MAKERERE UNIVERSITY

GROSS LESIONS AND ECONOMIC LOSSES ASSOCIATED WITH MEAT CONDEMNATION IN CATTLE AND SMALL RUMINANTS AT HOIMA CITY SLAUGHTERHOUSE

BY

AHEEBWA KELVIN LINUS

21/U/0909

2100700909

A SPECIAL RESEARCH PROJECT REPORT SUBMITTED TO THE COLLEGE OF VETERINARY MEDICINE, ANIMAL RESOURCES AND BIOSECURITY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF BACHELOR OF VETERINARY MEDICINE OF MAKERERE UNIVERSITY

OCTOBER, 2026

DECLARATION AND APPROVAL

I, **Aheebwa Kelvin Linus**, declare that this dissertation is an original copy of the work done by myself and has not been submitted to any other institution for the award for any degree, diploma or academic certificate.

Signature: ..... Date: 7th October 2026

This dissertation has been submitted with the guidance and supervision of;

Dr. Alfred Kinyera,
Department of Biosecurity, Ecosystems and Veterinary Public Health,
School of Biosecurity, Biotechnical and Laboratory Sciences,
College of Veterinary Medicine, Animal Resources and Biosecurity,
Makerere University, P.O Box 7062, Kampala.

Signature: ..... Date: 8/10/2026

DEDICATION

I dedicate this special project to the Almighty God for all His mercy and providence throughout my life and especially during my undergraduate studies.

ACKNOWLEDGEMENTS

I would like to appreciate my academic supervisor Dr Alfred Kinyera for the constant support, guidance and encouragement rendered to me during the conducting of this research project.

I would also like to thank Dr Samuel Kaheesi, Head of Department Production and Marketing for Hoima City Local Government for permitting me to conduct the study at the City Slaughterhouse premises, Mrs. Oliver Musinguzi, Veterinary Officer in charge of Hoima City area and inspector of the Slaughterhouse, Mr. Abdallah Bazanye, the Slaughterhouse manager, Mr. Badic Badru and the rest of the slaughterhouse staff for their close support and cordial relationship shared during the study period.

Lastly, I am grateful to the People and the Government of Uganda for financing my undergraduate studies through the Government Scholarship.

TABLE OF CONTENTS

DECLARATION AND APPROVAL.....i

DEDICATION.....ii

ACKNOWLEDGEMENTS.....iii

TABLE OF CONTENTS.....iv

LIST OF TABLES.....vii

LIST OF FIGURES.....viii

ABSTRACT.....ix

CHAPTER ONE: INTRODUCTION.....1

1.1 Background.....1

1.2 Problem Statement.....2

1.3 Research objectives.....3

1.3.1 General objective.....3

1.3.2 Specific objectives.....3

1.4 Research questions.....4

1.5 Justification for the study.....4

1.6 Conceptual framework.....5

CHAPTER TWO: LITERATURE REVIEW.....6

2.1 Introduction.....6

2.2 Causes of meat condemnation.....6

2.2.1 Fascioliasis.....7

2.2.2 Hepatic abscesses.....9

2.2.3 Hydatidosis.....9

2.2.4 Carcass bruising.....10

2.2.5 Aspiration of blood in the lungs.....11

2.2.6 Pneumonia.....12

2.2.7 Tuberculosis.....13

2.2.8 Cysticercosis 14
2.3 Conclusion 14
CHAPTER THREE: MATERIALS AND METHODS 17
3.1 Study area 17
3.2 Study design 17
3.3 Study population 17
3.4 Study period 18
3.5 Sampling method and sample size determination 18
3.6 Data collection and analysis 18
3.7 Economic loss evaluation 18
3.8 Ethical consideration 18
CHAPTER FOUR: RESULTS 19
4.1 Demographics of the study 19
4.2 Gross lesions that caused meat condemnation and their prevalence 19
4.2.1 Cattle 19
4.2.2 Goats 20
4.2.3 Sheep 20
4.3 Economic losses associated with meat condemnation 21
4.3.1 Cattle 21
4.3.2 Goats 22
4.3.3 Sheep 22
CHAPTER FIVE: DISCUSSION 25
5.1 Study strengths and limitations 28
5.1.1 Strengths 28
5.1.2 Limitations 28
5.2 Areas for future studies 28
CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS 29

6.1 Conclusion.....29
6.2 Recommendations.....29
REFERENCES.....30
APPENDICES.....38
Appendix I: Research Pictorial evidence.....38
Appendix II: Data collection form.....41

LIST OF TABLES

Table 1: Condemnation rates for cattle organs 19

Table 2: Condemnation rates for goat organs 20

Table 3: Condemnation rates for sheep organs 21

Table 4: Economic loss in cattle 21

Table 5: Economic loss in goats 22

Table 6: Economic loss in sheep 23

Table 7: Comparative analysis of the mean economic loss between species 23

Table 8: Comparative analysis of the mean economic loss between gross lesions among cattle 23

Table 9: Comparative analysis of the mean economic loss between gross lesions among goats 24

Table 10: Comparative analysis of the mean economic loss between gross lesions among sheep 24

LIST OF FIGURES

Figure 1: Conceptual framework adopted with modification from Ogwang et al (2025) & Opio et al (2021) 5

Figure 2: Sketch map showing the study area (Hoima district) 17

ABSTRACT

Abattoir inspection and surveillance is a ready source of valuable information on the incidence and epidemiology of animal diseases that are both of public and animal health importance. This information is important in preventing spread of such diseases and promoting food safety, which consequently leads to cases of meat/ livestock being condemned, bearing economic and food security implications. This study was conducted on cattle and small ruminants slaughtered at Hoima City slaughterhouse and its aim was to identify the major gross lesions and evaluate the economic losses associated with meat condemnation. It was done by conducting a survey which included all livestock slaughtered in the month of January 2026 i.e. 548 cattle, 520 goats and 110 sheep. The study revealed that liver was the most condemned organ in all species with a rate of 57.5% (315/548) in cattle, 26.5% (138/520) in goats and 38.2% (42/110) in sheep. The leading cause of liver condemnation in cattle was fascioliasis with 26.3% (144/548) while in goats and sheep it was hepatitis with 11.9% (62/520) and 18.2% (20/110) respectively. Other gross lesions that caused condemnation were pneumonia (9.7%, 14.2% and 19.1% in cattle, goats and sheep respectively), blood aspiration in lungs, hepatic abscesses (11.1% in cattle), muscle bruising in cattle (34.9%). The total economic loss associated with meat condemnation during the study period for each species was as follows; UGX 18,300,600 in cattle, UGX 3,124,400 in goats and UGX 939,700 in sheep. The study results showed that there was significant meat condemnation resulting in heavy losses cumulatively, which implied that more efforts are required, both on individual and policy level to undertake measures and techniques to prevent animal diseases, especially those that cause meat condemnation.

CHAPTER ONE: INTRODUCTION

1.1 Background

Meat plays a critical role in human nutrition by providing protein, micronutrients, and energy that are vital for growth, development, and maintenance of health. Globally, the demand for meat has steadily risen due to urbanization, population growth, and changing dietary preferences (FAO, 2025). The Food and Agriculture Organization (2021) estimates also indicated that the per capita meat consumption in developing countries has more than doubled since the 1960s, reflecting the increasing reliance on livestock and livestock products as a source of food security and livelihood.

Agriculture is the backbone of Uganda's economy, contributing 24% to the national GDP, 24% to the total export earnings and employing 70% of the country's population (FAO, 2025). The livestock production sector is a significant contributor to the agricultural GDP, as well as an important source of livelihood to people, through the sale of live animals and their products e.g. meat, milk, eggs, etc. (Herrero *et al*, 2013). These products serve as important protein sources. Proteins play a vital role in growth, body maintenance and in chemical processes which drive body functions (Corsetti *et al*, 2024). In addition, livestock serve as a form of savings, which can easily be liquidated into cash and provide many other benefits both directly and indirectly (Banda *et al*, 2021).

The Government of Uganda, in efforts to address food safety, public health and animal welfare issues, sets and enforces legislation regarding animal slaughter. The law requires that all food animals whose products are intended for public sale and consumption are slaughtered and inspected in designated slaughter facilities by qualified and experienced veterinary practitioners (MAAIF, 2025).

This inspection is done starting with ante mortem examination which happens ranging from 24 hours before to just before animals are slaughtered. Animals are physically examined for signs of disease or injury. Those passed are slaughtered and then undergo post mortem examination, where internal body organs are visually examined for abnormal changes, presence of parasites and disease indicators. Carcasses and organs are passed, passed conditionally, partially condemned or totally condemned, according to results of the examination (MAAIF, 2025).

Animal food products which are passed upon examination (or deemed fit for human consumption) have been 'confirmed' to be free of zoonotic diseases, parasitic infections, and compliant with national or regional meat quality standards (MAAIF, 2025).

Livestock production and processing is a business and a major source of livelihood for the majority of stakeholders in Hoima City abattoir; meat condemnation can therefore have significant economic implications on those traders. Each kilogram of meat condemned is a financial loss suffered by the livestock trader. A study by Abuseir (2019) done in Northern Palestine revealed a loss of nearly USD 16,500 in 6 months as a result of meat condemnation. A similar study by Abunna *et al*. (2013) in Ethiopia showed a nearly USD 24,500 loss due to condemnation in 4 months. In Uganda and Hoima City in particular, several animals are slaughtered weekly yet many are considered unfit for human consumption with meat being partially or wholly condemned due to various reasons. However limited studies have been conducted in this area focusing on the drivers and quantifying the economic losses associated with such meat condemnation.

This study therefore, seeks to investigate the drivers of meat condemnation and the resulting economic losses associated with meat condemnation at Hoima City Slaughter House in Hoima City.

