

## Prevalence of Ovine Lung Worms- Around Bahir Dar, East Africa, Ethiopia

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**Abstract:** A cross sectional study was conducted in and around Bahir Dar from October, 2011 to March, 2012 with the aim of determining the prevalence of ovine lungworm infection, to assess associated risk factors and to identify lungworm species involved in the area. In this study a total of 456 fecal samples from sheep of all age groups, management, body condition score and both sexes were examined using modified Baerman technique to extract L1 larvae. The finding indicated that 92(20.2%) were found infected with different species of lungworms namely; *D. filaria* (11.2%), *M. capillaries* (6.1%) and *P. rufescens* (0.7%). Mixed infection was observed in 2.2% of the cases. There was a significant difference ( $P=0.04$ ) in the prevalence of lungworm infection with regard to sex (female 24.5% and male 13.4%), management system (extensive 20.9% and semi-intensive 9.7%). The prevalence of lung worm in different age groups (<1year 23.7%, 1-3years 26.4% and > 3years 9.5%) and body conditions (poor 24%, medium 19.8% and good 19.6%) was not statistically significant ( $P>0.05$ ). In this study younger sheep were found more affected with *Dictyocaulus filaria* (*D. filaria*), while older ones were more infested with *Muellerius capillaries* (*M. capillaries*). Additionally 200 sheep from Bahir Dar Municipal abattoir and private hotel Azewa, were examined postmortem and 121(60.5%) were found to harbor different species of lungworms. The overall prevalence of ovine lungworm infection was found to be higher in postmortem (60.5%) than coproscopic examination (20.2%). It can be summarized that the high prevalence of Verminous pneumonia was as the result of the three lung worm species. Finally possible control measures of the disease are forwarded.

**Key words:** Bahir Dar • *Dictyocaulus filarial* • Lungworm • *Muellerius capillaries* • *Protostrongylus rufescens* • Prevalence • Ovine

### INTRODUCTION

Ethiopia is a leading African country in livestock population and ranks 9<sup>th</sup> in the world [1]. The livestock subsector accounts for about 40% of the agricultural Gross domestic product (GDP) and 20% of the total GDP [2] without considering the contribution livestock in terms of draught power, manure and transport services. Excluding exports of live animals and other products, leathery and leather products alone contribute 18% of the total exports [3].

In Ethiopia livestock population (in millions) is estimated at 44.3 cattle, 23.6 sheep, 23.3 goats, 2.3 camels, 6.1 equines (donkeys, horses and, mules) and 42.9 chickens [4]. However the economic gains from these animals remain insignificant when it is compared to their

huge number [1]. This low productivity is a reflection of disease, limited genetic potential and husbandry standard. The morbidity of animals generally estimated to be in the range of 8-10% of national cattle herd per annum and 14-16% and 11-13% of national sheep and goat flock per annum. respectively with average live weight loss of 70kg for cattle and 6kg for sheep and goat. The national value of this direct loss is estimated to be of 550 million Ethiopian birr [5].

Helminthes of ruminants are ubiquitous and prevalent with many tropical and sub-tropical environments of the world providing nearly perfect conditions for their survival and development [6]. Diseases of respiratory system are some of the leading cause of morbidity and mortality in sheep and major source of economic losses [7], among these the common infections of lung of

sheep is lung worms. These are *D. filaria*, *M. capillaries*' and *P. rufescens*. Although mixed infections can occur [8, 9]. The signs of lung worm infection (Varminouspneumonia), range from moderate coughing with slightly increased respiratory rates to sever persistent coughing [9]. Dyspnea, nasal discharge, weight loss, in case of associated bronchopneumonia also reveals death [9-11]. Control of these parasites is essential, for releasing the potential of sheep production. For proper control the knowledge of parasitic diseases and rules for their control must be applicable to all regions. For this reason a study of epidemiology of each parasitic disease should not be limited to small areas [12]. In Bahir Dar different researches conducted by Sisay [13] and Muluken [14] in relation to ovine lung worm infection who reported 13% and 18.5% respectively. But the incidence of lung worm varies greatly from place to place and time to time depending on the relative importance of many of the factors. In order to investigate a sound lung worm control strategy at local and regional level further and detailed investigation on epidemiology and importance of lung worm infections with respect to its temporal distribution is necessary. Therefore, the objectives of this study were:

- To determine the prevalence of lung worm infection in sheep.
- To identify lung worm species those are involved in the area.
- To assess major risk factors associated with the disease.

