

PREVALENCE AND IDENTIFY ECTO-PARASITES ON SMALL RUMINANTS IN AND AROUND ARSI NEGELLE

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✉ Supporting Information, ► Supplementary Data

ABSTRACT: A cross sectional study was conducted to determine the prevalence and identify Ecto-parasites on small ruminants. A total of 422 small ruminants; sheep (n=246) and goats (n=176) were included in and around Arsi Negelle. Simple random sampling method was used to determine clinical infested animal from healthy animals and data was analysed using SPSS 16 software for the description of p-value and chi-square. The result indicated that overall prevalence of ectoparasite in small ruminant was 126 (29.9%). Of which the prevalence of ectoparasite in sheep and goat was about 77 (31%) and 49 (27%), respectively. The most common ectoparasite encountered in order of their predominance were, lice (31.7%), flea (24.6), tick (19%), mixed (12.7%) and mite (12%). The statistical analysis indicated that sex ($X^2=13.774$, $P=0.0001$), body condition ($X^2=40.463$, $P=0.0001$) and age ($X^2=6.129$, $P=0.013$) were some of the important factors showed significant difference to ectoparasite infestation of small ruminants. No statistical significant difference ($P>0.05$) were found between the species of small ruminants and ectoparasite infestations. The major ectoparasites at genus level identified on sheep and goat, were *Ctenocephalides* spp (23%), *Bovicola* (20.6%), *Linognathus* species (11.9%) *Rhipicephaluses* (8.7%), *Amblyomma* (7.1%), *sarcoptes* (7.1%), *Hyalomma* (5%) and *Demodex* (4.8). This study was conducted to identify the major ectoparasite and their prevalence on the small ruminants in study area. The most important ectoparasite identified, were lice, flea, ticks and mite. Therefore based on the findings following recommendations are forwarded: Strategic treatment of small ruminants with insecticides should be practiced in the study area to minimize the impact of ectoparasite on the health of animals; Awareness creation for the local farmers about the control of ectoparasite is essential and Further detailed study on economic loss associated with ectoparasite should be conducted.

Keywords: Ectoparasite, Prevalence, Small Ruminant, Arsi Negelle

INTRODUCTION

Ethiopia has the largest livestock inventories in Africa, including, about 53.99 million cattle, 25.5 million sheep, 24.06 million goats, 1.91 million horses, 6.75 million donkeys, 0.35 million mules, 0.92 million camels and about 50.38 million poultry are estimated to find in the country (CSA, 2013). In addition, wool and manure are also important by products of small ruminants' production (MoARD, 2005). Ectoparasite such as lice, flea, ticks, and mites are widely distributed in all agro-ecological zones in Ethiopia, causing serious economic losses in small holder farms (Kumsa et al., 2012). It was reported that 35% of sheep and 56% of goats skin rejection in Ethiopia are attributed to ectoparasite (Kassa, 2006).

Studies and reports from different parts of the country showed that skin quality deterioration is very evident mainly due to ectoparasite (Tefera, 2004; Numery, 2001; Ermias, 2000). All these established facts imply that ectoparasite pose serious economic losses to the farmers, the tanning industry and the country as a whole (Berhanu et al., 2011). This is because small ruminants' production in Ethiopia is constricted by the compound effects of diseases, poor feeding and poor management (Kassa, 2005; Ayele et al., 2003). Despite the large population of sheep and goats in the region, ectoparasite are also among serious problems in east Arsi zone of Oromia region (Hailu, 2010).

Even though the Oromia Regional State has started control program against ectoparasite in some selected districts of east Arsi zone which is the neighbor of west Arsi. However, there are no any reports presented on prevalence of ectoparasite from Arsi Negelle district. So this paper addresses the current prevalence of ectoparasite in small ruminant in Arsi Negelle, Southeastern Ethiopia, Oromia Regional State. Therefore the objectives of this thesis were: A) To identify common ectoparasite on small ruminant in and around Arsi Negelle district; B) To determine the prevalence of common ectoparasite of small ruminant in and around Arsi Negelle district; C) To determine major risk factors associated to the disease.

