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Study on Prevalence of GI Nematodes in Indigenous Bonga Sheep Breed at Three Selected Agro Ecologies of Kaffa and Bench Maji Zones, Ethiopia

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Abstract
The current study was conducted to determine the prevalence of Gastro Intestinal Tract (GIT) nematodes of Bonga indigenous sheep breed in three selected districts of Kaffa and Bench Maji zones of Southern Region from September 2010 - April 2011. Cross sectional study for prevalence determination using post mortem and fecal examination and longitudinal prospective study for characterization of the partial seasonal dynamics of nematodes was carried out in the study. A total of 60 animals were subjected to post mortem examinations and 2304 fecal samples were analyzed using standard coprological techniques (flotation and modified McMaster fecal worm egg counts). Questionnaire survey was conducted in randomly selected 6 PA's and 60 households from three districts. Results from coprological examination revealed the overall prevalence of nematodes in Bonga sheep were 96.7%. During post mortem examination, four nematode species (*Haemonchus contortus*, 76.8%), (*Oesophagostomum venulasum,* 43.3%), (*Bunostomum trigonocephalum*, 30%) and (*Trichostrongylus axei* 25%), were identified. Fecal examination results in all study sites from population of Bonga sheep during two sampling periods (early rainy and late dry) indicated significant differences in mean Egg count per Gram (EPG) in the two season of the years ($p<0.05$). About 90 % of Bonga sheep had EPG value 5- 800 the remaining had 801-1200. Poly parasitism predominated in all study areas varying from 100% in Adio kaka, and 95% in N.Bench, 95% in Gimbo. . Absence of veterinary services and lack of helminthes control strategies were believed to be responsible for such higher worm prevalence in the areas. These findings indicate that nematode parasites are a serious threat to the existing small ruminant population and livestock productivity at large in these study districts and require an immediate professional intervention.
Key words: Gastro intestinal nematode species; Small ruminants; Prevalence; Egg per Gram

1. Introduction

Ethiopia has the largest livestock inventories in Africa, including more than 38,749,320 cattle, 18,075,580 sheep, 14, 858,650 goats, 456,910 camels, 5,765,170 equines and 30,868,540 chickens with livestock ownership currently contributing to the livelihoods of an estimated 80 percent of the rural population (CSA, 2006). In the arid and semi-arid extensive grazing areas in the northeastern, eastern, western as well as southern lowlands cattle, sheep, goats, and camels are managed under migratory pastoral production systems. However, the full exploitation of these huge resources was hindered due to a combination of factors such as drought, poor genetic potential of animals, traditional system of husbandry and management as well as the presence of numerous diseases (Mtenga *et al*., 1994).

Sheep and goats are a major source of food protein, income, savings, skin, fiber and manure. Despite their physiological adaptation and ability to thrive under harsh environmental conditions, the full exploitation of these resources is hindered in the tropical environment and particularly in Africa due to a combination of factors such as drought, poor genetic potential of the animals, traditional system of husbandry and the presence of numerous diseases (Waruiru *et al*., 2005). Among prevalent diseases, GI helminthes, particularly nematodes have been recognized as one of the major factors that limit production. Gastro-intestinal nematodes reduce productivity, by causing production losses which is manifested by reduced weight gain; lowered meat and milk production and moralities especially in lambs and kids (Kaufmann, 1996). However, under natural field condition, polyparasitism predominates in most cases and the prevalence varies depending up on the area and the parasite species involved.

Domestic ruminants are frequently exposed to multiple parasitic infections throughout their life. In most cases of natural infections animals are known to harbour single or mixed parasites with various species or several different types of parasites is a common phenomenon (Cox, 2001). In the field while sharing common pasture, animals are exposed to a variety of parasites among which are GI nematodes that cause considerable animal health problems in many parts of the world (Waller *et al*., 2004).

In Ethiopia helminthes infections in ruminants are characteristically chronic and insidious in nature and have attracted very little attention, including research funds, when compared with viral, bacterial and some protozoan diseases. This is in spite of the fact that they undoubtedly exert a heavy toll on the heath and productivity of this vitally important livestock resource, with obvious implications for the rural and national economies of the country (Bekele *et al.,* 1982; Tekelye *et al*., 1987).

