STUDY ON TREMATODE PARASITES OF CATTLE AND SHEEP AND THEIR INTERMEDIATE SNAIL HOST IN AND AROUND WELMERA DISTRICTS, OROMIA REGIONAL STATE, ETHIOPIA

ADDIS ABABA UNIVERSITY

COLLEGE OF VETERINARY MEDICINE AND AGRICULTURE

DEPARTMENT OF VETERINARY PATHOLOGY AND PARASITOLOGY

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JUNE, 2024

BISHOFTU, ETHIOPIA

APPROVAL SHEET

The research thesis paper entitled "*Study on Trematode Parasites of Cattle and Sheep and their Intermediate Snail Host in and around Welmera Districts, Oromia Regional State, Ethiopia*" has been submitted by Wubishet Admasu (GSR/7195/15) for the presentation with my approval as an academic advisor.

Advisor name: Dr. Dinka Ayana

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Study on trematode parasites of cattle and sheep and their intermediate snail host in and around Welmera Districts, Oromia Regional State, Ethiopia

A Thesis Submitted to the Department of Veterinary Pathology and Parasitology in Partial Fulfillment of The Requirements for The Degree of Master of Science in Veterinary Parasitology.

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As members of the examining board of the final MVSc open defense, we certify that we have read and evaluated the thesis prepared by Wubishet Admasu entitled: **Study on trematode parasites of cattle and sheep and their intermediate snail host in and around Welmera Districts, Oromia Regional State, Ethiopia** and recommend that it be accepted as fulfilling the thesis requirement for the degree of Master of veterinary science in Veterinary Parasitology.

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I hereby affirm that this thesis is my original work and that all sources of materials utilized in its preparation have been properly acknowledged. This thesis is submitted as part of the requirements for the Master's degree in Veterinary Parasitology at Addis Ababa University, College of Veterinary Medicine and Agriculture. It has been deposited in the college library to be made available to borrowers following the library's regulations. I certify that this thesis has not been submitted to any other institution to obtain any academic degree, diploma, or certificate.

Wubishet Admasu

Signature ____________________ Date ____________________

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ACKNOWLEDGEMENTS

I would like to forward my gratitude to my advisor Dr. Dinka Ayana who devoted his precious time to comment on this thesis write-up and commencement. Successful accomplishment of the thesis would have been very difficult without his generous, constructive, and ever teaching comments and thus I am indebted to him for his kind and tireless effort that enabled me to finalize the thesis. Then, I also extend my warrant thanks to the NATIONAL AGRICULTURE BIOTECHNOLOGY RESEARCH CENTER, the Holeta municipal abattoir, and farmers. Finally, I would like to express my sincere gratitude to all my family, and relatives for their financial and moral contributions to the completion of this thesis, exceptional care, and kind encouragement in all my life.

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ABSTRACT

Sanil-born trematode parasites have a major impact on the well-being and productivity of sheep and cattle. A cross-sectional study was conducted from October 2023 to June 2024 in and around Welmera Districts, Oromia Regional State, Ethiopia, to estimate the prevalence and burden of trematode parasites, identification of species or genera of trematode parasites, and the risk factors in cattle and sheep, and their intermediate hosts from the study area. Fecal samples collected from 300 cattle and 300 sheep were examined by the sedimentation and Stoll's eggs count technique, 384 cattle were examined for adult trematode parasites by post-mortem examination technique, and 500 snails collected were examined on their morphological features of the shell. Based on coprological findings the overall prevalence of trematode parasites was 57.7% and 63.75 in cattle and sheep respectively. The burden and prevalence of *Dicrocelium* 13.33(11%), *Paramphistomum* 26.33(19%), *Fasciola* 44(27.67%) in cattle, and *Paramphistomum* 29.87(17.33%), *Dicrocelium* 33(20.67%) and *Fasciola* 40.33(25.67%) in sheep, identified, While post-mortem finding the overall prevalence of trematode parasites was 78.9% in slaughtered cattle. The burden and prevalence of *Fasciola hepatica* 2.30(34.64%), *Fasciola gigantica* 2.30(17.45%), *Paramphistomum* 24.74(24.74%), and *Dicrocelium* 0.03(24.74%) identified. From snails identification results in frequency and percentage were Lymnaea 446(89.20%) and Bulinus 54(10.80%) from the study area. There was a statistically significant difference ($p < 0.05$) in body conditions, deworming history, and management systems for Fasciolosis and only body conditions was a significant difference ($p < 0.05$) for Paramphistomiosis and age, sex, deworming history was a significant difference ($p < 0.05$) for Dicroceliosis in cattle, while in sheep body conditions, deworming history, and management systems was a significant difference ($p < 0.05$) for Fasciolosis and sex, body conditions was a significant difference ($p < 0.05$) for Paramphistomiosis and age, deworming history was a significant difference ($p < 0.05$) for Dicroceliosis. Therefore, Animal owners and the community should be educated about trematode infections in livestock, intermediate host roles, regular deworming animals, and further diagnostics should be used.

Keywords: *Cattle and Sheep*, *Intermediate Snail Host*, *Trematode Parasites*, *Welmera Districts*

1. INTRODUCTION

Nearly a billion people rely on the livestock industry for their livelihoods and food security, and it is a highly dynamic global sector that accounts for 40% of agricultural output. They are an important asset that serves as a store of wealth, collateral for loans, and a vital safety net in times of crisis in addition to their direct role in producing food and revenue (Radostits et al., 2000). With the most varied topography, climatic topographies, and a multitude of agroecological zones, Ethiopia is well-suited to support a vast animal population, providing 15% of its growth domestic products and 33% of its agricultural output. It also has the largest livestock population in Africa (Bacsi et al., 2023). Among the small ruminants in Ethiopia, Sheep are the most common small ruminant animals, and they contribute up to 63% of the country's financial income and 23% of the value of food that is needed for sustenance. Due to recurring droughts, problems with the infrastructure, outbreaks of animal diseases, inadequate nutrition, poor husbandry practices, a lack of trained labor, and a lack of government policies for disease prevention and control, Ethiopia is unable to fully utilize these resources (Chaouadi et al., 2019).

Parasitic infections have a major impact on the well-being and productivity of sheep and cattle worldwide. Liver flukes and gastrointestinal nematodes are two kinds of internal parasite infections that are frequently thought to be the most dangerous for sheep and cattle. Although the effects on animal owners are unknown, parasitic diseases caused by helminths, protozoa, and arthropods in particular can result in larger financial losses than those caused by bacteria and viruses (Kowalczyk et al., 2018). The subclass Digenea includes all trematode species that parasitize animals. The families of trematodes that comprise parasites of significant veterinary interest are the *Schistosomatitidae*, *Paramphistomatidae*, *Dicroceliidae*, and *Fasciolidae*. The adult trematodes are frequently referred to as flukes. Globally, the most significant flukes that have been identified are *Schistosoma*, *Paramphistomes*, and *Fasciola* (Dreyfuss et al., 2006).

In domestic ruminants (cattle) in Africa, Schistosomiasis can be caused by *Schistosoma bovis*, *Schistosoma Mattheei*, and *Schistosoma Leiperi*. Schistosomiasis is usually considered to be of little consequence in large ruminants, and clinical signs of the disease are infrequently recognized even in cases when a high frequency of the parasite is detected in slaughtered cattle. Conversely, an infection may result in severe clinical symptoms (Van Wyk & Mayhew, 2013). A pathogenic condition known as paramphistomosis affects domesticated ruminants and results in large financial losses for the dairy and meat industries. With the highest frequency in tropical and subtropical areas, especially in Africa, Asia, Europe, and Australia, it is regarded as a neglected tropical disease (Roy & Lyndem, 2019).

The two species *Fasciola hepatica* and *Fasciola gigantica* are most commonly identified as the etiological agents of Fasciolosis and affect domestic animals, mostly cattle and sheep, and infrequently humans, and are significant economically. Liver fluke infection in adult cattle typically manifests clinically, unless the illness is severe. Thus, clinical illness is only likely in young animals under normal circumstances (Love, 2017; Lulie & Guadu, 2015). On the other hand, even a mild infection can cause a notable decrease in milk production as well as a fall in weight growth quality. In contrast, clinical Fasciolosis in calves infected with more than 1000 metacercariae results in symptoms resembling those of anemia, hypoproteinemia, and weight loss in sheep. Fasciolosis not only reduces output but also results in large financial losses because of liver condemnation during slaughter. Estimates of the annual losses in Ethiopia resulting from ovine fasciolosis were 48.4 million, of which 46.5%, 48.8%, and 4.7% were attributable to death, reproduction waste and weight loss, and liver condemnation at slaughter, respectively (Phiri et al., 2005).

