SciMedCentral

Journal of Veterinary Medicine and Research

Review Article

Asses Risk Factors Associated with Ovine Fasciolosis, Identification Fasciola and Snail Species in Debre Birhan District, North Shawo Zone, and Amhara Region Central Ethiopia

Tesema Zebene*

North Showa Zone Livestock Office Animal Health Expert, Ethiopia

***Corresponding author**

Tesema Zebene, North Showa Zone Livestock Office Animal Health Expert, Ethiopia

Submitted: 13 August 2023

Accepted: 30 September 2023

Published: 30 September 2023

ISSN: 2379-948X

Keywords

- Fasciolosis
- Sheep
- Fasciola species
- Anthelmintics resistance
- Intermediate host

Abstract

A cross-sectional study design was conducted; starting from December to April 2013 for five months in Debre Birhan districts, North Showa zone, Amhara Region Central Ethiopia, to assess the risk factors associated with infestation of the disease and Prevalence of ovine Fasciolosis. Simple random sampling was employed for the questionnaire survey and sheep selected. For questionnaire survey 102 households were chosen by Yamane, 1967 formula, for coprological 322 animals were sampled by Thru-field, 2005 formula. The data collected by face to face interview and the fecal sample collected direct from the rectum and adult fluke parasite collected from the liver via its duct. The data was managed by descriptive statistics of SPSS and the strength of associations of predictor to the outcome variable was analyzed using χ^2 test and odds ratio (OR). The overall result, 79.4% of farmers were a graze their animal in both marshy and drought area. The source of water for the majority of small holder farmers 41.2% was open well. Prevalence of ovine Fasciolosis was 51.2% and 63.4% found by faecal and postmortem examination respectively. The overall prevalence of snail species in different habitats was that 42.7% in swamp grazing area, 36.4% in water bodies and 20.9% in muddy area. Lymnaea truncatula species were widespread than Lymnaea natalensis species in Debre Birhan districts because of Lymnaea truncatula species prefers highland agro-ecological.

INTRODUCTION

Background and Justifications

Ethiopia has been a large number of livestock populations in Africa, its accounting 59.5 million cattle, 30.70 million sheep, and 30.20 million goats. Ethiopia has the largest numbers of small ruminant population in Africa [1]. In Ethiopia sheep are the most important small ruminant next to large ruminant [2]. They are important protein sources in the diets of the poor and help to provide extra income and support survival for many farmers in the tropics and sub-tropical areas [3]. Small ruminant has a significant role to maintain the household food security and economic strength to providing meat, milk, skin, wool and generate cash income by selling its products [4]. Sheep and goats have a unique role in small holder agriculture as they require small investments, faster growth rates, have shorter production cycles, and greater environmental adaptability as compared large ruminants [3]. Regardless of, the larger number of livestock populations in Ethiopia, its performance and involvement of the national economics has been comparatively low as a result of infestation of parasitic diseases, inappropriate health care and poor management systems [4]. The parasitic diseases have been among the ruminant animal constraint so as to the obstruction of productivity and reproductively performance of sheep, in many tropical countries [4].

The highland of the Ethiopia has been water logging marshy area and it provides suitable for habitat of the snail, which was intermediate hosts of Fasciola SPP [2]. The epidemiological occurrence of the Fasciola SPP are associated with water logging and swampy grazing area fields known the ideal used for the dissemination as well as maintenance of the intermediate host, which was the snail SPP [2]. Additional, in Ethiopia rational prophylactic program has sound Fasciolosis control strategically programs is needed based on local epidemiological information the parasite disease [5]. Epidemiology of the parasite infestation with respect to the time of rainfall, temperature area, humidity condition, favorable altitude and marsh area is very important in planning the control programs and also estimating the economic burden to the country due to the parasite infestation [6]. Apparently, losses by infestation parasitic diseases including