Even though in Southern Ethiopia particularly in the study area other local sheep breed is also available, the predominating sheep population is the indigenous Bonga breed. The Bonga sheep have a characteristic fat-tail, which hangs just above or at the hocks. Tail length was 31 and 41 cm for female and males, respectively. Coat colour is predominantly plain light brown to dark brown (37%), creamy white (9%), and black (5%). As a combination, white with brown, black, or fawn constituted 44% while the combination of brown mainly with white and rarely with black is 39%, and black with white, brown, or fawn was 16%. They had shorthairs, some of them having slightly woolly undercoat. The sheep were polled with a slightly convex head profile. Wattle is absent except for 3% of the female sheep. They are mainly reared under traditionally and high meat yield (Markos and Gimbar, 2004).

Even though Southern region is known to have a large population of sheep managed under traditional system; studies are lacking so far on the epidemiology and prevalence of nematode parasites particularly in indigenous Bonga sheep breed. The main objectives of the present study were therefore to: determine the prevalence of GIT nematodes in three selected site of Kaffa and Bench Maji zones, identify the major nematode species parasitizing indigenous Bonga sheep breed in the area and assess the major predisposing risk factors.

2. Materials and methods

2.1. Study area

The study was conducted in three different selected districts of Southern Regional state. The selected sites were Kaffa and Bench Maji zones of SNNPR. Adio Kaka is one of the 10 districts of the Kaffa zone and is located at a distance of 516 km from Addis Ababa, capital city of Ethiopia. It is bordered to the south by Cheta, to the north by Gimbo, to the west by Telo and to the east by Kulo Konta. The mean average temperature of the area is 8-$32^0{}_C$ with the annual rainfall of 950-1200mm/Annum; altitude ranging 1400-2800 (Kaffa zone RDO, 2010). Gimbo is also part of the Kafa zone, bordered to the south by the Decha wereda, to the north by the Jimma zone, to the west by Gewata and to the east by Adio kaka an average temperature is 25-31^0c with the annual rainfall of 900mm-1150mm/Annam; altitude ranging 1050-2400 (Gimbo RDO, 2008). North bench is one of the wereda's in Bench Maji zone, bordered to the north by Chena wereda to the east by the South bench, to the south by Yeki wereda,to the west by Sheh Bench, an average temperature is 15-28 c with the annual rainfall 0f 1500mm-2000mm/annum (Bench Maji RDO, 2010).

2.2 Study animals

The study animals were sheep population targeting indigenous Bonga sheep breed raised under traditional management system in the three purposely selected districts.

2.2.1 Study methodology

2.2.2. Study type

Cross sectional study for prevalence determination using post mortem and fecal examination and longitudinal prospective study for characterization of the partial seasonal dynamics of nematodes according to Toma *et al*., (1996) were employed.

2.2.3. Study procedures

Post mortem examination method

Nematode species identification and worm burden determination were carried out using post mortem examination beginning from October 2007 up to April 2008. Samples were obtained by systematic random sampling method. 60 sheep and goats were purchased from selected study sites and subjected to post mortem examination. A day before slaughter, antemortem examination was performed and the origin, age, sex, and general health condition of the animals were properly recorded. The age of the animals was determined by the protocol developed by Gatenby (1991) and Mike (1996).

Following slaughter, the gastrointestinal tracts were removed, and the abomasums, small intestines and large intestines were immediately isolated by three ligatures (between omasum and abomasum, abomasum and small intestine, ileum and cecum) to avoid mixing of the contents. Collection of the contents of abomasum and intestines, identification of the parasites and counting procedures were conducted according to Jorgen and Brian, 1994, Kaufmann, 1996. In a mixed infection of nematode species, the intensity of nematode infection was classified as low (< 2000 nematode), moderate (2000-10,000) and high (>10,000) as described in Radostits *et al.* (2000).

Fecal sampling for prevalence study and quantification

For each district and both species of animals the sample size was determined using the formula described in Thrusfield (2005):

$$N = \frac{1.962 \text{ x Pexp } (1-\text{Pexp})}{d^2}$$

Where N is the required sample size, Pexp is expected prevalence based on previous preliminary survey; d is the level of precision (5%), 1.96 to indicate 95% confidence level.

Based on the above formula, our sample size for each district was therefore, 384 (by considering 50% expected prevalence of GIT nematodiosis in the study area. Hence, the overall sample size was 384 *3 sites* 2 seasons = 2304 fecal samples.