1.2 Problem Statement

Meat condemnation, defined as the rejection of carcasses or organs that are unfit for human consumption, is of great public health concern due to substantial economic, health, and food security implications (Ciui *et al.,* 2023). Globally, the economic losses from meat condemnation due to disease, contamination, or improper handling vary widely across regions, and are particularly high in Sub-Saharan Africa, with facility-level or period losses ranging from hundreds to thousands of U.S dollars (Kiswaga *et al.,* 2016; Kouam *et al.,* 2019; Taha *et al.,* 2023).

Studies by da Silva *et al.* (2023) and Yibar *et al.* (2014) reported economic losses amounting to USD 243,737 over 3 years and 245,483 over six months in Brazil and Turkey, respectively. Similar studies in Tanzania by Kiswaga *et al* (2016), and South Sudan by Taha *et al* (2014) indicated that USD 205,700 and USD 29,686, respectively, were lost over three months.

In Uganda, livestock farmers and traders are currently suffering financial losses due to partial or total condemnation of meat from their animals in slaughter facilities, with studies in Kumi district projecting an annual loss of USD 11,665 (Ogwang, 2023) This is further worsened by the absence of proper documentation of these losses, hence many farmers/ traders remain ignorant of the actual financial impact that these condemnations are having on them, silently stagnating their financial growth, causing frustration, endangering livelihood, survival and worsening conditions of living.

The Government of Uganda, through the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), has constructed a modern abattoir in Hoima city with funding from Uganda Support to Municipal Infrastructure Development (USMID) project, as a designated slaughter facility for Hoima City and neighbouring areas (Abaanabasazi, 2025). Veterinary personnel were recruited and deployed by city authorities to be in charge of meat inspection in this facility.

However, limited studies have been conducted focusing on drivers and associated economic loss due to meat condemnation in slaughter facilities in Uganda, particularly in the district of Hoima, which creates a significant knowledge gap that affects livestock traders, veterinary personnel, policy actors, and other stakeholders in the meat value chain in developing appropriate strategies to minimise these losses.

This study therefore, seeks to investigate the gross lesions that cause meat condemnation and resulting economic losses at Hoima City Slaughterhouse in Hoima City.

1.3 Research objectives

1.3.1 General objective

To determine the gross lesions and the economic losses associated with meat condemnation at Hoima City Slaughterhouse in Hoima City.

1.3.2 Specific objectives

i. To identify the gross lesions that cause meat condemnation at Hoima City Slaughterhouse.
ii. To evaluate the economic losses associated with meat condemnation at Hoima City Slaughterhouse.

1.4 Research questions

1. What are the gross lesions that cause meat condemnation at Hoima City Slaughterhouse?
2. What are the economic losses associated with meat condemnation at Hoima City Slaughterhouse?

1.5 Justification for the study

This study seeks to generate and document new information about drivers and economic losses associated with meat condemnation in Hoima City abattoir. This information will help in influencing government policy making which will improve resource allocation towards health interventions and extension services regarding livestock production. As a consequence, this will render increased government support towards farmers, so that incidence of animal health problems is reduced, and animal production technologies are improved contributing to reduced chance of meat condemnation at slaughter facilities, and growth of the livestock sector at large. These proposed benefits give justification to the study.

In addition, the study is in agreement with The 2030 Agenda for Sustainable Development program of the United Nations, with the 17 Sustainable Development Goals (SDGs) at its core. SDGs 1, 2 and 3; No Poverty, No Hunger and Good Health and Wellbeing respectively, are being specifically tackled as a result of this study.

1.6 Conceptual framework

This study is based on a systems-based epidemiologic and economic evaluation framework, which illustrates the causal pathway from pre-slaughter animal characteristics to post-mortem findings and their eventual economic and public health implications.

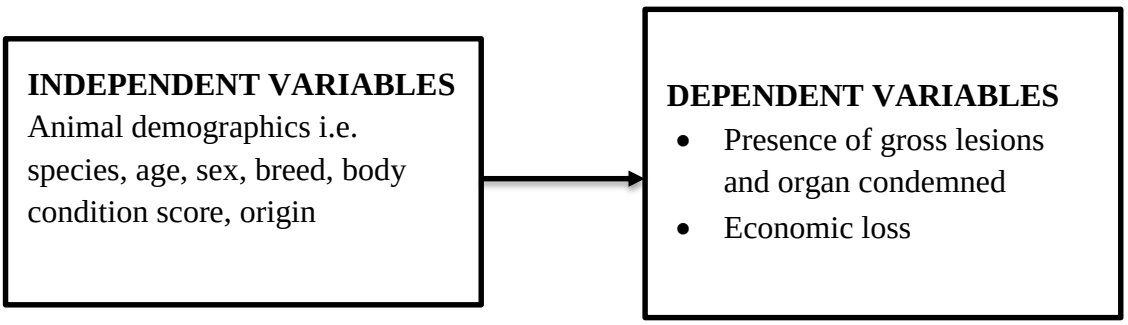


Figure 1: Conceptual framework adopted with modification from Ogwang et al (2025) & Opio et al (2021)

The independent variables in this study are identified as animal demographic characteristics i.e. species, age, sex, breed, body condition score, origin, while the independent variables are presence of gross lesions and organ condemned, and economic loss (Okoye & Hosseini, 2024). The animal demographics have a causal effect on the gross lesions that cause condemnation as well as resulting economic loss. This relationship has been reported by Ogwal et al, 2025 and Opio et al, 2021.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Slaughterhouses are designated places for slaughter and inspection of animals whose meat products are intended for public consumption (Ibrahim *et al*, 2021). They play an important role in contributing to public health, as an intersection between animal and human health as a result of the former (García-Díez *et al*, 2023).

The slaughter house acts as a centre for quick and easy sentinel disease surveillance of animal diseases since it is a gathering point of animals from various geographical locations e.g. Transboundary animal diseases like Foot and Mouth Disease can be detected long before outbreaks are reported (Ibrahim *et al*, 2021). In addition, information obtained from post mortem inspection on frequency of occurance of key conditions like tuberculosis, helminthiasis (e.g. Fascioliasis) serves as indicator of shortage/ insufficiency in preventive medicine programs for the locations or regions of origin of the animals in question (García-Díez *et al*, 2023).

2.2 Causes of meat condemnation

Various factors have been pointed out as being responsible for rendering meat unfit for human consumption. These factors are either diseases or conditions that cause pathological changes to the normal structure and composition of body organs and tissues that drastically reduce the quality of meat or pose a hazard or threat to human health (Jubb *et al,* 2012). These conditions can be broadly categorized as infectious and non-infectious causes (Jubb *et al*, 2012).

Infectious causes are those introduced by microorganisms and parasites such as bacteria, viruses, protozoa, parasitic worms, etc, and include tuberculosis, brucellosis, salmonellosis, fascioliasis and cysticercosis (Quinn, 2025).

Non-infectious causes of meat condemnation on the other hand are those caused by genetic, physiological, environmental or behavioural factors and include emaciation, haemorrhages from traumatic injuries (da Silva & Costa, 2022).

In Sub-Saharan Africa however, the most common causes of meat condemnation were reported to be bacterial diseases and parasitic worms (Berbersa *et al*, 2016). In Tanzania, Tembo *et al* (2015) identified Fascioliasis and hydatidosis as the major causes of meat

condemnation, with similar findings from Ethiopia indicating Fascioliasis, cysticercosis and hydatidosis as the highest ranking causes of meat condemnation (Berbersa *et al*, 2016). In a Ugandan study conducted in the Northern district of Gulu, the prevalence of Fascioliasis was reported to be 65.7% (Opio *et al*, 2021).

2.2.1 Fascioliasis

Fascioliasis is an economically important parasitic zoonosis in ruminants caused by the helminths *Fasciola hepatica* and *Fasciola gigantica* of the Order Trematoda (Saleem, 2017). The disease is an important limiting factor for ruminant production and causes significant economic loss due to morbidity and mortality. Clinical disease is mainly characterised by weight loss, anaemia and hypoproteinaemia. It is usually diagnosed at post mortem inspection with adult parasites found in bile ducts in the liver (Tsega *et al*, 2015).

The fascioliasis causing helminthes, generally termed as liver flukes, consist of *F. hepatica* found in temperate areas and in cooler high altitude areas and *F. gigantica* is predominantly distributed in the tropics and subtropics (Otranto *et al*, 2024). *F hepatica* is leaf shaped with broad anterior and cone shaped anterior projection. *F gigantica* is larger than *F hepatica* and can reach a length of 7.5 cm. Its shape is more leaf-like, and its eggs are larger than those of *F hepatica*. *Fasciola* eggs are operculated with a yellowish brown shell and embryonic cells. (Otranto *et al*, 2024).

The risk of infection of Fascioliasis is determined by the number of infected *Lymnae* snails in the grazing area. The disease has a pattern of predictability in regions where snails are active for only certain parts of the year such as rainy seasons. Cattle and sheep are the main reservoir host species. In tropical regions, Fascioliasis is considered as one of the most important helminthes infection for cattle where the reported prevalence is 30% - 90%, 25% - 100%, 25% - 90% in Africa, in India and in Indonesia respectively (Kruchynenko *et al*, 2022).

Snails of the genus *Lymnae* have been implicated as the intermediate hosts for Fascioliasis while most mammals including man, sheep and cattle, are identified as the final host with cattle being most important final host. Infection is by ingestion of contaminated grass and in utero transmission in sheep, although not common (Tsega,

2015). Adult sheep and cattle can potentially remain carriers for many years because of the longevity of adult flukes (Constable *et al*, 2016).

