SOCIAL DETERMINANTS OF HUMAN ANTHRAX TRANSMISSION IN ZAMBIA

By

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A thesis submitted to the University of Zambia in fulfilment of the requirements for the degree of Doctor of Philosophy in One Health (Public Health)

University of Zambia

Lusaka

2019

DEDICATION

To my family, for their love, support, and endurance

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DECLARATION

I, **Doreen Chilolo Sitali**, hereby declare that the project report titled **"Social Determinants of Human Anthrax Transmission in Zambia"** submitted to the University of Zambia is entirely original work done by me under the guidance of my supervisors. I further declare that, to the best of my knowledge, the information given in the thesis is authentic, and that the work of others has been duly acknowledged. Also that, the thesis has not been submitted for any other degree or professional qualification.

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Signature Date

APPROVAL

This thesis of Doreen Chilolo Sitali has been approved as fulfilling the requirements for the award of a Doctoral degree in Public Health (One Health) by the University of Zambia.

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ABSTRACT

Zambia has experienced an unprecedented increase in the number of human anthrax outbreaks in the Western Province where cycles of epidemic outbreaks commonly occur at the onset of rains after prolonged dry periods and frequent outbreaks occur in Chama District of Muchinga Province. Epidemics are triggered by an interplay of environmental and human activity factors. Notwithstanding that ecological and epidemiological factors have been researched to some extent, there is insufficient information concerning the social factors that influence human behavior associated with anthrax transmission in Zambia. The study was set to explore the socio-economic, cultural and political determinants associated with human anthrax transmission in Zambia.

The study was conducted in the Western and Muchinga Provinces of Zambia. A convergent parallel mixed methods design was used to collect both quantitative and qualitative data. A questionnaire survey involving 1,127 respondents, six focus group discussions, and eight key informant interviews were conducted to collect data. The respondents included cattle farmers as well as those who are in contact with animals. Descriptive statistics of quantitative data and thematic analysis of qualitative data were run concurrently but separately. The use of matrices facilitated interpretation of both quantitative and qualitative results.

Many of the socio-demographic and socio-economic characteristics of respondents suggested that the majority were living below the poverty datum line. A larger proportion (85%) of respondents never attended school. The study also found that most of the respondents in both regions (76%) in Western and (51%) in Muchinga respectively, had no access to safe drinking water and sanitation facilities. The study further established that, though the majority (88%) of respondents were knowledgeable about anthrax and knew that vaccination was a useful preventive measure, they had negative attitudes towards most control measures due to low perceived efficacy of the vaccine and lack of trust of professional staff. Also, 78.1% of those interviewed ate, sold or shared meat from dead animals suspected to have died of anthrax. A large proportion (68%) of respondents participated in slaughtering moribund animals, and only 13% had their cattle incinerated or buried when they died of disease. Based on the study findings, it can be argued that poverty; cultural practices such as mafisa (a traditional practice common in the Western Province where a cattle owner entrusts his cattle to another herder to reduce risk of losing all the animals), gender roles and responsibilities, and socio-economic factors are fundamental drivers influencing human anthrax transmission. Also, lack of community involvement, inadequate collaboration among veterinarians, ecologists, medical professionals, and social scientists, and inadequate logistical support adversely affects the control of anthrax in the communities affected. Lastly, geographical remoteness of the two regions compromised the effective monitoring and control of the disease by veterinary staff.

Based on the study's findings, government needs to provide funding for anthrax control and tackle poverty. Collaboration with ecologists, medical professionals, and social

scientists within the One Health framework is essential to effectively tackle the socio-cultural issues surrounding cattle rearing and meat consumption beliefs.

There is need to conduct a comparative random sampling based study that will allow for generalization of findings and provide a comprehensive understanding of how different factors shape anthrax transmission.

Key words: Anthrax, Social Determinants, Zambia

ACKNOWLEDGMENTS

I would like to express my gratitude to the following people:

My Principal Supervisor, Professor J.B. Muma for his support, patience, motivation, enthusiasm, and immense knowledge of Veterinary Public Health. His guidance helped me throughout my research. I could not have a better mentor for my PhD study.

The rest of the supervisory team members, Professor Andrew State, Professor Consolata Kabonesa, Dr. Likwa Ndonyo, and Dr. Oliver Mweemba for their insightful comments and encouragement.

Professor Eystein Skjerve, for his immense intelligence and support throughout my project work. This work would not have come to completion without his valuable input and technical, and, moral support.

The Norwegian Program for Capacity Development in Higher Education and Research (NORHED) - Capacity Building in Zoonotic Diseases Management using Integrated Approach to Ecosystems Health at the Human-livestock- wildlife Interface in Eastern and Southern Africa (CAPAZOMANINTECO) Project. I am grateful for the scholarship that enabled me to undertake my study.

Dr. Musso Munyeme, Mrs.Purity Simasiku and Dr. Chisoni Mumba for their sacrifice to forego their comfort and endure hardships of fieldwork for my sake. Your support contributed a lot to the success of my project.

My project colleagues without whose input, encouragement and love, would not have helped me to manage the stress of this Ph.D. work. Thank you for all the fun we had and the fruitful discussions that helped to shape up my work. Special thanks to Dr. Chisoni Mumba for his companionship and support throughout the journey of this project.

Dr.Twaambo Chisanga and her team for her support and commitment during my fieldwork which provided an enabling environment for data collection. Your support made it possible for me to reach sites which I could not have reached.

The Western Provincial Veterinary Officer, Dr. Fredrick Banda, and Senior Veterinary Officer,Dr. Nicholas Banda for providing an enabling environment and logistical support for my data collection. The District Veterinary Officers for Mongu, Nalolo, Limulunga, and Chama, Dr. Nicholas Sakuya, Dr. Bertha Kasanga and Dr. Victoria. Kanjela, for their support during my fieldwork.

Mr.E. Nga'ndu, Mr.E. Simaata, and Mr.Ndui Likando, for their guidance and resourcefulness during my fieldwork.

Dr. B. Sikateyo for providing the most necessary reading materials which helped me to improve my writing.

Members of the Ph.D. journal club for their encouragement and critical inputs into my project. Also, the Dean, School of Public Health and faculty members for their support and encouragement.

Last but not the least; l would like to thank enumerators in Western and Muchinga Provinces, Terrel Kalumbi, C. Mwila, Herbert Sichembe, Sha Nalishiwa, K.Mukumbuta, K. Kachanta, Miyanda Shankomone, D.Sianga, G. Kafunda and Bruce Mwanañono for collecting data for me.

All the respondents and participants for their trust to share their daily struggles with me. This research would not have been possible without their cooperation and hospitality.

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ABBREVIATIONS AND ACRONYMS

CBPP	Contagious Bovine Pleural Pneumonia
CSDH	Commission on the Social Determinants of Health
CSO	Central Statistical Office
FGD	Focus Group Discussion
HIV/AIDS	Human Immuno-virus/ Acquired Immune-deficiency Syndrome
HPAI	Highly Pathogenic Avian Influenza
ICONZ- Africa	Integrated Control of Neglected Zoonotic Disease in Africa
IEC	Information, Education, and Communication
KII	Key informant interview
LCMS	Living Conditions Monitoring Survey
OH	One Health
OIE	*Officine Internacional de Epizooties* (World Health Organization for Animal Health)
PHC	Primary Health Care
SAP	Structural Adjustment Program
SDH	Social Determinants of Health
TB	Tuberculosis
UK	United Kingdom
UNICEF	United Nations International Children's Educational Fund
UNZABREC	University of Zambia Biomedical Research Ethics Committee
US	United States
WHO	World Health Organization

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DEFINITION OF TERMS

Social determinants – concept encompasses the full set of economic and social conditions in which people live and work (Solar & Irwin, 2007). It includes the socio-economic position and political context.

Context - encompasses a broad set of structural, cultural and fundamental aspects of a social system (Solar & Irwin, 2007).

Socio-economic status – this is the social positioning of an individual that determines access to resources. It includes income, education, and occupation (Solar & Irwin, 2007).

Political context – social and policy mechanisms that generate configure and maintain social hierarchies. It includes public policy, culture, gender and governance (Solar & Irwin, 2007).

Household – a household is a group of persons who usually eat and live together. They may or may not be related by blood but make common provision for food and other essentials for living (Central Statistical Office, 2015).

Household head – this is the person all members of the household regard as the head and who normally makes day to day decisions concerning the running of the house (Central Statistical Office, 2015).

Cold chain - is the network of equipment and procedures that are organized and maintained to ensure vaccine potency. The equipment include personnel, refrigerators, thermometers, and transport and cold boxes.

CHAPTER ONE: INTRODUCTION

1.1 Background

Anthrax is an infectious disease caused by a Gram-positive endospore-forming bacterium called *Bacillus anthracis*. The disease commonly occurs in three forms: cutaneous, gastrointestinal, and inhalational. However, since 2009, a new kind of anthrax, injection anthrax has emerged among heroin users in Europe (Hicks *et al.,* 2012;Berger *et al.,* 2014). Even with prompt treatment, inhalational anthrax has a mortality of about hundred percent (World Health Organization, 2008). Humans contract the disease directly by eating infected meat or indirectly from handling animals or animal products (World Health Organization, 2008).

Even if anthrax is distributed worldwide, it has been difficult to estimate its global incidence due to inadequate surveillance systems and unreliable reporting (Hendricks *et al.,* 2014).The under-reporting of anthrax cases has resulted in an underestimation of its global burden which has resulted in neglect of the disease by policy-makers, and funding agencies. Globally, there is a general reduction in the number of reported anthrax outbreaks in livestock, wildlife and humans, although the disease persists in most agricultural communities with tropical climates and poor socio-economic conditions (Dragon & Rennie, 1995; Mebratu *et al.,* 2015). The disease still exists in animals and humans in most countries of sub-Saharan Africa, Asia, in several European countries, America and some parts of Australia (Dragon & Rennie, 1995).

Anthrax is a neglected zoonotic disease of public health importance (Siamudaala *et al.,* 2006). The disease negatively affects the livestock industry and causes worldwide concern because of its potential use as a biological weapon (Jernigan *et al.,* 2001). Anthrax does not only affect human health but also perpetuates poverty and causes emotional stress, in particular among the poor populations whose livelihoods depend on pastoral farming (Molyneux *et al.,* 2011).

This is because quarantine measures necessitated by disease outbreaks result in restricted livestock trade between areas, and hindrance of exchange of animals for draught power. Since anthrax-infected animals are destroyed during outbreaks, often without indemnity, household food security is affected, and farmers experience financial losses (Siamudaala *et al.,* 2006).Also, the burden of taking care of a sick family member or the death of a breadwinner can push a household into further poverty (Welburn *et al.,* 2015).Therefore, persistence of the disease adversely affects the attainment of sustainable development goals (SDGs) of eradicating poverty and hunger, ensuring healthy lives for all ages, and ending the epidemics of neglected tropical diseases.

In Zambia, the first case of anthrax was reported in 1914 in Luambe National Park, in Luangwa District (Tuchili *et al.,* 1995).Since there were no quarantine measures at the time, anthrax was suspected to have been introduced into the country by cattle moving from Southern Africa through the Livingstone border. With the introduction of quarantine measures in 1931, the disease was brought under control during the pre-colonial (British rule) period with isolated cases only occurring among the traditional farming communities in Southern and Western Provinces of Zambia (Mweene *et al.,* 2006). However, following the post-independence economic reforms that were introduced by the central government, there was a breakdown in control measures. The introduction of the Structural Adjustment Programme (SAP) resulted in reduced funding for the Veterinary Department (Muuka *et al.,* 2012). Reduced funding failed to provide veterinary services and provide free vaccines to traditional farmers. The laying off of some workers led to a shortage of veterinary personnel and collapse of extension services. Critical workers such as Cordon guards, who managed international boundaries against livestock movement, were laid off, leaving no personnel to enforce the cordon lines and ensure that no cattle crossed into the country from Angola where infected cattle were suspected to come from (Muuka *et al.,* 2012). This ultimately resulted into vandalism of the existing cordon lines and infrastructure. As a consequence, anthrax has persisted in the Western Province and spread to other provinces.

Although the disease has been brought under control in Southern and Central Provinces, currently it is still endemic in the Western Province, and periodic

outbreaks occur in Muchinga Province. Siamudaala et al. (2006) reported that between 1989 and 1995, 1,626 cases of suspected animal anthrax were reported in the Western Province and 51 were confirmed. An outbreak with 220 cases of human anthrax also occurred with a case fatality rate of 19.1% and another with 248 human cases with a case fatality rate of 7.7% in 1991.The outbreak in 2011 resulted in 233-suspected human cases with six deaths and approximately 80 hippos dying. The latest outbreaks occurred in Muchinga and Western Provinces in 2016. Between September and October 2016, 80 people and 25 buffalos and hippos were affected in Chikwa area of Chama District (Mwambi *et al.,* 2017). The latest anthrax outbreak in the Western Province occurred between November 2016 and January 2017. In this outbreak, 67 human cases and one death were reported (Kasese - Chanda *et al.,* 2017).

In Zambia, anthrax predominantly occurs in traditional farming communities. Epidemics are usually triggered by an interplay of environmental and human activity factors. Even though the occurrence of anthrax has been associated with ecological factors such as cycles of rain followed by periods of dry weather, high evaporation potential of flood water, the presence of calcareous soils and ambient temperatures above 15.5^0c, human behavior has equally been implicated in the transmission of anthrax (Siamudaala *et al.,* 2006).Despite acknowledging that human behavior is equally responsible for the persistence of the disease, there is little understanding of the influence of social causes on this human behavior.

Because many research studies focus on host-pathogen interactions, interventions are targeted at individual level factors, leading to short-term impacts (Liverani *et al.,* 2013). It is, therefore, essential to recognize the critical role that social determinants play in influencing zoonotic anthrax transmission.

A growing body of literature indicates that diseases are not only biologically determined but are also constructed and distributed as a result of the social conditions that people live in, work and age (Centre, 2003).Social determinants ultimately shape food safety behaviors including, food production and consumption practices and food handling (World Health Organization, 2010).

Food safety behaviors ultimately influence exposure, vulnerability, and consequences of zoonotic diseases such as anthrax.

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Understanding of the social determinants of anthrax is vital for its control because it helps to understand how sickness is influenced by the way society is organized; it also examines the impact of social class, culture, gender and political context on the production and distribution of disease. Marmot (2015) proposed that if professionals have to understand why health and disease are distributed the way they are and do something about them, they have to understand the social determinants. Generally, social determinants play a significant role in human behaviors and subsequent exposure to infections. Therefore, application of control measures requires the application of interventions based on natural and social causes (Marmot, 2015).

The emergence and re-emergence of infectious diseases that are mostly zoonotic (Influenza H5N1 and H1N1, SARS, Nipah Virus and HIV), triggered the realization that the animal-human interface should form a key focus for searching for new highly pathogenic infectious agents (Conrad *et al.,2009)).*Outbreaks of emerging and re-emerging zoonoses contributed to calls for greater cooperation between the health, veterinary and environmental sectors through the 'One Health' movement (Okello *et al.,* 2014).One Health is defined as a collaborative, multisectoral, and trans-disciplinary approach — working at the local, regional, national, and global levels — with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment (CDC, 2017). Therefore the "One Health' initiative was adopted as a more holistic and effective approach of controlling and preventing zoonotic diseases and promoting food safety. Many countries around the world have therefore embraced the initiative.

The 'One Health' initiative seeks to increase collaboration and cooperation across a variety of disciplines including human medicine, veterinary medicine, public health, microbiology, ecology and others (Kahn, 2011).

The major aim of ‘One Health” is to reduce the risk and minimize the global impact of epidemics and pandemics due to emerging infectious diseases. The initiative also recognizes the need to move away from a mode of crisis response to one of a sustained response to the prevention and control of zoonotic diseases. The One Health concept was recognized and adopted in Zambia as an effective strategy for zoonosis control, anthrax included. Generally, the concept aims at fostering collaborative efforts between natural and social sciences to enhance the understanding of the interactions between humans, animals, and the environment to improve human and animal health (SACIDS, 2013).Though recent outbreaks of anthrax were mitigated through Intersectoral responses, One Health has provided few opportunities for social science contribution or engagement (Craddock, 2015). As a result, there is still poor understanding of how social and cultural factors influence anthrax distribution. Therefore, this study aimed at exploring the social causes of human anthrax transmission in Zambia.

1.2 Problem Statement

Even if the human case fatality rate for anthrax reduced from 19.1% to 1.2% between 1990 and 2011 (Siziya, 2017), the disease remains a public health concern in Zambia. Generally, anthrax is endemic in the Western Province, with cycles of epidemic outbreaks commonly occurring at the onset of rains, particularly after prolonged dry periods (Rennie *et al.,* 2001). Frequent outbreaks also occur in Chama District of Muchinga Province. Outbreaks in Muchinga Province often involve wildlife, while cattle are the most affected in the Western Province (Mwambi *et al.,* 2017). Animal fatalities subsequently result in human illness and or deaths due to consumption of contaminated meat or handling of dead animals.

Apart from causing disease and death in humans, anthrax has persisted and continues to perpetuate poverty, cause emotional stress, negatively impact on trade, and lead to economic losses. To contain the spread of the disease, quarantine measures are enforced during disease outbreaks.

This results into restricted livestock trade between areas and hindrance of exchange of animals for draught power, therefore perpetuating poverty, especially among the poor populations whose livelihoods depend on pastoral farming. Due to the destruction of infected animals, household food security is affected, and farmers experience substantial financial losses that cause emotional stress that is difficult to quantify (Pokhrel *et al.,* 2011). Furthermore, anthrax leads to loss of eco-tourism due to loss of wild game. Anthrax outbreaks in the Luangwa Valley often affect wild animals, especially buffalos and hippos. According to Munang'andu et al. (2006), the African buffalo is one of the major tourist attractions in Zambia, accounting for 8.7% and 12.4% of the total animal species hunted in the Game Management Areas and Zambia's total hunting revenue. Apart from supporting tourism, wild animals are important in maintaining natural ecosystems. Therefore, wildlife diseases such as anthrax pose a threat to the country's ecosystem and adversely affect the attainment of sustainable development goal number fifteen of halting the loss of biodiversity by 2020 and protect and prevent the extinction of threatened species.

Anthrax morbidity and mortality in cattle, wildlife, and humans including risk factors have to some extent been researched and documented because many published studies have focused on biomedical and epidemiological aspects rather than human behavior (Blanchard *et al.,* 2005).Moreover, anthrax diagnosis and control measures (e.g., vaccination and destruction of carcasses) have depended mainly on surveillance and management of biological agents, including medical treatment, contamination and decontamination (Blanchard *et al.,* 2005) and not on the drivers of human behaviors. This study argues that the lack of understanding of socio-economic, cultural, and political factors have contributed to the ineffective implementation of anthrax control measures.

1.3 Justification

To provide an integrated (One Health) and sustained control of anthrax in the country, Zambia established an Intersectoral Anthrax Task Force in 1989 (Turnbull *et al.,* 2001).

The team has been utilizing guidelines formulated by the World Health Organization Anthrax Working Group that was established in 1990.The guidelines for surveillance and control were drawn using Zambia as a model country.

Since Zambia's adoption of the "One Health" concept in 2007 there has been an increased realization of the importance of taking an integrated approach to the control of zoonotic diseases, anthrax included. Using the "One Health "strategy, Intersectoral Task Forces are formed in the affected districts whenever there are outbreaks. Examples of these include a National Task Force on influenza prevention and control that was established to coordinate Avian Influenza activities at the national level. This Task Force preceded the development of the integrated response plan. In 1987, an Intersectoral Task Force was formed to control the anthrax epidemic (Siamudaala, 2005). The team comprised of wildlife personnel, veterinary and health officials together with representatives of the provincial wing of government (Siamudaala,2005).Through the Intersectoral Anthrax Task Force, control measures are implemented during disease outbreaks such as burning of carcasses, inoculation of the most vulnerable species against anthrax and public awareness programs among the local communities (Siamudaala, 2005).Generally, the Task Force often comprises of health personnel, veterinary staff, and wildlife staff. Although collaboration across disciplines has been achieved since the adoption of One Health, recognition of the social causes of disease has been inadequate. As a result, most interventions have focused on individual-level factors and ignored the social determinants of disease causation. Consequently, most control measures have been episodic and short-term, resulting in a lack of ability to successfully and sustainably mitigate the disease.

Secondly, there is poor research documentation regarding the influence of social factors in the construction and distribution of anthrax in the affected communities. Most research conducted have focused on biological and epidemiological causes of anthrax transmission rather than the social causes (Blanchard *et al.,* 2005).

The data collection methods employed in most past studies conducted in the past have only provided a limited understanding of the contextual factors shaping the persistence of this zoonosis among Zambia's rural populations. Furthermore, the affected communities have not been engaged in generating data on how the political and social context they are found in affects their livelihoods.

The above has resulted in a poor understanding of the role of social and political factors in disease distribution and construction. Ultimately, there has been the construction of narrowly focused interventions that do not yield long-term impacts.

Also, affected communities do not seem to accept conventional control programs as evidenced by continuing to eat meat suspected to be contaminated by anthrax, failure to report cattle mortalities to veterinary officers, and exhuming carcasses that are buried by professional staff (Sitali *et al.,* 2017). The situation mentioned above could be because control measures are not culturally appropriate due to lack of understanding of how societies shape and are shaped by their socio-economic, political, cultural and historical contexts. This has resulted in a lack of trust and confidence in professionals and poor acceptance of control interventions such as vaccination programs (Sitali *et al.,* 2017).

The persistence of 'neglected tropical diseases' is partly due to the predominant efforts to develop new drugs and improve surveillance systems and ignoring how social determinants of health affect health equity. It is essential that the role of social factors in disease construction and distribution be considered if interventions are to offer holistic approaches that will yield the most significant gains. Also, it is vital for program implementers to have the competence to assess and appropriately direct their interventions to make them culturally

acceptable. It is, therefore, essential that the socio-cultural factors that influence anthrax transmission be investigated and documented if the disease is going to be effectively managed.

1.4 Study significance

The current study generally aimed at exploring how the socio-economic and political context of affected provinces has influenced transmission and distribution of anthrax.

The study has generated evidence of context-specific social factors that shape how communities behave, perceive and respond to control interventions. Based on the above, policymakers and practitioners can be well informed so that interventions will be directed where the most significant gains will be obtained. This may contribute to a reduction in the occurrence of epidemics of anthrax and ultimately contribute to the attainment of sustainable development goal number three, which is to ensure healthy lives and promote well-being for all ages. Furthermore, the study findings can inform further policy revision that may result in broader impacts that enable long-term effects. It is also hoped that the current study will help justify and document the need for collaboration between disciplines in natural and social sciences about anthrax control.

Finally, the study findings will contribute to the scientific body of knowledge concerning how social factors influence exposure, vulnerability and anthrax disease outcomes.

1.5 Aims and objectives

The overall purpose of the study was to explore the socio-economic and political determinants affecting human anthrax transmission in the Western and Muchinga provinces of Zambia.

