Prevalence of Bovine Fasciolosis and Identification of Risk Factors in Bahir Dar, Ethiopia

Tesfaye Mesfin[1], Theobesta Solomon[2] and Abraham Belete Temesgen[2*]

[1]Department of Animal Science, College of Agriculture and Natural Resource, Debre Markos University, Ethiopia

[2]Department of Veterinary Pathobiology, College of Veterinary Medicine and Animals Sciences, University of Gondar, Ethiopia, P.O. Box: 196

Corresponding Author: abrham.belete@uog.edu.et; https://orcid.org/0009-0009-5926-5568

Abstract

Bovine fasciolosis is a parasitic disease of cattle caused by the ingestion of liver fluke metacercariae from the genus *Fasciola*. A cross-sectional study was conducted from November 2021 to April 2022, encompassing a total of 384 cattle randomly selected from diverse locations. The study included cattle of all ages and both sexes, with the aim of assessing the prevalence of bovine fasciolosis and identifying associated risk factors in Bahir Dar, Ethiopia. To detect fluke eggs, fecal tests were performed, and the data was analyzed using a descriptive statistics. The overall prevalence of fasciolosis was 49.21%. Based on origin, Sebatamit had the most incidence at 61.84%, followed by Kebele 11 at 59.37%, Tikurit at 50%, and Latammba at 27.65%. Statistical analysis revealed significant disparities in occurrence among areas. Cattle in poor condition had the largest prevalence (64%), followed by medium condition (50%) and fat cattle (26.96%). This variation was statistically significant. Age-group analysis revealed comparable prevalence rates, with young cattle at 50.38%, adults at 47.33%, and elderly cattle at 50.47%, with no significant differences found. There were no significant sex variations in prevalence, with males exhibiting a prevalence of 49.73% and females 48.73%. Local cattle had a slightly higher prevalence (51.62%) than crossbreds (46.15%), although the difference was not statistically significant ($P > 0.05$). These findings highlight the need for targeted, location-specific control measures and emphasize the importance of maintaining good nutritional and health management practices to reduce the burden of fasciolosis in cattle populations.

Keywords : *Bahir Dar; Bovine fasciolosis;Fecal examination; Prevalence; Risk factors*

1. Introduction

Ethiopia has one of the largest livestock populations in Africa, comprising an estimated 55.03 million cattle, 27.32 million sheep, and 28.16 million goats as of 2019. Cattle play a central role in the country's agricultural economy, with the dairy sector, which is primarily cattle based, contributing approximately 81.2% of total milk production. Despite this large population, livestock productivity remains low due to challenges such as diseases, poor nutrition, and inadequate management. Among these, parasitic diseases, particularly fasciolosis, are a major constraint, causing significant economic losses through reduced productivity and increased animal morbidity and mortality [1].

Fasciolosis is a parasitic disease caused by trematodes of the genus *Fasciola*, commonly known as liver flukes. The primary route of infection occurs through the ingestion of metacercariae, which are the infective stage of the flukes. These metacercariae typically contaminate pasture, water sources, and raw vegetables, which livestock consume while grazing or drinking. *Fasciola* species, including *Fasciola hepatica* and *Fasciola gigantica*, are responsible for the infection, and both are widespread across different regions of the world. *F. hepatica* is the most common cause of fasciolosis in temperate regions, while *F. gigantica* is more prevalent in tropical areas, including parts of Africa, such as Ethiopia [2-4]. Transmission of the parasite to livestock is facilitated by the presence of suitable aquatic snail species that serve as intermediate hosts. In particular, *Lymnaea truncatula* and *Lymnaea natalensis* are known to host the larval stages of the flukes in regions with favorable ecological conditions for snail breeding, including stagnant water bodies and moist environments [5].

The pathology of fasciolosis is primarily associated with the damage caused by migrating flukes in the liver. As the flukes mature and migrate through the liver tissue, they induce severe inflammatory responses that result in the obstruction of bile ducts, hepatocellular necrosis, and fibrosis. These pathological changes lead to a range of clinical manifestations, including liver congestion, jaundice, and general ill-thrift. In addition to the direct impact on the liver, fasciolosis also predisposes animals to secondary infections, as the liver's immune function is compromised. Mortality and morbidity rates can be high, particularly in heavily infected animals, leading to significant losses in terms of both livestock numbers and overall productivity [6].

