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Prevalence, Risk Factors and Financial Losses Due to Bovine Fasciolosis, In Toke Kutaye District, West Shewa Zone, Oromia, Ethiopia

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1. ABSTRACT

A study was carried out from April 2022 to half of June, 2022 at Toke Kutaye district on Guder town, Melka Naga and Naga File Keble by centering Guder Veterinary clinic. The aim was to estimate the prevalence of bovine fasciolosis and its associated risk factor depending on cross sectional study. From total of 383 fecal sample taken and laboratory, coproscopic examination carried out using the standard sedimentation technique to detect Fasciola eggs. 29 cattle or (7.83% P) cattle were found positive. From total 29 positive; 21 was adult age group while 8 were depending on poor body condition. The highest prevalence 27.59% was estimated on poor body condition from BCS. Depending on age 11.73% were estimated on adult. Therefore, statistically there is very great significant association on age and body condition score since ($p<0.05$). There was no significant association between prevalence of bovine fasciolosis, sex, and breed of animals as well as sampling site ($p>0.05$).

The age group compositions of the sampled animals were 47%, 37% and 16% for adult animals, young and calves, respectively; whereas 59% and 41% of the sampled animals were male and female animals, respectively. From the risk factors the old age groups and poor body condition has strong association with prevalence of the disease.

The annual economic loss due to liver condemnation (ALC) by fasciolosis at Guder municipal abattoir was estimated to Ethiopian birr 523,467.36 birr.

Keywords: Guder; Municipal abattoir

2. INTRODUCTION

Fasciolosis is a major problem that affects the productivity of livestock throughout the world. It is caused by the digenean of the genus *Fasciola* which is commonly called liver fluke.[1] *Fasciola hepatica* and *Fasciola gigantica* are the two species commonly implicated as the etiological agents of fasciolosis. Both species can infect a wide variety of domesticated animals, wild life and humans. *F. hepatica* is found in temperate areas and in cooler areas of high altitude in the tropics and sub tropics, whereas *F. gigantica* predominates in tropical areas. Fasciolosis is commonly distributed in countries where cattle and sheep are raised and there is a niche for *Lymnaea* snail. It had been reported from different continent such as America, Australia, Europe, Asia and Africa.[2]

The life cycle of Fasciolosis takes place in the intermediate snail hosts of the genus *Lymnaea* and the definitive hosts including cattle, sheep, equine, swine and rabbits. The spread of fasciolosis is largely dependent on the distribution of the intermediate host that serves as means of transmission to animals. The aquatic snail, *Lymnaea natalenesis*, is an important intermediate host for *F. gigantica* in Africa, where as *Lymnaea natalenesis truncatula*, is an amphibian snail, widely distributed worldwide, and the most common intermediate host for *F. hepatica.* Adult flukes found in the bile duct, shed eggs into the bile then enter into the intestine to pass outside with feces.[3] The eggs hatch to motile, ciliated miracidium which infect the snail then, develop through the sporocyst and radial stage to the final stage, called cercaria. Cercaria shed from the snail and attaches to grass blades to form the infective metacercaria, which then ingested by the final host, exist in the small intestine, migrate through the gut wall, cross the peritoneum and penetrate the liver capsule.[4]

The disease is associated with liver damage and hemorrhage due to migration of flukes through the liver parenchyma. There is also haematophagic activity of the adult flukes and damage to the bile duct mucosa by their cuticular spines due to fluke residence in the bile duct. Diagnosis of fasciolosis depends on the epidemiology of the disease, clinical signs, and information on grazing history.[5] However, confirmatory diagnosis is based on coproscopic examination in the laboratory and post-mortem examination of infected animals by the detection of parasite in the liver.