## MATERIALS AND METHODS

**Study Area:** The study was conducted in and around Bahir Dar. Bahir Dar is the capital city of Amhara Regional State and located at 11°29'N latitude, 37°29'E longitude at about 570km North-West of Addis Abeba. The area has middle altitude ranges from 1500 - 2300 meters above sea level which is called "Woyenadega". The area receives a bimodal rainfall with an average annual rain fall ranges from 1200-1600mm. The mean annual temperature of the study area is 23°C. The presence of the biggest Lake Tana and River Abay influence the climatic condition of the study area. The area has a mixed farming practice with crop and livestock production. According to the census that was made by CSA(4), there are 158,564 cattle, 18,827 sheep and goats, 8,000 equine and 366,666 poultry in and around Bahir Dar.

**Study Population:** The study population was all sheep that were found in and around Bahir Dar town. The total of 456 sheep of indigenouse breed of different sex, age, body condition and different management conditions were selected and of which 277 of them females and 179 were male sheep. From the total study population 425 sheep were selected from extensive farms while the rest 31 sheep were from semi - intensive farms that were selected randomly by their percentage proportion from the total population of sheep.

**Study Design and Sampling Techniques:** The study was cross-sectional with simple random sampling technique to determine the prevalence of ovine lung worm infection in and around Bahir Dar. A total of 456 sheep were randomly selected from each Kebeles that are found in and around Bahir Dar.

Coprolologicalfaecal examination of faecal samples was used to determine the prevalence of lung worm invasion in study area. In addition, the lungs of two hundred sheep that were slaughtered at Bahir Dar Municipal Abattoir and in one private hotel named "Azewa" were examined post mortem procedure to determine the prevalence of adult lung worm infection.

**Sample Size Determination:** The study was conducted from October 2011 to March 2012 in and around Bahir Dar. The sample size required for this study was determined depending on the expected prevalence of lung worm invasion and the desired absolute precision. The sample size was computed using the formula given byThrutfield (15) as follows.

$$N = \frac{1.96^2 P_{exp} (1-P_{exp})}{d^2}$$

where: N = required sample size;  $P_{exp}$  = expected prevalence; d= desired absolute precision.

Previous studies that were conducted on prevalence of lung worm in sheep in the study area show 18.16% of prevalence rate. Therefore, an expected prevalence of 18.16% was used to estimate the sample size. Using desired 95% confidence interval, 5% precision and 18.16% expected prevalence, the number of sheep needed to determine the prevalence lung worm in study area were 228 sheep.

However, to increase the level of precision the number of sheep was doubled and 456 sheep were sampled. In addition, a total of 200 sheep lungs were also examined by post mortem examination to see the presence of adult parasites.

## Study Methodology

### Coprological Examination

**Sample Collection:** Total of 456 faecal samples were collected in universal bottles and transported to the Regional Veterinary laboratory as soon as possible. Faecal samples were collected directly from rectum by two fingers after wearing disposable gloves. All samples were clearly labeled with the date of sampling, sex, age, body condition score and the management system that was used. The age of animals was gathered from the owners and dentations.

**Laboratory Technique:** Using Baermantehique Twenty five grams of fresh faeces was weighed from each sample. The larvae and enclosed gauze fixed on to astringe rode was submersed in a clean glass tube which was filled with warm water left for 24 hours and the sediment was examined under lower power of microscope after siphoning off the supernatant. Finally a drop of 1% iodine solution was added to the slide to immobilize the larvae as soon as the larvae are detected under microscope. to identify the species of the larvae. If not identified under microscope, the examined samples were registered as negative for lung worm infection. In both cases, the result that was obtained for each sample was recorded to their corresponding specific animal [16, 17].

**Post Mortem Examination:** The lungs of sheep that were slaughtered at Bahir Dar municipal abattoir and in Azewa private hotel were examined for lung worm infection were digitally palpated to diagnose the presence of protostrongylidea nodules on affected lung tissues. And the nodules were trimmed off and the adult worms were extracted from the tissues by gentle comprising of a small non-calcified nodules or part of large nodule using two glass slides and were carefully tested.

