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Study on the Prevalence and Economic Significance of Bovine Fasciolosis at Gondar Elfora Abattoir, Gondar, Ethiopia

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ABSTRACT

A cross sectional study was conducted to determine the prevalence and economic significance of bovine fasciolosis at Gondar Elfora abattoir, Gondar Ethiopia from November 2018 to April 2019. A total of 384 cattle were selected by systematic random sampling techniques for postmortem examination at Gondar Elfora abattoir. Out of these 90 (23.4%) cattle were found positive for fasciolosis. The prevalence of fasciolosis in poor body conditioned cattle were known to be 30.8% followed by medium body conditioned (22.7%) and good conditioned animal (15.2%) . Statistical analysis of the data showed the presence of significant difference (P=0.028) on the prevalence of fasciolosis on the basis of body condition score. Higher prevalence of bovine fasciolosis in the study area was observed in older than adult animals 28.7% and 19.5% respectively. There was statistically significant association among age of the animal and prevalence of bovine fasciolosis (P=0.037). The predominant Fasciola species identified was *Fasciola hepatica* 57 (14.8%) followed by *Fasciola gigantica* 21 (5.5%) and mixed species (*Fasciola hepatica and F. gigantica*) 12 (3.1%). The total annual economic loss due to bovine fasciolosis in Gondar Elfora abattoir was calculated as 1,919,640 ETB (65,922 USD). The economic loss due to bovine fasciolosis at the study area showed that fasciolosis is an economically important disease in the Gondar Elfora abattoir. Hence, a combination of anthelminthic and vector control measures have to be used to ensure a satisfactory degree of control in the long run.

Keywords: Cattle, *Fasciola gigantica*, *Fasciola hepatica*, Gondar, Prevalence

Ethiopia is rich in livestock and believed to have the largest livestock population in Africa. The central statistical agency report indicated the total cattle population of the country which is estimated to be about 59.5 million, female (55.5%) and male (44.5%). The sector has been subsidizing a significant portion to the country economy and still promising to rally round the economic development of the country (CSA, 2017). Livestock are the main stays of the livelihood of the majority of the human population by giving draft power, income to farming communities, means of investment and important source of foreign exchange earning to the nation. Moreover, livestock are important cultural resources, social safety nets and means of saving, and are also supply for crop production and transport, as source of meat, milk and source of income (DACA, 2006).

However the presence of this huge livestock population, Ethiopia is not exploiting its livestock resources as expected due to a number of factors such as animal diseases, recurrent drought, infrastructures problem, rampant animal diseases, poor nutrition, poor husbandry practices, shortage of trained man power and lack of government policies for disease prevention and control (ILRI, 2009). The widely prevalent livestock diseases are major constraints to Ethiopian livestock development. The vulnerable of livestock production and trade to disease epidemics is undermining investment in a potentially valuable economic activity which would increase employment in rural areas, raise rural incomes and assist in alleviating poverty (Shitaye *et al.,* 2007). Among the animal diseases that hinder the animal health are parasitic

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infections that have great economic impact (Abdulhakim and Addis, 2012).

Among helminthes, fasciolosis is an economically important parasitic disease, which is caused by trematodes of the genus Fasciola that migrate in the hepatic parenchyma and establish in the bile ducts (Aliyu *et al.*, 2014).Fasciolosis is a major disease, which imposes direct and indirect economic impact on livestock production, particularly of sheep and cattle (Menkir *et al*., 2007). 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 the country (Solomon and Abebe, 2007).

The complex nature of the lifecycle and epidemiology of this snail-borne disease presents challenges for predictive mapping at the herd level, as well as disease management and animal husbandry at the individual level (Mungube *et al*., 2006). The distribution of *Fasciola hepatica* is limited to temperate areas and high land of tropical and sub-tropical regions while *Fasciola gigantica* is wide spread in most parts of tropical Africa. Thus, the distribution of two Fasciola species overlap in many African and Asian countries and sometimes in the same country, although in such cases the ecological requirements of the flukes and their snail intermediate host is distinct (Walker *et al*., 2008). Fasciola is commonly recognized as liver flukes and are responsible for wide spread morbidity and mortality in ruminants characterized by weight loss, anemia and hypoproteinemia (Swanakar and Sagar, 2014).