The economic impact of fasciolosis on livestock production in Ethiopia is profound. The disease contributes to high levels of liver condemnation during slaughter, which results in substantial financial losses for farmers and the meat processing industry. Furthermore, fasciolosis adversely affects growth rates, fertility, and milk production, reducing the overall productivity of affected animals. The disease also leads to increased veterinary treatment costs, including anthelmintic drugs and veterinary services, which place an additional financial burden on livestock owners. The combination of these factors makes fasciolosis a significant constraint to the development of Ethiopia's livestock sector and agricultural economy [7].

Epidemiological studies on fasciolosis have highlighted several factors that influence the prevalence and severity of the disease in livestock. These include host-related factors such as age, sex, and breed, as well as management practices and environmental conditions. Older animals, for example, tend to have higher rates of infection due to cumulative exposure to infected pastures and water sources. Additionally, certain breeds of cattle, sheep, and goats may exhibit higher susceptibility to infection due to genetic predispositions. Sex differences in susceptibility to fasciolosis have also been noted, with some studies suggesting that females are more frequently infected than males due to differences in grazing behavior and reproductive cycles. Management factors, such as the type of pasture, access to contaminated water sources, and the use of anthelmintic treatments, also play a critical role in the epidemiology of the disease [8-10].

While previous research has provided valuable insights into the epidemiology of fasciolosis in Ethiopia, much of the focus has been on specific localities or regions, with limited data on the disease's prevalence and associated risk factors in various parts of the country. Given the diversity of livestock farming systems across Ethiopia, including variations in ecological, cultural, and management practices, it is important to conduct region-specific studies that can better inform control strategies tailored to local conditions. For instance, the central and northern highlands of Ethiopia, where livestock farming is a major economic activity, may present distinct environmental and ecological conditions that influence the transmission dynamics of *Fasciola* species[11-14].Therefore, this study aimed to assess the prevalence of bovine fasciolosis and identification of risk factors in Bahir Dar, Ethiopia.

2. Materials and Methods

2.1. Study Area

The study was carried out in Bahir Dar, Ethiopia, between November 2021 and April 2022 (Figure 1). Bahir Dar is located roughly 575 kilometers northwest of Addis Abeba, at an elevation ranging from 1500 to 2600 meters above sea level. The latitude and longitude coordinates for the city are 12° 29' N and 37° 29' E. It receives an average annual rainfall of 1200 to 1600 mm with temperatures ranging from 8 to 31 degrees Celsius. The region is distinguished by plain plateaus that encompass around 70% of the land and include a variety of shrub formations, low woodlands, evergreen lands, and semihumid highland vegetation. Crops grown in the area include teff, wheat, maize, and pulse crops [1].