Fasciolosis is predictable to be highly in temperate area such as Ethiopia was strategic and the most effective disease control strategic program is missing [6]. Epidemiology of the parasite infestation and prevalence of 50.8% ovine Fasciola has been reported by coprological study at Debre Birhan research center [7]. Also the prevalence of ovine Fasciolosis has been reported 24.4% at Haromaya municipal abattoir [8]. Similarly the incidence of ovine Fasciolosis was 32.6%, 70.2% and 49% have been reported at Addis Ababa abattoir [9], in North Showa, at Menz Lalo [10], in Dawa-Cheffa, at Kemissie [5], respectively. Fasciola causes significantly decreasing sheep productivity and reproductively and also economic loss due to the cost of flukicides for the controlling of ovine Fasciolosis [11]. Virtually, flukicides may differ in chemical structure, mode of action and also the efficacy drug against different developmental stages of liver fluke [11,12]. The anthelmintic drugs which used for treatment against liver fluke infection are triclabendazole, albendazole, tetraclozan and benzimidazoles [13]. Triclabendazole is a drug of choice for the treatment of ovine Fasciola, it was effectively treated both immature and mature liver flukes from the age of 2 days and albendazole is effectively treated only against mature flukes from 12 weeks onwards and a short withdrawal period for milk 60 hr. [12]. Therefore, form the above reason, this research thesis was initiated that the aim to assess the epidemiological occurrence with associated risk factors ovine Fasciolosis, identification of the predominate species of Fasciola as well as the snail species in small holder farmers in the study area of Debre Birhan selected districts.

MATERIALS AND METHODS

Description of the Area

This study was conducted selected sites of the study area in Debre Birhan districts, it located at central high land of Ethiopia, in North Showa Zone, at Amhara Regional State and situated at distance of 125Km Northeast Addis Ababa, Ethiopia lying between 9°41'-9.683° N latitude and 39°32'-39°.533° E longitude and an elevation of 2,840 m.a.s.l [14]. The rainfall pattern in the study area was bimodal. The mean annual rainfall was 927.10mm Hg and its rainfall pattern is characterized by the maximum 1293.02mm Hg in August as well as the minimum 4.72mm in December. Similarly, monthly the maximum temperature the area was 18.6 °C and minimum temperature of 8.20 ^{0}C. The total land coverage is 18,081.95Km^{2}. The climate condition of the area was characterized by two seasons namely the summer /wet/ season from June to September and winter /dry/ season from October to May. The farming system in the study area is mixed agricultural system characterized by crop and livestock rearing. The location map of Debre Birhan town administrative and project site [15] (Figure 1).

Study Population

An estimated 20,200 sheep was reared around the study area in Debre Birhan districts in North Showa Zone Amhara administrative Regional State [16]. The study area was consisting nine kebele. The study animal comprised different breeds indigenous breed "*Menze*", cross breed "*Menze* with *Awassi*" and "*Awassi* "breed, indigenous breed ("*Menze*") cross breed as well as *Awassi* breed, and also different age, sex, body conditions groups and category found under the extensive free grazing system in the study area [15].

Study Design

A cross-sectional study design has been employed from November to May 2013 for four months in Debre Birhan districts. From three kebele 102 household were selected by simple random sampling strategy. The study was conducted assess risk factors associated with ovine Fasciolosis by using questionnaire survey, determine the prevalence of ovine Fasciolosis through faecal and postmortem examination, identification predominate Fasciola species via postmortem inspection, and to identify the species of snails based on field survey in and around selected districts. Data was gathered interviewing farmers and animal health experts at their respective areas. Animal level the data consists the age, sex, body condition scores, management system, number of sheep at risk, number of case and death was recorded, for coprological study the faecal sample was collecting from the rectum of each sheep and the snail sample was collecting from the field.

Sampling Strategy/Technique

Simple random sampling was conducted in selected households and kebeles. A total numbers of kebeles around Debre Birhan districts were nine. A total numbers of household that rearing sheep in nine kebeles were 1425. Three kebeles were selected from nine kebeles by simple random sampling. Similarly, from three kebeles 102 small holder farmers were selected by simple random sampling. Study populations (sheep) were selected from each small holder farmers by simple random sampling. Sampling units (sheep) were assigned proportionally to each kebele depending on the total population in each kebele.