Bovine fasciolosis is an economically important parasitic disease of cattle in tropical and subtropical countries responsible for considerable economic losses in the cattle industry, mainly through mortality, morbidity, reduced growth rate, condemnation of fluke infected liver, increased susceptibility to secondary infections and expense due to control measures. Production loss in livestock industry is estimates at more than 90 million USD annually (Rahmeto *et al*., 2010).

Liver fluke infection is economically significant parasite of livestock and is emerging zoonotic infection. The majority of reported human cases of fasciolosis are due to infections of *F. hepatica*. However, some reports indicate a rise in human infections due to *F. gigantica* in Vietnam (Mas-Coma *et al.,* 2005). Millions of human population is infected with fascioliasis and about 180 million are at risk of fascioliasis according to WHO estimation. Its prevalence is growing in human population and has been reported from 70 different countries of world (Nyindo and Lukambagire, 2015).

The previous researchers Gebremeskel *et al*. (2017) it was reported that the prevalence of 21.2% bovine fasciolosis at Gondar Elfora Abattoir. Although the most prevalent species of Fasciola as well the indirect economic loss due to faciolosis were not studied by the researcher at Gondar Elfora abattoir. Hence, the objectives of the current study were;

- ❒ To determine the prevalence of bovine fasciollosis at Gondar Elfora abattoir.
- ❒ To identify the most important Fasciola species involved in the infection.
- ❒ To estimate the direct and indirect economic loss due to fasciolosis

MATERIALS AND METHODS

Study area

The study was conducted from November 2018 to April 2019 at Gondar Elfora abattoir. The study area located in Amhara regional state of central Gondar zone at Gondar town located 727 Km away from Addis Ababa the capital city of Ethiopia, at elevation of 2,220 m above sea level the town is aligned on latitude of 12°36’N 37° 28’E and longitude of 12.6°N 37.467°E. The average annual rain fall varies from 880 to1172 mm with the average annual temperature of 20.3°C and the average relative humidity is 55.7% (Shewangzaw and Addis, 2016).

Study population

The study animals were male indigenous Zebu (*Bos indicuss*) cattle brought for slaughter from different localities in the Gondar Elfora abattoir. A total of 384 cattle were selected based on systemic random sampling. The slaughtered cattle were brought from different cattle markets; it was difficult to know the exact geographical origins of the slaughtered animals. So, the finding could not related to the locality of slaughtered animals.

Study design

A cross sectional study was conducted from November 2018 to April 2019 to determine the prevalence and economic significance of bovine fasciolosis at Gondar Elfora abattoir, Gondar Ethiopia. Both ante mortem and post mortem inspection procedures was carried out during the study periods.

Sample size determination and sampling techniques

The animals were selected by using systemic random sampling method. The sample size was determined according to the formula given by Thrusfield (2005). The previous study conducted by (Gebremeskel *et al*., 2017), shown the prevalence rate of 21.2% bovine fasiolosis in the same Gondar Elfora abattoir. Therefore, by using 21.2% as expected prevalence and 5% absolute precision at 95% confidence level, the number of sampled animals needed in the study was 257.

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

Where n = required sample size

P_{exp} = expected prevalence (21.2%)

d = desired absolute precision (usually 0.05)

Accordingly, $n = 1.96^2 * 0.212\ (1- 0.212)/0.0025 = 257$ cattle were the calculated sample size. However, a total of 384 cattle were included in the study to increase the sample size and for maximizing the precision of the study under taken.

Study methodology

Ante-mortem examination

Inspection of the animals was made while at rest or in motion for any obvious sign of disease and abnormality following the FAO guidelines. On each visit, AM inspection was conducted after coding the systematically selected animals. During ante mortem examination each of study animal was identified based on the number marked on their body before slaughter and their general behavior, signs of disease, nutritional status, cleanliness and any type of abnormality can affect the fitness of the animal for slaughter will be recorded (Gracy *et al*., 1999). Body condition for each cattle was estimated based on Nicholson and Butterworth (1986) ranging from score 1 (emaciated) to 5 (obese). Therefore, in this study three classes of scoring which include poor (Score 2), medium (Score 3) and good (score 4 and 5) were used. No animals were slaughtered at score 1(emaciated). The age of the animal was estimated on the basis of dentitions (De-Lahunta, and Habel, 1986).