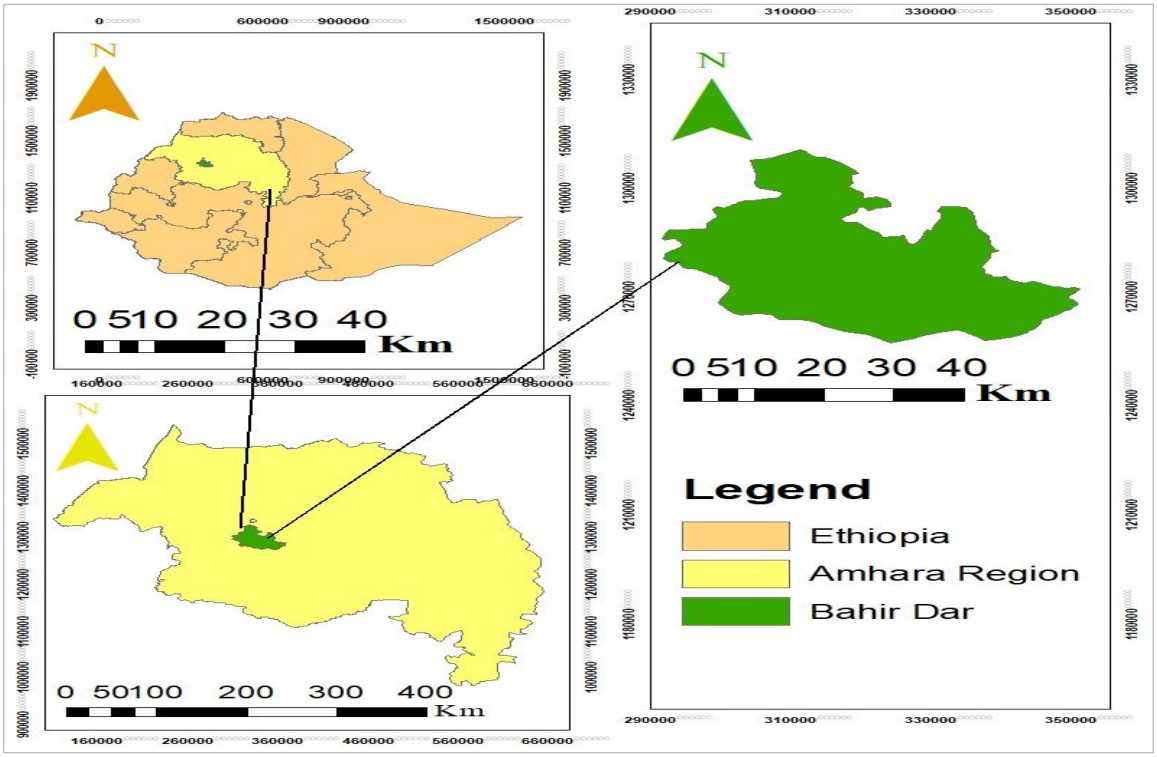

Figure 1 : Map of the study area.

2.2. Study Animal and Sampling Method

The study animals comprised cattle from selected sites in Bahir Dar, specifically Kebele 11, Sebatamit, Tikurit, and Latammba Kebeles. These cattle included both native and crossbred Holstein Friesian

cattle. A total of 384 cattle were picked at random from various origins, encompassing all age groups and both sexes. The cattle's average age was assessed using dentition (categorized as young or adult) as described by Cringoli et al. [18], and their body condition ratings were recorded in accordance with Nicholson and Butterworth [19].

2.3. Study Design and Sample Size

A cross-sectional study was done in Bahir Dar between November 2021 and April 2022 to assess the prevalence of bovine fasciolosis and identifying associated risk factors. Origin (location), breed, age, sex, and body condition were all considered risk factors for fasciolosis. The sample size for collecting fecal samples from the bovine population was determined following Thrusfield's [20] recommendations, which comprised a 95% confidence interval and 5% absolute precision, with a 50% anticipated prevalence.

$$n = \frac{1.96^2 \times Pexp \times (1 - Pexp)}{d^2}$$

Where n represents the required sample size, Pexp denotes the expected prevalence, and d stands for the desired absolute precision.The estimated sample size will be 384 animals.

2.4. Fecal Examination and Identification of *Fasciola* Eggs

Fecal samples were taken directly from the animals' rectums and kept in universal bottles with 10% formalin before being sent to the Bahir Dar Regional Veterinary Laboratory for investigation. The sedimentation technique was used in the laboratory to detect fluke eggs in the samples, according to protocols detailed by Faria et al. [21] and Elelu et al. [22]. To distinguish between Fasciola species eggs and others, such as Paramphistomum species eggs, a methylene blue solution was applied to the substrate. Hussein et al. [23] described Fasciola eggs as having a unique yellowish tint and being larger in size with thin, operculated shells. Mifsut and Ballarin [24] described how Paramphistomum eggs tint blue.

2.5. Data Analysis

The raw data from the study was organized and entered into a Microsoft Excel database using spreadsheet software. The data was then analyzed using descriptive statistics in STATA Version 16.0 to determine the prevalence of bovine fasciolosis. A chi-square (χ^2) test was used to evaluate the correlation between infection rates and risk factors such as age, sex, breed, and location. The test evaluated infection rates based on these parameters, with a significance level of $P < 0.05$.