Sample Size Determination

The total numbers of small holder farmers were included in the study determined depending the formula given by [17]. it has been provide a simplified to calculate as:-

$$n = N/1+ N (e)^{2}$$

Where: n = sample size, N= total number of targeted population, e = the error term of the precision level, which was 5% used for the standard error and at 95% confidence level.

$$n = 137/1+137(0.05)^{2} = 102$$

A total of 102 small holder farmers were involved in the present study. According to kebele livestock extension workers documentations a total of 1425 small holder farmers were rearing sheep in nine kebeles, 432 small holder farmers were rearing sheep in selected three kebeles from their 137 small holder farmers selected which has rearing only sheep in each kebeles 47 in 01(Atakilt) 35 in 08 (Zangira) and 55 in 09 (Fagi).

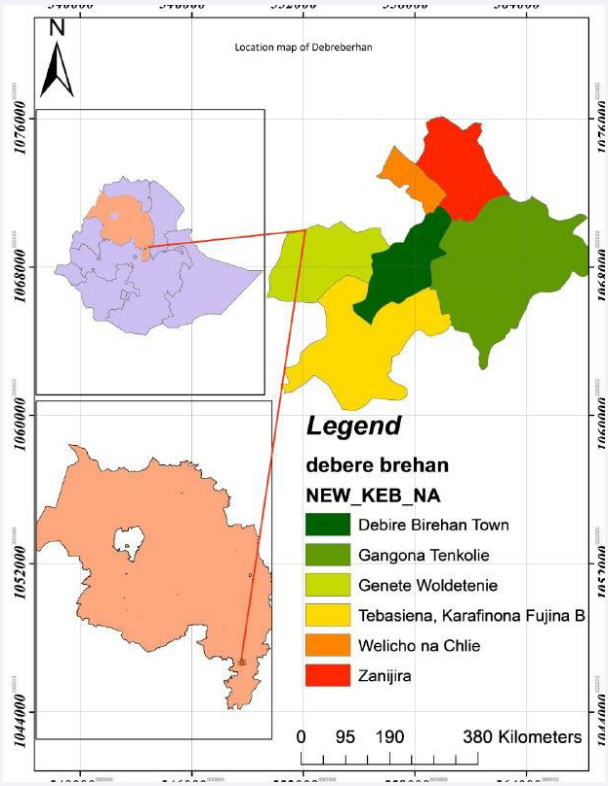

Figure 1 Map Debre Birhan town at North Showa Zone in Amhara administrative Region.

The required sample size was determined by using stratified sampled formula adopted [18]. Taking 1.96 as multiplier for 95% CL, 70.2% predictable prevalence, at 5% absolute precision into consideration:-

$$n = \frac{z^2(P)\ (1-P)}{d2}$$

Whereas: - n= total sample size; z = 1.96; p = predictable prevalence; d= absolute precision value. Therefore, it substituting the values into the above formula yields:-

$$n = \frac{1.96^2(0.702)\ (1\text{-}0.702)}{(0.05)^2} = 322$$

A total of 322 heads of sheep have been examined. The sheep were proportionally allocated in three 50% (161) heads of sheep kebele 01(Atakilt); 16% (52) heads of sheep kebele 08 (Zangira) and 34% (109) heads of sheep kebele 09 (Fagi).

DATA COLLECTION METHODS

Questionnaire survey

A structured and organized questionnaire was prepared and administered to obtain the data on ovine Fasciolosis. The questionnaire was pre-framed in such a way that farmers have been provided the information which was recent and easy to recall, and it was filled directly by interviewing face-to-face. Household data include information about the age, sex, breed and body condition of the sheep, watering and feeding system, seasonality of the disease, and number of diseased and dead animals and frequently dewormed against Fasciolosis disease. Fecal sample collected

Fresh faecal samples were collected directly the rectum of sheep and kept in universal bottle containing 10% formalin and labeled sample code and without delay placed in cold box with ice, transported into Veterinary Parasitology Laboratory, stored in a refrigerator at 4°C if it has been processed more than two days kept at room temperature. Fasciola egg was identified by sedimentation technique [19]. Three grams of faecas was added into 42 ml of water in a graduated cylinder and mixed thoroughly using a glass rod, and it poured through a tea strainer, due to remove large debris. After that two drop of methylene blue was added and a drop of sediment was placed on slide covered with a cover slip and then viewed on by using compound microscope and detected presence or absence of Fasciola eggs.

