both sheep and goat hosts of the study area. Skin lesions caused by ectoparasites lead to downgrading of skin and decrease the quality of wool and skin, there by decreasing the supply of skin for leather industry for export as well as for domestic consumption.

The overall findings regarding ectoparsitism suggest the importance of the disease in the study area in reducing the production and productivity of small ruminants. Considering the importance of skin and hide as a main source of foreign currency to Ethiopia, the high prevalence of ectoparasites recorded in sheep and goats of the study districts in Gamo-Gofa Zone in southern Ethiopia deserves serious attention at all levels in order to minimize the spread of infestation and improve the living standard of farmers which are dependent on their animals.

Based on the above conclusions the following recommendations are suggested::

- Integrated control of ectoparasites need to be launched.
- Livestock owners should be well informed about the importance of ectoparasites.
- The animal health services delivery systems should be strengthened in these districts to control losses due to diseases.
- Further investigations on economic impacts of ectoparasites on small ruminants should be conducted.
- Coordinated research should be conducted on ectoparasites and associated skin lesions in small ruminants to generate base line data that can be used to control the disease allover the country.

7. REFERENCES

Abdulhamid, N. (2001): Prevalence of effects of ectoparasites in Goats and fresh Goat pelts and assessment of wet-blue skin defects at Kombolcha tannery, South Wolo, Northern Ethiopia, DVM thesis, AAU, FVM, Debre Zeit, Ethiopia.

Asfaw, W. (1997): Country report, Ethiopia. In: proceedings of a seminar on livestock development policies in Eastern and Southern Africa, 28 July to 1 August, 997. OAU/IBAR and the Ministry of Agriculture and Cooperatives, Swaziland, Mbabane.

Ashine, S. (1987): Survey and treatment trial of mange mites in sheep and cattle of Robe area of Bale Administrative Region. DVM thesis, AAU, FVM, Debre Zeit, Ethiopia

Bancroft J.D. Harry C.C. (1994): Manual of Histopathological Techniques and their diagnostic application, second edition. Singapore Longman Singapore. Pp 1- 4.

Bayou, K., (1998): Control of sheep and goat skin diseases. In: Ian, B. C, Bayou. (Eds.). Proceedings of control of sheep and goats skin diseases for improved quality of hides and skins, 13-14 February, 1998, FAO, Addis Ababa.

Bayou, K., Mengiste, B., Sirac, A., Tefera, A., (1999): Control of ekek skin defects in sheep by using insecticides and shearing. *J.Soc.Leath. Tech. Chem.*, **83:** 147-148.

Bowman D.D. and Lynn, R.C. (1995): Georgis' parasitology for veterinarians. Seventh edition, W.B. Sounders Company. Pp 29-35, 38-39, 46-53, 61-62, 294.

Chane, M. (2007): Study on Gross and microscopic skin lesions in sheep and goats caused by ectoparasites in selected woredas of Amhara Regional State. MSc thesis, AAU, FVM, Debre Zeit, Ethiopia.

Carlton William w., Donald M., Gavin Mc (1995): Thomson's special veterinary pathology second edition. Pp 461-511.

Colebrook, E., Wall. R., (2004): Ectoparasites of livestock in Europe and the Mediterranean region. Vet. Parasitol. **120**: 251-274.

Cole, H. E, (1986): Veterinary clinical pathology. 4th edition W.B. Sounders Company, Philadelphia, Pp 391-403.

CSA (2002): Central statistics Agency of Federal Democratic Republic of Ethiopia

Cynthia Kahn M., Dana Allen G. (2005): The Merck Veterinary Manual. Ninth edition. N.J.White house station. Merck and Co.Inc. USA. Pp625-670.

de Castro J. J. (1997): Sustainable tick and tick-borne diseases control in livestock improvement in developing countries. Vet. Parasitology.**71:** 77-97.

Gaim, H. (1994): prevalence mange mite infestation in camels, cattle, and sheep in and around Mekele.DVM thesis, AAU, FVM. Debre Zeit, Ethiopia.

Gatenbty, M.R. (1991): Sheep. In: Coste, R., Smith, J.A. (Eds.), the Tropical Agriculturalist. Macmillan.CTA, London, Wageningen. Pp6-11.