Specific objectives

The specific objectives were to;

1. Describe the knowledge, attitudes, and meat consumption practices.
2. Explain how socio-cultural practices influence cattle rearing practices and shape meat handling and meat consumption practices.
3. Explain how the socio-economic positioning of respondents have influenced vulnerability to anthrax.
4. Explain how policy has influenced anthrax transmission and control.
5. Identify the barriers faced by professional staff involved in the control of anthrax.
6. Generate a practical framework for anthrax control using participatory approaches.

1.6 Research questions

The study endeavoured to address the following research questions;

1. How do socio-economic conditions in the affected communities influence anthrax transmission?
2. How do gender, cultural beliefs, and practices influence cattle rearing and meat consumption practices, and subsequent transmission of anthrax in the affected communities?

CHAPTER TWO: LITERATURE REVIEW

2.1 Anthrax in Animals

Anthrax is primarily a disease of wild and domesticated herbivores (e.g., cattle, sheep, goats, camels, antelopes, buffalos, and hippos). Animals primarily acquire the infection through ingestion of spores during grazing or browsing. Direct animal-to-animal transmission is usually insignificant except for carnivores that feed on infected victims. Carnivores are more resistant to infection although they may die from the infection in enzootic areas. It is uncommon for anthrax to spread from animal to animal. Anthrax spores remain viable for as long as 48 years (Davis, 2016) in the soil and therefore become a potential source of infection for grazing wild and domestic animals. Then, if ingested or inhaled by an animal, or on entering through cuts in the skin, they can germinate and cause disease. Grazing animals commonly become infected by ingesting spores that are on the ground or in the animal feed. In addition to direct transmission, consumption of contaminated meat has been reported in carnivores such as dogs and pigs. Biting insects have also been implicated in transmitting the bacteria from one animal to another. The incubation period ranges from 1 to 14 days. Typically, ruminant animals are often found dead with no indication that they had been ill. In peracute cases, anthrax in cattle commonly presents with a sudden onset of illness, often with a rapidly fatal outcome. An acute septicemia accompanied with high fever, staggering, dyspnea, trembling, collapse, a few convulsive movements, and death may occur in cattle, sheep, or goats with only a brief evidence of illness. There may be bloody discharges from the natural body openings with absent or incomplete rigor mortis (stiffening of the body after death) after the death of an animal. After the animal's death, the bacteria produce spores on contact with oxygen. Because the blood of infected animals sometimes fails to clot and may leak from body orifices, insects can spread the bacteria to other animals.

Even though anthrax is susceptible to antibiotic therapy, its rapid clinical course rarely offers the opportunity to treat infected animals. During outbreaks, rapid detection and reporting, quarantine, and burning or burial of suspect and

confirmed cases are instituted. Therefore, anthrax can only be adequately controlled through vaccination programs.

Prevention of human contact with infected animals is paramount during outbreaks. Vaccination should be done with the Sterne vaccine at least 2 to 4 weeks before the season when outbreaks may be expected. Below are pictures showing bovine anthrax in the Western Province (Figure 2.1).

Figure 2. 1: Dead oxen from anthrax being disposed by burying in the Barotse floodplains in Kalabo. Photo by Sitwala Silwendo

2.2 Anthrax in Humans

Anthrax, normally a disease of ruminants, is caused by a spore-forming bacterium called *Bacillus anthracis*. It has a relatively short incubation period from two to six days (World Health Organization, 2008). Anthrax is a non-invasive bacterium that has an extracellular toxin. The toxin contains three proteins; protective antigen (PA), edema factor (EF) and lethal factor (LF) that act synergistically to cause the disease. The rod-shaped bacteria exist in the soil in a dormant form called spores, where they can survive for several decades. Generally, humans acquire the infection by contact with infected animals or occupational exposure to infected or contaminated animal products. Equally, anthrax does not spread from person to person and is not considered infectious.

It is difficult to estimate the global prevalence of anthrax due to weak reporting systems and poor surveillance systems (Hendricks *et al.,* 2014). However, literature shows that though the incidence of anthrax has decreased in developed countries, the disease is still a problem in most developing countries (Oncu *et al.,* 2003).

Anthrax is still endemic in Zambia though little literature has been published on human cases (Siziya, 2017). However, Siziya (2017) reports that the case fatality rate of human cases has decreased.

Anthrax occurs in four main forms, cutaneous, injection, inhalational and gastrointestinal. Of these forms, inhalation and injection anthrax have the highest mortalities. Cutaneous anthrax, which is the commonest form (Oncü *et al.,* 2003; World Health Organization, 2008), is mostly associated with the history of occupational contact. Most lesions occur in exposed skin areas on the arms, hands, followed by the face and neck. The skin lesion begins as a papule that progresses to a vesicular lesion that later ends up as a depressed black eschar. Although the disease usually remains localized, some patients develop systemic symptoms. Figure 2.2 shows suspected cases of cutaneous anthrax with eschar on the neck and forehead.

(a) (b)

Figure 2.2: Skin lesions of cutaneous anthrax (eschar) indicated by arrows. Photo by Sitali (a) and Sitwala (b)

On the other hand, inhalational anthrax is commonly contracted through inhalation of pathogenic endospores. The disease presents with first flu-like symptoms that are followed by the development of hypoxia and dyspnea, with radiographic evidence of mediastinal widening (Oncü *et al.,* 2003).

Gastrointestinal anthrax is as a result of ingestion of undercooked contaminated meat. The symptoms of this form of anthrax include nausea, loss of appetite, bloody diarrhea, and fever followed by a severe toxicity (World Health Organization, 2008).

Diagnosis of anthrax is made by taking various tests. The occupational history of a client should be obtained to determine occupational exposure. Bacterial cultures of skin smears or throat swab or sputum can also be taken. In case of inhalational anthrax, a chest x-ray will show characteristic changes in the lungs. In severe cases, anthrax bacteria may be seen in blood on microscopic examination. Early treatment with broad-spectrum antibiotics such as tetracycline, doxycycline or ciprofloxacin results in recovery of individuals (World Health Organization, 2008). For example Tetracycline 500mg three times daily for five to seven days can be used. Even with appropriate treatment, inhalational anthrax has a high mortality.

Although human vaccines are available, they are targeted at persons in high-risk occupations (members of armed forces, veterinarians, workers in factories processing animal products such as wool).

Anthrax is a notifiable disease. It is prevented by controlling the disease in animals through vaccination and surveillance. Anthrax is endemic in Zambia though there is little literature published on human prevalence (Siziya, 2017).

2.3 The One Health concept

The American Veterinary Medical Association defines One Health as “the collaborative efforts of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals (livestock and wildlife), and the environment” (Bidaisee & Macpherson, 2014). One Health recognizes that

the health of people is connected to the health of animals and the environment. The concept aims to foster collaborative efforts of multiple disciplines to work together to achieve the best health for people, animals, and the environment.

Below is a graphic presentation depicting the interrelationships between animal health, human health and the environment (Figure 2.3).

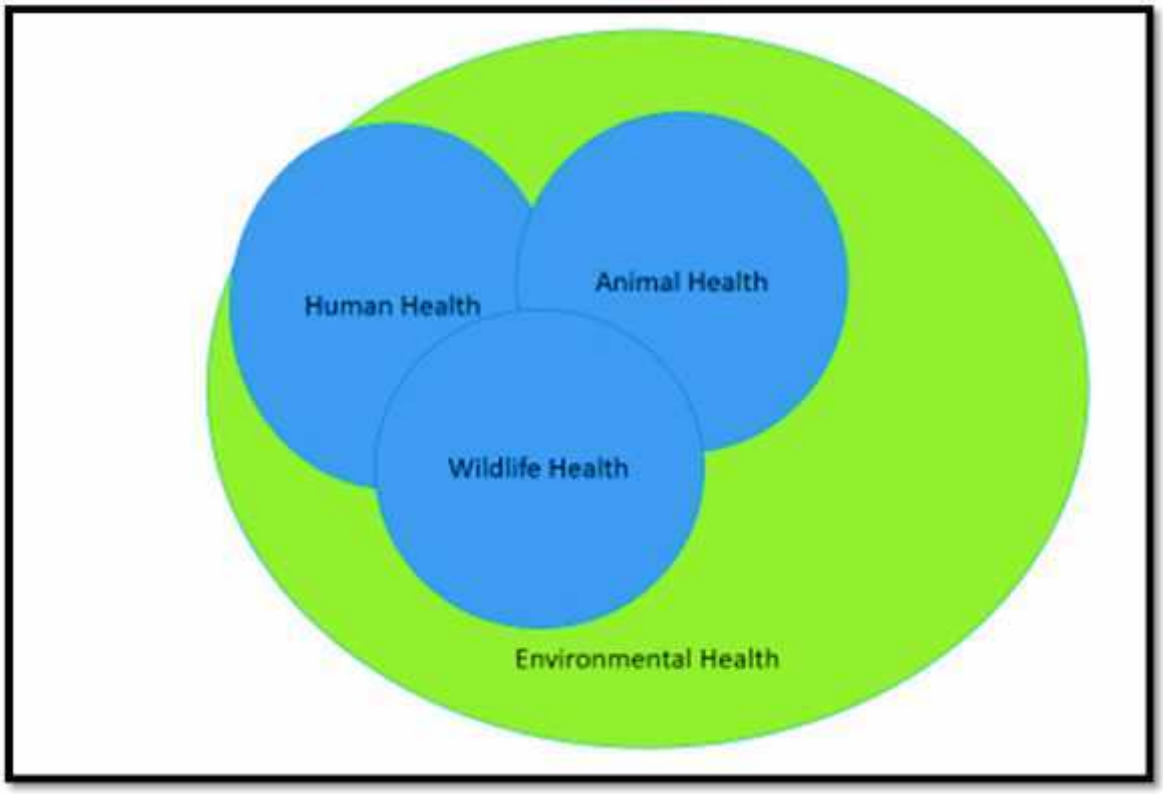


Figure 2.3: A One Health concept. Adopted from CDC One Health, from concept to action. Source: http://www.cdc.gov.onehealth (2018)

2.3.1 Historical background and rationale

Until the 20th century, animal and human medicine were separately practiced though scientists noted similarities in disease processes between humans and animals (Evans & Leighton, 2014).Rudolf Virchow, a famous pathologist at the time, coined the term “One Medicine” as he was quoted to have said, *“Between animal and human medicine there is no dividing line—nor should there be. The object is different but the experience obtained constitutes the basis of all*

medicine."(ibid). Virchow called for stronger training links between human and animals (Evans & Leighton, 2014).

However, his efforts did not receive much recognition until in 1976 when the term one medicine was officially coined (Schwabe, 1984). Therefore, One Health is not a new concept but is a concept that has become more important in the recent years. One Health received a renewed focus due to the emergence and re-emergence of infectious diseases and the outbreaks of zoonotic diseases such as AIDS, Marburg, West Nile Virus and Ebola in the 1990s (Zinsstag *et al.,* 2012). Increasing human populations, loss of habitats and decreasing biodiversity, globalization of trade, and evolution of pathogens led to increased calls for a multidisciplinary approach of handling diseases(Evans & Leighton, 2014). The concept was officially adopted by major health-related International organizations such as The World Health Organization (WHO), The World Organization on Animal Health (OIE), and The Food and Agriculture Organization (FAO) with the support from The United Nations Children's Educational Fund (UNICEF).In 2008, representatives from more than 120 countries and 26 international organizations met in Sharm-el Sheikh and endorsed One Health as a strategy for Fighting Avian influenza and other infectious diseases (CDC, 2017).In 2009, a One Health office was established at the Centre for Disease Control (CDC).The office is a point of contact between external animal health organizations and facilitates exchange of information among researchers across disciplines and sectors (CDC, 2017).

The recent emergence and re-emergence of zoonoses in the last three decades triggered the realization that human, animal and environmental heaths are inter-dependent. The outbreaks such as Highly Pathogenic Avian Influenza (HPAI) and Severe Acute Respiratory Syndrome (SARS) contributed to calls for greater cooperation between the health, veterinary and ecological sectors through the 'One Health' movement (Okello *et al.,* 2014).

Therefore the "One Health' initiative was adopted as a more holistic and efficient approach to controlling and preventing zoonotic diseases and promoting food safety. The 'One Health' initiative seeks to increase collaboration and cooperation across a variety of disciplines including human medicine, veterinary medicine, social science, public health, microbiology,

ecology, and others (Kahn, 2011).The major aim of ‘One Health” is to reduce the risk and minimize the global impact of epidemics and pandemics due to emerging infectious diseases. The initiative also recognizes the need to move away from a model of crisis response to one of a sustained response to the prevention and control of zoonotic diseases.

In 2004, health experts and representatives from major international organizations met in New York to discuss the movement of disease between domestic animals, humans and wildlife populations. The meeting discussed principles that would guide the prevention of zoonotic diseases while maintaining the biodiversity of the environment. These principles seek the holistic approach to disease prevention while maintaining the integrity of ecosystems. The principles propose an international multidisciplinary, Intersectoral approach to the prevention, surveillance, and control of zoonotic diseases while preserving the environment. These guidelines are referred to as the Manhattan principles (FAO/OIE/WHO, 2009).

2.3.2 Major achievements and challenges of One Health

2.3.2.1 One Health Global -World Organization for Animal Health (OIE)

The World Organization for Animal Health is a non-governmental organization that was founded in 1924 as the Office International des Epizooties (OIE). Over the years, OIE has formed a large number of official collaborations with other international organizations, such as the World Health Organization, the Food and Agriculture Organization, and the World Trade Organization. The organization has four primary functions; to inform governments of the occurrence and course of animal diseases worldwide and of ways to control them; coordinates studies related to surveillance and control of animal diseases at the international level; harmonizes regulations to facilitate trade in animals and animal products among member countries; and maintains working relations with other international organizations. The OIE is mandated to collect and publish information about animal diseases globally to create health standards to protect international trade in animals and their products. The OIE

uses a collaborative global approach, which is the One Health concept to understand risks for human and animal health and ecosystem health as a whole. Using a One Health concept, professionals come together to address health issues affecting animals and humans.

From the time 'One Health' was adopted, significant successes in the control of global zoonotic pandemics have been recorded. Notably, in 2003, the HPAI H5NI pandemic in Asia was brought under control due to the joint efforts of international and national institutions that put their resources and expertise together as equal partners (Gibbs, 2014).

The same approach was used to mitigate the H1N1 Influenza pandemic that broke out in the United States in 2009 (Gibbs, 2014).The outbreak of Ebola in West Africa in 2004 was eventually brought under control due to coordinated efforts of the World Bank and World Health Organization working with various governments and international agencies (DingWall, 2015). Most zoonotic diseases that were previously neglected have received greater attention, especially in developed countries because of the One Health concept.

Success of the One Health concept has been observed mainly in developed countries where most zoonotic diseases have been brought under control. A study was conducted in Switzerland to investigate the opportunities for implementation of One Health. Semi-structured face-to-face interviews were conducted with 16 key experts selected from among the leading personalities in the Swiss health system. The findings indicated that the experts expressed positive attitude that the initiative can bring about.

The majority of the experts pointed to the existence of a positive attitude among professionals, cooperation between faculty, institutions and agencies, existence of an electronic database for communicable diseases where everyone can readily access data and the existing platforms for free exchange of information (Meisser *et al.,* 2011).

However, the implementation of the concept has not been without challenges. Generally, it has been observed that while the concept has been successfully implemented and zoonotic diseases brought under control in most developed countries, many challenges have been faced in developing countries. Many

reasons have been advanced in some studies and reports (Welburn, 2011; Okello, 2014; Gibbs, 2014). These reasons include; poor public health infrastructure characterized by most developing countries, lack of or inadequate policy frameworks to support implementation of the concept, cultural differences between professionals, inadequate funding, and, poor surveillance, shortage of human resources, and, lack of political will, and, poor governance (Mulei *et al.,*2012).

2.3.2.2 One Health- regional

In Africa, a regional bank was established to control rabies in Africa and Asia through collaboration between the Organization for Animal Health (OIE) and donor agencies (Osburn *et al.,* 2015). Equally, a five-year project (ICONZ-Africa) involving twenty-one European and African universities and research institutions was established to improve human and animal health production in developing countries through integrated control of neglected zoonotic diseases in animals based on scientific innovation and public engagement (Gibbs, 2014).

Similarly, the outbreak of Ebola in West Africa in 2004 was eventually brought under control due to coordinated efforts of the World Bank and World Health Organization working with various governments and international agencies (DingWall, 2015).

Despite the successes scored, One Health has not been without challenges especially in Africa. The National Centre for Emerging Zoonotic Infectious Diseases (2014) compiled a report on the performance of One Health activities in 17 international countries where The Centres for Disease Control (CDC) operate. Out of the 17 countries, six were African (South Africa, Uganda, Egypt, Congo, Nigeria, and Kenya). An assessment of One Health activities was conducted by examining eight activity domains; the first domain was whether a particular country has a primary contact person for in-country 'One Health' and zoonotic disease projects. Out of the 17 countries, six had no primary contact person for in-country One Health. Of these six countries, three (3) were African countries. The second domain was whether a country had endorsed a One

Health Organization or whether the government maintains an ongoing agreement for collaboration between ministries. It was found that only six out of the 17 countries had such collaborations. Of the six that do not have such activities, five were African. It was also found that fifteen out of the seventeen countries had a CDC-led Field Epidemiology Training Program or Field Epidemiology and Laboratory Training Program, or Epidemic Intelligence Service like program. Two out of the fifteen countries with this training program did not include veterinarians.

2.3.2.3 One Health - Zambia

Zambia was a member of ICONZ-Africa, which was a collaborative five-year project funded by The European Commission (Ocholi, 2011). The project commenced in April 2009 involving 26 African and European countries. The overall objective of the project was to develop integrated control packages for the control of eight key "neglected" zoonoses (anthrax, Bovine Tuberculosis, brucellosis, rabies, cystic echinococcus, porcine cysticercosis, leishmaniasis, and trypanosomiasis). Under the ICONZ-Africa project, a program to monitor Community total led Sanitation (CTLS) for the control of porcine cysticercosis was undertaken in Katete District of Zambia (Bulaya, 2015). To build capacity for One Health in the country, The University of Zambia, School of Veterinary Medicine established two masters programs in One Health Analytical Epidemiology and Food Safety in 2011 and 2016 respectively (Muma *et al.,* 2012).There has also been an increase in the involvement of social science skills in zoonosis research. Furthermore, the Hokkaido Centre for Zoonosis Control in Zambia was established in 2007 to foster collaboration in research in viral zoonosis.

Despite several successes being scored through the 'One Health' efforts, the concept still faces many technical, scientific and institutional challenges. For example, in Zambia, there is no policy framework to guide the domestication and implementation of One Health. Therefore, the concept has been left to line ministries and academic institutions to implement.

Furthermore, even if there has been greater collaboration between veterinary and human medicine, other critical disciplines, in particular, the social sciences have remained marginal.

Generally, the One Health concept has recorded successes which are useful in enhancing control of zoonotic diseases. However, for more significant achievements, there is need for a policy framework and functional structures which enable effective implementation.

2.4 Historical perspectives on action on social determinants of health

The recognition that social conditions influence health was firstly founded in the field of social science by nineteenth-century physicians such as Virchow (Link *et al.,* 2015). Virchow (1848) said, “Medicine is a social science” (Link *et al.,* 2015). This discovery resulted from the observed strong association between indicators of poverty, and health.

Since then, there has been a recognition that disease is not only biologically determined but is also socially constructed and distributed as a result of the social conditions in which people are born, grow, live, work and age (Link *et al.,* 2015).

The study of social determinants dates back to as far as 600 BC in ancient Greece. In Athens, Greeks worshiped the goddess of sanitation and hygiene called Hygea.The goddess was associated with prevention of sickness and continuation of good health. Later on, Hippocratic doctors formulated a philosophy of thinking that covered every aspect of health- mind, body, and environment. The influence of this thinking continued to impact on public health reforms during the last two centuries (Elizondo & Roldan, 2012).

The importance of social conditions of health was later supplanted by the credence of the germ theory that was proposed in the 16th century through to the nineteenth century through Anton van Leeuwenhoek’s work (Kelsey Willcox, n.d.).

Following the famous theory of pathogenesis, Aaron Antonovsky's new theory of salutogenesis was proposed and demystified the theory of pathogenesis (Lindström, 2005).According to the salutogenic theory, people move to the healthy side of the continuum by utilizing assets at their disposal. These assets could be social, financial or environmental. Therefore, the salutogenic model brought about a renewed interest in social conditions that promote health. Antonovsky's theory gave way to the upstream approach to the Health Promotion movement in the 1980s (Lindström, 2005).

Due to the established recognition of the role of social conditions in disease causation, action on the social determinants of health (SDH) has been recurring since WHO's founding in 1948 (Irwin & Scali, 2007). Currently, the Commission on the Social Determinants of Health (CSDH) provides leadership on tackling the social determinants of health (Irwin & Scali, 2007).

In 1950, the World Health Organization (WHO) founders shared a vision of health as pre-eminently shaped by social conditions. Therefore, WHO provided space for a social model that explicitly acknowledged the impact of social and political conditions on health and the need for collaboration with sectors to achieve health gains (Commission on Social Determinants of Health, 2007; Irwin & Scali, 2007).However, the implementation of the social model was hampered by the post-world war politics. This brought WHO under the influence of the USA that favored health technologies delivered through targeted campaigns. Furthermore, there was a proliferation of major drug research breakthroughs and other medicines, inspiring the sense that technology was the answer to the world's health problems (Commission on Social Determinants of Health, 2007; Irwin & Scali, 2007). By the early 1970's, it was evident that the dominant medical and public health models were not meeting the needs of most impoverished and disadvantaged populations (Irwin & Scali, 2007).Out of this necessity, local communities and health workers began to search for alternative solutions which gave rise to a renewed concern with the social, economic and political dimensions of health. By 1978, the social model of health was revived at the Alma-Ata Declaration on Primary Health Care (PHC) and the Health for All movement (Commission on Social Determinants of Health, 2007; Irwin & Scali, 2007).

The Health for All movement argued for greater engagement with social dimensions of health, arguing that common health problems derive from parts of society itself. They also argued that actions outside the field of health perhaps have more significant health effects than strictly health interventions (Irwin & Scali, 2007).

Among the pillars for PHC was Intersectoral action to address social and environmental determinants. Although many governments implemented the principle of Intersectoral Action on Social Determinants of Health (SDH) under the auspices of Health for All, the introduction of neoliberalism in the 1980s gained prominence and created challenges to the policy action (Commission on Social Determinants of Health, 2007). In 1980, there was a rise in the dominance of the neoliberal approach which emphasized efficiency over equity as the ultimate goal and often reduced disadvantaged social groups' access to health care services (Commission on Social Determinants of Health; Irwin & Scali, 2007). Moreover, Structural Adjustment Programs (SAPs) imposed on many developing countries by international financial institutions mandated sharp reductions in government's social sector spending and their ability to address SDH.The dissatisfactions brought about by neoliberal approaches led to a growing movement of social and political protests that surged into international action. Shaken by the unprecedented wave of criticism and popular anger, the institutions began to rethink their respective missions. During 1980 and early 1990, The UK's Black Report on inequalities in health sparked debates and triggered national inquiries into health inequities and their effects on health in countries such as Sweden, Netherlands, and Spain (Irwin & Scali, 2007).By the late 1990s and early 2000s, health equity and social determinants of health had been recognized as major policy concerns by most countries (Commission on Social Determinants of Health, 2007).During this period, new policies focused on tackling SDH in most European countries while developing regions called for action to address the social roots of ill-health (Commission on Social Determinants of Health; Irwin & Scali, 2007).

