

Prevalence of Bovine Fasciolosis in and Around Haramaya Town, Eastern Ethiopia

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Abstract

The study was conducted to estimate the prevalence of bovine fasciolosis in and around Haramaya town from December 2007 to March 2008 based on the result of faecal examination and abattoir findings. A total of 384 bovine faecal samples were collected from different sites (kebeles). Out of the total sampled 207 (53.9) were positive for fasciolosis. According to coprological examination higher rate of infection was observed in March and lower in February. Variation in prevalence rate among the localities was statistically not significant ($p > 0.05$) as well as the result revealed no statistically significant difference between sexes and breeds ($p > 0.05$). Of the total 440 bovines livers examined, at Haramaya municipal slaughter house 200 (45.45%) were found positive for fasciolosis. Of the total of infected liver 84 (42%), 78 (39%) and 38 (19%) were lightly, moderately and severely affected, respectively. 66% of the livers harbored *F. hepatica*, 26% *F. gigantica* and 8% infected by both species of *Fasciola*. The mean fluke burden per infected liver was 28. Fasciolosis is an economically important health threat to live stock in the study area particularly during long dry season when nutritional conditions are compromised. Results obtained in this area were discussed in comparisons with the findings of other works. Appropriate control strategies were recommended by considering the limiting local factors of the study area.

Keywords: Fasciolosis, Cattle, Prevalence, Abattoir

1. INTRODUCTION

Animal production is an important part of agricultural sector of the Ethiopian economy. Despite the large livestock population of Ethiopia, the economic benefits remain marginal due to prevailing disease, poor nutrition, poor animal production system, reproductive inefficiency, management constraints and general lack of veterinary care. Endoparasites are responsible for the death of one third of calves, lambs, and kids and considerable losses parts of carcasses condemned during meat inspection (Anon, 1997). Helminthiasis is considered as one of the major constraints in livestock improvement programs in Ethiopia. One of the helminthiasis that causes immense direct and indirect losses especially, in domestic ruminants, is fasciolosis (Brook, 1985).

Fasciolosis is known by different local names in various part of the Ethiopia that vary according to the region and language. In Amharic it is called 'kulkult', 'Wadammo', 'Yegubet till'. In Oromia region it is known as 'Dada'o', 'Losha', 'and Raammootiruu'. In Tigray language it is termed as Ifil' (Adem, 1994).

Bovine fasciolosis is economically important parasitic diseases of cattle caused by fasciolidae trematodes of the genus *fasciola*, which penetrate the gut wall, then transverse to abdominal cavity and migrate in the hepatic parenchyma and establish and develop in the bile ducts. The two most important species of *Fasciola* are *fasciola hepatica* found in the temperate areas and cooler areas of high altitude in the tropics and subtropics, and *fasciola gigantica* which predominates in the tropic areas (Troucy, 1989, Urquhart, *et al.* 1996). The geographical distribution of trematode species is dependent on the distribution of suitable species of snails (Urquhart, *et al.* 1996).

In Ethiopia, the presence of both *Lymnaea truncatula* and *Lymnaea natalensis* have been reported (Bergeon, 1968, Graber, 1975). *Lymnaea truncatula* is an amphibious snail living in shallow pods, wetlands and water troughs while *Lymnaea natalensis* is a true mollusc which lives in immersed clear water and slow flowing rivers. The optimal temperature range for development of snails is 15 -16°C, when rapid production of snail egg masses occurs. These eggs hatch within two weeks and resulting snail mature a month later. No development and no reproduction activity take place at a temperature below 10°C, but snails may survive adverse condition for months buried in the mud (Hansen and Perry, 1994).

Mixed infections by both species of *Fasciola* may occur in areas where ecology is conducive for replication of snail, intermediate host. In our country, *Fasciola hepatica* is a wide spread in areas with altitude above 1800-2000 meters above sea level while *Fasciola gigantica* appears to be the most common species in areas below 1200 meters above sea level. Both species co-exist in areas with altitude ranging between 1200-1800 meters above sea level (Graber, 1975). Fasciolosis occurs commonly as a chronic disease in cattle and the severity often depends on the nutritional status of the host. It also cause wide spread of morbidity and mortality in cattle characterized by weight loss, anemia and hypoproteinemia (Graber, 1975).

Many workers have studied the economic impact of this disease in different parts of the world. In dairy cows reduction in milk yield has been shown to be related to the number of adult flukes in the liver (Ross, 1970). Production losses in growing cattle occur at even low levels of infections, for example, an infection with 54

flukes per animal resulted in an eight percent reduction in weight gain (Cawdery, 1977). Even infection as low as 24 flukes per animal depressed feed conversion and growth rates and subsequently reduced conception rates of heifers and daily milk losses due to fasciolosis to be about 16% and daily weight gain decrease by 5% (cited in Adem, 1994).

