Prevalence and Financial Losses Associated with Bovine Fasciolosis at Asella Municipal Abattoir, South Eastern Ethiopia

Tizazu Worku, Tamirat Herago and Mihret Amajo

Abstract: A cross-sectional study was conducted from December 2014 to April 2015 in Assela municipal abattoir to assess prevalence and economic significance of bovine fasciolosis. In this study, out of 349 cattle examined, 105 (30.1%) revealed the presence of Fasciola species. Among these, 73 (69.6%) were infected with F. hepatica, 16 (15.2%) by F. gigantica and 16 (15.2%) had mixed infection. Among examined cattle 347 were males, from these, 104 (29.8%) were positive for fasciolosis and 2 of them were females from which only 1(0.3%) showed prevalence of fasciolosis. This study indicates a prevalence of 28.95% and 36.54% in age group of adult and old animals, respectively. Statistical analysis however showed the absence of significant variation (P>0.05) in the occurrence of fasciolosis among the different age groups of animals. The study also showed that there was statistically significant difference (P< 0.05) in prevalence of Fasciola species. The mode of affection of liver due to fasciolosis was mild (43.8%), moderate (41%) and severe (15.24%) in which the variation was statistically significant (P<0.05). The total annual economic losses due to liver condemnation and carcass weight loss due to fasciolosis was estimated to be birr 2000506.2 ETB. Therefore, implementing control of bovine fasciolosis with an integrated approach has paramount importance in the area of the study site.

Key words: Abattoir - Assela - Cattle - Fasciola gigantica - Fasciola Hepatica

INTRODUCTION

Ethiopia has the largest livestock inventories in Africa, including more than 38,749,320 cattle, 18,075,580 sheep, 14,858,650 goats, 456,910 camels, 5,765,170 equines and 30,868,540 chickens with livestock ownership currently contributing to the livelihoods of 80% of the rural population [1].

Ethiopian livestock productivity, despite its huge population size, remains marginal due to various diseases, malnutrition and management constraints. Parasitism represents a major obstacle to the development of sub-sector [2].

Bovine fasciolosis is one of the most important parasitic diseases of cattle causing mortality and production losses in various parts of Ethiopia. Fasciolosis is the priority disease in the highland as well as in lowland areas of Ethiopia [3]. It is caused by two liver fluke species, which are: Fasciola hepatica and Fasciola gigantica. Fasciola hepatica has cosmopolitan distribution, mainly in temperate zones, while F. gigantica is found in tropical regions of Africa and Asia. Thus, the two Fasciolid species overlap in many Africa and Asian countries [4].

The infections occur in areas above 1800 meters above sea level and below 1200 meters above sea level, respectively which has been attributed to variations in the climatic and ecological conditions such as rain fall, altitude, temperature and livestock management system [5]. The disease is found generally in vast water lodged and marshy grazing field condition anticipated to be ideal for the propagation and maintenance of high prevalence of fasciolosis. In Ethiopia, the highlands contain pockets of water logged marshy areas. These provide suitable habitats year round for the snail intermediate hosts [3].

In Ethiopia, the prevalence of bovine fasciolosis has shown to range from 11.5% to 87% [2].
Fasciola hepatica was shown to be the most important fluke species in Ethiopian livestock with distribution over three quarter of the nation except in the arid northeast and east of the country. The distribution of F. gigantica was mainly localized in the western humid zone of the country that encompasses approximately one fourth of the nation [2,6].

Fasciolosis causes a substantial economic loss which includes; death, loss in carcass weight, reduction in milk yield, condemnation of affected liver, decline production and productive performances, cost of treatment expense and predisposes animals to other disease. Both F. hepatica (high land) and F. gigantica (low land) type of liver flukes cause severe losses in Ethiopia where suitable ecological conditions for the growth and multiplication of intermediate host snails are available [7].

Apart from its great veterinary important throughout the world, F. hepatica has recently been shown to be a re-emerging and wide spread zoonosis affecting numerous human populations in the world [8].

A review of available literature strongly suggests that fasciolosis exists in almost all parts of the country. It is regarded as one of the major setbacks to livestock productivity, incurring huge direct and indirect losses in the country [3, 6, 9]. Assela is one of the areas where the environmental conditions and altitude is conducive for the occurrence of fasciolosis. However, little information is available about its prevalence and economic significance in the study area. Therefore, the objectives of this study were

- To determine the prevalence of bovine fasciolosis in cattle slaughtered at Assela municipal abattoir
- To identify Fasciola species involved and economic loss due to liver condemnation and carcass weight loss in cattle slaughtered at Assela municipal abattoir.