Postmortem Examination

Postmortem examination was conducted to compare the prevalence of ovine Fasciolosis and to identify the species of Fasciola based on its morphology, which species of Fasciola is more pre-dominate Debre Birhan district. A total of 322 livers of slaughtered sheep were selected from Debre Birhan municipal abattoir by using simple random sampling and examined each

liver to find out the liver flukes in the liver parenchyma and gall bladder.

Snail Collection and Identification

The snails were carried out in the morning when environmental temperature relatively low humidity was available suitable for snail survival. The potential habitat of snails was visited including edges of springs, irrigation canal, swamps and dam areas. Snails were identified morphologically using field guide to African freshwater snails [20]. Identification of the snail species by its morphology *L. natalensis* was longer in length, larger in width, high spire, and small aperture [14]. Also the surface of the spiral rows was small transverse grooves and lack strong spiral ridges of periostracum. *L. truncatula* was small in length, short in width, small the spire, high the aperture and strongly convex whorls.

Dataset Management and Analysis

All data have been analyzed with a statistical computer package for social sciences (SPSS) version 23 software. Descriptive statistic used to analyzed questionnaire survey, coprological laboratory findings, and strength of associations of predictor outcome variable was analyzed using χ^2 test and odds ratio. The significant differences when P-value was ≦0.05 at 95% CL.

RESULT AND DISCUSSION

Coprological Examination

From 322 sheep a fecal sample was collected and examined, from their 165 sheep have been positive for Fasciola. In general the prevalence of ovine Fasciolosis was 51.2% in the study area. The highest prevalence was recorded in local breeds 56.9%; n=132 while the lowest in exotic breed 33.3%; n=4, the difference was significant (p=0.005), also highest prevalence 90.8% in poor; n=79, whereas the lowest 28.3%; n=13 in good body condition, the difference was significant (p=0.000). It was also apparent adult sheep were more infected (53.6%) than young and similarly female sheep were more infected (55.3%) than males, the difference was non-significant.

Prevalence & risk factors of ovine Fasciolosis based on coprological examination: In this finding, the prevalence of ovine Fasciola was 51.2% based on coprological examined, and agrees with the previous study, 52.3% reported by [21], and 62.7% reported by [22], in the same area, but lower than 70.2% reported [10], in Manze Lalo. The variation in the prevalence due to seasonality, difference management practices, and diagnosis of Fasciola was very difficult because of the patent period was intermittent [22].

In this finding, the prevalence was 56.9% (n=132), in local 37.2% (n=29 in cross and 33.3% (n=4) in exotic breeds. The significant difference among breeds (P=0.005). This result was agreed with the previous study 54.2% in local, 32.1% in cross breeds [22]. Variation and significant difference among breeds was genetic effect and immune reaction [23]. Similarly, the prevalence of ovine Fasciolosis was 90.8% (n=79) in poor, 38.6% (n=73) in medium and 28.3% (n=13) in good body conditions. There was significant difference among body condition scores (P=0.000). The variation and significant difference among different body condition might be because of immunological reaction is better in sheep with good body condition score (Table 1).

Postmortem Examination

A total numbers 322 liver of sheep were examined, from their 204 liver affected by Fasciola lesions. Overall Fasciola lesion was 63.4%. Predominate species was *F. hepatica* with 47.8% Table5). Current finding, predominant species was *F. hepatica* (75.5%) followed mixed infection (15.2%) and 9.3% *F. gigantica*. [22]) reported predominant species was *F. hepatica* (68.8%) followed by *F. gigantica* (25.6%) and mixed infection (5.6%) in Debre Birhan municipal abattoir. The reason the difference was the distribution of Fasciola closely related with intermediate host the snail where *L. truncatula* prefers highland and amphibious while *L. natalensis* prefers low land (Table 2).