According to Ross (1970) the economic losses caused by bovine fasciolosis indicated that the productive efficiency was reduced by 8% in mild infection and over 20% in severe infection. In sub-Saharan Africa, data on bovine fasciolosis report up to 60% incidence rates, up to 50% liver condemnation rates, up to 5% reduction in weight gain (Hyera, 1984), 16% loss in daily milk production (Bahru and Ephrem, 1979) and annual loss of 0.198 kg of body weight per fluke (Ogunrinade, 1981).

Fasciolosis also has public health importance. It is frequent in some countries and accidental infections of humans with liver fluke has been reported (Maldonado, 1960). Man is exposed to infection by ingesting aquatic vegetables such as water cress. Incidence is generally low but serious outbreaks have been recorded in humans from various parts of the world. In some parts of Peru prevalence rates are relatively high because of the most common use of water cress as a vegetable or for medicinal purposes (Maldonado, 1960). In Cuba human fasciolosis is quite common, particularly in certain provinces in some years actually reaching epidemic proportions (Kouri, 1948). Sporadic human infections were also reported in Ethiopia, at Holeta (Yilma, 1983).

Several workers have reported the presence and economic significance of fasciolosis in Ethiopia. The prevalence of the disease is known to be relatively high (Bahru and Ephrem, 1979) causing considerable economic loss in livestock production. However, few attempts have been made to study the epidemiology of this parasitic problem in various sections of the country with the specific aim of determining the parasitic burdens, especially in relation to months of the year, rain fall, temperature, humidity, altitude and other related factors. These information are very important in planning control programs and also estimating the economic burden to the country as a result of this parasite.

Regarding the prevalence of fasciolosis in and around Haramaya district information is scant except the work of Hymanot (1990) who reported the prevalence rate of 42.9% in Eastern Hararghea Administrative Region, by collecting fecal samples from Deder, Kombolcha, and Dire-Teyara and from Harar and Deder Municipal slaughter houses.

Therefore, the objectives of this research was to assess the prevalence of bovine fasciolosis in the field and determine liver condemned rate attributed to the disease in abattoir.

2. MATERIALS AND METHODOLOGY

2.1. Study area

The study was conducted in and around Haramaya town specifically around the previous Haramaya Lake and Haramaya municipal Abattoir. Haramaya Woreda is located 510 km east of Addis Ababa at an altitude of 1980m.a.s.l. 9° 26'N latitude and 42° 3'E longitude with average annual rain fall of about 780mm. The mean minimum and maximum annual temperature are 8.25°C and 23.4°C respectively (AUA, 1998).

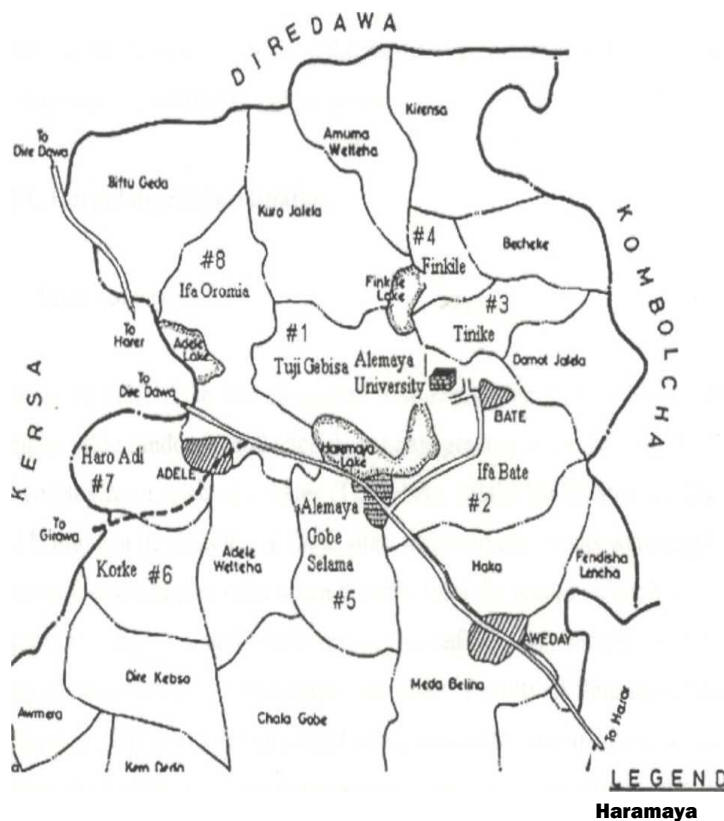


Figure 1. Map of Haramaya and the surrounding kebeles

2.2. Study animals

Study population are cattle that graze in previous Haramaya Lake and that are slaughtered in Haramaya municipal slaughter house. All cattle slaughtered were local breeds. The animals used in this study originated from Garmul'ata, Kurfachalle, Babile, Gursum and , Badanno.