Snails are invertebrate creatures belonging to the class Gastropoda and it is inhabit a variety of locations throughout the world. The fact that snails are intermediate hosts for many diseases that affect both humans and animals has drawn a lot of attention to them. In many tropical and sub-tropical nations, human and animal health is seriously at risk from parasite diseases carried by snails, such as Schistosomiasis and Fascioliasis (Darraj, 2022). The agroecology of the snail environment affects the prevalence and dispersion of diseases carried by snails.

Animal trematode infections are more common in areas with standing water, marshy pasture land, and free grazing systems. Conversely, temperature and precipitation have a significant impact on the distribution of different types of snails and the prevalence of diseases carried by snails (Ahmed et al., 2007). The transformation of a forest ecosystem into agricultural land has a significant impact on the shape of streams, water chemistry, increased siltation, changed nutrient dynamics, and hydrology. This is likely to raise the danger of trematode infection and produce favorable conditions for the survival of snails (Oso & Odaibo, 2021).

1.1. Objectives

1.1.1.General objectives

The general objective of the study the epidemiology and burden of the trematode parasite of cattle and sheep as well as to identify the snail intermediate hosts in and around Welmera district, Oromia, Ethiopia.

1.1.2. Specific objective of the study

Despite a great deal of research on different trematode infections in sheep and cattle, as well as reports of specific trematode parasites in Ethiopia, it is still necessary to produce regular and up-to-date data on the concurrent prevalence, burden of trematodes and the factors that were linked to them. Therefore the following objectives were set for the current study:

- The estimation prevalence, burden, and identifications of species or genera trematode both by post-mortem and Parasitological methods
- Identifications of risk factors associated with the occurrence of trematode parasites
- Identification of snail intermediate host from the study area

2. LITERATURE REVIEW

2.1. Definition and Taxonomy

There are two subclasses of trematodes: Digenia, which needs an intermediary host, and Monogenia, which has a direct life cycle. The Trematoda families, which contain parasites of significant veterinary interest, are made up of the families Fasciolidae, Dicrocoeliidae, Paramphistomatidae, and Schistosomatidae, whereas the Pozathorchiidae and Troglotrematidae families are less significant (Urquhart et al., 2003). Since prehistoric times, animals and humans have been negatively impacted by snail-borne trematodes. Additionally, they may result in cancers that are incurable or life-threatening. In many nations across the world, particularly in humid tropical and subtropical locations, schistosomiasis, paramphistomosis, and fasciolosis significantly hinder economic animal production. The flat, leaf-like form and suckers that distinguish adult trematodes make them easily recognized. Trematodes of veterinary importance come in two varieties: those that inhabit inside vertebrates as internal parasites and those that live outside fish as external parasites. The mouth of a monogeneous fluke contains a single sucker, but several suckers are connected to a conspicuous posterior attachment organ. Since they have direct life cycles and no intermediary host, illnesses can spread quickly through direct transmission in aquaculture systems (Jacobs et al., 2015).

One of the most varied platyhelminth genera is Digenea, which parasitizes a wide range of vertebrate and invertebrate hosts. These worms are found in the intestines, lungs, liver, and vascular system of the vertebrate final host, among other organs. These parasite infections result in significant losses for the domestic ruminant sector and it suckers are solely ventral and oral. Food is propelled into two seemingly limitless caecas through the muscular pharynx, which is attached to the mouth. Some genera, like *Fasciola*, branch these to increase surface area. Since there is no anus, they must regurgitate waste products through their mouths. Adult amphistomes are normally harmless, but their immature stages can have serious, and occasionally fatal, impacts in warmer, wetter environments (Fürst et al., 2012).

2.2. Etiology

Fasciola

The two most significant species are *Fasciola gigantic* and *Fasciola hepatica*. *Fasciola* gigantic is only found in the tropics and (27 to 75 mm) x (3 to 12 mm), while *Fasciola* hepatica is found in temperate zones (high altitude parts of east Africa) and measures (20 to 30 mm) x (10 mm) (Ayele & Hiko, 2016).

Paramphistomum

Paramphistomum Cervi, Paramphistomum cotylophorum, Paramphistomum cracile, Paramphistomum gotoi, Paramphistomum grande, Paramphistomum ichikawai, Paramphistomum leydeni, Paramphistomum liorchis, and Paramphistomum microbothrioides are a few of the most widely recognized Paramphistomes species (Lotfy et al., 2010).

Schistosoma

Domestic animals can be impacted by Schistosoma species found in tropical regions, including *Schistosoma bovis, Schistosoma indicus, Schistosoma nasalis, Schistosoma suis*, and *Schistosoma mattheei*. Additionally, humans, cats, and other animals in Africa have been shown to harbor Schistosoma japonicum (Bowman, 2003).

Dicrocelium

Dicrocelium species, which include *Dicrocelium dendriticum* and *Dicrocelium hospes*, primarily infect sheep, goats, cattle, buffaloes, roe-deer, and camels. They also sometimes affect humans, dogs, horses, rabbits, and pigs. More commonly found in Europe, Asia, North Africa, and North America is *Dicrocelium dendriticum*, while *Dicrocelium hospes* is primarily found in Africa (Campo et al., 2012)

2.3. Morphology

Fasciola

Flukes that are 30 by 13 mm in size and have a flattened, leaf-like shape. The front section of these liver flukes is broader, and they include two massive shoulders orientated laterally after an anterior cone-shaped protrusion. In addition to the suckers, the tegument's well-armed backward-pointing spines provide an effective means of holding the parasite within the bile duct (Ballweber, 2006). *Fasciola hepatica* eggs are operculated and measured 130–150 micrometers in length and 63–90 micrometers in breadth with a characteristic yellow color. They were not readily differentiated from *Fasciola gigantica* eggs (Garcia & Procop, 2016).

Paramphistomum

Adult Paramphistomes are tiny, pink or reddish, conical-shaped flukes that are about 1 cm long and primarily parasitic in the foreguts of ruminants. Similar to other flukes, rumen flukes possess both male and female reproductive organs, making them hermaphrodites and clear-shelled eggs have an operculum at one end (Lotfy et al., 2010).

Schistosoma

The operculate, spherical to oval-shaped eggs contain a miracidium embryonic larva. Schistosoma species can be distinguished from one another according to variations in their egg shapes and spine positions. Certain types of eggs have spines when they are released in the urine of *Schistosoma hematobium* and the feces of *Schistosoma mansoni* and *Schistosoma japonicum*. Miracidia are 200 mm long, elliptical, free-swimming larval stages covered in cilia. Growing cercariae are found inside pleomorphic sac-like structures called sporocysts. Flukes are long, tubular worms that have primitive ventral and oral suckers. They range in length from 10 to 20 mm and compared to females which are shorter and stouter, and they have a Gynecophoral canal where the long, thin female rests folded (Radek et al., 2001).

Dicrocelium

Dicrocelium is flat, transparent, and spindle-shaped, with an adult, measuring up to approximately 10 mm by 2.5 mm. It possesses oral and ventral suckers that resemble each other. Testes are distinguished by lobed testes in the anterior part of the body, and the uterus is located in the posterior part. The eggs of Droceollium are approximately 40 µm in length, not quite oval, with a thick, yellow-brown, smooth shell and an operculum and each egg contains a miracidium (Jeandron et al., 2011).

2.4. Life Cycle

Fasciola

Faeces and the biliary ducts are the places where immature eggs are expelled. Water is used to embryonated eggs. Once the eggs are fully developed, the parasitic fluke escapes and lands on one of the acceptable intermediate snail hosts, like those in the genera Galba, Fossaria, and Pseudosuccinea. It then releases miracidia from the eggs. In the rediae, cercariae, and sporocysts of snails, parasites go through multiple developmental stages. The metacercariae, which are infectious for the final host on aquatic plants or other surfaces, are released from the snail and encyst with the cercariae. Metacercariae-carrying plants are the source of infection for mammals. Watercress is one of the freshwater plants that can harbor metacercariae, which can infect humans. Metacercariae 8 expel themselves in the duodenum after consumption, passing through the intestinal wall, peritoneum, liver parenchyma, and biliary ducts before reaching maturity (Urquhart et al., 2003).

Paramphistomum

In the final host, infection is caused by eating encysted metacercariae that are floating in the water. Snails belonging to the genera Bulinus, Planorbis, and Stagnicola serve as intermediate hosts for miracidia after they enter their bodies, but ruminants are definitive hosts as well. To become ciliated miracidia, eggs must develop in water (Hotessa & Kanko, 2020).

Adult flukes in the stomach release their eggs into the environment and it takes around two weeks for the miracidia to emerge from the eggs. Before they find a suitable snail, they float around in the water. They enter the snail and develop into rediae and sporocysts, which are capable of asexual reproduction and the creation of daughter rediae. There are about 15–30 cercariae in each medium. Mature cercariae find aquatic plants to attach to and encyst into metacercariae by the use of their two eye spots and lengthy fins (Jones et al., 2019). Mammalian hosts ingest the infectious larvae. As soon as they enter the duodenum, their cysts are extracted. Through severe mucosal damage, they breach the intestinal wall and proceed to the rumen, where they develop into adult flukes and start laying eggs. Metacercariae require two to four months following ingestion by the ultimate host to complete their development and start laying eggs (Sanabria & Romero, 2008).