The study period was divided in to two based on the seasonal condition and rainfall pattern of the area as late wet season (October and December) and early dry season(January to April).

Fecal samples and worms recovered from GIT were preserved in 70% ethanol and 10% formalin, respectively for later examination in the laboratory. The fecal samples were examined by both qualitative (flotation) and quantitative (modified McMaster) techniques. Fecal egg count was determined using modified McMaster technique, each nematode egg counted represents 50 eggs per gram of feces, when the fecal samples became negative for nematode egg in modified McMaster technique, and it was subjected to flotation technique.

The intensity of infection was classified as light (50-800 epg (Egg count per Gram)), moderate (801-1200 epg) and heavy infections (>1200 epg) as described in Jorgen and Brian (1994) for the mixed infections in grazing small ruminants.

2.2.4. Questionnaire survey

The questionnaire survey was conducted to assess risk factors like management practices, nutrition and helminthes control measures. A total of 6 peasant associations from randomly selected 60 households were interviewed.

2.2.5. Data analysis

Microsoft Excel was used to store all the data and Strata 2005 version and SPSS 17.0 software were used to analyze the data. Statistical tests like the, percentages; means and ANOVA and Pearson chi-square (x2) were employed for data analysis. An association was considered as significant when the P value was less than 0.05.

3. Results

3.1. Post mortem results

3.1.1. Nematode species identification and their prevalence

A total of four different species of nematodes were recovered from the gastrointestinal tracts of 60 indigenous Bonga sheep breed during the study period.

The parasite species identified and their percent prevalence in decreasing order was as follows: Haemonchus contortus 76.7%, Oesophagostomum Columbianum 43.3%, Bunostumum spp 30% Trichostrongylus axei 25% were only encountered.

The overall prevalence of GIT nematodiosis of small ruminants in the three agro ecological zones of the study sites was 95% and in the agro ecological bases; 99%, 98%, and100% in lowlands, midlands and high lands, respectively.

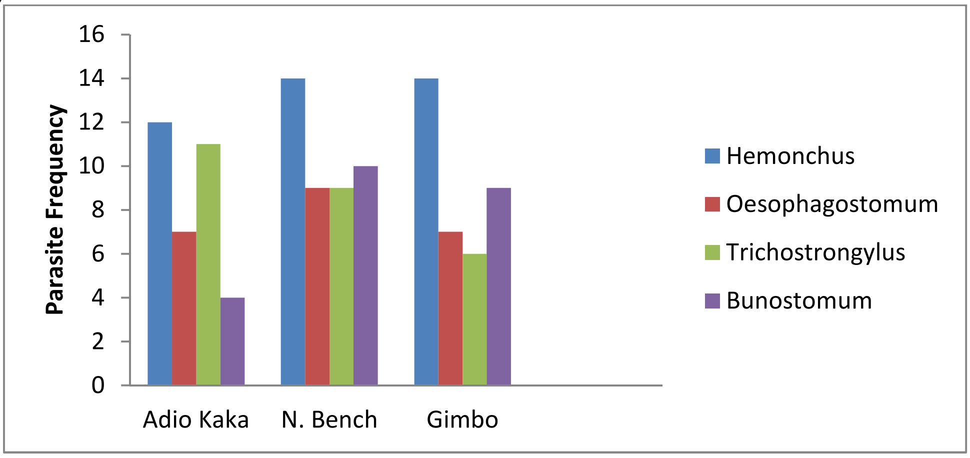

Figure 1: Percentage of animals infected by a given number of parasites

The overall prevalence of GIT nematodiosis of small ruminants in the three agro ecological zones of the study sites was 96.7% and in the agro ecological bases; 99%, 98%, and100% in lowlands, midlands and high lands, respectively.

The results of post mortem examination have shown that 75 % of the infected animals harbored light infection, 16.7 % moderate.

The results of post mortem indicated that out of 90% of infected animals in the study area, 96.7% were infected by more than one nematode species. On district bases; 100%, 95%, and 95% of infected sheep in Adiokaka, N.bench and Gimbo of the study sites respectively had mixed infections. Poly parasitism of more than two parasites in a single host predominates in all study areas.

The prevalence of GIT parasites was not significantly different between Districts, seasons of the year, between the two sexes.

3.1.2. Correlation of nematode count to EPG counts from slaughtered small ruminants

The mean total nematode burden and mean total epg count both from slaughtered animals in this study was positively correlated, and their correlation was significant r=0.131, p=0.01.