2.3. Study design and sample size determination

A cross-sectional study design was used in this study where samples were collected once from the selected study subjects. Two conventional approaches were employed to carry out this study; coprological examinations from cattle that graze at the field and postmortem survey on animals slaughtered at Haramaya Municipal slaughter house.

A 50% conservative expected prevalence, 5% absolute precision and 95% confidence level were considered in the calculation. Accordingly, a minimum number of cattle required to determine the prevalence was 384 (Thursfiled,2007).

2.3.1. Field survey sample collection and coprological examination

A fresh fecal sample of about 20gm was collected from the rectum of each cattle grazing in the previous Haramaya Lake which are coming from selected kebeles using sterile disposable plastic gloves. Each collected sample was placed in a labeled clean glass bottle container and was transported to Haramaya University, Faculty of Veterinary Medicine, parasitology laboratory.

The selected kebelles were: Tujigabisa, Adale, Ifa-Oromia, Ifa-Baate, Haramaya 01 and Haramaya 02 Kebeles). In these Kebeles, animals were randomly selected and faecal samples were taken directly from the rectum of each animal. The approximate age, sex and breed were registered for every sampled subject. The collected samples were brought to Haramaya University, Faculty of Veterinary Medicine, parasitology laboratory being placed in a plastic container and kept in a cool box. In the laboratory coproscopic examinations were performed using direct smear, sedimentation and Mac master egg counting technique. During study period a total of 384 faecal samples from cattle were collected from field and examined.

2.3.2. Abattoir survey

During the period from December, 2007 to May, 2008, from 440 cattle slaughtered at Haramaya municipal slaughtered were systematically inspected. The sex and breed of the slaughtered animals were registered. This survey was accomplished in three ways.

Prevalence study

Postmortem examination of the livers was made for the presence of flukes first by visual inspection to observe enlarged bile ducts and irregularity of the morphology of the liver, then by palpation and carrying out multiple incisions of all visible bile ducts and their branches to look for adult fasciola lodged there. At the end of examination of the liver according to the procedure described, the organs were registered as being positive or negative for fasciolosis.

Classification of hepatic lesion.

Hepatic lesion in fasciola positive liver was further grouped in to three different pathological categories depending on the severity of damage inflicted by the parasite. The affected livers were classified as lightly affected, if none or only one enlarged bile duct is seen before cutting and cutting revealed enlarged or calcified bile ducts and/or flukes; moderately affected, if more than one enlarged bile duct was visible before cutting; and severely affected, if atrophy of left lobe and hyperplasia of the right lobe is seen giving the liver triangular shape (Ogunrinadeet *al.*, 1981).

Fluke burden and species determination

In an attempt made to estimate the average fluke burden per affected liver, a total of 23 representatives liver from the three pathological categories were taken and fluke count was performed according to the following procedure. The gall bladder was first separated from the liver, emptied, washed and watched for the presence of adult flukes. Then both larger and smaller bile ducts were opened with scissors and flukes encountered were counted. After this identification the species of fasciola encountered in each affected liver based on size parameters and morphological features described for *fasciola hepatica* and *fasciola gigantica* by Soulsby (1986). Finally the numbers of livers inflicted with either of the two species or both was registered.

Data Analysis

The data was entered into Microsoft sheet Excel 2003 and coded for analysis. The test statistics used includes chi-square(χ^2), percentage (%), mean (X) and standard deviation.

3. RESULTS

3.1. Field Result

Coprological examination conducted from December, 2007 to March, 2008 showed that a total of 384 faecal samples originated from cattle examined, 207 samples were found to be positive for *Fasciola*eggs (53.91%).

Analysis of the result on locality basis (table 1.) indicates that of six selected sampling sites, the highest rate of infection was encountered at Tujigabissa (58.06%) and the lowest rate of infection encountered at Adele (47.19%).