Schistosoma

In the mesenteric and hepatic veins of the host, schistosomes produce eggs with a characteristic terminal or lateral spine while feeding on blood; *Schistosoma nasale*, on the other hand, resides in the nasal veins. Those who are infected discharge parasite eggs into the environment, which hatch into free-swimming miracidium when they come into touch with fresh water. Through the snail's foot, miracidia infect freshwater snails. Following infection, the 10 miracidium around the penetration site transforms into the primary sporocyst. Following their division, the germ cells within the original sporocyst will go to the snail's hepatopancreas to generate secondary sporocysts. After entering the hepatopancreas, germ cells in the secondary sporocyst divide once more to produce hundreds of cercariae, parasite larvae that can infect mammals (Rinca et al., 2019).

Dicrocelium

The life cycle of *Dicrocelium* involves two invertebrate intermediate hosts. The initial intermediate host is a land snail, while the subsequent intermediate host is an ant. The mature flukes live in the bile duct of the final host and lay eggs with embryos, which are then released into the host's feces. Inside the snail, the miracidia hatched from the eggs enter the snail's body and transform into cercariae. Metacercariae manipulate ant behavior, causing it to be eaten by a ruminant, increasing the parasite's chance of reaching its next host (Goater & Colwell, 2007).

2.5. Epidemiology

Fasciola

All around the world, Fasciolosis affects both humans and animals. The snails most commonly found and crucial to the spread of *Fasciola* parasites are the intermediate host, Lymnae. They are mostly fed algae, and they develop best at temperatures between 15 and 22 ^{o}C; below 5 ^{o}C, they stop developing. The typical locations for this snail are regions with poor drainage, ditches for drainage, seepage from springs or broken drains, muddy entrances, tire ruts from vehicles, and animal traces on clay soil (Krauth et al., 2015).

Paramphistomum

Paramphistomum is most commonly found in tropical and subtropical regions, particularly in Russia, Africa, Asia, and Australia. The dynamics between parasites, hosts, and environments control the epidemiology of paramphistomosis. Among epidemiological variables that influence animal worm loads, the infection rate in pastures is the most significant. Additionally, the climate conditions necessary for pasture egg development, hatching, and survival govern it (Ozdal et al., 2010; Rojo-Vázquez et al., 2012).

Schistosoma

It resembles *Fasciola* and Paramphistome in appearance. Water is essential for the growth of Schistosoma eggs. In somewhat acidic environments, eggs can hatch. Temperature affects cercariae shedding, particularly in locations with large, permanent bodies of water and marshy pastures. Schistosoma develops slowly in snails. An excellent predisposing factor for the establishment of these parasites is high rainfall (Dey et al., 2022).

Dicrocelium

Dicrocelium egg distribution and pasture contamination can happen to domestic and wild ruminants as well as rabbits and hares. Fecal eggs are extremely resilient to temperature changes, can overwinter, and can go on spreading disease for up to 20 months when left on pastures. It has been shown that, in natural settings, egg survival is a seasonal occurrence (minimum values in summer and 85% in winter) and is not correlated with age (Otranto & Traversa, 2002).

2.6. Host Range

2.6.1. Definitive host

Paramphistomum: can infect a variety of wild ruminants as well as cattle, sheep, goats, and other animals. The best hosts are ruminants (González-Warleta et al., 2013). Schistosoma: All domesticated mammals, cattle, and sheep, in particular, are the definitive host (Urquhart et al., 2003). *Fasciola*: Compared to other animals, domestic animals have a higher infection rate from snail-borne trematodes. The last hosts are mammals that typically prefer the liver, such as sheep, goats, cattle, horses, deer, and humans. The juvenile stage migrates and develops within the liver's biliary tract. As the substance develops, it inhibits the duct system. The single egg that the adult female lays is secreted into the stomach and released together with the feces (Taylor et al., 2015; Urquhart et al., 2003). *Dicrocelium*: Most common definitive hosts are ruminants, equids, and lagomorphs, whereas canids, rodents, suids, and primates including humans are occasional hosts Human infection could be related to the consumption of fresh vegetables where infected ants are attached, or to particular Asian food habits involving the consumption of ants (Johnson, 2002).

2.6.2. Intermediate host

Fasciola: Intermediate hosts are freshwater snails belonging to the Lymnaeidae family. The most prevalent intermediate host for *Fasciola* hepatica in Europe and South America is Galba truncatula (Krauth et al., 2015; Mazeri et al., 2016). Paramphistomes: Snails of the genera Bulinus, Planorbis, and Stagnicola serve as intermediate hosts (Tsegabirhan et al., 2015).Schistosoma: Physopsis and Bulinus snails have a major role in the spread of schistosomiasis in sheep and cattle (Urquhart et al., 2003). *Dicrocelium*: A variety of mollusk species can serve as the initial intermediate host and are involved in the dicroceliosis epidemiology. Only in the intestine of the mollusks that serve as intermediary hosts do egg hatching and miracidium liberation take place. Moreover, the parasite reproduces asexually inside mollusks, producing many cercariae from a single-eaten egg, which allows for massive parasite multiplication. Due to their abundance and widespread dispersion, ants serve as second intermediate hosts in the epidemiology of dicroceliosis (Otranto & Traversa, 2002).

2.7. Pathogenesis

Fasciola

A definitive host can become infected during either of the two phases: the biliary or parenchymal phases. Excessive immature flukes enter the parenchymal phase when they break through the intestinal wall. After entering the intestine, flukes pass through the abdominal cavity before arriving at the liver or other organs. Possible locations for ectopic fluke sites include the kidneys, intestinal wall, lungs, diaphragm, and subcutaneous tissue. Fluke migration causes physical harm to tissues, and fluke migratory paths are inflammatory. The second stage starts when the parasites enter the bile ducts of the liver. Flukes grow in biliary channels, feed on blood, and generally cause serious damage to liver tissue. Edema, hemorrhage, discoloration, necrosis, bile duct hyperplasia, and fibrosis are signs of this damage (Kaya et al., 2007; Mas- Coma et al., 2009).

Paramphistomum

Rumen fluke pathogenicity is associated with the intestinal stage of infection. The duodenal mucosa is badly damaged because the immature fluke feeds on plugs and characterized by enteritis, anemia, edema, bleeding, and ulceration.and leading to substantial productivity and financial losses (Dorny et al., 2011).

Schistosoma

Schistosomiasis is unique among helminth infections since a significant amount of the pathology is produced by host immune responses (granulomatous reactions and delayed-type hypersensitivity), with the majority of the pathogenesis being attributed to the eggs rather than larvae or adults. Three stages of an infection are commonly distinguished: migratory, acute, and chronic. When cercariae penetrate and move through the skin, the migratory phase begins. Although this illness is usually asymptomatic, sensitive people may experience transient dermatitis (also known as "swimmer's itch") and, in rare instances, pulmonary lesions and pneumonitis (Oliveira et al., 2004).

Dicrocelium

Compared with other flukes the hepatic lesions caused by *Dicrocelium* often remain undetected. It is relatively difficult to produce experimental infections to investigate the pathogenesis of *Dicrocelium* and field infections are mostly mixed infections of various and more pathogenic helminths that mask the merely *Dicrocelium*-induced symptoms and lesions. The behavior of young flukes may be the cause of the lack of evident lesions and symptoms the juvenile flukes migrate directly up the biliary duct system of the liver without penetrating the gut wall, liver capsule, or liver parenchyma as in the case of Fasciolosis (Kahl et al., 2021).

2.8. Clinical Signs

Fasciola

The clinical symptoms of Fasciolosis are generally closely related to the number of metacercariae ingested. In winter, *Fasciola* infections can lead to reduced milk production in dairy cows. They are difficult to diagnose clinically because the exposure to flukes is usually low and no anemia is evident. The main effects include a reduction in milk production and quality, particularly in terms of solids content rather than fat content (Kaya et al., 2007; Radostits et al., 2007a).

Paramphistomum

The most common clinical symptoms of stomach fluke infection are enteritis (inflammation of the small intestine) and severe bloody diarrhea secondary to dehydration, and drowsiness, the immature rumen fluke is a plug feeder that resides in the submucosa of the duodenum and feeds on the Brunner's gland epithelial cells, resulting in anemia, a decrease in plasma protein concentration, fetid diarrhea, and anorexia, all of which weaken the host. Additionally, rumenitis, anorexia, polydipsia, poor nutritional conversion and body condition, irregular rumination, and severe diarrhea are all caused by mature *Paramphistomum* and weight loss which can lead to death if left untreated (Sintayehu & Mekonnen, 2012; Williams, 2012).