When Lee- Jong Wook was elected as Director-General of WHO, he announced his intention to create a Commission on Social Determinants of Health at the 57th World Health Assembly in 2004.

Charged with the task of mobilizing emerging knowledge on social determinants in a form that could be turned into policy action in low and middle-income countries, the Commission on Social Determinants of Health was formally launched in 2005 (Commission on Social Determinants of Health, 2007; Irwin & Scali, 2007). The CSDH was formally launched in March 2005 and was to operate until May 2008. Its goal was to strengthen health equity. The commission aimed to enhance policy and institutional change to address SDH within countries, among institutions working in global health, and within WHO itself (Irwin and Scali, 2007).

2.5 Theoretical frameworks

2.5.1 Social production of disease theory or political economy of health

The roots of the social production of disease theory lie in the writings of Villerme Virchow and Engels, who discussed the poor working conditions and diseases of working class Europeans around the time of the industrial revolution during the late 19th century (Feldacker *et al.,* 2010). The theory was developed in part as a critique of the biomedical theory of disease that ascertains that disease is caused biologically because of individual lifestyles that result into people becoming sick or dying early. As opposed to the biomedical theory, social production of illness argues that diseases not only come as a result of nature or biology but are socially produced and distributed.

The theory analyses economic and political determinants of disease distribution and construction. The theory points out that the key variables shaping the production and dissemination of sickness are class, gender, ethnicity, and how professional groups define conditions as diseases (Feldacker *et al.,* 2010). The theory ascertains that economic processes and political decisions condition the private resources available to people and shape the nature of public infrastructure such as education, health services available, transportation, environmental controls, availability of food, quality of housing, occupational health regulations that form the basis of contemporary life. Thus, income inequality is a significant factor that affects population health.

Therefore, the theory argues that health differences among social groups originate from their deepest roots called the causes of the causes. These are the structural determinants, specifically socio-economic and political context.

According to the social production of disease theory, the social and economic conditions and political context of a particular society create differential opportunities that create social inequalities and therefore place people in different advantages and disadvantages. The theory identifies class, gender, and ethnicity as the dominant social determinants of health. Sydenstricker, Goldberg, and Davey-Smith developed this theory in the 1970s. After the construction of this theory, studies have been conducted to demonstrate the role of culture and gender in disease patterning. However, the theory has been criticized for its emphasis on social factors rather than biological factors, especially in non-communicable diseases. Furthermore, some opponents refer to the theory as being vague in its definition and therefore make it difficult to realize.

According to Krieger (2001), the theory fails to emphasize whether specific public health and policy interventions are needed to control the social inequalities and if so, which interventions are needed. The social production of health theory has also been criticized for its limitation to investigations of population distributions of known risks when most of those are found at the level of the individual rather than a group. Lastly, the theory entirely blames society rather than the individual. It does not elaborate the extent to which an individual can be held responsible for their health behavior. However, the theory is still useful in explaining how structural factors segregate individuals into different advantage and disadvantaged groups.

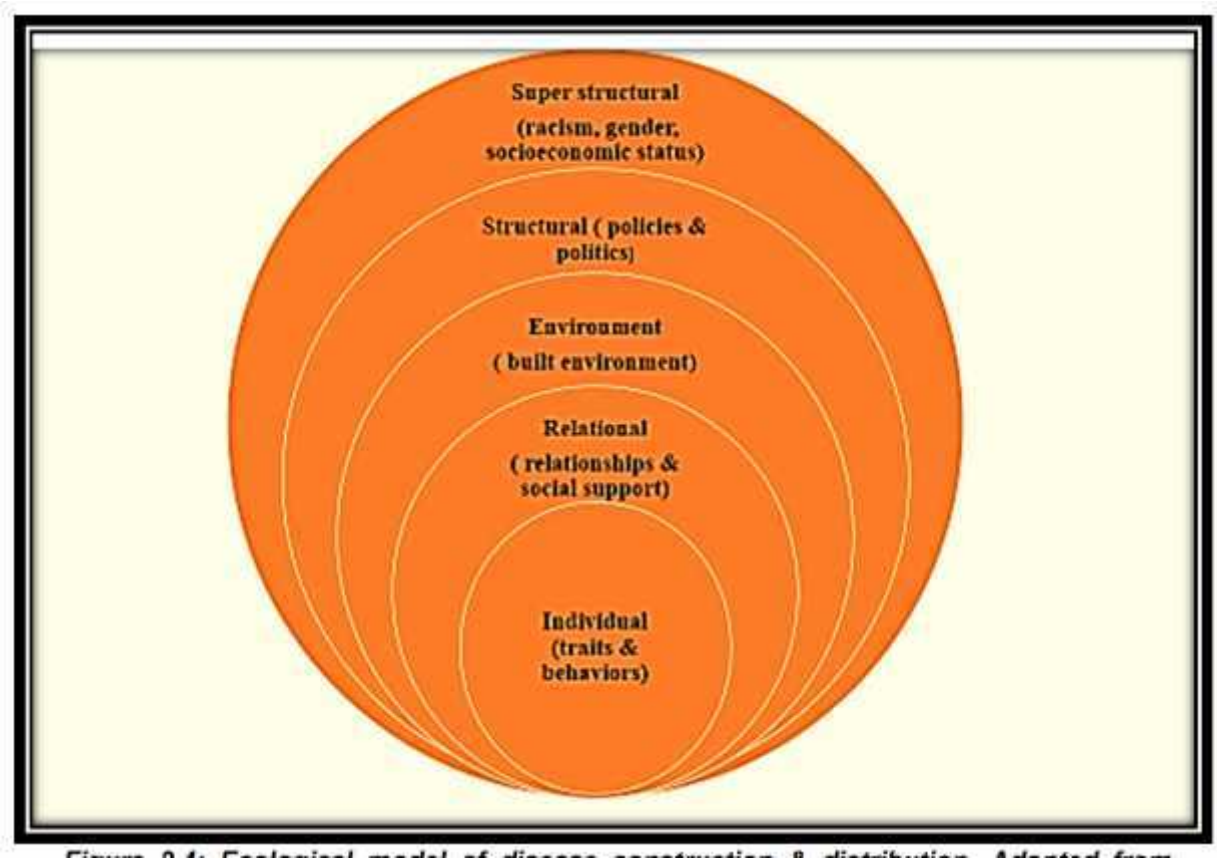
2.5.2. Ecological model

Ecological models on the other hand look at disease as being influenced by different levels that affect behavior. The models are based on two concepts; multiple layers and reciprocal causation (Winch, 2012). According to the theories, behavior affects and is affected by multiple levels of influence and

secondly, that individual behavior shapes and is shaped by the social environment. As a result, the models advance that health experiences and outcomes are influenced by factors situated within and beyond the individual (Mburu *et al.,* 2014).

One of the ecological models was developed by Sweat and Denison when the two were working on a project on reducing HIV incidence with structural and environmental interventions in developing countries. Sweat and Denison recognized potential social determinants at five levels; the individual (traits and behavior), the relational (relationships, social support), the environment (built environment), the structural laws (legislation, policies and politics) and the superstructural (social justice issues such as racism, low socio-economic status and gender) (Scott & Wilson, 2011).

The model was used to explain how multiple social factors influence food production and food consumption behaviors as well as food hygiene practices that are key in the transmission of anthrax. It was used to identify levels of influence where interventions can be directed to achieve the most significant gain. However, the ecological theory of Sweat and Denison have come under criticism for lack of clarity as to where household and community are placed. Household and community are two institutions that exert significant influence on individuals (Winch, 2012). Figure 2.4 is a graphic picture of the ecological model showing different levels of influence on human behaviors.



Fgure 2.4: Ecological model of disease construction & distribution. Adopted from Dahlberg & Krug (2002)

2.6 Empirical studies on social determinants of zoonoses

2.6.1 Culture and gender

Gender is defined as the socially constructed roles, behaviors, activities, and attributes that a given society considers appropriate for men and women (Winch, 2012).The construction of gender roles is done within society's cultural norms. Gender-related norms and behaviors can create different health consequences and outcomes for males and females. For example, in a study conducted in Nairobi, Kenya, to determine the risk exposure to cryptosporidiosis, gender was found to be a significant determinant (Kimani *et al.,* 2012). Data was collected through a cross-sectional survey that also collected qualitative data through participatory methodology. The study established that, while most women were infected because of caring for sick

family members, older male employees were mostly infected due to contact with cattle feces. On the other hand, children were more exposed to infection because of drinking raw milk (Kimani *et al.,* 2012). Therefore, the study concluded that gender and social factors are significant risk factors in the transmission of cryptosporidiosis.

Apart from influencing individual risk exposure, gender exerts an influence on public health food safety. Differential food safety behaviors between men and women which are constructed by different roles and responsibilities in society influence their food safety practices in public health food handling. This evidence was identified in a study conducted in Bodija, Nigeria to identify gender and group membership influence on food safety (Kimani *et al.,* 2012). Using both quantitative and qualitative approaches to data collection, the study found that women had significantly better food safety practices than men and the quality of beef in meat associations where women dominated was better. Generally, the above findings are evidence that there is an interaction between gender and infectious diseases. Therefore, it is essential to understand these interactions to increase the efficacy of control programs.

On the other hand, culture does not only influence the construction of gender roles but also directly influences zoonotic disease transmission by prescribing local food safety practices (Bardosh *et al.,* 2014;Thys *et al.,* 2015).

Culture means the ideas, customs, and social behavior of a particular society or people. Studies have been done to demonstrate the direct influence of culture on food safety practices and attitudes. For example, the cultural practices of slaughtering sick chickens influenced the transmission of avian flu to the local communities (Sultana *et al.,* 2012). Chickens were slaughtered commonly during ceremonies and rituals.

Similar results to those mentioned above were found in other studies carried out in different settings. For example, a study conducted in Lao concluded that transmission of porcine cysticercosis was determined mainly by cultural practices such as free-range rearing of pigs, lack of use of pit latrines and religious practices of offering and eating raw pork (Liverani *et al.,* 2013). In Ghana,human behavioral factors implicated in outbreaks of human anthrax in

the Tamale municipality of Ghana were associated with the practice of community members eating meat from moribund animals(Opare *et al.,* 2000).

In like manner, field reports (Kasese - Chanda *et al.,*2017), reviews (Mwambi *et al.,* 2017) and perspectives (Muuka *et al.,* 2012; Moraes, 2017) have identified culture as one of the responsible factors for the transmission of Contagious Bovine Pleural Pneumonia and anthrax in Zambia. These practices include *mafisa* (a form of social support and risk management system in the Western Province) or *Kusihya* (in the Southern Province) (Muuka *et al.,* 2012), *Lobola* (dowry price paid in form of cattle) (Muuka *et al.,* 2012), and, the consultation of traditional healers. All these practices involve exchange and movement of cattle from one area to another, therefore introducing sick animals to new areas. Moraes (2017) revealed that, in the Western Province of Zambia, community members ate meat from moribund animals and processed their hides to make mats and drums. This cultural practice has contributed to the persistence of anthrax in the province (Moraes, 2017; Kasese- Chanda *et al.,* 2017).

In the Petauke District of the Eastern Province of Zambia, it was found that cultural taboos partly influenced the transmission of porcine taeniasis regarding the use of pit latrines by community members (Thys *et al.,* 2015). Twenty-one focus group discussions with men, women, and children suggested that though pit latrines were perceived to contribute to good hygiene, men were not willing to use the pit latrines because of associated toilet taboos with their in-laws and grown-up daughters. Therefore, men preferred to use open defecation which provided access of fecal matter to free-roaming pigs in the communities (ibid).

The findings from studies mentioned above bring out important views about the role of culture in disease distribution. Generally, culture defines gender roles and food consumption practices. The gender roles and responsibilities defined through cultural values determine the exposure of men and women to diseases.

As demonstrated above, culture is a critical determinant in disease transmission. Therefore, it is a crucial component to be considered by program implementers if interventions are to be sustained. Hence, the current study aimed at determining the role of culture in the transmission of anthrax.

2.6.2 Socio-economic position and political determinants

After an outbreak of *Trichinellosis* in Serbia, an investigation was launched to identify the responsible factors (Djordjevic *et al.,* 2003). An epidemiological analysis was undertaken where retrospective data was collected from the public health institute database concerning the cases. It was found that the cause of the outbreak was the political turmoil of the country that led to the economic and social disruption that negatively affected the country's veterinary control infrastructure. The above conclusions are consistent with the results of Smith et al. (2008). In their paper review to examine rural-urban differentials in life expectancy and cause-specific morbidity and mortality within Australia, New Zealand, Canada, The USA (United States of America) and the UK (United Kingdom), they found that rurality per se did not lead to health disparities or rural-urban differences (Smith *et al.,* 2008). Instead, it was found that the socio-economic and political conditions exacerbated these health disparities. It was therefore concluded that to improve rural health; there was need to design policies which targeted all risk determinants collectively contributing to poor health outcomes. In Zambia, anthrax is endemic in rural areas that are characterized by poor social services and public health infrastructure. It was therefore of interest to explore how governance issues and the socio-economic status of a society influences public health infrastructure and control measures.

Embedded within political determinants is the influence of public policy. Government policy influences allocation of resources including public health services, and ultimately places people in differential social positions that affect their vulnerability, exposure and health outcomes. Similarly, Muuka et al. (2012) demonstrated how the Structural Adjustment Program (SAP) influenced control measures for Contagious Bovine Pleural Pneumonia (CBPP) in Zambia.

In 1991, the Zambian government implemented The Structural Adjustment Program (SAP). Under the SAP, funding to government ministries was reduced, some professional workers were laid off to reduce the wage bill and services were privatized. These measures led to reduced funding for the Veterinary

Department, shortage of critical staff involved in disease control, and failure to provide veterinary services to traditional farmers. Ultimately, these measures led to re-emergence of livestock diseases that had been previously controlled (Muuka *et al.,* 2012).

Similarly, a study conducted in Washington DC showed how social class influenced policy formulation for HIV/AIDS and TB control programs (Dievler & Pappas, 1999). A case study approach revealed that while the HIV/AIDS condom distribution program received support from public health programs in the USA, TB did not because it affected the marginalized populations such as prisoners, the homeless and the have-nots. These findings shed light on the role of public policies in shaping disease and creating inequity of health, especially for the marginalized populations(ibid). Dievler and Pappas, therefore, concluded that public health professionals need to have a better understanding of the politics of strategy formulation and should not take a dim view of the policy of seeing it as a "contaminant" of rational, scientific and expert decision making and implementation. The author'sconclusions underscore the need for public health professionals to have skills in public policy advocacy skills. The conclusions are also in tandem with Virchow's' saying, "Medicine is a social science and politics is nothing else but medicine on a large scale" (Ingleby, 2012). The findings above are also consistent with literature that has shown that zoonotic diseases are common among rural, marginalized populations where development is lagging (Molyneux *et al.,* 2011).

2.6.3 Race or ethnicity

There is growing awareness that migrants and ethnic minority groups are often among the marginalized groups in any society (Elender *et al.,* 1998).

Although ethnicity was ignored as a social determinant for most of the 20th Century, there has been a growing attention to this factor after the Commission on Social Determinants of Health, led by WHO drew the world's attention to it (Commission on Social Determinants of Health, 2007; Solar & Irwin, 2007).

Since then, studies have been conducted showing how ethnicity leads to health disparities.

An example of such studies has been those done among Aborigines of Canada where it was found that the life expectancy of Aborigines was 20 years less than an average Canadian (Reading & Wein, 2009). Other studies have shown that these health differences are not as a result of poverty alone but mainly due to marginalization and colonization of these indigenous groups (Ingleby, 2012). The results were similar to another study in Canada that showed that recent immigrant women (2 years or less in Canada) were more likely to report poor health than Canadian-born women. Immigrant women who had been in Canada 10 years and over were more likely to report poor health than Canadian-born women (Vissandjee *et al.,* 2004). Other studies include the one done by Crombie et al. (2005) which showed that the *Maori* and Pacific people had poorer health status at all levels of education and income than other New Zealanders and that in the US and UK, immigrant populations had the poorest health.

It was of interest for this study to explore ethnicity and understand its influence on anthrax transmission. Although Zambia is comprised of people from the same race, there exists different ethnic groups. Zambia has diverse ethnic groups than most countries. There are four major ethnic groups and several minor ones. Bemba is the largest ethnic group, constituting 21% of the total population. The second is Tonga, Lozi, and Chewa, constituting 14%, 6% and 7% of the total population respectively (WorldAtlas.com, 2016 n.d.) Other groups include the Nsenga, Tumbuka, Ngoni, Lala, Kaonde, Namwanga, Lunda, Mambwe, Luvale, Lamba, Ushi, Lenje, Bisa and Mbunda.All the groups are Bantu-speaking and have lived in peace despite the huge diversity. However, the Lozi ethnic group, which are found in the Western Province of Zambia are the least developed despite them having been the earliest exporters of gold, copper, and crops (WorldAtlas.com, 2016 n.d).

2.6.4 The influence of multi-level factors

Ecological theories advance that health is affected by an interaction of factors operating at multiple levels. The model treats the interaction between factors with equal importance. For example, Scott & Wilson (2011) conducted a study in a rural South American county that used the ecological framework.

Using a qualitative data collection approach, in-depth interviews were conducted; potential determinants of health at multiple ecological levels that had different abilities to affect a variety of health behaviors and clinical outcomes were observed.Scott's study supports the findings by Mburu et al. (2014) which showed that adolescents' experience of living with HIV are determined by factors located within and beyond themselves, including factors at the family and peer level, community level, and structural level. The study utilized a qualitative methodological approach that employed in-depth interviews and focus group discussions. It is likely that multiple factors in affected communities influence anthrax. These multi-level factors can make control of the disease to be very complicated if they are not well understood. It was, therefore, imperative that the study explores these interactions.

2.7 Analysis of knowledge gaps

There are few studies published (Djordjevic *et al.,* 2003; Scott & Wilson, 2011; Kimani *et al.,* 2012; Bardosh *et al.,* 2014; Thys *et al.,* 2015) on social determinants of anthrax and other zoonotic diseases. However, studies posted on other infectious diseases still demonstrate that social conditions are fundamental causes of disease distribution.

The themes generated in the literature underscore the critical role of socio-economic conditions and the political context of societies as significant drivers of disease distribution and patterning (Figure 2.5). Though most studies demonstrated the influence of these fundamental causes, most of them applied quantitative research methods. The literature evidence from Zambian studies presents little information about the social causes of anthrax.

Most of what is known were generated from perspectives, editorial comments, or field reports that lack the voice of the affected communities and personnel directly involved in the control of anthrax. Such literature provides a limited understanding of contextual factors and the social causes that drive the disease.

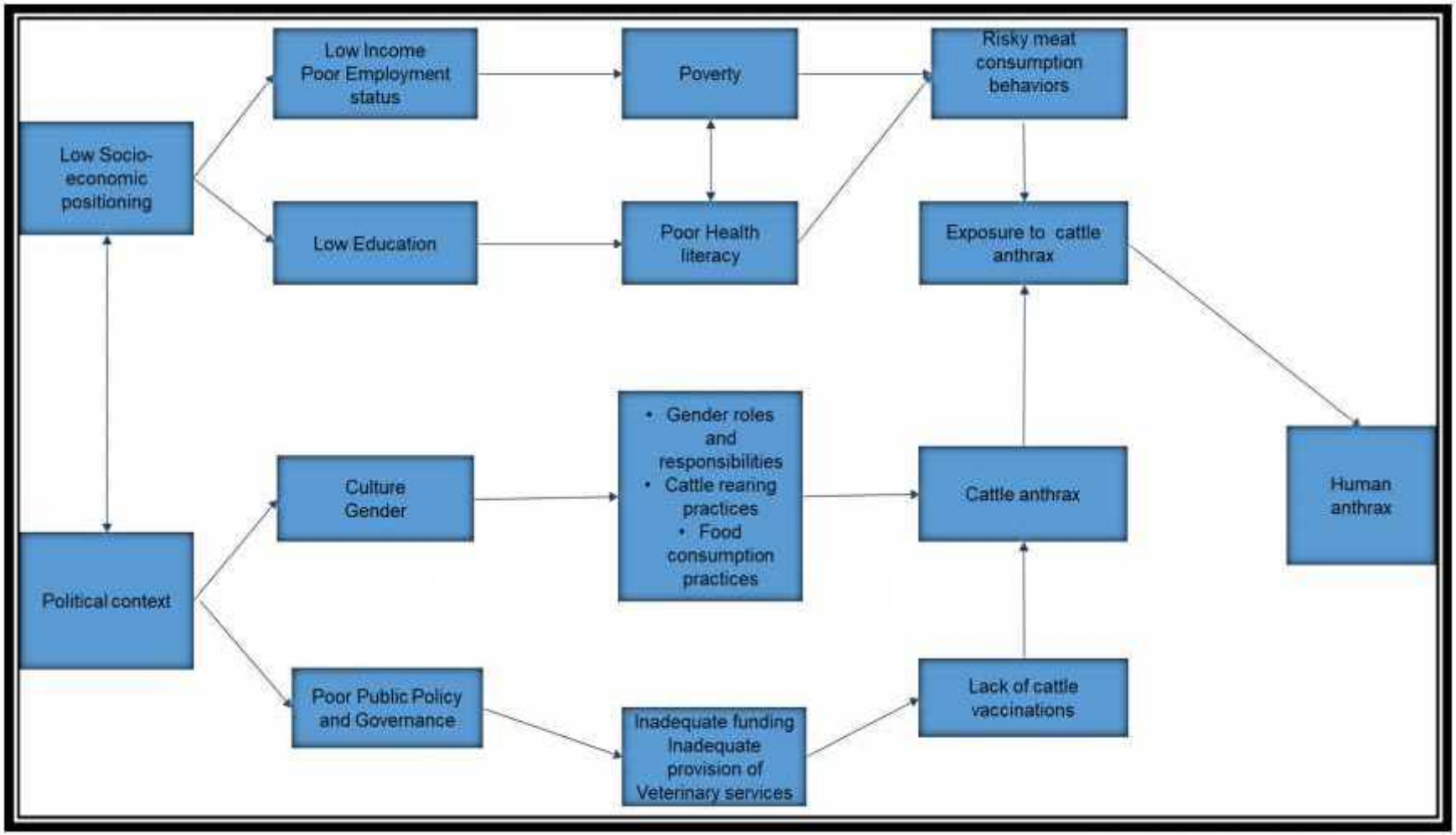


Figure 2.5: Conceptual framework for social determinants of human anthrax transmission. Adapted and modified from Dahlberg and Krug, 2002

CHAPTER THREE: METHODOLOGY

3.1 Criteria for selection of provinces

The study was conducted in the Western and Muchinga Provinces of Zambia (Figure 3.1).The two provinces were selected because anthrax has frequently been reported in these areas. The disease is endemic in the Western Province while recurrent outbreaks occur in Chama District of Muchinga Province. Three districts were randomly selected from the Western Province namely; Mongu, Nalolo, and Limulunga, while Chama district was purposively selected from Muchinga Province.

