Major causes of organ/carcass condemnation resultant financial loss estimates in cattle slaughtered in Wau abattoirs, South Sudan

BY

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A thesis submitted to the University of Zambia in fulfilment of the requirements for the award of the degree of Master of Science in Public Health and Zoonosis

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DECLARATION

I, Alfateh Hassan, do hereby affirm that this work entitled "**Financial Losses Arising from Condemnation of Cattle carcases in Wau Town, of South Sudan"**was authored by me and has not been submitted to this or any other higher education institution for the award of any degree.

Signed Date

…… ……

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APPROVAL

This thesis of Alfateh Hassan has been approved as fulfilling for the award of the Master of Science in Public Health and Zoonosis by the University of Zambia.

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Abstract

Slaughterhouses in South Sudan mirror the economic losses resulting from organ and carcass condemnation due to livestock zoonotic and epizootic diseases such as bovine tuberculosis, cysticercosis, and hydatidosis. However, due to the war in South Sudan, record keeping has been inconsistent, and thus the estimation of disease and its impact may be underestimated. Therefore, this study was conducted to investigate the major causes of carcass and organ condemnation in cattle slaughtered at the Lokoloko abattoir and to estimate the direct financial losses.

A five-year (2015-2020) database of condemned cattle carcasses and organs from the Lokoloko abattoir in Wau, South Sudan was retrieved and analysed. In addition, fresh meat inspections were carried out for two months (January and February 2021) with a focus on all diseases and their associated financial losses due to total and partial cattle carcass condemnation. Data were cleaned and analysed to obtain frequencies and percentage using SPSS version 26.A budgetary analysis was used to generate financial losses from partial or complete carcass condemnation.

Results revealed that a total of 25,002 cattle were slaughtered over a period of five years. Out of this, 3430 were found to have general tuberculosis representing a prevalence of 13.7% and financial losses of 1 equivalent to 186,184 (USD).This was followed by cysticercosis, with 2350 cases representing a prevalence of 9.1% and financial loss of USD 114,215.Liver was the organ that was mostly associated with partial condemnation due to Fasciolosis, with a total of 2350 cases giving a prevalence of 9.4% and financial loss of USD178,527.Liver Hydatidosis recorded a total of 2,340 cases giving a prevalence of 9.4% and financial loss amounting to 400 USD followed by lungs pneumonia with a total of 3121(12.5%) cases and financial losses amounting to USD 54,570. Bovine Tuberculosis, a disease of public health had the highest prevalence and financial losses.

There is need for public health education to avoid eating raw and undercooked meat, proper disposal of condemned organs, improved cattle management system, treatment of animals with anti-helminthic drugs.

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From the deepest of my heart, I would like to thank my dear wife, Dr. Shereen Ahmed and my son Mohammed for their patience, love, and persevering during my study. I am also indebted to my sister Malka, and all my brothers. Thank you for your encouragement.

DEDICATION

This work is dedicated to my beloved mother, Nieama Alberto, who inspired me always to look higher. May Allah continue blessing her with long life. To my lovely wife, who also stood by my side, inspiring, loving, and providing unlimited support so I could gain more success in life, may Allah protect her and our children with more blessing.

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LIST OF ABBREVIATIONSAND ACRONYMS

PPE	Personal Protective Equipment
SPSS	Statistical Package for Service Solutions
UBG	University of Bahr El Ghazal
USAID	United States Agency for International Development
USD	United States Dollar
WBGS	Western Bahr El Ghazal State
WHO	World Health Organization

OPERATIONAL DEFINITION

Boma: Is a lowest level of administrative division, below payams in South Sudan.

Payam: Is the second –lowest administrative division, below counties in South Sudan.

Knowledge: This is the ability of a person to have a correct understanding of Zoonotic disease

CHAPTER ONE

1.0 INTRODUCTION

1.1 Introduction

South Sudan's livestock wealth is still mainly in the hands of traditional agro-pastoralist and pastoralist systems that hold 47% and 43% of livestock wealth. The remaining 10% are in the hands of smallholder livestock keepers, mainly in urban and peri-urban areas (Musinga *et al.*, 2010).A definitive estimate of the number of livestock in the subsector is lacking. However, revised data base on Food and Agriculture Organization (FAO) estimates used officially by the national Ministry, and considered conservative by some key stakeholders, put the national herd size in 2013 at 11.7 million head of cattle, 12.5 million goats and 12.1 million sheep (Bouwman *et al.*, 2013).This would place the South Sudan national herd as the Seventh largest in Africa (Musinga *et al.*, 2010), worth an estimated 7 billion South Sudanese Pounds (SSP), approximately 10,606,061 in the US dollars. This is approximately 15% of the Gross Domestic Product (GDP) (Schomerus and Allen, 2010).

livestock are critically important in South Sudanese society1 and this is reflected in the role livestock play in the country's conflict, both serving as drivers of conflict and being negatively impacted by the conflict, with the two often reinforcing each other in a vicious cycle. Cattle raiding has been a traditional practice among pastoral communities in the region, notably between the Nuer, Dinka and Murle tribes. However, this generally occurred on a small-scale and involved minimal violence. A number of factors have contributed to this becoming more intense, involving greater violence and taking place on a far larger scale in South Sudan.

Abattoirs continue to be the sources of valuable data for the epidemiology of cattle diseases. They also provide information on the extent to which a community is exposed to certain zoonotic diseases. They can also be used to estimate the financial losses incurred through condemnation of affected organs and carcasses (Mesele and Guadu, 2012). Postmortem examinations of animals slaughtered in abattoirs give a better chance to recognise the most important diseases prevalent.

Each year there are significant economic losses that result from livestock mortality, poor weight gain, and condemnation of edible organs and carcasses at slaughter (Wright *et al.*, 2010). Globally, production losses in the livestock industry are estimated to be more than 900 million US Dollars annually. However, apart from these economic losses, a disease that occurs in cattle may have public health implications (Sheferaw and Abdu, 2017).

Diseases are the main reasons why beef gets condemned at the abattoir (Jaja and Mushonga, 2016).In South Africa, Ethiopia and Zambia, studies have shown that a large quantity of meat (carcass/organ) was totally or partially condemned due to zoonotic diseases such as Tuberculosis, Fascsiollosis, Hydaatidosis Pneumonia and Cysticercosis (Mesele and Guadu, 2012; Simwanza, Mumba, Pandey, *et al.*, 2012; Jaja, 2014).

Globally, one-third of world food production is lost or wasted along the food supply chain, yet around one billion people are starving (Kummu *et al.*, 2012). Food wastage contravenes a sustainable livestock production system, but the reduction of food losses is an essential means to boost food security (Kummu *et al.*, 2012).

Many factors responsible for post-slaughter meat loss are attributed to the failure of primary animal health care (PAHC) at the farm level (Yibar, Selcuk and Senlik, 2015a). Animal health and growth are important in the perspective of the socioeconomic impact that animal development has on human health, food security and wellbeing, as well as sustainable livelihoods (Seimenis, 2012).Animal healthcare is central to ensuring that livestock is healthy and free from preventable diseases. However, animal diseases are significant constraints because the animals of poorly resourced farmers are particularly vulnerable to disease due to the absence, cost or unsuitability of production and animal health input (Wright *et al.*, 2010).