Schistosoma

Upon the start of egg excretion, the animals showed symptoms including anemia, hypoalbuminemia, hyperglobulinemia, severe eosinophilia, severe diarrhea mixed with blood or mucus, dehydration, pale mucous membrane, marked weight loss, decreased production, and rough hair coat. While animals with less severe infections suffer from a chronic condition that causes growth retardation, highly affected animals usually die within a few months after infection. Three major clinical signs that appear after the onset of egg excretion are hemorrhagic enteritis, anemia, and emaciation and are associated with the intestinal and hepatic forms of schistosomiasis in animals (Dey et al., 2022)

Dicrocelium

Infected animals' lesion scores and worm burden were found to be correlated directly. Changes in the degree of infection were found to cause modifications to the bile duct surfaces and fibrotic lesions of the liver to grow up to 300 *Dicrocelium*. However, a decrease was detected above this value up to 600 flukes, possibly as a result of the host's response. A huge number of worms are found inside the bile ducts and gall bladder. When there are severe infections, the liver swells, the ducts become thicker, there is cholangitis, white patches on the surface, severe scarring, and cirrhosis, which impairs the liver (Sánchez-Campos et al., 2000).

2.9. Diagnosis

Fasciola

Considerations include season, weather, hematological and biochemical profiles, snail inspections, and clinical signs. Many techniques are employed based on this information to evaluate the state, such as the counting of fluke eggs, and post-mortem examination serological and molecular techniques (Krauth et al., 2015; Urquhart et al., 2003). Post-mortem examination which most straightforward, dependable, and economical method of detecting Fasciolisis is liver testing performed after slaughter or necropsy (Urquhart et al., 2003). Fluke Egg Count is The diagnosis of *Fasciola* was validated by the discovery of eggs in the feces. It's important to distinguish these eggs from those of other flukes, especially the big *Paramphistomum* eggs. The oval, yellow-brown eggs of *Fasciola* measure 130–150 m by 60–90 m. Every egg will have a distinct operculum (Ballweber, 2006; Taylor et al., 2007).

Paramphistomum

The history of grazing areas close to the snail habitat and young animals in the herd are often linked to the clinical signs of rumen fluke. An analysis of a faecal sample is not very useful because the disease develops during the prepatent period. The diagnosis can be verified by a post-mortem examination and the removal of the tiny fluke from the stomach. Sheep and cattle infected exhibit severe anorexia or impaired digestion. The primary diagnosis in cases of persistent diarrhea is due to a significant infection in the digestive tract. Examining watery feces allows one to identify immature flukes (Urquhart et al., 2003; Williams, 2012).

Schistosoma

Examining stool or urine for eggs is the main method of diagnosis for suspected Schistosome infections. Based on which parasite species are most likely to cause the infection, Schistosomiasis diagnosis depends on the type of sample used. Adult stages of *Schistosoma mansoni*, *Schistosoma japonicum*, *Schistosoma mekongi*, and *Schistosoma intercalatum* worms reside in the mesenteric venous plexus of infected hosts, while adult *Schistosoma haematobium* worms reside in the lower urinary tract venous plexus, where they deposit eggs in urine. When Schistosomiasis is suspected, a complete post-mortem examination reveals skin lesions and, if the mesentery is stretched, the typical skin lesions that occur from skin contact with water from ponds, lakes, streams, or the ocean that contain infective cercariae from snail intermediate hosts. The best method to determine early infection is to conduct a comprehensive postmortem investigation. During the early stages of infection, egg production is most advantageous because it declines as infection rises. Most eggs are spindle-shaped and do not have an operculum (Bowman, 2003).

Dicrocelium

Due to its typically mild form, Dicroceliosis frequently goes misdiagnosed or undiscovered clinically. Its diagnosis is mostly based on the identification of eggs during the coprological examination or the recovery of adults in the liver during necropsy. The method most frequently employed to diagnose Dicroceliosis is coprological examination. This may indicate the existence of tiny, thick-walled, yellowish-brown eggs (40 mm x 25 mm), each containing a miracidium. Techniques for sedimentation are typically employed (Manga-González & Ferreras, 2014).

2.10. Treatment

Fasciola: animals with fasciolosis have been treated with Halogenated phenols, Salicylanilides, Benzimidazole, Sulphonamides, and Phenoxy alkanes (Wolstenholme et al., 2004). And *Paramphistomum* has been demonstrated that levamisole, bithional, niclosamide, clorsulon, ivermectin, and resporantel are effective treatments (Georgi, 2008).

Schistosoma

All major Schistosoma species infections are treated with praziquantel. Since praziquantel works best against adult worms and necessitates the formation of an antibody response to the parasite, the timing of therapy is crucial. Over the years, several drugs with known Schistosoma but potentially dangerous side effects such as trichlorphon and antimonial have been studied against visceral Schistosoma infection in domestic rumina (CSA, 2020; Tsotetsi et al., 2013).

Dicrocelium

Many pro-benzimidazole (thiophanate) and benzimidazole (albendazole, triclabendazole, fenbendazole, mebendazole, cambendazole, thiabendazole) derivatives have been used against *Dicrocelium* at higher doses than those used against tapeworms, flukes, lung, and gastrointestinal nematodes among anthelmintic medications (Otranto & Traversa, 2002).

2.11. Control and prevention

Fasciola

Snail population decline is the most efficient long-term strategy for reducing the population of mud snails, such as Lymnae. If areas, where snail habitats are restricted, are fenced off or adding a molluskicide to the watery habitat of an intermediate snail host can be an effective control measure when the snail host is aquatic (Taylor et al., 2007; Urquhart et al., 2003). During April through August in the tropics, when fluke eggs are most prone to develop, pasture contamination by fluke eggs is prevented by the preventive use of fluke anthelmintics. A further course of treatment is to eradicate the fluke population while the animal is under a lot of stress due to feeding or pregnancy (Malek, 2018; Urquhart et al., 2003). Forecasting the climate affects the liver fluke life cycle and the incidence of fasciolosis.

Consequently, forecasting techniques based on meteorological data have been developed to estimate the likely onset and severity of the disease. By calculating data from May to August and putting control measures in place before cercariae shedding, the forecast is utilized to give an early warning of disease. This method can also be used to predict snail infection in the winter by adding the data for August, September, and October, even though it is mainly used to predict snail infection in the summer. Another tactic used is the "wet day" forecast. Twelve days with precipitation exceeding 1.0 mm are associated with a high prevalence of Fasciolisis from June to September (Taylor et al., 2007; Urquhart et al., 2003). immunological method The worm's enzymes and the antigen in the unsheathing fluid trigger the production of an antibody by the host. Immunity could be achieved through vaccination with helminth antigens. Since helminths do not multiply in the host like bacteria, viruses, and protozoa do, their immunity is frequently less potent and transient than that of microorganisms. Cattle's significant immune response to *Fasciola* species results in hepatic fibrosis, hyperplasia, and bile duct calcification, even though cattle have a higher immunological response than sheep (Radostits et al., 2007a).

Paramphistomum

As with *Fasciola*, the best management is to keep the animals from getting to natural water sources and to fill the troughs with piped water. Even so, there's a chance that snails will find their way into water troughs, so either manually remove the snails or apply a molluscicide at the source (Urquhart et al., 2003)

Schistosoma

The descriptions of diseases brought on by *Fasciola* and *Paramphistomum* resemble this. The best strategy for managing animals' Schistosomiasis in endemic locations is to enclose high-risk areas and provide clean water for the animals to prevent contact with the parasite. However, this isn't always possible in places where administration is nomadic. Additional management strategies include eradicating the snail intermediate host population via mechanical barriers or snail traps, or chemically or biologically destroying the population at transmission sites (Dey et al., 2020).

Dicrocelium

Its biological life cycle and epidemiology are complex, which makes controlling the small liver fluke challenging and unsatisfactory. The primary strategies for control have been to manage the first and second intermediate hosts, treat animals, and refrain from grazing in the early morning or late evening when ant infection is most common. As in the case of lungworms and liver fluke, soil maps should be assessed to detect the presence of calcareous soil, which are suitable habitat for *Dicrocelium* intermediate hosts. In practical terms, prophylaxis in endemic areas is based on the strategic treatment of all animals exposed directly by free grazing to infection (González-Lanza et al., 2000).