Getachew, T. (1995): Parasites of small ruminants. In: gray, G.D., Uilenberg, G. (Eds.) Parasitological research in Africa. Proceedings of International Conference, Bobo Diolasso. Burkina Faso.

Gebreab, F. (1983): Notes on tick species and tick-borne diseases on domestic animals in Ethiopia, Addis AAU, FVM, Debre Zeit, Ethiopia.Pp34-44.

Ghirotti M .and Maroli M. (1997): Ticks and Tick-borne diseases as a constraint to sheep and goat production in Italy. Selected features, parasitologia **39:**11-114.

Goldschmidt, M.H. (1993): Biopsies from the pathologists' point of view. *Sem. Vet Med.Surg. (Small anim.)* 8 Pp 284-288.

Gray, P. (1995): Parasites and skin diseases. First edition. J.A Allen and Company limited, London, Great Britain. Pp93-193.

Heath, A.C.G., Cooper, S.M., Cole, D.J.W., Bishop, D.M., (1995): Evidence for the role of the Sheep biting louse *Bovicola ovis* in producing cockle, a sheep pelt defect. Vet. Parasitol.**59** :53-58.

Izdebska J.N., (2001): European bison arthropod parasites from closed polish breeding facilities. Acta parasitol. **46:**135-137.

Legg, D.E., Kumar, R., Watson, D.W., Lioyod, J.E (1991): Seasonal movement and spatial distribution of the Sheep ked (Diptera: Hypoboscidae) on Wyoming lambs. J.ECON. ENT.**84** :1532-1539.

Jubb, K.F., Kennedy, P.C. and paimer, N. (1993): pathology of Domestic animals. Fourth edition. Academic Press Inc. UAS1. Pp 517-730.

Jongejan F. (1999): Integrated control of ticks and tick-borne diseases. Parasitologia **41:** 51-58.

Jones, T. C., Hunt, R. D. and King, N.W. (1997): Veterinary pathology. Sixth edition Lippincott Williams and Williams and Wilkins. Baltimore, Maryland, USA. Pp 817-872.

Kettle, D.S., (1984): Medical and Veterinary Entomology. Croom Helm, London, 658 Pp.

Kettle, P.R., J.M.Lukeirn (1984): Recovery of Sheep lice (Damalinia ovis) from baled wool; a technique allowing national-wide surveillance of louse-ridden flocks. New Zeal. J. Agr.Res.12:39-42.

Lassing,H., Prosl,Hinterdorfer,F.(1998): Parasites of the red fox(vulpes vulpes)in Styria. Wien. Tieraztil.Mschr.

Mathioson, A. O., (1991): Ectoparasites and their control. In: Martin, W.B., Aitken, I.D. (Eds.), Diseases of sheep, second ed. Blackwell Science publication, oxford, Pp 284 -289.

Mahmud, M. (2000): Raw hides and skin improvement in Ethiopian status and challenges. In: proceedings of the opportunities and challenges of goat production in East Africa, a conference held 10-12 November 2000. Debub University, Awassa, Ethiopia.

Mohamed, H. (2001): Study on skin diseases of small ruminants in central Ethiopia. DVM thesis, AAU, FVM, Debre Zeit, Ethiopia.

Minjauw, B.and Mc Leod, A. (2003):Tick-borne diseases and poverty. The impact of ticks and tick-borne diseases on the livelihoods of small-scale and marginal livestock owners in India and Eastern and Southern Africa

Mussema, K. (2000): Study on mange mite infestations in small Ruminants and Camels in two selected Agro-climatic Zones in Tigray, Northern Ethiopia. DVM thesis, AAU, FVM, Debre Zeit, Ethiopia.

Nelson, W. A., (1988): Skin eruptions in ked infested sheep. Vet. Rec. **122**:72.

Nigusie, C. (2001): Study on skin diseases in cattle, sheep and goats in and around Wolayta Soddo, Southern Ethiopia. DVM thesis, AAU, FVM, Debre Zeit, Ethiopia.

Nura, M. (2002): Epidemiological study on skin diseases of small ruminants in southern rage Lands of Oromia. DVM thesis, AAU, FVM, Debre Zeit, Ethiopia.