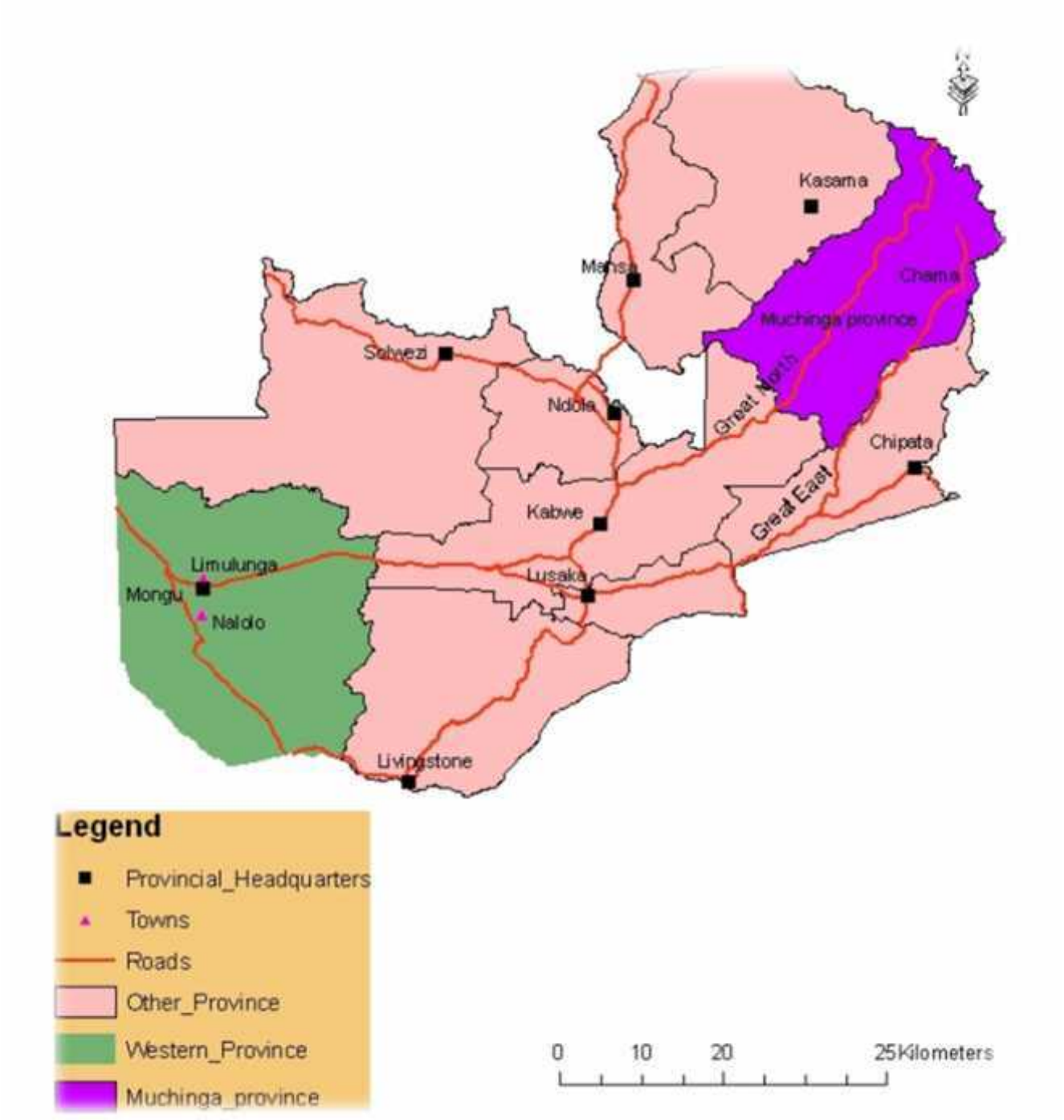


Figure 3.1: Map of Zambia showing the study sites. Green color is the Western Province and purple is Muchinga Province

3.2 A description of study areas

3.2.1.Western Province

The Western Province of Zambia encompasses the area formerly known as the Barotseland in the colonial era. The province is dominated by the Barotse Floodplains of the Zambezi River, extending from the confluence of the Zambezi with the Lungwebungu and Kabompo Rivers at the northern border of the province to a point below Senanga district and above the Ngonye Falls in the south (Ministry of Local Government and Housing, 2014).Difficult geographical and climatic conditions characterize the Western Province. Though it is the driest area of Zambia, the province experiences seasonal flooding from December to June.

Therefore, flooding provides natural irrigation for the grasslands on which huge herds of cattle depend. It also brings water to the settlements along the edges of the plain. The region has limited arable land that can sustain crop production (Chris McIntyre, 2004).Because there is limited land for cultivation, village settlements are scattered far apart, making access to most of them difficult.

The *Barotse* Kingdom was established in the 17th century. The *Lozi* people, formerly called *Luyi* are led by a king, The "*Litunga.*" In *Lozi* culture, all land is regarded to belong to the Litunga. The *Lozi* people have rights to land through cultivation, grazing, or procuring clay for making clay pots. This has made foreign and government investment in the province very difficult (Sumbwa, 2000). The *Lozi* people celebrate an important cultural, and now tourist event called *Kuomboka.* The ceremony indicates the migration of the *Litunga*, King of the *Lozi* people from his palace in *Lealui* (Royal residence on the plains) to *Limulunga* (Royal residence on the higher ground). Migration is done at the end of the rainy season when the upper Zambezi River floods the plains of the province. This compels the people and their cattle to move to an upland area. The *Lozi* ethnic group, which are found in the Western Province of Zambia, are the least developed despite them having been the earliest exporters of gold, copper, and crops (worldAtlas.com, 2016).

Other minor ethnic groups in the province include the Nkhoya- mbwela, Mbunda, Luyana, Luvale, and Lunda.

Cattle are the mainstay of the traditional economy of the Lozi, mainly for draught power; manure for fertilizing fields; milk for consumption; and for cash in times of need (Baidu-Forson *et al.,* 2014). Ownership of a large herd of cattle is usually associated with a greater responsibility towards kinsfolk and provision of economic stability for the local community in times of hardship. Cattle indicate economic power, and social position, and are used to fulfill social obligations. The Lozi rarely sell cattle or slaughter them for consumption except during traditional ceremonies, and funeral rites (Baidu-Forson *et al.,* 2014; Lutoombi, 2015). When necessary, cattle are sold when money is required for cash goods, school fees or medical expenses. It is also common for individuals who inherit the responsibility as heads of the kin groups or villages, to receive the major share of the cattle left, usually by their father.

Furthermore, persons with sizeable herds (over 40 herds) are expected to loan cattle to their relatives to help them establish their own herds. They will also engage in long-term, *'Mafisa,'* a local term for loan of cattle to non-relatives to help them build up their herds while gaining in return political support and security (Lutoombi, 2015). All cattle owners have a responsibility to help their sons and nephews to acquire cattle needed for the bride-price payment. Cattle rearing is predominantly a domain for males while females mostly rear chickens, goats, and pigs. Even if a woman owns cattle, they are usually kept by their male relatives as a form of security (Simona *et al.,* 1996). The Lozi predominantly keep the "Barotse breed" of cattle (Lutoombi, 2015). Cattle are traditionally kept in individual family kraals without separation of dairy from beef animals. It is common for herds of cattle to be owned by many family members as depicted below (Figure 3.2).

(a)

(b)

Figure 3.2: Typical family kraals (a) and (b) in the Western Province. Photos by Doreen Sitali

Common cattle feeding practices include traditional free-range grazing systems on communal lands by herders (Baidu-Forson *et al.,* 2014) and the transhumance grazing systems. In the latter system, cattle are moved from the flooded plains during the rainy season to the dry upland areas every year. The main challenges to cattle production in the Barotse plains are animal diseases such as anthrax, brucellosis, blackleg (Lutoombi, 2015), Contagious Bovine Pleural Pneumonia (CBPP), worms, especially liver flukes (Baidu-Forson *et al.,* 2014), and Foot and Mouth Disease.

The Western Province has a rural human population of approximately 780,000 (Central Statistical Office, 2012). It has fifteen districts, of which Mongu is the provincial capital. The region is connected to other provinces through two major roads; the Lusaka- Mongu road and the Livingstone-Sesheke road.

Apart from the Mongu-Kalabo road that was recently constructed, the road network within the province is generally poor. Most roads are characterized by sandy or muddy tracks passable only by trucks and four-wheel drive vehicles (Figure 3.3). Even with four-wheel drive vehicles, most tracks are difficult to navigate even during the dry season.

Figure 3.3: Common road status in Western Province

Economically, the Western Province is the second region with the highest poverty levels in Zambia, with about 80% of the population being regarded as poor and at least 70% of those in the poor category are women (Civil Society for Poverty Reduction, 2011). Since independence, the province has experienced a period of relative economic isolation compared to other

provinces. The employment rate is among the lowest in the country; at 7.7% (Central Statistical Office, 2012).

The mainstay of the people in the Western Province is subsistence farming and livestock production, supplemented by fishing. In reasonably good rainfall years, most areas are self-sufficient in staple food. Crops are grown on the fertile Barotse floodplains and along the margin of the floodplain, in particular, maize, rice, millet, cassava, and vegetables (Civil Society for Poverty Reduction Zambia, 2013).

Economically, the Western Province is mainly dependent on its natural resources such as rivers, fish, grass, and timber. The region also produces abundant cashew nuts (*Anacardium occidentale*) and mangoes (*Mangifera indica*) (Figure 3.4).

Figure 3.4: Mangoes rotting on the ground due to lack of organized market in Western Province

Poor investment into these natural resources has led to lack of value addition that would otherwise benefit the local people. As a result, most natural resources are exported outside the province in raw or semi-processed forms (Civil Society for Poverty Reduction in Zambia, 2011). Agriculture is the mainstay of the province. Rice growing is an essential economic activity in the province with about one in four families growing it (Civil Society for Poverty Reduction, 2011). However, the product has suffered from lack of organized market systems leading to low producer prices. Because of lack of investment in the marketing of the product, most farmers sell their rice to private traders, who often exploit them. Other crops grown include maize, millet, sorghum and cassava, sweet potatoes, and groundnuts.

Apart from rice growing, fishing is another significant economic activity in the province. Fish provide an essential source of protein and income for the local families. However, only 25% of the fish caught is sold outside the province, 75% of it is sold to private fish traders after drying (Baidu-Forson, 2014).

Furthermore, the province has a vast forest with a high potential for timber cutting and furnishing investment. However, there has been no investment to develop this resource. The industry has been left to private business companies. Currently, there are four Chinese companies and two non-Chinese companies involved in the timber logging business (Asanzi *et al.,* 2014). The locals also exploit the timber at a small scale for curios and canoe making. Although the logging for Zambian Teak (*Baikiaea plurijuga Harms*) was once a vibrant economic activity for the province, this industry has since declined due to the very slow rates of re-growth and the reduced demand for railway sleepers. The Zambian Teak (*Baikiaea plurijuga harms*) grows wild in the south of the province.

The province has some national parks with their surrounding game management areas namely: Kafue National Park, Liuwa Plain National Park, and Sioma -Ngwezi National Park (Chris McIntyre, 2004).Except during the *Kuomboka* ceremony, the region attracts very few tourists due to the bad road infrastructure.

3.2.2 Chama District

Chama District is the largest and least populated area of Muchinga Province. The district is also one of the most remote districts in the country. It is served by a tarred road which comes from Chipata, the provincial capital of Eastern Province, located 300 km to the south through Lundazi District. Chama District lies just inside the eastern edge of the upper Luangwa Rift Valley, at the foot of the highlands dividing Zambia and Malawi (Ministry of Local Government and Housing, 2017). The district includes a vast wilderness in the Upper Luangwa valley just north-east of the North Luangwa National Park. Much of the population of Chama district lives close to the Malawi border and shares cultural links with the people of the northern highlands of that country.

The people of Chama mostly belong to the Senga tribe, but members of the Tumbuka tribe also live in Chama (Zambia Daily Mail, 2017).

A dirt track connects the town to the South Luangwa National Park 200km southwest, running parallel to the Luangwa River.

Chama is an agrarian community dependent on subsistence farming and has a small cattle population of approximately 150,000 (National Livestock Epidemiology and information Centre, 2015) (NALEIC).The largest part of the district is a game management area with an estimated human population of 104,000 (Central Statistical Office, 2014).

The Luangwa River is the main geographical feature of Chama District. It flows through six of the Senga chiefdoms generally from North to South. Rising in the Lilonda and Mafinga Hills, the Luangwa River is one of the four largest rivers of Zambia. The upper and middle parts of the Luangwa Valley contain the North Luangwa National Park and South Luangwa National Park which are home to large populations of hippos *(Hippotamus amphibius)* and crocodiles *(Crocodylus niloticus*) (Huber, 2015).The park that is close to Chama has some wildlife species, including hippos, elephants, buffalo, big cats, and Zebras. However, poaching has dramatically reduced the number of elephants and rhinos into extinction (Huber, 2015).

The South Luangwa National Park has one of the largest concentrations of hippos in the world. Other wildlife includes elephants (*Elephas maximus*), Buffalo (*Bubalus Bubalis*), big cats, and Zebras *(Equus quagga).* Though the Luangwa River is one of the largest rivers, it is shallow and characterized by many ox-bow lakes and lagoons. During the dry season, some sections of the river dry up, leaving isolated pools. Therefore, during dry seasons and drought periods, the hippos are restricted to the isolated pools of water in search of vegetation (Dudley, 2015). It is during such seasons that hippos die from anthrax.

Chama is ranked as one of the districts with the highest poverty levels, with 74.4% of the population being classified as poor (Civil Society for Poverty Reduction, 2011). Agriculture is the leading industry, with maize as the most common crop grown in the district. Cotton, rice, tobacco, sorghum, soya beans and sunflower are grown as cash crops.

Other common food crops include groundnuts, sweet potatoes, pumpkin, cabbage, and sunflower. Besides the staple crop of maize, Chama is also known for producing rice. Apart from agriculture and tourism for North Luangwa Park, there are not many opportunities for employment, and there are not many other industries in the district. Human-animal conflicts are a common occurrence in the district because of the proximal location of human habitation to wildlife sanctuaries. Communities often face the destruction of crop fields, water supplies, human lives, livestock and demolishing of grain stores (Sobrevila, 2016). On the other hand, there is ongoing deforestation by humans due to the cutting of trees for charcoal and practice of unsustainable farming, particularly for tobacco, and cotton. This has intensified deforestation and reduced the living space and resources for both humans and animals, creating conflict.

Though poverty has played a role in driving poaching, other factors have also spurred this vice. Among these is China’s rising demand for ivory and rhino horns, and growing urbanization and affluence that has brought increased demand for wild game (Huber, 2015).

According to the Taronga Conservation Society Australia (2015), snaring of wildlife has increased substantially, posing a threat to species such as elephants, lions, and wild dogs.

3.3 Study design

A convergent parallel mixed method design was used, which is a variant of a concurrent triangulation design. Mixing of methods was done to have a comprehensive understanding of the disease under investigation. Anthrax is a zoonotic disease whose transmission is largely dependent on socio-economic factors, cultural practices, and human behavior. Furthermore, the disease in animals is associated with environmental and ecological factors. Therefore, mixing of the methods aimed at providing both objective and naturalistic ways of understanding the fundamental causes of anthrax. Also, the use of social science theories to a large extent required the use of qualitative approaches. Furthermore, the triangulation of methods helped to synergize the findings and make up for the weaknesses of each method (Creswell and Plano, 2011).

The study used the social production of disease theory and the ecological theory as frameworks for answering the research questions. The use of the social production of disease theory allowed the interrogation of how socio-economic and political context shapes disease production and distribution. The theory variables, socio-economic and political context define the social determinants of health. While socio-economic and political contexts exert their influence at structural levels, there are multiple levels of influence on human behavior. Therefore, the ecological model was included to account for other levels of influences on human behavior. The use of the ecological model helped in recognizing various levels of influence and aid with the formulation of prevention measures at different levels where influence is exerted. Above all, the ecological model helped to understand how human behavior influences the environment and vice versa.

The ecological model argues for reciprocal causation which postulates that human behavior influences the environment, and the environment, in turn, shapes human behavior.

3.3.1 Procedures for implementing the design

A convergent parallel mixed methods design enabled a deeper understanding of the existing socio-economic and political factors and their influence on vulnerability, exposure, and outcome in the transmission of anthrax. In this design, qualitative and quantitative data components were given equal weights. Data collection and analysis were conducted concurrently but separately. Though analysis of the two datasets was done separately, results of the two components were merged at the time of interpretation. The use of matrices facilitated interpretation of the quantitative and qualitative results.

The sample sizes were calculated separately because the two data components used different assumptions for calculating sample size. Participants for the qualitative inquiry were drawn from the survey sample population to avoid introducing extraneous concepts into the study. Various data collection tools and procedures were developed for each component. Below is a graphic presentation of the design (Figure 9).

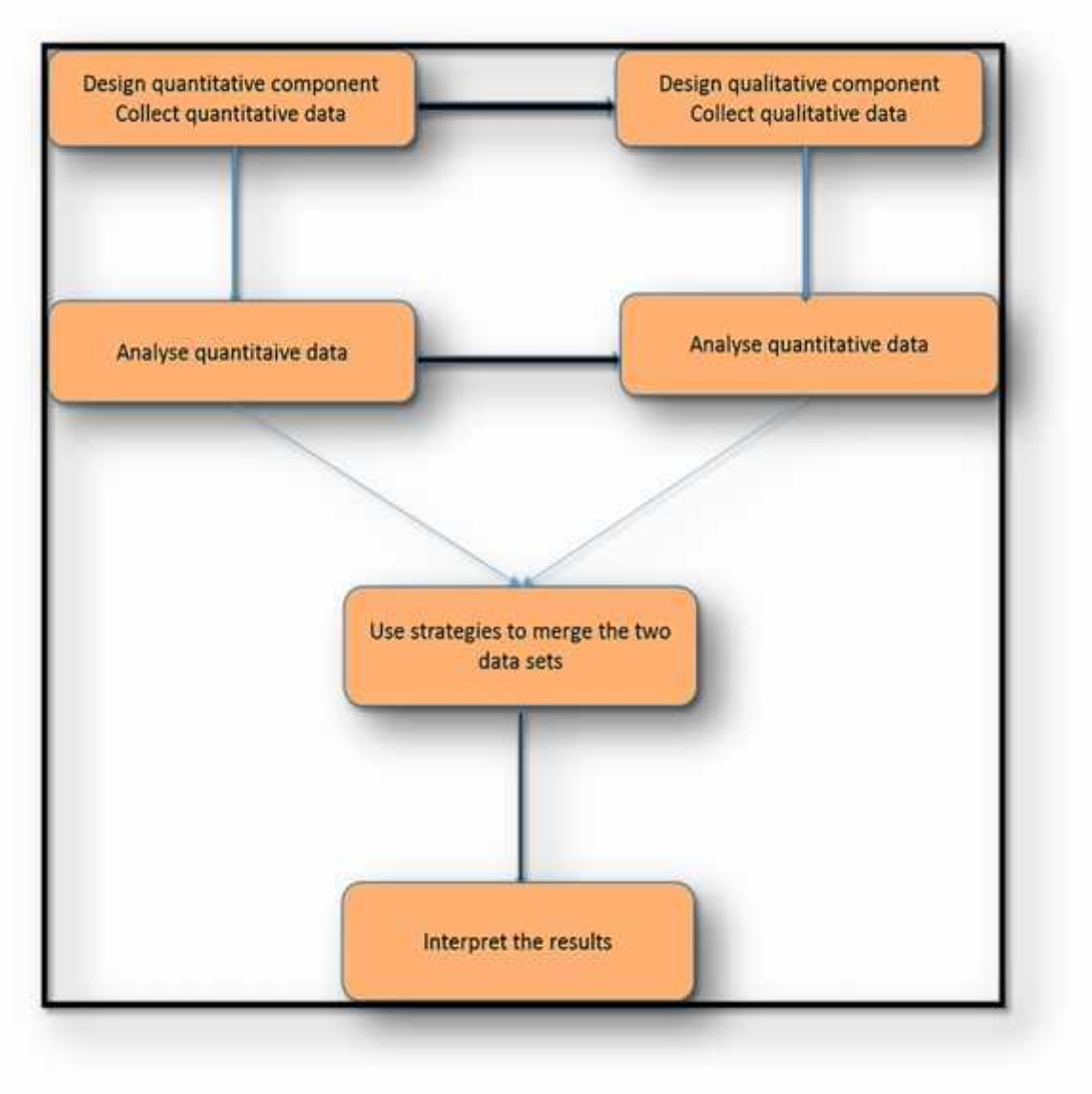


Figure 3.5: Flowchart of procedures for implementing a concurrent convergent design. Adapted from .Creswell & .Plano (2011)

3.3.2 Quantitative component

3.3.2.1 Sampling and data collection procedures

A cross-sectional survey was conducted to address the first objective of the study which was to describe the knowledge, attitudes, and meat consumption practices among affected communities. Information was collected using a structured questionnaire, concerning socio-demographic variables and socioeconomic status, knowledge of anthrax, attitudes, and perceptions. The questionnaire was administered using face to face interviews.

The data collection tool was translated from English to Lozi and Chi Nyanja, for the Western and Muchinga Provinces, respectively. This was to ensure that respondents understood the questions since most respondents used their local languages. The Table below shows how the variables were operationalized (Table 3.1)

Table 3.1: Measurement of variables

Variable	Definition	Attributes	Scale of measurement
Dependent variable	Person sick/died from anthrax	Yes No	Categorical
Independent variables			
Socio-demographic data	Age in years	Number	Continuous
	Sex of household head	Male female	Categorical
	Marital status	Married Single Divorced/widowed/separated	Categorical
	Occupation	Not employed Farmer Public service worker Self-employed	Categorical
	Educational level	No school Primary level Secondary level Tertiary level	Categorical
Socio-economic status	Monthly income	No income Less than K1,000 K1,000- 4900 K5,000 – K9,900 More than K10,000	Categorical
	Annual savings	Amount in Zambian Kwacha	Continuous
	Monthly food expenditure	Amount in Zambian Kwacha	Continuous
	Asset index: Does respondent own the following assets? Hammermill, borehole, ox-cart, bicycle, car, motorcycle, land, house, pressing iron, plow stove, television set, computer, cell phone, farming machinery, livestock, and poultry.	Yes/No	Categorical
	Type of housing	Concrete and bricks Wood and stone Pole and dug	Categorical
	Is house electrified?	Yes/No	Categorical

	Type of toilet	Flushable toilet VIP toilet Traditional latrine None	Categorical
	Source of drinking water	Piped water Borehole Shallow well Rivers surface water	Categorical
Knowledge concerning anthrax	Ever heard about anthrax Knows who gets infected with anthrax Knows the modes of transmission	Yes/No Yes/No Yes/No	Categorical
Attitudes towards anthrax	Percieves that animal vaccination is effective Perceives that animals transmit diseases to humans. Perceives that eating infected meat is risky Is satisfied with local veterinary services	Positive/Negative Positive/Negative Yes/No Yes/No	Categorical
Meat consumption and cattle rearing practices	Does not vaccinate animals. Does not consult veterinary services for diseased animals. Does not allow veterinary staff to investigate and incinerated diseased carcasses. Consumes meat from diseased carcasses. Participates in cooking meat from diseased carcasses. Takes part in dressing diseased carcasses. Handles animal products from diseased animals.	Yes/No Yes/No Yes/No Yes/No Yes/No Yes/No Yes/No	Categorical

The study population was households living in the veterinary camps where cattle are traditionally kept. The target population was household heads living in veterinary camps of the four selected districts. A veterinary camp is the smallest administrative unit of the Department of Veterinary and Livestock Services in Zambia, usually covering an area of 15km^2 (Munang'andu *et al.,* 2012). Households that had lived in the selected veterinary camps for at least six months were included in the study.