An animal with little or no veterinary care is susceptible to many infections and hence rejected post-slaughter at the abattoir during post-mortem meat inspection (PMMI) (Musemwa *et al.*, 2008; Seimenis, 2012). Post mortem Examination (PMMI) aims to remove from the food chain unhealthy and unwholesome meat to protect consumers and to assist in the detection and eradication of certain livestock diseases (Phiri, 2006; Yibar, Selcuk and Senlik, 2015a).Meat

condemnation represents a waste of ideal protein food sources capable of abating food insecurity in South Sudan and indeed worldwide (Musinga *et al.*, 2010).

A comprehensive survey aimed at quantifying the amount of food lost to condemnation and a factor contributing to these losses is a first step towards understanding the magnitude of the problem of food losses due to meet condemnation (Njombe *et al.*, 2012).

The global demand for food is rolling upward due to the expansion of the human population; hence food production and supply need to double with little or no waste to meet this demand (Njombe *et al.*, 2012).Food loss at any point in the value chain inhibits the stability of food security at the household and national levels (Musemwa *et al.*, 2008).Therefore, the present study aimed to identify the major causes of complete and partial cattle carcass condemnation in Wau Town, South Sudan and assess their financial losses.

1.2 Problem of Statement

South Sudan, as the youngest country on the continent, is burdened by several livestock diseases contributing to heavy mortality rates and total or partial condemnations of carcass at abattoirs annually (Musinga *et al.*, 2010).With the influx of returnees from the diaspora and neighbouring countries after the war, the demand for meat increased; thus, more cattle were subjected to slaughter to meet these needs. Policies directed to the identification of major diseases such as Tuberculosis, Fasciolosis and Cysticercosis and determination of the quantities of condemned meat are lacking. Livestock are extremely important in South Sudan. The sector is the main source of income and food for the majority of the population: pastoral farming is appropriate for South Sudan's challenging ecology, characterized by flooding, drought, swamplands and so on. Livestock bestows social status and prestige. Therefore, multifaceted and multidisciplinary studies are required to address this problem and inform policy for controlling such diseases contributing to total and partial condemnations.

1.3 Justification of the Study

The fact that diseases cause more significant economic losses due to total or partial condemnations of cattle carcasses cannot be disputed. The zoonotic nature of some of these

diseases remain a standing public health threat. The government requires an informed policy for the control and eradication of some diseases of economic and public health importance. The current study will establish valid and reliable data on diseases of zoonotic and economic importance that lead to total or partial condemnation of carcass and organs.

1.4 Research Questions

1. What are the major causes of complete and partial condemnations of cattle slaughtered in Wau Town for period of two months?
2. What are the major causes of complete and partial condemnations of cattle slaughtered in Wau Town from 2015-2020?
3. What is the magnitude of financial losses attributed to condemned carcases and organs in Wau Town?

1.5 Objectives

This study aimed to identify the major causes of complete and partial cattle carcass condemnation in Wau Town of South Sudan and assess their financial losses. The specific objectives were as follows:

1. To determine the major causes of complete and partial condemnation of cattle slaughtered cross sectional study?
2. To determine the major causes of complete and partial condemnation of cattle slaughtered in Wau Town from 2015-2020?
3. To determine the magnitude of direct financial losses attributed to condemned carcases and organs in Wau?

1. 6 Conceptual Framework

This framework conceptualizes the health and economic impact of zoonotic diseases in cattle intended for slaughter in the abattoir. Infected cattle in the abattoir might lead into contamination of the environment before the condemnation process. The abattoir workers might be infected through direct contact with infected carcass/ organs or indirectly via the contaminated environment which will have an impact on human resources (e.g. life loss, disability, absence due to diseases...Etc). Both infection of humans and condemnation of infected organs/carcasses will lead into a financial loss for cattle owners and abattoir workers.

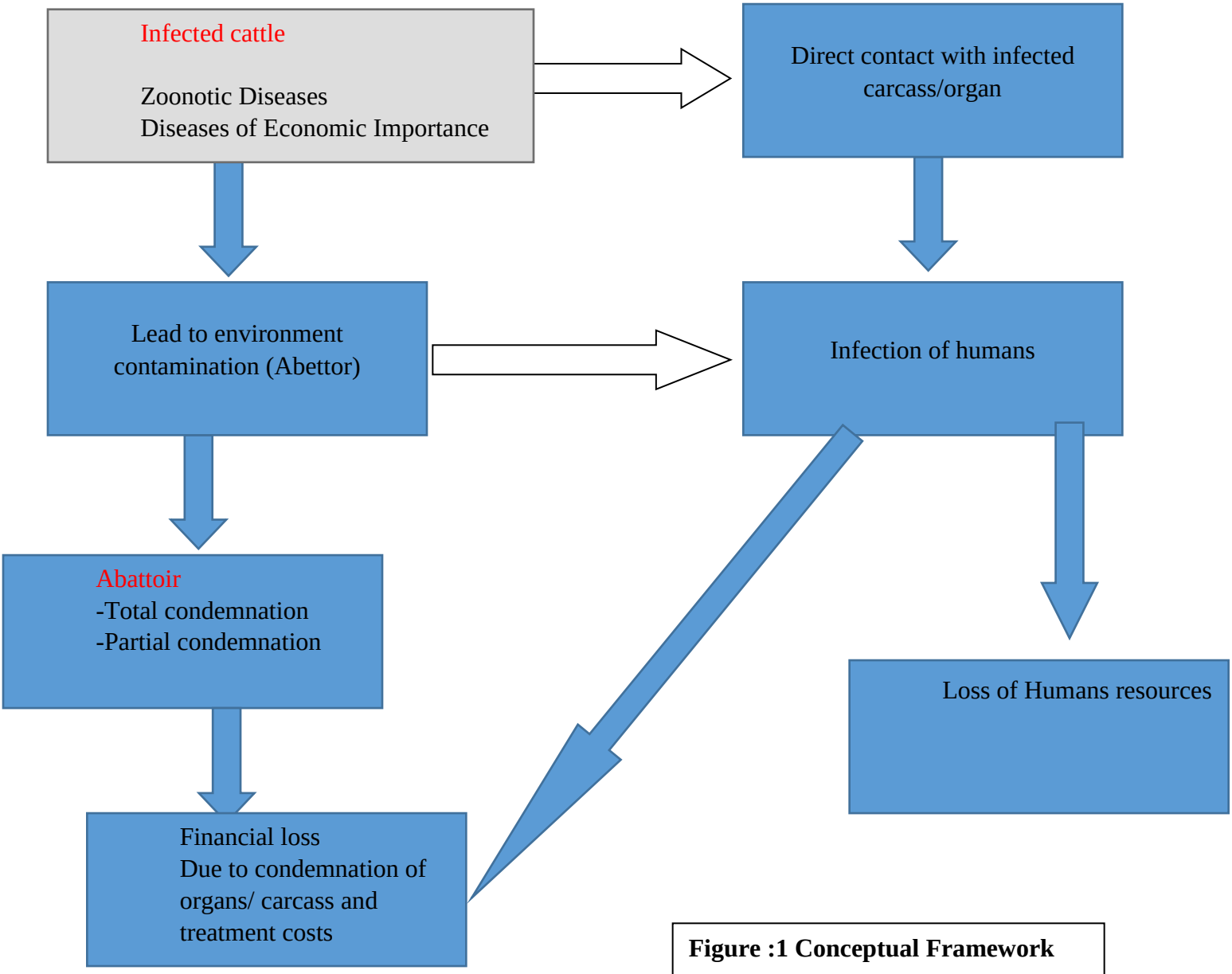

Figure :1 Conceptual Framework

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 General Overview

Today hunger and poverty are widespread globally, with developing nations, especially the African nations being the hardest hit (Njombe *et al.*, 2012). Attempts to resolve food insecurity through animal production are severely disadvantaged by several diseases that cause whole or parts of meat to be condemned at the abattoir. Meat condemnation further worsens food insecurity and leads to huge economic waste as both the farmer and the government cannot recoup their invested capital (Seimenis, 2012).