In addition, air passages were opened starting from the trachea down to the small bronchi with fine blunt pointed scissors to detect the adult parasites. All visible adult worms from affected lung tissues were carefully removed and transferred to glass beakers containing 10% formalin and were identified up to species level [12, 16].

**Data Management and Analysis:** The data were entered and managed in MS -Excel. All the data analysis was done by Statistical Package for Social Science (SPSS) soft ware version 16. Descriptive statistics such as percentages and frequency distributions were used to describe the

nature and the characteristics of data. The prevalence of lung worm infection was analyzed using percentages. The association of different risk factors with the disease was computed by Chi - square ( $\chi^2$ ) test.

## RESULTS

### Coprological Examination

**Overall Prevalence of Lung Worm:** Of a total 456 faecal sample of sheep that were examined 92 (20.2%) were found to be infected with either one or more of the lung worm species.

**Species Identification:** The prevalence rate of species of lung worm in sheep in the study area was different and mixed infestation of two or more species of lung worm were observed. Therefore, the prevalence rate of *D. filaria*, *M. capillaries*, mixed infestation and *P. rufescens* was 11.2%, 6.1%, 2.2% and 0.7% respectively. There was highly statistically significant difference ( $P < 0.05$ ). The prevalence of different species of lung worm in the study area are as indicated on (Table 1).

### Prevalence of Ovine Lung Worm in Different Sex and Age Groups:

An attempt was made to see if there was difference in prevalence rate of lung worm between sex groups. The result indicated that there was difference in isolation rate of lung worm between sex groups with prevalence rate of 24.5% in female and 13.4% in male sheep. The association of the prevalence rate of lung worm with sex was computed with Chi-square test. There was statistically significant difference ( $P < 0.05$ ) between the prevalence rate of lung worm and sex groups in sheep as indicated on (Table 2).

Similarly to sex the influence and association of age on the prevalence rate of lung worm infection was determined and it was found that there was difference in the prevalence rate of lung worm infection between age groups. It was 23.7% in sheep less than 1 year, 26.4% in sheep 1-3 years and 9.5% in sheep greater than 3 years. There was statistically significant difference ( $P = 0.04$ ) between the prevalence rate of lung worm and age groups as indicated on (Table 3).

The prevalence rate of different lung worm species that were isolated from different age groups was different with different age groups and there was highly statistically significant difference ( $P = 0.001$ ) between the isolation rates of different species of lung worm with age groups as indicated on (Table 4).

Table 1: Prevalence of the ovine lung worm infection with species variation

Lungworm spp.	Positive	95% CI	Prevalence (%)	$\chi^2$ - value	P – value
<i>D. filaria</i>	51	0.083-0.141	11.2	4.560	0.000
<i>M. capillaries</i> Mixed Infection	28	0.039-0.083	6.1		
<i>P. rufescens</i>	3	0-0.015	0.7		
Total	92	0.165-0.239	20.2		

Table 2: Prevalence of lung worm infection with sex variation

Sex	Sheep examined	Sheep infected	Prevalence (%)	95% CI	$\chi^2$ -value	P-value
Female	277	68	24.5	0.194-0.296	8.380	0.04
Male	179	24	13.4	0.238-0.506		
Total	456	92	20.2	0.165-0.239		

Table 3: Prevalence of lung worm infection with age variation

Age	Sheep examined	Sheep infected	Prevalence (%)	95% CI	$\chi^2$ -value	P-value
<1year	194	46	23.7	0.178-0.296	14.228	0.001
1-3years	125	33	26.4	0.187-0.341		
>3years	137	13	9.5	0.046-0.144		
Total	456	92	20.2	0.165-0.239		

Table 4: Prevalence of different species of lung worm with age and their association with different age groups

Identified species of lung worms							
Age	Sheep examined	<i>D. filaria</i>	<i>M. capillaries</i>	<i>P. rufescens</i>	Mixed	$\chi^2$ -value	P-value
<1year	194	39(20.1%)	4(2.1%)	0(0%)	3(1.5%)	56.893	0.00
1-3years	125	7(5.6%)	17(13.6%)	1(1.6%)	7(5.6%)		
>3years	137	5(3.65%)	(5.1%)	1(0.73%)	0(0%)		

Table 5: Prevalence of lung worm infection and its association with different management systems

