Ectoparasites of Sheep and Goats in North-West Amhara Regional State, Ethiopia

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Abstract

A cross-sectional study on ectoparasites of sheep (n=738) and goats (n=492) was conducted in Northwestern Amhara Regional State of Ethiopia from October 2009 to April 2010 to determine the prevalence of major ectoparasites of sheep and goats and the associated risk factors. Out of the clinically examined animals, 331(44.9%) sheep and 214 (43.5%) goats were infested with one or more ectoparasites. Ectoparasites identified in sheep were *Damalinia ovis* (30.9%), *Mellophagus ovinus* (10.8%), ticks (3.9%), *Linognathus* species (3.1%) and flea (1.1%). Among goats, *Linognathus* species, ticks, flea and demodectic mange were identified with respective prevalence of 27%, 17.7%, 2.6% and 2.2%. Sheep in midland were 3.7 and 2.3 times more at risk for *Damalinia ovis* infestation than sheep in highland and lowland, respectively and also goats in midland were 1.8 times at risk for *Linognathus* species than lowland sheep ($P < 0.05$). Sheep poor in body condition were 1.9 times more at risk for *Damalinia ovis* than good body condition sheep and goats poor in body condition were 3.5 times more at risk for *Linognathus* species than good body condition goats ($P< 0.05$). Age and wool length of sheep were important predictors for the presences of *Mellophagus ovinus* on highland sheep. The prevalence of *Mellophagus ovinus* was significantly higher in young and long wool sheep than in adult and short wool sheep ($P < 0.05$). The observed overall prevalence is generally high which may result in enormous economic losses through decreased production and productivity, damages to the skin and deaths of the animal which requires an immediate attention and professional intervention.

Key words: Ectoparasites, Ethiopia, Goat, Prevalence, Risk factors, Sheep.

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Introduction

In Ethiopia sheep and goats are important contributors to the economy; providing 25% of meat consumption, about half of the domestic wool requirements and 92% of the value of semi-processed skin and hide export trade. They also play an important role by providing export commodities such as live animals, meat and skins to earn foreign exchange to the country. Sheep and goat skins rank among the largest export commodities (Kleemann, 2008; Alemu Yami and Merkel, 2009). Ethiopian small ruminant skins, especially sheep skins traditionally have a very good reputation for quality in the world leather market due to their fine grain and compact structure. Though Ethiopia has very good potential to produce substantial quantities of skins, the quality of skins supplied is deteriorating from time to time. This has resulted in an ever increasing number of complaints about the quality of skins available to local tanners and the export market. The problem has adversely affected all aspects of the industry including the income derived from exports. Hides and skins were accounting for 14-16% of the country's total foreign trade revenues several years ago, this value has actually dropped to 9-10% due to a shortage of hides and skins of good quality (Kleemann, 2008).

Skin diseases caused by ectoparasites of small ruminants (lice, ked, mange mites and ticks) are among the major factors for shortage of hides and skins of good quality. Ectoparasites of small ruminants cause mortality, decreased production and reproduction of small ruminants and also they cause serious skin defects that end up with down grading of quality and rejection of skin (Kassa Bayu, 2005; Tefera Sertse and Abebe Wossene, 2007a, Mulugeta Yebegashet *et al*., 2010).

Parasitic mites, lice and keds are considered as a potential threats and pose a serious economic problem to the development of sheep and goats production and the tanning industry in the country and need control intervention (Tefera Sertse and Abebe Wossene, 2007b; Mulugeta Yebegashet *et al.*, 2010). Taking these effects into consideration regions which are most affected (Afar, Tigray and Amhara Regions) have launched control measures to major ectoparasites of small ruminants (MoARD, 2005) and implemented for the last three years (Kleemann, 2008).

Despite the ongoing ectoparasites control activity, problem of ectoparasitic skin diseases of small ruminants is still active and serious in northern parts of Ethiopia. For instance, in Tigray Regional state, after the realization of the control program an overall ectoparasite prevalence of 55.5 % in sheep and 58 % in goats were reported (Mulugeta Yebegashet *et al*., 2010). Similarly, in eastern Amhara region

by Tefera Sertse and Abebe Wossene (2007a) 50.5% in sheep and 56.4% in goats before the control program was launched. Therefore, the objectives of this study are to determine the current prevalence of major ectoparasites of sheep and goats after extensive implementation of control program and assess the potential risk factors associated with prevalence of ectoparasites.