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MATERIALS AND METHODES

Study area and population

The study was conducted from October 29, 2016 to June 16, 2017 in Arsi Negelle districts of West Arsi zone, Oromia regional state, the district capital Arsi Negelle is located 218 km away from Addis Ababa at 7°21'N latitude and 38°42'E longitude. Agricultural production system is of mixed crop and livestock production. Dairy farming using improved breeds is a common practice in urban and peri-urban areas. In rural areas, mainly local breeds are found, grazing on communal land. The area was selected on the basis of livestock production potential and the presence of different livestock species and breeds. The selected area represents typical crop-livestock production system of the Rift Valley area of Ethiopia. The minimum and maximum annual temperatures are 10 and 25°C, respectively. Generally, the climate of the area is divided into subhumid (32%), semi-arid (42%) and arid (26%) zones with an average annual rainfall ranging from 500 mm to 1150 mm. The target population for this study will be sheep and goat population in Arsi Negelle districts. The study animals include local breeds and including all age groups and both sexes that were selected randomly from the target population (ANAREB, 2016)

Study design and sample size determination

Cross sectional quantitative study design was used from October, 2016 to March, 2017 to determine the prevalence of ectoparasite and its major genus on the small ruminant in ad around Arsi Negelle town. The required sample size for this cross sectional study was estimated by considering 50% of population knowing about prevalence since there is no documentation on ectoparasite of small ruminant in the area before. Thus, the sample size was calculated according to [Thursfield \(2005\)](#) using 95% confidence interval and 0.05 absolute precision. This is calculated by using the following

$$\text{formula: } n = \frac{1.96^2 \times p_{exp}(1 - p_{exp})}{d^2}$$

Where

n = required sample size.

p_{exp} = Expected proportion of population (50%)

d^2 = Desired absolute precision (0.05). As a result, 384 study populations were selected.

Total sample size = 422 subjects to increase the precision

Sampling method, data collection tools and procedures

A multi-stage sampling technique was employed for the selection of the sampling units. From the entire Primary sampling unit, i.e. from 3 Kebeles and 5 PA (01, 02, 03, Ali wayo, Mako oda, Sogido ejo, Kersa gara, Edo jigessa), four kebeles were selected by simple random sampling technique (01, 03, Ali wayo and Kersa gara). The numbers of flock to be included in each kebeles were determined by proportional allocation based on the total number of small ruminant found in the field during study period. From the entire tertiary sampling unit, single flocks, in the selected kebeles were selected using a systematic random sampling technique. From each selected flock, further individual sheep or goat was selected by simple random sampling technique and examined.

The sampled animals were clinically inspected for presence of ectoparasites. Ectoparasite encountered either on the skin surface or attached to the hair were sampled or collected in 70% alcohol. For mite diagnosis, from animal showing signs of scales, crusts, alopecia itching, a skin scraping was taken. Scrape the edge of the affected area until blood oozed. Multiple sites were scrapped to increase the likelihood of ectoparasite detection. A few drop of 10% KOH solution were added to the sample, a cover slip applied and cleansing of debris allowed proceeding for 15-30 minutes before microscopic examination ([Smith and Sherman, 1994](#); [Bowman, 1999](#); [Wall and Shearer, 2001](#)).

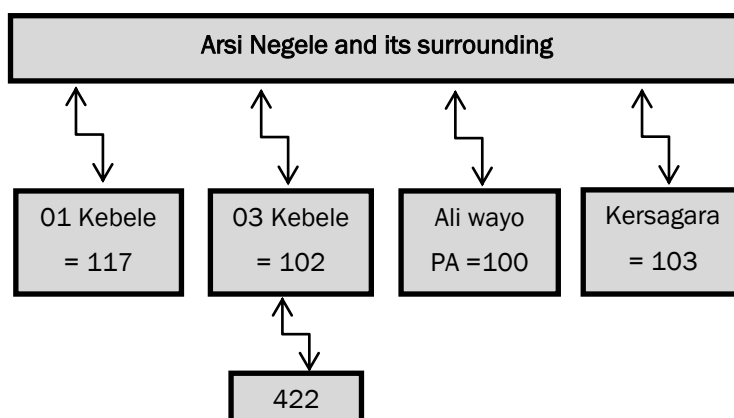


Figure 1 - Multistage sampling procedures, 2017

Data Management and Analysis

The data collected from the field were cleaned and checked for its completeness. Those incomplete and inconsistent were corrected when possible and removed otherwise. After complete check-up the data were coded and entered to Microsoft Excel and transport to statistical package for social (SPSS) version 16.0 and analysis made. The frequency distribution of both dependent and independent variables were worked out by using descriptive statics techniques (Frequencies and prevalence). Pearson's Chi square used to evaluate Association between independent variables such as species, sex, age, body condition and dependent variables i.e. presence of ectoparasite and genus level of ectoparasite that affects the animals. Body condition was recorded by palpating femoral bone and tail. if femoral bone was prevailed and the muscle of tail become emaciated the animal was considered as poor and otherwise it was considered as good. The age of animal was estimated by asking the owner and if the owner responded greater than three months it was assumed as adult and if it was less it assumed as young.