Prevalence & risk factors of ovine Fasciolosis based on postmortem examination: This results compare from previous, 70.2% was reported by [21], and 52.6% reported by [22], in Debre Birhan municipal abattoir. Lower prevalence 23.35% was reported by [4]. in Adwa municipal abattoir. Prevalence ovine Fasciolosis was different because of seasonal variation and associated risk factors. According to [21], reported occurrence of Fasciolosis was high in wet and rainy seasons, due to intermediate host more abundant.

The prevalence was higher in local (69.4%) breeds, and statistical significant (P=0.000). This result agrees with [22], was reported 54.2% in local, 32% in cross breeds. Also female was more affected (81.3%) than male sheep (51.9%) and difference was (P=0.000. Poor body condition was most affected (90.9%) than medium (67.6%) and good body condition (32.1%). This result agree with [22], was reported 61% in poor body condition, 46.5% in medium body conditioned and 37.5 % in good body conditions in Debre Birhan municipal abattoir [5]. Reported 73.7% in poor and 38.5% in good body condition was in Dawa Chefa municipal abattoir. Therefore, the difference was statistical significantly (p=0.000), due to this fact, cross breed sheep and poor body conditioned sheep has been lower immunity than medium and good body conditioned and also genetic effect and immune reaction. In addition to most of the time those sheep does not recommend for slaughtered (Table 3).

Questioner Survey

A minimum number of 102 small holder farmers were interviewed; from their 91.2% involved in mixed production system and 8.8% involved only livestock production system. Majority of the farmers (79.4%) were graze their sheep in both marshy and drought area. Also (41.2%) of the farmers were the source of water for drinking their sheep in open well followed by open well/stagnant water.

Table 1: Prevalence & risk factors of ovine Fasciolosis based on faecal sample examination in selected kebeles of Debre Birhan district

Variables		N	Positive	Prevalent	χ 2	p-value	OR	95% CI
Age	Young	128	61	47.7%	1.093	0.296	0.788	0.504- 1.232
	Adult	192	104	53.6%				
Sex	Female	161	89	55.3%	2.101	0.147	1.382	0.892-2.143
	Male	161	76	47.2%				
Breed	Local	232	132	56.9%	10.683	0.005**	.....	.....
	Cross	49	29	37.2%				
	Exotic	8	4	33.3%				
BCS	Good	46	13	28.3%	76.270	0.000***	.....	.....
	Medium	189	73	38.6%				
	Poor	87	79	90.8%				
Overall result		322	165	51.2%	.....	.....	.....	.....

N= total number, χ2= chi-square, OR= odd ration, CI= confidence interval, ** indicated p≦0.01, * indicated p≦0.05, *** indicated p=0.000 highly significance

Table 2: Prevalence of Fasciola species by postmortem inspection in selected kebeles of Debre Birhan district

Species Fasciola	Total number of liver (322)	Number infected livers	Prevalence
Positive	204	204	63.4%
Negative	118	.....	
Species Fasciola			
Fasciola hepatica	204	154	75.5%
Fasciola gigantica	204	19	9.2%
Mixed infection	204	31	15.3%

Table 3: Prevalence & risk factors of ovine Fasciolosis using postmortem examination in selected kebeles of Debre Birhan district

Variables		N	Positive	Prevalence	χ2	p-value	OR	95% CI
Age	Adult	322	204	63.4%	.....	.....	.....	.....
Sex	Female	75	61	81.3%	13.613	0.000***	3.169	1.682 - 5.970
	Male	247	143	57.9%				
Breed	Local	271	188	69.4%	26.696	0.000***	4.955	2.599 - 9.448
	Cross	51	16	31.4%				
Body condition	Good	53	17	32.1%	322.00	0.000***	....	.....
	Medium	247	167	67.6%				
	Poor	22	20	90.9%				
Overall result		322	204	63.4%	....	.....	.....	.....