Post mortem examination

A total of 384 cattle were examined during ante mortem inspection and post mortem inspection of liver and bile duct of each animal were carried out to check for the presence of Fasciola. Livers and bile ducts were dissected carefully. Liver was inspected by making multiple deep incisions of the lobes and making a deep cut with a number of small sub cuts. Bile duct was opened using a knife and thoroughly investigated for the presence of Fasciola. A collection of Fasciola species from each cattle was examined macroscopically using their morphological features. The species of Fasciola identification, after collecting the flukes in the universal sampling bottle containing 5% formalin as a preservative, Fasciola species were easily identified based on morphological characters such as shape and size in university of Gondar veterinary parasitology laboratory. They were classified as *Fasciola hepatica* (relatively small sized), *Fasciola gigantica* (relatively large sized and more leaf like), mixed forms (*Fasciola hepatica* and *Fasciola gigantica*) (Urquhart *et al*., 1996).

Data management and analysis

Data collected from study area were entered and stored in a Microsoft Office Excel 2007 spread sheet program and coded for analysis. Statically analysis was done on SPSS statistics version 20 statically soft ware programs. The prevalence was calculated for all data as the number of infected individuals divided by the number of sampled individual × 100 (Thrusfield, 2005). Categorical data was analyzed first with chi-square(x^2) test for independence as a screening process. A P-value<0.05 was considered as statically significant.

RESULTS AND DISCUSSION

Prevalence of bovine fasciolosis

A total of 384 adult and old indigenous Zebu (*Bos-indicuss*) cattle were slaughtered at Gondar Elfora abattoir and examined for fasciollosis. About the total cattle slaughtered and examined 90(23.4%) cattle were found infected with Facsiola. The most prevalent species were *F. hepatica*, which occurred in 57 animals (14.8%), *F. gigantica*, which occurred in 21 animals (5.5%) and mixed, which occurred in 12 animals (3.1%).

Table 1: Prevalence of bovine fasciolosis from November 2018 to April 2019

Total samples	Infected animals	Prevalence (%)
384	90	23.4

Prevalence of Bovine Fasciolosis Based on Body Condition

Poor body conditioned animals were mostly affected by bovine fasiolosis compared to medium and good body conditioned animals and shown a high statistical significant (P=0.028).

Table 2: Prevalence of bovine fasciolosis based on body condition of the animals.

Body condition	No of animal examined	Positive animal	Prevalence (%)	X^2	P-value
Poor	120	37	30.8		
Medium	172	39	22.7	7.178	0.028
Good	92	14	15.2		
Total	**384**	**90**	**23.4**		

Prevalence of Bovine Fasciolosis Based on Age

The prevalence of bovine fasciollosis is high in old animals (28.7%) as compared with adult animals (19.5%). There is significance difference on the prevalence of bovine fasciollosis and age of the animal ($X^2 = 4.348$; P=0.037).

Table 3: Prevalence of bovine fasciolosis based on age groups.

Age	No animal examined	Positive animal	Prevalence (%)	X^2	P-value
Adult	221	44	19.5		
Old	163	46	28.7	4.348	0.037
Total	**384**	**90**	**23.4**		

Prevalence of Bovine Fasciollosis Based on Fasciola Species Identified

From a total of 90 livers found positive for liver fluke infection during post mortem inspection of slaughtered cattle, 57 livers (14.8%) harbored *F. hepatica,* 21 livers (5.5%) *F. gigantica* and 12 livers (3.1%) infected with mixed species. The result showed that *F. hepatica* is the most predominant Fasciola species in the study area with compared to *F.gigantica* and mixed species.

Table 4: The prevalence of bovine fasciollosis based on Fasciola species identified

Species	No of positive liver	Prevalence (%)	X^2	P-value
F-hepatica	57	14.8		
F-gigantica	21	5.5	384.00	0.000
Mixed	12	3.1		
Total	**90**	**23.4**		

Economic Loss Assessment

The total economic loss due to fasciolosis in cattle slaughtered at Gondar Elfora abattoir from the summation of annual liver condemnation cost direct economic loss and cost loss due to carcass weight reduction indirect economic loss was assessed.