Materials and Methods

Study area and study animal

The study on small ruminant ectoparasites causing skin diseases was conducted in three districts (Metema from north Gonder, Bahir Dar from west Gojam and Farta from south Gonder zones) representing lowland, midland and highland agro-climatic zones, respectively, in western Amhara National Regional State, northwestern Ethiopia. The selected districts are about 923, 563 and 663 kms far from Addis Ababa, respectively. The geographical locations of study areas are 12,58,00 north and 36,11,00 east for Metema, 11,33,00 north and 37,22,00 east for Bahir-Dar and 11,51,00 north and 38,00,00 east for Farta. Metema district has a common boundary with The Sudan. The production system is mixed crop livestock in Bahir Dar and Farta and Agro pastoral in Metema. Livestock are managed under extensive system in all of the three districts. Small ruminants in the areas are indigenous breeds. In Metema they are managed separately from other livestock while in the other two districts they are managed mixed with other livestock.

Study design, sampling methods and sample size determination

A cross-sectional study on the prevalence of major ectoparasites (mites, lice, sheep keds, flea and ticks) of small ruminants was designed. The association of host and agro-climate (environment) related risk factors (explanatory variables) with the presence of the ectoparasites (response variables) were investigated. The host risk factors considered were age, body condition, wool length and species while highland, midland and lowland were environment related risk factors. From each district four peasant associations (PA) were identified conveniently for their accessibility and purposively to represent the different agro climatic zones (highland, midland and lowland). Sheep and goats from each PA were sampled randomly from populations that were collected on the communal grazing areas.

The sample size of animals to be included in the study was determined following

the formula given by Thursfield (2005). Based on this formula and taking estimated prevalence of 20% for each ectoparasite in each agro-climate, desired absolute precision (accepted error) 5% and confidence level of 95% the minimum sample size required were 246 sheep and 246 goats in each district. Goats were not considered in highlands because of their low population and inaccessibility. A total of 1230 small ruminants (738 sheep and 492 goats) were included in the study.

Clinical examination, sample collection and laboratory examination

Before clinical examination for ectoparasites related risk factors such as body condition score, age, sex and hairiness of each sampled animal were recorded. Body condition scoring was done by modifying systems utilized by Girma Abebe and Alemu Yami (2008) and by Steel (1996) for sheep and goats, respectively. Based on these poor body condition score was given to sheep and goats having body condition score of 0 and 1, while good body condition score was given to sheep and goats having body condition score of 2 to 5. Age categorization into young (lamb/kid) and adult was determined as described by Girma Abebe and Alemu Yami (2008) for sheep and goats. Accordingly sheep and goats up to one year were categorized as young and the rest as adult. The study animals were examined clinically for the presence of ectoparasites and/or skin lesions. Sheep and goats found infested by parasites were considered positive. The sites of infestation on the animal body were recorded.

Ectoparasites and their larvae unidentified during clinical examination, and skin scrapings of mange like lesions from clinically suspected animals were collected in clean universal bottles, for detailed laboratory examination. Skin scrapping for mange mites was collected and processed in the laboratory according to the method described by Chauhan *et al.,* (2006). Ticks and lice were collected by hand from their attachment site, put into containers and preserved in 70% alcohol (Urqhart *et al*., 1996). The collected samples were examined by Stereomicroscope and identification was done based on their morphological features given by Okelle-Onen *et al,* (1999) and Walker *et al.,* (2003) for ticks and Urquhart *et al.,* (1996) and Wall and Shearer (1997) for lice and mites. The samples were processed in Bahir-Dar Regional Veterinary Laboratory.

Three hypothesized risk factors (agro climate, age and body condition of sheep and goats) were considered for analysis to determine risk factors that are significantly associated with presence of ectoparasites in sheep and goats.

Data management and analysis

The significance of association of potential risk factors (explanatory variables) to the presence of ectoparasites was determined by binary logistic regression using SPSS-15 for windows software. The explanatory variables considered were separately analyzed to see their association with the outcome status of ectoparasite infestation of sheep and goat. Finally to identify important risk factors (explanatory variables) and to avoid a large type I error either forward or backward likelihood ratio method of variable selection was employed using Hosmer-Lemeshow statistics. For all tests P-value less than 0.05 were considered to be statistically significant.