Okello-Onen J, Shawgi M. Hassan and Suliman Essuman (1999): Taxonomy of African Ticks. An Identification Manual. CTA. ARPPIS, ICIPE, Nairobi, Kenya

Perry, B.D., Randolph, T.F., Mc Dermott, J.J., Sones, K.R. and Thornton, P.K. (2002): Investment in animal health research to alleviate poverty. International Livestock Research Institute, Nairobi Kenya.

Radostitis O.M., Blood, D.C. and Gay, C.C. (1994): Veterinary Medicine: A text book of the diseases of Cattle, Sheep, Pigs, Goats, and Horses. Eight edition. Bailliere Tindal. UK Pp 125-127.

Sertse, T and Wossene, A (205): A study on ectoparasites of sheep and goats in eastern part of Amhara region Northeast Ethiopia, smallrumres,12.010.

Sertse, T. and Wossene, A (205): Affects of ectoparasites on quality of pickled skins and their impact the tanning industries in Amhara regional state, Ethiopia. smallrumres12.011

Sinishaw, A., (2000): Distribution of ticks and tick borne diseases at Metekel ranch. Ethiopia. *Journal of the Ethiopian Veterinary Associstion*.4 Pp 40-60.

Sertse, T and Wossene, A (205): A study on ectoparasites of sheep and goats in eastern part of Amhara region Northeast Ethiopia, smallrumres12010.

Sertse, T. and Wossene, A (205): Affects of ectoparasites on quality of pickled skins and their impact the tanning industries in Amhara regional state, Ethiopia. Small ruminant research, doi10.1016/j smallrumres.2005.12.011, ELSEVIER

Sirak, Bayou, K, and Tefera, A. (1999): Pathological findings of small ruminant skin Affected by ectoparasites.

Soulsby, E.J.L (1986): Helminthes, Arthropods, and Protozoa of Domesticated Animals. 7th edition, Bailliere Tindal, Eastbourne, UK, Pp 456-475.

Tadesse, Z.1994): Survey on mange mites and ticks of Camels, and small ruminants in Dire Dawa Region, Eastern Ethiopia, DVM thesis, AAU, FVM, Debre Zeit, Ethiopia.

Tekle, G. (1986): Preliminary survey of mange mites in Blackhead Ogden Sheep, Goats and pigs in Administrative region of Hararge. DVM thesis, AAU, FVM, Debre Zeit, Ethiopia

Thrufield (2005): Veterinary epidemiology, third edition, Black well Science Ltd, UK, Pp231-234.

Urquhart, G. M., Amour, J.L., Dunn, A. M.and Jennings, F.W. (1996): Veterinary Parasitology. Fifth edition. Longman Scientific and Technical. UK.Pp141-205.

Worku, T. (2002): Study on small ruminant skin diseases in Sidama Zone, Southern Ethiopia.

DVM thesis, AAU, FVM, Debre Zeit, Ethiopia.

Young, A.S., Groocock, and C.M. & Kariuki, D.P (1988): Integrated control of ticks and tick-borne diseases in Cattle in Africa. Parasitology 96,403-432.

Radostits, O.M., Blood, and D.C.and Gay, C.C. (1994): Veterinary Medicine: A text book of the diseases of Cattle, Sheep, Pigs, Goats, and Horses. Eighth Edition Bailliere Tindal. Pp 125-127

8. ANNEXES

8.1: Procedures for clinical examination and collection of samples:

8.1.1. Clinical examination

Collection of ticks: According to the keys given by Okello-Onnen (1999).

Collection of lice, sheep keds and fleas was carried out according to that stated in Wall and Shearer (1997 and Soulsby, 1986).

8.1.2. Procedures for skin scraping:

Skin scraping was used in cases of apparent mange mite infestation (Sarcoptes, Notodres and Demodex).

The following steps should be used:

Selection of the areas for skin scraping with great care in order to include the predilection site for the ectoparasites

Scraping was done using scalpel blade held firmly between the thumb and first two fingers of one hand at an angle of 45^0 to the skin and drawn firmly across the surface towards the operator.

Clip the hair using scissors or scalpel blade and place in test tube for further reference

The skin should be wiped with swab moistened with sterile distilled water in order to adhere the scrapings to the blade.