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 Gondar Elfora abattoir and the average market price of one liver at Gondar town was

taken as 80 Ethiopian birr. The mean number of cattle slaughtered in Gondar Elfora abattoir was 2356 per year which depends on one year recorded data economic losses, calculated based on condemned livers due to fasciolosis. The information obtained was subjected to mathematical computation using the formula (Ogunrinade and Adegoke, 1982).

$$ALC = CSR \times LCX P$$

Where *ALC* = Annual loss from liver condemnation

CSR = Mean annual cattle slaughtered at Gondar Elfora abattoir

LC = Mean cost of one liver in Gondar town

P = Prevalence rate of the disease at the Gondar Elfora abattoir

= 2356 × 80ETB × 23.4%

= 2356X 80 ETB × 0.234

= 44,104 ETB (1515 USD)

Indirect economic loss

Indirect economic loss was associated with carcass weight reduction due to fasciolosis. Carcass weight loss in individual cattle due to fasciolosis is 10%. Average carcass weight of an Ethiopian Zebu was taken as 126 kg (Mari, 1989). The mean retain price of one kilogram of beef in Gondar town was taken as 270 Ethiopian birr. The annual carcass weight loss due to bovine fasciolosis assessed using the following formula set by Ogunrinade and Adegoke (1982).

$$ACW = CSR \times CL \times BC \times P \times 126\ \text{Kg}$$

Where *ACW* = Annual loss from carcass weight reduction

CSR = Average No cattle slaughtered per annual at Gondar Elfora abattoir

CL = Carcass weight loss in individual cattle due to fasciolosis

BC = an average price of 1 kg beef at Gondar town

P = Prevalence rate of fasciolosis at the Gondar Elfora abattoir

126 kg = Average carcass weight of Ethiopian Zebu

ACW = CSR × CL × BC × P × 126kg

= 2356X 10% X 270 ETB X 23.4% X 126kg

= 2356 × 0.1 × 270 ETB × 0.234 × 126kg

= 1,875,536 ETB (64,407 USD)

Therefore, the total annual economic loss due to bovine fasciolosis in the study abattoir is the summation of the losses from liver condemnation (direct loss) and carcass weight reduction (indirect loss) and thus a total of 1,919,640 ETB (65,922 USD). NB: 1 USD was equivalent to 29.12 ETB.

Bovine fasciolosis is economically important and widely distributed disease in almost all region of Ethiopia. The result revealed that the disease is also problem in cattle slaughtered at Gondar Elfora abattoir causing economic loss due to liver condemnation and carcass weight reduction. The prevalence of fasciolosis in Ethiopia varies from 11.5% in low land area to 87% in high land area (Tolosa and Tigre, 2007).The high lands area have poor drainage, which favors the development of the parasites (Hylegebriel *et al*., 2012). During the study, a total of 384 cattle were examined out of which 90 cattle were found to be infected with fasciolosis giving a prevalence of 23.4%. The result of this study is relatively close to the finding by Kassaye *et al.* (2012) (20.3%) in Addis Ababa, Petros *et al.* (2013) in Nekemte (21.9%) and Alemu and Mekonnen (2013) (22.14%) from Dangila municipal abattoir, (24%) from Andassa livestock research center, Berhe *et al*. (2009) (24.3%) from Mekelle and Ephrem *et al*. (2012) 25.2% at Dessie municipal abattoir respectively. This result is higher than the values reported by Fufa *et al*. (2009) at Wolaita Sodo municipal abattoir (12.7%), Abunna *et al*. (2010) at Wolaita Soddo abattoir (14.0%) and Daniel, (1995) at Dire Dawa municipal abattoir (14.4%). The reason for this might be attributed to the variation in agro-ecological conditions favorable to both (*F-hepatica* and *F-gigantica*) the parasite and the intermediate host. The prevalence of bovine fasciolosis in the present study was lower as compared with the previous reports in different parts of Ethiopia (Tadele and Worku, 2007) at Jimma municipal abattoir (46.58%), Ayalew and Endalawaw (2013) 45.3% at the Bahir Dar municipal abattoir, Alemnew *et al*. (2013) 43.25% at Quarit district municipal abattoir, Yemisrach and Mekonnen (2012) 39.8% at Hashim Nur's Ethiopian