The life cycle of Fasciola involves the adult flukes residing in the bile ducts shedding eggs into the bile which are passed into the intestinal tract and voided with faeces. After being passed out, they require a minimum of 10 days to develop and hatch into motile miracidium (Ibrahim, 2017). This miracidium has a short life span and must locate and penetrate a suitable snail host within 3 hours. Upon successful penetration, the miracidium develops into sporocyst, radia and cercaria which is then shed from the snail as a motile form which attaches itself to surfaces such as grass blades and then develop into the infective metacercariae. The metacercariae infest the final host and encysts in the small intestine and migrate through the gut wall, cross the peritoneum and penetrate the liver capsule. The young flukes tunnel through the liver parenchyma and then enter the bile ducts from where they migrate into the gall bladder (Otranto *et al*, 2024).

Pathogenesis is according to the phase of parasite development in the liver. Migration through the liver parenchyma causes liver damage and haemorrhage, and damage to the biliary mucosa and blockage of the ducts causes jaundice. Acute disease often occurs in sheep as sudden death resulting from grazing on heavily contaminated herbage but rarely occurs in cattle (Constable *et al*, 2016). Chronic disease doesn't become apparent until several weeks after the disease has receded and it occurs when the flukes reach the bile duct (Taylor *et al*, 2015).

Diagnosis is based on clinical signs, grazing history and seasonal occurance, however examination of faecal samples in the laboratory is crucial in confirming the disease in live animals (Constable *et al*, 2016). Serology can also be used to detect serum antibodies against Fasciola but the most reliable method for diagnosis of this condition is necropsy. Adult flukes can be found in hepatic bile ducts which are often inflamed (Taylor *et al*, 2015). Liver cirrhosis is also an associated finding probably resulting from parenchymal injury caused by parasite migration (Otranto *et al*, 2024).

For treatment, not all chemicals are equally effective against the various stages of development of *F. hepatica*; in an acute disease, the selected drug must be highly effective against the juvenile stages, while for chronic cases, adult flukes are targeted with Triclabendazole being considered highly efficacious against adult parasites

(Constable *et al*, 2016). It is also ovicidal and kills any eggs present in the bile duct or intestinal tract at the time of treatment (Constable *et al*, 2016).

2.2.2 Hepatic abscesses

Liver abscessation is a condition characterised by formation of multiple abscesses within the lung parenchyma. It has been commonly reported in feedlot cattle and often results from diets that are predominantly of grain and low roughage feed which triggers ruminal acidosis with liver abscessation resulting. This condition is of great economic importance due to reduced feed conversion, decreased weight gain leading to lower carcass weight, and condemnation of liver at slaughter houses (Taylor *et al*, 2025).

Fusobacterium necrophorum is considered to be the primary causative agent of this condition as it is the most commonly isolated bacterium from liver abscesses (Calcutt *et al*, 2014). In the beef production value chain, the final stage is often the feedlot, where beef cattle are transitioned from a forage based diet to a diet with high concentrations of grain and low roughage feed. Over time as cattle receive this kind of diet, the ruminal bacteria rapidly digest the readily available starch in this diet causing a rapid buildup of lactic acid within the rumen. The resulting acidic conditions in the rumen cause damage of the ruminal epithelium leading to rumenitis. The weakened integrity of the ruminal barrier causes escape of ruminal bacteria into portal circulation that goes to the liver where they proliferate and form encapsulated abscesses that can grow to various sizes (Amachawadi *et al*, 2022).

The only effective and definitive method of detecting liver abscesses is visual examination of the liver at slaughter. Other options such as ultrasonography have been explored but proven to be highly limited. For control of this condition, in-feed antibiotics such as tylosin have been used and proven effective (Amachawadi *et al*, 2016; Amachawadi *et al*, 2017).

2.2.3 Hydatidosis

Hydatidosis, also called cystic echinococcosis, is one of the most important helminth zoonoses and poses a significant problem worldwide. It is caused by a tapeworm of the genus *Echinococcus*, and causes considerable economic loss due to organ condemnation as well as reduced animal productivity for meat and milk. It also poses a major public health threat because it is zoonotic.

Two causative agents are recognized for hydatidosis i.e. *E. granulosus* and *E. multilocularis*, although *E. granulosus* is most widespread (Shiferaw *et al*, 2018). The definitive host of *E. granulosus* is the dog which harbours the adult parasite and sheds the parasite eggs along with its faeces, while ruminants and humans are intermediate hosts. Humans get infected when they ingest the parasite's eggs and develop cysts in visceral organs such as the liver and lungs. The disease in intermediate hosts is caused by the hydatid which is the larval stage (Shiferaw *et al*, 2018).

Transmission happens when intermediate hosts such as bovine, ovine, caprine, swine and human ingest herbage or grass contaminated with the parasite's eggs (Regassa, 2019). They then migrate through the stomach wall into the blood stream and are carried to various internal organs, usually the liver and lungs and sometimes the brain. The eggs in those tissues then develop into larvae enclosed in watery cysts, which proliferate and enlarge. The cyst containing organs are then ingested by the final/ definitive hosts and attach onto the intestinal wall where they develop into adults that then lay eggs that are shed with faeces (Gessese, 2020).

In animals, the disease is usually diagnosed at post mortem in slaughterhouses when visceral organs are found with cysts. These organs are totally/ wholly condemned due to the zoonotic nature of the disease and for meat quality reasons. This disease is a significant contributor to economic losses at slaughter houses worldwide. Tefere *et al* (2012) reported a 19 million ETB loss solely due to hydatidosis in Addis Ababa, Ethiopia.

2.2.4 Carcass bruising

A bruise is a focal discolouration (reddening) of the carcass surface caused by rapture of blood vessels and extra-vascular accumulation of blood due to the impact of a blunt instrument (Sánchez *et al*, 2022). At meat inspection, bruised carcasses are considered unfit for human consumption because of their unappealing appearance and poor meat quality due to their rapid rate of spoilage and since blood is a favourable growth medium for bacteria (Cruz-Monterrosa *et al*, 2017).

Bruising commonly occurs as a result of poor animal handling and welfare standards. Any event that causes a blunt force to be applied onto an animal's body sufficient to cause rapture of blood vessels leads to bruising. Such events may include kicking or prodding

with sticks in attempts to drive animals to move, structural hazards such as sharp corners on gates, narrow crushes/ races, protruding parts in transport vehicles, slipping or falling which occurs on poorly designed and slippery floors of lairages at slaughter houses (Miranda-de la Lama *et al*, 2012). Majority of bruising originates during animal transportation.

Several factors increase the risk of occurance of events that cause bruising in animals along the farm to slaughter value chain. Transport distance and duration is a major risk factor as prolonged transportation increases fatigue, increasing the frequency of falls and collisions among the animals (Folitse *et al,* 2017). High stocking density in trucks causes frequent collisions among animals whereas in undercrowding, animals lack support and stability and are tossed around against the vehicle walls (Hoffman *et al*, 2012). In addition, aggressive handling by humans also poses a serious risk for bruising. It is a common practice for animal transporters in Uganda to tie cattle by their horns and tails to the rails of the truck canopy to keep them standing still (Editor, 2025). Animal breeds with a larger frame and horns are also at a higher risk of injuring themselves during transit.

The economic impact of bruising is such that all bruised meat is to be condemned at meat inspection. This standard is mostly upheld by developed countries due to meat quality concerns pointing to the unappealing appearance of carcasses as well as meat hygiene reasons due to the blood being a growth medium for bacteria triggering rapid rates of meat spoilage (Cruz-Monterrosa *et al*, 2017). In many countries with developing economies, bruised meat is commonly passed for human consumption in local markets regardless, due to economic reasons (Cruz-Monterrosa *et al*, 2017). In some cases, bruise trimmings for cases of localised bruising are redirected for lower value processing e.g. mincing, canning, etc. Carcass bruising is very common and its economic losses are a substantial problem in the meat value chain and have been estimated at several million dollars annually by several authors. (Huertas *et al*, 2015, Folitse *et al,* 2017).

2.2.5 Aspiration of blood in the lungs

Aspiration of blood in the lungs is one of the common findings during post-mortem inspection at slaughter houses, particularly where ritual slaughter methods that involve open transverse cutting of the neck before stunning are used. It is defined as the inhalation of blood into the trachea and bronchi until it finally reaches the lung parenchyma.

It is usually a consequence of religious slaughter methods e.g. Halal, Kosher, etc, where animals are bled to death without stunning. These methods involve a swift deep transverse incision across the neck, severing the trachea, oesophagus and jugular/ carotid blood vessels (Farouk *et al*, 2014). Since the animal is not stunned, the animal remains conscious for a while before complete blood loss. During this time, the brain triggers a powerful inhalation reflex which is effected by the contraction of the diaphragm creating a negative pressure within the thoracic cavity. The vacuum created in the thoracic cavity pulls blood pooling in the neck from the severed vessels into the open severed trachea which then flow through the bronchial tree till the alveoli (da Silva & Costa, 2022).

During post mortem inspection, affected lungs appear externally as having generalised reddish spots or patches that alternate with healthy tissue creating a patchy or mottled pattern. Upon incision, frothy blood is found in the airways as well as the lung parencyma Ferreira *et al*, 2023).

Lungs found with aspirated blood are condemned for two reasons, the first being that the appearance is not aesthetically pleasing due to the blood patch appearance. Secondly, the blood within the lungs makes the meat highly perishable since it is a favourable growth medium for bacteria. Leite *et al* (2022) reported an 8.36% prevalence of condemnation in Brazil due to blood aspiration. Achollah *et al* (2020) who conducted a similar study in Kenya reported a prevalence of 1.8%.

2.2.6 Pneumonia

Pneumonia is defined as the inflammation of lung parenchyma (Carvallo & Stevenson, 2022). It is among the major causes of meat (or lung) condemnation at slaughterhouses throught the world. Mohammed *et al* (2025) reported pneumonia as a major cause of condemnation at an abattoir in Egypt with a prevalence of 26.2% while Kelo & Alemu (2018) reported a prevalence of 20.3% in Ethiopia.

