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Study on the prevalence and production impact of Bovine lung worm in and around Woreta town, Western part of Amhara region and Northern part of Ethiopia

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Abstract
Prevalence study of lung worm in bovine was conducted in and around Woreta town from October 2017 to April 2018. The study was carried out to determining the prevalence of lungworm infection in bovine through laboratorial examination in and around Woreta town. Likewise, the study was assessed the association factors of different parameters and the burden of larval output during the study time. A total of 352 Bovine were examined during the study period. The output of the study indicated the overall prevalence of lungworm infection is 30.1% based on coprological examination. The prevalence of lungworm in infected bovine with different species were 41.5 % *Dictyocaulus filaria,* 17.9% *Protostrongylus rufescens,* 16.0% *Muellerius capillaris* and 4.7% mixed infections with *D. filaria* and *M. capillaris,* 5.7% *D.filaria* and *P.rufescens,* 9.4% *M. capillaries and P. rufescens,* and 4.7% *D. filaria, M. capillaries and P. rufescens.* Prevalence in age group and body condition score showed statistically significant variation ($P<0.05$). On the other hand, prevalence in sex and management system statistically insignificance ($P>0.05$). As stated above the prevalence of lung worm in bovine was high and also true in three lung worm species in and around Woreta town. The Prevalence of lungworm diseases main in the area requires attention to minimize the impact of the problems on production. Strategic deworming should be applied on time to reduce the disease on there.

Keywords: *Dictiocaulus fillaria,* lungworm, *Muelleris capillaries,* bovine, *Protostrongylus rufescens,* Woreta town, 2018

Introduction
In Ethiopia, livestock production contributes about 30-33% of agricultural gross domestic prod uct (GDP) and more than 85% of the farm cash income is mainly from meat, milk, eggs, wool, hides and skins [24]. Small ruminants are important contributors to food production in Ethiopia providing 40% of cash income, 33% meat consumption and 14% milk consumption [3, 36]. Eventhough sheep are important componens of the Ethiopian farming system their contribution to food production, rural income and export income are far below than expected potential. This is because sheep production is constrained by the compound effect of disease, poor feed quality and poor management [13]. Among the many constrains that limit productivity in livestock populations are parasites. Endo parasites are problem forsheep farmers throughout the world [24]. Among endoparasites the most common and economical significant ones are lungworm. Lung worms are widely distributed throughout the world but are particularly common in countries with temperate climates, and in the highlands of tropical and sub tropical countries. The species of importance in ruminants belongs to two different families; the Trichostrong Lisa Ann the Metastrongyliodae. The Dictyocaulidae include *Dictyocaulus viviparus* in cattle and buffaloes, and *Dictyocaulus filaria* in sheep and goats. These worms are 5-10 cm long and live in the trachea and bronchi. The Metastrongylidae are represented by at least two species in small ruminants. *Protostrongylus rufescens,* a small worm (1.5-3.5 cm) found in the bronchioles and *Muellerius capillaris* (1.2-2.5 cm) which are located in the alveoli. An infection of the lower respiratory tract by any of these nematode species may result in bronchitis or pneumonia, or both [32].

Dictyocaulidae and/or certain Metastrongylidae are known to exist in east Africa (Ethiopia, Kenya, Tanzania and South Africa) [32]. Endoparasites, lungworms, are the major cause of mortality and morbidity in the Ethiopian highlands. Up to half of all sheep mortality on farms in Ethiopia highlands are caused by pneumonic and endo-parasites [17]. The effect of lungworms depends on their location within the respiratory tract, the number of infective larvae ingested and the immune system of the animals [11]. Prevention and control of these parasites is, therefore, critical to enhance the economic benefit from these species of livestock. However the incidence of respiratory helminthosis varies greatly from place to place depending on the relative importance of factors [2]. Baseline data on the type, distribution and seasonal incidence of lungworms is important to devise and implement strategic and technical control measures. However, information on lungworm in the study area is scarce. Therefore, the objectives of this study were:-To determine the prevalence of lung worm infection in Cattle, to recognize the species of lung worm involved in study area and to assess possible risk factors of lung worm infection in the study area.