Several parts of the animal which constitute meat, such as the liver, spleen, lungs, kidney, heart and head, are regularly rejected at the abattoir due to several diseases, including tuberculosis, cysticercosis, hydatidosis, fasciolosis, pneumonia and many others (Yibar, Selcuk and Senlik, 2015a).In addition, several non-disease factors like emphysema, abscess, inflammation and faulty evisceration contribute to meat condemnation (Mwabonimana *et al.*, 2010).The need for public enlightenment on the dangers of eating poorly processed meat products and farmer education on the improvement of animal husbandry are key to reversing the prevalence of diseases that contribute to meat condemnation (Njombe *et al.*, 2012).Knowledge about the dangers of zoonosis and its implication on human health will protect the public from infection.

2.2 Importance of Abattoirs and their Roles

Abattoirs play a significant role in the investigation of zoonotic diseases. It allows all animals destined for human consumption to be examined for infrequent signs, lesions or known diseases (Yibar, Selcuk and Senlik, 2015a).The reasons for meat inspection are to protect public health and to provide safe foods to the public. Moreover, it offers information that can be applied to animal disease control. Abattoir data is an excellent option for detecting economic and public health diseases (Arbabi and Hooshyar, 2006), especially in establishing the magnitude to which humans are exposed to certain zoonotic diseases and assessing the financial implications of

carcass condemnations (Phiri, 2006). Meat inspection assists in detecting certain livestock diseases, preventing the distribution of infected meat that could give rise to disease in animal and human populations, and ensuring product competitiveness in the local market (Mohamed, 2021b).

Abattoir meat inspection and slaughter records contribute to disease surveillance and control through macroscopic identification and recording of basic lesions, thus the first step in monitoring diseases in the national herd and flock (Jaja, 2014).The information received through surveillance studies provides feedback to the veterinary service to control and eradicate animal diseases and protect the public from zoonotic hazards (Mohamed, 2021b). It also reveals causes of meat condemnation even in healthy animals, and this information can be communicated back to the farmer to improve farm management and husbandry.

Many factors responsible for post-slaughter meat loss suggest the farm level's failure of primary animal health care (PAHC) (Mohamed, 2021b).Animal healthcare is central to ensuring that livestock is healthy and free from preventable disease, and animal diseases are important constraints because the animals of poorly resourced farmers are particularly vulnerable to disease due to the absence, cost or unsuitability of production and animal health input(Jaja, 2014).

2.3 Diseases that lead to cattle condemnation in the Abattoirs

2.3.1 Bovine Tuberculosis

Bovine tuberculosis (bTB) is a chronic infectious disease which affects a broad range of mammalian hosts, including cattle, humans, deer, llamas, pigs, domestic cats, and wild carnivores (Demelash *et al.,* 2009).Humans can be infected by drinking raw milk from infected cattle or inhaling infective droplets.In some countries, up to ten percent of human tuberculosis is due to bTB (Cosivi *et al.,* 1998).

High-risk individuals include abattoir workers, butchers and hunters, and those who consume or use cattle products such as hides, milk, or meat. People who drink raw (unpasteurised) milk or consume dairy products made from raw milk are also at greater risk. Symptoms of TB disease caused by *M. bovis* are similar to the symptoms of TB caused by *M. tuberculosis*. This can

include fever, night sweats, and weight loss. Other symptoms might occur depending on the part of the body affected by the disease.

The abattoir workers are at higher risk of *M. bovis* infection; therefore, they should undergo regular screening for TB infection. Screening tests include the tuberculin skin test (TST) and the interferon-gamma release assay blood test (Cosivi *et al.*, 1998).

2.3.1.1 Bovine Tuberculosis Economic Significance

Bovine TB is primarily economically important as it can directly affect milk and meat production and animal reproduction. Moreover, the disease may indirectly affect national and international trade and other economic sectors (Amuamuta, 2012).The public health importance of cattle TB was recognised early by WHO, which in its 1950 report of the Expert Committee on Tuberculosis stated that the committee recognises the seriousness of human infection with bovine tuberculosis in countries where the disease is prevalent in cattle (Cosivi *et al.*, 1998).

2.3.1.1 Bovine Tuberculosis Prevention and Control

Disease eradication programs consisting of post-mortem meat inspection, intensive surveillance including on-farm visits, systematic individual testing of cattle and removal of infected and in-contact animals, as well as movement controls have been very successful in reducing or eliminating the disease (Gumi *et al.*, 2012). Postmortem meat inspection of animals looks for the tubercles in the lungs and lymph nodes (OIE Terrestrial Animal Health Code). Detecting these infected animals prevents unsafe meat from entering the food chain and allows veterinary services to trace back to the herd of origin of the infected animal, which can then be tested and eliminated if needed.

Pasteurization of milk of infected animals to a temperature sufficient to kill the bacteria has prevented the spread of disease in humans (Gumi *et al.*, 2012).Treatment of infected animals is rarely attempted because of the high cost, lengthy time, and the larger goal of eliminating the disease. Vaccination is practised in human medicine, but it is not widely used as a preventive measure in animals: the efficacy of existing animal vaccines is variable, and it interferes with testing to eliminate the disease (Collins, 2006).

Successful application of a test-and-slaughter policy requires sustained cooperation of national and private veterinary services, meat inspectors, and farmers and adequate compensation for services rendered (de la Rua-Domenech *et al.*, 2006).

2.3.2 Cysticercosis

Bovine cysticercosis is a worldwide zoonotic disease that affects cattle caused by the larval stage of the tapeworm *Taenia saginata*, the adult parasite that causes taeniasis in humans. Cysts are of soft consistency (or very hard, an involuted cyst) and are typically found in muscles: especially in the heart, masseter, tongue, and diaphragm. The size of the cysts is 0.5-1 x 0.5 cm. (Schandevyl and Vercruysse, 1982).

Cattle become infected with bovine cysticercosis by ingesting materials contaminated with tapeworm eggs originating from human faeces. Humans, the definitive host, become infected via the consumption of raw or undercooked beef (Abay and Kumar, 2014).In people, the adult tapeworm ranges from 5m to 15m in length and whilst infection may occasionally be associated with diarrhoea or abdominal pain, it is usually asymptomatic and is mainly objectionable on aesthetic grounds. Eggs are passed by the host (human) and survive on the pasture. The oncosphere is then ingested by the intermediate host, the (cow) in this case. These infect the striated muscle, which is visible as cysts (Dermauw *et al.*, 2018).