Families whose household heads could not be accessed were left out of the study as well as those who declined to participate in the study. A multistage sampling was employed to select respondents for the survey. In the first stage, the Western and Muchinga Provinces were purposively selected because they

are known endemic areas for anthrax. This was followed by simple random selection of three districts from the fourteen in the Western Province, where anthrax has historically been reported. A list of names of the districts in the Western Province was first generated. Numbers were then assigned to the designated districts. This was followed by writing numbers on small pieces of paper and shuffling them around in a little box. Three pieces of paper from the box were then randomly picked, one at a time without replacement. The numbers were then checked against their corresponding district name on the list. On the other hand, Chama district was purposively selected from Muchinga Province because it is the only known district in the province where anthrax cases have ever been recorded. After the districts had been selected, all the 21 veterinary camps in the three districts were enlisted for study. Information on the number of veterinary camps was obtained from the District Veterinary Officers. Due to lack of comprehensive information on the number of households in the predetermined study areas and corresponding cattle herds, the study was not able to establish a sampling frame. Furthermore, the difficult terrains and scattered village settlements in the two provinces made it difficult for randomization to be achieved. For this reason, to try and approximate a simple random sampling process, we utilized a spatial sampling process. The spatial sampling process involved selecting random points (defined by coordinates which were sent to the research team by Veterinary officers in the respective areas). These were selected points which were known to be anthrax hot spots. Based on the knowledge of local expertise, we used a GPS (Global Positioning System) unit to pinpoint the location and mark the routes to the centers of the pinpointed coordinates. When the GPS receiver indicated that the site had been reached, a simple random process was utilized to allocate crush-pens and to randomly visit households within the affected areas without prioritizing according to previous information of an outbreak in either cattle or humans. Thiswas done in areas where the actual hotspots were not readily identifiable. From the central coordinates, with the help of Veterinary assistants, the research team members would then spread out to various cattle crush-pens (Figure 3.6a and b) and households to collect necessary information.

This approach risked bias towards unaffected populations so in areas where the hot spots were known, they were purposively visited to get key first-hand information on the subject matter from affected households.

The rest of the households were sampled from the milk collection center, abattoir, and villages (Figures 3.6) that were within reach. Data collection was done during the time of vaccination campaigns for Foot and Mouth Disease to ease accessibility to most areas in the Western Province. In Chama district, all household heads were sampled from among the villages that could be reached by motorcycles.

(a)

(b)

Figure 3.6: Field data collection sites; (a): crush-pen and (b) milk collection centre. Photos by Doreen Sitali

Sample size calculations for number of households are complex in these surveys with variable levels of occurrence for different factors. The overall design included three districts from one province (Western) and one from Muchinga Province. Thus, the study needed to split households between districts to allow inference about differences between the four districts. In this situation, power considerations were more appropriate, and thus the study used the calculated matrix of sample size (AusVet EpiTools, 2017) to detect differences between two samples.

Table 3.2: Matrix of sample sizes needed to detect a difference between two samples given no design effect

	P2=0.01	P2=0.05	P2=0.1	P2=0.2	P2=0.3	P2=0.4	P2=0.5	P2=0.6	P2=0.7	P2=0.8	P2=0.9	P2=0.95	P2=0.99
P1=0.01		333	121	50	30	21	15	12	9	7	6	5	5
P1=0.05	333		474	88	43	27	19	14	11	8	7	6	5
P1=0.1	121	474		219	72	38	25	17	13	10	8	7	6
P1=0.2	50	88	219		313	91	45	28	19	13	10	8	7
P1=0.3	30	43	72	313		376	103	49	29	19	13	11	9
P1=0.4	21	27	38	91	376		408	107	49	28	17	14	12
P1=0.5	15	19	25	45	103	408		408	103	45	25	19	15
P1=0.6	12	14	17	28	49	107	408		376	91	38	27	21
P1=0.7	9	11	13	19	29	49	103	376		313	72	43	30
P1=0.8	7	8	10	13	19	28	45	91	313		219	88	50
P1=0.9	6	7	8	10	13	17	25	38	72	219		474	121
P1=0.95	5	6	7	8	11	14	19	27	43	88	474		333
P1=0.99	5	5	6	7	9	12	15	21	30	50	121	333	

According to the matrix Table, 408 households were required from each province to detect a prevalence of 50% in each province.

The initially calculated sample size was then adjusted for the design effect (multistage sampling) by multiplying with a factor two: 408* 2= 816 households for the two provinces (Salganik, 2006;Doh, 2001). The estimated sample size was adjusted for 10% non-response. This gave a total sample size of 898 households. However, the study resources allowed us to reach more respondents, therefore, we interviewed 1,127 respondents. The number of respondents was proportionately distributed among the districts as follows; Mongu-307; Limulunga- 280, Nalolo -249, and Chama - 291.

3.3.2.2 Pre-testing of questionnaire / training of research staff

The Principal Investigator, Research Assistant, two research supervisors, and Veterinary Camp Officers collected the data. At the end of each field day,

questionnaires were checked for completeness and given serial numbers according to the Veterinary camps where they were administered. Questionnaires which had at least ten percent of the responses not filled were excluded from the study. After the data collection had been completed, a codebook was formulated,and coding of all questionnaires was done. Questionnaire data was then entered into an excel sheet. Data cleaning was done to correct errors in entries. After cleaning, data was exported into STATA statistical software for analysis.

Before initial analysis, some continuous variables like age in years, monthly income, monthly expenditures on food and school fees and annual savings were categorized. Descriptive statistics of socio-demographic and socio-economic variables were done. Knowledge, attitudes, practices variables were also described. Since most of the variables were categorical, proportions were used to describe them. Since there were no significant differences between most characteristics between the three districts in the Western Province, results for the descriptive statistics were compared across the two provinces to note if there were any significant differences between the provinces. The significance level was set at $p< 0.05$. Results were presented using Tables. The next level of analysis tested for associations between the dependent variable (illness or death from anthrax) with various independent variables such as educational attainment, attitudes of respondents, practices, and perceptions. Results that gave a $p<0.05$ were considered to be statistically significant. A logistic regression analysis was run to determine the multiple effects of predictor variables that were statistically significant on the outcome (anthrax). All the variables that had a significant level of $p< 0.2$ in the binomial logistic regression were to be included in the logistic model.

3.3.2.3 Data quality control

Before the field work, a pilot study was conducted in Mongu town. After the pilot, questions were adjusted and rephrased to ensure clarity. Data was mostly collected by the Principal Investigator, two research supervisors, a research

assistant, and Veterinary Camp Officers in the respective veterinary camps. Veterinary Camp Officers were oriented to the questionnaire before using the tool to ensure consistency in data collection (Figure 3.7).

Also, collection of data was done in the company of either, the Principal Investigator, research supervisors or the research assistant. There were five research team members involved in data collection including, two research supervisors (from the School of Veterinary Medicine), the Principal Investigator, one Social Science Ph.D. fellow from the Veterinary School, and a research assistant who was a student in the Department of Public Health. Questionnaires administered by Veterinary Camp Officers were checked for correctness at the end of each field day. Questionnaires that had more than 10% of the questions not answered were sorted out and excluded from the study.

Figure 3.7: Orientation of data collectors. Photo by Doreen Sitali

3.4. Qualitative component

A phenomenological approach was conducted to answer the last four objectives of the study. These were; to explore how gender roles and socio-cultural practices influence cattle rearing practices and shape meat handling and meat

consumption practices; to understand how the existing socio-economic and political conditions have influenced anthrax transmission; to explore the challenges and opportunities faced by professional staff involved in the control of anthrax; and, to generate a framework for anthrax control using participatory approaches.Participatory approaches such as proportional piling, transect walks, and observations were used to collect additional field data. Pictures of activities or events of interest were captured to supplement observational findings. This was to understand how socio-economic positioning and political contexts influence the community‘s animal rearing practices and access to resources such as veterinary and health services.

The study explored what influences community decisions to vaccinate or not to vaccinate their animals and how the choices of handling sick animals were made. Perceptions of the risk of anthrax, its significance to human health and the communities’ livelihoods were also explored. Data was collected on how the structuring of veterinary and health infrastructure influences their utilization and access to health and veterinary services and what communities make of quarantine controls imposed on them during anthrax outbreaks. Also, the Statutory Instrument no. 24 of the Animal Health Act, 2010 was specifically reviewed to understand how the legislation affects anthrax control.

3.4.1 Sampling and data collection procedures

Participants for the qualitative inquiry were drawn from the survey sample respondents to avoid introducing extraneous information. Participants were selected mainly based on their interest to participate in the focus group discussions (FGD). Participants included male and female household heads who either owned or did not own cattle, local community leaders, and those whose households had been affected by anthrax before.

A total of six FGDs were held, five in the Western Province and one in Muchinga Province. These were divided as follows; one FGD took place in Chama District, one in Limulunga District, two in Nalolo District, and two in Mongu. Two of the FGDs were conducted with female participants only (Figure 3.8b), and one was

held with male participants only (Figure 3.8a). Initially, sex segregation was done to streamline differential gender perspectives. However, the narratives generated in the first two districts indicated that there were no significant differences in gender perspectives and therefore, the rest of the three FGDs were conducted with a mixed sex. All but one FGD were conducted within the villages where participants lived. One FGD took place at the crush- pen. The number of participants in the FGDs was between 5 and 14. A focus group interview guide, with open-ended questions, was used to guide focus group discussions (Appendix 4). The guide was translated into Lozi and Chi Nyanja by the Languages section of the School of Education of the University of Zambia to facilitate understanding.

During the FGDs, participants were asked to rank animal and human diseases in order of their importance. Each participant was given 20 seeds of beans to pile against each of the diseases. To start with, community members were asked to brainstorm and list four most crucial animal diseases in the community followed by four critical diseases in humans. It was then agreed that the most important disease was to be given a maximum of five seeds by each participant while the least one was to receive one. Participants listed anthrax, contagious bovine pleural pneumonia (CBPP), hemorrhagic septicemia (HS), and black leg for animal diseases. They also listed malaria, chest infections, anthrax, and skin sores as the most important human diseases. This was then followed by proportional piling of seeds against each of the diseases according to how each participant perceived its importance.

Also, community members were also given an opportunity to brainstorm and suggest solutions for the control of anthrax. The suggestions were incorporated in the proposed logic model for anthrax control.

Also, key informant interviews with veterinary staff, healthcare staff, wildlife staff and agricultural staff were conducted. The interviewees were purposively selected because they were serving in the veterinary camps where the study took place. Nine key informant interviews were held as follows; one with a Senior Veterinary Officer, four with Veterinary Assistants, two with healthcare

staff, one with a wildlife staff, and one with an Agriculture Extension Officer. All the interviews took place in the informants' offices or home environments.

(a) (b)

Figure 3.8: Focus group discussions with males (a) and females (b) in the field. Photos by Doreen Sitali

An interview guide with open-ended questions was used to conduct the interviews (Appendix 6). Since all respondents understood the language, key informant interviews were conducted in English.

Key informant interviews and FGDs were recorded on digital audio recorders with permission from participants and interviewees respectively. In addition, field notes were taken during interviews by a note taker to supplement interview narratives.

During community visits, transect walks were undertaken to have a deeper appreciation of the geographical factors at play. Photographs of grazing areas, crop fields, toilet facilities and water sources were taken.

3.4.2. Data quality control and analysis

The recorded narratives were replayed at the end of each field day so that the investigator could familiarize herself with the information. Any aspects of discussions that needed further clarification or inquiry were noted, and questions were adjusted for subsequent interviews or discussions. This procedure was repeated until no new information was emerging from the discussions. Also, recorded information was compared with field notes to

ensure that no information was missed. After completion of fieldwork, audio recordings were repeatedly replayed to familiarize with the data. This was followed by transcription of the narratives into computer files. The Principal Investigator transcribed most of the interviews, and one qualified transcriber did a few.Those transcripts that were done by other staff were counterchecked for correctness by the Principal Investigator. Later, all the written text was compared with the recorded narratives to ensure that they were accurately transcribed.

After checking for accuracy of transcriptions, FGD transcripts were taken for translation at the Languages Section of the School of Education, at the University of Zambia. The transcribed narratives were then read and re-read to internalize the data. Broad themes were extracted from the research objectives and used to group data into common themes. Variables from the theoretical frameworks too were extracted and used to formulate some of the themes. Other themes were generated by looking for commonly used words from participants' narratives. Summaries for each broad theme were then written.

After this, the transcribed files were exported to Nvivo software version 11 by QRS International, Australia. Data from the FGDs and KIIs was coded. Coding is the process of combing the data for themes, ideas, and categories and then marking similar passages of text with a code label so that they can easily be retrieved at a later stage for further comparison and analysis (Gibbs, 2005). Nodes were created using broad themes that had been generated, and coding was done. This was followed by detailed coding at child nodes. Later on, case nodes were formulatedso that comparisons between the two provinces and between data sets could be facilitated. After that treemaps, graphs, and word frequencies were generated to aid interpretation.

During fieldwork, interview and focus group guides were frequently reviewed to ensure that they captured the desired concepts. Narratives from participants were validated by triangulating information from FGDs with those from key informants and observations. Where necessary, written records from the veterinary offices were requested for and checked against data that seemed contradictory. More importantly, the FGD guides were translated into the local

languages to enhance comprehension of questions. Lastly, all but one interview took place in the respondents' environments to help them feel in control and express their ideas in their natural environments. All FGDs were conducted in the company of local health and veterinary staff that were already working with the communities. The following strategies were employed to enhance the free flow of information during the interviews; foremost, the data collectors initiated personal relationships with respondents during the survey. Second, all the interviews were conducted within respondents' villages. Also, data collectors participated in some of the village activities that respondents were involved (Figure 3.9 a & b).

3.5 Synthesis of quantitative and qualitative methods and data

Respondents for the qualitative inquiry were identified and sampled from among the survey subjects. Close-ended questions asked in the survey questionnaire were redesigned into open-ended questions to allow respondents to give meaning and add context to the responses.

Qualitative interviews and discussions also allowed a more in-depth exploration of factors that could not be identified through surveys and also provided an opportunity to gain an in-depth understanding of issues that could not be identified by the researchers. Quantitative and qualitative results were separately analyzed, but results were integrated during the discussion.

Apart from giving meaning, qualitative data was used to synergize, clarify or validate quantitative findings.

3.6 Ethical considerations

The research proposal was approved by the University of Zambia Biomedical Research Ethics Committee (UNZABREC), reference number 013-08-15 (appendix 2). Permission to collect data was obtained from the Provincial Veterinary Officer of the Western Province and the District Veterinary Officer

for Chama. For the communities, veterinary camp officers made prior arrangements with crush pen chairpersons to collect data.

The three ethical principles of researching human participants were observed thus; respect for autonomy, beneficence, and justice.

Being cognizant of participants' right to informed choice and voluntary participation in the investigation, the purpose of the survey and the intended use of the research findings were explained to the respondents. Detailed information of the procedures, possible risks, and benefits to all participants in the study was given on an information sheet (appendix 3a). The information sheet was translated into the local language to enhance comprehension of information (appendix 3b). For those interviewed during vaccination campaigns, they were informed that their refusal to participate in the study would not exclude them from having their cattle vaccinated. Once perceived as having understood the objectives of the investigation, verbal consent was obtained from participants. Respondents were identified using numbers to facilitate anonymity.

Before starting interviews, participants were assured that no part of the data being discussed would be disclosed outside the research team.

Participants were also encouraged to ensure that they did not disclose other peoples' information outside the discussion groups. For professional staff, no personal identifiers were used. Instead, titles and names of districts only were used.

Verbal permission to record interviews and focus group discussions was obtained before proceeding to record. Before taking field pictures, participants were informed of the possibility of using the photos in the report. Further, obscuring of faces in the written report has been done to avoid exposing the respondents. For one staff who refused to be recorded, notes were taken down during the interview.

For key informant interviews, they were all conducted in the privacy of the respondents' homes or offices. Data generated from participants was only shared with persons who were directly involved in the investigation. During

FGDs, numbers were assigned to participants. No personal identifying information was collected or recorded on the questionnaires. No names or personal identifiers were included in data interpretation and publication. Instead, numbers and places were used.

No compensation for participating in the study was made. However, refreshments were provided to participants during focus group discussions. During the survey, respondents who had calves within their herds were treated with Albendazole Tablets to deworm their calves. This was done as part of the vaccination exercise that was going on during the data collection.

3.7 Study Limitations

The conduct of this study was not without limitations. These limitations resulted mainly from geographical remoteness and infrastructure challenges posed by the study areas. The following are some of the limitations:

1. Due to lack of comprehensive information on the number of households in the predetermined study areas and corresponding cattle herds, the study was not able to establish a sampling frame. Furthermore, the difficult terrains and scattered village settlements in the two provinces made it difficult for randomization to be achieved. For this reason, to try and approximate a simple random sampling process, we utilized a spatial sampling process. The spatial sampling process involved selecting random points (defined by coordinates which were sent to the research team by Veterinary officers in the respective areas). These were selected points which were known to be anthrax hot spots. This approach risked bias towards unaffected populations.

2. The study could not explain how seasonal variations affected hunger levels and influenced meat consumption practices.

3. The findings may have systematic errors due to self-reporting and recall bias. However, the study endeavored to ensure internal validity and reliability by triangulation of quantitative and qualitative results. Instead of contradicting, the

two components seem to be clarifying aspects of data that do not appear to agree.

4. Lastly, the study could not estimate the prevalence of anthrax in the affected communities due to the acute nature of the condition.

CHAPTER FOUR: RESULTS

4.1 Quantitative results

The quantitative results in this section are aimed at answering the first objective of the study which was to describe the knowledge, attitudes, and meat consumption practices of respondents. Therefore, the findings here include detailed results of socio-demographic characteristics of respondents, socio-economic characteristics, and knowledge of interviewees about anthrax, meat consumption practices and perceptions of respondents concerning anthrax transmission. Results were presented as comparisons between Western and Muchinga Provinces using chi-square test of significance between groups. This is because there were no significant differences observed in the characteristics observed between the three districts of the Western Province.

4.1.1 Socio-demographic characteristics

1,127 respondents participated in the survey. Of these, 836 (74.2%) respondents were from Western, and 291 (25.8%) were from Muchinga Province. The age range of the whole cohort of respondents was 18-99 years, with a median age of 43.5 years. There were 851 (76.5%) males and 262 (23.5%) females. Most of the respondents in both provinces had never been to school; and, in both provinces majority of the respondents were subsistence farmers. Of the total sample, 13% of respondents in Western Province reported to have had a family member who either suffered or died from anthrax in the previous twelve months while only 11% did so in Muchinga Province. Based on chi-square tests, significant differences in socio-demographic characteristics between the two provinces are shown (Table 4.1).

Table 4.1: Socio-demographic characteristics of respondents

Characteristic	Category	Province		p-Value
		Western n = (%)	Muchinga n= (%)	
Age (years) (n= 1,108)	18-28	87 (10.6)	80 (27.9)	<0.001
	29-39	229 (27.9)	102 (35.5)	
	40-49	228 (27.8)	52 (18.1)	
	50-59	164 (20)	22 (7.7)	
	60-69	73 (8.9)	18 (6.3)	
	70-99	40 (4.9)	13 (4.5)	
Sex (n= 1,112)	Male	709 (85.7)	142 (49.8)	<0.001
	Female	118 (14.3)	143 (50.2)	
Marital status (n=1,113)	Married	710 (85.9)	141 (49.3	<0.001
	Single	117 (14.1)	145 (50.7)	
Educational level (n= 1,119)	None	720 (87)	241 (82.8)	0.001
	Primary	61 (7.4)	42 (14.4)	
	Secondary	45 (5.4)	7 (2.4)	
	Tertiary	2 (0.2)	1 (0.3)	
Occupation (n= 1,123)	Not employed	21 (2.5)	16 (5.5)	0.001
	Farmer	761 (91.4)	242 (83.4)	
	Public service worker	23 (2.8)	9 (3.1)	
	Private sector employee	28 (3.4)	23 (7.9)	
Total number of household members (n=1,126)	1-5	98 (11.7)	42 (14.4)	< 0.001
	6 -10	306 (36.6)	156 (53.6)	
	11-15	256 (30.7)	50 (17.2)	
	16-20	147 (17.6)	26 (5.8)	
	20+	28 (45.3)	17 (5.8)	

4.1.2 Socio-economic characteristics of respondents

The results in Table 4.2 show that most of the respondents (87.9%) in the two provinces were farmers owning 1-5 hectares of land. Also, majority (41%) of respondents in the two regions had six to ten household members and had an average monthly income of less than ZMK 1000 (USD 100). Furthermore, most (48.6%) of the respondents spent less than ZMK 500 (USD 50) on food per month in both provinces and were not able to make any annual savings. While 86% of respondents owned cattle in the Western Province, only a few (3.1%) did so in Muchinga Province. Regarding housing and amenities, the majority of respondents in the Western and Muchinga Provinces owned homes where they lived. Most of the houses were commonly constructed with wooden poles and mud with grass thatched roofs. Most (66.5%) of the respondents in Western Province got their drinking water from shallow wells and open surface rivers (Figure 4.1), while the majority (43.1%) in Muchinga had access to borehole water. Equally, most (83%) of respondents had no access to electricity in the two provinces. Chi-square tests showed significant differences between socio-economic characteristics as shown in Table 4.2. Low socio-economic position is associated with poor access to resources, increased vulnerability to disease due to unhealthy life adjustments and poor outcomes of disease.