Results

Investigation of 738 sheep and 492 goats for ectoparasite infestations was conducted to determine the prevalence of infestation. From the study, the overall prevalence of ectoparasites in sheep and goats were 44.9% and 43.5%, respectively. On sheep, infestation with *D. ovis, M. ovinus,* ticks, *Linognathus* species and flea were identified with respective prevalence of 30.9%, 10.8%, 3.9%, 3.1% and 1.1% .The ectoparasites identified on goats were *Linognathus* species (27%), ticks (17.7%), flea (2.6%) and demodectic mange (2.2%). Both on sheep and goats mixed infestation by two or more ectoparasites were recorded with prevalence of 5.0% and 6.9 %, in order (Table 1). Tick species of *A. variegatum*, *A. lepidum* and *B. decoloratus* were collected from sheep and *R. preatextatus, R. sanguineus, B. decoloratus*, *A. variegatum, H. marginatum. marginatum*, *H. maginatum, rufipes and H. impeltatum* were found in goats.

The common sites of *D. ovis* infestation on sheep were the sides, the back, the neck, the rump and the shoulder with decreasing proportion. The major tick attachment sites in sheep were on legs, head/ear, belly /sternum and other sites in decreasing order; while in goats 91.8% were found to attach on head/ear and the rest on the other sites of the body (leg, belly and scrotum).

Table 1: The prevalence of ectoparasites identified on sheep and goats

Ectoparasites	Sheep(n=738)			Goat (n=492)		
	Total positive	Prevalence	95% CI	Total positive	Prevalence	95% CI
D. ovis	228	30.9	26.0-34.2	0	0	0
D. caprae	0	0	0	4	0.8	nd
M. ovinus	80	10.8	8.6-13.0	0	0	0
Linognathus species	23	3.1	1.9-4.4	133	27.0	25.0-29.0
Ticks	29	3.9	2.5-5.3	87	17.7	14.3-21.1
Demodex	0	0	0	11	2.2	0.9-3.5
Flea	8	1.1	0.4-1.9	13	2.6	1.2-4.0
Mixed infestations	37	5.0	3.4-6.6	34	6.9	4.7-9.1
Overall	331	44.9	41.3-48.5	214	43.5	39.1-47.9

nd refers to not determined

Among sheep, agro climate and body condition were significantly associated with prevalence of *D. ovis* and *Linognathus* species. The prevalence of *D. ovis* in midland sheep (48.4%) was significantly higher than the prevalence on both lowland (24.8%) and highland sheep (19.5%) (OR=2.3 and 3.7, respectively; P=0.000). The presence of *D. ovis* in lowland sheep was also 1.6 times compared to the highland sheep which was statistically significant (P=0.04). The prevalence of *Linognathus* species in midland sheep (8.1%) was significantly higher than that in lowland sheep (1.2%). The prevalence of *D. ovis* and *Linognathus* species in sheep were significantly higher in poor than in good body condition sheep (OR=1.9, P= 0.000 for *D. ovis* and OR=3.5, P=0.03 for *Linognathus*). For tick infestation of sheep it was only age which was found significant predictor of infestation (Table 2).

On goats, agro-climate and body condition of the animal were significantly associated with the prevalence of *Linognathus* species infestation. The prevalence was 1.8 times higher in midland than lowland goats and 3.5 times higher in poor than in good body condition goats (P< 0.05) (Table 3). The predicted risk factors were also considered for analysis to determine risk factors that are significantly associated with prevalence of tick infestation in goats and it was only agro climate that was significantly associated with prevalence of tick infestation. The prevalence of tick in lowland goats (21.1%) was significantly higher than the prevalence in midland goats (14.2%) (OR=1.7; P=0.024). This study also indicated that agro climate could be risk factor for the presence of flea infestation on goats. The presence of flea infestation on midland goats was 11.8 times higher P=0.02) compared to the lowland goats (Table 3).

Table 2: Logistic regression analysis result for association of potential risk factors with the prevalence of ectoparasites in sheep