3. Results

3.1. Prevalence

The prevalence of bovine fasciolosis was determined in this study by examining 384 animals. The overall prevalence in the research area was discovered to be 49.21 percent. Based on origin, Sebatamit (61.84%) had the most incidence, followed by Kebele 11 (59.37%), Tikurit (50%), and Latammba (27.65%). The statistical analysis showed a substantial variance in prevalence across these areas ($P < 0.05$) (Table 1). Cattle in poor condition had the highest prevalence (64%), followed by those in medium condition (50%), and fat cattle (26.76%). The difference was significant ($P < 0.05$) (Table 2). When age categories were considered, the prevalence was 50.38% in young cattle, 47.33% in adults, and 50.47% in elderly animals. However, no significant variance was seen between these groups ($P > 0.05$) (Table 3). Similarly, there was no significant difference in prevalence between males (49.73%) and females (48.73%) ($P > 0.05$) (Table 4). Local cattle had a little higher prevalence (51.62%) than crossbreds (46.15%), although this difference was not statistically significant ($P > 0.05$) (Table 5).

Table 1: Prevalence of Bovine Fasciolosis Based on Origin.

Origin	**Examined**	**Positive (%)**	**χ2**	**P-value**
Tikurit	118	59 (50%)		
Sebatamit	76	47 (61.84%)	26.31	0.000
Latammba	94	26 (27.65%)		
Kebele 11	96	57 (59.37%)		
Total	384	189 (49.21%)		

Table 2: Prevalence of Bovine Fasciolosis Based on Body Condition.

Body Condition	Examined	Positive (%)	χ2	P-value
Poor	125	80 (64%)		
Medium	170	85 (50%)	28.6	0.000
Fat	89	24 (26.96%)		
Total	384	189 (49.21%)		

Table 3: Prevalence of Bovine Fasciolosis Based on Age Group.

Age	Examined	Positive (%)	χ2	P-value
Young	129	65 (50.38%)		
Adult	150	71 (47.33%)	0.839	0.3503
Old	105	53 (50.47%)		
Total	384	189 (49.21%)		

Table 4: Prevalence of Bovine Fasciolosis Based on Sex

Sex	Examined	Positive (%)	χ2	P-value
Male	187	93 (49.73%)	0.844	0.3503
Female	197	96 (48.73%)		
Total	384	189 (49.21%)		

Table 5: Prevalence of Bovine Fasciolosis Based on Breed.

Breed	Examined	Positive (%)	χ2	P-value
Local	215	111 (51.62%)	0.287	1.134
Cross	169	78 (46.15%)		
Total	384	189 (49.21%)		

3.2. Identification of *Fasciola* Eggs

The egg of the *Fasciola* species detected in the cattle fecal sample in the study is presented in Figure 2. Hussein et al. [23] and Mifsut and Ballarin [24] developed identification criteria based on morphological traits. These eggs are distinctively ovoid in shape, with a thick, yellowish-brown shell that frequently has an operculum on one end.

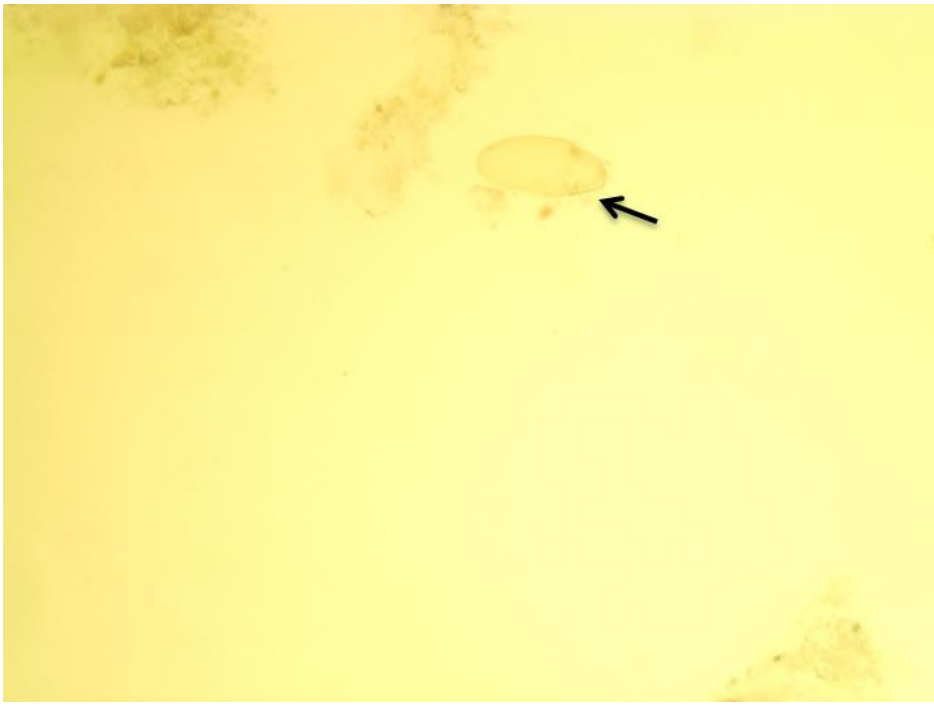

Figure 2 : Egg of *Fasciola* species: yellowish egg (arrow).