Table 4.2: Comparison of socio-economic characteristics of respondents in the Western and Muchinga Provinces

Characteristic	Category	Province		p-value
		Western n (%)	Muchinga n (%)	
Average monthly income (n= 1,115)	None	373 (45.3)	89 (30.6)	<0.001
	Less than 1000	337 (40.9)	154 (52.9)	
	10000 – 4900	96 (11.6)	34 (11.7)	
	4900 +	18 (2.2)	14 (4.8)	
Other sources of income (n=1,091)	Farming	819 (98.2)	248 (96.5)	0.093
	Trading	12 (1.4)	5 (1.9)	
	Social welfare	1 (0.1)	3 (1.2)	
	Farming and trading	2 (0.2)	1 (0.4)	
Other working family member (n=1,120)	No	649 (78)	258 (89.6)	< 0.001
	Yes	183 (22)	30 (10.4)	
	None	30 (3.8)	4 (1.4)	
Monthly food expenditure (n= 1,067)	1-100	69 (8.8)	100 (35.6)	< 0.001
	110-500	390 (49.6)	129 (45.9)	
	540-1500	259 (32.9)	32 (11.4)	
	1700 -2500	30 (3.8)	12 (4.3)	
	3000 -7000	8 (1.0)	4 (1.4)	
Annual school fees (n= 1,091)	None	103 (12.8)	80 (28.0)	<0.001
	1-500	226 (28.0)	120 (42.1)	
	510 -3200	286 (35.5)	64 (22.5)	
	3450 -5400	55 (6.8)	9 (3.2)	
	5800 -10,000	89 (11.0)	5 (1.8)	
	10,000 - 30220	47 (5.8)	7 (2.5)	
Annual savings (n=1,089)	None	307 (38.3)	145 (50.4)	<0.001
	20-500	114 (14.2)	81 (28.1)	
	600-1000	98 (12.2)	32 (11.1)	
	3000 -5000	104 (13.0)	8 (2.8)	
	6000 -50000	95 (11.9)	6 (2.1)	
Land ownership (n = 1,123)	Yes	775 (93.0)	212 (79.1)	<0.001
	No	58 (7.0)	78 (26.9)	
Cattle ownership (n=1,021)	Yes	723 (86.8)	9 (3.1)	< 0.001
	No	110 (13.2)	281 (96.9)	
House ownership (n=1,119)	Yes	795 (95.5)	253 (89.1)	<0.001
	No	37 (4.5)	34 (11.9)	
Water source (n=1,122)	Piped water	48 (5.8)	16 (5.6)	<0.001
	Borehole	149 (17.9)	124 (43.1)	
	Well water	555 (66.5)	51 (17.7)	
	Open surface river water	82 (9.8)	97 (33.7)	
Toilet facility (n=1,119)	None	114 (13.7)	47 (16.5)	0.04
	Flushable	19 (2.3)	2 (0.7)	
	VIP	62 (7.4)	11 (3.9)	
	Traditional latrine	639 (76.6)	225 (78.9)	
Access to electricity (n=1,116)	Yes	115 (13.8)	74 (26.1)	<0.001
	No	717 (86.2)	210 (73.9)	

(a) (b)

Figure 4.1: Common sources of water in Western Province, open Surface River (a) and shallow well (b)

4.1.3 Knowledge on anthrax transmission

Though the majority (88.3% in Western and 81.4% in Muchinga Province) of respondents were aware of anthrax and knew that the disease could be transmitted by eating infected meat, only 23% were aware that handling infected animal products and participating in slaughtering infected animals could lead to infection. Most (64.2%) respondents were also aware that both animals and human beings could be infected with anthrax. Though 83.5% of the interviewees in the Western Province acknowledged that animal vaccination was a useful control measure for anthrax, 69.4% in Muchinga Province did not. Using the chi-square tests, significant differences in awareness levels of modes of anthrax transmission were noted between the two provinces except for knowledge on eating infected meat (p=0.29) which was similar across the two provinces. Detailed results are shown (Table 4.3).

Table 4.3: Comparison of knowledge of anthrax among respondents in the two provinces, given as percentages (n=1,127)

Characteristic	Category	Province		p-value
		Western n (%)	Muchinga n (%)	
Awareness of anthrax (n= 1,127)	Yes	738 (88.3)	237 (81.4)	0.003
	No	98 (11.7)	54 (18.6)	
Awareness of who can be infected by anthrax (n=1,125)	Human	210 (25.0)	18 (6.2)	< 0.001
	Animal	14 (1.7)	51 (17.5)	
	Human & animal	543 (64.9)	179 (61.5)	
	Do not know	67 (8.0)	43 (14.8)	
Awareness of vaccination as an effective control measure (n=1,127)	Yes	685 (83.5)	89 (30.6)	< 0.001
	No	151 (18.0)	202 (69.4)	
Awareness of mode of transmission (n=1127)	Eating infected meat	722 (86.4)	244 (83.9)	0.291
	Touching infected meat	383 (45.8)	109 (37.5)	0.01
	Slaughtering infected animals	135 (16.1)	71 (24.4)	0.002
	Handling infected animal products	275 (32.9)	74 (25.4)	0.018
	Touching infected animal feces	147 (17.6)	63 (21.6)	0.125
	Drinking infected milk	247 (29.5)	43 (14.8)	<0.01
	Don't know	75 (9.0)	24(8.25)	0.707
Source of information	Radio only	189 (22.8)	71 (25.2)	< 0.001
	Radio & Friends	378 (45.6)	50 (17.7)	
	Friends only	150 (18.1)	112 (39.7)	
	Professional workers	94 (1.3)	43 (15.2)	
	Professionals & Radio	17 (2.0)	6 (2.1)	

4.1.4 Attitudes and practices towards anthrax

Attitudes of respondents - *68*% of the respondents in the Western and Muchinga Provinces knew that animals can transmit diseases to humans. However, 73.8% of respondents did not believe that eating contaminated meat exposed them to anthrax. Lastly, most respondents (89.7%) in the Western Province were satisfied with the quality of veterinary services they received, but few (22.1%) did so in Muchinga Province.

4.1.5 Practices of respondents

While 82.3%) of respondents in the Western Province reported that they vaccinated their cattle against anthrax, only 5.2% did so in Muchinga Province. Despite the majority (85%) for the Western and 73.2% in Muchinga Province) of respondents indicating that they reported cattle mortalities to Veterinary Officers, only 2% in the Western Province and none (0%) in Muchinga indicated that the carcasses were buried or burned. Furthermore, a significant proportion of respondents in both provinces indicated that they shared meat among community members when an animal died of an unknown disease. It was also established that all of the respondents participated either in the dressing (skinning, gutting, and butchering) of carcasses or cooking meat when an animal died in their community. Generally, the Western and Muchinga Provinces had similar practices in handling meat from suspected anthrax carcasses (Table 4. 4).

Table 4. 4: Community practices of relevance for anthrax in the two provinces, reported as percentages in each province.

Characteristic	Category	Province		p-value
		Western n (%)	Muchinga n (%)	
Vaccinates cattle against anthrax (n=767)	Yes	674 (82.3)	15 (5.2)	<0.01
	No	74 (9)	4 (1.7)	
Treat dead animals from anthrax (n=1,209)	Reported to vets	711 (85)	213 (73.2)	< 0.01
	Sold meat	55 (6.6)	10 (3.4)	0.05
	Ate meat	101 (12.1)	83 (28.5)	<0.01
	Used animal products	17 (2)	3 (1.0)	0.26
	Buried or burned	16 (2)	0 (0)	0.02
Practices when animal dies from unknown disease (n= (1,421)	Reported to local vet authorities	370 (44.3)	19 (6.5)	>0.01
	Sold meat	205 (24.5)	56 (19.2)	0.07
	Ate meat within family	200 (23.9)	13 (4.5)	> 0.01
	Shared meat among community members	271 (32.4)	135 (46.4)	>0.01
	Buried /burned carcass	70 (8.4)	82 (28.2)	>0.01
Activities participated in when animal dies in community (n=1,127)	Gutting	636 (76.1)	135 (46.4)	>0.01
	Skinning	12 (1.4)	6 (2.1)	0.46
	Butchering	142 (17)	26 (8.9)	> 0.01
	Cooking	163 (19.5)	79 (27.1)	0.01

Characteristic	Category	Province		p-value
		Western n (%)	Muchinga n (%)	
Vaccinates cattle against anthrax (n=767)	Yes	674 (82.3)	15 (5.2)	<0.01
	No	74 (9)	4 (1.7)	
Treat dead animals from anthrax (n=1,209)	Reported to vets	711 (85)	213 (73.2)	< 0.01
	Sold meat	55 (6.6)	10 (3.4)	0.05
	Ate meat	101 (12.1)	83 (28.5)	<0.01
	Used animal products	17 (2)	3 (1.0)	0.26
	Buried or burned	16 (2)	0 (0)	0.02
Practices when animal dies from unknown disease (n= (1,421)	Reported to local vet authorities	370 (44.3)	19 (6.5)	>0.01
	Sold meat	205 (24.5)	56 (19.2)	0.07
	Ate meat within family	200 (23.9)	13 (4.5)	> 0.01
	Shared meat among community members	271 (32.4)	135 (46.4)	>0.01
	Buried /burned carcass	70 (8.4)	82 (28.2)	>0.01
Activities participated in when animal dies in community (n=1,127)	Gutting	636 (76.1)	135 (46.4)	>0.01
	Skinning	12 (1.4)	6 (2.1)	0.46
	Butchering	142 (17)	26 (8.9)	> 0.01
	Cooking	163 (19.5)	79 (27.1)	0.01

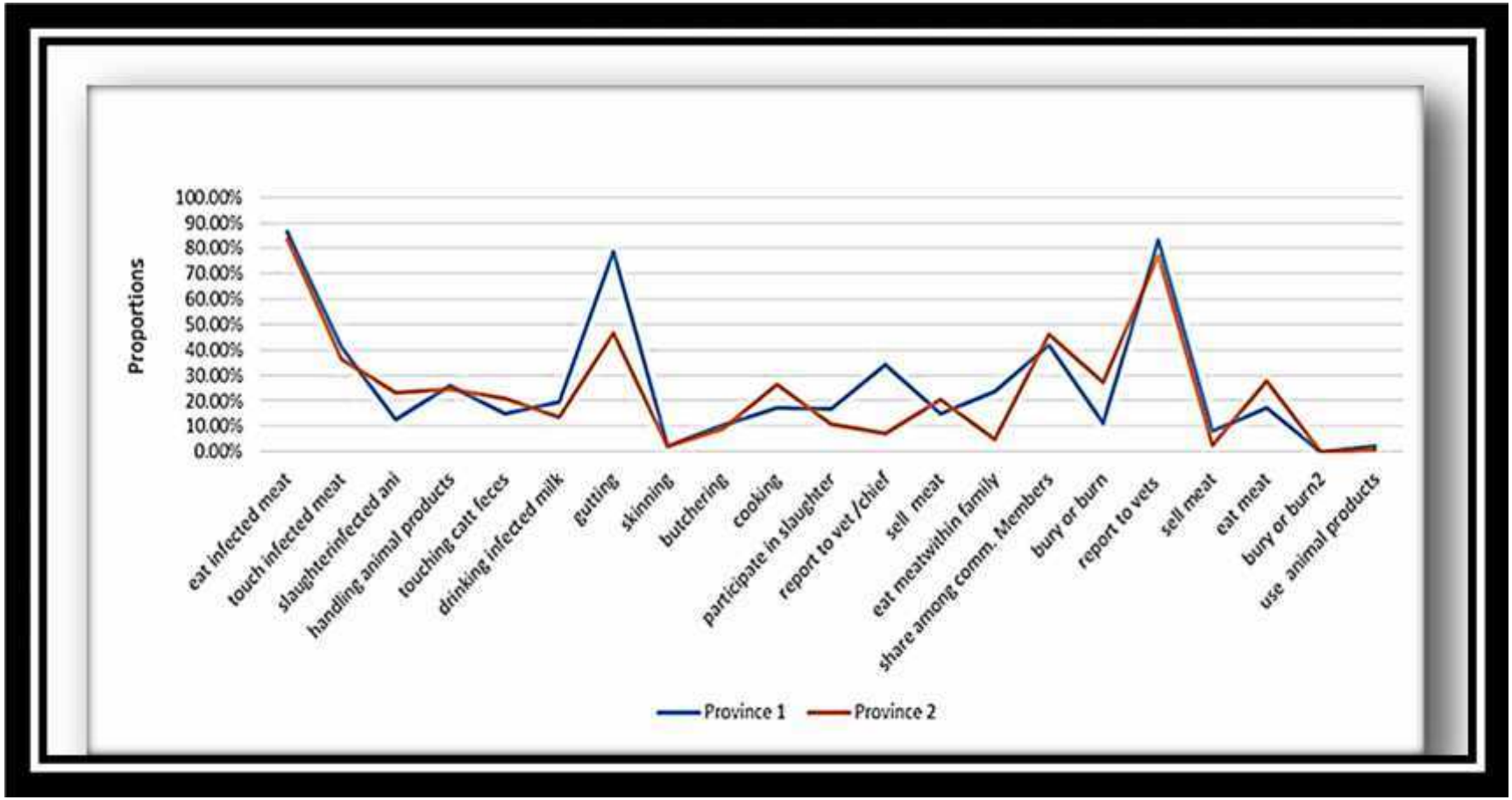


Figure 4.2: Summary line graph showing differences & similarities in meat handling and consumption practices between the Western (province1) and Muchinga (province 2)

4.1.6 Binomial logistic regression

Apart from marital status, the other demographic variables such as sex, educational level, and occupation were not significantly associated with having anthrax. For marital status, being married was found to be associated with lesser odds of suffering from anthrax compared to those who were single, OR= 0.4 (95% CI; 0.23 – 0.68; P =<0.01). The Table below shows results of associations of socio-demographic variables and anthrax (Table 4.5).

Table 4.5: Univariate analysis for relationship between anthrax and socio-demographic variables

Characteristic	Anthrax		Unadjusted	
	n	(%)	OR (95% CI)	p value
Sex			0.67 (0.42 - 1.06)	0.09
Male	113	13.4		
Female	24	9.4		
Marital status				
Married	121	14.4		
Single	16		0.40 (0.23 – 0.68)	
		6.2		<0.01
Educational level				
No school	123	12.9	1.19 (0.67 – 2.12)	0.56
Primary education	15	15		
Secondary & college education	0	0		
Occupation			0.22 (0.30 – 1.64)	
Farmer	136	12.6		0.14
Public worker	1	12.4		

4.1.7 Association between socio-economic characteristics and anthrax

Monthly income was found to be significantly associated with anthrax OR=3.4, 95% CI (2.18 -5.31), P<0.01. Furthermore, monthly food expenditure was equally associated with anthrax as results show that respondents who earned

no income were twice more likely to be infected with anthrax compared to those who did, OR=2.4, 95% CI (1.14 -5.02) P<0.01.Among the practices associated with transmission of anthrax, eating infected meat was found not to be significantly associated with anthrax transmission, OR= 0.76; 95% CI (0.45-1.28).

Table 4.6: Univariate analysis of anthrax and practices of relevance

Variable	Anthrax		Unadjusted	
	n	(%)	OR (95% CI)	p value
Aware of anthrax				
No	7	5.4	2.7 (1.25 – 6.0)	0.01
Yes	131	13.6		
Animal vaccination				<0.01
No	36	8.7	1.8 (1.20 – 2.70)	
Yes	100	14.6		
slaughter				
No	73	8.6	3.52 (2.43 - 5.11)	< 0.01
Yes	63	24.9		
Cook meat				
Yes	19	8.1	0.56 (0.34 -0.93)	0.02
No	119	13.6		
Eat infected meat				
Yes	18	10.1	0.76 (0.45 -1.28)	**0.30**
No	120	12.9		
Cattle ownership				
No	34	8.9	1.72 (1.14 - 2.60)	0.01
Yes	104	14.3		
Lost cattle to anthrax				
No	30	3.6	18.18 (11.7 -28.29)	< 0.01
Yes	103	40.4		

4.1 8 Multinomial logistic regression

After running the Univariate analysis, it was observed that all the variables that were statistically significant (awareness of anthrax, not vaccinating cattle, participating in animal slaughter, cattle ownership, and losing cattle to anthrax) were not causative factors but were rather predisposing factors. The factors, therefore, had no biological plausibility.

Second, it was observed that the factors, though mutually exclusive, interacted with each other and acted synergistically. It was, therefore, difficult to predict the effect of each one of them without the interaction of the other variables.

For example, a farmer who lost cattle to anthrax due to lack of vaccination was likely to participate in slaughtering the animal and eating the meat due to lack of awareness of the risk of anthrax. Though the variables were not statistically collinear, they in reality interplayed with each other and could not be predicted independent of each other.

4.2 Qualitative results

4.2.1 Attributes of participants

Six focus group discussions and nine key informant interviews were conducted. The Tables below show the attributes of focus group participants and key informants (see Tables 4.7 and 4.8)

Table 4.7: Attributes of focus group participants in the Western and Muchinga Provinces

Case	Attributes				
FGD	**Sex**	**Age range**	**Place of interview**	**No. of participants**	**District**	**Province**
1	M	22- 83	Village	10	Mongu	Western
2	M	41- 77	School	14	Chama	Muchinga
3	F	27-37	Village	5	Mongu	Western
4	F	38-67	Crush-pen	9	Nalolo	Western
5	M	44- 66	Camp house	10	Nalolo	Western
6	MS	33- 72	Village	12	Limulunga	Western

Sex: F= female, M= male, MS= mixed sex

Table 4.8: Attributes of key informants in the Western and Muchinga Provinces

Case	Attributes							
KII	Sex	Age	Position	Place of interview	Years of experience	Institution	District	Province
1	Male	51	VO	Respondent's Office	25	Veterinary	Mongu	Western
2	Male	32	AO	District Office	17	Agriculture	Chama	Muchinga
3	Male	33	VO	District Office	15	Veterinary	Chama	Muchinga
4	Male	72	VO	Respondent's home	30	Veterinary	Nalolo	Western
5	Male	49	VO	Respondent's Office	22	Veterinary	Limulunga	Western
6	Male	34	HW	District Office	10	Health	Chama	Muchinga
7	Male	53	WO	District Office	15	Wildlife Authority	Chama	Muchinga
8	Male	43	VO	Seminar room (Vet School)	9	Veterinary	Kalabo	Western
9	Male	29	HW	Home	7	Health	Mongu	Western

VO= Veterinary Officer, AO= Agriculture Officer, WO= Wildlife Officer, HW= Health Worker

Five themes were generated by extracting variables from specific objectives and identifying recurrent words in the narratives. The Figure 4.3 shows the themes and sub-themes that were generated.

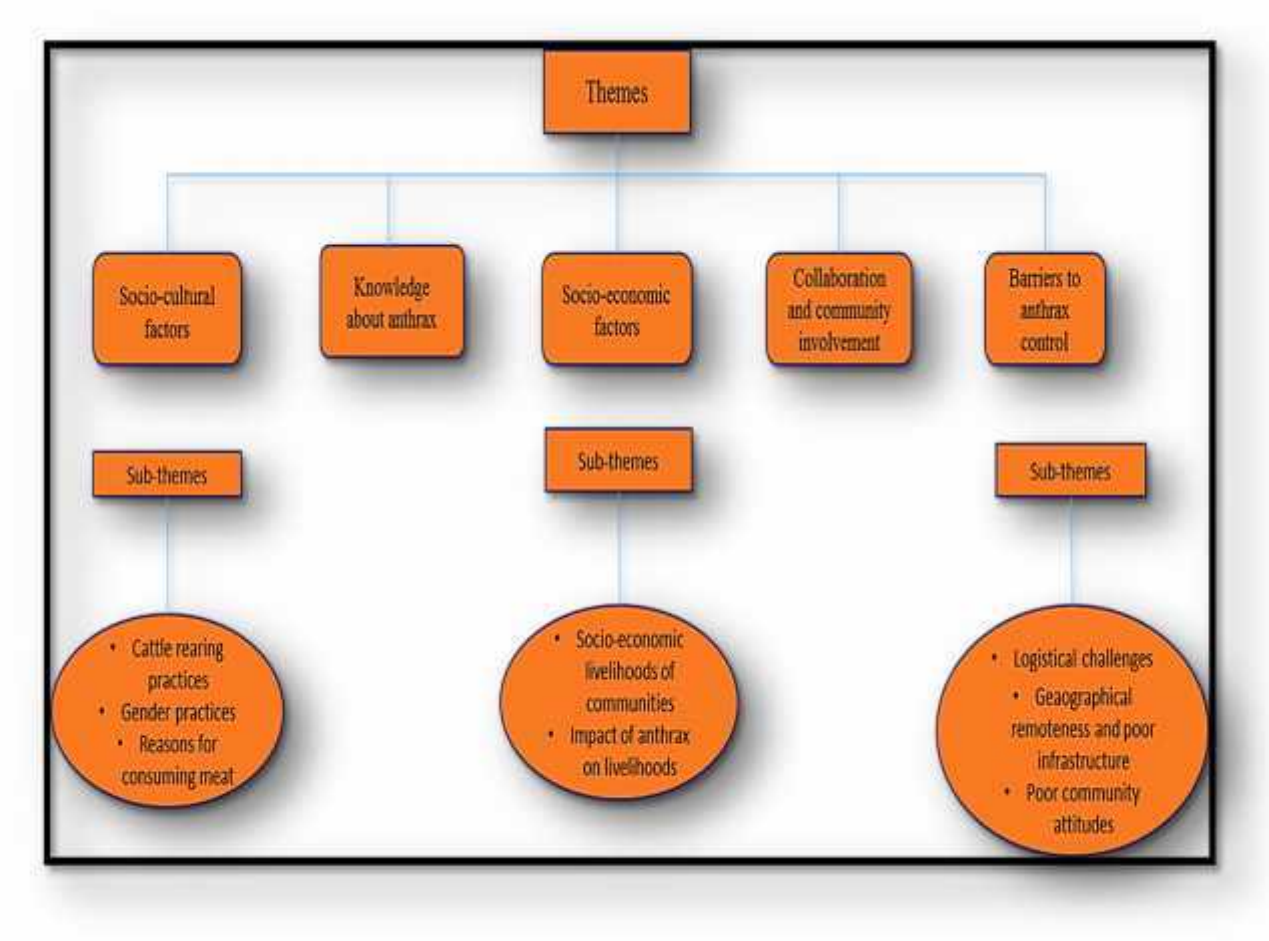


Figure 4.3: Themes and sub-themes of the focus group discussions and key informant interviews

Figure 4.3 shows percentage coding for the themes of the narratives from focus group discussions and key informant interviews. Both focus group and key informants discussed socio-economic, socio-cultural determinants, impact of anthrax on livelihoods, and challenges faced in control of anthrax. On the other hand, only two key informants discussed gender issues.