Table1. Prevalence of Bovine Fasciolosis at different kebeles in and around Haramaya town

Survey area (site)	No. of examined animals	No. of -ve animals	No. of +ve animals	Prevalence rate %
Tujigabisa	93	39	54	58.06%
IfaOromia	52	26	26	50%
Adele	89	47	42	47.19%
Haramaya 01	51	23	28	54.9%>
Haramaya 02	50	21	29	58%)
Ifa Bate	49	21	28	57.14%
Total	384	177	207	53.9

Pearson $\chi^2 = 3.1459$, $pr = 0.678$ ($p > 0.05$)

Table 2.Prevalence of Bovine fasciolosis versus sex groups

Sex	No. of examined animals	Number of Negative animals	Number of positive animals	Prevalence
Male	125	65	60	48%
Female	259	112	147	56.4%
Total	384	177	207	53.9%

Pearson $\chi^2 = 2.6019$, $pr = 0.107$ ($p > 0.05$)

Regarding breeds, prevalence rates of 52.22% in local breeds and 61.4 in Holstein Friesian were registered (Table 3.). Analysis of this result of breed basis shows no significant variation ($p > 0.05$).

Table 3.Prevalence of Bovine fasciolosis in local and Holstein Friesian breed

Breed	No. of faecal sample examined	No. of -ve animals	No. of +ve animals	Prevalence rate (%)
Local	314	150	164	52.22
HF	70	27	43	61.42
Total	384	177	207	53.9

Pearson $\chi^2 = 1.9495$, $pr = 0.163$ ($p > 0.05$)

When prevalence rate among age groups is considered, analysis of data indicates that infection rate increase as ages increase (from young to adult) this is since animals started to graze swampy area along the previous Haramaya Lake (Table 4).

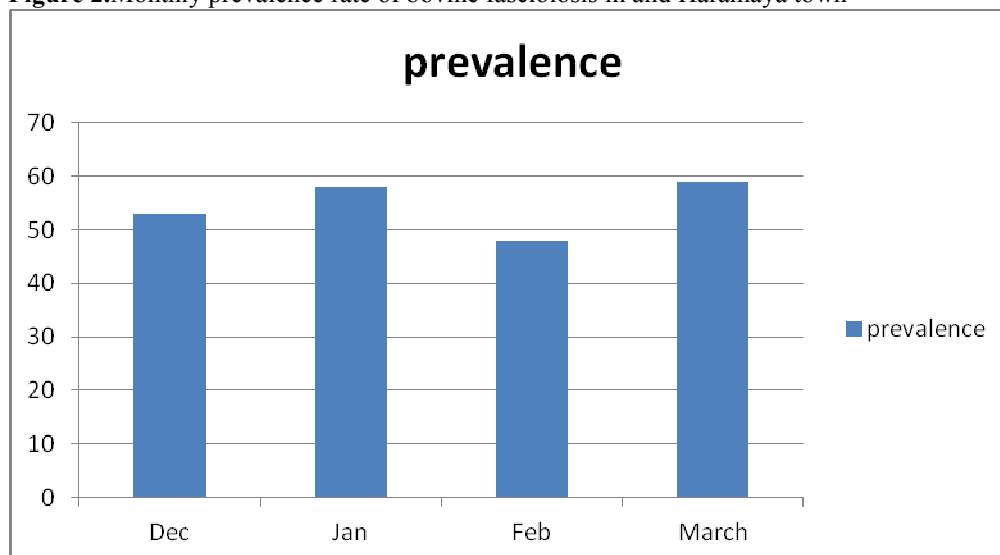
Table 4.Prevalence of Bovine fasciolosis versus age groups of examined animals

Age group	No. of examined animals	No. of positive animals	Prevalence
Young	140	48	34.28%
Adult	244	159	65.16%
Total	384	207	53.9%

Pearson $\chi^2 = 419.7164$, $pr = 0.000$

When monthly prevalence rates are statistically analyzed, insignificant monthly infection rate was observed ($p > 0.05$), and the highest infection rate was recorded in March (Figure 2).

Figure 2.Monthly prevalence rate of bovine fasciolosis in and Haramaya town



Pearson $\chi^2 = 2.8968$ $Pr = 0.408$ ($p > 0.05$)

Table 5.Comparison of mean EPG between sexes (two -sample t-test with equal variance)

sex	No. animals examined	Mean	Std. Dev.	95%conf.
Female	36	373.6	232.8	294.831-452.4
Male	18	330.5	192.6	234.8
total	54	359.3	219.4	299.3846-419.3

$t = 0.6764$ $P = 0.2509$ $p > 0.05$

3.2. Abattoir Results

A survey done from December, 2007 to May, 2008 at Haramaya municipal slaughter house revealed that out of 440 livers from slaughtered animals 200 (45.45%) were positive for Fasciola.

Classification of Hepatic lesion

Out of 200 livers found to be positive for fasciola infection, 84 (42%) were lightly, 78 (39%) moderately and 38 (19%) severely affected (Table 6).