The surrounding skin is tensed with fingers of the other hand

Continue scraping until the first signs of capillary bleeding appear

8. 2. Laboratory examination procedures:

8.2.1. Ectoparasites identification:

The procedure for identifying ticks:

Pour preserved specimens of ticks into Petri dish

Separate ticks from foreign materials (hair, scales or dry skin)

Spread them on filter paper, and then blot to absorb excess preservation fluid

Clean ticks by gently rubbing them on filter paper

Place ticks on clean filter paper in a Petri dish on the stage of a stereoscopic dissecting microscope and expose to adequate illumination

To prevent the specimens from drying, occasionally damp them with 70% alcohol

Use the low power objective to separate genera and sexes of ticks.

Use the medium or high power objectives to identify to species level. Use forceps to manipulate ticks and tilt them towards the light source or put them on one side, so as to clearly see the key diagnostic features.

Table 17: Basic morphological features used for distinguishing between soft and hard ticks

Morphological characters	Argasidae	Ixodidae
Scutum	Not sclerotised	Sclerotised whole dorsal aspect of male ,but about a third of dorsum of female
Cuticle	Texture smooth and glossy	Dark brown/brown and in some cases ornamented
Capitulum	Located away from anterior end of tick, not visible dorsally	Located at anterior end of body and visible dorsally
Hypostome	Less developed-does not facilitate firm and long attachment	Strongly developed with firm retrograde teeth (chelicera)
Eyes	Absent or present on lateral folds	Absent or preset and exposed near lateral margins of scutum
Spiracular plates	Small, located in unique positions anterior to coxae IV	Large, located posterior to coxae IV
Festoons	Absent	Present or absent
Ventral plates	Absent	Present and located in

		various portions
Genital aperture	Locaterd more or less between first pair of coxae	Located between first and second pairs of coxae

8.2.2. Microscopic examination of the skin scrapings:

Direct smear:

Place the scrapings on slide and mix with 10% solution of potassium hydroxide

Cover the specimen with cover slip

Gently heat until potassium hydroxide begins to boil

Examine under x10 objectives (low power)

Suspension method:

Suspend scrapings in 20% potassium hydroxide

Suspension was warmed to accelerate clearing

Apply cover slip and examine under x40 objective.

Digestion method:

In test tube add 10% potassium hydroxide to the scrapings

Heat gently until the hair is dissolved for about 5 minutes

Allow the tube to stand for minutes in order to cool

Centrifuge the sample

Decant the supernatant

Sample from the sediment using glass rode or dropper and transfer to the microscopic slide

Cover with cover glass and examine under the lower power.

8.2.3. Procedures for histopathological techniques:

Sampling

Procedures for collecting skin biopsy samples:

The animals should be well restrained

Gross lesions observed should be described and recorded

Preparation of biopsy sites by gentle clipping of hairs from the area

Infiltrate the area using local anesthesia

Clean the area using 70% alcohol

Incision biopsy method apply using scalpel blade and forceps to obtain 4 mm to 1cm specimen

The collected skin tissue immediately after obtaining the sample Should be preserved in10% buffered neutral formalin solution with ten times greater volume than the volume of the specimen.

Fixation

Preparation of preservatives (Buffered Neutral Formalin Solution):

37-40% formalin----------100 ml

Distilled water----------900 ml

Sodium phosphate monobasic----------4.0 g

Sodium phosphate dibasic (anhydrous) ----------6.5 g

Tissue processing:

Tissue specimen are trimmed and allowed in tissue cassettes with their identification numbers for further processing.

To ensure fixation there are two passes of 10% buffered neutral formalin with two hours each before dehydration.

Dehydration

Dehydration is the removal of all extractable water by a dehydrant diffusing through the tissue. The common dehydrant is ethyl alcohol. The process is done by using graded alcohol:

70%----------1 hour

95%----------1 hour

100%----------1 hour

100%----------2 hours

Clearing

Clearing reagent must be miscible with the dehydrant and the paraffin. As dehydrant is removed the tissue clears and becomes translucent signifying the completion of the process. Xylene is the most widely used clearing agent.

Embedding

Embedding is the orientation of tissue in melted paraffin, which was solidified. This provides a firm medium for keeping intact all parts of the tissue when sections are cut.