Triclabendazole is effective treatment against all developing stages parasite and moreover reduction of snail population is important measure in the control and prevention strategies.[6]

The disease poses a threat to animal welfare and may also cause major economic losses through mortality, ill thrift, treatment and veterinary costs. [7] In Ethiopia Fasciolosis is a widely distributed disease which imposes economic impact on livestock production particularly of cattle and sheep.[8] A study on ovine Fasciolosis in the Ethiopian highlands estimated an annual economic loss of 48.4 million Ethiopian Birr, of which, 46.5, 48.8 and 4.7% were due to mortality, loss of productivity (weight loss and reproductive wastage) and liver condemnation, respectively,[9] In the country, *F. hepatica* was shown to be the most important fluke species in livestock population 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's.[3]

Since epidemiology of fasciolosis is dynamic and may change with years and also the risk factor for occurrence of the disease varies with years, therefore it is important to monitor its development to determine trends in prevalence and estimate its associated risk factor. Fasciolosis is economically important disease however there is scarcity of study on the fasciolosis among cattle in Toke kutaye woreda, central Oromia, Ethiopia. Therefore the aim of this study was:

- To estimate the prevalence of bovine fasciolosis
- To define its associated risk factors in Guder veterinary clinic.
- To estimate the financial losses attributable to the disease in cattle slaughtered at

3. MATERIALS AND METHODS

3.1. Study area

The study was conducted in Toke kutaye district, West Shewa zone, Oromia Regional State, Ethiopia. Toke kutaye district is located at a distance of 126 km west Addis Ababa. The altitude of the area ranges from 1250 to 3200 meters above sea level (m.a.s.l). The study area receives an average annual rainfall of 800 to 1100mm, and the annual mean temperature ranges from 16ºC to 22 ºC. The rain fall is a bimodal type, the short rainy season commonly occurs from February to May and the long rainy season extends from June to September. The farming system in the area is a mixed livestock/crop farming system in which livestock plays an essential role in the livelihood of the farming community. Toke kutaye district has a total cattle, sheep, goat, and equine population of 145,460, 50,413, 24,772 and 20,600, respectively. At the same time the total population of human in Guder town is 134,767, out of which 66,492 are male and 68,275are female

3.2. Study population

In this study two separate study populations was used to determine the magnitude of fasciolosis in alive and slaughtered animals. The study population for the clinic based study was including all cattle brought to Toke kutaye clinic during the study period. The study population was comprise cattle of different breeds (local and cross-breed) age, body condition score as well as sex category, originating from different locality of the district. Whereas the study population for the abattoir based survey was include all cattle brought to Toke kutaye town municipal abattoir during the study period. The composition of this population was the same as the population of the clinic based study described above.

3.3. Study design

A cross-sectional study design was employed whereby the sample animals were selected from the study population by the systematic random sampling method in the clinic based study.

3.4. Sample size determination

The sample size for each cross-sectional study (clinic based and abattoir based studies) was determined using the formula for simple random sampling by[10], with 95% confidence interval, 5% desired level of precision (d) and expected prevalence (P_{exp}) of 50% (since there was no previous study in the area) as follows:-

$n = 1.96^2 (P_{exp})*(1-P_{exp})/d^2$

Where n= sample size

95% CI = 1.96, d= 0.05

Pexp= 0.5

n= 1.96^2 * 0.5* (1-0.5) = 384

Therefore, 384 cattle were randomly selected from each study population and were used as the sample animals for each study.

3.5. Methodology

3.5.1. Clinic based study

Before sampling identification number was given to each randomly selected sample animals and faecal samples was collected directly from the rectum of each cattle using disposable plastic gloves and placed in to a separate clean universal bottle. Each sample was then be labeled with the animal identification number and, age, sex, breed, BCS; date of collection and origin of animals was recorded. All samples was preserved in 10% formalin solution to avoid development and hatching of eggs and transported to the parasitology laboratory of the department of Veterinary science, Guder Mamo Mezemir Campus, Ambo University.

3.5.2. Retrospective study:

Documented data of three years (2019-2021 was collected from the record book of Guder town municipal abattoir.

3.5.3. Laboratory examination

In the laboratory coproscopic examination was carried out using the standard sedimentation technique to detect *Fasciola* eggs and to determine the number of eggs per gram of feces (EPG) (Annex-1). Morphological identification of eggs of *Fasciola* species was done according to[11]. A drop of methylene blue solution was added to the sediment of the samples so as to differentiate eggs of *Fasciola* species from that of paramphistomum species, *Fasciola* eggs show yellowish coloration while eggs of paramphistomum species stained by methylene blue[12].