RESULT

Results of clinical and laboratory examination of sheeps and goats based species exposed for ectoparasite

Out of 246 sheep and 176 goats examined for ectoparasite; 77 (31%) sheep and 49 (27%) goats were infested with one or more ectoparasite (Table 1). The major ectoparasite identified on sheep were *Bovicola*, *Ctenocephalides spp*, *Mixed infestation*, *Sarcoptes*, *Amblyomma*, *Demodex*, *Hyalomma* and *Rhipicephalus* were 32.5%, 26%, 15.6%, 10.4%, 6.5%, 5.2%, 2.6% and 1.2%, respectively. Also the ectoparasite identified on goats were *Linognathus species*, *Ctenocephalides spp* *Rhipicephalus spp*, *Hyalomma*, *Amblyomma*, *Demodex*, mixed, and *sarcoptes* infestations were, 30.6%, 18.4%, 18.4%, 10.2%, 8.2%, 4.1%, 4.1% and 2%, respectively.

The prevalence of ectoparasite in sheep and goat was 31% and 27% respectively. The difference was statistically not significant ($X^2=0.586$, $P=0.444$). The small ruminant of both species were highly affected by lice, ctenocephalides spp and tick from highly prevalent to lower prevalent respectively (Figure 2). An overall prevalence of ectoparasite was observed in the two small ruminant species at genera level of ectoparasite. In sheep *Bovicola* (32.3%) was the abundant followed by *ctenocephalides* (26%) and (15.6%). while in goats abundant genera ectoparasite were encountered with the prevalence of 30.6%, 18.4% and 18.4% on *Linognathus*, *ctenocephalides spp* and *Rhipicephalus*, respectively. The frequency of this study animals related with the ectoparasite genus indicate that lice spp were the most abundant which was followed by flea and tick in study area (Table 2).

Table 1 - Prevalence of ectoparasite on sheep and goats in and around Arsi negele, 2016/17. (n=422)

Species	No of examined	No of positive	Prevalence (%)	X ² (P-value)
Ovine	246	77	31	
Caprine	176	49	27	0.586 (0.444)
Over all	422	126	29.9%	

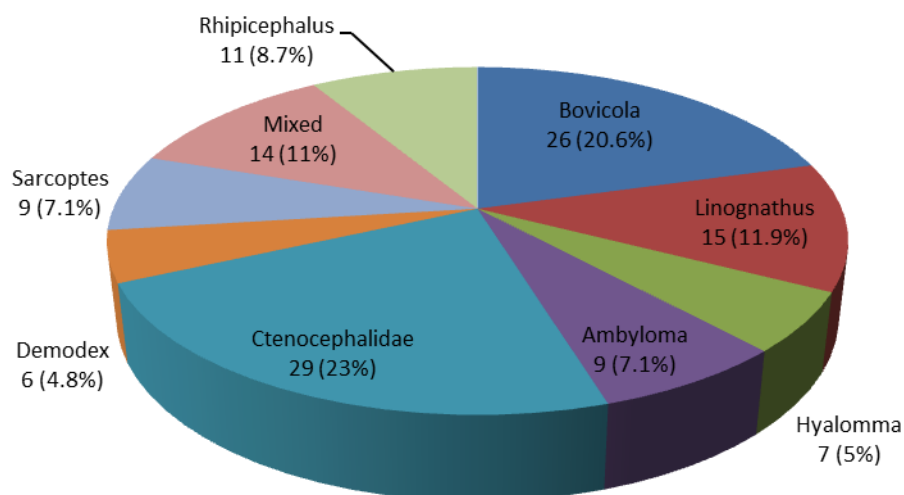


Figure 2 - The percentage of each genus of ectoparasite in small ruminant in and around Arsi nagele, 2016/17 (n=422).