Materials and Methods

Study Area

The study was conducted in and around Woreta town. which is located at 11°29'N latitude, 37°29'E longitude around 630km distance North-West of Addis Abeba. The area has midland altitude ranging from 1800 - 2500 meters above sea level which is called "Woyenadega". The area receives a bimodal rainfall with an average annual rain fall ranging from 1200-1600mm. The mean annual temperature of the study area is 23°C. The presence of the largest 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 a survey by [7].

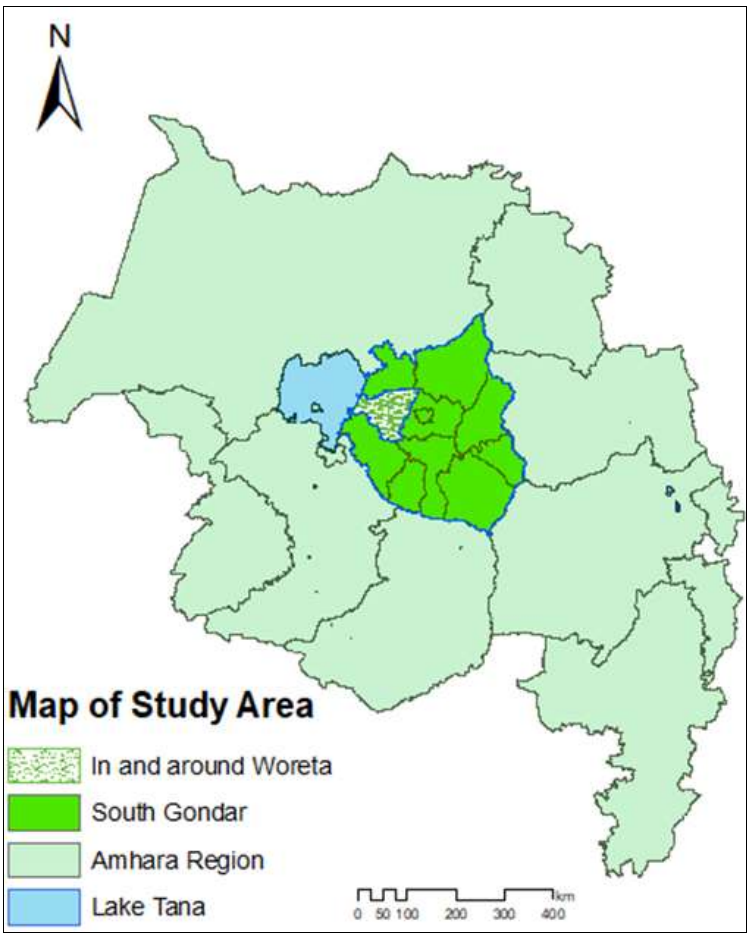

Fig 1: Map of study area in Amhara region South Gondar zone in and around Woreta town in 2013/14

Study Population

Study population included all cattle that were found in and around Woreta town. A total of 352 cattle of different sex, age, body condition within different management system were selected. When I was added some amount of population in the study to increase the accuracy (precisions). Of these, 236 were female and 116 were male. Of which, 236 were selected from extensive farms while the rest 116 cattle were selected from semi-intensive farms, which were selected randomly by their percentage proportion from the total population.

Study design and sampling techniques

Simple random sampling technique was used to determine the prevalence of bovine lung worm infection in and around Woreta town. A total of 352 cattle were randomly selected in and around study area and aslo coprological fecal examinations

was used to identify the species of the parasite from fecal sample.

Sample size determination

The sample size required for this study was determined based on the expected prevalence of lung worm invasion and the desired absolute precision. The sample size was computed using the formula given by [31] as follows:

$$N = (1.96)^2 \frac{Pexp\ (1\text{-}Pexp)}{d^2}$$

Where

N = required sample size; Pexp = expected prevalence; d= desired absolute precision. Previous studies that were conducted on prevalence of lung worm in cattle 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 sample used to determine the prevalence of lung worm in the study area was 228 cattle. Alternatively, to increase the level of precision the number of sample was increased by 124 and so a sum total of 352 cattle were used.