3.5.4. Economic loss assessment

The annual economic loss was estimated as the sum total of the direct and indirect economic losses resulting from fasciolosis.

Direct economic loss :-The direct economic losses the loss resulting from liver condemnation at the abattoir and was assessed using the formula set by[12], considering the overall prevalence of the disease, the average number of animals slaughtered at Guder abattoir during a year period and the average market price of a liver in Guder town

ALC = MCS * MLC * P

Where ALC=Annual loss due liver condemnation,

MCS= Mean Number of cattle slaughtered per year at Toke kutaye abattoir,

MLC= Mean cost of a liver in Guder town, P= Prevalence of the disease at Guder abattoir.

Indirect economic loss:- The indirect economic loss is the loss due to reduced carcass weight of *Fasciola* infected animals and was calculated based on the estimated carcass weight loss due to fasciolosis of 10%[13]., the average carcass weight of an Ethiopian zebu, 126 kg,[14], and the annual economic loss estimation formula due to carcass weight reduction set by (12).The disease is responsible for considerable economic loses in the cattle industry mainly through mortality, liver condemnation reduced production of meat, milk and wool, and expenditures for anthelmintic.

ACW=CSR*CL*BC*P*126kg

ACW= Annual loss from carcass weight reduction

CSR= Average number of cattle slaughtered per annum at Guder abattoir

CL= Percentage of carcass reduction

BC= average price of 1 kg beef in Guder town

P= prevalence rate of fasciolosis at Guder abattoir,

Average carcass weight of Ethiopian zebu=126 kg

Data management and analysis

All collected data was entered into a computer using Microsoft Excel and transferred to STATA version 14.0 (Stata Corp. College Station, TX, USA) for analysis. Descriptive statistics was used to calculate the prevalence of fasciolosis. Logistic regression was used to test significance of the effect of various risk factors on the prevalence of fasciolosis. Univariable logistic regression was used in which the level of the risk factors for the occurrence of the pathogen was compared using an odds ratio (OR). The level with the lowest prevalence was used as the reference category for all risk factors. Statistical significance was considered at P<0.05. Variables that have P<0.25 was investigated using correlation matrix in order to assess collinearity and all non-collinear variables was offered to multivariable logistic regression. After checking for confounders, variables with a significant association (P<0.05) with the dependent variable was retained in the final model. The model validity and predictive ability was assessed using the Hosmer-Lemeshow goodness-of-fit test and ROC curve, respectively.

4. RESULTS

4.1. Prevalence of Fasciolosis

A total of 383 fecal samples were collected and examined at the parasitology laboratory of Ambo University. 29 of the examined samples were found positive of Fasciola eggs resulting in an overall prevalence of 7.83% (95% CI: 4.91-10.23). The prevalence in Adult animals, 11.73 (95% CI: 6.97-16.49; p=0.006), was significantly higher than the prevalence of 5.63% (95% CI: 1.80-9.47) in Young animals and the prevalence of 0 % in calves. the prevalence of fasciolosis in Good body condition score (BCS) animals, 0%, was statistically significantly lower than the prevalence of 3.60% (95% CI: 0.46-6.73; p=0.000) in Medium Body condition score animals and the prevalence of 27.59% (95% CI: 18.02-37.1) in Poor BCS animals. There was no statistically significant difference observed in the prevalence of fasciolosis between male and female animals (p=0.223), between local breed and cross-breed animals (p=0.527) and between animals sampled from the three sites (Guder, Melka and Naga F) (p=0.977) **(Tables.1&2)**

Table 1: Prevalence of Bovine Fasciolosis in toke kutaye district

Variables	Category	Number examined	Prevalence %	Std. Deviation	95% Confidence	Interval (CI)
Age group	Adult	179	11.73	32.27	6.97	16.49
	Calf	62	0	0	0	0
	Young	142	5.63	23.139	1.8	9.47
Sex	Female	226	6.19	24.159	3.03	9.36