3.2. Coprological results

3.2.1. Results of fecal egg count

The majority of examined animals had a fecal egg count in the range of 50-800 epg and the rest animals had fecal egg count over 800.

Fecal examination was done in all study sites from population of Bonga indigenous sheep, during two sampling periods; early wet (September- November), late dry (December- March), indicated no significant seasonal variation (p>0.05) for all study sites.

3.3. Influence of season, age, and sex differences in fecal egg counts

Fecal samples collected from 2304 sheep and examined by the modified McMaster technique using flotation fluid sodium chloride as the floating medium revealed that 86.6%, 95.3 % 80% of the samples during early rainy season and 86.8%, 93.8%, 89.3% during late dry season in Adio Kaka, N. Bench, Gimbo district respectively. Mean EPG count in three study area have showed no variation in two season of the year (p>0.05) for early wet and late dry seasons, but in districts mean epg counts there was significant difference (p=.000).

Table 1**:** Mean EPG count by sex

Sex	EPG			P-value
	N=1152	Mean+ SD	CL at 95%	
Male	609	596.38+446.792	371.45	.000
Female	542	441.93+321.537	395.44	

N = Sample Size, EPG = Egg count per Gram, SD = Standard Deviation, CL= Confidence Level

Table 2: Mean EPG count by Age

Age	EPG			P-value
	N=1152	Mean+SD	CL at 95%	
< 1or = 1	36	443.765±319.45		0.407
>1 and = 3	1073	497.765±357.28		
>3	47	560.465±478.11		

N = Sample Size, EPG = Egg count per Gram, SD = Standard Deviation, CL= Confidence Level

Age differences of the animals had shown no significant difference in EPG count in all seasons of the year (p>0.05).

Table 3: Mean EPG count by Agro-ecology

Agro ecology	EPG			P-value
	N=1152	Mean+SD	CL at 95%	
Highland	384	359.65+287.323	321.834	
Midland	384	681.49+564.334	580.691	.000
Lowland	384	517.o6+467.462	479.259	

N = Sample Size, EPG = Egg count per Gram, SD = Standard Deviation, CL= Confidence Level

Table 4: Prevalence of GI nematodes during early rainy and late dry season in the three study districts

	Adio Kaka %	N. Bench %	Gimbo %	P-value
Early rainy season	86.6	95.3	80	0.000
Late dry season	86.8	93.8	89.3	0.051

3.4. Questioner survey

3.4.1. Management

Result of 60 livestock owners interviewed revealed in this three district, 90% of livestock owners use a communal grazing and they use a free grazing system. Different age group and specie graze together. Availability of livestock pasture was better during (September to November) and short rainy months (March to April) than the dry season (December to February).

3.4.2. Livestock diseases

Bacterial diseases (Blackleg and Anthrax), Pasteurollosis, gastrointestinal helminthiasis and Bloating were the most important livestock diseases in the area. During the survey 58.3% of the interviewed farmers ranked gastrointestinal helminthiasis as major, 25% as moderate and 16.6% as "least important". Gastrointestinal helminthiasis was found to affect cattle and small ruminant both during the rainy and dry seasons.

3.4.3. Drug purchase and usage

The farmers (66.6%) buying antihelmentic drugs from veterinary clinic and health post but 33.3% from unauthorized persons in black market. Furthermore, all farmers administer the drug in their house.

4. Discussion

4.1. Identification of nematode species

4.1.1. Nematode prevalence

The postmortem examination of 60 sheep during the study period enabled the identification of four nematode species parasitizing the Bonga sheep breed in the study area where 96.7% of sheep were infected with one or more species of parasites. This is in agreement with the result obtained by Amenu (2005) and Menkir *et al* (2006).

The most common species of nematodes associated with parasitic gastro-enteritis in small ruminants in most sub-Saharan countries are Haemonchus contortus, Oesophagostomum columbianum and Trichostrongylus colubriformis. Trichostrongylus axei, Bunostomum trigonocephalum, Cooperia curticei, Trichuris ovis, Strongyloides papillosus, and Chabertia ovina also contribute to the syndrome. In winter rainfall and cool highland areas, Ostertagia circumcincta and Nematodirus filicollis are also involved in the pathogenesis of parasitic gastro-enteritis small ruminants (Grabber, 1973). The prevalence and seasonal activity, life cycle and pathogenicity of each species vary with animal species, country and/or climatic region (Urquhart *et al*., 1996).
The result of our study revealed the existence of commonly reported species such as, H. contortus Oe. Columbianum, Trichuris ovis, T. axei, and Bunostumum were found in higher percentage throughout the study period in all Districts of the study area. This is in agreement with findings of other workers in other parts of the country (Bayou, 1992; Dereje, 1992; Esayas, 1999; Kasambara, 1999; Abebe and Essay, 2001; Amenu, 2005).