Study methodology and laboratory examination

Sample collection and laboratory technique

Total of 352 fecal samples were collected directly from the rectum of all selected animals and stored in universal bottles containing 10% formalin and transported to the Bahir Dar animal health investigation and diagnostic laboratory for laboratory examination. In the laboratory, the collected fecal samples were processed according to conventional methods for lungworm larvae (Baermanization) [14].

During sample collection, sex, age, date of sampling, body condition and management was recorded. In the laboratory, 25 g of feces was weighed from each sample for the extraction of larvae using modified Baermann technique [14]. The feces were enclosed in gauze fixed on the string rod and submerged in a clean glass tube filled with warm water. The whole apparatus was left for overnight. The larva leaves the feces and migrates through the gauze and settles at the bottom of the glass. After siphoning off the supernatant, the sediment was examined under the low power of the microscope to the larvae of lungworm [12, 34]. Finally a drop of 1% iodine solution was added to the slide to immobilize the larvae when the larvae are detected under microscope to identify the species of the larvae. If have not a chance to see the larvae 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 indicated to their corresponding specific animal. All the area under the cover slip was thoroughly and uniformly searched for the presence of lungworm larvae [16]. The age of the animal was gathered from dentitions [32].

Data management and analysis

The data were entered and managed in MS –Excel spreadsheet. All the data analysis was done by Statistical Package for Social Science (SPSS) software version18. 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 (x^2) test.

Result

Overall prevalence of lungworm

Of a total352 fecal sample of cattle that were examined, 106(30.1%) were found to be infected with either one or more of the lungworm species.

Species identification

The prevalence rate of species of lung worm in cattle at study area was different and mixed infestation of two or more species of lungworm were observed. Therefore, the prevalence rate of *D. filaria*, *M. capillaris*, *P. rufescens*, *D. filaria & M. capillaris*, *D.filaria & P. rufescens* and *D. filaria, M. capillaris, and P. rufescens* infestation were 41.51%, 16.04%,17.92%, 4.72%, 5.66%,9.43% and 4.72%,respectively (Table 1)

Table 1: Prevalence of bovine lung worm infection with species variation

Lung worm spp.	Positive	Prevalence (%)
D. filaria	44	41.51
M. capillaris	17	16.04
P. rufescens	19	17.92
D. felaria & M. capillaris	5	4.72%
D. felaria & P. rufescens	6	5.66%
M. capillaris &P. rufescens	10	9.43%
D. felaria, M. capillaris & P. rufescens	5	4.72%
Total	106	30.1%

χ^2=8.859, P=0.263

Prevalence of bovine lungworm in different sex

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 33.47% in female and 23.28% in male cattle. However, the difference in prevalence rate of lungworm infection did not show statistically significant association between sexes of the animals (Table 2 below).

Table 2: Prevalence of lung worm infection with sex variation

Sex	No-of cattle examined	No-of cattle infected	Prevalence (%)
Female	236	79	33.47
Male	116	27	23.28
Total	352	106	30.11

χ^2=4.93, P= 0.669

Contrary 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 40.74% less than 1year, 20.90%% between 1&3 years and 32.85% greater than 3 years. There was statistically high significant difference (P<0.05) between the prevalence rate of lung worm and age groups (Table 3).

Table 3: Prevalence of lung worm infection among different age groups

Age	No- of cattle examined	No-cattle infected	Prevalence (%)
<1year	81	33	40.74
1-3year	134	28	20.90
>3year	137	45	32.85
total	352	106	30.11

$\chi 2$=7.04, *P*<0.00

The prevalence rate of lung worm species that were isolated from different age groups was different within the age groups and it was statistically significant (*P*< 0.05).Generally, the prevalence of *M. capillaris* and *P. rufescens* increases with age of the animal, whereas the prevalence of *D. filaria* was high in young age groups of the animals. Mixed infection was common in old age group of the animals (Table 4).