	Male	157	9.55	29.49	4.91	14.2
Breed	Cross	84	5.95	23.802	0.79	11.12
	Local	299	8.03	27.216	4.93	11.12
Body condition score (BCS)	Good	157	0	0	0	0
	Medium	139	3.6	18.689	0.46	6.73
	Poor	87	27.59	44.954	18.017	37.1
Sampling site	Guder	269	7.43	26.283	4.28	10.59
	Melka	48	8.33	27.931	0.22	16.44
	Naga F	66	7.58	26.664	1.02	14.13
	Total	**383**	**7.57**	**26.489**	**4.91**	**10.23**

Table 2: ANOVA table**:** mean prevalence of Fasciolosis across risk factors

variables	**Sum of Squares**	**df**	**Mean Square**	**F**	**p-value**
Age	7185.689	2	3592.845	5.234	0.006*
Sex	1045.552	1	1045.552	1.492	0.223
Breed	282.18	1	282.18	0.402	0.527
BCS	46047.233	2	23023.617	39.41	0.000*
Samp. Site	32.876	2	16.438	0.023	0.977

4.2. Risk factors of Fasciolosis

The risk factors for the prevalence of Fasciolosis considered in this study were age group, sex, breed, and Body condition score (BCS) and sampling sites. The age group compositions of the sampled animals were 47%, 37% and 16% for adult animals, young and calves, respectively **(Figure 1).** Whereas 59% and 41% of the sampled animals were male and female animals, respectively **(Figure 2).** Similarly the composition of the sampled animals by breed, Body condition score (BCS) and Sampling sites are stated in **(Figures 3, 4 &5)** below.

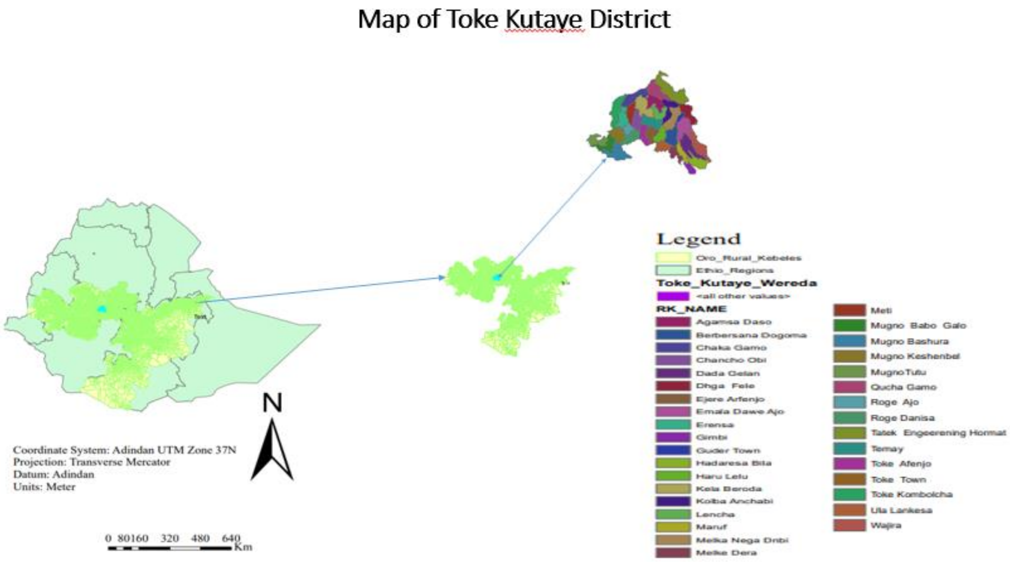

Figure 1: Map of the Study area.(Toke kutaye district Administrative Office)