2.3.2.1 Economic Significance of Bovine Cysticercosis

Bovine cysticercosis is economically significant to the beef industry due to meat inspection costs and public health control. Infected carcasses are usually condemned or downgraded or must be subjected to cold storage at temperatures not exceeding -7ºC for up to three weeks to ensure the metacestode stage of the parasite is killed, rendering the carcass safe for human consumption (Tolossa, 2015).

2.3.2.2 Bovine Cysticercosis Prevention and Control

Routine meat inspection should be applied in all slaughterhouses. The farmer should be encouraged to engage in an intensive management system rather than an extensive animal

production system to reduce the exposure rate (Tolossa, 2015).Traditional slaughtering in rural areas should be replaced with modern slaughterhouses (Unger *et al.*, 2008).

2.3.3 Bovine Hydatidosis

Cystic Echinococcosis (CE) or Hydatidosisis caused by infection with the larval stages of *Echinococcosis granulosus*. CE is found in Africa, Europe, Asia, the Middle East, Central and South America, and in rare cases, North America (Mulatu *et al.*, 2013).The parasite is transmitted to dogs when they ingest the organs of other animals that contain hydatid cysts. The cysts develop into adult tapeworms in the dog (Amuamuta, Akalu and Chanie, 2012).Infected dogs shed tapeworm eggs in their faeces that contaminate the ground. Cattle, sheep, goats, and pigs ingest tapeworm eggs in the contaminated ground. Once ingested, the eggs hatch and develop into cysts in the internal organs (Mulatu *et al.*, 2013).

The most common transmission mode to humans is the accidental consumption of soil, water, or food contaminated by an infected dog's faecal matter. *Echinococcus* eggs deposited in the soil can stay viable for up to a year (Baldock, Arthur and Lawrence, 1985).The disease is most commonly found in people raising cattle and sheep due to the cattle role as an intermediate host of the parasite and the presence of working dogs that are allowed to eat the offal of infected sheep (Amuamuta, Akalu and Chanie, 2012).

Humans with cystic Echinococcosis often remain asymptomatic until hydatid cysts containing the larval parasites grow large enough to cause discomfort, pain, nausea, and vomiting. The cysts grow over several years before reaching maturity, and the rate at which symptoms appear typically depends on the location of the cyst (Baldock, Arthur and Lawrence, 1985).The cysts are mainly found in the liver and lungs but can also appear in the spleen, kidneys, heart, bone, and central nervous system, including the brain and eyes. Cyst rupture is most frequently caused by trauma and may cause mild to severe anaphylactic reactions, even death, due to the release of cystic fluid (Toffik Kebede, 2014).

Alveolar Echinococcosis (AE) is characterised by parasitic tumours in the liver and may spread to other organs, including the lungs and brain. In humans, the larval forms of *E. multilocularis*do not fully mature into cysts but cause vesicles that invade and destroy surrounding tissues and cause discomfort or pain, weight loss, and malaise (Kebede *et al.*, 2009).AE can cause liver failure and death because of the spread into nearby tissues and, rarely, the brain.AE is a dangerous disease resulting in a mortality rate between 50% and 75%, mainly because most affected people live in remote locations and have poor health care (Filippou *et al.*, 2007).

2.3.3.1 Economic Significance of Bovine Hydatidosis

Hydatidosis is a severe disease of mammals, including men and also causes considerable economic loss in livestock due to condemnation of the organs, reduction in milk and meat productions, reduced hide and fleece value and decrease in fecundity (Fromsa and Jobre, 2012). In humans, if one or both lungs are affected, it will cause respiratory symptoms, and if several hydatid cysts are present in the liver, there may be gross abdominal distention. If the cyst ruptures, this can be a risk for death from anaphylaxis, or if the person survives, released daughter cysts may resume developing in other body regions (Kebede *et al.*, 2009). The risk of infection of humans by this parasite is high due to lack of hygiene in rural areas, the high infection rate of dogs, the high level of environmental, water and food contamination with *E. granulossus* eggs and the lesser awareness of the mode of transmission of the parasite by the community (Fromsa and Jobre, 2012).

2.3.4Liver Fascioliasis

Fascioliasis is an important parasitic disease of domestic ruminants caused by two liver fluke species, *Fasciola hepatica* and *Fasciola gigantica*, common liver fluke or the cattle liver fluke. Both types can infect human beings (Simwanza, Mumba, Pandey, *et al.*, 2012). Fascsiollosis prevalence of 28.63%, 20.77% and 6.7% have been reported in Ethiopia (Abebe *et al.*, 2010), Zambia (Simwanza, Mumba, Pandey, *et al.*, 2012), and Tanzania (Mwabonimana *et al.*, 2010), respectively.

Fascioliasis is found in all continents except Antarctica, in over 70 countries, especially where there are cattle or sheep (Abunna *et al.*, 2010). People usually become infected by eating raw watercress or other water plants contaminated with immature parasite larvae (Ogunrinade and Ogunrinade, 1980).The young worms move through the intestinal wall, the abdominal cavity, and the liver tissue into the bile ducts, where they develop into mature adult flukes that produce eggs. The pathology typically is most pronounced in the bile ducts and liver. Human fascioliasis is usually recognised as an infection of the bile ducts and liver, but infection in other body parts can occur (Bekele, Tesfay and Getachew, 2010).

2.3.4.1 Liver Fascioliasis Symptoms

Symptoms in cattle in the early (acute) phase, symptoms can occur because of parasite migration from the intestines to and through the liver. Symptoms include gastrointestinal problems such as nausea, vomiting, and abdominal pain/tenderness (Dorny *et al.*, 2009).Fever, rash, and difficulty breathing may occur (Bekele, Tesfay and Getachew, 2010). During the chronic phase (after the parasite settles in the bile ducts), the clinical manifestations may be similar or more discrete, reflecting inflammation and blockage of bile ducts, which can be intermittent. Inflammation of the gallbladder and pancreas also can occur (Abunna *et al.*, 2010).

2.3.4.2 Economic Significance of Liver Fascioliasis

Fasciolosis cause an important economic loss in the meat industries (Abunna *et al.*, 2010).Over the years, the prevalence has increased, and it is likely to continue increasing in the future (Schweizer *et al.*, 2005).The economic ramifications are clear when cattle become clinically ill because of a parasitic infection. However, clinical disease is uncommon, and cattle tend to harbour parasitic infections that are clinically unapparent. Although infected cattle may not appear ill, subclinical parasitic infections are recognised as causing economically important reductions in animal productivity (Abunna *et al.*, 2010).Economic losses from liver flukes may result directly from increased liver condemnations at slaughter and indirectly from decreased livestock productivity. Although direct losses are easier to measure, indirect losses are considered to be far more economically important (Abunna *et al.*, 2010).

2.3.4.3 Liver Fascioliasis Prevention and Control

Cattle grazing need to be controlled, especially in Fascioliasis endemic areas. As always, travellers to areas with poor sanitation should avoid food and water that might be contaminated (tainted).Vegetables grown in fields that might have been irrigated with polluted water should be thoroughly cooked, as should viscera from potentially infected animals (Abunna *et al.*, 2010).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1Study Area

The study was conducted in Wau, Western Bahr El Ghazal state, South Sudan. The state shares international borders with Sudan to the North and Central African Republic to the West and lies along coordinates of 8.6452°N,25.2838°E and 626.9 meters above sea level. The climate is tropical, with annual rainfall between 400-1600 mm and mean annual temperatures between 23.8°C and 40°C.Wau is located on the western bank of Jur River, consisting of two administrative parts: Wau North and Wau South. Both North and South have got their abattoirs besides small slaughter slabs. Wau Town was chosen for this study because it is the largest town in the greater Bahr El Ghazal region, a hub for livestock marketing and has the largest abattoir with experienced veterinarians in the region.