Lung inflammation has a wide variety of causes, including bacteria, viruses, parasites and aspiration, and in many cases is caused by a combination of agents (Carvallo & Stevenson, 2022). The common causes of pneumonia in livestock include; bacterial; Pasteurella/ Mannhemia species, Mycoplasma species; Parasitic: Lungworms such as Dictyocaulus viviparous (Jubb *et al*, 2012).

Risk factors for pneumonia include long distance animal transportation which causes stress and immunosuppression triggering multiplication of normal flora bacteria. Another is poor ventilation leading to high ammonia levels causing irritation of the upper respiratory tract (Constable *et al*, 2016).

Lungs found with pneumonia of any stage are strictly and totally condemned from human consumption. In some cases the pneumonia may be part of a systemic infection (septicaemia) causing condemnation of the whole carcass (Adebowale *et al,* 2021). At the preslaughter stage, infected animals suffer stunted growth, weight loss and poor feed conversion rates, representing financial loss to the farmer (Constable *et al*, 2016).

2.2.7 Tuberculosis

Tuberculosis (TB) is a zoonotic disease of public health importance caused by bacteria of the genus *Mycobacterium* (Khan *et al*, 2019). Tuberculosis in livestock is caused mostly by *M bovis* and is usually a chronic, debilitating disease, although it can be acute and rapidly progressing. Because tuberculosis is a zoonosis that causes grave disease in humans, it is of great public health and economic importance, affecting both animal productivity and international trade (Lema & Dame, 2022).

Constable *et al* (2016) mentions that tuberculosis affects a wide range of domestic livestock and wild animals and the common causative agents are *M bovis, M tuberculosis, M avium, M caprae*. The disease is distributed worldwide although it is most common in developing countries in Africa and Asia.

The disease is transmitted through inhalation of aerosol droplets from infected animals. The risk of exposure is greatest in enclosed areas such as barns. Inhalation is the common route of infection for farm workers and veterinarians who work with diseased livestock (Gortázar *et al*, 2023). TB causes abscess like lesions called granulomas or tubercles in visceral organs, especially the lungs. The disease can definitively diagnosed at post mortem inspection at slaughterhouses (Khairullah *et al,* 2024). Carcasses found with lesions consistent with TB are totally condemned which causes great economic loss to the livestock sector (Ibrahim *et al,* 2021).

2.2.8 Cysticercosis

Cysticercosis in livestock refers to the infection of cattle and sheep with the larval stage of a parasitic flat worm of the genus *Taenia* originating from either humans or dogs as final hosts (Taylor *et al*, 2015). The disease remains one of the most significant challenges in the meat industry and veterinary public health. According to Alemneh *et al* (2017) Bovine cysticercosis is most prevalent in developing countries in Subsaharan Africa, with many exceeding 10% with 33% in Kenya, 22% in Zaire and 10% in Nigeria, with his theory being that these countries still face challenges of poverty and poor hygienic conditions.

The life cycle of the *Taenia* worm is completed over two hosts; a final and intermediate host. The adult resides within the digestive tract of the final hosts as it lays eggs which are shed along with faeces into the environment which are picked by the intermediate hosts via contaminated feed/ herbage and water (Calero-Bernal & Horcajo, 2026). *T solium* causes the disease in cattle, with humans as the final host while *T ovis* causes disease in sheep, with dogs as the final host. When the eggs are ingested by the intermediate hosts, they hatch into larvae in the small intestine and then enter into the bloodstream and spread to various organs, primarily striated muscle. The larvae then encysts forming a fluid filled bladder containing a single invaginated scolex (the head of the future tapeworm) (Taylor *et al*, 2015). These lesions are termed as muscle cysts and the most commonly affected muscles include heart, shoulder, masseter and the tongue.

The infection rarely causes clinical diseases in live animals, but when lesions consistent with the disease are discovered at post mortem meat inspection, the carcasses are subject to strict regulatory action often leading to condemnation and economic loss (Kumar & Tadesse, 2011).

2.3 Conclusion

Various studies demonstrated similar study methods of diagnosis of causes of meat condemnation e.g. antemortem and post mortem examination (Ssimbwa *et al*, 2014, Takang *et al*, 2020). In addition, similar methods were used in determination of economic loss due to the condemned meat, where condemned portions or whole organs were weighed and and the loss calculated from multipling the weight obtained by unit market price for the respective organs (Takang *et al*, 2020, Dlamini *et al*, 2025). Others such as

Achollah *et al* (2020) used an eqaution described by Mwabonimana *et al*. (2010) to calculate the direct financial loss from meat/ organs condemned. A number of studies that focused on Fascioliasis as a cause of meat condemnation e.g. Ogwal *et al* (2025), Dlamini *et al* (2025) and Joan *et al* (2015) recorded an association between prevalence of the condition and communal grazing in swampy areas as well as rainy/ dry seasons.

In many previous studies conducted, variations have been observed in the results obtained. Dahesa *et al* (2026) reported a 14% prevalence of Fascioliasis in Ethiopia while Barre *et al* (2026) recorded 41% in Malaysia. In Uganda, Joan *et al* (2015) reported a Fascioliasis prevalence of 84%, while Opio *et al* (2021) reported 65.7%. In Cameroon, Takang *et al* (2020) reported a prevalence of 18% in cattle and 27% in sheep. Variations have also been seen with regard to economic loss due to meat condemnation. There have also been differences in methodologies used among previous studies such as Silva *et al* (2023) and Madzingira *et al* (2018) who used retrospective study designs whereas others like Joan *et al* (2015) and Ssimbwa *et al* (2014) used prospective study designs. Sheferaw & Abdu (2017) on the other hand used a combination of both prospective and retrospective designs to conduct their studies. The above noted variations in previous studies imply that differences in results are to be expected, and that no study is identical with another with regard to methodology and study results

Majority of the studies that attempted to determine the annual economic loss due to meat condemnation did so by extrapolating the loss calculated during the study over 12 months Ssimbwa *et al*, 2014; Abunna & Hordofa, 2013; Joan *et al*, 2015). This method is flawed because that it increases the margin of error leading to inaccurate estimates. It is less erroneous to stop at calculating the economic loss suffered during only the study period, as Lyimo *et al* (2017) and Sheferaw & Abdu (2017) did.

A number of studies carried out in various parts of Uganda over the years such as Ssimbwa *et al* (2014); Joan *et al* (2015); Opio *et al* (2021); Ogwal *et al* (2025) have reported and continue to report high meat/ organ condemnation prevalence directly translating to huge financial losses to the livestock production and trade sector. Since the condemnation burden remains significant due to limited sectoral support by government authorities, this study seeks to perform another research study on the same issues to emphasize their gravity and inform future policy formulation and decision making as well as to trigger attitude and mindset change among the various stakeholders in the industry.

This study also seeks to fill an existing knowledge gap within the study area since no studies on this topic have previously been conducted in Western Uganda and Hoima in particular.

CHAPTER THREE: MATERIALS AND METHODS

3.1 Study area

The study was conducted in Hoima City Slaughterhouse, located in Kyentale Ward, Hoima East Division in Hoima City, which is surrounded by Hoima District. Hoima District is located in the mid-western region of Uganda, and borders the Democratic Republic of Congo to the West. Hoima has a cattle population of 29,967 (UBOS, 2024).

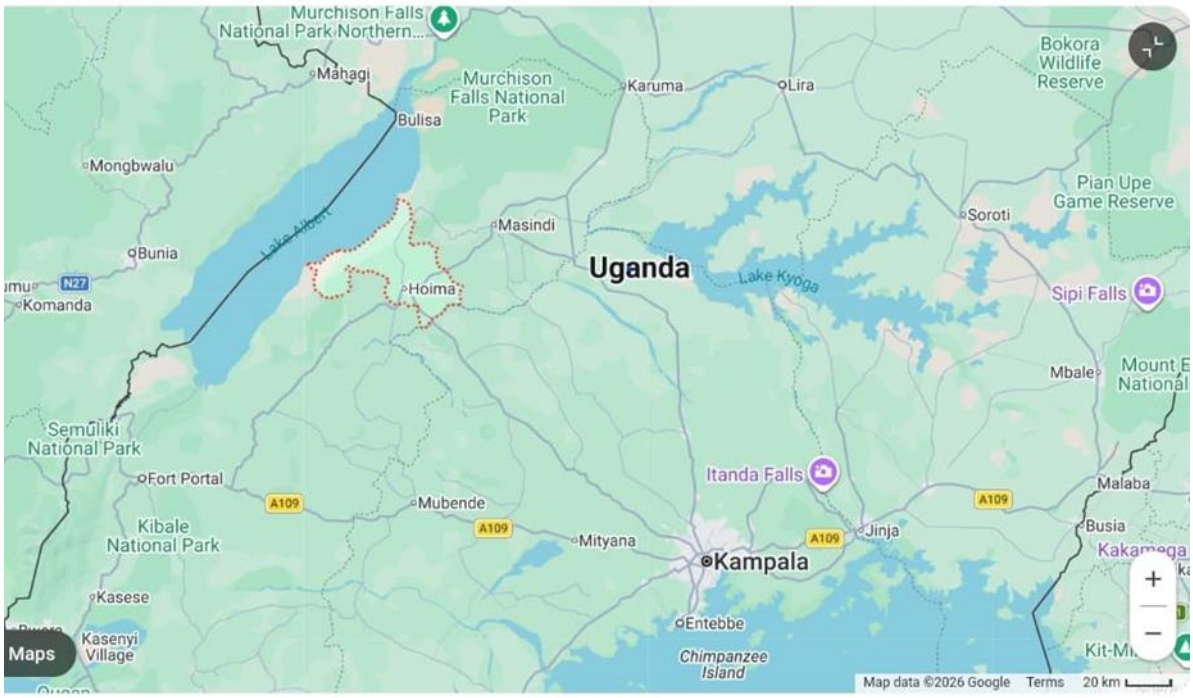


Figure 2: Sketch map showing the study area (Hoima district)

3.2 Study design

A cross-sectional quantitative study was used to investigate the gross lesions and associated economic losses due to meat condemnation in Hoima City Slaughterhouse.