livestock and meat export industrialized abattoir in Debre Zeit and Atenafe and Melaku (2012) 31.51% at Ginnir district municipal abattoir.. This might be due to the differences in altitude, topography and weather conditions or due to the difference in the awareness of the livestock owners on how to keep their cattle healthy, protect their cattle from reaching infected area, keeping pastures dry and eliminating surrounding contaminated vegetation which might be a suitable medium for Fasciola infection and due to the differences in the practice of using anti-helminthes to treat infected animals by veterinary health personnels. However, the present finding is lower than the previous finding reported by Yilma and Mesfin (2000) (90.7%) was conducted at Gondar Municipal abattoir. This might be due to epidemiological factors such as snail population, as a result of favorable conditions and differences in the practice of using anti-helminthes to treat Fasciola infected animals.

This study indicates a prevalence of 30.8%, 22.7% and 15.2 % in poor, medium and good body conditioned animals respectively. Poor body conditioned animals were mostly affected by bovine fasiolosis compared to medium and good body conditioned animals and There was a statistically significant association between body conditions of the animals and the prevalence of bovine Fasciola infection (P=0.028). In support of this finding, a study conducted by Gebremeskel *et al*. (2017) at Gondar Elfora abattoir indicated that the association between the prevalence of bovine fasciolosis and body condition of the animals was also statistically significant (P = 0.036).

Similarly in the previous study reported by Habte and Yifter (2017) at Arba Minch municipal abattoir poor body (58.02%) conditioned animals were mostly affected by bovine fasciolosis than medium body (41.32%) conditioned and good body (20.22%) conditioned animals, Hagos (2007) the prevalence reported was 37.7%, 33.1% and 29.1% in poor, medium and good body conditioned animals and Petros *et al*. (2013) at Nekemte Municipal abattoir, these researchers reported that poor body (37.11%) conditioned animals showed more affected by bovine fasciolosis than medium (20.58%) and good body (11.11%) conditioned animals. This might be poor body condition usually less resistant and are consequently susceptible to various diseases including fasciolosis and due to reduced performance of the animals created by lack of essential nutrients and poor management by the animal owner. Different studies revealed the relationship between body conditions and fasciolosis has shown that there is a positive association between fasciolosis and cattle weight loss. It is known that animals in good intensive management systems and with adequate veterinary care should be in better body condition than cattle extensively managed with little veterinary services (Jaja *et al*., 2017).

This study indicates a prevalence of 19.5% and 28.7% in age group of adult and old animals respectively. There was statistically significant association among age of the animal and prevalence of bovine fasciolosis (P=0.037). Similarly, several studies in Ethiopia Gebrestadik *et al*. (2010) reported age as one of the important risk factors influencing bovine fasciolosis in cattle, Tizazu and Ahmed (2017) reported old cattle (36.54%) more infected by bovine fasciolosis than adult cattle (28.95%). The possible explanation might be older cattle were more susceptible and less resistant to infection of bovine fasciolosis than adults and bovine fasciolosis is a chronic disease, the older animals reflects a much longer period of exposure to infection.

A total of 90 positive livers for fasciolosis species identified, 14.8% of them were infected by *F. hepatica* where as 5.5% were infected by *F. gigantica* and 3.1% were mixed infections (both *F. hepatica* and *F. gigantica*). The predominant species involved bovine fasciolosis in the study area was *F. hepatica*. Similarly the previous study conducted by Gebretsadik *et al*. (2009) reported that the predominant species involved bovine fasciolosis in the Mekelle area was *F. hepatica*, 56.42%, 9.17% of cattle were infested with *F. hepatica* and with *F.gigantica* respectively, Tolosa and Tigre (2014) reported that 63.30% of infected by *F. hepatica*, whereas *F. gigantica* were recovered to be 23.85% and the study conducted at Zeway abattoir reported 60.3% of the liver harbored *F.hepatica*, 10.2% *F. gigantica* (Adem, 1994). However, in another study, Habt and Yifter (2016) stated that the most common liver fluke species affecting cattle at Arba Minch municipal abattoir was *F-gigantica* 88.18% of liver infected by *F. gigantica* where as 7.39% were infected by *F. hepatica* and Abunna *et al*. (2009) recorded higher prevalence of *F. gigantica* than *F. hepatica* in cattle slaughtered at Wolaita Soddo abattoir in southern Ethiopia. The high prevalence of *F. hepatica* as compared to *F. gigantica* may be associated with the presence of intermediate host *L. truncatula* and