Table 4.9: Percentage coding of themes from FGDs and KIIs

Theme	Sources												
	FGD (% coding)						**KII (% coding)**						
	1	2	3	4	5	6	1	2	3	4	5	6	7
Socio-economic factors	48.4	8.4	6.0	11.7	10.4	15.1	41.7	20.4	6.1	6.6	1.9	2.8	20.5
Socio-cultural practices	50.8	41.7	14.3	30.8	14.6	6.9	77.6	38.7	19.3	22.4	10.6	20.9	32.8
Gender roles	14.8	60.9	15.7	0	20.7	13.2	0	0	33.9	66.1	0	0	0
Knowledge about anthrax	57.9	42.0	19.6	36.9	25.4	26.9	13.2	6.6	0	0	1.0	19.9	60.0
Challenges in anthrax control	78.7	25.6	19.8	44.4	19.6	17.0	44.5	83.0	24.2	3.2	16.5	13.8	57.6
Impact of anthrax on livelihoods	42.9	17.2	6.6	13.7	19.9	0.18	20.3	28.5	8.8	12.4	4.2	6.1	19.7
Collaboration between sectors	3.6	8.8	0	56.6	15.6	15.4	13.5	21.4	5.0	7.5	19.7	25.3	7.5

4.2 Socio-cultural factors influencing anthrax transmission

4.2.2.1 Cattle rearing practices among communities

The Lozi people of the Western Province are traditionally cattle keepers. Ownership of cattle indicates prestige, economic power, and social position. Cattle are kept in family kraals without separation of beef or milk animals. A herd of cattle is commonly owned by a kinship, some of whom live away from the village. Cattle are taken care of by heads of the family or village. Therefore, decisions to sell or slaughter an animal has to be collectively made. Cattle are reared for draught power, milk, manure for fertilizing crop fields, and for cash in times of need. Cattle are rarely slaughtered for consumption except during special ceremonies or funeral rites. Most often, beef is eaten if an animal dies on its own as was indicated by one participant who said; '*Us Lozi's we do not slaughter cattle for relish unless it dies on its own*' (FGD 3).

Such a practice could lead humans to be exposed to anthrax if the animal was infected.

The Lozi people and their livestock migrate from the floodplains every year at the beginning of the rainy season (November/December) to the upland and return when the floodwaters recede (April/May). Therefore, human and livestock populations are low on the floodplains during the peak rainy season and increase during the dry months. Because water becomes scarce during the dry season, pasture is only found close to a few water points. As a consequence, cattle crowd around those points and graze close to the ground, increasing the likelihood of ingesting anthrax spores. These ecological factors have been known to influence the transmission of anthrax to animals. The ecological model postulates that the environment influences disease transmission.

Since the colonial times, the Lozi people have been involved in a traditional cattle practice called *'Mafisa.'* The Ngoni and Chewa people of Eastern Province call it Kwikila (meaning entrusting) while the Tswana in Botswana call it *Mafisa* as well (Sumbwa, 2000). According to Sumbwa (2000), the *Mafisa* system in Bulozi was set up by the Lozi King, the *Litunga.* The King established cattle posts throughout his kingdom by entrusting his cattle with indunas (Village Headmen).The animals belonging to the King were called Likomu zambuwa (meaning The King's cattle) and those who herded the cattle were referred to as *Imutongo* or Bo *Imbuwa.*The system was meant to help cattle owners spread the risk of losing animals from diseases and empower those who did not have cattle (Sumbwa, 2000). *Mafisa* is done for many reasons as explained by a key informant:

> *'…….. because in Western Province it is not so easy to keep many animals on the same kraal, so in most cases,you would give to other people to.… for many reasons, one is to help, two is to spread the risk. You give to other people, so they keep for you, yah, in return okay you give them one animal or so per year or so, whatever agreement it is……'*(KII 7).

Generally, the *mafisa* practice is a form of social support and risk management system.

However, if an animal dies while under the agreement, the caretaker is obliged to prove that they did not sell the animal. Therefore, meat is dried and taken to the cattle owner. Sometimes, parts of the animal such as the hide (Figure 4.4 a & b) and or horns are preserved for the owner's inspection. A participant explained what commonly happened when an animal under the mafisa agreement died, he said:

> *'……. It can die (meaning cattle) at the mafisa and the one keeping it will not do anything about it until the owner comes. I can say that sometimes the owner of the cattle for mafisa is not around, went somewhere because of fear of getting into trouble what will he do is, just skin that cattle and dry it to wait for the owner to come and get it when he is back.'(*FGD 1**)**

(a) (b)

Figure 4.4: Dried cattle hide preserved for the owner's inspection (a) veterinary staff taking sample of hide for testing (b). Photo by Doreen Sitali

The practices mentioned above pose a risk of transmitting anthrax because its spores are known to survive on hides and other tissues for many years.

Further to the above, through the *mafisa* practice, cattle owners sometimes distribute their livestock to other areas when they hear rumors of animal disease outbreaks to spread out the risk of losing all the animals.

However, such actions are sometimes taken when a disease has already infected a herd. A key informant explained one scenario that he observed during a CBPP outbreak, he said:

> *'…this farmer whose herd was infected, actually the first herd was somewhere near Shangombo District, at a place called Lueti. So when he heard that there was CBPP in Shangombo, then he told his sons to go and*

take those animals which were at Lueti to avoid getting infected with CBPP, not knowing that the herd was already infected. So when they got the herd, they were also advised to distribute again to some other members along the way where other animals were, so they distributed those animals along the way and the disease spread like that and a lot farmers were affected like that……' (KII 8)

Though the scenario mentioned above did not happen due to anthrax, what the key informant implied was that generally, distribution of cattle to other areas was common when farmers heard of rumors of animal diseases including anthrax.

Through the same *Mafisa* agreement, the herder is expected to send to the cattle owner any calves that are born from the loaned cattle, once the calves are weaned off. Such a practice carries a risk of transmitting animal diseases such as anthrax to new areas should the calves be infected. A male participant explained what commonly obtained in the agreements sometimes, he said:

'the mafisa scheme, even the calves which come across the river from the mafisa production tend to get the infections and carry it to the kraals where the big cattle are, that way they also infect the big and may end up losing all the animals.'(FGD 1)

The mafisa agreement is commonly held between families that live on the plains and those on the upland.

On the contrary, Chama district is a Game Management Area and therefore communities around there were not able to rear cattle due to fear of predatory animals. A key informant said this:

' …… traditionally those people who are living along the Luangwa River, especially people in Chikwa, they do not keep domesticated animals like pigs, goats for fear of wild animals like lions and hyenas'(KII 1).

Based on the above quote it is implied that beef protein was not readily available unless it was imported from outside the district or obtained from wild game. In Chama, some participants indicated that they eat game meat from moribund animals because they have no access to butcheries where they can buy beef.

4.2.2.2 Gender practices in cattle rearing and meat handling

Herding cattle is a sole responsibility of men in the Western Province. Apart from herding the cattle, men milked the cows, sold the milk, and, provided some for family consumption, and took cattle to the crash pens when they needed to be vaccinated. Since men were the major decision-makers in their families, they also decided when and which animal was to be sold and controlled the use of the income. One female participant had this to say:

> *'it is the men who are found at the kraal and are the ones who milk…. Then they bring the milk at home, but sometimes they sell the milk just there at the kraal… when we are to sell the cattle, the one with control is the man. ' (FGD 2, females only).*

Women's responsibilities were limited to cooperating with their husbands on how money was to be used, ensuring that animals were secured in the kraal in the evening, and storing livestock drugs to ensure that children did not have access. They were also responsible for preparing meals for cattle herders of the day. If a woman-owned cattle but was not married, their cattle were taken care of by their male relatives. Participants argued that the gender responsibilities were constructed on the understanding that herding cattle was a physically tasking job, which could not be handled by women.

Female participants felt that they had many responsibilities to attend to, such that, they could not participate in herding cattle.

> *' I would like to say that, the issue of looking after cattle we are supposed to be involved , to admit it is true but we are involved in a number of chores, we get up early in the morning to go to the field, to cut grass probably the whole week, with little time to get involved in cattle rearing……' (FGD 4 females only)*

However, one participant indicated that these roles were overtly influenced by old cultural beliefs that prohibited women from going near cattle kraals.

When it came to meat handling, men were responsible for slaughtering animals. Slaughtering was commonly done outside the village camp where only adult

males and young boys participated. It was common practice for men who participated in skinning to receive small portions of meat, which they could roast while dressing the carcass. This practice was called '*Maleu. '* Equally, in Chama, men were the ones who skinned and gutted wild animals when they died. After the meat was dressed, portions of meat were then shared out to the women to go and prepare. If meat needed to be dried, the women and girls cut it into threads and dried it.

4.2.2.3 Cattle vaccination practices in Western Province

Veterinary officers explained that farmers were responsible for getting their cattle vaccinated against anthrax. Therefore, the responsibility of procuring vaccines and logistics lay with the farmer. They explained that the government only provided funding for free vaccinations when there were anthrax outbreaks.

> *' Our departmental policy is that anthrax is supposed to be handled by farmers…… we do not vaccinate free of charge…. It is the farmers' responsibility to; the farmer is supposed to buy the drugs and prevent anthrax. It is unlike these other diseases like CBPP, CBPP is the responsibility of the government for Western Province, every year, we have to vaccinate animals against CBPP. But that is not so for anthrax, so the only thing that we can do for anthrax is extension, to tell the farmers to vaccinate the animals against anthrax. But in most cases aaah…..Itis not fundedI mean we do not have funds for that…. to go round. ' (KII 7).*

Many interviewees reported that most farmers in their veterinary camps did not get their cattle vaccinated against anthrax though, one key informant indicated that the situation was not so in his veterinary camp. However, the provincial vaccination records indicated that the annual average coverage rates for the previous five years were less than 10%.A senior veterinary officer explained that vaccination coverage was better in areas that were nearer to the district offices than those that were not. One key informant explained that the claim by respondents that they vaccinated their animals was not accurate as he noted that most of them did not understand the vaccination schedule. Many factors

appeared to be responsible for the low vaccination coverage. Participants and interviewees identified negative attitudes of communities, lack of cold chain facilities, poor logistical support, and poor access to the vaccine and inconsistent supply, remoteness of areas and high cost of vaccination. A senior veterinary officer explained to say:

> '*The other thing that I discovered is that the vaccination schedule, it is not clear to the farmers ….. when you go today for CBPP vaccinations, to them,it is animals are being vaccinated. The jargon of the actual disease for which animals are vaccinated for is unclear .....so to them;one vaccination covers all diseases… that is what the problem is. ' (KII 3)*

Key informants explained that community members had certain beliefs and misconceptions about the vaccine that led them to resist cattle vaccinations.

> '*The people hinder the progress of vaccinations; others would even hide their animals they do not bring them to the crush pen for fear that they might die from vaccination. ' (KII 3)*

Some focus group participants equally expressed their beliefs and perceptions about cattle vaccinations. They felt that vaccinations did not protect their animals; instead, the vaccine killed them. One participant had this to say:

> *' We have observed that the vaccines are injected in our cattle but what we have seen is that the disease continues to escalate. Because just after vaccination the cattle would die and again a week after another. ' (FGD 5)*

Some key informants explained that, because of these misconceptions and beliefs, some communities acted violently towards veterinary staff.

> *' What we realise in our district is that people are very difficult here…….. there is much non-compliance by the farmers to have their animals vaccinated such that in some areas you may even be confronted…….they confront you with spears,and all sorts of stuff to attack you, so they can even use some guns, because that area is close to the Angolan border …. ' (KII 8)*

These misconceptions seemed to have been founded on vaccination experiences that the communities had in the past. Key informants indicated that

in the Western Province, it was common practice for government to release free vaccines when there was already an outbreak of anthrax. However, vaccinating livestock after anthrax outbreaks is not recommended because herds may already have been infected.

> *‘ …… They have various reasons to give; their belief is that, when veterinary people come to our area to vaccinate the animals, they bring diseases. Our animals usually die after they have vaccinated them. And this belief, it is like it emanated from the early years of 1970s when the first outbreak of CBPP occurred in Western Province. Because the vaccine that was being used then, the route of injection was the tail swish, so animals reacted by losing their tails, then because of that they believed that veterinary staff bring diseases to our animals. ‘ (KII 8)*

On the other hand, participants complained that they could not afford the cost of vaccinating their animals. Though some felt that the cost was affordable, most key informants equally agreed that the cost of getting animals vaccinated was unaffordable by most farmers. There was no logistical support (such as fuel, and field allowances for personnel) provided for this activity because the veterinary department was not funded for anthrax vaccination. Therefore, farmers were expected to procure the vaccine, and buy fuel for a veterinary officer to travel to their area to vaccinate the animals. Further, the vaccine was not readily accessible to the local communities as it was only available in Lusaka (capital city of Zambia).One male participant, who wore a frown on his face, said this in a raised voice:

‘*What I want to add on is that our leader (referring to the president) should be looking for solutions for this disease, not just sitting there in Lusaka. The local government of Limulunga it should have some of the vaccines so that when we have a problem, we can call the veterinary there to come here to treat our cattle. Not that when we need the vaccine, the veterinary people say that the vaccine is only found in Lusaka. The vaccine is kept very far from here. ‘ (FGD 5)*

Lack of access to the vaccine compounded the ability of farmers to get their cattle vaccinated. Key informants equally agreed that lack of access to the vaccine was a major constraint for the farmers.

'… so that is really another constraint. The farmers may want to protect their animals against anthrax, but now the vaccine is not readily available in the nearest vet camp ….. What is involved to get their animals vaccinated it is not easy. ' (KII 7)

The situation in Chama was different. The Wildlife Officer explained that wild animals such as hippos and buffalos that were most susceptible to anthrax could not be vaccinated against anthrax because government policy was to conserve them in their natural environments. This meant that wild animals had no disease modifiers, once infected by anthrax; they depended on their natural immunity to survive the disease.

Apart from the high cost of vaccination, participants and interviewees explained that they had no cold chain facilities to maintain vaccine potency. Key informants reported that cold chain facilities were only available at district offices.

The narratives under this theme illustrate how socio-cultural practices shape disease vulnerability. Gender roles can lead to different exposure risks between men and women.

Cultural beliefs and practices influence the construction of gender roles but also influence community perceptions about control interventions and professional staff.

4.2.2.4 Reasons for consuming contaminated meat

Generally, the Lozi people rarely slaughtered cattle for consumption. Meat was only consumed during special occasions such as funeral rites and ceremonies, or when cattle died from disease or natural causes. This practice meant that contaminated meat with anthrax were likely to be eaten. On the contrary, in Chama District, local communities ate game meat from moribund wild animals. This was because of restrictions in hunting rights imposed by the establishment of the Wildlife Authority. Participants explained that they ate game meat from

moribund animals because they had no access to other forms of meat protein and were not allowed to hunt. One female participant in Chama had this to say:

> *' As we do not have where to buy meat here…..that is why whenever we hear of information about dead animals, even for small animals we go and get it to eat.' (FGD 6)*

From the quote mentioned above, it was suggestive that the local communities in Chama District lacked access to meat protein, whether from cattle or wild game. There were no butcheries in the area and communities were not allowed to hunt. Therefore, the only opportunity to consume meat was when wild game died as illustrated in Figure 4.5a & b.

(a) (b)

Figure 4.5: Hippo carcass (a) and dried hippo meat (b). Photo courtesy of T Kalumbi

In all the focus group discussions held, participants indicated that poverty was the major reason why they ate infected beef or game meat. They cited crop failure (Figure 4.6), lack of employment and geographical remoteness as some of the reasons for their poverty.

> *' those who eat the cattle is due to misery caused by hunger (illustrated in Figure 4.6), there is drought in Lozi land, rains do not fall, crops are not doing well thus there is no food, so due to lack of enlightenment and hunger they eat the dead cattle's meat.'(FGD 4)*

(a)

(b)

(c)

Figure 4.6: Stunted maize due to drought (a), Mangoes being boiled for lunch (b), woman preparing to cook mangoes for lunch (c). Photo by Doreen Sitali

In the two provinces, communities relied on natural resources for their livelihoods. Subsistence farming was the primary economic activity.

However, the two regions lie in the driest parts of Zambia. The areas are prone to droughts which occur at least once every five years (USAID, 2014) and receive low to medium rainfall (800-1000mm/ year) (AGWATER ,2009).Therefore; crop failure is common during the drought

years. Also, the areas are among the poorest provinces of the country with poverty levels higher than the national average (74% for Western and 70% for Muchinga Provinces, respectively). One female participant said:

> **'***.....there is drought in Lozi land, rains do not fall, and crops are not doing well thus there is no food.....' (FGD 4)*

Respondents explained that most people ate contaminated meat because they did not understand how anthrax could be transmitted to human beings. One respondent explained this and said: *' The thing is that some people in the village lack awareness, many of them do not know anything…'* (FGD 4)

For those participants who understood that meat could be contaminated with anthrax, they still believed that meat could be rendered safe by boiling it for hours. Still, other participants explained that they first fed the meat to dogs.

If a dog showed no signs of disease in a few days, then they would conclude that the meat was free of anthrax and would go ahead and eat the meat. One female respondent said: *' Us we are of the belief that meat when it is cooked then bacteria are killed, then anthrax cannot be transmitted to us that is our belief in the village. '* (FGD 5)

The other reason advanced by participants and interviewees was that most people ate the meat because they could not readily access veterinary services to inspect and confirm that the animal died of anthrax. One participant explained what commonly happens when an animal dies of a disease. He said:

> *' Sometimes I see that when we call the veterinary officers, they do not come as arranged leading to the meat getting spoilt. To avoid that from happening, we skin the carcass so that we salvage something. ' (FGD 5)*

To reduce the socio-economic shocks of losing cattle, communities rather ate (Figure 4.8 a) or sold the meat or exchanged it for other goods or services. Some of the meat was dried (Figure 4.8 b) and kept for future consumption or taken to the owner of the animal if the cattle was under the *mafisa* agreement.

(a) (b)

Figure 4.8: Fresh meat from suspected anthrax carcass being boiled for consumption (a), dried meat from suspected anthrax carcass (b). Photo by Sitwala

According to the participants, sometimes they consumed meat from moribund animals to emancipate themselves from a sense of loss of their assets. This is how one participant described the feelings and emotions associated with loss of cattle:

> *'Cattle are the only source of our livelihoods. So when they die many people fail to bury so, they sell some meat to get something out of it instead of losing everything. That is what causes that they sell meat from cattle, which died on its own. ' (FGD 5)*

It appeared that cultural beliefs influenced consumption of meat from moribund animals by the communities. According to the discussions from most participants, their ancestors had been eating meat from moribund animals without getting sick. This cultural belief was contrary to health education messages from professional staff. Therefore, the practice has persisted, and professional staff has perceived it as a negative attitude. Therefore, most key informants complained that community behaviors were difficult to change. One of the key informants gave an illustration of how communities responded to health education messages. He said that community members would say:

> *'I mean, this is meat that we have been eating for years and years, our ancestors have been eating, and now you say it is infected, it is making us sick, me I refuse because as far as we are concerned, there is no grave for cattle.'(KII 7)*

(a) *(b)*

Figure 4.14: (a) Carcass disposal by burying and incineration and (b) remains of carcass exhumed by community members.

Participants in Chama district expressed similar sentiments. They explained that, from a long time ago, game meat from moribund animals was eaten in their communities without people getting sick.

One of them said: *' Long ago, we used to eat the meat (referring to game meat) for free and there were fewer diseases. ' (FGD 6)*

Based on the above, it could be assumed that community members suspected that professional staff was stopping them from eating meat so that they could get the meat and take for sale. Some participants indicated that during anthrax outbreaks, they observed that some professional staff went away with sacks of dried game meat. One female participant had this to say about what she had observed during previous anthrax outbreaks:

> *' Because even doctors (implying medical staff serving the community) are not supposed to eat too, but they carry sacks, right (looking at fellow participants). They stop us from eating yes, but they carry the meat away in sacks in their vehicles and go away (conversation accompanied by soft laughter by all participants) …' (FGD 6)*

The above discussion suggests lack of trust in professional staff by the community members. Trust was further eroded when professional staff was involved in activities that were not consistent with the health education messages they disseminated to communities. Some interviewees in Chama

reported that Wildlife Village Scouts were involved in selling or exchanging the meat for maize to unsuspecting community members.

> *'The Village scouts who went to patrol along the Luangwa River found a hippo and got some meat, and they brought it into the village. When they ran out of food, they started exchanging the same meat with food that is, maize. ' (KII 1)*

One interviewee and participant explained that Village Scouts worked as volunteers and so the Wildlife Authority did not pay them. Therefore, when a wild animal died, they ceased the opportunity to sell meat or exchange it with maize or rice. However, during anthrax outbreaks when meat became too much, they freely gave out the meat to the villagers.

The above narratives suggested that the drivers for consuming contaminated meat were socio-economic, cultural and sometimes political. The theory of social production of diseases proposes that disease is not only biologically determined but also socially constructed.

The theory further argues that poor socio-economic positioning of individuals influences the health choices that they make.

4.3 Socio-economic factors

4.3.1 Socio-economic livelihoods of communities

Livestock production and subsistence farming is the mainstay of the Lozi's traditional economy. Though cattle were not reared for commercial sale, they were an important asset of the people's daily lives. Cattle were used for transport, milk, manuring crop fields, and income generation in times of need for school fees, household commodities or medical expenses. Therefore, most participants likened the importance of cattle to their livelihoods to that of what copper is to the Zambian economy. Copper is the main source of income for the country as it covers 85% of all the country's exports. A participant had this to say about the importance of cattle in *Bulozi*:

'Cattle here in Lozi land is our mine (meaning Coppermine) because we do not work, is very important. We manage to send our children to school because of cattle. If it were not for cattle, we would not be able to manage……' (FGD 1)

Participants in the Western Province explained that most of them were able to send their children to school because they had cattle. Inadequate social services characterize the Western Province. There were few secondary schools, most of which were located in the central town districts, far from most villages. Therefore, most children in higher education had to attend boarding schools, which required payment of fees. Apart from paying tuition fees, income realized from selling cattle was used to purchase household commodities, or pay medical expenses. Cattle products such as hides were also used to make stools or drums for sale. In other circumstances, cattle would be exchanged for other commodities such as maize, or poles and grass for building houses as these resources were scarce in the floodplains. One participant explained how cattle were used in their day to day lives. He said:

'The use of cattle is not only the bulls even the cows, all of them; you sell the skin, you use the money to at least feed your family. The bull is used to pull logs then you earn money from that. Can also be used to transport things to Limulunga and money earned can be used to buy mealie meal and you feed your children. ' (FGD 5)

For subsistence farming, the Lozi people depended on cattle for draught power and manuring of crop fields. Participants complained that the cost of synthetic fertilizers was too high for them to afford but cattle provided cow dung for fertilizing their soils. During one of the focus group discussions, a participant said this:

' I use bulls for ploughing fields. Also, I use cow dung as fertilizer for my fields because commercial fertilizer is very expensive and we cannot afford it. Like that, there will still be a harvest because you have manure from the cow dung. ' (FGD 5)

Sometimes cow dung was used as a source of energy because firewood was scarce in the floodplains. Further, cattle provided animal traction for transport. Most areas of the Western Province were located far from most social facilities

such as health centers, schools, and market centers. Participants indicated that they walked for hours to get to most of these facilities and therefore ox-carts were an efficient means of transportation.