3. MATERIALS AND METHODS

3.1 . Description of Study Area

Welmera district is 40 km away from the capital city, Addis Ababa, and the area is situated at 9o04'- 9o13' N latitude and 38o29'- 38o39' E longitude. It is bordered on the south by the Sebeta Hawas, on the west by the West Shewa zone, on the North by the Mulo district, and on the Northeast by the Sululta. Menagesha Kolobo and Holeta Genet are the towns located in the districts (Figure 1). The average altitude of the area ranges from 2200-2500 meters above sea level. The district is known for its crop-livestock mixed farming system is a common practice. The rainfall pattern of the district is bimodal, with a short rainy period from February to April and a long rainy season from mid-June to September. The annual temperature and rainfall ranges from 18°C to 24°C and 1000 to 1100 mm, respectively (Getahun *et al*., 2023)

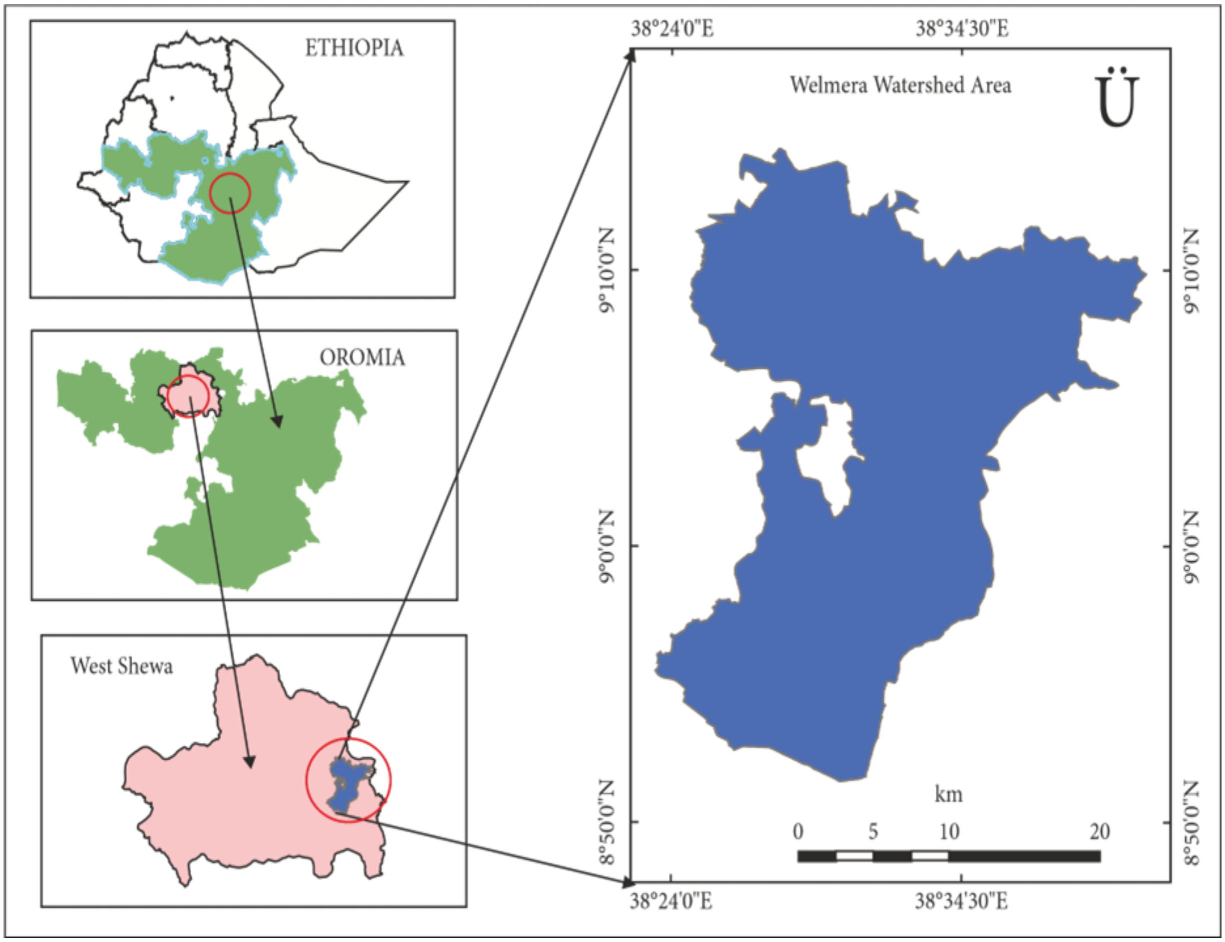

Figure 1: Map of the study area as generated by google map

3.2. Study design and study population

A cross-sectional study was conducted from October 2023 to June 2024 for trematode parasites of cattle and sheep and their intermediate snail host in the study area. According to a livestock population survey conducted by the Central Statistical Agency of Ethiopia in 2019, Welmera districts had a total livestock population of 150,680. This included 59,570 cattle, 65,310 sheep, 22,120 goats, and 3,680 equines (horses, mules, and donkeys). The survey also found that the majority of households in Welmera districts owned at least one type of livestock. Specifically, 91.5% of households owned cattle, 97.7% owned sheep, 71.7% owned goats, and 20.2% owned equines. Before collecting samples of the study animals (cattle and sheep), primary data on the sex, and age of sheep groups such as young (<2 years) and adults (≥2 years), which was determined by asking owners and by dentition method, body conditions score categorized as poor, medium, and good, based on observation of anatomical parts such as the vertebral column, ribs, and spines (Nicholson & Sayers, 1987), deworming history, and management systems, age of cattle which was groups as young (< 4 years) and adults ((≥4 years) based on Tooth eruption and wear, kept in and around Welmera districts were recorded (Cringoli et al., 2002).

3.3. Sampling method and sample size determination

The sample size was calculated according to: (Thrusfield, 2018) with a 26.56% expected prevalence of the parasites (Dejene *et al*., 2022). as follows:

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

where n = the required sample size,

Pexp = expected prevalence (P = 26.56%)

d = desired absolute precision (5%).

Z = 1.96 for a 95% confidence interval.

$$n = \frac{1.96^2\ (0.266)\ (1-0.266)}{(0.05)^2} = \frac{0.75005}{0.0025} = 300.$$

Therefore, the sample size required for one animal species was 300. Since considering two animal species, the total sample size was 300*2 =600 for coprological examination. The sample size for a post-mortem examination of all cattle presented for slaughter originating from the Welmera district as well as neighboring districts was calculated according to (Thrusfield, 2018). There was no documentation based on post-mortem examination, therefore the expected prevalence in the study area was 50%. So, the sample size was 384 by considering only cattle by simple random sampling technique. For the identification of snails intermediate hosts of trematodes parasite of ruminants (cattle and sheep), five hundred (500) snails were collected from in and around Welmera districts.

3.4. Sample collection and examination

Using sterile disposable plastic gloves, faecal samples (about 10 grams) were directly taken from the rectum of the study animals and put into a universal container. The species, management system, breed, deworming history, age, sex, and physical condition of the sheep and cattle were noted beside each sample, which was also serially numbered. The samples were shipped to the National Agriculture Biotechnology Research Center in Holeta town, where they were kept in an icebox until the study animals' feces could be examined. The sample was looked at right away. Because feces suspension is heavier than most feces particles, it was possible to determine the presence of trematode eggs by dilution of the mixture using the sedimentation technique. Using ova identification keys under a microscope, the eggs were identified based on their morphology (Palmer, 2013; Van Wyk & Mayhew, 2013). To separate trematode parasite eggs, a drop of methylene blue solution was added to the faecal materials. Eggs from *Fasciola* were yellowish, while eggs from *Paramphistome* had translucent granules and were dyed with methylene blue (Urquhart et al., 2003).

The stoll egg technique was used to estimate the burden of infection by trematode parasites as per the guideline described by (Cook & Zumla, 2008). For examination and identification of adult trematode parasites, a post-mortem examination was done on animals slaughtered at the Holeta municipal abattoir. On every visit animals that had flukes-infested liver and forestomach were examined. The liver, in particular the bile ducts, the gallbladder, the rumen, and the reticulum of 384 cattle were eviscerated, incised, and examined for adult trematode parasites identification. Because these organs are known to be predilection sites for liver and rumen flukes. Snails were directly collected from the study area. Water-visible snails floating on the water's surface and moist mud, vegetation, and leaf litter were picked by hand using a glove. After being gathered, the snail samples were sent to the National Agriculture Biotechnology Research Center in Holeta town and stored in plastic buckets. The snail was then identified using the shell's morphological characteristics (Molaba et al., 2023).

3.5. Data management and statistical analysis

Predesign notebooks were used to record all data, which was then entered onto a computer using a Microsoft Excel worksheet. The dataset was thoroughly examined for mistakes before statistical analysis. The data was imported from Microsoft Excel and analyzed using the Stata software. ANOVA and Chi-square ($\chi 2$) were employed and the strength of the relationship between potential risk variables, including age, breed, sex, body condition score, deworming history, and management system, was assessed using logistic regressions. A p-value of less than 5%, at a 95% confidence level, suggests that a significant link exists, whereas a p-value of more than 5% indicates that the relationship is not statistically significant.