Table 6.Classification of livers based on the severity of pathological lesions

Extent of lesion	No. of livers examined	Percentage (%)
Lightly affected	84	42
Moderately affected	78	39
Severely affected	38	19
Total	200	100

Fluke burden determination and species identification

Fluke count made on 23 livers taken from each of the three pathological categories reached that the overall fluke burden per affected liver was 28 (Table 7). From the total of 200 liver positive for fluke parasite 52 livers (26%) harboured *F.gigantica*, 132 livers (66%) *F.hepatica* and the remaining 16 livers (8%) infected with both species (mixed) of *Fasciola* (Table 8)

Table 7. Mean Fluke burden for 23 *Fasciola* positive livers for which total fluke burden count was made

Pathological category	No. of livers	Mean fluke burden	Percentage
Lightly effected	8	12	34.78
Moderately affected	10	28	43.47
Severely affected	5	52	21.71

Table 8. Species of *Fasciola* encountered in affected livers during post mortem examination

Species of <i>Fasciola</i>	No. of livers	Percentage
<i>F. hepatica</i>	132	66%
<i>F. gigantica</i>	52	26%
Mixed (both)	16	8%
Total	200	100

Pearson $\chi^2 = 6.3916$ Pr = 0.712 (p > 0.05)

4. DISCUSSION

Prevalence rate of 53.91% was found by coprological examination. This present finding in and around Haramaya town is almost similar to that of Wondwossen (1990), who noted the prevalence rate of 51.7% at Arsi in cattle. This result when compared with that of Hymanot (1990), in Eastern Hararghe Administrative Region (42.9% mean prevalence late in bovine), is higher. This may be due to the presence of conducive ecological factors for the intermediate host snails (previous Haramaya lake) starting from rare of IfaOromiaKebele passing through Tujigabisa to kurro kebele. Animals also resort daily this area from the selected kebele's.

A complete study on seasonal variation and prevalence rate of fasciolosis was not possible because of shortage of time, however, high infection rate was encountered in March (58.03%) and lower in February (47.19%). The higher infection rate observed in March may be attributed to the fact that, when the dry season begins other feed sources such as sorghum residues are exhausted and no other alternative grazing land is available, animals come to graze the marshy pasture field in the previous Haramaya Lake. As a result it is logical to expect fasciola eggs in the faeces of these grazing animals 3-4 months after they acquired infection during grazing, for this prepatent period for fasciola within the interval of 12 to 16 weeks. This explanation is in agreement with that of Blood and Radostits, (1989) and Graber, (1975). These authors stated that the high risk time for fasciolosis is when wet seasons which allow snail multiplication are followed immediately by dry seasons which force animals to graze on small heavily infected marshy areas.

Infection rate of Bovine fasciolosis in Tujigabisa was relatively higher than the other five study sites; this may be attributed to the existence of more favorable environment for both the snail intermediate host and the parasite in Tujigabisa kebele and difference in sampling sizes.

Prevalence rate of 56.75% and 48% was recorded in both female and male animals respectively. There was no statistically significant difference (p > 0.05) between the two sexes; this signifies sex seems have no impact on the infection rate and both male and female animals are equally susceptible and exposed to the disease. Similar results that support the present figure were reported by Adem (1994), Yehene (1985), Fekadu (1988), Rahmeto, (1992), Hymanot (1990), Wondwossen (1990) and Dagne (1994). However, workers found higher prevalence rate in the male than female, their justification is related to the management system with longer exposure for males out doors when females are kept in door at the beginning of lactation (Balock and Arthur, 1985), but here female animals mostly graze out side but the male one is kept inside the house for fattening purpose.

Infection rate of bovine fasciolosis also analysed based on the determination of EPG on basis of sex, insignificance difference was observed by t-test (t = 0.6764) (p = 0.2509).

The lower prevalence rate of bovine fasciolosis observed in abattoir survey (45.45%) as compared to that found on coprological examination (53.91%) This is because of most of cattle slaughtered at Haramaya municipal slaughter house originated from neighboring districts (Babile, Garemul'ta, Gursum, Kurfachalle, Finkille, and Badanno) which are low in swampy lands.