**MATERIALS AND METHODS**

**Description of Study Area:** The study was carried out in Assela municipal abattoir. Assela town is situated at 60591-8049 N latitude and 380411-400441 E longitude in central Ethiopia, 175 km south east of Addis Ababa. The altitude of the area ranges from 1780-3100 meter above sea level and characterized by mid subtropical temperature ranging from 5 °C to 28 °C. The annual average rainfall is 1200 mm and the area has a bimodal rainfall occurring from March to April (Short rainy season) and July to October (long rainy season). The area covers 23674.72 km square and topographically has highland escapement and lowland areas. The high land areas are found centrally and the low lands dominate the periphery of the area. The livestock population of the area is 85893 cattle, 57118 sheep, 10725 goats, 7841 horses, 15642 donkeys, 517 mules and 35489 poultry. The farmers in the area practice mixed crop-livestock farming system [10].

**Study Animals:** The study animals were cattle that were slaughtered at Assela municipal abattoir. The cattle slaughtered in the abattoir were collected from different parts of the country which is characterized by different climato-ecological conditions mainly due to altitudinal differences. It is often difficult to trace the origin of the animals as they usually pass a chain of markets. Some animals come directly to the abattoir from grazing while others pass through feedlots where they are routinely de-wormed.

**Sample Size Determination:** The desired sample size was calculated using the standard formula described by Thrusfield [11]. The expected prevalence was 35% according to Shiferaw et al. [12]. Therefore, the sample size in this study was:

\[
\text{n} = \frac{(1.96)^2 \times p(1-p)}{d^2}
\]

Where:
- n = Sample size
- p = Expected prevalence (35%)
- 1.96 = the value of Z at 95% confidence level
- d = Desired absolute precision = 5%.

**Therefore, the Sample Size was 349 Cattle**

**Sample Collection and Examination Procedure:** Complete ante-mortem examination of the animals was carried out shortly prior to slaughter. Inspection of the animals was made while at rest or in motion for any obvious sign of disease. The body condition for each animal was scored according to Mari [13] and the age of animal was scored according to Del-Lahunta and Habel [14] as adult (2 to 7 years old) and old (Above 7 years old). A total of 349 slaughtered cattle liver were incised and grossly checked for the presence and identification of Fasciola parasite. The liver of each study animal was carefully examined for presence of lesions suggestive of Fasciola infection externally and sliced for confirmation. Each mature fluke was identified to species level according to its shape and size [15].
Besides, identification of the fluke species, assessment of the severity of liver lesions was carried out. Pathological lesions were judged to be condemned based on Herenda et al. [16] guidelines on meat inspection for developing countries.

**Study Design:** A cross-sectional abattoir based survey was conducted from November 2014 to April 2015 on randomly selected cattle to investigate the prevalence of fasciolosis in bovine slaughtered at Assela town municipal abattoir and post-mortem inspection of liver was carried out.

Economic loss was assessed using formula set by Ogunrinade and Adegoke [17]. Generally, all infected livers with fasciolosis were considered to be unfit for human consumption and if any liver was infected by *Fasciola* at the Assela municipal abattoir, it was totally condemned. Economic losses were calculated based on condemned livers due to fasciolosis.

**Direct Economic Loss:** Direct economic loss was resulted from condemnation of liver affected by fasciolosis. All livers affected with fasciolosis were totally condemned. The annual loss from liver condemnation was assessed by considering the overall annually slaughtered animal in the abattoir and retail market price of an average zebu liver. Annual slaughtered rate was estimated from retrospective abattoir records of the last three years, while retail market price of an average size zebu liver was determined from the information collected from butcheries in Assela Town. The information obtained was subjected to mathematical computation using the formula:

\[
ALC = CSR \times LC \times P
\]

Where
- \(ALC\) = Annual loss from liver condemnation
- \(CSR\) = Mean annual cattle slaughtered at Assela municipality abattoir
- \(LC\) = Mean cost of one liver in Assela Town.
- \(P\) = Prevalence rate of the disease at the study abattoir