Figure 1: Study Area, Wau, South Sudan as pointed by the arrow(Google Maps)

3.2 Study Design

This was both a cross-sectional and retrospective study design, which combined quantitative and qualitative approaches. The retrospective study was done using abattoir records retrieved between January 2015 and December 2020.These five years elucidate the causes and magnitude of condemnation during this period.

The cross-sectional study that generated primary data was supported and strengthened to validate the retrospective data.

3.3 Study Population

The target population include all cattle slaughtered in the Wau abattoir for a period of Two (2) months (cross-sectional study). However, the (retrospective study) was taken for an extended period from 2015-2020.

3.3.1 Inclusion Criteria

All cattle were slaughtered in Wau (Lokoloko) main abattoir, from 2015-2020 (retrospective) and from January – February 2021(cross-sectional).

3.3.2Exclusion Criteria

Cattle from other abattoirs rather than (Lokoloko) or data collected out of the study prescribed period above.

3.3.3Sample Size

For the cross-sectional study, all cattle slaughtered in Wau town's central abattoir (Lokoloko) for two (2) months were included. Also, all cattle slaughtered for the period from 2015-2020 were included in the retrospective study.

3.3.4Data Collection Technique

Data collection sheets was used as tool for data collection.

For the cross-sectional study, all cattle slaughtered in Wau town's abattoir on the daily bases (Lokoloko) for two (2) months January and February 2021 were included.

The type of data collected included:

Organ/carcase, cause of condemnation, type of condemnation, total weight and price per KG/ financial loss.

Retrospective data (from 2015-2020) were retrieved from the achieves of the Ministry of Animal Resources and Fisheries to give a picture of the trend of diseases and magnitudes of condemnations.

3.5 Data Management and Analysis

Quantitative data was collected, coded, and double-checked to ensure consistency of information, then entered into Microsoft Excel® spreadsheet before being exported intoStatistical Products and Service Solutions SPSS version 22 software for analysis. Univariate analysis was carried out to generate frequencies and percentages.

Data from performed meat inspections were recorded, entered and analysed using Microsoft Excel spreadsheets. The average number of cattle slaughtered each year and the average number of the whole organ and partial condemnations due to most disease was calculated to come up with the disease prevalence estimate.

For the cross-sectional study, primary data were collected daily for two months, all animals examined were recorded at the abattoir, and the average number of the whole organ and partial condemnations due to most diseases were calculated to come up with the disease prevalence estimate. Retrospective data were obtained from the available abattoir records from 2015-2020.Additionally, the average weight of affected organs was taken from the record, and the average sale price of organs per kilogram was obtained through a survey conducted at the Wau abattoir in the study area.

3.5.1 Analysis of financial loss due to total or partial Organs Condemnations

Budgetary analysis was used to estimate total annual financial losses incurred due to whole carcases and partial condemnations for each year from 2015 to 2020 using several parameters, which included:

1. The average number of cattle slaughtered per year
2. Prevalence of most affected organs per year
3. The average sale price (Av Pr) of the most affected organ for each year was obtained through a survey conducted at the Wau abattoir (Lokoloko).
4. Average weight in kilograms (Av Wt.) of most affected organs in mature cattle.

The direct loss (DL) resulting from condemnations of whole and partial condemnation was calculated using the formula below as described by(E. S. Swai and Ulicky, 2009)

DL=TNA x Pf x (Ao Wt) x (Ao Pr)……..equation 1

Where: TNA = Total number of cattle slaughtered Pf = prevalence of most affected disease,

Ao Wt =average weight of affected organ (kg) and Ao Pr = average price of affected organ /kg

3.6 Ethical Considerations

The study was approved by an ethical committee from UBG, South Sudan **RF: UBG/CVS/.RE.50.A/1**.Additional approval was sought from the Ministry of Animal Resource and Fisheries (MARF) Wau, South Sudan.

CHAPTER FOUR

4.0 RESULTS

4.1 Descriptive Statistics of Cattle Cases from Lokoloko Abattoir (Retrospective Study)

A total of 25002 cattle were slaughtered in the retrospective study of which 16,271(100%) were condemned due to different disease of Zoonotic in Wau abattoir. Of this disease tuberculosis was the higher frequent in the total condemnation with total of 3430/25002 and percentage of 21.1% as shown in table 4.1.

Table 4.1 Descriptive Statistics of Cattle Cases in Lokoloko Abattoir

Disease	**Type of condemnation**	**Total cattle slaughtered**	**Frequency**	**Percentage**
Tuberculosis	Total	25002	3430	21.1%
Carcass Cysticercosis	Total	25002	2350	14.5%
Liver Fasciolosis	Partial	25002	2350	14.5%
Liver Hydatidosis	Partial	25002	2340	14.4%
Lungs Pneumonia	Partial	25002	3121	19.1%
Heart Cysticercosis	Partial	25002	2680	16.4%
Total		**25002**	**16,271**	**100%**

4.2 Descriptive Statistics of Cattle Cases from Lokoloko Abattoir (Cross Sectional study)

310 cattle were slaughtered of which 185 cattle were condemned. Tuberculosis (23.5%), liver facsiolosis (24.9%) and Lungs pneumonia (19.5%) were the reasons for total and partial condemnation as shown in Table 4.2

Table 4.2 Descriptive Statistics of Cattle Cases from Lokoloko Abattoir (Cross Sectional study)

Disease	**Type of condemnation**	**Total cattle slaughtered**	**Frequency**	**Percentage**
Tuberculosis	Total	310	47	25.3%
Liver Fasciolosis	Partial	310	46	24.9%
Liver Hydatidosis	Partial	310	56	30.3%
Lungs pneumonia	Partial	310	36	19.5%
Total		**310**	**185**	**100%**

4.3 Major Causes of Total or Partial Condemnation (Retrospective Study)

The major cause for total or partial condemnation was assessed through a retrospective survey, which was done from the data recorded at the abattoirs. The recorded data were grouped into every six months for a period of five years 2015-2020.Many of the recorded cases showed that generalized tuberculosis was the main reason for total condemnation with a mean of 20,583cases of total condemnation. Partial condemnation was caused by Fascsiollosis with a mean 19,566cases as shown in Table 4. 3.

Table 4.3: Major Causes of Total or Partial Condemnation (Retrospective Study**)**

Causes of condemnation	**Type of condemnation**	**Total No examined**	**Mean**
Whole carcass Tuberculosis	Total	25002	20,583
Liver Fascsiollosis	Partial	25002	19,566
Liver Hydaatidosis	Partial	25002	19,500
Lungs Pneumonia	Partial	25002	17,675
Heart Cysticercosis	Partial	25002	17,675
Lungs Hydaatidosis cyst	Partial	25002	19,500

4.4 Financial losses (Retrospective) due to Total and Partial Condemnation of Cattle Carcasses in Wau, Abattoir

Results indicate that a total number of 25002 cattle were slaughtered. Total condemnation was the most reported, with 3430/25002 found to have generalized tuberculosis giving a prevalence of 13.7% and financial loss of equivalent to USD 186,184. However, the liver accounted for most of the partial condemnation. This was due to fasciolosis with a total number of cases of 2350, giving a prevalence of9.4% and financial losses amounting to equivalentlyUSD178,527. This was followed by carcass cysticercosis with total cases of 2350 (9.1%) and financial losses equivalent to USD 114,215, as shown in Table 4.4.