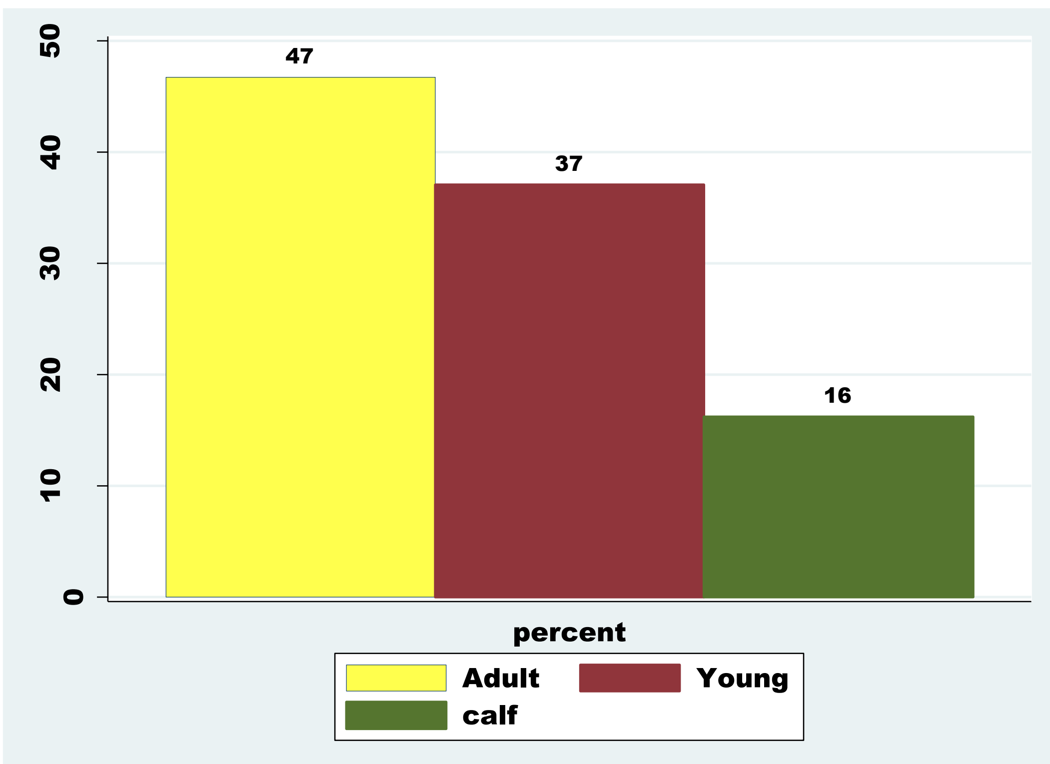

Figure 2: Percentage of the sampled animals by age group

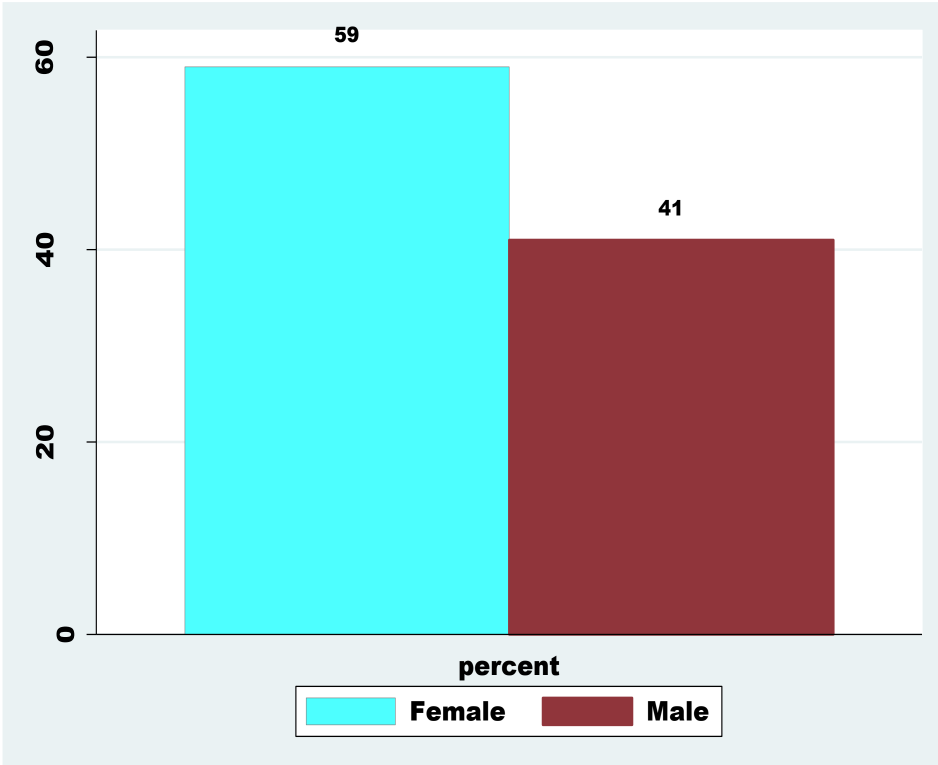

Figure 3: Percentage of the sampled animals by sex

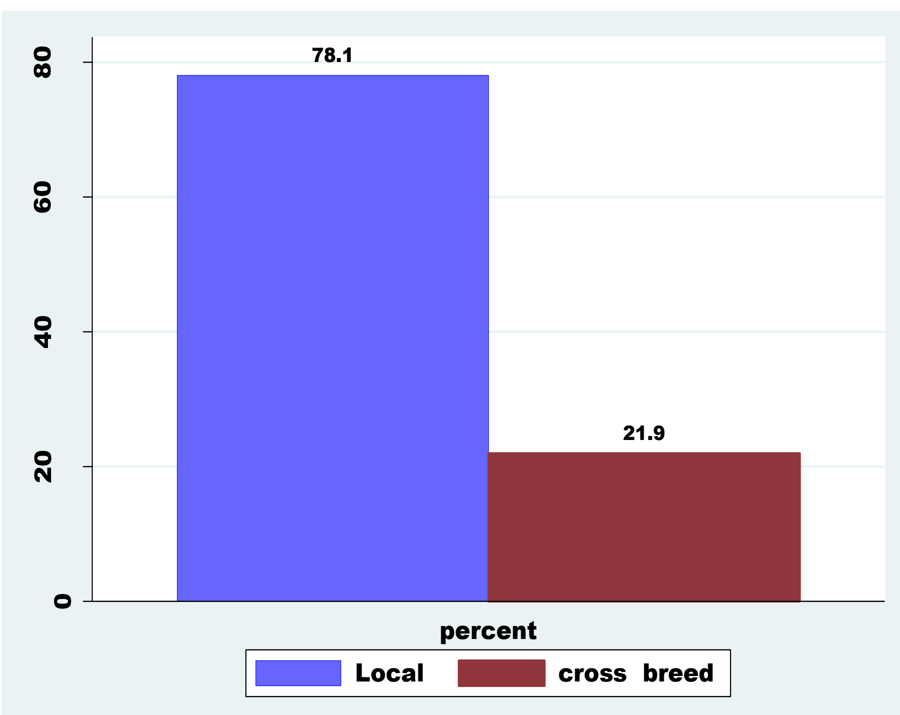

Figure 4: Percentage of the sampled animals by breed

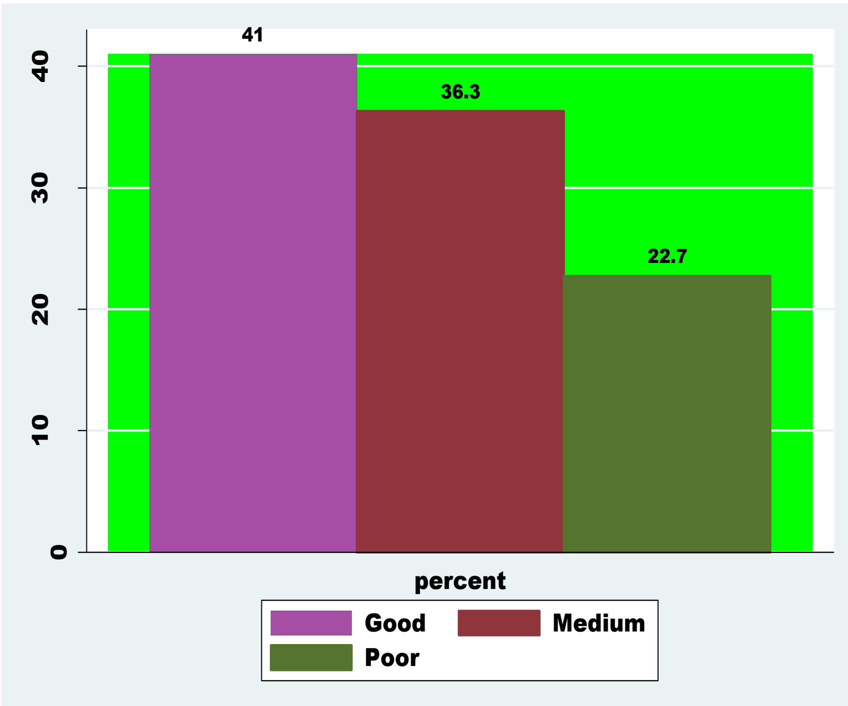

Figure 5: Percentage of the sampled animals by BCS

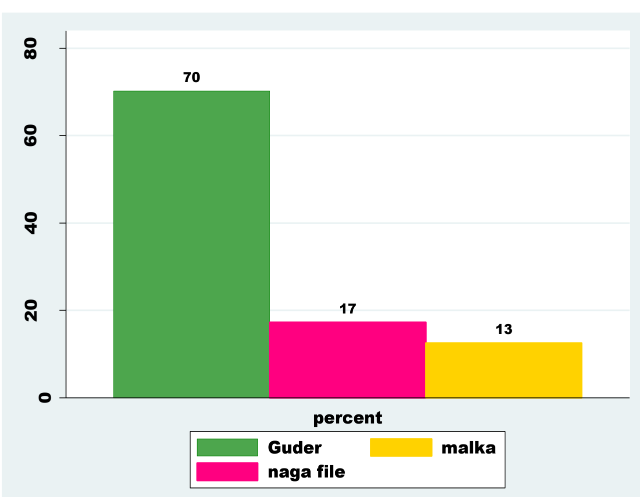

Figure 6: Percentage of the sampled animals by sampling sites

4.3. Association of the risk factors with prevalence of Fasciolosis

From the risk factors assessed in this study age group and body condition scores have shown association with the prevalence of bovine fasciolosis with chi square value of (χ^2 =10.27, p=0.006) and (χ^2 = 65.8, p=0.000) , respectively . On the other hand, sex, breed and sampling sites have not shown any association with prevalence of fasciolosis **(Table 3).