Management systems	Sheep examined	Sheep infected	Prevalence (%)	95% CI	$\chi^2$ -value	P-value
Extensive	425	89	20.9	0.164-0.240	2.276	0.131
Semi-intensive	31	3	9.7	0-0.201		
Total	456	92	20.2	0.165-0.239		

Table 6: Prevalence of ovine lung worm infection in different body conditions and its association with different body condition scores

BCS	Sheep examined	Sheep infected	Prevalence (%)	95% CI	$\chi^2$ - value	P-value
Poor Medium Good	50	12	24	0.122-0.358	0.511	0.774
	253	50	19.8	0.149-0.247		
	153	30	19.6	0.133-0.259		
Total	456	92	20.2	0.165-0.239		

Table 7: Prevalence of adult lung worm burden with species during postmortem examination of lung

Lungworm spp.	Lung examined	Lung infected	Prevalence (%)	95% CI
<i>D. filaria</i>	200	35	17.5	0.122-0.228
<i>M. capillaries</i>	200	58	29	0.227-0.353
<i>P. rufescens</i>	200	28	14	0.092-0.188
Total	200	121	60.5	0.537-0.673

Table 8: Coproscopic and Post mortem examination results of lung worm

Type of examination	Examined	Positive	Prevalence (%)	95% CI
Coproscopic Postmortem	456	92	20.2	0.165-0.239
	200	121	60.5	0.537-0.673

**Prevalence of Ovine Lung Worm under Different Management Systems:** In this study the prevalence of lung worm was determined in sheep that were reared in two different management systems (extensive and semi-intensive management systems) and the prevalence of lung worm was found to be higher in sheep with the extensive management system (20.9%) as compared to the semi-intensive management system (9.7%). However, there was no statistically significant difference ( $P > 0.05$ ) between the prevalence of lung worm infection of sheep in the two management systems as indicated on (Table 5).

**Prevalence of Ovine Lung Worm Infection in Different Body Conditions of Animals:** All sheep that were examined for lung worm infection were categorized in to three groups as poor, medium and good body condition. It was observed that the prevalence of lung worm infection was 24%, 19.8% and 19.6% in sheep with poor, medium and good body conditions respectively. There was no statistically significance difference ( $P > 0.05$ ) between the prevalence rates of lung worm infection in different body conditions as indicates on (Table 6).

#### Postmortem Examination

**Over All Prevalence of Lung Worm:** From the total sheep that were slaughtered in Bahir Dar Municipal Abattoir and private hotel “Azewa” during the study period two hundred sheep lungs were randomly selected and examined by post mortem procedure to investigate the adult parasite of lung worm. The result showed that the overall prevalence of adult lung worm infection was found to be 60.5%. Then the adult parasites were identified up to species level and three species of lung worms *D. filaria*, *P. rufescens* and *M. capillaries* were identified with prevalence rate of 17.5%, 14% and 29% respectively (Table 7).

**Coprosopic and Post Mortem Examination Results of Ovine Lung Worm Infection:** Comparison of the overall prevalence of ovine lung worm infection was found to be higher in postmortem examination (60.5%) than Coprosopic examination 20.2 % as indicated on (Table 8).

## DISCUSSION

Lung worm infection (Verminous bronchitis, Verminous pneumonia) is a chronic and prolonged nematodosis that affects the lungs of sheep and goats. This disease results in substantial economic losses due to the reduction of growth rate, morbidity and mortality as

the disease exposed the animals to secondary bacterial infections. It also causes an economic loss due to organ condemnation and medication costs.

In this study, attempts were conducted to know the prevalence of lung worm infection in and around Bahir Dar. Coprological examination of faecal samples and postmortem examination of lungs were used to determine the overall prevalence of lung worm in the study area. Coprological examination of faecal samples revealed 20.2% of overall prevalence of lung worm infection in the study area. Almost similar results were reported previously by Muluken [14] in Bahir Dar, Mengestom [18] in Atsbi and Dawit and Abdu (19) in Jimma who reported the prevalence of lung worm infection 18.16%, 21.5% and 25.6% respectively. The isolated parasites were identified up to species level and *D. filaria*, *M. capillaries* and *P. rufescens* were the major respiratory nematodes of sheep in the study area. However the current prevalence of lung worm is lower than the prevalence that was reported by Netsanet [20] in Debrebirhan, Alemu [21] in North West Ethiopia, Mezgebu [22] in Addis Ababa and Mihreteab and Aman [23] in Tiyo with the prevalence of 73.25%, 53.6%, 48% and 57.1% respectively. The present finding is higher than the prevalence of lung worm that was reported by Teffera [24] in Dessie and Kombolcha, Frewengel [25] in Tigray and Sisay [13] in Bahirdar with prevalence of 15.47%, 11.24% and 13% respectively. These differences in the prevalence might be associated with the variations in agro-ecology of the study areas which favor the survival of parasites larvae in general and/or the presence or absence of snail intermediate host in case of *P. rufescens*; biological difference of the host and the seasonal variation when samples were collected.