Major ectoparasites	Risk factors	Risk factor category	Prevalence (%)	P-value	OR	95% CI for OR
D. ovis	Agro-climate	Highland (n=246)	19.5			
		Lowland (n=246) *	24.8	0.04	1.6	1.0-2.5
		Midland (n=246) *	48.4	0.000	3.7	2.4-5.5
		Midland (n=246) **	48.4	0.000	2.3	1.5-3.4
	BCS	Poor (n=362)	40.1	0.000	1.9	1.4-2.8
		Good (n=376)	22.1			
	Age	Young (n=297)	36.7	0.119	1.3	0.9-1.8
		Adult (n=441)	27.0			
Linognatus species	Agro-climate	Highland (n=246)	1.2			
		Lowland (n=246)	0.0	-	-	-
		Midland (n=246) *	8.1	0.003	6.3	1.8-21.6
	BCS	Poor (n=362)	5.2	0.03	3.5	1.1-10.6
		Good (n=376)	1.1			
	Age	Young (n=297)	3.0	0.297	0.6	0.3-1.5
		Adult (n=441)	3.2			
Ticks	Agro-climate	Highland (n=246)	0.0	-	-	-
		Lowland (n=246)	8.1			
		Midland (n=246) **	3.7	0.124	0.5	0.2-1.2
	BCS	Poor (n=362)	2.8	0.807	0.9	0.4-2.1
		Good (n=376)	5.1			
	Age	Young (n=297)	1.0			
		Adult (n=441)	5.9	0.008	5.3	1.5-18.0

* Highland reference ** Lowland reference

Table 3: Logistic regression analysis result for association of potential risk factors with the prevalence of ectoparasites in goats

Risk factors	Category of risk factors	Ectoparasites								
		Linognathus			Ticks			Flea		
		P (%)*	P-value	OR (95% CI for OR)	P (%)*	P-value	OR (95% CI for OR)	P (%)*	P-value	OR (95% CI for OR
Agro-climate	Midland(n=246)	34.6	0.007	1.8 (1.2-2.8)	14.2			4.9	0.019	11.8 (1.5-93.0)
	Lowland(n=246)	19.5			21.1	0.024	1.7 (1.1-2.8)	0.4		
BCS	Poor (n=181)	44.2	0.000	3.5 (2.3-5.3)	19.9	0.15	1.4 (0.9-2.3)	3.9	0.528	1.4 (0.5-4.4)
	Good (n=311)	17.0			16.4			1.9		
Age	Young (n=242)	31.0	0.064	1.5(0.9-2.3)	15.7	0.225	0.7 (0.5-1.2)	3.3	0.363	1.7 (0.5-5.3)
	Adult (n=250)	23.3			19.6			2.0		

*=prevalence

In this study, *M. ovinus* was found to infest only highland sheep with a prevalence of 32.5%. Analysis of hypothesized risk factors (wool length, age and BCS) with the presence of *M. ovinus* showed wool length and age to be potential risk factors. The prevalence in long wool sheep was significantly higher than the prevalence in short wool sheep (OR=5.4 and P=0.000). The presence of *M. ovinus* infestation in young sheep was 4.1 times compared to the adult sheep. (Table 4).

Table 4: Prevalence of *M. ovinus* on highland sheep based on risk factors

Risk factors		prevalence(%)	P-value	OR	95% CI for OR
Wool length	Short wool (n=112)	14.3		1	
	Long wool (n=134)	47.8	0.000	5.4	2.7-10.5
Age	Adult (n=139)	19.4		1	
	Young (n=107)	49.5	0.000	4.1	2.1-7.5
BCS	Good (n=123)	24.4		1	
	Poor (n=123)	40.7	0.735	1.1	0.6-2.1

Discussion

In this study the overall prevalence of ectoparasites found both for sheep and goats were high, but it was lower than the overall ectoparasites prevalence previously reported both in sheep and goats in the country by Tefera Sertse and Abebe Wossene (2007a); Mulugeta Yebegashet *et al* (2010) and Asnake Fekade (2008). The relatively low overall ectoparasites prevalence found in this study may be due to the effect of the ongoing ectoparasites control program in the region.

Lice infestations were the most prevalent ectoparasites recorded both in sheep and goats. The prevalence of *D. ovis* infestation in sheep in this study was higher than that was reported in different parts of Ethiopia (Yacob Hailu *et al.*, 2008 and Mulugeta Yebegashet *et al*., 2010). But it was relatively lower than the report of 38.5% prevalence in Eastern Amhara (Tefera Sertse and Abebe Wossene, 2007a). The prevalence of *Linognthus* species in goats observed in this study was higher than that was reported by scholars in Ethiopia (Numery Abdulhamid, 2001). On the contrary, it was almost similar to that was reported by Tefera Sertse and Abebe Wossene (2007a) and Mulugeta Yebegashet *et al.,* (2010).