** Further analysis by the Univariable logistic regression analysis showed that the association of these two factors with prevalence of fasciolosis was very strong (P=0.040) and (P=0.000) (table 4), respectively. Extra supplementary scrutiny using the multivariable logistic regression analysis showed that the odds of bovine fasciolosis in adult cattle was 3 times than young animals and calves (OR=2.578, 95%CI=1.010-6.582) **(Table 5),** and the odds of bovine fasciolosis in poor body condition cattle was about 12 times more than in good body condition and medium body condition animals (OR=11.871, 95%CI=4.224-33.363) **(Table 5**).

Table 3: Association of the risk factors with prevalence of Fasciolosis

Pearson Chi-Square Tests			
Risk factors	**Value**	**DF**	**Asymp. Sig. (2-sided)**
Age Group	10.268	2	0.006
Sex	1.494	1	0.222
Breed	0.403	1	0.525
Sampling Site	0.047	2	0.977
Body Condition Score	65.796	2	0

Table 4: Univariable analysis of the risk factors of Fasciolosis

Variables	**B**	**d/f**	**Sig.**	**OR**	**95% C.I. for OR**	
					Lower	Upper
Age	-1	1	0.04	0.37	0.14	0.956
Sex	-0.82	1	0.08	0.44	0.177	1.1
Breed	0.157	1	0.8	1.17	0.358	3.83
BCS	-2.64	1	0	0.07	0.024	0.21
Sampling. Site	-0.4	1	0.53	0.67	0.195	2.327

Table 5: Multivariable logistic regression analysis of the risk factors of Fasciolosis

Variables	B	d/f	Sig.	OR	95% Confidence Interval for OR	
					Lower Bound	Upper Bound
Age group	0.95	1	0.05	2.578	1.01	6.582
BCS	2.47	1	0	11.87	4.224	33.363

4.4. Economic loss assessment

Years	2019	2020	2021	Total
Av. No. Of Animal slaughtered	864	900	1044	2,808

4.4.1.Direct Economic loss:

The economic impacts of bovine fasciolosis due to liver condemnation at Guder town municipal abattoir was calculated by depending on the formula mentioned above; and by using the prevalence of abattoir based research done recently at Ambo town municipal abattoir since the two are on similar location and neighbor. The research was done November 2018 and the prevalence was 39%. Total cattle slaughtered at Guder municipal abattoir was calculated by using retrospective method of three consecutive years (2019-2021) recorded data at Guder municipal abattoir that was 2,808. A single liver price was estimated 100 birr.