Table 4: Prevalence of different species of lung worm within different age groups

Age groups	Identified species of lung worms							
	No-of cattle examined	DF	MC	PR	DF&MC	DF&PR	MC&PR	DF, MC&PR
<1year	81	27	1	2	0	1	0	2
1-3years	134	7	5	7	3	0	6	1
>3years	137	10	11	10	2	5	4	2
Total	352	44	17	19	5	6	10	5

χ^2=58.986 *P*<0.00

DF: *D. filaria*, MC: *M. capillaris*, PR*: P. rufescen.*

Prevalence of ovine lungworm under different management systems

In this study the prevalence of lung worm was determined in cattle that were reared in two different management systems (extensive and semi - intensive management systems) and the prevalence was found to be higher in cattle in the extensive management system (31.42%) as compared to the semi-intensive management system (27.78%). However, there was not statistically significant association within the management systems (χ^2 = 7.452, *P* > 0.05) (Table 5).

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

Management system	No- of cattle examined	No-cattle infected	Prevalence (%)
Semi-intensive	126	35	27.78%
Extensive	226	71	31.42%
Total	352	106	30.11%

χ^2=7.452, *P*<0.383

Prevalence of Bovine lungworm infection in different body conditions of animals

All cattle 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 34.04%, 29.76% and 29.20% in cattle with poor, medium and good body conditions, respectively.

There was statistically significant difference (*P*<0.05) in lungworm infection rate among the different body condition scores (BCS) (Table 6).

Table 6: Prevalence of lung worm infection in different body condition scores

BCS	No- of cattle examined	No-cattle infected	Prevalence (%)
Good	137	40	29.20
Medium	168	50	29.76
Poor	47	16	34.04
Total	352	106	30.11

χ^2=23.86, *P*<0.04

Discussion

Lung worm infection is a chronic and prolonged nematodosis that affects the lungs of cattle and goats and other animals. 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 the present study, coproscopic results made known an overall lungworm infection prevalence of 30.11% in cattle in and around Woreta. Of the total infected animals, 41.51%, 16.04%, 17.92%, 4.72%, 5.66%, 9.43% and 4.72% prevalence was due *D. filaria*, *M. capillaris*, *P. rufescens*, *D.filaria & M. capillaries*, *D. filaria & P. rufescens* and *D. filaria*, *M. capillaris*, *P. rufescens* species of lungworm, respectively. The overall prevalence result almost coincides with the previous researcher reports in Ethiopia, like with that of [33] in Gaint awraje (32.4%), Addis and his colleagues [1] in Gondar (33.83%), Weldesenebet and Mohamed [35] in Jimma (26.7%), Dawit and Abdu (2011)in Jimma (25.6%), Teffera(1993) in Dessie and Kombolcha (27.8%), Brook and co-workers [5] in and around Bahir Dar (27.8%). However, a relative higher and lower prevalence were also reported in different parts of the country including 40.4% in Dessie and Kombolcha districts, Northern Ethopia, by Regassa [28] 22.7% in and around Bahir Dar, by Tewdrose (2010), 21.57%in Tigray, by Mengstom [20] and 20.2% in and around Bahir Dar, by Kassa and Abdu [18]. But, the present study is higher than the observation made from the same area by Muluken [24], 18.16%, and Sisay [29], 13%. Contrarily, the finding is lower than the prevalence of lung worms that were reported by Netsanet [25] in Debrebirhan, Alemu [2] in North West Ethiopia, Mezgebu [21] in Addis Ababa and Mihreteab and Aman [22] in Tiyo with the prevalence of 73.25%, 53.6%, 48% and 57.1%, respectively.

The possible explanation for such infection rate variation could be attributed to variation in season of examination on the respective study areas, which may have good turn or bad turn to the survival of parasite larvae [9]. In addition to that, the snail which is the intermediate host of *P. rufescens and M. capillaris* in encouraging seasons may be considered to be creating the difference. At the end of summer, the parasites multiplication increases as a result of wet season, which is favors multiplication of the parasite. And the intermediate host also obtains complimentary state to survive and multiply. Therefore, the increase in prevalence rate might be due the fact the data was collected in November and December. Moreover, the occurrence of lungworms is associated with nutritional status, level of immunity, and management practice of the animal [4] which is at different levels among the different parts of the country. With regard to the species of lungworms, it was observed that *D. filaria* was the predominant species in the

area followed by *P. rufescens*, whereas *M. capillaris* was the least prevalent. This is in total agreement with the work by Mihreteab and Aman [22].