Moreover, according to Bradford [26] and Soulsby [27] the occurrence of lungworms is associated with nutritional status, level of immunity, management practice of the area, rain fall, humidity and temperature and seasonal differences when the sample were collected for examination in the respective study areas.

With regard to the species of lungworms, *D. filaria*, *M. capillaries* and *P. rufescens* were the major species of lung worms that were identified in the study area and *D. filaria* was the predominant species followed by *M. capillaries*, mixed infection and *P. rufescens* with prevalence of 11.2%, 6.1%, 2.2% and 0.7% respectively, which was in total agreement with the work of Alemu (21); Netsanet [20]; Nemat and Moghadam [28]. The difference was highly statistically significant ( $P < 0.05$ ). This could be due to the fact that the parasites have different life cycles.

Since *D. filarial* has a direct life cycle and requires shorter time to develop to an infective stage (larvae of these parasites can be shed with faeces within 5 weeks [27], it is the most predominate species of lung worm in the study area. Compared with *D. filarial*, the transmission of *P. rufescens* and *M. capillaries* is epidemiologically complex and requires host, parasite and intermediate host relationship. That is why their prevalence is lower in the study area.

In this study, attempts were conducted to know if there is variation in lung worm infection between different sex groups. The study showed the prevalence of lung worm infection was 24.5% in females and 13.4% in males. The difference was statistically significant ( $P < 0.05$ ). This could be due to the fact that the hosts have different resistance to infection which may be decreased in females at the time of parturition and during early lactation. That is why lung worm infection is more prevalent in females than males which were in total agreement with the work of Sissay [13] and Sefinew [30].

In relation to the age of animals, the prevalence of lung worm infection was varied with age of animals and it was found to be 23.7%, 26.4 % and 9.5% in sheep with the age of less than one year; 1-3 years and greater than 3 years respectively. The difference was statistically significant ( $P < 0.05$ ).

This could be due to the fact that the acquired immunity that developed in older animals due to previous exposure and sheep that recovered from the infection have better immunity against re-infection [31, 32]. However this study contradicts when we look in the case of sheep with the age of less than 1 year (23.7%) and young sheep with the age of 1 - 3 years (26.4%). This is because young sheep with the age of less than one year (mostly lambs) are not allowed for free grazing in order to prevent the lamb from the predator. That is why even if the immunity of lamb is not well developed, the prevalence of lung worm infection is less than young sheep, which was in total agreement with the work of Uqbazghi (29) and Wondowossen [33] who reported that young sheep were found to harbor as many lungworms as compared with adult sheep.

In this study Young sheep  $< 1$  year were found to be more affected to lung worm species of *D. filaria*. This finding agrees with the finding of Uqbazghi (29) in Hamasein Who reported younger animals of sheep was found to be more susceptible to *D. filarial* while older once were more infested with *M. capillaries*. The same finding was also reported by Teffera [24] in Dessie and Kombolcha and Sisay [27] in Bahir Dar. The reason why adults are more affected by *M. capillaries* is that it has

indirect life cycle; takes longer time to reach the infective stage and after ingestion; the larvae can appear in faeces after several weeks. The other reason is that the probability of infection, transmission and re- infection with in a season would be much lower as compared with *D. filaria*. This factor might be why young animals have low infection rate of *M. capillaries* infection [18].