N= total number, χ 2= chi-square, OR= odd ration, CI= confidence interval, ** indicated p≦0.01, * indicated p≦0.05, *** indicated p=0.000 highly significance

The production, the availability of feed and water system: The questionnaire survey indicated that the sheep were high exposed to Fasciola infections, because of the risk factors that associated with the infection of the disease, the difference was significant difference (p<0.05 in the study area. The survey showed that 79.4% of the farmers were grazing their sheep in both marshy and drought area, and the difference was statistical significant (p=0.000). Also 41.2% of the farmers were drinking their sheep in both open-well and stagnant water, there was statistical significant difference (p=0.000). From this research result the associated risk factors as well as the infection of the disease highly significant difference (p<0.05 in the study area (Table 4).

The questioner survey showed that, majorities 83.3% of the respondent did not know about snail as intermediate host for Fasciola. Apparently, 92.2 % of small holder farmers mentioned that snails are found in water body. Actually, 98% of the respondent farmers did not use snail control methods.

The distribution, location and control method of intermediate host snails: The result showed that, 83.3% of small holder farmers were not known the intermediary host the snail, but 16.7% of farmers were known the intermediary host the snail, there was statistical significant difference (p=0.001). Among them 92.2% of the farmers were know the location of the snail in water body but 2% of farmers in grazing area. Due to this fact, the occurrence of Fasciolosis was very high. The disease was endemic in the study area because of the risk factors which are associated the infection such as favorable temperature and climatic conditions, marshy and muddy grazing area, stagnant and open well water source favorable for the growth and development of intermediate host [23]. This research finding was approved [21], report most of the time the prevalence was high in wet and rainy seasons because of the intermediate hosts have been more abundance in the study area (Table 5).

The distribution, the location and the Habitat of intermediary host the snail species: A total 110 snail samples were collected from which 47 snails from grazing areas, 40 snails from water bodies, and 23 snails from muddy areas. Prevalence of snail species in different habitats was that 42.7% in swamp grazing area, 36.4% in water bodies and 20.9% in muddy area.

Table 4: Production, grazing and water system in selected kebeles at Debre Birhan district

Variable		Frq.	%	χ2	p-value	SEM	Var.	SD
Production systems	Only Livestock	9	8.8	10.461	0.005**	0.028	0.081	0.285
	Mixed	93	91.2					
Livestock activities	Small ruminant	10	9.8	12.217	0.002**	0.030	0.089	0.299
	Dairy/small	92	90.2					
Grazing Area	Marshy	6	5.9	28.725	0.000***	0.056	0.315	0.562
	Drought	15	14.7					
	Marshy/drought	81	79.4					
Water Source	River	28	27.5	31.098	0.000***	0.166	2.821	1.679
	Open well/river	31	30.4					
	Open well/stagnant	42	41.2					

Freq=frequency, χ 2=chi-square, SEM=standard error mean, Var=variance, SD=standard deviation

Table 5: Knowledge of farmers were about snail as intermediate host of Fasciola, its location and availability of control methods in selected kebeles of Debre Birhan district

Variable		Frequency	%	χ 2	P-value	SEM	Var.	SD
Snail in locality	Yes	17	16.7	14.481	0.001**	0.037	0.140	0.375
	No	85	83.3					
Snail found	Grazing	2	2	8.893	0.142	0.028	0.078	0.279
	Water	94	92.2					
	Grazing/Water	6	5.9					
Snail control	Yes	2	2	1.118	0.572	0.014	0.019	0.139
	No	100	98					

%= percentage, χ 2= chi-square, SEM= standard error mea, Var= variance, SD= standard deviation ** indicated p≦0.01, * indicated p≦0.05, *** indicated p=0.000 highly significance

Table 6: The distribution, location and snail species and Habitat at Debre Birhan district

Habitat of snails	Total number	SPP of snails		χ2	p-value
		L .truncatula	*L.* natalensis		
Swamp grazing area	47 (42.7%)	42 (45.7%)	5 (27.8%)	2.244	0.326
Water bodies (river)	40 (36.4%)	31 (33.7%)	9 (50%)		
Muddling area	23 (20.9%)	19 (20.7%)	4 (22.2%)		
Overall Prevalence		92 (83.6%)	18 (16.4%)		