3.3 Study population

The study was based on the livestock slaughtered at Hoima City Slaughterhouse, which include cattle, goats and sheep. These animals originated mainly from within the district of Hoima, as well as neighbouring districts of Kikuube, Kakumiro, Kibaale, Kagadi, Masindi, Buliisa, Kiryandongo, Kyankwanzi, Kiboga as well as others like Mbarara and Lira.

3.4 Study period

This study was conducted during the month of January 2026.

3.5 Sampling method and sample size determination

A census/ survey was conducted which included all animals that were slaughtered in the month of January 2026 at Hoima City Slaughterhouse i.e. 548 cattle, 520 goats and 110 sheep.

3.6 Data collection and analysis

Data was collected through daily abattoir visits during the study period.

For each animal found with gross lesions, carcasses and/ or organs condemned were weighed using a weighing scale and the gross lesions that caused these condemnations were recorded. The prevalence of gross lesions that caused meat condemnation was determined as a proportion of number of condemned organs out of the total number of organs examined. No data was collected on age, sex, breed, body condition score, and origin of each of the livestock brought for slaughter.

The collected data was entered into Microsoft Excel 2016, which was also used to generate descriptive statistics, such as frequencies and percentages for the different variables, calculation of economic loss, as well as data analysis.

3.7 Economic loss evaluation

The economic loss associated with meat condemnation during the study period was calculated by multiplying the total weight of meat condemned per organ by its local market price per Kilogram at the time of study.

3.8 Ethical consideration

Clearance was sought from the Dean, School of Veterinary Medicine and Animal Resources to conduct this study. Additionally, permission and consent was sought from Hoima City Council Administration to undertake the study at the abattoir premises and consent for participation was obtained from the butchers and animal traders association.

CHAPTER FOUR: RESULTS

4.1 Demographics of the study

A total of 548 cattle, 520 goats and 110 sheep were slaughtered and inspected during the study period of one month (31 days), averaging 18 cattle, 17 goats and 4 sheep per day. For cattle, 351 (64.1%) females and 197 (35.9%) males were slaughtered. No data was collected on age, sex (except cattle), breed, body condition score, and origin of each of the livestock brought for slaughter.

4.2 Gross lesions that caused meat condemnation and their prevalence

4.2.1 Cattle

From the organs examined in 548 cattle, 87 lungs (15.9%), 315 livers (57.5%) and 191 carcasses (34.9%) were condemned either partially or wholly due to various gross abnormalities (causes) accordingly, as unfit for local and international markets.

Out of the total lungs inspected, 53 (9. 7%) were condemned due to pneumonia and 34 (6.2%) due to blood aspiration.

Out of the total livers inspected, 144 (26.3%) were condemned due to fascioliasis, 106 (19.3%) due to hepatitis, 61 (11.1%) due to hepatic abscessation. 1 (0.2%) due to hepatomegaly and 3 (0.5%) due to hepatic melanosis.

Out of the total carcasses inspected, 191 (34.9%) were condemned (all partially) due to bruising (muscle haemorrage).

Table 1: Condemnation rates for cattle organs

Organ	Gross lesion	Number condemned	Prevalence (%)
Lungs	Pneumonia	53	9.7
	Blood aspiration	34	6.2
	Total	87	15.9
Liver	Fascioliasis	144	26.3
	Hepatitis	106	19.3
	Hepatic abscesses	61	11.1
	Hepatomegaly	1	0.2
	Hepatic melanosis	3	0.5
	Total	315	57.5
Carcass/ Skeletal muscle	Bruising/ haemorrhage	191	34.9

4.2.2 Goats

From the organs examined in 520 goats, 99 lungs (19.0%) and 138 livers (26.5%) were condemned either partially or wholly due to various gross abnormalities (causes) accordingly, as unfit for local and international markets.

Out of the total lungs examined, 74 (14.2%) were condemned due to pneumonia, 25 (4.8%) due to blood aspiration.

Out of the total livers examined, 45 (8.7%) were condemned due to fascioliasis, 62 (11.9%) due to hepatitis and 31 (6.0%) due to hepatic abscessation.

Table 2: Condemnation rates for goat organs

Organ	Gross lesion	Number condemned	Prevalence (%)
Lungs	Pneumonia	74	14.2
	Blood aspiration	25	4.8
	Total	99	19.0
Liver	Fascioliasis	45	8.7
	Hepatitis	62	11.9
	Hepatic abscesses	31	6.0
	Total	138	26.5

4.2.3 Sheep

From the organs examined in 110 sheep, 29 (26.4%) lungs and 42 (38.2%) livers were condemned either partially or wholly due to various gross abnormalities (causes) accordingly, as unfit for local and international markets.

Out of the total lungs examined, 21 (19.1%) were condemned due to pneumonia and 8 (7.3%) due to blood aspiration.

Out of the total livers examined, 15 (13.6%) were condemned due to fascioliasis, 20 (18.2%) due to hepatitis and 7 (6.4%) were condemned due hepatic abscessation.

Table 3: Condemnation rates for sheep organs

Organ	Gross lesion	Number condemned	Prevalence (%)
Lungs	Pneumonia	21	19.1
	Blood aspiration	8	7.3
	Total	29	26.4
Liver	Fascioliasis	15	13.6
	Hepatitis	20	18.2
	Hepatic abscesses	7	6.4
	Total	42	38.2

4.3 Economic losses associated with meat condemnation

4.3.1 Cattle

During the study period, a total weight of 295.8kg of cattle lungs was condemned. The average market price of lungs during the study period was UGX 13,000, hence the total economic loss due to lung condemnation was UGX 3,845,400.

A total weight of 701.2kg of cattle liver was condemned. Since the unit price of liver was UGX 18,000, the total economic loss due to liver condemnation was UGX 12,621,600.

A total weight of 114.6kg of carcass was condemned. Since the unit price of carcass meat was UGX 16.000, the total economic loss due to carcass condemnation was UGX 1,833,600.

The total economic loss associated with meat condemnation in cattle was **UGX 18,300,600 ($ 4975.53).**

Table 4: Economic loss in cattle

Organ	Gross lesion	Weight loss (Kg)	Average daily weight loss (Kg)	Unit cost per organ (UGX)	Averade daily economic loss (UGX)	Total loss (UGX)
Lungs	Pneumonia	180.2	5.8		75400	2342600
	Blood aspiration	115.6	3.7		48000	1502800
	Total	295.8	9.5	**13000**	123500	3845400
Liver	Fascioliasis	291	9.4		169200	5238000
	Hepatitis	215	6.9		124200	3870000
	Hepatic abscesses	174.4	5.6		100800	3139200
	Hepatomegaly	5.2	0.1678		3020	93600
	Hepatic melanosis	15.6	0.5032		9060	280800
	Total	701.2	22.6	**18000**	406800	12621600
Muscle	Bruising	114.6	3.8	**16000**	60800	1833600
TOTAL					**590300**	**18300600 ($ 4975.53)**

4.3.2 Goats

During the study period, a total weight of 70.4kg of goat lungs was condemned. The average market price of lungs during the study period was UGX 14,000, hence the total economic loss due to lung condemnation was UGX 985,400.

A total weight of 107kg of goat liver was condemned. Since the unit price of liver was UGX 20,000, the total economic loss due to liver condemnation was UGX 2,139,000.

The total economic loss associated with meat condemnation in goats was UGX 3,124,400 ($ 849.45).

Table 5: Economic loss in goats

Organ	**Gross lesion**	**Weight loss (Kg)**	**Average daily weight loss (Kg)**	**Unit cost per organ (UGX)**	**Average daily economic loss (UGX)**	**Total loss (UGX)**
Lungs	Pneumonia	52.6	1.70		23700	736600
	Blood aspiration	17.8	0.57		8000	248900
	Total	70.4	2.27	**14000**	31700	985400
Liver	Fascioliasis	34.9	1.125		22500	697500
	Hepatitis	48.1	1.55		31000	961000
	Hepatic abscesses	24.0	0.775		15500	480500
	Total	107.0	3.45	**20000**	69000	2139000
TOTAL					**100800**	**3124400 ($ 849.45)**

4.3.3 Sheep

During the study period, a total weight of 20.6kg of sheep lungs was condemned. The average market price of lungs during the study period was UGX 14,000, hence the total economic loss due to lung condemnation was UGX 288,700.

A total weight of 32.6kg of sheep liver was condemned. Since the unit price of liver was UGX 20,000, the total economic loss due to liver condemnation was UGX 651,000.

The total economic loss associated with meat condemnation in goats was UGX 939,700 ($ 255.48).

Table 6: Economic loss in sheep

Organ	Gross lesion	Weight loss (Kg)	Average daily weight loss (Kg)	Unit cost per organ (UGX)	Average daily economic loss (UGX)	Total loss (UGX)
Lungs	Pneumonia	14.9	0.48		6740	209000
	Blood aspiration	5.7	0.18		2570	79600
	Total	20.6	0.67	**14000**	9310	288700
Liver	Fascioliasis	11.6	0.375		7500	232500
	Hepatitis	15.5	0.5		10000	310000
	Hepatic abscesses	5.4	0.175		3500	108500
	Total	32.6	1.05	**20000**	21000	651000
TOTAL					**30300**	**939700 ($ 255.48)**

Table 7: Comparative analysis of the mean economic loss between species

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Cattle	31	18300.6	590.342	30507.296
Goats	31	3124.4	100.787	860.243
Sheep	31	939.7	30.313	69.832

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	5768718.38	2	2884359.19	275.248	4.443E-39	3.098
Within Groups	943121.135	90	10479.124			
Total	6711839.515	92				

Since the p-value is less than 0.05 (α), the null hypothesis is rejected in favour of the alternative, which states that there is a significant difference between the mean economic losses between cattle, sheep and goats.