4. RESULTS

4.1. Coprological finding

In coprological the overall prevalence was 57.7% in cattle and 63.7% in sheep. the prevalence and mean egg burden of trematode parasites were *Fasciola* 44(27.67%), *Paramphistomum* 26.33(19%) and *Dicrocelium* 13.33(11%), and *Fasciola* 40.33(25.67%), *Paramphistomum* 29.87(17.33%) and *Dicrocelium* 33(20.67%) in cattle and sheep, respectively (Table 1). In cattle the odd ratio of acquiring *Dicrocelium* rises about 2.21 times when males than in females (P=0.049, AOR= 2.21, CI= 1.00-4.89), less about 0.36 times when young animals than in adults (P= 0.020, AOR= 0.36, CI= 0.15-0.85) and less 0.35 times when animals treated than not treated animals (P=0.045, AOR= 0.35, CI= 0.13-0.98). The odd ratio of occurrence of

Fasciola rises about 9. 05 times when poor animals than medium and good animals (P=0.000 AOR= 9.05, CI= 3.47-23.5), less about 0.17 times when treated animals than not received drugs (P=0.000 AOR= 0.17, CI= 0.07-0.40) and less about 0.19 times when animals sem-intensively managed than extensively kept (P=0.001, AOR= 0.19, CI= 0.07-0.49). The odd ratio of harbored *Paramphistomum* rises about 12.8 times when animals body condition was poor than medium and good ones (P=0.000, AOR= 12.8, CI= 4.46-37.01) in cattle and (Table 4).

Table 1: Coprological prevalence and burden of cattle and sheep trematode parasites

Parasite genera	Cattle		Sheep	
	No.positive (%)	Mean egg burden	No. positive (%)	Mean egg burden
Fasciola	83(27.67)	44	77(25.67)	40.33
Paramphistomum	57(19)	26.33	52(17.33)	29.87
Dicrocelium	33(11)	13.33	62(20.67)	33

In sheep, the odd ratio of occurrence of *Dicrocelium* less about 0.37 times in young animals than in adults (P=0.003 AOR= 0.37, CI= 0.19-0.72) and less about 0.35 times in animals treated than not received drugs (P=0.034, AOR= 0.35, CI= 0.13-0.98). The odd ratio of harbored *Fasciola* rises about 16 times in poor animals than in medium and good body condition (P=0.000 AOR= 16, CI= 6.17-41.43), less about 0.28 times when animals received drugs than not treated ones (P=0.001, AOR= 0.28, CI= 0.13-0.61), and less about 0.34 animals sem-intensively kept than extensively managed (P=0.001, AOR= 0.34, CI= 0.04-2.81). The odd ratio of occurrence of *Paramphistomum* less about 0.49 times in male than female animals (P=0.034, AOR= 0.49, CI= 0.26-0.95) and rises about 3.49 times poorer in animals than in medium and good body condition (P=0.006, AOR= 3.49, CI= 1.43-8.55) (Table 5).

Table 2: Prevalence and burden of cattle trematode infections based on risk factors according to coprological examination

Risk factors	Variables	*Fasciola*		*Paraphistomum*		*Dicrocelium*	
		No.positive (%)	Mean	No. positive (%)	Mean	No. positive (%)	Mean
Breed	Exotic	29(18.13)	37.88	18(31.58)	21.21	11(33.33)	10.61
	Local	131(81.88)	48.81	39(68.42)	30.36	22(66.67)	15.48
Sex	Female	37(44.58)	39.73	32(56.14)	31.51	12(36.36)	9.59
	Male	46(55.42)	48.05	25(43.86)	21.43	21(63.64)	16.88
Age	Adult	53(63.86)	46.20	39(68.42)	30.44	25(75.76)	16.85
	Young	30(36.14)	40.52	18(31.58)	19.83	8(24.24)	7.76
Body condition score	Good	7(8.43)	9.24	6(10.53)	9.01	6(18.18)	6.60
	Medium	28(33.73)	37.82	16(28.07)	18.02	12(36.36)	12.84
	Poor	48(57.83)	122.60	35(61.41)	62.82	15(45.45)	22.35
Deworming history	Not-treated	174(89.16)	73.46	38(66.67)	31.48	28(84.85)	20.37
	Treated	9(10.84)	9.42	19(33.33)	20.29	5(15.15)	5.07
Management system	Extensive	75(90.36)	60.71	97(88.99)	32.65	28(84.85)	17.86
	Sem-intensive	8(9.64)	12.50	12(11.01)	14.42	5(15.15)	4.81

Table 3: Prevalence and burden of sheep trematode infections based on risk factors according to coprological examination

Risk factors	Variables	*Fasciola*		*Paraphistomum*		*Dicrocelium*	
		No.positive (%)	Mean	No. positive (%)	Mean	No. positive (%)	Mean
Sex	Female	49(63.64)	51.61	35(67.31)	38.71	34(54.84)	36.77
	Male	28(36.36)	28.28	17(32.69)	20.28	28(45.16)	28.96
Age	Adult	52(67.53)	46.20	35(67.31)	36.93	49(79.03)	43.18
	Young	25(32.47)	40.52	17(32.69)	19.67	13(20.97)	18.55

Body condition score	Good	7(9.09)	11	10(19.23)	16.16	15(24.19)	25
	Medium	21(27.27)	28.23	20(38.46)	27.42	18(29.03)	20.16
	Poor	49(63.64)	98.68	22(42.31)	52	29(46.77)	64.47
Deworming history	Not-treated	67(87.01)	62.94	36(69.23)	37.5	51(82.26)	47.06
	Treated	10(12.99)	10.77	16(30.77)	20	11(17.74)	14.62
Management system	Extensive	76(98.70)	40.82	49(94.23)	30.82	100(62)	35.23
	Sem-intensive	1(1.30)	16.67	3(5.77)	15.79	0(0)	0

Table 4: Logistic regression analysis of the association between the occurrence of trematode parasite in cattle and the assumed risk factors

Risk factors		*Fasciola*		*Paraphistomum*		*Dicrocelium*	
		Adjusted OR(95%CI)	P-value	Adjusted OR(95%CI)	P-value	Adjusted OR(95%CI)	P-value
Breed	exotic	1		1		1	
	local	0.52(0.53-2.37)	0.082	1.13(0.53,2.37)	0.744	0.98(0.41,2.36)	0.971
Sex	female	1		1		1	
	male	1.56(0.84,3.01)	0.151	0.77(0.40,1.47)	0.430	2.21(1.00,4.89)	0.049*

Age	adult	1		1		1	
	young	0.68(0.36,1.30)	0.245	0.61(0.30,1.19)	0.146	0.36(0.15,0.85)	0.020*
Body condition score	poor	9.05(3.47,23.5)	0.000*	12.8(4.46,37.01)	0.000*	2.18(0.73,6.51)	0.161
	medium	4.15(1.61,10.7)	0.003*	3.04(1.11,8.34)	0.031*	1.79(0.61,5.24)	0.291
	good	1		1		1	
Deworming history	treated	0.17(0.07,0.40)	0.000*	1.73(0.78,3.83)	0.178	0.35(0.13,0.98)	0.045*
	not treated	1				1	
Management system	extensive	1		1			
	semi-intensive	0.19(0.07,0.49)	0.001*	0.41(0.17,1.05)	0.065	0.42(0.13,1.34)	0.144

Note:OR: Odd ratio; CI: Confidence interval, * significant difference

Table 5: Logistic regression analysis of the association between trematode parasite of sheep and the risk factors

Risk factors		*Fasciola*		*Paramphistomum*		*Dicrocelium*	
		Adjusted OR(95%CI)	P-value	Adjusted OR(95%CI)	P-value	Adjusted OR(95%CI)	P-value
Sex	female	1		1		1	
	male	0.56(0.29,1.08)	0.082	0.49(0.26,0.95)	0.034*	1.04(0.57,1.92)	0.894
Age	adult	1		1		1	
	young	0.63(0.33,1.23)	0.180	0.70(0.37,1.37)	0.307	0.37(0.19,0.72)	0.003*

Body condition score	poor	16(6.17,41.43)	0.000*	3.49(1.43,8.55)	0.006*	1.83(0.84,3.97)	0.129
	medium	2.67(1.05,6.79)	0.039*	1.83(0.80,4.17)	0.153	0.86(0.40,1.87)	0.710
	good	1		1		1	
Deworming history	treated	0.28(0.13,0.61)	0.001*	0.87(0.42,1.78)	0.695	0.35(0.13,0.98)	0.045*
	not treated	1		1		1	
Management system	extensive	1		1		1	
	semi-intensive	0.34(0.04,2.81)	0.001*	1.20(0.32,4.53)	0.792	1	