4.1.2. Seasonal dynamics in prevalence of nematode species

The seasonal dynamics in prevalence of identified nematode species indicated highly significant variation ($p<0.001$) between two seasons of the year and between species of animals (Table 4). This present finding coincides from the findings of Nwosu *et al*. (1996) in Nigeria; Tembely *et al*. (1997) at Debre-Berhan of Ethiopia, Magona & Musisi (1999) in Uganda; Debela, (2002) in Adami Tulu; Ng'ang'a *et al*., (2004a) and Ng'ang'a *et al*., (2004b) in Kenya Amenu, (2005) in Southern, Nations, Nationalities and People's Regional State who indicated clear seasonal differences and Menkir *et al*., (2006) in a semi-arid region of eastern Ethiopia.

4.2. Intensity and type of infection

The decreased mean nematode burden obtained during the early wet season (485.49) compared with late dry season (513.34) disagrees with some findings such as Yadav and Tandon (1989), Charles (1989); Debela (2002); Ng'ang'a *et al* (2004a) and Umur (2005), decreased mean nematode burden during early wet season and increased mean nematode burden is probably attributed to overstocking of sheep in the communal grazing areas highest number of infective larvae present in the pasture at late dry season and exposure to a high larval challenge and favorable condition to the infective stage of the parasite (Troncy, 1989 , Urquhart *et al*., 1996).
The significant variation ($p<0.05$) obtained in mean fecal egg output in male animals (596.38 ± 446.796) than female (441.93 ± 321.537) agrees with the results of Amenu (2005) who reported higher EPG output in male animals than females. But not in agreement with Assefa and Sissay (1998) and Debela, (2002) who reported female animals to have higher fecal egg output than male animal. Other authors (Esayas, 1988; Achenef, 1997; Getachew, 1998) reported the absence of difference in fecal egg output between the two sexes. In the study areas sheep are used for meat to family consumption and to the market with good market price as they have greater demand. In this animals whose sexual cycle is seasonal when having a good pasture in rainy seasons, parasites tend to synchronize their reproductive cycle with that of their hosts. For instance, ewes show a spring rise in fecal nematode ova that coincides with lambing and on the onset of lactation. Similarly, the development of helminth larvae ingested by the host in early winter tends to be inhibited until spring in a phenomenon called hypobiosis (Urquhart *et al*., 1996).

The prevalence of polyparasitism from necropsied animals in this study (99.9%) agrees with the work of Yoseph, (1993) but higher than most of the findings (Gebre-yesus, 1986; Solomon, 1987; Ahmed, 1988; Esayas, 1988; Tesfa-alem, 1989; Melkamu, 1991; Bayou, 1992; Dereje, 1992; Getachew, 1998). The existence of more than two nematode species in a single host has an additive pathogenic effect on the host. The pathogenicity is usually high when Hemonchus, Trichostrongylus and Oesophagostomum occur together (Jorgen and Brian, 1994).

4.3. Coprological study

The significant difference in the prevalence of nematodes in early wet season, 86.6%, 95.3%, 80% and late dry season 86.8%,93.8%,89.3% in Adio Kaka, N. Bench, Gimbo distiricts respectively is in agreement with the results of other studies such as Yoseph (1993); Achenef (1997) and Amenu (2005) who reported higher EPG output in male animals than females. But disagree with the results of other studies like that of Agyei, (1997) who reported female animals to have higher fecal egg output than male animal.

In this study significant difference ($p<0.05$) in the EPG between the study seasons was observed. This finding disagrees with the findings of other authors (Achenef, 1997); (Vlassoff *et al*, 1999 and Good *et al*, 2006). Age differences of the animals had shown significant difference in EPG count in two seasons of the year ($p<0.05$). This result coincide with the findings of other authors Achenef, (1997); Vlassoff et al, (1999), Ng'ang'a et al., (2004a), Ng'ang'a et al., (2004b), Mbae, (2004), Magona and Musisi, (2002), Debela, (2002) and Good et al, (2006).