**Indirect Economic Loss:** Indirect economic loss was associated with carcass weight reduction due to fasciolosis. A 10% carcass weight loss in cattle is due to fasciolosis. Average carcass weight of an Ethiopian Zebu was taken as 126 kg [13].

\[
ACW = CSR \times CL \times BC \times P \times 126\ Kg
\]

Where
- \(ACW\) = Annual loss from carcass weight reduction.
- \(CSR\) = Average No cattle slaughtered per annual at the study abattoir.
- \(CL\) = Carcass weight loss in individual cattle due to fasciolosis.
- \(BC\) = an average price of 1kg beef at Assela town
- \(P\) = Prevalence rate of fasciolosis at the study abattoir. 126 kg = Average carcass weight of Ethiopian Zebu

**Data Management and Analysis:** The raw data that was inserted into Microsoft excel spread sheet to create a data base. Then this data was further analysed by using SPSS ver. 20 software program. Finally, the data was summarized with tables in accordance to the different age groups, sex, Fasciola species, mode of affection and body condition. Chi-square test was used to determine the variation in infection prevalence between sex, age, body condition, fasciola species and mode of affection. Statistical significance was set at \(P < 0.05\) to determine the presence of significant differences between occurrence of fasciolosis and risk factors. The total prevalence was calculated by dividing the number of Fasciola positive animals by the total number of animals tested or sampled.

**RESULTS**

In this study, out of the 349 cattle examined, 105 (30.1%) revealed the presence of *Fasiciola* species. Among these, 73 (69.6%) were infected with *F. hepatica*, 16 (15.2%) by *F. gigantica* and 16 (15.2%) had mixed infection. Among examined cattle 347 were male, from these, 104 (29.8%) were positive for fasciolosis and 2 of them were females from which only 1 (0.3%) showed prevalence of fasciolosis.

**Prevalence of Bovine Fasciolosis Based on Age:** of the total 349 examined animals, 297 were adult and 52 were old. Fasciola was detected in all age groups and a higher prevalence of Fasciola recorded in old animals (36.54%) than adult (28.95). However, statistically significant difference in prevalence of Fasciola was not observed among the different age groups (\(p>0.05\)).
Prevalence of Bovine Fasciolosis Based on Sex:
The prevalence of fasciola in male cattle was 29.8% and in female was 0.3% which is almost similar and the difference is not statistically significant ($P>0.05$).

Prevalence of Bovine Fasciolosis Based on Body Condition Score: Approximately the same prevalence was observed with cattle whose body conditions were poor (42%) and medium (38.9%). The lowest prevalence (28.75%) was recorded for cattle whose body conditions were good. The study shows that there was no significant variation.

Distribution of Fasciola Species Found in Infected Liver:
Species identification of the recovered Fasciola was also conducted based on morphological features of the agents and classified in to $F. hepatica$ and $F. gigantica$ [15]. Of the infected liver $F. hepatica$ comprises highest percentage (69.6%).

Distribution of Fasciola Species According to Mode of Affection: The study shows that there was significant variation in the prevalence of fasciolosis and mode of affection conditions ($P<0.05$).

Economic Loss Assessment
Direct Economic Loss: Direct economic loss was resulted from liver condemnation as the result of fasciolosis. Generally, all infected livers with fasciolosis are unfit for human consumption. In the study abattoir the average annual cattle slaughtered rate was estimated to be 3300 while mean retail price of bovine liver in Assela town as 250 ETB. Prevalence of fasciolosis in Assela municipality abattoir estimated was (30.1%). Therefore, the estimated annual loss form organ condemnation is calculated according to the formula:

$$ACL = CSR \times LC \times P$$

$$= 3300 \times 250 \times ETB \times 30.1
g= 3300 \times 250ETB \times 0.301$$

$$= 248,325 \text{ ETB}$$

Indirect Economic Loss: Indirect economic loss was due to carcass weight reduction as result of Fasciola infection. In the study area the average price of 1kg beef was 140 ETB. The annual economic loss from carcass weight due to annual economic loss reduction due to bovine fasciolosis is calculated by using the formula:

$$ACW = CSR \times CL \times BC \times P \times 126kg$$

$$= 3300 \times 10\% \times 140 \text{ ETB} \times 30.1\% \times 126\text{kg}$$

$$= 1,752,181.2 \text{ ETB}$$

Therefore, the total annual economic loss due to bovine fasciolosis in the study abattoir is the summation of the losses from organ condemnation (Direct loss) and carcass weight reduction (Indirect loss) and thus a total of 20,00506.2 ETB.