Note:OR: Odd ratio; CI: Confidence interval, *significant difference

4.2.Post-Mortem finding

Out of 384 slaughtered cattle examined, the overall prevalence was 78.9% and the prevalence and mean burden of the adult fluke infections were 2.30(34.64%) of *Fasciola hepatica*, 2.30(17.45%) of *Fasciola gigantica*, 32(24.74%) of *Paramphistomum* and 0.03(24.74%) of *Dicrocelium* parasites (Table 6) and mixed infections 59(15.36%) of *Fasciola hepatica* and *Fasciola gigantica*, 31(8.07%) of *Fasciola* and *Paramphistomum*, 5(1.30 %) of *Fasciola* and *Dicrocelium* and 5(1.30%) of Paraphistomum and *Dicrocelium* were recorded (Table 7)

Table 6: Prevalence and burden of trematode parasites of cattle as per post-mortem examination

Parasite genera/ species	No of positive	Prevalence(%)	The mean burden of adult fluke
Fasciola hepatica	133	34.64	2.30
Fasciola gigantica	67	17.45	2.30
Paramphistomum	95	24.74	32
Dicrocelium	8	2.08	0.03

Table 7: Prevalence of mixed trematode parasites of cattle according to post-mortem examination

Parasite genera/ species	No of positive	Prevalence(%)
Fasciola (hepatica + gigantica)	59	15.36
Fasciola + *Paramphistomum*	31	8.07
Fasciola + *Dicrocelium*	5	1.30
Paraphistomum + *Dicrocelium*	5	1.30
Fasciola+Paramphistomum+Dicrocelium	5	1.30

4.3. Identification of intermediate hosts

From the morphological feature of the shell point of view, 446 (89.20%) of the snails acquired were recognized as Lymnaea, and Bulinus 54(10.80%) were identified (Table 8).

Table 8: The frequency and percentage of snail intermediate host of trematode parasite collected from the study area (N=500).

Snails category	Frequency	Percentage (%)
Bulinus	54	10.80
lymnaea	446	89.20

5. DISCUSSION

Based on coprological examination and the result of this study, the highest egg per gram and prevalence identified trematode parasites were recorded for *Fasciola* 44(27.67%) followed by Paramphistomes 26.33(19%) and *Dicrocelium* 13.33(11%) and *Fasciola* 40.33(25.67%) followed by *Dicrocelium* 33(20.67%) and *Paramphistomes* 29.87(17.33%) in cattle and sheep respectively. Prevalence of bovine Fasciolosis and ovine Fasciolosis based on the coprological examination was 27.6% and 25.6% respectively and our study was in line with previous studies of 23.7% in and around Wolaita Sodo (Alemu, 2019) and 27% in north-eastern Algeria (Mekroud et al., 2004) in cattle. While sheep at 26.3 % in the Jimma Area of South Western Ethiopia (Kedir et al., 2012), 30% in the Awash River Basin (Asrat, 2004), 28.7%, in Debre Zeit town, Ethiopia (Abdulhakim & Addis, 2012) and 28% in Kenya (Mungube et al., 2006). This was linked to the presence of an ecologically suitable environment for the biology of parasites as well as the interaction between the infected animals and their intermediate hosts.

The prevalence of *Fasciola* infections in this study in cattle was lower than in the previous study 33.42% in Gonder (Yilma & Mesfin, 2000), 50.79% in and around Inchini town (Assefa et al., 2015), 37.2% in Mecha and Fogera (Woldemariam & Wossene, 2007), 54.2% in Eastern Shoa (Mohammed et al., 2018), 43% in central Vietnam(Ananta et al., 2014),66.14% in Bangladesh (Karim et al., 2015) and 31.7% in Zimbabwe (Pfukenyi & Mukaratirwa, 2004). But higher than 15.9% at Nekemte Veterinary Clinic (Tilahun et al., 2014), 19.1% in and around Zenzelma Bahir Dar Ethiopia (Legesse et al., 2017), and 19.25% in Pakistan (Shahbaz et al., 2021).The prevalence of *Fasciola* infections in this study in sheep was lower than 70.20% in Northeast Ethiopia (Chanie & Begashaw, 2012), 50.8% in and Around Chole Woreda, Ethiopia (Hussien et al., 2017), and 39.1% in Nigeria (Isah, 2019). But higher than 18.8% in Dessie, northern Ethiopia (Berhe et al., 2017),6.6% in Mazandaran, northern Iran (Khanjari et al., 2014), 14.7% in Egypt (Amer et al., 2016).

The prevalence of *Paramphistomum* infections in this study in cattle was 19% and lower than 45.83% in northwest Ethiopia (Yeneneh et al., 2012). But higher than 9.5% in and Around Hosanna Town, Southern Ethiopia (Tiele et al., 2023), 5.5% in Germany (Forstmaier et al., 2021), 5% in Malaysia (Khadijah et al., 2017) and the *Paramphistomum* infections in this study in sheep was 17.33% and higher than 0.87% in northwest Ethiopia (Dagnachew et al., 2011), 1.09% in Iran (Moghaddar & Khanitapeh, 2003) and 4% in Egypt (Haridy et al., 2006). But lower than 23.7% in Tigray (Tsegabirhan et al., 2015), 39.1 % in Kutaber Woreda, South

Wollo, Amhara Region, Ethiopia (Wondmnew et al., 2019), and 48.8% in China (Wang et al., 2006).

The prevalence of *Dicrocelium* infections in this study in sheep was 20.67% and was in line with the previous study 21.1% in Northern and Southern Germany (Alstedt et al., 2022) This because of associated with the existence of a favorable ecological condition both the biology of parasites and their intermediate hosts and higher than 0.8% in Spain (García-Dios et al., 2021), and 0.3% in Germany (Raue et al., 2017), 1.76% in the south of Iran (Ansari-Lari & Moazzeni, 2006). But lower than 51.1% in Italy (Scala et al., 2019), and 36.21% in Iran (Majidi-Rad et al., 2018), and the prevalence of *Dicrocelium* infections in this study in cattle was 11% and lower than 66.0% in south Iran (Ahmadi & Meshkehkar, 2010), 23.6% in Turkey (Gargili et al., 2009), 18.3% in Borno (Nwosu & Srivastava, 2003), 22.3% in Plateau (Omowaye et al., 2012) and 39.0% in Kogi (Iyaji et al., 2018). But higher than 2.5% in South-Western Nigeria (Adedipe et al., 2014) and 3.1% in West Africa (Amadi et al., 2012).This variation because was of the differences in climatic conditions and expansions of animal health extension.

Depending on post-mortem examination and the result of this study, from the lowest to the highest mean burden of adult flukes and prevalence identified trematode parasites were recorded for *Dicrocelium* 0.03 (2.08%), *Fasciola gigantica* 2.30 (17.45%), *Paramphistomum* 32 (24.74%) and *Fasciola hepatica* 2.30(34.64%) and *Dicrocelium* 1.30%, *Fasciola* and *Dicrocelium* 1.30%, Paraphistomum and *Dicrocelium* 1.30%, *Fasciola* and *Paramphistomum* 8.07% and *Fasciola hepatica* and *Fasciola gigantica* 15.36% in single infections and mixed infections in slaughtered bovine, respectively.

According to our results, the prevalence of *Fasciola* species in bovine was *Fasciola hepatica* 34.64% and *Fasciola gigantica* 17.45%. The current finding of *Fasciola hepatica* is 34.64%, higher than 12.5% in Indonesia (Ananta et al., 2014), 11.1% in Italy (Cringoli et al., 2002), in Australia17.8% (Duscher et al., 2011), 21.3% in Brazil (Alves et al., 2011), in Algeria 27.0% (Mekroud et al., 2004).But lower than 40.0% in Argentina (Kleiman et al., 2007) and 71.0% in Spain (Paz-Silva et al., 2007), 56.42% in the Mekelle area of Ethiopia (Berhe et al., 2009). The prevalence of *Fasciola gigantica* was 17.45% and lower than 9.17% at Soddo municipal abattoir, southern Ethiopia (Abunna et al., 2010), 23.3% in Nigeria (Njoku-Tony & Okoli, 2011), 30.0% in Sudan (El -Mannan et al., 2001), 37.1% in Zimbabwe (Pfukenyi & Mukaratirwa, 2004) 45.3% in Ethiopia (Abebe et al., 2011) and 48.9% in Zambia (Phiri et al., 2005). The prevalence of *Paramphistomum* was 24.74% and lower than 6.0% in Spain (Ferreras et al., 2014), 12.0% in northern Portugal, and in north-west Spain (Arias et al., 2011), 15.8% in Netherland (Ankum, 2015). But higher than 28.0% in Belgium (Malrait et al., 2015), 45.7% in north-eastern Algeria (Titi et al., 2010), 51.8% in Ethiopia (Ayalew et al., 2016), 70.0% in New Caledonia (Cauquil et al., 2016), 75.6% in India (Swarnakar et al., 2014) and 29% in Scotland (Sargison et al., 2016).