4. Discussion

The current study found an overall prevalence of bovine fasciolosis of 49.21% in the studied area, which is comparable with the findings of various prior investigations. Tsegaye et al. [25] found a frequency of 41.41% in Woreta, whereas Demssie et al. [26] discovered a greater prevalence of 54.5% in Jimma. In comparable regions, Eshetu et al. [27] in Angacha Woreda, Ayelign and Alemneh [28] in the North-East Amhara Region, and Mohammed et al. [29] in Eastern Shoa, Kuyu District, observed prevalence rates of 40.62%, 47.10%, and 54.2%, respectively. The consistency of these findings across studies demonstrates the prevalence of bovine fasciolosis in Ethiopia, which may be attributed to common agro-ecological factors such as the prevalence of intermediate hosts such as Lymnaea snails, as well as practices such as communal water usage and irrigation, which facilitate the contamination of pastures and water sources [30].

In contrast, several Ethiopian regions reported lower rates of prevalence. For example, investigations in Soddo (Southern Ethiopia) [9], Nekemte (East Wollega Zone) [31], and Wolaita Soddo (Southern Ethiopia) [32] found prevalence rates of 4.9%, 15.9%, and 15.9%, respectively. Other investigations in Mecha District, West Gojam Zone (31.5%) [35], Zenzelma, Bahir Dar (26%) [1], and Bahir Dar (32.3%) [16] all found slightly lower percentages. Differences in prevalence can be linked to a variety of factors, including altitude, geography, environment, and disease management techniques. These factors influence snail host abundance, anthelmintic treatment effectiveness, and pasture management techniques [42].

The prevalence of fasciolosis varied significantly across the research area. Sebatamit had the highest incidence (61.84%), followed by Kebele 11 (59.37%), Tikurit (50%), and Latammba (27.65%). These findings are consistent with previous research [16, 17, 27, 36, 38, 40], which indicated large geographical disparities in prevalence. Climate variables (for example, altitude, rainfall, and temperature), animal management techniques, and access to veterinary services and treatment may all play a role in these variances [28].

Cattle in poor condition had the highest prevalence of fasciolosis (64%), followed by those in medium condition (50%), and fat cattle (26.96%). This is consistent with the results of previous investigations [1, 17, 26, 27, 29, 30-32, 34, 35, 38-41]. The higher occurrence in cattle with low physical condition is

most likely related to malnutrition, chronic illnesses, and environmental stresses, all of which increase fasciolosis susceptibility. Concurrent parasite and non-parasitic diseases may worsen the physical condition of infected cattle, rendering them more susceptible to the disease [17]. However, several research [15, 16, 33, 36, 37] found no significant differences based on physical state, indicating that other factors may influence illness susceptibility.

.

In terms of age, there were no significant differences in prevalence between young (50.38%), adult (47.33%), and older cattle. This finding is consistent with other earlier studies [1, 16, 25, 29, 30, 32, 36-39] that demonstrated no significant variation in prevalence among age groups. However, other research [15, 27, 28, 33-35, 40, 41] found significant disparities, which could be attributed to variances in exposure levels or management approaches that influence all age groups.

Sex did not appear to have a substantial impact on the prevalence of bovine fasciolosis, with males exhibiting a prevalence of 49.73% and females 48.73%. These findings support earlier study [1, 15, 16, 25, 28, 32, 34-38], indicating that both sexes are equally susceptible to the condition. However, a few studies [27, 29, 33] found that prevalence varied between sexes, most likely due to differences in management strategies or environmental conditions.