In this study, higher prevalence of Bovine fasciolosis (45.45%) was obtained when compared with the prevalence reported by Daniel, (1995) (14.4%) at Dire Dawa municipal abattoir. This probably due to ecological and climatic difference, and different origin of animals slaughtered between the two localities. Moreover, the management systems in practice could also be the probable reason for the variation. The 45.45% prevalence of fasciolosis found in this study is similar with the 46.58%, 47%, 56.6% and 54% prevalence of bovine fasciolosis

reported at Jimma, Sodo, Ziway and Arsi by Tadele (2006), Abdul (1992), Adem (1994) and Wondowossen (1990) respectively but when compared with those of Roman (1987) at Gonder Abattoir (75%), Fikadu (1988) at Bahir Dar Abattoir (84.7%>), Abera (1990) at Dambi Dollo slaughter house (77.8%), it is lower; However, the prevalence rate of Bovine fasciolosis found presently in Haramaya municipal abattoir exceeds those of Abebe (1988) at Nekemte Abattoir (30%) and Rahmeto (1992) at Waliso Abattoir (34%).

Of the total livers, 66% of them were found to be positive for Bovine fasciolosis infected by *F.hepatica*, where is *F.gigatic* a and unidentified (mixed) forms of *Fasciola* species were recovered to be 26 and 8% diagnosed as positive for fasciolosis respectively. Similar study conducted at Jimma abattoir and Ziway abattoir reported 63.30% of liver harboured *F.hepatica*, 23.85% and *F.gigantica* 11.93% infested by both species and 60.3% of the liver harboured *F.hepatica*, 10.2% *F.gigantica* and 29.5% infested by both species (Tadele, 2006 and Adem, 1994). This is attributed mainly to the variation in the climatic and ecological conditions such as altitude, rainfall, temperature and livestock management system (Yilma and Malone, 1998). Additionally Graber (1975) and Dagnes (1994) reported that in Ethiopia *F.hepatica* and *F.gigantica* infection occur in areas above 1800 m.a.s.l and below 1200 m.a.s.l. respectively. The high prevalence of *F.hepatica* may be associated with the existence of favorable ecological biotypes for *Lymnaea truncatula* relatively small proportion of cattle were found infected with *F.gigantica* alone and mixed infection with both species. This may be explained by cattle coming for slaughter from highland and middle altitude zone flood prone areas, drainage ditches are favorable habit to *Lymnaea natalensis* of Urquart *et al.*, (1996).

According to fluke count made on 23 livers positive for *Fasciola*, the mean fluke burden per affected liver was found to be 28. This figure is less than that of Adem (1994) at Ziway abattoir (74 flukes per liver), by Tadele (2006), at Jimma abattoir (76 flukes per liver) Rahmeto (1992) at Waliso abattoir (72 flukes/liver). These amounts of fluke burden per affected liver reflect the pathogenic effect produced by the flukes on the host. The greater the fluke burden an animal has, the more evident will be, the production loss it suffers. Infection with as low as 24 flukes per animal depressed feed conversion, growth rates and subsequently reduced conception rates of heifers cited in Adem (1994). Cawdery *et al.*, (1977) indicated that the infection with 54 flukes per animal resulted in 8% reduction in weight gain. Viewed in light of this, it should be stressed that the mean fluke burden found in this survey is enough to cause considerable reduction in productivity of the animals.

An assessment of the reaction between hepatic lesion and fluke burden does not show significant direct association, in that the average fluke count in moderately affected livers exceeds that observed in severely damaged ones. This is in comply with the assertion of Dwinger, *et al.*, (1982) that severe fibrosis impedes the passage of immature flukes and an acquired resistance and calcification of bile ducts results in the expulsion of adult flukes

Generally, based on the present study confirmation which was investigated in and around Haramaya town, it can be concluded that fasciolosis has been and yet being one of the major commonly occurring disease and obstacles for livestock development in the study area inflicting remarkable direct and indirect losses where its occurrence is closely associated to the presence suitable environmental conditions for the development of snail intermediate host exist. Therefore, proper attention should be paid to this parasitic problem and control strategies should devise at least to reduce the infection rate to economically tolerable level.

One or more measures are under taken and involve control of snails, eradication of adult worms and reduction of chances of infection by adequate livestock management grazing and watering by such techniques as drainage and fencing to ensure provision of uncontaminated feed and water.

Ecological control should aim at the reduction of the transmission rates in the life cycle. Nevertheless, however, broad spectrum the possibilities in theory, in fact, practical methods to achieve these are seldom, available. The complete separation of susceptible stock from snail infested areas is only practical in intensive husbandry system. The snail control is the most effective single measures in control of snail borne diseases; this is so, because the snail represents the weakest link in the life cycle of parasite. However, control of snails is cumbersome and often met with many practical problems, since it hardly possible to apply such measures without disturbing the delicate ecological balance.