Table 2 - The Frequencies and Prevalence of Ectoparasite on the study animals in and around Arsi Nagelle, 2016/17 (n=422)

Ectoparasite	Frequencies	Prevalence %
Lice	40	31.7
Flea	31	24.6
Tick	24	19
Mite	15	12
Mixed	16	12.7
Total	126	100

Results of clinical and laboratory examination of sheep's and goat's sex for ectoparasite

Statistically significant variation in the prevalence of ectoparasite was recorded between male and female of area ($P < 0.05$). Hence, the prevalence of ectoparasite was significantly ($X^2 = 13.774$, $P = 0.000$) higher in the female animals than male animals due to one female mounted by money male during estrus, stress of female animal during pregnancy and poor grooming behavior of female animal during pregnancy and lactating period (Table 2).

Results of clinical and laboratory examination of sheep's and goat's age for ectoparasite

With regard to age wise comparison, among the 422 animals examined the high prevalence ectoparasite was recorded 36.8% in adult and 25.5% was recorded in young during study period. Furthermore, the association between the two age categories and ectoparasite were statistically significant ($X^2 = 6.129$, $P = 0.013$) (Table 3).

Results of clinical and laboratory examination of sheep's and goat's body condition for ectoparasite

The overall prevalence of ectoparasite in good and poor body condition were recorded as 17.7% and 46.4% respectively. As a result poor body conditions are more affected by ectoparasite due to weakness of immunity, uncertain grooming behavior of emaciated animal and loss of wool due to malnutrition. The association between the risk factor and ectoparasite is also highly significant ($X^2 = 40.463$, $P = 0.000$).

Table 3 - Prevalence of ectoparasites with regard to sex of small ruminants in and around Arsi Nagelle, 2016/17 (n=422)

Sex	No of examined	No of positive	Prevalence (%)	X ² (P-value)
Male	199	42	21	
Female	223	84	37.7	13.774 (0.0001)
Overall	422	126	58.7	

Table 4 - Prevalence of ectoparasite with regard to age in sheeps and goats in and around Arsi Nagelle, 2016/17 (n=422)

Age of animals	No of examined	No of positive	Prevalence (%)	X ² (P-value)
Adult	163	60	36.8	
Young	259	66	25.5	6.129 (0.013)
Overall	422	126	62.3	

Table 5 - Prevalence of ectoparasite with regard to age in sheeps and goats in and around Arsi Nagelle, 2016/17 (n=422)

Age of animals	No of examined	No of positive	Prevalence (%)	X ² (P-value)
Good	243	43	17.7	
Poor	179	83	46.4	40.463 (0.0001)
overall	422	126	64.1	

DISCUSSIONS

The moderate prevalence of ectoparasite recorded in sheep (31%) and goats (27%) is suggestive of the importance of these health problems in small ruminants of the study area. Poor management and poor level of awareness of sheep and goat owners on the effect of ectoparasite are believed to have contributed to widespread occurrence of the diseases. Lice infestations were the most prevalent ectoparasite recorded in small ruminant with a prevalence of 31.7% (Table 2).

The current study has shown that 31% of the sheep and 27% of the goats examined were found to be infested by at least single or mixed external parasites. The medium prevalence of ectoparasite in study area could be due to the fact

that sheep and goats could have frequent exposure to the same communal grazing land that favored the frequent contact and management system of animals, this result is lower than the report of (Tefera, 2004) with a prevalence of 50.5% of sheep and 56.4% of goats. Similarly, (Mulugeta et al., 2010) reported 55.5% and 58% in sheep and goats, respectively in Tigray region and (Sertese et al., 2007) reported about 50.5% and 56.4% prevalence of external parasites, respectively in sheep and goats in different agro climatic zones of eastern Amhara region of Ethiopia.

The overall prevalence of lice obtained in this study area (32.3% in sheep and 30.6% in goats) was higher than observations made in southern range land 0% in sheep and 1.55% in goats (Mohammed, 2001), but lower than the prevalence reported by Tefera (2004) in Amhara region (39.8% in sheep and 29.2% in goats) and (Yisehak, 2000) at Sebata (89.5%) in fresh sheep skin examinations. The genera of lice identified on sheep and goats in the study areas was, *Damalina* which was the highest observed ectoparasite with the prevalence of 32.3% on sheep. *Linognathus* was the second genera of lice identified in the study area with the prevalence of 30.6 on goats.

Flea infestation with *Ctenocephalides spp.* was one of the ectoparasite problem encountered in small ruminants of the study area. It is generally true that ruminants including sheep and goats, horses and pig do not have their own species of fleas (Urquhart et al., 1996). However, most species of flea are not host specific and feed on any available animals, but in many case full fertility is achieved after feeding on specific host. *Ctenocephalides spp.* Occasionally infest sheep and goats and the clinical signs includes; papule, crusts, pruritus and excoriation (Wall and Shearer, 1997). In this study the prevalence of *Ctenocephalides spp.* was found to be 8.3% in sheep and 5% in goats. In goats, the prevalence of *Ctenocephalides spp.* in midlands (23.3%) was significantly higher than the lowland (0.8%) and the highlands (1.2%). This is probably associated with the high humidity, usually above 70% required for ovipositor of their eggs (Wall and Shearer, 1997).