Fasciolosis prevalence was not shown to be significantly influenced by breed, with native breeds having a prevalence of 51.62% and crossbreeds displaying a rate of 46.15%. This finding is consistent with previous research that indicated no substantial changes in incidence based on breed [1, 30, 32]. However, certain studies [15, 25, 31] found variations in incidence among breeds, which could be attributed to genetic variables or other unknown factors connected to breed-specific features. The lack of substantial differences in the current investigation implies that both local and crossbred cattle are equally susceptible to fasciolosis risk factors [1].

5. Conclusion

This study revealed a high overall prevalence of bovine fasciolosis (49.21%) in the Bahir Dar area, confirming its importance as a major parasitic disease affecting cattle in the region. Notable variations in prevalence were observed among different localities, with Sebatamit recording the highest rate (61.84%) and Latammba the lowest (27.65%). Risk factor analysis demonstrated a significant

association between body condition and fasciolosis prevalence, with poorly conditioned cattle being more susceptible to infection. In contrast, no statistically significant differences were identified based on age, sex, or breed, indicating that cattle across all demographic groups are generally at risk. These findings highlight the need for targeted, location-specific control measures and emphasize the importance of maintaining good nutritional and health management practices to reduce the burden of fasciolosis in cattle populations.

Data sharing statement

Data is provided within the manuscript.

Ethical Statement

Not applicaple

Author Contributions

T.M: writing – review & editing, writing – original draft, resources, formal analysis, investigation, conceptualization, methodology, validation. T.S: writing – review & editing, resources, validation, methodology, visualation. A.B.T: writing the original draft, review editing, funding accusation, resources, methodology, investigation, conceptualization, formal analysis, supervision and data curation. All authors read and approved the final manuscript.

Finding

None

Acknowledgements

The authors extend their sincere gratitude to all the dedicated staff members of the Bahir Dar Regional Veterinary Laboratory.

Conflict of interest

The authors declare that they have no competing interests.

References

1. S. Legesse, S. Tsegaye, S. Lamesgen, Y. Wolelaw, D. Garikipati, W. Wondimagegn, “Coprological prevalence and associated risk factors of bovine fasciolosis in and around Zenzelma, Bahir Dar, Ethiopia,” *European Journal of Experimental Biology* 7, no. 5 (2017): 34.
2. M. B. Ardo, Y. H. Aliyara, H. Lawal, “Prevalence of bovine fasciolosis in major abattoirs of Adamawa State, Nigeria,” *Bayero Journal of Pure and Applied Sciences* 6, no. 1 (2013): 12–16.
3. M. Figtree, M. H. Beaman, R. Lee, M. Porter, E. Torey, T. J. Hugh, B. J. Hudson, “Fascioliasis in Australian travellers to Bali,” *Medical Journal of Australia* 203, no. 4 (2015): 186–188.
4. M. A. Najib, N. J. N. Izani, W. A. W. W. N. Amilah, A. M. Faez, Z. Shafizol, “A scoping review of the prevalence of fascioliasis in Malaysia and risk factors for infection,” *Malaysian Journal of Medical Sciences* 27, no. 1 (2020): 22.
5. M. B. Irsik, C. H. Courtney III, E. Richey, “Liver fluke control in beef cattle: VM120/VM089, rev. 7/2007,” *EDIS* 2008, no. 3 (2008).
6. M. A. Aleixo, D. F. Freitas, L. H. Dutra, J. Malone, I. V. F. Martins, M. B. Molento, “Fasciola hepatica: Epidemiology, perspectives in the diagnostic and the use of geoprocessing systems for prevalence studies,” *Semina: Ciências Agrárias* 36, no. 3 (2015): 1451–1465.
7. R. Sah, S. Khadka, M. Khadka, D. Gurubacharya, J. B. Sherchand, K. Parajuli et al., “Human fascioliasis by Fasciola hepatica: The first case report in Nepal,” *BMC Research Notes* 10 (2017): 1–4.
8. F. Kleiman, S. Pietrokovsky, L. Prepelitchi, A. E. Carbajo, C. Wisnivesky-Colli, “Dynamics of Fasciola hepatica transmission in the Andean Patagonian valleys, Argentina,” *Veterinary Parasitology* 145, no. 3–4 (2007): 274–286.
9. F. Abunna, L. Asfaw, B. Megersa, A. Regassa, “Bovine fasciolosis: Coprological, abattoir survey and its economic impact due to liver condemnation at Soddo municipal abattoir, Southern Ethiopia,” *Tropical Animal Health and Production* 42 (2010): 289–292.
10. T. G. T. Nguyen, T. H. Le, T. H. T. Dao, T. L. H. Tran, N. Praet, N. Speybroeck et al., “Bovine fasciolosis in the human fasciolosis hyperendemic Binh Dinh province in Central Vietnam,” *Acta Tropica* 117, no. 1 (2011): 19–22.
11. J. C. Boray, S. Love, “Liver fluke disease in sheep and cattle,” *Prime Fact* 446 (2007): 1–10.
12. C. D. C. Bernardo, M. B. Carneiro, B. R. D. Avelar, D. M. Donatele, I. V. F. Martins, M. J. S. Pereira, “Prevalence of liver condemnation due to bovine fasciolosis in Southern Espírito Santo:

Temporal distribution and economic losses," *Revista Brasileira de Parasitologia Veterinária* 20 (2011): 49–53.

13. A. M. Phiri, I. K. Phiri, C. S. Sikasunge, J. Monrad, "Prevalence of fasciolosis in Zambian cattle observed at selected abattoirs with emphasis on age, sex and origin," *Journal of Veterinary Medicine Series B* 52, no. 9 (2005): 414–416.
14. J. D. Keyyu, A. A. Kassuku, L. P. Msalilwa, J. Monrad, N. C. Kyvsgaard, "Cross-sectional prevalence of helminth infections in cattle on traditional, small-scale and large-scale dairy farms in Iringa district, Tanzania," *Veterinary Research Communications* 30 (2006): 45–55.
15. F. Aregay, J. Bekele, Y. Ferede, M. Hailemelekot, "Study on the prevalence of bovine fasciolosis in and around Bahir Dar, Ethiopia," *Ethiopian Veterinary Journal* 17, no. 1 (2013): 1–11.
16. Y. Gebrie, M. Gebreyohannes, A. Tesfaye, "Prevalence of bovine fasciolosis in and around Bahir Dar, northwest Ethiopia," *Journal of Parasitology and Vector Biology* 7, no. 4 (2015): 74–79.
17. G. Yitayal, W. Taddie, "Prevalence of bovine fasciolosis in postmortem examination at Bahir Dar Municipal Abattoir, Bahir Dar, Ethiopia," *Journal of Animal Husbandry and Dairy Science* 4 (2020): 30–36.
18. G. Cringoli, L. Rinaldi, F. Capuano, L. Baldi, V. Veneziano, G. Capelli, "Serological survey of Neospora caninum and Leishmania infantum co-infection in dogs," *Veterinary Parasitology* 106, no. 4 (2002): 307–313.
19. M. J. Nicholson, M. H. Butterworth, *A guide to condition scoring of zebu cattle*, ILRI (aka ILCA and ILRAD), 1986, 3–31.
20. M. Thrusfield, *Veterinary Epidemiology*, 3rd ed., Blackwell Publishing, UK, 2005, 433 pp.
21. R. N. Faria, M. C. Cury, W. S. Lima, "Evaluation of two available methods to detect eggs of Fasciola hepatica in cattle faeces," *Arquivos Brasileiros de Medicina Veterinária e Zootecnia* 60 (2008): 1023–1025.
22. N. Elelu, A. Ambali, G. C. Coles, M. C. Eisler, "Cross-sectional study of Fasciola gigantica and other trematode infections of cattle in Edu Local Government Area, Kwara State, north-central Nigeria," *Parasites & Vectors* 9 (2016): 1–11.
23. A. N. A. Hussein, I. M. Hassan, R. M. A. Khalifa, "Description of eggs and larval stages of Fasciola, light and scanning electron microscopic studies," *Research Journal of Parasitology* 5, no. 1 (2010): 1–12.
24. B. L. Mifsut, *Helminths: Handbook for identification and counting of parasitic helminth eggs in urban wastewater*, IWA Publishing, London, 2015, 27–56.