Table 1: Prevalence of Bovine fasciolosis in different age groups

<table>
<thead>
<tr>
<th>Category</th>
<th>Examined</th>
<th>Positive</th>
<th>Prevalence (%)</th>
<th>$x^2$</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult</td>
<td>297</td>
<td>86</td>
<td>28.95</td>
<td>1.209</td>
<td>0.174</td>
</tr>
<tr>
<td>Old</td>
<td>52</td>
<td>19</td>
<td>36.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>349</td>
<td>105</td>
<td>30.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Prevalence of Bovine fasciolosis based on sex category

<table>
<thead>
<tr>
<th>Category</th>
<th>Examined</th>
<th>Positive</th>
<th>Prevalence (%)</th>
<th>$x^2$</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>347</td>
<td>104</td>
<td>29.8</td>
<td>0.379</td>
<td>0.512</td>
</tr>
<tr>
<td>Female</td>
<td>2</td>
<td>1</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>349</td>
<td>105</td>
<td>30.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Prevalence of bovine fasciolosis based on body condition scores

<table>
<thead>
<tr>
<th>Body condition</th>
<th>Examined</th>
<th>Positive</th>
<th>Prevalence (%)</th>
<th>$x^2$</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>306</td>
<td>88</td>
<td>28.75</td>
<td>2.12</td>
<td>0.402</td>
</tr>
<tr>
<td>Medium</td>
<td>36</td>
<td>14</td>
<td>38.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>7</td>
<td>3</td>
<td>42.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>349</td>
<td>105</td>
<td>30.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4: Species of Fasciola identified during post mortem examination of slaughtered animals

<table>
<thead>
<tr>
<th>Fasciola species</th>
<th>No of liver infected</th>
<th>Prevalence (%)</th>
<th>x^2</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>F. hepatica</td>
<td>73</td>
<td>20.91</td>
<td>349.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>F. gigantica</td>
<td>16</td>
<td>4.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed</td>
<td>16</td>
<td>4.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
<td>30.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5: Distribution of fasciola species according to mode of affection

<table>
<thead>
<tr>
<th>Mode of affection (%)</th>
<th>F. hepatica</th>
<th>F. gigantica</th>
<th>Mixed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>30(34.28)</td>
<td>11(10.48)</td>
<td>5(4.67)</td>
<td>46(43.8)</td>
</tr>
<tr>
<td>Moderate</td>
<td>32(30.47)</td>
<td>5(4.67)</td>
<td>6(5.71)</td>
<td>43(41)</td>
</tr>
<tr>
<td>Severe</td>
<td>11(10.48)</td>
<td>0(0)</td>
<td>5(4.67)</td>
<td>16(15.24)</td>
</tr>
<tr>
<td>Percentage (%)</td>
<td>20.91</td>
<td>4.3</td>
<td>4.3</td>
<td>30.1</td>
</tr>
</tbody>
</table>

DISCUSSIONS

The overall prevalence of bovine fasciolosis 30.1% (n=349) observed in this study is in line with the report of Mihreteab et al. [18] at Adwa municipal abattoir, Pikukenyi and Mukaratirwa [19] from Zimbabwe and Hailu [20] at Awasa 30.43%, 32.3% and 31.7%, respectively, which is a bit higher than a work reported by Gebretsadik et al. [21] at Mekelle (24.32%) and it was significantly higher than the prevalence of bovine fasciolosis reported by Fufa et al. [22] at Wolaita Sodo (12.7%), Swai and Ulicky [23] at Hawi, Tanzania (14.05%), Daniel [24] at Dire dawa municipal abattoir (14.4%) and Abunna et al. [25] at Wolaita Soddo abattoir (14.0%). The reason for this might be attributed to the variation in agro-ecological conditions favourable to both the parasite and the intermediate host.