The lice infestation prevalence differences observed between the different studies may be partly attributed to differences in agro climate and season of study since there is strong seasonal cycle in louse numbers (James *et al.,* 1998). The

management and health care of sheep and goats in the study areas will also be another factor since lice infestation is an indication for some other underlying problems such as malnutrition and chronic diseases (Kettle, 1995; Kaufmann, 1996; Wall and Shearer, 1997). Furthermore, the sensitivity of the diagnostic method used and spatial distribution of lice on sheep may be another factor (James *et al.,* 2002b). In addition to this, rubbing is a powerful indicator of infestation and choosing a sheep with rubbed fleece greatly increases the likelihood of detection (James *et al*., 2007) and hence, the prevalence of infestation.

M. ovinus was the second most prevalent ectoparasites observed in sheep with an overall prevalence of 10.8%. This figure was nearly similar to that was reported for eastern Amhara (12.5%) (Tefera Sertse and Abebe Wossene, 2007a). However, it was lower than that were reported by Mulugeta Yebegashet *et al.,* (2010) for Tigray 19.1 %. The difference observed may be due to the agro-climate difference and method of study. The parasite establish itself in temperate countries and in the cooler highlands of tropics but is absent from the hot, humid tropics and heavy infestation occurs in cold wet seasons (Radostitis *et al.*, 1994). In line with this in the present study the parasite was observed only in highland sheep.

In this study, mange caused by demodex was registered with 4.4% prevalence only in goats. According to ABoA (2000**),** Metema district was one of the severely mange affected areas. But in this study except demodectic mange there were no other causes of mange in small ruminants all over the study areas. This may be due to the effect of the three years ectoparasite control activity practiced in the region.

From the predictor variables considered for association with the presence of lice on sheep and goats, only agro climate and body condition were significantly associated with presence of *D. ovis* in sheep and *Linognathus* species both in sheep and goats. Lice breed within narrow temperature range; when temperature is cooler than optimum, eggs do not develop while hotter temperature prevent egg laying and kill the lice. Optimum temperature for *D. ovis* is between 37°C and 39°C. Environmental conditions which subject lice to temperatures outside of this range reduce louse reproduction (Kettle, 1995; Radostitis *et al*., 1994). These are facts explaining the present finding that the presence of *D. ovis* in midland sheep was significantly higher than both in lowland and highland sheep. The same fact will also explain the observed significant association of agro-climate with presence of *Linognathus* spp. both on sheep and goats.

Furthermore, Shearing directly removes 30–50% of lice and many more die subsequently because of exposure to environmental influences and if the fleece

remains saturated with moisture, as can occur in fleece after heavy rain, for more than six hours many nymphs and adults can drown and hatching of eggs is inhibited (Kettle, 1995; Urqhuart *et al*., 1996). In line with this, the authors observed that the highland farmers practice shearing and dipping sheep in water as best treatment for *M. ovinus*. Exposure of the lice to environmental influences (temperature and moisture) through such practices may partially explain the lower prevalence of *D. ovis* in highland sheep than both midland and lowland.

Lice infestation both in sheep and goats were significantly higher in poor than in good body condition sheep and goats. This could be due to lowered immune response as a predisposing factor and/or the poor body condition could be the result of chronic ectoparasite infestation (James *et al.* 2002a).

In this study, significant association was observed between agro-climate and the presence of tick infestation in goats. The odds of tick infestation on lowland goats were 1.74 times compared to midland goats. This may be partially due to the vegetation cover that exists in Metema district (lowland) which controls the moisture content of the environment which is important factor for the survival of ticks (Morel, 1989; Urquahrt *et al*., 1996).

The significant association observed between wool length and presence of *M. ovinus* on sheep could be directly related to the biology of the *M. ovinus* and sheep management practices in the area. Long wool is favourable for the development of different stages of *M. ovinus*. At shearing (which is also frequently practiced in the study area) 80-90% of adult and almost all pupal cases will be removed, and the combination of hot condition and a short fleece kills many of the remaining *M. ovinus* (Kettle, 1995). *M. ovinus* are blood sucking parasites and heavy infestations may cause severe anaemia, which can weaken the animal and make it more susceptible to other diseases. The excreta can stain the wool and downgrade the fleece. They also cause skin irritation, which result in animal biting and rubbing with resultant damage to the fleece and development of vertical ridging on the skin called cockle that downgrade the skin quality (Urquhart *et al.,* 1996; Bates, 2000; Talley, 2007).

The study revealed that ectoparasites of small ruminants were widely distributed and prevalent in all agro-ecological zones and in all age groups of small ruminants in the study area. The observed overall prevalence is generally high which will result in high economic losses through decreased production and productivity, deaths of the animal and damages of the skin demanding an immediate attention and professional intervention.

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