In this study, three genera of ticks (*Rhipicephalus*, *Amblyomma* and *Hyalomma*) were identified which made a total prevalence of 9% and 34% in sheep and goats, respectively. This was in disagreement with (Teshome, 2002) with the prevalence of 23.8% in sheep and 16% in goats which were reported from the Sidama Zone in Southern Ethiopia. In addition, high prevalence rate of ticks in sheep and low prevalence in goat with current result was reported by Yacob et al. (2008) in and around Wolaita sodd, Southern Ethiopia with the prevalence of (68% in sheep and 19% in goats respectively) and (Abebe et al., 2011) with prevalence of 40% and 58.8% in sheep and goats in selected districts of Tigray region, Ethiopia.

In small ruminants, two mite genera were identified. These were *sarcoptes* and *demodex*. The first one is commonly detected in sheep and goats with a prevalence of 3.3% and 0.6%, respectively. This result is closely in agreement with Tefera (2004) with the prevalence of 5.49% and 6.3%. The second is also detected in both species with the prevalence of 1.6% and 1.1% respectively. This result is closely in agreement with (Tadesse et al., 2011) with the prevalence of 6.58% in sheep and 1.51% in goats. The Prevalence of mange mite obtained in this study area were higher than other researches done in different parts of country, 7.4 % by Assegid (2000) and 1.86% by Chalechaw (2001). This increment agreed with Pangui (1994) high temperature, humidity and sunlight favor mange mite infestation.

Several health problems, welfare issues and losses in productivity due to blood loss, pain, lameness, irritation, debilitation, mechanical damage, inflammation and hypersensitivity, secondary complications and transmission of pathogenic agents to small ruminant in the current study areas are possibly associated with the ectoparasite identified, as has been described by Kok and Fourie (1995), Jongejan and Uilenberg (2004) and Mekonnen et al. (2007). For instance, Walker et al., (2003) have described *R. (B.) decoloratus* as a vector of *Borrelia theileri* in ruminants and horses. In addition, Kumsa et al. (2012) recently reported molecular detection of zoonotic bacteria pathogenic to humans from *B. ovis* of sheep and other lice of ruminants in Ethiopia. The other ectoparasite such as ticks is well-known vectors of piroplasmosis and rickettsial diseases of ruminants, zoonotic rickettsial and viral diseases (Kumsa et al. 2012a; Mekonnen et al., 2007; Pegram et al., 1981; Walker et al., 2003). In view of these facts, ectoparasite should play a role in the transmission of pathogenic organisms to small ruminant of the study areas.

CONCLUSION AND RECOMMENATION

This study was conducted to identify the major ectoparasite and their prevalence on the small ruminants in study area. The most important ectoparasite identified were, lice, flea, ticks and mite. Lice were the most abundant ectoparasite in the study area followed by flea, tick, and mite. The infestations of ectoparasite are important affecting the health and productivity of small ruminants in and around Arsi -Negelle. Lack of awareness about the significance of the problems among owners for control schemes have contributed to the wide spread nature of ectoparasite in the area. Species was not found as a risk factor of all ectoparasite infestation in the current study. However, sex, age and body condition were important factors for different ectoparasite infestation in the current study.

In view of the findings of the present study it is possible to conclude that due to absence of control campaign several species of lice, flea, tick and mite represent common health and productivity problems of small ruminant in and around areas of Arsi-Negelle district.

Therefore based on the above points and others the following recommendations are forwarded.

✓ Strategic treatment of small ruminants with insecticides should be practiced in the study area to minimize the impact of ectoparasite on the health of animals.

- ✓ Awareness creation for the local farmers about the control of ectoparasite is essential.
- ✓ Control programs should be designed and implemented with the participation of all stakeholders (farmers, tanners, government and other concerned bodies) and there should be strong coordination between neighboring regions and/or districts with strict follow up and control.
- ✓ Even though control campaign was implemented the prevalence of ectoparasite is still high hence, the regional government should be find out the causes and set solution.
- ✓ Further detailed study on economic loss associated with ectoparasite should be conducted.