In this study, an attempt was conducted to know if there is difference in prevalence of ovine lung worm infection under different management systems. It was found that the overall Prevalence of ovine lungworm infection was 20.9% and 9.7% in extensive and semi-intensive management systems respectively. The difference was not statistically significant ( $P > 0.05$ ). This could be due to the fact that animals under semi-intensive have a chance of grazing in the field, exposure to the intermediate host (snail or slugs) or directly can be infected with lung worm while they are grazing in the grazing field. This finding disagrees with the finding that was reported by Dawit [35] in Tse-Ada-Emba; with the prevalence of 30.43% and 25% in extensive and semi - intensive farms respectively.

This could be due to the difference in agro-ecology and season of the two study areas; sampling and sampling techniques that are used and it may be due to the differences in breed and the biology of animals.

In this study, another attempt was conducted to know if body condition has influence on prevalence of ovine lung worm infection; and it was found that the prevalence of ovine lung worm infection was 24%, 19.6% and 19.8% in sheep with poor, good and medium body condition score respectively. There was no statistically significant difference ( $P > 0.05$ ) which was in total agreement with the work of Thomson and Orita [36]. The possible explanation for question; why do sheep with poor body condition more affected by lung worm? It could be due to immuno-suppression in sheep with poor body conditions, concurrent infection by other parasites including GIT helminthes and/or malnutrition [37]. Poorly nourished sheep appear to be less competent in getting rid of lungworm infection [38, 11]. Evidently, infestation with the parasite by itself might result in progressive emaciation of the animals. However this result disagrees with the report of Dawit and Abdu [19] in Jimma who reported the prevalence of ovine lung worm in poor (26.8%) medium (25.6%) and good (28.3%) body condition and were not statistically in significant difference ( $P > 0.05$ ). The difference in prevalence of ovine lung worm infection between the two studies in three body condition scores is may be due to differences in breed, study areas, antihelmentic drug applications and management systems.

In addition to coprological examination, postmortem examination of the lungs of sheep that were slaughtered in Bahir Dar Municipal Abattoir and private hotel; “Azewa” was performed to know the prevalence of ovine lung worm infection in and around Bahir Dar. The result revealed that the overall prevalence of lung worm infection to be 60.5%. The overall prevalence of lung worm infection that was obtained by post mortem examination of infected lung was found to be almost 3 times higher than that of the prevalence of lung worm infection obtained by coprological examination. The higher prevalence in post mortem examination agrees with the finding of Teffera [24] around Dessie and kombolcha, Frewengel [25] in and around Mekele and Eyobe [40] in Assela who reported higher prevalence in postmortem than coprological examination.

But, the present finding disagrees with the finding of Sissay [26] in Bahir Dar, Paulos [39] in Arsi (chilallo) who reported higher prevalence in faecal than post mortem examination. This might be associated with the difference in the methods followed in the detection of lung worm larvae and the absence of larvae in the prepatent or post patent phases [16]. The other reasons could be due to those larvae which reach the lungs of sheep remain in the parenchyma and become encysted in fibrous nodules. Because such nodules may not be deposited in air passages [11].

The result of this study revealed that *M. capilaries* is the most prevalent of the total lungs examined and this result agrees with the reports of Muluken [14] and Sisay [13] at Bahir Dar. But this study disagrees with reports of Nestanet [20] in Debrebirhan and Uqubazghi [30] in Hamasein. This could be associated with differences in agro- ecology in Bahir Dar and the suitability of Lake Tana and River Abay for the survival of the intermediate host in case of *M. capilaries*.

#### CONCLUSION AND RECOMMENDATIONS

The study on lung worm infection of sheep using faecal and post mortem examination in and around Bahir Dar revealed prevalence of 20.2% and 60.5% respectively. The respiratory nematodes were *D. filaria*, *M. capillaries* and *P. rufescens*. This high prevalence of Verminous pneumonia as the result of these three species is considered as one of the important nematode infection for sheep in the study area. It is found that young sheep were most affected by *D. filaria*, while adult were, most

affected by *M. capilaries*. The prevalence of lung worm infection has significant association with sex and age in the study area. The economic implication of the disease seems very huge. In view of these facts the following recommendations are forwarded.

- Regular strategic deworming with broad spectrum ant-helmentics.
- Animals should not be allowed to have access to moist and swampy pastures.
- Prohibitions of sheep to graze early in the morning and evening and in rainy weather when the intermediates host (snail and slug) are prominent.
- Isolation of most susceptible age groups (young) from adult in the first season of grazing.
- Supplementation of additional feed to sheep's to make well nourished and good body condition.

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