Table 8: Comparative analysis of the mean economic loss between gross lesions among cattle

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Fascioliasis	31	5238	168.968	7213.632
Bruising	31	1833.6	59.148	292.6384

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	186934.5	1	186934.5	49.808	1.996E-09	4.001
Within Groups	225188.1	60	3753.135			
Total	412122.6	61				

Since the p-value is less than 0.05 (α), the null hypothesis is rejected in favour of the Alternative, which states that there is a significant difference between the mean economic losses due to Fascioliasis and Bruising in cattle.

Table 9: Comparative analysis of the mean economic loss between gross lesions among goats

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Pneumonia	31	736.6	23.761	45.352
Hepatitis	31	961	31	90.749

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	812.183	1	812.183	11.935	0.001	4.001
Within Groups	4083.025	60	68.050			
Total	4895.208	61				

Since the p-value is less than 0.05 (α), the null hypothesis is rejected in favour of the alternative, which states that there is a significant difference between the mean economic losses due to Pneumonia and Hepatitis in goats.

Table 10: Comparative analysis of the mean economic loss between gross lesions among sheep

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Pneumonia	31	209	6.742	5.221
Hepatitis	31	310	10	7.660

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	164.532	1	164.532	25.546	4.33E-06	4.001
Within Groups	386.434	60	6.441			
Total	550.967	61				

Since the p-value is less than 0.05 (α), the null hypothesis is rejected in favour of the alternative, which states that there is a significant difference between the mean economic losses due to Pneumonia and Hepatitis in sheep**.**

CHAPTER FIVE: DISCUSSION

This study investigates the causes of meat condemnation and associated economic losses among 548 cattle, 520 goats and 110 sheep slaughtered at Hoima City Slaughterhouse for the month of January 2026. For cattle, a higher proportion of cows (64.1%) were slaughtered than bulls (35.9%), probably because of the high demand for fatty beef (Joan *et al,* 2015). For all these livestock species, liver had the highest rate of condemnation, with Fascioliasis as the leading cause. This is in agreement with various studies conducted in various countries such as Mellau *et al* (2011) (Tanzania), Endale *et al* (2026) (Ethiopia) and Chinonyerem & Kalu (2019) (Nigeria), although Mohammed *et al* (2025) Ethiopia reported lungs as having the highest rate of condemnation.

9.7% of bovine lungs were condemned due to pneumonia, which is higher than 4.1% reported by Abunna & Horfoda, (2013) in Ethiopia and 2.5% reported by Madzingira *et al* (2018). This is probably because of differences in attitudes towards herd health and preventive medicine husbandry practices meant to prevent incidences and control of spread of respiratory diseases.

6.2% of bovine lungs were condemned due to blood aspiration, higher than 4.0% from Malaysia (Barre *et al*, 2026) and 2.5% from Tanzania as reported by Lyimo *et al*, 2017. The higher figure in this study in comparison to others is probably due to difference in slaughter techniques whereby in this study, Halal slaughter was used increasing the risk of blood aspiration.

Fascioliasis as a cause of bovine liver condemnation had a prevalence of 26.3%, which is significantly lower than many studies conducted in Uganda, such as Joan *et al* (2015) with 84% and Opio *et al* (2021) with 65.7%, although Sheferaw & Abdu (2017) from Ethiopia seems to be in agreement with 25.6%. Variations with previous studies are probably due to differences in the seasons/ time of the year in which the studies were conducted. This study was conducted in the month of January which is in the dry season, hence creating unfavourable conditions for multiplication and spread of the intermediate host, the fresh water snail, as well as the juvenile stages of the *Fasciola* parasite, leading to a break in the *Fasciola* life cycle and a reduced rate of infection.

Hepatitis was among the leading causes of bovine liver condemnation with a rate of 19.3%. This study is close to Sheferaw & Abdu (2017) in Ethiopia with 13.5% and much

higher than Adebowale *et al*, 2021 in Nigeria with 6.8%. Variations in condemnation rates can be attributed to variation in climate and ecological conditions such as altitude, rainfall, temperature, deworming practice and availability of veterinary services in the area.

Hepatic abscesses was responsible for condemnation of 11.1% of bovine livers, which is slightly above Mohamed (2021) in Sudan and Mohammed *et al* (2025) in Egypt who reported 7.6% and 8.1% prevalence respectively. Differences in results could be attributed to variations in animal husbandry and productions systems, access to veterinary medical services, as well as sectoral support by respective government authorities.

Muscle bruising among bovine carcasses had a condemnation rate of 34.9% in this study. Folitse *et al*, 2017 reported 16.8% from Ghana, Tihapi (2013) reported 2.1% from South Africa and Madzingira *et al* (2018) with 11.9% from Namibia. Higher condemnation rates in his study could be due to poor standards of animal welfare during animal transportation and handling. Animals for slaughter are usually transported using inappropriate means e.g. tricycle (*Tuku tuku*), overcrowding of cattle in transportation trucks. It is a common practice for animal transporters in Uganda to tie cattle by their horns and tails to the rails of the truck canopy to keep them standing still (Editor, 2025). Aggressive handling also contributes to injuries to carcasses causing bruises.

Out of the total small ruminant lungs examined post-mortem, 99 (19.0%) and 29 (26.4%) of lungs were condemned due to gross pathological conditions in goats and sheep respectively. Of these conditions, pneumonia was found as the leading cause, with 14.2% and 19.3% prevalence in goats and sheep respectively. The increased occurence of pnuemonia is probably due to long distance transportation triggering stress, suffocation in the vehicles and immediate entering of animals into slaughter house without rest. This study is in agreement with Kelo & Alemu (2018) with 17.3% in goats and 25.3% in sheep, although the prevalences are lower than those reported by Negero & Ferede (2017) with 48.1% in goats and 44% in sheep.

Among small ruminants, the rate of liver condemnation due to fascioliasis was found higher in sheep (13.7%) than in goats (8.6%) which can be explained by differences in nutrition and feeding habits. Since sheep are usually grazers, they have a higher chance of exposure to *Fasciola* eggs as they feed on low grass, which is the usual dwelling place for

vector snails whereas goats are usually browsers which normally feed on higher vegetation and are less exposed to the parasite. Negero & Ferede (2017) reported higher prevalences of 17% and 17.6% in goats and sheep respectively, while Kelo & Alemu (2018) reported lower figures of 2.7% in goats and 11.4% in sheep.

The rate of hepatic abscessation in small ruminants was 5.9% in goats and 6.1% in sheep, which agrees with Negero & Ferede (2017), although slightly higher than Kelo & Alemu 2018 with 1.5% in goats and 4.4% in sheep. Variations in condemnation rates can be attributed to variations in climate and ecological conditions such as altitude, rainfall, temperature, deworming practice and availability of veterinary service in the area.

The economic loss associated with condemnation of bovine liver in this present study was UGX 12,621,600 ($ 3431.53), which is much higher than Endale & Mathewos (2016) with $436.8. This is probably due to differences in sample size (548 vs. 334), rate of liver condemnation (57.5% vs. 33.3%) as well as unit price of liver since the studies are from different countries (Uganda Vs. Ethiopia). Several studies conducted in Uganda focused bovine hepatic fascioliasis, reporting varying results of economic loss; Ssimbwa *et al,* 2014 reported $ 330.4 loss which is lower, although their sample size was smaller (n=260) and prevalence higher (35.8%); Opio *et al* (2021) reported a lower loss of $ 396.4 with a higher prevalence (65.7%) and lower sample size (n=216); Joan *et al* (2015) reported a much higher monthly loss of $ 7,706,218 with a higher prevalence (84%) and slightly lower sample size (n=511).

In summary, liver was the organ with the highest rate of condemnation in all species as well as the highest resultant economic economic loss. This observation is an indicator of the critical burden of parasites (especially *Fasciola*) within farms and supply catchment areas, as well as a gap in animal production and management techniques and practices to prevent incidences of parasitic infections, which reveal a systemic breakdown in national livestock extension services, especially ineffective parasite or vector control programs, sporadic antihelmintic distribution and poor pasture management policies. In addition, these results directly affect agricultural economics and the livestock food products supply chain. Butchers and slaughterhouse operators experience the immediate impact of financial loss due to organ condemnation; this burden is consequently channeled downward to the traders and producers (farmers) who are forced to contend with low or discounted prices when livestock buyers factor or consider organ condemnation risks.

Finally at the macro level, these findings signify a stagnation in national economic growth as micro (individual) losses aggregate into significant sectoral losses at the national level, causing a reduction in the national agricultural GDP. This significantly affects the national economy as agriculture is the backbone of Uganda's economy, leading to a stagnation in national development (FAO, 2025).

5.1 Study strengths and limitations

5.1.1 Strengths

This study was conducted as a census or survey (as opposed to sampling), hence all members of the slaughter population in the month of January 2026 were included in the study, which ensured accuracy, reliability and completeness of study results obtained.

5.1.2 Limitations

Determination of weight loss due to condemned organs was obtained by directly weighing these organs or portions. Lesions usually make organs weigh heavier than normal, therefore this method could have overestimated the weight losses.

5.2 Areas for future studies

Estimation of On-Farm Production losses e.g. losses due to decreased milk yield, reduced live weight gain, reproductive inefficiency, veterinary medical service costs, etc.

Laboratory identification of etiologies of gross lesions using histopathological and molecular techniques.

A longitudinal study covering multiple years to investigate seasonal variations of various gross lesions or conditions that warrant condemnation.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The results of this current study revealed that hepatic fascioliasis, hepatitis and muscle bruising were the major causes of meat condemnation in both cattle and small ruminants, with the highest resultant economic losses. The high economic losses revealed a need for interventions to be undertaken to improve animal health and handling to facilitate reduction in condemnation rates and consequently reduction of economic losses.