In the current study higher level of prevalence was observed in female (33.47 %) animals compared to that of male animals (23.3%). However, sex dependent variation was not significantly associated; hence both sexes are believed to have almost equal susceptibility to infection with lungworms. This was coinciding with research study reported by Nibret [26] and Hasen [15], but disagree with report of Alemu [2, 22]. These may be due to the fact that improper distribution of sample selection between the two sexes [27]; or else most of the sampled females were not in preparturient period and early lactation during the study time. These preparturient period and early lactation are relaxation of resistance result in the female's inability to expel adult worms [34, 6]. Which cause higher level of larvae detection.

In comparison to age groups, significant difference (χ^2= 7.04, P < 0.05) in the prevalence rate of lungworm infection was observed. Among lungworms identified, high prevalence rate of *D. fillaria* (41.51%) followed by *P. rufescens* (17.92%) was recorded. The prevalence of *M. capillaris* and *P. rufescens* increases with age of the animal, whereas the prevalence of *D. filaria* was high in young age groups of the animals. This could be due to not well develop immunity against the infection. However, a high infection prevalence of overall lungworm was recorded in young than adults. This is in agreement with the observations of Soulsby [30] and Mireteab and Aman [22] This has been partly explained by the analysis given as; infection with *M. capilleris* and *P.rufescens* did not show development of acquired immunity. The acquired immunity developed by older cattle due to previous exposure of *D. filaria* and that recovered from the infection have better immunity against re-infection [30, 6]. Mixed infection was common in old age group of the animals.

An infection rate of bovine lungworm was statistically analyzed on the basis of body condition to study the impact of the disease in debilitating/emaciating infected animals. The result indicated that an infection rate of 34.04%, 29.76% and 29.2% in poor, medium and good body condition scores, respectively; with a significant variation (P<0.05). This signifies that poor body conditioned animals are more susceptible to an infection. The possible explanation for this observation could be due to immuno-suppression in cattle with poor body conditions, concurrent infection by other parasites including GIT helminthes and/or malnutrition [10]. The reason for this could be partly due to the fact that poorly nourished animals appear to be less competent in getting ride-off lungworm infection although it is unusual for well-fed animals to submit to the disease provided the right environmental conditions are made available. Kassai [19] has also reported that well nourishment and watering lead to less risk of helminthes infection.

In this study, an attempt was conducted to know if there is difference in prevalence of bovine lung worm infection under different management systems. The overall prevalence of bovine lungworm infection was 31.42 % and 27.78% in extensive and semi-intensive management systems, respectively. However, the difference was not statistically significant (P > 0.05); it could be due to the fact that animals under semi-intensive management system have a chance of grazing in the field, being exposed to the intermediate host (snail or slugs) or directly can be infected with lung worm while they are grazing in the grazing field. This study agrees with the finding that was reported by Kassa and Abdu [18] in and Bahir Dar; with the prevalence of 20.9% and 9.7%in extensive and semi - intensive farms, respectively. In contrary, it is not in agreement with the finding of Dawit [8] in Tse-Ada-Emba; with the prevalence of 30.43% and 25% in extensive and semi - intensive sytems, 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 also be due to the differences in breed and the biology of animals.

Conclusion and recommendations

The study on lungworm infection of cattle using fecal examination in and around Woreta town revealed prevalence of 30.1%. The present study result indicated that lungworm is one of the most important helminthosis of cattle in the study area and the prevalence of infection was higher in young age groups, and poor body conditioned cattle. Young animals are mostly affected by the most pathogenic species of lungworm, D. *filaria*, than adults, on the contrary which are highly affected by *M. capillaries* and *P. rufescens*. Based on the above conclusions the following recommendations are forwarded:-Isolation of most susceptible age groups (young) from adult at summer end season of grazing, Supplementation of additional feed to cattle to ensure animals are well-nourished and became good body condition, Emphasis strategic deworming were provided well to be reduced its prevalence.

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