Those above described procedures are expensive, often uneconomic and are difficult to institute. Therefore, limited and strategic application of chemotherapy with appropriate flukicidal drugs is often the only possible practical control measures that can be implemented. This approach, in addition to alleviating the fluke burden of the host animal, also helps in minimizing contamination of pasture by reducing faecal egg out puts and thus, interrupting the life cycle of the parasite.

The efficacy of antihelmenthics will be high if combined with either management practices such as; grazing animals away from water resources, avoiding grazing in marshy area, fencing and draining grazing of swampy marshy areas. To apply this antihelmenthic treatment, consideration of climatic condition of the given county or region or zone is important. In Ethiopia condition two treatment schedules per year can be recommended. The first is at the end of the main rain season, to eliminate adult flukes so that the animals pass the dry season water holes. The second treatment should be planned for the end of dry season to kill immature flukes should be used.

Since the effect of fasciolosis on the ruminant host is aggravated by polyparasitism, attention should also be given to the control of other internal helminth parasites too, and for this purpose broad spectrum anthelmintic, active against both trematode and nematode infections are recommended.

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4. REFERENCES

- Abdul, J.R. (1992). Economic Significance of Bovine fasciolosis and Hydatidosis, In Soddo, *DVM Thesis*, Addis Ababa University, Faculty of Veterinary Medicine, DebreZeit, Ethiopia. Pp 20.
- Abebe, M. (1988). Prevalence of Bovine fasciolosis and its Economic significance at Nekemte, *DVM Thesis*, Addis Ababa University, Faculty of Veterinary Medicine, DebreZeit, Ethiopia. Pp 22.
- Abera, B. (1990). Prevalence and Economic significance of fasciolosis in " *Neur cattle*" slaughtered at DambiDollo slaughter house. *DVM Thesis*, Addis Ababa University, Faculty of Veterinary Medicine, DebreZeit, Ethiopia. Pp 26.
- Adem, A. (1994). Prevalence of bovine and ovine fasciolosis: A preliminary survey around Ziway region. *DVM Thesis*, Addis Ababa University, Faculty of Veterinary Medicine, DebreZeit, Ethiopia.
- Anon, J. (1997). National Livestock Development Programme. Ministry of Agriculture (MOA) Animal and Fishery Resources Development Department Addis Ababa, Ethiopia.
- Anon, J. (2004). State of Ethiopian's Animal Genetic Resources Country report. A contribution to the first report on the state of world's animal Genetic resources. Institute of Biodiversity Conservation (IBC), Addis Ababa Ethiopia. Pp 74.
- AUA, (1998). Alemaya University of Agriculture proceeding of the 15th annual review meeting of Alemaya, Ethiopia.
- Bahru, G. and Ephrem, M. (1979). Preliminary survey of Bovine fasciolosis in Ethiopia *Eth. J. Agri. sci.* 15-12
- Balock, F.C. and Arthur, R.J. (1985). A Survey of Fasciolosis in Beef cattle killed at abattoir in Southern Queensland. *Aust. Vet. J.* 62 (10):320-326.
- Bergeon, P. (1969). Report to the Government of Ethiopia on veterinary parasitology survey: FAO, Rome. Pp 105.
- Blood, D.C. and Radostits, O.M. (1989). Veterinary Medicine: A Textbook of the Disease of Cattle, Sheep, Pigs, Goats and Horses, 7th edition (ELBS) English Language Book Society, Bailliere, Tinland ppl502.
- Brook, L. (1985). The Seasonal occurrence of Fasciolosis and some other helminthes disease of sheep in four selected sites in Ethiopia (Asella, Awassa, DebreBerehan and DebreZeit) MSc. Thesis, Addis Ababa University, DebreZeit, Ethiopia. pp 28.
- Cawdery, M.J., Strichland, K.L., Conway, A., Crowe, P.J. (1977). Production effects of liver fluke in cattle. The effects of infection in weight gain, feed intake and food conversion efficiency in beef cattle. *British veterinary journal*, 133: 145-159.
- Dagne, M. (1994). Survey on Prevalence and Economic Significance of Bovine Fasciolosis in DebreBerhan Region, *DVM thesis*. Faculty of Veterinary Medicine, Addis Ababa University, DebreZeit, Ethiopia.
- Daniel, F. (1995). Economic importance of organs condemnation due to Fasciolosis and Hydatidosis in cattle and Sheep slaughtered at Dire Dawa Abattoir. *DVM Thesis*, Addis Ababa University, Faculty of Veterinary Medicine, DebreZeit, Ethiopia.
- Dwinger, R.M., Lericha, P.D and Kuhne, G.I. (1982). Fasciolosis in Beef cattle in North West Argentina, *Trop, Anim Hlth prod.* Pp 14 (3) 167-171.
- Fekadu, R. (1988). A preliminary Survey on Bovine fasciolosis in and around Bahir Dar. *DVM Thesis*, Addis Ababa University, Faculty of Veterinary Medicine, DebreZeit, Ethiopia.
- Graber, M. (1975). Helminthes and Helminthiasis of different domestic and wild animals of Ethiopia. *Bull. Anim. Hlth. prod. Afri.* 23:57-85.
- Hansen, J. and Perry, B. (1994). The Epidemiology Diagnosis and control of Helminthes parasite of Ruminants. A hand book of Animal production and Health division, FAO, Rome, Italy pp 171.
- Hyera, J.M.K. (1984). Prevalence, Seasonal variation and Economic significance of fasciolosis in cattle as observed at Iringa abattoir between 1976 and 1980, *Bull. Anim. Hlth. prod. Afri.* 3:356-395.
- Hymanot, A. (1990). Prevalence survey of Bovine fasciolosis in Eastern Hararghea Administrative Region. *DVM Thesis*, Faculty of Veterinary Medicine, Addis Ababa University, DebreZeit, Ethiopia. pp 21.
- Kouri, P. (1948). Diagnostic, Epidemiology and profilaxis de la fasciolosis human en cuba. *Rev. kuba. de. Med. Trop. Parasitol.* 3:5-7.
- Maldonado, J. F. (1960). Fasciolosis in Mac Graw Hill encyclopedia of science and Technology 5th ed. Vol 5 McGraw Hill company, Pp 36.
- MOA, (1990). Ministry of Agriculture, Animal and Fishery Resources Development main Department. Animal