6.2 Recommendations

Veterinary extension services should be made more available to farmers to improve their knowledge and attitude in preventive medicine and herd health husbandry practices e.g. deworming, sanitation, vaccination, disease surveillance to prevent disease and health conditions that cause meat condemnation.

Animal welfare education and practices should be taught and emphasized among farmers, traders, transporters, handlers, etc., to improve handling and prevent avoidable injuries made to animals before slaughter.

REFERENCES

Abaanabasazi, P. (2025). Hoima city gets sh2b slaughterhouse, butchers ordered to vacate condemned facility, New Vision (Monday 25th August 2025).

Abunna, F., & Hordofa, D. (2013). Major causes of organ condemnation for cattle and its financial impact at Wolaita Soddo municipality abattoir, southern Ethiopia. *Global Veterinaria*, *11*(6), 730-734.

Abunna, F., & Hordofa, D. (2013). Major causes of organ condemnation for cattle and its financial impact at Wolaita Soddo municipality abattoir, southern Ethiopia. *Global Veterinaria*, *11*(6), 730-734.

Abuseir, S. (2019). Major Causes and associated economic losses of carcass and organ condemnation in cattle and sheep in the northern part of Palestine. *World's Veterinary Journal*, *9*(4), 317-323.

Achollah, A. M., Karanja, D. N., Ngâ, C. J., & Bebora, L. C. (2020). Causes of organ condemnations in cattle at slaughter and associated financial losses in Siaya County, Kenya. *Journal of Veterinary Medicine and Animal Health*, *12*(2), 27-35.

Adebowale, O., Ekundayo, O., Olasoju, M., Bankole, N., Oladejo, O., & Awoseyi, A. (2021). Causes of organ condemnation in food animals slaughtered at a municipal abattoir in Oyo State, Nigeria. *Savannah Veterinary Journal*, (4).

Alemneh, T., Adem, T., & Akeberegn, D. (2017). Mini review on bovine cysticercosis. *ARCHIVOS DE MEDICINA*, *2*(2), 15.

Amachawadi, R. G., & Nagaraja, T. G. (2016). Liver abscesses in cattle: A review of incidence in Holsteins and of bacteriology and vaccine approaches to control in feedlot cattle. *Journal of animal science*, *94*(4), 1620-1632.

Amachawadi, R. G., & Nagaraja, T. G. (2022). Pathogenesis of liver abscesses in cattle. *Veterinary Clinics: Food Animal Practice*, *38*(3), 335-346.

Amachawadi, R. G., Purvis, T. J., Lubbers, B. V., Homm, J. W., Maxwell, C. L., & Nagaraja, T. G. (2017). Bacterial flora of liver abscesses in crossbred beef

cattle and Holstein steers fed finishing diets with or without tylosin. *Journal of animal science*, *95*(8), 3425-3434.

Banda, L. J., & Tanganyika, J. (2021). Livestock provide more than food in smallholder production systems of developing countries. *Animal Frontiers*, *11*(2), 7-14.

Barre, A., Siam, M. A., Mortuza, C. G., Ray, C. K., Riyad, M. R., Jesse, F. F. A., ... & Thlam, P. B. (2026). Pathological Causes and Economic Impact of Organs and Carcass Condemnation in Slaughtered Ruminants of Cattle, Sheep and Goats. *International Journal of Agriculture and Veterinary Sciences*, *8*(1), 210-220.

Berbersa, S. M., Mengistu, T. S., & Woldemariyam, F. T. (2016). Major causes of organ condemnation and associated financial loss in cattle slaughtered at Hawassa Municipal Abattoir, Ethiopia. *Journal of Veterinary Medicine and Animal Health*, *8*(10), 150-156.

Calcutt, M. J., Foecking, M. F., Nagaraja, T. G., & Stewart, G. C. (2014). Draft genome sequence of Fusobacterium necrophorum subsp. funduliforme bovine liver abscess isolate B35. *Genome announcements*, *2*(2), 10-1128.

Calero-Bernal, R., & Horcajo, P. (2026). Cysticercosis in cattle. In *Encyclopedia of Livestock Medicine for Large Animal and Poultry Production* (pp. 341-345). Cham: Springer Nature Switzerland. Calero-Bernal & Horcajo (2026)

Carvallo, F. R., & Stevenson, V. B. (2022). Interstitial pneumonia and diffuse alveolar damage in domestic animals. *Veterinary pathology*, *59*(4), 586-601.

Ciui, S., Morar, A., Tîrziu, E., Herman, V., Ban-Cucerzan, A., Popa, S. A., ... & Imre, K. (2023). Causes of post-mortem carcass and organ condemnations and economic loss assessment in a cattle slaughterhouse. *Animals*, *13*(21), 3339.

Constable, P. D., Hinchcliff, K. W., Done, S. H., & Grünberg, W. (2016). *Veterinary medicine: a textbook of the diseases of cattle, horses, sheep, pigs and goats*. Elsevier Health Sciences.

Corsetti, G., Pasini, E., Scarabelli, T. M., Romano, C., Singh, A., Scarabelli, C. C., & Dioguardi, F. S. (2024). Importance of energy, dietary protein sources, and

amino acid composition in the regulation of metabolism: an indissoluble dynamic combination for life. *Nutrients*, *16*(15), 2417.

Cruz-Monterrosa, R. G., Reséndiz-Cruz, V., Rayas-Amor, A. A., López, M., & la Lama, G. C. M. D. (2017). Bruises in beef cattle at slaughter in Mexico: implications on quality, safety and shelf life of the meat. *Tropical animal health and production*, *49*(1), 145-152.

da Silva, A. B. P., & Costa, W. L. R. (2022). Data survey on pulmonary condemnatios for blood aspiration in swine slaughter under the Bahia state, Brazil inspection service from 2018 to 2020.

Dahesa, G. D., Kebede, I. A., Tilahun, A. A., Borena, B. M., Muleta, Y. J., Gebremeskel, H. F., ... & Gudina, S. B. (2026). Co-infection of fasciolosis and hydatidosis in cattle at Jimma Municipal Abattoir, Ethiopia: Prevalence, risk factors, and economic impact. *Parasitology Research*.

Dlamini, S. V., Gugu, D., & Masuku Sakhile, K. S. (2025). Spatial Distribution and Risk Mapping of *Fasciola hepatica* and *Fasciola gigantica* Infections in Cattle Slaughtered in Eswatini, July 2023 to January 2024–The Case of Eswatini Meat Wholesalers. *Int J Family Med Healthcare*, *4*(3), 1-8.

Editor (2025). Put an end to animal cruelty. Daily Monitor (Tuesday 7th October 2025).

Farouk, M. M., Al-Mazeedi, H. M., Sabow, A. B., Bekhit, A. E. D., Adeyemi, K. D., Sazili, A. Q., & Ghani, A. (2014). Halal and kosher slaughter methods and meat quality: A review. *Meat Science*, *98*(3), 505-519.

Ferreira, M. F., Fàbrega, E., Pires, I., & Vieira-Pinto, M. M. (2023). Agonic Aspiration of Blood: Not Useful as an Animal-Based Indicator of Electrical Stunning Ineffectiveness in Pigs (Sus scrofa domesticus). *Animals*, *13*(14), 2292.

Folitse, R., Owusu, A., Amemor, E., Opoku-Agyemang, T., Tasiame, W., & Emikpe, B. (2017). Preliminary study of bovine carcass bruises and its associated financial losses in Kumasi abattoir, Ghana. *Animal Research International*, *14*(2), 2715-2719.

Food and Agriculture Organisation of the United Nations (2025). Uganda at a glance. https://www.fao.org/uganda/our-office/uganda-at-a-glance/en (Accessed on 24th October 2025).

García-Díez, J., Saraiva, S., Moura, D., Grispoldi, L., Cenci-Goga, B. T., & Saraiva, C. (2023). The importance of the slaughterhouse in surveilling animal and public health: a systematic review. *Veterinary Sciences*, *10*(2), 167.

Gessese, A. T. (2020). Review on epidemiology and public health significance of hydatidosis. *Veterinary medicine international*, *2020*(1), 8859116.

Gortázar, C., De la Fuente, J., Perelló, A., & Domínguez, L. (2023). Will we ever eradicate animal tuberculosis?. *Irish Veterinary Journal*, *76*(Suppl 1), 24.

Herrero, M., Grace, D., Njuki, J., Johnson, N., Enahoro, D., Silvestri, S., & Rufino, M. C. (2013). The roles of livestock in developing countries. *animal*, *7*(s1), 3-18.

Hoffman, L. C., & Lühl, J. (2012). Causes of cattle bruising during handling and transport in Namibia. *Meat science*, *92*(2), 115-124.

Huertas, S. M., van Eerdenburg, F., Gil, A., & Piaggio, J. (2015). Prevalence of carcass bruises as an indicator of welfare in beef cattle and the relation to the economic impact. *Veterinary Medicine and Science*, *1*(1), 9-15.

Ibrahim, N. (2017). Fascioliasis: systematic review.

Ibrahim, S., Kaltungo, B. Y., Uwale, H. B., Baba, A. Y., Saidu, S. N. A., Mohammed, F. U., & Dahiru, H. M. (2021). Role of slaughter facilities management in zoonoses and safety of meat produced for human consumption in Nigeria: a review. *Bulletin of the National Research Centre*, *45*(1), 137.

Joan, N., Stephen, M. J., Bashir, M., Kiguli, J., Orikiriza, P., Bazira, J., ... & Stanley, I. J. (2015). Prevalence and economic impact of bovine fasciolosis at Kampala City abattoir, Central Uganda. *British Microbiology Research Journal*, *7*(3), 109-117.