Table4.4:Financial Lost due to Cattle Total and Partial Condemnation from 2015-2020 in Wau, Abattoir**.**

Case of condemnation	**Condemnation type**	**Average No. Cattle slaughtered**	**Average No. Cattle condemned**	**Average prevalence**	**Price/KG**	**Average weight (KG) condemned**	**(USD)**
Tuberculosis	Total	25002	3430	13.7	5	523000	186,184
Carcass Cysticercosis	Total	25002	2350	9.4	5	705000	114,215
Liver Fasciolosis	Partial	25002	2350	9.4	6	889,000	178,527
Liver Hydatidosis	Partial	25002	2340	9.4	6	702000	48,471
Lungs Pneumonia	Partial	25002	3121	12.5	1	923200	54,570
Heart Cysticercosis	Partial	25002	2680	10.7	5	185000	40,190

4.5 Financial Losses from Cross-sectional Study due to Cattle Total and Partial Condemnation in Wau, Abattoir

A cross-sectional study was conducted for a period of two (2) months from January to March 2021.Results showed that a total number of 310 cattle were slaughtered during this period. Out of these,47(15.2%) carcasses were found with generalized tuberculosis and a financial loss of SSP equivalent to USD 12,226. This was followed by liver fasciolosis with total cases of 46(14.8%) partial condemnations and financial loss equivalent to USD 9,593 as shown in Table 4.5.

Table 4.5: Financial losses from Cross-sectional Study due to Cattle Total and Partial Condemnation in Wau, Abattoir

Case or disease	**Condemnation type**	**Average No.Cattle slaughtered**	**Average No.Cattle condemned**	**Average prevalence%**	**Price/KG**	**Average weight (KG) condemned**	**Cost (USD)**
Tuberculosis	Total	310	47	15.2	5	2259	12,226
Liver Fasciolosis	Partial	310	46	14.8	6	1550	9,593
Liver Hydaatidosis	Partial	310	56	14.8	6	850	6,176
Lungs Pneumonia	Partial	310	36	11.6	1	4300	2,721
Tongue Cysticercosis	Partial	310	35	11.3	6	935	3,362
Heart Cysticercosis	Partial	310	31	10	5	720	1,691

CHAPTER FIVE

DISCUSSION

5.0 Discussion

This study demonstrated the usefulness of meat inspection records in monitoring disease conditions and economic loss of the investigated causes of condemnation. Although abattoir surveys have limitations, they are an economical way of gathering information on livestock diseases, especially in a developing country like South Sudan. Post-mortem meat inspection is intended to spot and remove from the food chain all carcasses/Organs that present grossly identifiable abnormalities that may affect the meat product's safety, security, and wholesomeness.

The broad objective of this study was to identify causes of carcass and organ condemnation in slaughtered cattle in Wau abattoirs of South Sudan and to determine the financial losses associated with such condemnation. Abattoirs play an essential role in the surveillance of human and animal health diseases. Examination at the abattoir lead to all animals for human consumption to be examined for abnormal signs, lesions, or specific diseases(Alton *et al.*, 2010; Deschamps *et al.*, 2013; Thomas-Bachli *et al.*, 2014).In this study, cattle were condemned at the abattoir due to disease. Some of these diseases identified as the principal causes of carcass and organ condemnation have been classified as zoonotic or emerging zoonotic diseases. It is estimated that 75% of emerging human pathogens are zoonotic (Dorny *et al.*, 2009).

Method of meat inspection, inspector’s experience (Raji, Salami and Ameh, 2010; Ochi, Akol and Lukaw, 2016), farm management differences, sampling method, lesion location and degree of degenerated cysts (Ochi, Akol and Lukaw, 2016), additionally to other factors might significantly contribute to variations within the recorded prevalence of bovine cysticercosis. The prevalence of cysticercosis obtained in the current study could be an underestimation of the true prevalence due to improper recording (some partial condemnation is not recorded) and an undefined number of livers condemned for calcification. This emphasizes the requirement for

investigating the causes of liver calcification so as to implement prevention and control measures.

In this study, the prevalence of tuberculosis was (15.2%) and (13.7%) in active retrospective studies, respectively. However, in combined active and retrospective studies, total condemnation as a result of generalized tuberculosis accounted for USD 198,410. The retrospective study and active abattoir survey found that 5,862 cattle carcasses were condemned due to Generalized tuberculosis and cysticercosis. These conditions were known to be major causes for the condemnation of carcass in many African countries such as Ethiopia, Sudan and South Africa (Jaja, 2014).

Liver condemnations was the first leading cause in the partial condemnation have been studied by several researchers in different African countries namely Ethiopia, Tanzania, Zambia, Ethiopia , Zimbabwe, Sudan and South Sudan shown a high prevalence of preventable zoonosis, demonstrating a weakness in the proper herd health programs necessary for the promotion of animal health in the various farms where these animals are bred (E S Swai and Ulicky, 2009; Ghanem *et al.*, 2009; Bogale *et al.*, 2012; Guideline, 2014; Sungirai, Masaka and Mbiba, 2014). The situation in South Sudan may be more critical and the animal health programs need to be improved to cope with the international standard, the increasing animal population and increasing national and global food consumption rates.

Cysticercosis was the second leading cause of total carcass condemnations (9.1%) during the study, this prevalence was much higher than that reported reported by (Basem *et al.*, 2009), prevalence of 1.69, 0.32 and 0.23% from Egypt, Northern Ecuador and Swaziland abattoirs respectively. The higher prevalence of bovine cysticercosis in this study might be attributed to lack of awareness and personal hygiene through un proper use latrine which may contribute much contamination of grazing land by human excreta containing T. saginata eggs that may lead subsequent increase of chance of infecting the intermediate host cattle (Basem *et al.*, 2009).

A lower prevalence of hydatidosis cattle livers (3 %) was reported in Sudan (Mohamed, 2021a), while a higher percentage was obtained in the current study (9.1 %) the difference in the prevalence rate may be attributed to lack of improvement in the veterinary services, the location of the study, livestock husbandry, abundance of infected definitive host, nature of the pasture and grazing patterns of the slaughtered cattle.

The liver, Lung, and heart were the most condemned organs. The major causes of their partial or total condemnation were Fasciolosis, Hydatidosis, and Pneumonia. On the other hand, the major causes of carcass condemnation were TB and TB-like lesions and cysticercosis. Subsequently, these diseases resulted in a substantial monetary loss in the Wau abattoir. Hence, animal wellbeing extension work should be in place to generate awareness of animal producers on issues like proper disposal of condemned organs and carcass and treatment of sick animals.