- Health extension Manual, Addis Ababa, Ethiopia pp 25.
- Ogunrinade, A. F., Okan, E.D. and Fasan, M. (1981).The prevalence of Bovine fasciolosis in Nigeria.*Trop. Anim. hlt. Prod. Afr.* **29**:381-397
- Rahmeto, A. (1992). Fasciolosis: Clinical occurrence, coprological, abattoir and Snail survey in and around Waliso. *DVM Thesis*, Addis Ababa University, Faculty of Veterinary Medicine, DebreZeit, Ethiopia.
- Read, C. P. (1960). Introduction to Parasitology with special reference to parasite of man 10th edition. Johns Wiley and Sons inc. pp 822.
- Roman, T. (1987). Study on Economic significance of Bovine fasciolosis and Hydatidosis at Gonder abattoir. *DVM Thesis*, Addis Ababa University, Faculty of Veterinary Medicine, DebreZeit, Ethiopia. Pp 36.
- Ross, F.B. (1970). The Epidemiology of fasciolosis in Northern Irland. *vet Res.* **87**:370372.
- Sissay, M. M. (2007). Helminth parasites of Sheep and Goats in eastern Ethiopia: Epidemiology, and antihelminthic resistance and its management. *Doctoral Thesis*, Swedish University of Agricultural Science, Uppsala, Sweden.
- Soulsby, E. (1986). Helminthes, arthropods and protozoa of domestic animals 7th edition BailleireTinland. London. Pp 809.
- Tadele, T. (2006). The Prevalence and Economic importance of Bovine fasciolosis in Jimma Municipal Abattoir. *DVM Thesis*, Addis Ababa University, Faculty of Veterinary Medicine, DebreZeit, Ethiopia
- Troucy, P.M. (1989). Fasciolosis of ruminants. In: Manual of tropical veterinary parasitology. CTA, C.A.B. International. Pp 63-74.
- Urquhart, G., Armour, J., Duncan, J.L., Dunn, A.M., Jennings, F.W. (1987). Veterinary parasitology. Low priced. English Language Book society (ELBS) Longman. Pp 286.
- Urquhart, G. M, Armour, J, Duncan, J. L., Dunn, A. M, and Jennings, F.W. (1996) Veterinary parasitology. Blak well, New York, pp 120-137.
- Yehnew, M. (1985). Prevalence of fasciolosis at Gonder clinic and around Lake Tana. *DVM Thesis*, Faculty of Veterinary Medicine, Addis Ababa University, DebreZeit, Ethiopia. Pp 25.
- Yilma, J.M. (1983). Economic importance of bovine fasciolosis: An assessment trial of DebreZeit Abattoir. The second students scientific Journey, Faculty of Veterinary Medicine, Addis Ababa University, DebreZeit, Ethiopia, pp 22.
- Yilma, J.M. and Malone, J .B. (1998). A Geographic information system fore cast model for strategic control of fasciolosis in Ethiopia, Faculty of Veterinary Medicine, Addis Ababa University, DebreZeit, Ethiopia. Pp 28.