25. B. Tsegaye, H. Abebaw, S. Girma, “Study on coprological prevalence of bovine fasciolosis in and around Woreta, Northwestern Ethiopia,” *Journal of Veterinary Medicine and Animal Health* 4, no. 7 (2012): 89–92.
26. A. Demssie, F. Birku, A. Biadglign, M. Misganaw, M. Besir, M. Addis, “An abattoir survey on the prevalence and monetary loss of fasciolosis in cattle in Jimma Town, Ethiopia,” *Cell* 251, no. 912112251 (2012): 912112251.
27. E. Eshetu, N. Thomas, A. Awukew, A. Goa, B. Butako, “Study on the prevalence of bovine fasciolosis and estimated financial losses due to liver condemnation: In case of Angacha Woreda, Kambata Tembaro Zone, Southern Ethiopia,” *Journal of Biology, Agriculture and Healthcare* 7 (2017): 78–83.
28. M. Ayelign, T. Alemneh, “Study on prevalence and economic importance of bovine fasciolosis in three districts of North-East Amhara Region, Ethiopia,” *Journal of Infectious and Non Infectious Diseases* 3 (2017): 24.
29. C. Mohammed, L. Nigussie, J. Dugasa, U. Seid, “Prevalence of bovine fasciolosis and its associated risk factors in Eastern Shoa, Kuyu District Central Ethiopia,” *Archives of Veterinary Science and Technology* (2018): 1–5.
30. M. Gebrie, T. Alemneh, “Prevalence of bovine fasciolosis in and around Gondar, Northwestern Ethiopia,” *Acta Parasitologica Globalis* 6 (2015): 231–237.
31. N. M. Asrese, M. G. Ali, “Bovine fasciolosis: Prevalence and economic significance in Southern Ethiopia,” *Acta Parasitologica* 5 (2014): 76–82.
32. Z. Tilahun, D. Nemomsa, H. Himanot, K. Girma, “Study on prevalence of bovine fasciolosis at Nekemte Veterinary Clinic, East Wolega Zone, Oromia, Ethiopia,” *European Journal of Biological Sciences* 6, no. 2 (2014): 40–45.
33. A. Zewde, Y. Bayu, A. Wondimu, “Prevalence of bovine fasciolosis and its economic loss due to liver condemnation at Wolaita Sodo Municipal Abattoir, Ethiopia,” *Veterinary Medicine International* (2019): 9572373.
34. A. Petros, A. Kebede, A. Wolde, “Prevalence and economic significance of bovine fasciolosis in Nekemte municipal abattoir,” *Journal of Veterinary Medicine and Animal Health* 5, no. 8 (2013): 202–205.
35. A. Ewnetu, S. Derso, R. Tesfaye, “Prevalence of bovine fasciolosis and its associated risk factor in Mecha District, West Gojam Zone, Northwestern Ethiopia,” *European Journal of Biological Sciences* 7, no. 3 (2015): 132–138.

36. G. Mebrahtu, K. Beka, “Prevalence and economic significance of fasciolosis in cattle slaughtered at Dire Dawa Municipal Abattoir, Ethiopia,” *Journal of Veterinary Advances* 3 (2013): 319–324.
37. K. Bayou, T. Geda, “Prevalence of bovine fasciolosis and its associated risk factors in Haranfama municipal abattoir, Girja District, South-Eastern Ethiopia,” *International Journal of Animal Science* 2, no. 2 (2018): 1018s1.
38. G. Desa, W. Mitiku, “Prevalence and economic significance of bovine fasciolosis in Shambu Municipality Abattoir, Ethiopia,” *Acta Parasitologica* 10 (2019): 103–110.
39. E. Belay, W. Molla, A. Amare, “Prevalence and economic losses of bovine fasciolosis in Dessie Municipal Abattoir, South Wollo Zone, Ethiopia,” *European Journal of Biological Sciences* 4, no. 2 (2012): 53–59.
40. M. Yusuf, I. Nuraddis, W. Tafese, Y. Deneke, “Prevalence of bovine fasciolosis in municipal abattoir of Haramaya, Ethiopia,” *Food Science and Quality Management* 48 (2016).
41. B. S. Kassie, S. F. Ali, “Study on the prevalence and economic significance of bovine fasciolosis at Gondar Elfora Abattoir, Gondar, Ethiopia,” *Journal of Animal Research* 9, no. 5 (2019): 623–631.
42. A. Y. Asressa Yeneneh, H. K. Hassen Kebede, T. F. Tewodros Fentahun, M. C. Mersha Chanie, “Prevalence of cattle flukes infection at Andassa Livestock Research Center in north-west of Ethiopia,” *CABI Databases* 2 (2012): 85–89.