The prevalence of bovine fasciolosis in the present study is lower as compared with the previous reports in different parts of Ethiopia [6] at Jimma (46.58%) and Mulualem [26] in South Gondar (83.08%). Similarly, Yilma and Mesfin [9] reported a 90.7% prevalence of fasciolosis in cattle slaughtered at Gondar abattoir which higher than present study. This wide gap may be due to the variation in sampling time which result higher prevalence in certain months and vice versa, there will also be variation in accessibility of cattle to swampy communal grazing land which is the main factor for the presence of variation in the prevalence and due to the wide expansion of deforestation from day to day resulting in depletion of swampy grazing area.

This study indicates a prevalence of 28.95% and 36.54% in age group of adult and old animals, respectively. Statistical analysis however showed the absence of significant variation (P>0.05) in the occurrence of fasciolosis among the different age groups of animals. This indicates that there is no difference in acquiring Fasciola infection between adult and old which contradicts the works of Solomon and Abebe [3] and Yilma and Mesfin [9].

In the current work, no significant variation (P>0.05) was observed in the prevalence of fasciolosis whether the animal slaughtered is in a poor, medium or good body condition. This could be because body condition deterioration in cattle is manifested when fasciolosis reaches its chronic stage [3].

Both species of Fasciola were identified during the study period; however, F. hepatica was the most prevalent (69.5%) species compared to F. gigantica (15.24%) and mixed infection (15.24%). This finding is lower when compared with that of Fikirtemariam et al. [27] at Bahir Dar. Similarly, several abattoir studies in different parts of Ethiopia reported the predominance of F. hepatica to F. gigantica [28, 29]. Abunna et al. [25] however, recorded higher prevalence of F. gigantica than F. hepatica in cattle slaughtered at Wolaita Soddo abattoir in southern Ethiopia. The high prevalence of rate of F. hepatica may be associated with the existence of favourable ecological biotopes for Lymnea truncatula. Relatively small proportion of cattle were found infected with F. gigantica alone or mixed infection with both species. Flood prone areas and draining ditches are favourable habitats to Lymnea natalensis [15]. The finding of mixed infection with the two species of Fasciola indicates that there are places in the country where the climato-ecological conditions favour the existence of the intermediate snail hosts for both species.
The present study showed that there was statistically significant difference (P<0.05) in prevalence of Fasciola species which is further supported by the findings of Tadele and Worku [6], Gebretsadik et al. [21] and Mebratu and Beka [30].

The result of present study showed that age has no significant (P> 0.05) effect on the prevalence of bovine fasciolosis. This showed that age groups have no effect for the presence or prevalence of fasciolosis; hence, both animals were equally exposed to infection which contradicts with the work of Solomon and Abebe [3], Yilma and Mesfin [9] and Alula et al. [31].

The mode of affection of liver due to fasciolosis was mild (43.8%), moderate (41%) and severe (15.24%) in which the variation was statistically significant (P<0.05). As present study revealed *F. hepatica* affects liver moderately than severely and mildly which agrees with report of Mihreteab et al. [18].

The total annual economic loss due to bovine fasciolosis in Assela town was calculated as 2000506.2 ETB. The present finding is by far higher than the results reported by Daniel [24], Alula et al. [31] and Abdul [32] who reported a total economic loss of 154,188, 215,000 and 63,072 ETB, respectively annually in cattle due fasciolosis at Ziway, Dire Dawa municipal abattoir and Nekemte municipal abattoir, respectively. These higher values may be due to higher number of animals slaughtered at the Assela and increment of cost of liver and meat.

**CONCLUSION**

As cattle slaughtered at Assela municipal abattoir originate from almost every corner of the town it could be concluded that fasciolosis is still prevalent in cattle in Assela which causes great economic losses as a result of condemnation of infected livers. The total annual economic losses due to liver condemnation and carcass weight loss due to fasciolosis is estimated to be birr 20,00506.2 ETB. The study has also confirmed *F. hepatica* was found to be the predominant fasciola species causing bovine fasciolosis in the study area which in turn results in largest proportion of liver condemnation at Assela municipal abattoir.

In order to alleviate the existing problem and to promote the status of the livestock dependent people living in this area, the following recommendations were forwarded:

- Combined approach of chemotherapy with vector control should be considered more practically and economically.
- Farmers should be aware and informed about the importance of disease control programs and good management system if bright future and improvement in livestock production is needed.
- Further studies on the epidemiological conditions and seasonal dynamics of parasites in the study area should be conducted to implement integrated control strategies.

**REFERENCES**