may be explained by the fact that most cattle for slaughter came from high land areas. Malone and Yilma (1998) indicated that *F. gigantica* in Ethiopia is found at altitudes below 1800 meters above sea level. While *F. hepatica* is found at altitude of 1200-2560 meters above sea level. Mixed infections by both species can be encountered at 1200-1800 meters above sea level. According to Malone and Yilma (1998), such discrepancy is attributed mainly to the variation in climatic and ecological conditions such as altitude, rainfall and temperature as well as livestock management systems. In addition, it may be optimal base temperature to the levels of 10 ºC and 16ºC are necessary for snail vectors of *Fasciola hepatica* and *Fasciola gigantica*, respectively. These thermal requirements are also needed for the development of Fasciola with in the intermediate host. The ideal moisture conditions for snail breeding and development of larval stages within the snails are provided when rainfall exceeds transpiration and field saturation is attained. Such conditions are also essential for the development of fluke eggs, miracidiae searching for snails and dispersal of cercariae (Urquhart *et al*., 1996).

The direct economic loss incurred during this study as a result of condemnation of liver of cattle was estimated about 44,104 ETB (1515 USD) per annual and indirect economic loss due to carcass weight reduction was estimated about 1,875,536 ETB (64,407 USD) per annual. The total annual economic loss due to bovine fasciolosis in Gondar Elfora abattoir was calculated as 1,919,640 ETB (65,922 USD). The present finding was higher than the economic loss reported by Mekonnen *et al*. (2017) 1,751,432 ETB at Sheno municipal abattoir, Bayu *et al*. (2013)157,684 ETB at Addis Ababa enterprise abattoir, Mihretab *et al*. (2010) 4672 USD at Adawa municipal abattoir, Rahmeto *et al*. (2010) 106,400 ETB at Hawassa municipal abattoir, Ibrahim *et al*. (2010) 49,491 ETB at Kombolcha Industrial abattoir, Habte and Yifter (2016) 726,561 ETB (52,649 USD) at Arba Minch municipal abattoir. These higher values might be due to the increment of cost of liver and beef. The present finding is by far lower than the results reported by Belay *et al*. (2012) 2,495,346 ETB at Dessie municipal abattoir, Tizazu and Ahmed (2017) 2,340,576 ETB (114,678 USD) at Assela municipal abattoir, respectively. These higher values might be due to higher number of animals slaughtered at the Dessie and Assela municipal abattoirs and the ecological and climatic difference between the two localities.

CONCLUSION AND RECOMMENDATIONS

The study was conducted on the prevalence and economic significance of bovine fasciolosis at Gondar Elfora abattoir revealed prevalence of 23.4%. This study revealed that the presence of *F. hepatica*, *F. gigantica* and mixed species. The prevalence of bovine fasciolosis has significance association with age and body condition of animals. Poor body conditioned animals were mostly affected by bovine fasiolosis compared to medium and good body conditioned animals. The dominant Fasciola revealed was *Fasciola hepatica* at the study site that induces economic losses due to liver condemnation and carcass weight reduction. In general it can be concluded that fasciolosis is one of the major problem for livestock development in the study site by inflicting direct, 44,104 ETB (1515 USD) and indirect economic losses, 1,875,536 ETB (64,407 USD) respectively. Based on the above conclusion the following recommendations are forwarded:

- A combination of appropriate anthelminthic and vector control include drainage; fencing and molluscides have to be used to ensure a satisfactory degree of control in the long run.
- Strategic use of antihelmintics should be performed to reduce pasture contamination with fluke eggs and to delay development of antihelmintics resistance.
- Awareness creation should be delivered to the owner about the impact of illegal use of anthelmentics, under dose of anthelmintic and inappropriate use of drugs.
- Farmers should improve feeds to their animals to have good body condition that helps to enhance their resistance against fasciolosis.

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