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4.4. Questionnaire survey

4.4.1. Management

The result indicated that most of the farmers used free grazing system for their animals. Due to the scarcity of feed particularly during the dry season, all animals were concentrated in the same area and this situation might have increased the chance of infection by gastrointestinal helminthes.

4.4.2. Livestock diseases

58.3% of the interviewed farmers ranked gastrointestinal helminthiasis as major, 25% as moderate and 16.3% as "least important". Gastrointestinal helminthiasis was found to affect cattle and small ruminants both during the rainy and dry seasons. This could emanate from the fact that the areas get rainfall throughout the year and are hence favorable for development of GIT parasite.

The observed positive association between free-range grazing and FEC compared to zero-grazing is due to the increased risk of infection and re-infection in free-range grazed animals compared to their zero-grazed counter-parts. This is in agreement with reports from other authors that under traditional free-range grazing systems there is continuous infection and re-infection from heavily contaminated pastures rendering anthelmintic treatment of limited value compared to the situation under zero-grazing (Waller, 2004).

4.4.3. Drug purchase and administration

To improve helminth control and productivity in this area, farmers need to integrate management practices aimed at minimizing animal exposure to parasites with reduced reliance on anthelmintics. Therefore, a sustainable integrated helminth control strategy for this area should include adoption of supplementary feeding, and effective anthelmintic treatment regimes. An example of an effective anthelmintic treatment strategy that could be adopted in this resource-poor farming system is the FAMACHA© procedure that was developed for resource-poor farming systems in South Africa (Van Wyk, and Bath 2002) and has been validated in other countries (Kaplan *et al*., 2004 and, Ejlertsen *et al*.; 2006). This system is based on assessment of anemic status of parasitized animals and treating only anemic animals that are succumbing to the effects of helminthoses. Although the drawback of this method is that it assumes that the anemia is solely a result of helminthoses, it has great potential in helminth control in resource-poor farming systems. Compared to conventional strategic anthelmintic treatments where all animals are treated, the FAMACHA© system results in a large proportion of the animals not being treated.

From the results of this study it is quite clear that GIT nematodiosis of sheep in the study areas was one of the major problems that hampered efficient utilization of the available small ruminant resources at hand. Favorite climatic conditions, backward level of management, poor level of consciousness and awareness of farmers about livestock diseases absence of veterinary services are believed to have contributed for widespread distribution and occurrences of these. This growing threat of GI nematodes to small ruminant production and resources at these areas needs well coordinated and urgent intervention

5. Conclusion and recommendations

The present study revealed that GIT nematodiosis in Bonga sheep breed was one of the major problems in the study areas that hampered an efficient utilization of the available sheep population. The wide spread existence of four nematode species Oesophagostomum columbianum, Haeminchus contortus, Trichostrongylus axei, Bunostomum trigonocephalum at the three selected study sites suggests the importance of GI nematodiosis in hampering the productivity and health of the indigenous Bonga sheep breed in the study area.

The partial assessment of two seasons in prevalence of overall nematodiosis has shown significant changes over time; which indicates that in early wet season there was a high prevalence of the GIT nematodiosis than in the late dry season. However, some of economically important nematode species such as H. contortus, T. axei and O. columbianum and B.trigocephaium have indicated significant differences in their prevalence in different site of study area.

Bonga sheep were exposed to multiple nematode infections in most cases harboring various species of nematode within one or both seasons. In addition sheep and goats sharing common pasture were exposed to a variety of common parasites. The mean nematode burden and mean nematode fecal egg count was varied seasonally in three study sites indicating that season of the year is among influential factors in the biology and development of different nematode species.

Generally, veterinary services and infrastructures should be developed in all Districts, to improve the health and productivity of animals. Strategic treatment using broad-spectrum anthelmenthics should be practiced based on the epidemiology of the disease; at the beginning of rain season and at the end of rain season during which the prevalence, fecal egg output and adult nematode burden before the pasture contamination is high. Education of the farmers on the impact of gastrointestinal helminthes of small ruminants, training on the appropriate utilization of pasture land via rotation and proper use of anthelmintics should be applied. Further studies covering other districts should be done in all regions of the country, as there could be unidentified nematode species that could cause significant economic losses.

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