Liver Fasciolosis reported in this study both in retrospective and active data survey was (9.1%) and (14.8%) respectively this result is in line with a study done in Tanzania where liver Fasciolosis prevalence was found to be17.8%. The overall prevalence of Fasciolosis acquired from the present study (23.9%) is comparable to the previous report of (22.9) a study from Ethiopia, 20.77% reported by Simwanza et al (2014) in Zambia.

Pneumonia is the third cause important disease for lung condemnation in this abattoir during the study period. The prevalence of pneumonia was 11.6%. This finding is higher than the condemnation rate (4.8 and 8.8%) that was reported by (Basem *et al.*, 2009). in cattle slaughtered at Zaria and it was higher than that reported (0.14%) in cattle slaughtered at Zango abattoir (Raji, Salami and Ameh, 2010). A number of factors may explain the high prevalence of pneumonic lungs, including stress factors such as exposure to dust from the environment or exhaustion during long treks of pastoral livestock in search of pasture and water and when animals are taken to livestock markets or abattoirs and parasitism.

The present findings indicated that a high number of livers were condemned due to various abnormalities. Of these, fasciolosis and hydatidosis were found to be the major causes for liver condemnation at Lokoloko abattoir. Losses from liver condemnation were assumed to occur

since hepatic pathology is associated to infection that might have public health importance and aesthetic value (Mesele *et al.*, 2012). Previous studies have indicated a higher economic loss resulting from condemnation of eatable organs and carcass due to parasitic causes.

The present study revealed that, tuberculosis, fasciolosis, cysticercosis, hydatydosis, and pneumonia were the main causes of carcass/organs condemnation in cattle leading to considerable economical loss of meat. Eradication of those diseases requires cooperation between the general public health and official veterinary authorities. It is recommended for each country to establish a public health education for farmers and to implement farmer based organization extension. Farmer's education is necessary to avoid eating raw meat, proper disposal of condemned organs, cattle management system, treatment of animals with anti-helminthic drugs and grazing management of animals during the dry season to avoid the access of the animals to the parasite's eggs.

Generally, retrospective studies possess some limitations that could result in an underestimated prevalence of liver diseases due to several reasons e.g. meat inspector's judgment errors, only clinically healthy animals are passed for slaughter, relying on gross pathological lesions for the diagnosis of diseases lead to condemnation of livers and general substandard record keeping. Furthermore, localized or partial infection of livers that might have been passed as fit for human consumption after trimming of the affected parts and not included in the slaughterhouse records.
Our findings show an annual loss of 27,411.8 USD due to liver Fasciolosis. This finding is higher than that reported in Tanzania, where a loss of USD 18,000 was reported. However, the financial loss estimation did not include some livers with a partial infection passed as fit for human consumption after trimming the affected parts (Mwabonimana *et al.*, 2010).

The financial loss reported in this study was (186,184 USD) and (12,226 USD) due to tuberculosis for both retrospective and active data, respectively. However, financial loss due to liver in the partial condemnation was observed in this study, was (178,527USD) and (9,593 USD) for the data recorded and active abattoir survey, respectively.

loss of cattle poses serious long-term threats to farmer communities. As well as income and food, livestock is critical for education and marriage and integral to South Sudanese culture and society. Any post-conflict recovery will have to include reacquisition of cattle for such communities.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATION

6.0 Conclusions and Recommendations

6.1 Conclusions

The results identified various causes of organ condemnation and their economic importance in the area. Among those identified, the zoonotic disease Tuberculosis, Liver Fasciolosis, Hydatidosis and Cysticercosis were the major causes of partial and total condemnation of organs and carcasses in cattle in the Wau abattoir resulting in considerable financial loss in cattle production, which remain the most critical diseases deserving thoughtful attention for prevention and control actions. Hence, the current study may be valuable locally and nationally by providing data for monitoring disease conditions and management practices of animals that have public health hazards and aesthetic value.

6.2 Recommendations

Recommendations Eradicating these diseases requires cooperation between public health and official veterinary authorities. Public health education to avoid eating raw meat, proper disposal of condemned organs, cattle management system, treatment of animals with anti-helminths'drugs and grazing of animals during the dry season to prevent the access of the animals to the parasites eggs are important. In addition, proper and detailed meat inspection at the abattoir is also recommended. Bovine cysticercosis impacts the cattle industry and poses a serious health risk to beef consumers. Therefore, to reduce the transmission of taeniasis/cysticercosis, adequate meat inspection, public education to avoid consumption of raw/undercooked meat, use of latrines and improved standards of human hygiene is recommended.

Further cross-sectional studies for a period of six months in the rainy and dry seasons must be conducted to accurately capture more diseases and asses their financial losses are recommended. Also, the recommended cross-sectional should involve laboratory confirmation of the collected samples.

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Appendices

Appendix I: Ethical Approval

University of Bahr el-Ghazal
College of Veterinary Science
Research & Ethics Committee

Date: 18/01/2021

Our Ref: UBG/CVS/RE.50.A/1

Research and Ethics Committee Review and Endorsement

The research and Ethic committee only accepts for review and approval, research proposals that have been found both scientifically and ethically acceptable in accordance with guidelines on institutional Ethical Review Boards.
We the undersigned institutional Ethical Review Committee established by College of Veterinary Science do certify that we have reviewed the research proposal **entitled Economic Losses arising from condemnation of cattle carcass and organs in Wau Town submitted by Mr. Alfateh Abdomnem Hassan (Reg.No. 2019112116), School of Veterinary Medicine, University of Zambia.**
We attest to scientific and Ethical merit of this study and competency of the investigator to conduct the research on slaughtered animals and their samples.
Signatures

1. **Asso.Prof.Dr. Ambrose Jubaru---------- Head of Ethics Committee----------**
2. **Prof.Dr. Lewis Khamis Jaja ----------Member of Ethic Committee----------**

Appendix 11: Request for Permission

THE UNIVERSITY OF ZAMBIA
SCHOOL OF VETERINARY MEDICINE
OFFICE OF THE ASSISTANT DEAN (POSTGRADUATE)

Telephone: 293727
Telegrams: UNZA, LUSAKA
Telex: UNZALU ZA 44370
Fax: 293727/253952
School Fax: 293727
Vet. Clinic Telephone: 291513

P.O. Box 32379
Lusaka, Zambia

Your Ref:

Our Ref:

12th December 2020

TO WHOM IT MAY CONCERN,

RE: INTRODUCTORY LETTER-ALFATEH ABDOMONEM HASSAN (COMPUTER NUMBER 2019112116)

I write to request for permission from your office to allow Alfateh Abdomonem Hassa, an MSc student in Public Health and Zoonosis at the University of Zambia, School of Veterinary Medicine, Department of Disease Control, to conduct research in your institution or Company. The candidate's research is entitled ***"Economic losses arising from condemnation of cattle carcases in wau Town, of South Sudan."***

Please find attached a copy of the project concept note and ethical approval letter for your reference. Please do not hesitate to contact my office for any clarification.