It can be done using a pan/dish

In the pan filled with filtered melted paraffin each piece of tissue is placed in position with the appropriate identifying mark besides it

Orientation of tissue specimen is performed in the actual position not to miss the normal histological structure

Cool embedded tissue for latter sectioning first at room temperature, under +4, then under -20C^0

Sectioning

The embedded tissue must be cut into sections with 4-5μ (ribbons are obtained)

Place sections on the surface of warm water in water bath to remove wrinkles

Take the sections on frosted microscopic slide

Place the glass slides on warm plate for about 10 minutes at 39-40 C^0 to help adherence of the section to the slide.

Transfer slides to a warm oven till staining.

8. 3: Stains and staining procedures (Hematoxylin and Eosin):

A. Preparation of chemicals:

Mayer's Hematoxylin:

Hematoxylin crystals----------1.0 gm

Distilled water----------1000 ml

Sodium Iodate----------0.2 gm

Ammonium or potassium alum----------50 gm

Citric acid----------1.0 gm

Chloral hydrate----------50 gm

Dissolve the alum (Ammonium Aluminum Phosphate or Potassium Aluminum Phosphate) in water without heating; add and dissolve the hematoxylin in this solution. Then add sodium iodate, citric acid, and chloral hydrate, shake well until all components are in complete solution.

Eosin (counter stain for Hematoxylin):

1% stock alcoholic eosin:

Eosin Y, water soluble----------1.0 gm

Distilled water----------20 ml

Dissolve and add alcohol 95%----------80 ml

Working solution:

Eosin stock solution----------1 part

Alcohol 80%----------3 parts

Glacial acetic acid----------100 ml

B. Staining procedures

Deparafinize in xylene with two changes each for 5 minutes

Hydrate to water using four changes in absolute alcohol each for 3 minutes and with 70% alcohol

Mayer's hematoxylin 15 minutes

Wash in running tape water for 15 minutes (if newly prepared stain, otherwise reduce the time to 10 minutes)

Counter stain with eosin from 15 seconds up to 2 minutes depending on the age of eosin

For even staining result dip slides several times before allowing them to set in the eosin for the desired time

If eosin is water soluble, wash in running tape water

Dehydrate beginning with 70% up to absolute alcohols, two changes of 2 minutes each or until excess eosin is removed

Check under microscope

Clear in xylene, two changes of 2 minutes each

Mount in DPX

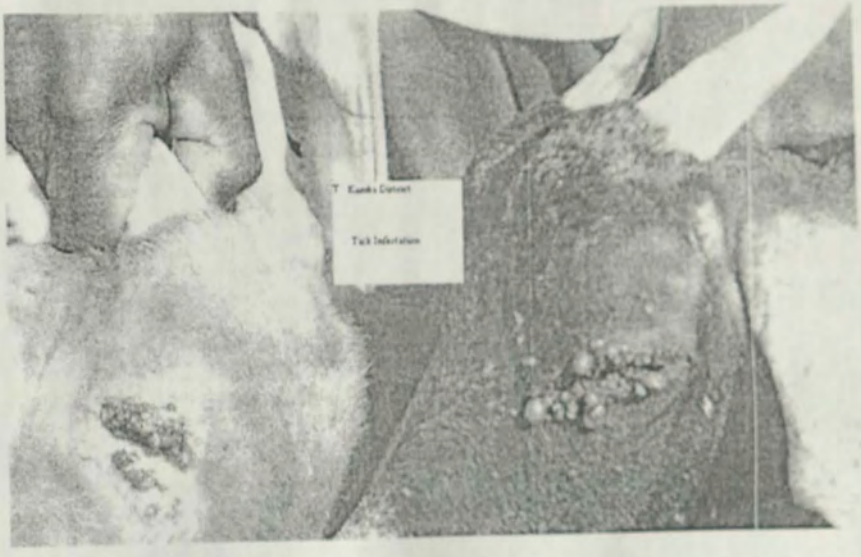
Result

Nuclei	blue with some metachromacia
Cytoplasm	Various shades of pink

Picture1

Picture 2

Picture3



Picture4

Picture 5

9. SIGNED DECLARATION SHEET

I, the under signed, declare that the thesis is my original work and has not been presented for a degree in any University.

Name: Menale Getachew Shibeshi

Signature .....

Date of submission 25/06/2008.....

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

Name Dr Bulto Giro

Signature.....

Name Dr. Bersissa Kumsa

Signature.....