The prevalence of *Dicrocelium* infections was 2.08% approximately in line with 2.28% in south-western Iran (Ahmadi & Meshkehkar, 2010). But lower than 11.03% in north-eastern Iran (Oryan et al., 2011), and 66% in northern Iran (Ahmadi et al., 2010). This may be due to conducive environmental conditions for parasites, snail populations, and ants. The current study in cattle showed body conditions, deworming history, and management systems variation in the burden and prevalence of *Fasciola* parasite, and the level of burden and prevalence of *Fasciola* infection was significantly higher in poor body conditions animals 122.60 (57.83%) than the 37.82 (33.73%) medium and 9.24 (8.43%) good body conditions animals. This agrees with (Marquardt et al., 2000). This indicates that fasciolosis plays a significant role in weight loss, and *Fasciola* infection was linked to poor physical body condition since the infection lowers blood and tissue fluid and even affects the parenchyma of the liver, eventually resulting in protein loss and decreased bile flow to the duodenum, bile output, and fatty acid and lipid-soluble vitamin digestion and absorption, all of which contribute to weight loss and in sheep the level of burden and prevalence of *Fasciola* infection was higher in poor body conditions animals 98.68 (63.64%) than the 28.23 (27.27%) medium and 11 (9.09%) good body conditions animals. This was in line with (Radostits et al., 2007b). This indicates the significant role of Fasciolosis in causing weight loss, which could be because sheep with poor conditions typically have a weaker immune system and were more susceptible to *Fasciola* infections.

The mean parasites burden and prevalence of *Fasciola* infection in cattle was higher in not-treated animals 73.46 (89.16%) than in the treated 9.42 (10.84%) animals while in sheep was higher in not-received drug animals 62.94 (87.01%) than in the treated 10.77 (12.99%) animals. This could be the result of effective anthelmintics reducing the parasite population. Burden and the prevalence of *Fasciola* infections in cattle were higher in extensive management systems at 60.71 (90.36%) than in sem-intensive 12.50 (9.64%) managed animals and the extensively managed sheep were higher at 40.82 (98.70%) than sem-intensively managed 16.67 (1.30%) sheep. This could be due to not having a well-fed animal and a poor diet usually resulted in more *Fasciola* infections and increasing fluke populations in animals.

The burden and prevalence of *Paramphistomum* infections were significantly higher in 38.71 (67.31%) female sheep than in 20.28 (32.69%) male sheep. This was in line with a study (Galdhar & Roy, 2005; Mazid et al., 2006). This was because of the alteration in the physiological condition of the females during pregnancy, lactation, and parturition. The high burden and prevalence of *Fasciola*, *Paramphistomum*, and *Dicrocelium* parasites 48.81 (81.88%), 30.36 (68.42), 15.48 (66.67%) in local breed cattle were observed than in adult exotic breed cattle 37.88 (18.13%), 21.21 (31.58%), 10.61 (33.33%) respectively. Immunity in cattle suppresses worm fecundity and reduces egg production, with natural immunity differences between local breed and exotic breed cattle (Ayele & Hiko, 2016). However, The study revealed no significant association. The findings were in agreement with (Yeneneh et al., 2012).

When the spires of the Bulinus and Lymnaea snails were held with their points facing away from the observer, the openings were on the left and right, respectively (Salew & Munshea, 2018). The current study showed that the higher prevalence genera were 446 (89.20%) Lymnaea than 54 (10.80%) Bulinus and Lymnaea snails were known for potential as a host for *Fasciola*, which was an agreement with (Cuadrado, 2015; Luka & Mbaya, 2015).

6. CONCLUSION AND RECOMMENDATION

The current study revealed that the prevalence and burden of trematode infections were *Dicrocelium* 13.33(11%), *Paramphistomum* 26.33(19%), *Fasciola* 44(27.67%), and *Paramphistomum* 29.87(17.33%)in cattle *Dicrocelium* 33(20.67%) and *Fasciola* 40.33(25.67%) in sheep and *Fasciola* hepatica 2.30(34.64%), *Fasciola* gigantica 2.30(17.45%), *Paramphistomum* 24.74(24.74%), and *Dicrocelium* 0.03(24.74%) of cattle and the snail frequency and percentage 446(89.20%) of Lymnaea and 54(10.80%) as Bulinus in and around Welmera districts as investigated through a coprological examination, post-mortem examination and morphological feature of shell identified, respectively and body conditions, deworming history, and management systems were the risk factors for Fasciolosis, but only body conditions and sex for Paramphistomiosis, age, and deworming history for Dicroceliosis in cattle, while in sheep body conditions, deworming history, and management systems were contributions factors for Fasciolosis, sex, and body conditions for Paramphistomiosis and age and deworming history for Dicroceliosis.

Based on the conclusions from this paper, the following could be recommended as follows:

- Animal owners and the community should be educated about the causes, and effects of trematode infections in livestock and the role of the intermediate host.
- regular deworming of animals, drainage of swampy areas, and fencing of watering points in the study area to safeguard animal health for improved productivity.
- Due to the low sensitivity of coprological examination, post-mortem examination, and morphological feature shell identification, it should be supported by serological and molecular techniques.

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8. ANNEXES

Annex 1: Equipment, procedures of sedimentation technique, and Stoll's eggs count.

1) Weigh approximately 3g of feces into a beaker & mix it with 50 ml of tap water thoroughly
2) Filter the suspension through a tea strainer into a container
3) Pour the filtered material into a test tubes
4) Allow sedimenting for 5 minutes
5) Remove the supernatant very carefully
6) Re-suspend the sediment in 5ml of water
7) Allow sedimenting for 5 minutes

8) Discard the supernatant carefully

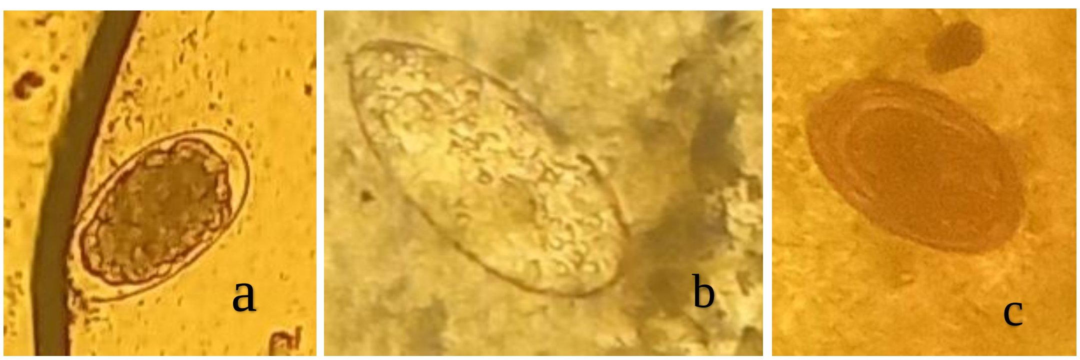
9) Stain the sediment by adding one drop of methylene blue

10) Put 2 drops of the stained sediment into a microscope slide using a pipette

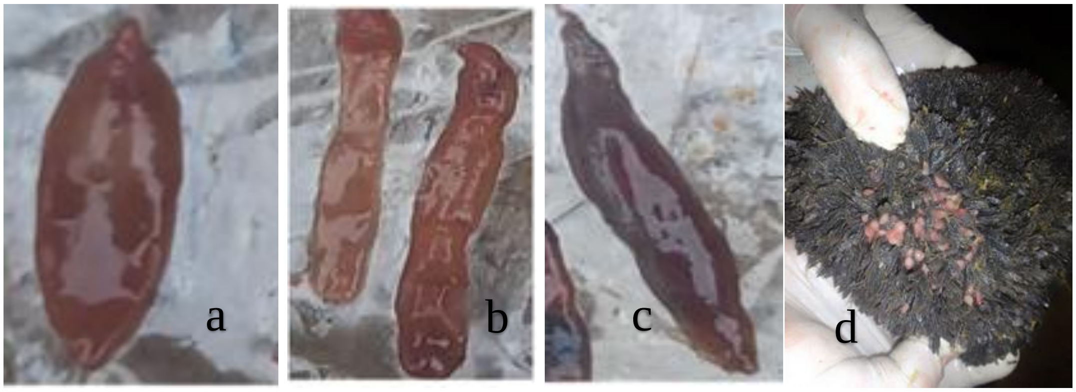
11) Cover with a coverslip and examine under a microscope at 10X objective Magnification

12) Count the eggs of the whole content and multiply the number by 100 to get eggs per gram of feces value.

Annex 2: Eggs of trematode parasite identified from cattle and sheep using a sedimentation method. *Fasciola* (a) *Paramphistomum* (b) and *Dicrocellium* (c).



Annex 3: Adult trematode parasites identified from cattle during the study (a) *Fasciola hepatica* (b) *Fasciola gigantica* (c) *Dicrocellium* and (d) *Paramphistomum*


a
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