χ2= chi-square, p-value at 95% confidence level, SPP=species

Occurrence of snail species in swamp grazing was 45.7% *L. natalensis* and 27.8% *L. truncatula,* in water body 33.7% *L. natalensis* and 50% *L. truncatula* and also in muddy area 20.7% *L. natalensis* and 22.2% *L. truncatula*, the reason variation is that *L. truncatula* prefers highland agro-ecological than other species of snail. Virtually, *L. truncatula* was the abundant snail species encountered in the study area, duo to *L. truncatula* prefers highland agro-ecological zone favorable for the survival of the intermediate host [24,25] (Table 6).

CONCLUSION AND RECOMMENDATION

Generally this finding showed that incidence of ovine Fasciolosis was highly occurred and endemic disease in Debre Birhan district because of the existence of different associated risk factor of the disease. Along with the questionnaire survey result, it was evident that small holder farmers were not control the intermediate host the snails and the utilize anthelmintics drug was not properly and strategically. The overall result showed that, prevalence of ovine Fasciolosis was 51.2% and 63.4%, by coprological and postmortem examined respectively. This study revealed that higher prevalence of ovine Fasciolosis was recorded in postmortem than coprological, the reason that postmortem was a golden standard. According to this study finding showed that, the geographically allocation of the intermediate host the snails species were most abundant in marsh grazing area, irrigated water bodies, and muddling area in decreasing order. Lymnaea truncatula was highly prevalent than Lymnaea natalensis in the study area, because Lymnaea truncatula prefers highland agro-ecological zone.

Recommendation

To prevent and control ovine Fasciolosis the method was drainage of marshy grazing areas as well as stagnant water bodies, improving the management systems such as especially grazing, housing and watering system, and use mulluscicidal this method was important to eliminate the intermediate host the snail populations Strategic deworming to prevent pasture contamination and eliminate adult flukes such as at August/ September from autumn and winter and at January/ February: during late spring and early summer.

North Showa zone livestock office as well as Debre Birhan livestock department was implements strategic planning and extension activities for the prevention and control of ovine Fasciolosis.

This study was dealing about to assess the associated

risk factor ovine Fasciolosis, epidemiological occurrence of Fasciola species, the distribution of the intermediate host and anthelmintics resistance of ovine Fasciola in the study area at Debre Birhan district.

ACKNOWLEDGEMENTS

I would like to express my deepest thanks to God for allowing me permission to do all daily activities, Dr. Mussie Hailemelekot; Dr. Kassa Demssie and Dr. Wedajo Muleta for their advice, encouragement starting from proposal development and until my thesis writing up.

I would like to acknowledge Bahir Dar University, from the beginning to give a free education sponsorship to my post graduate study with the agreement of Amhara Region Bureau of Civil Service, and the study was financially supported.