DECLARATIONS

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Consent to publish

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

AM conceived the study, coordinated the overall activity, and carried out the statistical analysis, drafted the manuscript. MY, MB and MY conceived the study, coordinated the overall activity, and reviewed the manuscript. All authors read and approved the final manuscript.

Availability of data and materials

Data will be made available up on request of the primary author

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ANNEXES

Annex 1. Laboratory procedures

Mange mite Identification

Examination of skin scrapings is essential in the diagnosis of mange. In long standing cases mites are often very few in number and extremely difficult to find and their absence from the skin scraping doesn't negate a diagnosis (Jackson, 1991). Multiple sites should be scrapped to increase the likelihood of ectoparasite detection. Superficial skin scraping (epidermal surface examination) after removing coat hair by gentle clipping can be used to identify surface mites while deep skin scraping (deep epidermal examination) until capillary ooze occurs is useful in the diagnosis of burrowing and follicular mites such as *Sarcoptes scabiei* and *Demodex* spp. (Hendrix, 1998; Wall and Shearer, 2001). A few drop of 10% KOH solution or liquid paraffin are added to the sample, a cover slip applied and cleansing of debris allowed proceeding for 15-30 minutes before microscopic examination. Large samples may be processed by boiling 10 minute in 10% KOH solution, centrifuging and performing sugar flotation on the sediment (Smith and Sherman, 1994; Bowman, 1999).

Tick Identification

According to (Wall and Sheare 2001) the procedure for identifying ticks is as follows; the preserved specimens of tick collected from the field are poured in to petridish and separated from material such as hair, scale or dry skin. Ticks which are dirty should cleaned their scutum by gently rubbing with cotton. Each tick are placed on clean petridish on the stage of a stereoscopic dissecting microscope and identified. Specimens should not be allowed to dry completely. Low power objective is use to separate genera and sexes of ticks. To identify at the species level medium or high power objective is used. The key morphological structures such as gnathosoma, capitulum, basis capituli, eyes, anal grooves, coxae, festoons ornamentation of the scutum, ventral shield, palpas, chelicaera etc used for identification of ticks.

Lice Identification

According to Wall and Sheare (2001) under light microscope structure such as claws per leg, segment of the antennae, eyes, mouth part, stylets of the ventral pouch, thoracic segment, spiracles, head and etc are used to identify the species and genera of the lice.

Fleas Identification

Flea is bilaterally flattened wingless insects with three body parts i.e. head, thorax and abdomen. The thorax has 6 legs arranged in 3 bilateral pairs, and the hind limb are enlarged and specially adapted for jumping. Adult fleas vary in size according to gender, female fleas are larger measuring up to 2.5 mm in length, while male are smaller <1mm. the head often bears genal ctenidium (spines).the two species of small ruminant i.e. *c.canis* and *c.felis* are differentiated with this structural part

Annex 2 - Format for field sample collection.

s/n	Species		Sex		Age		Body condition		parasite	Lab identification	Kebeles	date
1	O	C	M	F	A	Y	P	G	L,F,T,M			
2												
3												

Where, Species: O- ovine and C- caprine, Sex: M- male and F- female; Age: A- adult and Y-young; Body condition: P- poor and G- good; Parasite: L- lice,F-flea, T- tick and M- mite

Annexe 3 - body condition scores

Body condition score 1	Whole body-emaciated, bony process can be easily felt Spine-dorsal spinous process are sharp and prominent, easily felt through skin Lones-no fat cover, lone muscle very shallow transverse process- transverse process sharp and easy to pass fingers underneath them
Body condition score 2	Whole body- thin, more difficult to feel between each process Spine-dorsal spines process still prominent but not sharp Loin-loin eye muscle fuller, virtually no fat cover transverse process-transverse process rounded on edge, slight pressure needed to push underneath them
Body condition score 3	Whole body-average Spine-smoother and less process, some pressure required to feel between them Loin- loin muscle full and some of fat cover Transverse process-smooth, firm pressure needed to push fingers between under edge
Body condition score 4	Whole body-fat, fat accumulation over tail head Spine-considerable pressure needed to feel dorsal spinous processes Loin- loin eye muscle with discernible fat cover Transverse process- can't be felt
Body condition score 5	Whole body-obese, fat pad over tail head Spine-dorsal spinous process can't felt, depression often present where they would normally be felt Loin- loin eye muscle very full and thick covering of fat Transverse process-can't be felt

Source: Gatenby, (1991)