Jubb, K. V. F., Kennedy, P. C., & Palmer, N. (2012). *Pathology of domestic animals*. Academic press.

Kelo, B., & Alemu, B. (2018). Major disease that cause lung, liver and carcass condemnation and its financial loss at Modjo Modern export abattoir. *Journal of Health, Medicine and Nursing*, *54*.

Khairullah, A. R., Moses, I. B., Kusala, M. K. J., Tyasningsih, W., Ayuti, S. R., Rantam, F. A., ... & Nurhidayah, N. (2024). Unveiling insights into bovine tuberculosis: A comprehensive review. *Open Veterinary Journal*, *14*(6), 1330. Khairullah *et al*, 2024

Khan, M. K., Islam, M. N., Ferdous, J., & Alam, M. M. (2019). An Overview on Epidemiology of Tuberculosis. *Mymensingh medical journal: MMJ*, *28*(1), 259-266.

Kiswaga, C., Mayenga, E. L., Silayo, F. V., & Swai, E. S. (2016). Prevalence, causes and economic losses resulting from condemnations in the slaughterhouses/slabs in Eastern and North-eastern zones of Tanzania. *Livest. Res. Rural Dev*, *28*(11).

Kouam, M. K., Meningue, R., & Fon, D. E. (2019). Parasitic causes of organ condemnation in cattle slaughtered in Fako abattoirs, South-West region of Cameroon, and estimate of financial losses. *Journal of Helminthology*, *93*(3), 367-371.

Kruchynenko, O. V., Mykhailiutenko, S. M., & Petrenko, M. O. (2022). Prevalence of Fascioliasis in Ruminants of the World—meta-analysis. *Zoodiversity*, *56*(5).

Kumar, A., & Tadesse, G. (2011). Bovine cysticercosis in Ethiopia: a review. *Ethiopian Veterinary Journal*, *15*(1).

Leite, J. S. A. F., Passos, R. S. F. T., Cruz, T. D. M. P., Barreto, B. G., da Silva, M. C. A., & Cavalheiro, C. P. (2022). Main causes of cattle slaughter condemnation under the state sanitary inspection in Bahia, Brazil. *Semina: Ciências Agrárias*, *43*(1), 61-72.

Lema, A. G., & Dame, I. E. (2022). Bovine tuberculosis remains a major public health concern: A review. *Austin J Vet Sci Anim Husb*, *9*(1), 1085.

Lyimo, E. G., Ntikabuze, B. B., Olkitok, M. M., & Nyalyoto, N. D. (2017). Causes of organ condemnations and financial losses in cattle slaughtered at Mahenge slaughter facility in Ulanga District, Morogoro, Tanzania.

Madzingira, O., Chinyoka, S., Yule, J., Mwenda, E. N., Kandiwa, E., Samkange, A., & Mushonga, B. (2018). A retrospective study of carcass and organ condemnations at a beef abattoir in Namibia.

Ministry of Agriculture, Animal Industry and Fisheries (2023). Standard Operating Procedures For Veterinary Inspections at Ports of Entry/ Exit.

Miranda-de la Lama, G. C., Leyva, I. G., Barreras-Serrano, A., Pérez-Linares, C., Sánchez-López, E., María, G. A., & Figueroa-Saavedra, F. (2012). Assessment of cattle welfare at a commercial slaughter plant in the northwest of Mexico. *Tropical Animal Health and Production*, *44*(3), 497-504.

Mohammed, E. A., Abdelrahman, H., & El-Essawy, M. (2025). Identification and Evaluation of the Main Reasons for Condemnation of Organs and Carcasses of Slaughtered Animals in a Selected Abattoir. *Suez Canal Veterinary Medical Journal. SCVMJ*, *30*(1), 131-143.

Mwabonimana MF, Kassuku AA, Ngowi HA, Mellau LSB, Nonga HE, Karimuribo ED (2010). Prevalence and economic significance of bovine fasciolosis in slaughtered cattle at Arusha abattoir, Tanzania. Tanzania Veterinary Journal 26(2):68-74. doi: 10.4314/tvj.v26i2.53804.

Ogwal, A., Okello, D. M., Aliro, T., Owiny, D. O., & Ndyomugyenyi, E. K. (2025). Prevalence of Bovine Fasciolosis, Financial Losses and Risk Factors Associated with the Disease in Lira and Gulu Districts, Northern Uganda. *Veterinary Medicine International*, *2025*(1), 7757654.

Ogwang, F. S. (2023). *Liver condemnation in cattle and its financial losses at Kumi municipality slaughter house* (Doctoral dissertation, Makerere University).

Okoye, K., & Hosseini, S. (2024). Understanding dependent and independent variables in research experiments and hypothesis testing. In R programming: Statistical data analysis in research (pp. 99-107). Singapore: Springer Nature Singapore.

Opio, L. G., Abdelfattah, E. M., Terry, J., Odongo, S., & Okello, E. (2021). Prevalence of fascioliasis and associated economic losses in cattle slaughtered at lira municipality abattoir in northern Uganda. *Animals*, *11*(3), 681.

Otranto, D., & Wall, R. (2024). *Veterinary parasitology*. John Wiley & Sons.

Quinn, P. J. (2025). *Veterinary microbiology and microbial disease*. John Wiley & Sons.

Regassa, B. (2019). Review on hydatidosis in small ruminant and its economic and public health significance. *J Dairy Vet Sci*, *11*(2), 1-8.

Saleem, H. (2017). A review on epidemiology, global prevalence and economical losses of fasciolosis in ruminants. Microbial Pathogenesis. https://doi.org/10.1016/J.MICPATH.2017.06.006

Sánchez, J. N., Félix-Leyva, B. J., Velázquez, D. Z., Rosiles, J. R., Montero, A., Strappini, A. C., ... & Dávila-Ramos, H. (2022). Prevalence, risk factors, and main characteristics of bruises in cattle: A meta-analysis in the American continent: A systematic review and meta-analysis. *Veterinaria México OA*, *9*.

Sheferaw, D., & Abdu, K. (2017). Major causes of organ and carcass condemnation and associated financial losses in cattle slaughtered at Kombolcha ELFORA abattoir from 2008-2012, Ethiopia. *Ethiopian Veterinary Journal*, *21*(1), 54-66.

Shiferaw F, Bekele W, Giro B, Mequanint Y (2018) Epidemiology and Economic Importance of Hydatidosis in Domestic Animal and Human in Ethiopia- A Review. J Vet Sci Technol 9: 563. doi:10.4172/2157-7579.1000563

Silva, W. C. D., Camargo, R. N. C., Silva, É. B. R. D., Silva, J. A. R. D., Picanço, M. L. R., Santos, M. R. P. D., ... & Lourenço, J. D. B. (2023). Perspectives of economic losses due to condemnation of cattle and buffalo carcasses in the northern region of Brazil. *Plos one*, *18*(5), e0285224.

Ssimbwa, G., Baluka, S., & Ocaido, M. (2014). Prevalence and financial losses associated with bovine fasciolosis at Lyantonde Town abattoir. *Livestock research for rural development*, *26*(9), p-165.

Taha, A., Saad, S., Jubara, A., Wani, C., Phiri, A. M., Simuunza, M., ... & Mumba, C. (2023). Financial losses arising from cattle organ and carcass condemnation at Lokoloko Abattoir in Wau, South Sudan. *Advances in Preventive Medicine*, *2023*(1), 7975876.

Takang, E. E., LeBreton, M., Ayuk, C. E., & MacLeod, E. T. (2020). A socio-economic study of Fasciola infections in cattle and sheep at the Etoudi slaughterhouse, Yaoundé, Cameroon. *Journal of Helminthology*, *94*, e92. doi:10.1017/S0022149X19000890

Taylor, D. D., Groenendaal, H., Morley, P. S., & Zagmutt, F. (2025). Economic costs of liver abscesses in US beef feedlot cattle: a comprehensive economic analysis. *Journal of Animal Science*, *103*, skaf127.

Taylor, M. A., Coop, R. L., & Wall, R. (2015). *Veterinary parasitology*. John Wiley & Sons.

Tembo, W., & Nonga, H. E. (2015). A survey of the causes of cattle organs and/or carcass condemnation, financial losses and magnitude of foetal wastage at an abattoir in Dodoma, Tanzania. *Onderstepoort Journal of Veterinary Research*, *82*(1), 1-7.

Terefe, D., Kebede, K., Beyene, D., & Wondimu, A. (2012). Prevalence and financial loss estimation of hydatidosis of cattle slaughtered at Addis Ababa abattoirs enterprise. *Journal of Veterinary Medicine and Animal Health*, *4*(3), 42-47.

Tsega, M. , Dereso, S. and Getu, A. (2015) A Review on Ruminant Fasciolosis. *Open Access Library Journal*, **2**, 1-8. doi: 10.4236/oalib.1101655.

Uganda Bureau of Statistics (2024). National Livestock Census 2021 Report, Kampala,

Uganda.

Yibar, A., Selcuk, O., & Senlik, B. (2015). Major causes of organ/carcass condemnation and financial loss estimation in animals slaughtered at two abattoirs in Bursa Province, Turkey. *Preventive veterinary medicine*, *118*(1), 28-35.

APPENDICES

Appendix I: Research Pictorial evidence





Bovine lungs (blood aspiration)



Bovine lungs (pneumonia)





Bovine livers infested with Fascioliasis



Hepatic abscessation (small ruminants)



Bruised thigh muscles (cattle)



Bruised intercoastal muscle (cattle)



Hepatitis (small ruminant)



Fascioliasis (small ruminant)



Hepatic abscessation (small ruminant)





Postmortem inspection of bovine carcasses



Weighing of condemned organs



Postmortem inspection of visceral organs



Postmortem inspection of small ruminant carcasses

Appendix II: Data collection form

Date: ……..

Species	Serial number	Sex	Organ	Gross lesion	Total/ partial condemnation	Weight