REFERENCE

1. CSA (Central Statistical Agency). Agricultural sample survey was report on livestock and livestock characteristics. Addis Ababa, Ethiopia. 2017; 2: 9-12.
2. Solomon Tsehaynesh, Alemu Biruk. Economic loss caused by organ condemnation in cattle slaughtered At Hawassa Municipal Abattoir, Southern Ethiopia. J Global Biosci. 2019; 8: 5966-5977.
3. Nottor DR. Genetic Improvement of reproductive efficiency of sheep and goat. Anim Reprod Sci. 2012; 130: 147-151.
4. Mas-Coma S, Bargues MD, Valero MA. Fascioliasis and other plant borne trematode zoonosis. Int J Parasitol. 2005; 35: 1255-1278.
5. Molalege Bitew, Nuradis Ibrahim. Study on the prevalence of ovine Fasciolosis in and around Dawa-Cheffa, Kemissie. Afr J Agric Res. 2010; 5: 2981-2985.
6. Mungube EO, Bauni SM, Tenhagen BA, Wamae LW, Nginyi JM, JM Mugambi. Prevalence and economic significance of Fasciola gigantica and hepatica in slaughtered animals in the Semi-arid Coastal Kenya. Trop Anim Health Prod. 2006; 38: 475-483.
7. Tsegaye Asredie, Anwar Shifaw. Coprological studies on the prevalence of ovine fasciolosis in Debre Birhan agricultural research center, Ethiopia. Eur J Biol. 2015; 7: 103-107.
8. Nuraddis Ibrahim. Fascioliasis: Systematic Review. Advances in Biological Research. 2017; 11: 278-85.
9. Yehualashet Bayu, Adane Zewde, Wondimu Anteneh. Prevalence of bovine Fasciolosis and its economic loss, due to liver condemnation at Wolaita sodo municipal abattoir Ethiopia. Vet Med Int. 2019; 2019: 9572373.
10. Mersha Chanie, Sahle Begashaw. Assessment of the economic impact and prevalence of ovine Fasciolosis in Menz Lalo Midir District, Northeast Ethiopia. Vet World. 2012; 5: 261-264.
11. Fair-weather I. Triclabendazole resistance treatment of immature and mature Fasciola hepatica infections in sheep. Vet Rec. 2012; 168: 514-515.
12. Brock-well YM, Spithill TW, Anderson GR, Grillo V, Sangster NC. Comparative kinetics of serological and coproantigen ELISA and faecal egg count in cattle experimentally infected with Fasciola hepatica and following treatment with Triclabendazole. Vet Parasitol. 2014; 196: 417-426.
13. Skuce PJ, Zadoks RN. Liver fluke: a growing threat to UK livestock production. Cattle Pract. 2013; 21: 138-149.
14. CSA (Central Statistical Agency). Ethiopia agricultural sample enumeration statistical report on livestock population. Part 4. Addis Ababa, Ethiopia. 2012.
15. Debre Birhen Woreda office of livestock and agriculture department. 2019/20.
16. CSA (Central Statistical Agency). Federal Democratic Republic of Ethiopia agricultural sample was survey report on livestock and livestock characteristics. Addis Ababa, Ethiopia. 2015; 2.
17. Yamane Toru. Statistical Introductory Analysis. 2nd Edition Harper and Row Inc. 1967.
18. Thru field. Veterinary epidemiology (3rd Edition). Black-well science Ltd. UK. 2005; 229 - 267.
19. Urquhart G, Armour J, Duncan JL, Dunn AM, Jennings FW. Veterinary Parasitological. In (Ed.) (2nd Ed). Longmann, Harlow, United Kingdom. 2007.
20. KN de Kock, CT Wolmarans, M Bornman. Distribution and habitat of the snail Lymnaea truncatula intermediate host of liver fluke Fasciola hepatica. In South Africa. J S Afr Vet Assoc. 2003; 74: 117-122.
21. Yeshimebet Chanyalew, Tadesse Eguale, Getachew Tilahun, Chekol Demis, Tadiwos Asfaw, Enyiew Alemnew, et al. Comparative efficacy of major anthelmintic against naturally infected Fasciola species infection in local sheep at Debre Birhan Agricultural Research Center, Ethiopia. Ethiopian Biotechnology Institute. JSID. 2010; 2: 1-16.
22. Markos Tibbo, Kassaye Aragaw, Asefa Deressa. Effects of anthelmintics and supplementation On Productivity of Menz /Menz-Awassi/ cross breed sheep with sub-clinical helminthosis. Ethiop Vet J. 2012; 8: 1-22.
23. Boray JC. Liver fluke disease in sheep and cattle. State of New South Wales through Department of Primary Industries. 2007; 446.
24. Desalew Salew, Abaineh Munshea. Identification and distribution of intermediate host snails in Mecha Woreda, Amhara, North West of Ethiopia. Biodiversity Int J. 2018; 2: 441-445.
25. Brown DS. Fresh water snails of Africa and their medical importance. (2nd Edition.) Taylor and Francis Ltd. London. 1995; 169-487.