Yours sincerely,

Dr. Chisoni Mumba, PhD
ASSISTANT DEAN (PG), SCHOOL OF VETERINARY MEDICINE
Email: cmumba@unza.zm, mkmumba@yahoo.com
Mobile: +260 977717258

Cc: *Dean, School of Veterinary Medicine*
Assistant Registrar, School of Veterinary Medicine

Appendix III: Permission for Data Collection

University of Bahr El Ghazal
College of Veterinary Sciences

جامعة بحر الغزال
كلية العلوم البيطرية

Date: 18th January 2021

Our Ref: UBG/CVS/50.A/1

TO WHOM IT MAY CONCERN

Dear Sir/ Madam

Re: Permission for data collection

Mr. Alfateh Abdomneem Hassan is a research student at the **school of Veterinary Medicine, University of Zambia.** His present in the State to carry out a research project as a partial fulfillment of his master of science in public health and zoonosis. Mr. Alfateh's topic of research is entitled: **Economic Losses arising from condemnation of cattle carcass in Wau Town, South Sudan,** which has already been approved by College of Veterinary Science Ethics committee.

The purpose of this communication therefore is to introduce to you Mr. Hassan and request your esteemed office to grant him permission to collect data for his research.
All assistance accorded to Mr. Alfateh in this regard will be highly appreciated.

Yours sincerely,

Dr. Ambrose Samuel Jubara
Associate Professor
Dean College of Veterinary Science
Tel: + 2119 133 877 27
E.Mail: asjubara@yahoo.com

Appendix IV: Permission to Undergo Field Research

Republic of South Sudan
Ministry of Agriculture, Forestry, Animal Resources & Fisheries
Western Bahr el Ghazal State – Wau
Directorate of Animal Resources & Fisheries
Director General's Office

Date: 20th January, 2021

TO WHOM IT MAY CONCERN

Subject: Permission to undergo Field Research for Student/ Alfateh Abdomnem Hassan

This is to certify that, the above mentioned subject is a Research Student registered for a Master of Economic in Public Health and Zoonosis at Zambia University, Zambia.
Therefore, he has been given approval for data collection from cattle and goats slaughtered at slaughter houses within Wau Municipality.
Kindly provide him with all necessary assistance.

Regards,

Edward Lino
Director General
Directorate of Animal Resources and Fisheries
Western Bahr el Ghazal State/Wau

Cc:
- ✓ **Mayor/ Wau Municipality**
- ✓ **National Security/Wau**
- ✓ **CID/Wau**
- ✓ **Wau International Airport**
- ✓ **Juba International Airport**

Appendix V: Slaughterhouse Data Collection Sheet (Retrospective)

UNIVERSITY OF BAHR EL-GHAZAL

COLLEGE OF VETERINARY SCIENCE

SLAUGHTERHOUSE DATA COLLECTION SHEET

RETROSPECTIVE STUDY (5 YEAR)

YEAR: ——————————

Carcass/Organ	Causes of condemnation	Total condemnation	Partial condemnation	Number	Weight (Kg)	Unit price(SSP)	Financial losses (SSP)	Financial losses (USD)
Carcass	Generalized Tuberculosis ( )							

	Anthrax ( )							
	Cysticercosis ( )							
	Jaundice ( )							
	Discoloration( )							
	John's Disease( )							
Total								
Liver	Fasciolosis ( )							
	Abscesses ( )							
	Hydatidosis ( )							
	Hepatitis( )							
	Calcified cysts ( )							
	Fibrosis( )							
Total								

2

Lungs	Pneumonia( )							
	Hydatid cyst( )							
	Emphysema( )							
	Abscesses( )							
	Tuberculosis( )							
	Pleurisy( )							
	Calcified cyst ( )							
	Congestion( )							
	CBPP( )							
Total								
Spleen	Splenomegaly( )							
	Abscesses( )							
	( )							

3

Total								
Heart	Calcified cyst( )							
	Cysticercosis( )							
	Pyocarditis( )							
	( )							
Total								
Intestines	Pimply gut( )							
	Enteritis( )							
	Abscesses( )							
	Gangrene( )							
	Peritonitis( )							

4

	Tape worms ( )							
Total								
Rumen	Abscess( )							
	Gastritis( )							
	TRP( )							
	Paramistomiasis( )							
Total								
Kidneys	Cyst( )							
	pyelonephritis( )							
	Melanosis( )							
	Calculi( )							
	Hydronephrosis( )							
Total								

5

Thorax	Pleurisy( )							
	Tuberculosis( )							
	Abscess ( )							
Total								
Udder	Gangrene( )							
	Abscess( )							
	Mastitis( )							
	Tumor( )							
Total								
Limbs	Abscess( )							
	Gangrene( )							
	Fracture( )							

Total								
Heads	Abscess ( )							
	Tuberculosis( )							
	Myiasis ( )							
Total								
Plucks	Abscess( )							
	Tuberculosis( )							
	Pleurisy( )							
	( )							
Total								
Tongue	Cysticercosis( )							
	Actinbacillosis( )							
	Discoloration( )							

	Abscess( )							
	( )							
Total								

Appendix VI Slaughterhouse Data Collection Sheet (Crossectional)

UNIVERSITY OF BAHR EL-GHAZAL

COLLEGE OF VETERINARY SCIENCE

SLAUGHTERHOUSE DATA COLLECTION SHEET

PROSPECTIVE STUDY (2 MONTH)

MONTH: ---------------------WEEK: ---------------------DAY: -----------DATE: ----------------------

Carcass/Organ	Causes of condemnation	Total condemnation	Partial condemnation	Number	Weight (Kg)	Unit price(SSP)	Financial losses (SSP)	Financial losses (USD)
Carcass	Generalized Tuberculosis ( )							
	Anthrax ( )							
	Cysticercosis ( )							
	Jaundice ( )							
	Discoloration( )							
	John's Disease( )							

Total								
Liver	Fasciolosis ( )							
	Abscesses ( )							
	Hydatidosis ( )							
	Hepatitis( )							
	Calcified cysts ( )							
	Fibrosis( )							
Total								
Lungs	Pneumonia( )							
	Hydatid cyst( )							
	Emphysema( )							
	Abscesses( )							
	Tuberculosis( )							
	Pleurisy( )							
	Calcified cyst ( )							
	Congestion( )							
	CBPP( )							
Total								
Spleen	Splenomegaly( )							
	Abscesses( )							
	( )							
Total								

Heart	Calcified cyst( )							
	Cysticercosis( )							
	Pyocarditis( )							
	( )							
Total								
Intestines	Pimply gut( )							
	Enteritis( )							
	Abscesses( )							
	Gangrene( )							
	Peritonitis( )							
	Tape worms ( )							
Total								
Rumen	Abscess( )							
	Gastritis( )							
	TRP( )							
	Paramistomiasis( )							
Total								
Kidneys	Cyst( )							
	pyelonephritis( )							
	Melanosis( )							

Heart	Calcified cyst( )							
	Cysticerosis( )							
	Pyocarditis( )							
	( )							
Total								
Intestines	Pimply gut( )							
	Enteritis( )							
	Abscesses( )							
	Gangrene( )							
	Peritonitis( )							
	Tape worms ( )							
Total								
Rumen	Abscess( )							
	Gastritis( )							
	TRP( )							
	Paramistomiasis( )							
Total								
Kidneys	Cyst( )							
	pyelonephritis( )							
	Melanosis( )							

Plucks	Abscess( )							
	Tuberculosis( )							
	Pleurisy( )							
	( )							
Total								
Tongue	Cysticercosis( )							
	Actinbacillosis( )							
	Discoloration( )							
	Abscess( )							
	( )							
Total								