ALC = MCS * MLC * P

=2,808*100 birr*39%

=109,512 birr

4.4.2. Indirect economic loss:

The Indirect economic loss due to reduced Carcass weight of *Fasciola* infected animals Likewise 39% prevalence of Ambo municipal abattoir of November 2018 was used to calculate loss due to liver condemnation; we also should have to use to calculate loss due to reduced Carcass weight of *Fasciola* infected animals. Annual slaughtered rate was estimated from the retrospective abattoir records of the last 3 years (2019-2021) i.e. =2,808. While the retail market price of beef/kg of zebu carcass was determined from the butcheries in Guder town=300 birr. The estimated carcass weight loss due to fasciolosis of 10%[13]., the average carcass weight of an Ethiopian zebu, 126 kg[14],.When we use the formula above to calculate:-

ACW = CSR* CL * BC * P*126 kg

=2,808*10%*300 birr*39%*126kg

= 413,955.36

The annual economic loss was estimated as the sum total of the direct and indirect economic losses resulting from fasciolosis. = 109,512 +413,955.36 = 523,467.36 birr

5. DISCUSSION

Bovine fasciolosis exists in almost all region of Ethiopia. However, the prevalence, epidemiology and Fasciola species involved vary with locality.[14] This is mainly attributed to the variation in the climate and ecological condition such as altitude, rainfall, and temperature and livestock management system, the overall prevalence of fasciolosis in cattle recorded in this study (7.83%) was lower than previous reports of 14% from Soddo, Ambo municipal 39%, from Jimma 26%. Since the study was done at dry season April to half of June at this time there is no favorable condition for the intermediate host of Fasciola since there is no marshy area of grazing area. The expected reason even for this much one is due to animal movement through trade, and movement of developed metacercaria, and green grass grown on the hem of irrigation canal and small portion of river side green grass is the only expected reason. The highest record of prevalence 11.73 on adult was estimated due to these factors. The body condition of the cattle was strongly associated ($P < 0.005$) with risk of infection. Accordingly, cattle with poor body condition (OR=1) showed higher prevalence of fasciolosis than cattle with medium. This is due to body condition is intimately related to animal's health, quality or vigor and has been widely claimed to be an important determinant of fitness. This implies that fasciolosis causes emaciation of the animals. Low body score was associated with liver fluke infection. However, other than fluke infection, inadequate nutrition and concurrent infection of the animals with other bovine pathogens could enhance the effects of the flukes for the emaciation of the animals. The results of the present study revealed that sex have no significant effect on the prevalence of bovine fasciolosis. This is in agreement with several previous reports in different parts of the countries. This could be associated with similar management given to both male and females cattle. In communal grazing areas, both females and males graze on the same grazing area.

6. CONCLUSION

Many factors can reduce the prevalence of bovine fasciolosis at this study area. Among this the dryness of grass due to the weather condition during the study period play very great role, the increased awerance of the society of deworming their cattle at a regular interval of time, lack of marshy area grazing field and indoor feeding due to territory restriction. Even though all this factors play very great role, in addition to all this reading of false negative in the laboratory is not less. Also we cannot say 100% an animal is free of liver fluke science the immature Fasciola cannot lay egg.

But when we conclude the fasciolosis economic impact

around this study area both due to liver condemnation and reduced carcass weight; most of the time the animals slaughtered at Guder municipal abattoir was purchased from those animals comes from different corners of western and southern parts of Ethiopia to Guder cattle market. This is why the figure of the loss was high.

Recommendation

- In order to keep up on the reduced prevalence of fasciolosis and to reduce more than this:-new purchased animals should have to be dewormed by using anthelmintic of Fasciola drugs.
- Secondly special care should have to be taken for the risk factors according to this study shows.
- When animals are bought for slaughter in order to save their liver; and reduce carcass loss better to quarantine and deworm.

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