> '*Cattle are a good asset because they help us to transport sick people to the clinic. Here in the villages, we are far from the clinics, so when you are sick, you just mount ox-cart to take you to the health facility. Even our pregnant women are transported to the health facility to give birth using ox-carts. ' (FGD 5)*

Key informants equally acknowledged the socio-economic significance of cattle among the Lozi people. One of them who had served in the Western Province for twenty-two years had this to say:

> *' They are very important (referring to cattle), in that they provide income. Yes, they depend on cattle for agricultural activities, ploughing, manuring the crop fields, socially they depend on animals (meaning cattle) for everything they do, yes. ' (KII 3)*

In Chama District, the mainstay of the people was subsistence farming. Maize, cotton, sunflower, rice and other crops were mainly grown. However, due to lack of an organized market system, sale of these crops was mostly to private businesspersons who often offered to pay at very low prices. Because, the people of Chama practice traditional farming, they harvest crops once in a year. This meant that they generated income once in a year. Therefore, to supplement this income, some engaged in illegal poaching because game meat attracted good revenue in the urban areas. Because of the hunting restrictions by the Wildlife Authority, the local people smuggled infected game meat to urban areas where it fetched prices that are more attractive. An Agricultural Officer explained that game meat was commonly smuggled out of the district. He said:

'*… We had a lot of game meat going out of Chama during the outbreak because it was also a harvesting season for crops. So, the meat was smuggled in cotton bales or packed in bags for groundnuts that were being transported to the Copper belt. ' (KII 4)*

In summary, it can be concluded that the livelihoods of the people in the Western Province are dependent on cattle. Most of their economic activities

depended on cattle while those in Muchinga depended on subsistence farming. Cattle are the main source of income and a vital part of their livelihood.

Their socio-economic status, social well- being, education, and access to health care, which are fundamental determinants of health, are influenced by ownership of cattle. Therefore, loss of cattle impacts negatively on household incomes and well-being. To mitigate these effects, families are likely to engage in risky initiatives such as eating and selling contaminated meat.

4.3.2 Impact of anthrax on communities' livelihoods

Participants in the Western rather than Muchinga Province mostly discussed this theme. This could have been because the people of Chama were not cattle keepers. Participants expressed varied impacts that anthrax had on their lives. These ranged from socio-economic to social, cultural and emotional impacts. Apart from losing cattle, control measures negatively affected these communities.

As earlier indicated, cattle was the main source of livelihood for the people in Western Province. Therefore, most participants indicated that loss of cattle plunged them into poverty. One widow expressed this during the FGD discussions, she said:

> *'I had cattle, but they got infected with anthrax while I was away in Lusaka and died. Now I find it difficult to send my children to school because their father is dead. If I had cattle, I would have sold it to solve the problems of school fees. ' (FGD 2)*

Participants also explained that they experienced emotional stress when they lost their cattle. For example, one female participant likened the stress of losing cattle to that of losing a child. She said:

> *'If your cattle die, because it is an asset that helps us when you sell it, it helps you, but when cattle die you feel bad, yes we feel bad. It is the same as losing a child in a household. ' (FGD 2)*

Another male participant explained that a man who lost cattle was as good as ‘dead.‘ This expression was culturally symbolic of a man who was not able to provide for his family. The participant said:

> *‘ If cattle die you will feel bad such that you just look up and down, it is hard. You feel bad thinking a lot, turning your thoughts here and there, it is finished, and you are dead as well……‘ (FGD 5)*

Most participants indicated that anthrax had depleted their cattle populations in Western Province. Some participants recounted how many cattle they had lost to anthrax. One of them said:

> ‘*This disease (referring to anthrax) has continued ravaging, our animals are finished as I am talking now we do not even have a kraal where we keep animals, and there is nothing at the moment. ‘ (FGD 4)*

Loss of cattle could lead to emotional stress that had potential to trigger diseases of stress as expressed by one participant: *‘……but now the cattle have died, now you start feeling bad, can even have blood pressure problems over that.‘(FGD 2)*

Illness of family members sometimes followed the loss of cattle if they consumed the meat; these illnesses sometimes resulted into death, which could trigger further emotional stress.

One key informant explained that whenever there was an outbreak of anthrax, it created fear and anxiety among communities and professional staff. This was because control operations sometimes required police involvement and this created anxiety and fear among communities. Police were sometimes engaged to curb hostilities and resistance to vaccinations or surrender of suspected anthrax-contaminated meat.

One key informant explained that anthrax sometimes caused far-reaching socio-cultural consequences, such as family split, disbanding of villages and, sometimes relocation. This resulted when witchcraft was suspected when a family member suffered or died from anthrax. Two key informants explained that sometimes victims of anthrax were taken to witchdoctors instead of a health facility; especially for those who lived far away from health facilities.

In summary, it was concluded that anthrax has socio-economic, social, emotional and cultural impacts that may not always be quantifiable using scientific methodologies. Generally, the disease deprives communities of their source of livelihoods and plunges them into further poverty and emotional despair. Poverty, in turn, compromises the ability of the communities to control the disease. This is a demonstration of how poverty perpetuates disease vulnerability, exposure, and outcomes as argued by the theory of social production of disease and the ecological model of reciprocal causation.

4.4 Knowledge about anthrax among communities

While some communities had a basic understanding of anthrax, others did not. There was limited knowledge of the disease among those communities that had never experienced anthrax. During group discussions, participants were able to describe the origin of anthrax in their settings, the routes of transmission, signs and symptoms, seasonality, and how it could be prevented.

In the Western Province, anthrax was called '*Lubete,'* while in Chama it was called '*Chigwere.'* The terms are local translations for spleen *(Lubete)* and hippo *(Chigwere)* respectively. Participants in the Western Province explained that, when cattle were infected with anthrax, the spleen was enlarged and that is why they called the disease '*Lubete*.' In Chama, participants explained that the disease was contracted by eating contaminated hippo meat. One of them said: *'Yes this disease from hippos we have it here. We say that when a hippo is dead in Luangwa, that is where we get hippo meat from. ' (FGD 6)*

These responses indicated that participants understood the origin of the disease in their settings. However, this knowledge sometimes led to adverse behaviors because community members gutted the dead cattle in an attempt to examine for an enlarged spleen. This is contrary to the standard guidelines for anthrax management where post-mortem is not recommended for fear of disseminating anthrax spores.

Participants identified the signs and symptoms in cattle and human beings. For human anthrax, most participants identified the cutaneous form rather than the

other forms of anthrax. Cutaneous anthrax is the most prevalent form of anthrax in the two provinces. One participant had this to say about the signs of animal anthrax:

> *'The disease of anthrax, the infection spreads without you really noticing the progression in the herd. When cattle die, blood comes out from the nose and mouth and at the tail (pointing to the anal area). Many cattle would die in a short space of time……. ' (FGD 1)*

Lastly, participants knew that anthrax was common during the dry season of the year and that a vaccine was available for cattle. Moreover, respondents mentioned that anthrax spread through the cattle corridor that was used by farmers to take their cattle from Shangombo (a district along the Angolan border where anthrax is believed to have originated) to Mongu (the provincial capital where most farmers sell their cattle to a meat processing company) for sale. They added that the cordon lines and guards that used to restrict and control animal movements were no longer in place. One male participant had this to say about the control of anthrax:

> *'In the past, there used to be buffer zones from Shangombo where the people used to control the spread of diseases. However, today, those zones which were set up, and the wire fences have been damaged. So that the disease is actually spreading from Shangombo.People bring the disease from there when they cross the river to bring cattle enroute to the Boma to sell their cattle…..' (FGD 1)*

The information in the quote above is consistent with that which was pointed out by some key informants. One respondent identified the same area that participants had mentioned as being the region where anthrax started. He said:

> *' Nguma veterinary camp is actually bordering Shangombo and Nalolo district, where the disease was earlier reported. Again Ng'uma veterinary camp is the major trade route for cattle being trekked to the abattoirs in Mongu. And those animals are coming from the northern part of Shangombo district and some parts of Nalolo…. ' (KII8)*

After the introduction of the Structural Adjustment Program in 1992, there was reduced funding to the veterinary department. The aim was to reduce the wage

bill as was recommended by the World Bank. Consequently, some government personnel were laid off including Cordon Guards in the veterinary department. This led to vandalism of cordon lines which corresponds to what the FGD participants pointed out.

4.5 Barriers to anthrax control

Both FGD participants and interviewees identified several barriers to the control of anthrax. The major constraints identified included poor logistical support, shortage of staff, geographical and infrastructure constraints and poor community response.

4.5.1 Poor logistical support

Poor funding– All the key informants indicated that the Veterinary Department was poorly funded. It was further clarified that government policy on anthrax stipulates that a farmer was responsible for getting his cattle vaccinated against anthrax.

> *' For control of anthrax…. As I said we do not get funding, yes.As a result, a farmer is supposed to buy fuel and put in a motorbike so that a Veterinary Officer can go and vaccinate……. ' (KII 7)*

The above quote is consistent with the Statutory Instrument number 24 of the Animal Health Act of 2010 that indicated that a farmer was responsible to procure anthrax vaccine and give the same to a veterinary officer to vaccinate his animals. Lack of funding for anthrax control meant that there was no funding for animal vaccinations, anthrax surveillance activities, health education campaigns, or training and support of Community Livestock Workers (CLWs).Most key informants explained that funding for other veterinary services was not only inadequate but inconsistent as well. One Veterinary Officer said:

‘ …… you find that the funding for vet services is not adequate, of late the funding has been erratic. It has not been consistent, like last year, we only received funding three times. ‘ (KII 6)

The above is in line with the reports of FGD participants who complained that veterinary staff rarely attended to their needs. Participants indicated that they often had to follow the staff to their offices, which took them hours of walking.

Shortage of transport – Secondly, key informants indicated that the veterinary camps were too vast for them to manage without any reliable transport. Some Veterinary Officers indicated that their camps covered a radius of up to 50 to 60 kilometers away from their camp offices. Lack of motorbikes further compounded this situation. Most of the districts had no motorbikes for their activities. For the few that had, the motorbikes were old and often broke down. It was also pointed out that most of the newly established administrative districts did not have any form of transport. One Veterinary Officer explained the transport situation in his district as follows:

‘Yes, the motorbike (Figure 4.9) is in fact not in good condition because the motorbikes were bought in 2008. So right now in the district we just have one motorbike, it is one of the old motorbikes actually in the province. ‘ (KII 2)

Figure 4.9: Motorbike broken down in the floodplains).Photo by Doreen Sitali

Generally, motorbikes are the most efficient form of transport in the provinces because of the bad terrains and lack of proper road infrastructure. Due to lack of transport, veterinary officers were not able to effectively deliver extension services to the farmers. A similar situation was experienced in the wildlife sector. A Wildlife Officer explained that they had challenges of transport such that they were not able to carry out sanctuary patrols and effectively identify dead animals in the animal sanctuaries due to lack of reliable transport.

Staffing–All the key informants identified shortage of professional staff as a constraint that affected their operations. Some veterinary camps had no staff; for those camps that had; some of them lived away from the camps because of lack of accommodation. Most participants in the FGDs complained that communities were deprived of the most needed services because camp officers stayed outside the veterinary camps. During the fieldwork, it was observed that one officer lived about 100 kilometers away from his camp because the

designated house where he was supposed to stay was in a deplorable state. During a focus group discussion in this camp, one participant said:

> *'We are supposed to have a Veterinary Assistant, but in the state the house is there is no way it can be occupied, it is deplorable……. The house must be refurbished so that a veterinary Assistant can occupy it so that when there is a problem with our cattle, we rush for help. ' (FGD 1)*

Apart from lacking accommodation, some veterinary camps had no office accommodation. Therefore, officers either operated from their homes or used borrowed office space. One key informant narrated how he worked for years without office accommodation until he used his initiative to construct one. He *said:*

> *`When I came here in 2000, there was no office. So this office we are sitting in here is my fourth office. First one was in my house… so my wife was not happy, so I went outside under this mango tree (pointing to a tree outside)……So sometimes if it rained like this during the rainy season….. if you went to the slaughter slab to carry out meat inspections you found papers flying all over…… so what I did, I came up with another initiative, I had to put up a makeshift office built of thatched grass and poles, that is the office there (pointing to a picture on the wall), that was my third office……. then I had to lobby for money from government, I made proposals and teamed up with farmers until they funded us through community development funds to construct this office you are sitting in today.'(KII 2)*

The veterinary officer had stuck a picture of the temporary office he had constructed as evidence, and a photo of it was taken as shown in Figure 4.10.

Figure 4.10: Temporally grass thatched office constructed by Veterinary Assistant

A similar situation obtained in the Ministry of Health and Wildlife Authority. In both provinces, there was a shortage of professional staff working at the health centers. In one district, the District Medical Officer indicated that only five out of the twelve health centers had qualified health staff. Of those centers that had professional staff, most of them were paramedical staff who were mostly environmental health technicians. For example, at one of the health centers, the research team found that a Security Guard was in charge of the Health Centre and was responsible for screening patients. When he was interviewed, the Security Officer indicated that he had been serving at that clinic for seven years. This situation implied that anthrax cases were either missed or overestimated due to utilization of under-qualified staff. Also, unqualified staff may not be competent in reporting cases to relevant authorities leading to underestimation of the burden of anthrax. Because of shortage of qualified staff,

sometimes the Principal investigator had to abandon data collection to help with screening patients since she was a qualified nurse (Figure 4.11a); sometimes the research vehicle had to be released to transport critical patients to the nearest hospital (Figure 4.1b) because the health centers had no transport.

(a) (b)

Figure 4.11: Principal investigator administering injection (a), project vehicle waiting to cross pontoon to refer patient to district hospital (b)

4.5.2 Poor accessibility of vaccines and non- availability of cold chain facilities.

In the Western Province, these facilities were only available at district offices.

This implied that Veterinary Camp Officers could not stock the anthrax vaccine within their veterinary camps. This contributed to the low vaccination coverage because farmers could not readily access the vaccine. One Senior Veterinary Officer explained the situation in this manner:

> *' We find it very difficult to control anthrax because of the cold chain. For example the whole district, you find that the cold chain is just here in Mongu. However, there are times when yougomay be 40km, 50km away, so let mejust say that the only place that has facilities to store the vaccines is Mongu and Limulunga. So, these areas like …… (Sitoya) where we had an outbreak of anthrax there is no facility to actually store the vaccine. Such facilities are actually important in the control of the disease. ' (KII 2)*

Non-availability of anthrax vaccine – Apart from lack of cold chain facilities, availability of the vaccine was another barrier. The vaccine was manufactured

at the Central Veterinary Research Institute (CVRI) in the capital city, Lusaka. Therefore, the vaccine could only be procured from Lusaka. This raised the cost of the vaccine, especially that cattle farmers were also expected to fund the transportation of veterinary officers when they went for cattle vaccinations. Ultimately, these challenges compromised the ability of farmers to have their cattle vaccinated and led to low vaccination coverage.

> *'…… but now the problem is, down the villages there ….. because you need a cold chain to go and vaccinate. There are further places where we have outbreaks….. The transportation of the vaccines to that place and the cold chain, because you cannot just carry it like any other vaccine, you need a cooling facility……so the cost is higher, that is another constraint. They want to protect their animals (referring to farmers) against anthrax but now the vaccine might not…is not readily available in the nearest camp.' (KII 7)*

4.5.3 Geographical remoteness and poor infrastructure

The study areas were remote places with poor social and public health infrastructure. Most areas were accessible through gravel tracks which were challenging to navigate. Telephone facilities even the mobile phones were either absent or poor. The roads were impassable, sometimes even during the dry season. During the peak rainy season, some areas were completely cut off from the rest of the districts. In the Western Province, the plains had no tarred roads except for small tracks that were characterized by Kalahari sand dunes. Village settlements were located far apart, making it time-consuming to access villages. This increased the cost of transport, vehicle maintenance, and repair. Chikwa, the epicenter for anthrax outbreaks in Chama, is located 80 kilometers away from the district offices. The road connecting the area to the rest of the district had its connecting bridge collapse in 2016 (Figure 4.12).This had made

accessibility to the area difficult, especially during the rainy season. Therefore, these terrains made it challenging to provide veterinary and health services.

Figure 4.12: Broken Bridge on the road to Chikwa (Chama District). Photo by Doreen

Most key informants reported that one of the major challenges they faced in anthrax control was non-compliance by communities. Farmers often resisted having their animals vaccinated during anthrax outbreaks.

Also, community members resisted surrendering dried meat stocks that they had. Key informants indicated that some communities reacted with hostilities such that it was necessary to work with police (Figure 4.13a and b) to protect professional staff or compel community members to have their animals vaccinated or dry meat confiscated.

> *'What we realize in ….. (name withheld) is that people are very difficult there…….. there is a lot of non-compliance by the farmers to have their animals vaccinated. Even despite this veterinary assistant acquiring some vaccine, others were still resisting to pay for the animals. They have various reasons to give; their belief is that, when vets come to our area to vaccinate the animals, they bring diseases. Our animals usually die after they have been vaccinated…..' (KII 8)*

In the Western Province, sometimes-professional staffs were accused of plotting to eradicate cattle in the province or practicing Satanism. One key informant gave this explanation and said:

> *' The other part again is where you do sero surveillance, you have to collect blood samples…... So when you collect blood from the animals they say that these vets are practicing Satanism, where do they take the blood of our animals? So again even then, we had to work with the police to convince them to take blood samples. Usually, after you have handcuffed someone, usually they give in. ' (KII 8)*

(a) *(b)*

Figure 4.13: Some community members handcuffed by police to allow vet officers vaccinate their cattle. Photo by Silwendo Sitwala

These perceptions sometimes influenced communities to react violently towards professional staff. They also contributed to non-compliance to control measures and negative attitudes.

In conclusion, it can be said that inadequate funding and lack of logistical support are fundamental political issues that influence disease distribution. Anthrax is one of the neglected zoonoses. Neglected zoonoses are common in marginalized populations with poor social infrastructure.

4.5.5 Collaboration across sectors and community involvement

Ecological, cultural and biological factors influence the transmission and distribution of anthrax. Therefore, collaboration between various disciplines (One Health) is key to ensuring a holistic approach. Further, community involvement is vital to promote cooperation, ownership, and acceptance of interventions by local communities.

All the key informants agreed that there was good collaboration between health, wildlife, and veterinary sectors whenever there was an outbreak of anthrax. Collaborations usually involved formation of task forces comprising of veterinarians, health, and wildlife staff and occasionally, police personnel. The task forces are usually involved in outbreak investigations, identifying and disposal of infected carcasses, identifying and treating human cases, mass vaccinations of cattle, treatment of human cases, and confiscating suspected infected meat stocks. However, some of the key informants pointed out that collaborations only occurred when there were disease outbreaks, mostly involving human cases. They explained that, once the disease was controlled, each sector worked independently. However, it is essential that collaborations be sustained beyond disease outbreaks if the concept of One Health is to be effective.

Further to the above, both FGD participants and key informants indicated that community involvement in the control of anthrax was poor. Foremost, key informants explained that Community Livestock Workers (CLW) who acted as a link between government workers and the communities were few. CLW were trained a long time ago, and they did not receive refresher courses due to inadequate funding. Also, local community leaders were not involved in control programs. Though health centers had Community Health Workers, these were mostly focused on other health problems. However, it is crucial for local communities and their leaders to be involved in the planning, implementation, and evaluation of control measures to enhance cooperation, create a sense of ownership and promote trust and acceptance of interventions.

4.6 Disease ranking by the communities

(a)

(b)

(c)

Figure 4.14 a, b and c: Disease ranking using proportional piling by community members

Among the animal diseases, anthrax was ranked first followed by HS, CBPP, and blackleg. Malaria was ranked as the most critical disease among humans followed by chest infections, anthrax, and skin sores were last. Participants explained that anthrax was ranked first among animal diseases because it killed their animals in large numbers within a short period. They also explained that when anthrax attacked their animals, cattle had no chance of recovery and the disease spread very fast between herds. Among humans, anthrax was ranked as the least important disease. According to the participants, anthrax in humans was not very important because treatment was readily available. Figures 4.14 a, b, and c shows disease rankings.

In Kaungalueti village, anthrax was ranked as the second most important human disease in their community. This community was known to be the

epicenter of anthrax outbreaks in Nalolo district. Anthrax was ranked third in Sitoya veterinary camp. Sitoya veterinary camp is another epicenter of anthrax outbreaks in Limulunga District. However, community members felt that human anthrax is not very important to them because treatment is readily available if one gets sick. In Mongu, anthrax was listed as the most important disease in animals but not in humans, while in Chama, anthrax was not perceived as a disease of importance in humans. Table 4.10 shows the rankings.

Table 4.10 showing disease rankings for each district

	Ranking	
District	**Animal diseases**	**Human diseases**
Nalolo	1. Anthrax 2. Blackleg 3. Hemorrhagic septicemia 4. Foot and Mouth	1. HIV/AIDS 2. Anthrax 3. Tuberculosis 4. Malaria
Mongu	1. Anthrax 2. Blackleg 3. Hemorrhagic septicemia 4. CBPP	1.Malaria 2. HIV/AIDS 3. Tuberculosis 4. Diarrhoea
Limulunga	1. Anthrax 2. Hemorrhagic septicemia 3. Blackleg 4. CBPP	1.Malaria 2. Chest infections 3. Anthrax 4. sores
Chama	1. New castle disease	1. Malaria 2. Chest infections 3. Skin infections 4. Diarrhea

4.7 Document analysis

Statutory Instrument No. 24 of 2014 of the Animal Health (Control and Prevention of Animal Disease) Order, 2014 was reviewed. The Act gives guidance on mandatory vaccinations against animal diseases. It also specifies the regions where the vaccinations are administered and the periods when these vaccinations are expected to be conducted. Review of the document revealed that government considered anthrax vaccination to be mandatory by

all farmers in Eastern, Western, and Chiawa District of Lusaka. Therefore, farmers were expected to vaccinate their cattle against anthrax. Apart from anthrax, there were other mandatory vaccinations such as HS, Blackleg, CBPP, and Foot and Mouth Disease (FMD) were conducted. According to the Order, vaccinations for anthrax were scheduled to take place between April- June. This is the same period when vaccinations for Black Leg, HS, and FMD. Therefore, it may have been difficult for farmers to specify which diseases their cattle had been vaccinated against if they were not explicitly informed. Further, farmers were not given any written document to help them remember the type of vaccinations except for Rabies and African Horse Sickness. This scenario could explain why most survey respondents indicated a misguided vaccination status for anthrax.

4.8 Proposed model for anthrax control

Based on the findings of the study, a model for anthrax prevention and control was designed using the logic model. Interventions were drawn from the input of community members made during the focus group discussions.

A logic model is a map, Table or flow chart that presents a picture of how interventions are supposed to work. The logic model explains why a strategy is a good solution to the problem at hand and makes an explicit, visual, statement of the activities that will bring about change you expect to see for the community. The logic model provides a roadmap that shows the steps taken to reach a specified destination (Centre for Community Health and Development, 2017). This roadmap aspect of a logic model reveals what causes what, and in what order. The model indicates precisely how each activity will lead to desired changes. The logic model has six components that include; purpose, context, inputs, activities, outputs, and effects. These are explained below;

Purpose or mission- this explains the problem that the program is going to address. In this situation, the purpose was to improve the quality of life by

reducing the incidence of human anthrax among the affected communities in the Western and Muchinga Provinces.

Context or conditions – expresses the climate in which change will take place. Context shows the trends that compete with the efforts to engage in control activities. This may include the political and economic climate for investing in control activities.

Inputs, resources, or infrastructure – These are the raw materials that will be used to conduct the effort or initiative. Inputs can also include constraints on the program, such as regulations or funding gaps, which may be barriers to the objectives of the program.

Activities or interventions–are the initiatives to be done with the resources to direct the course of change

Outputs – these are indicators that demonstrate that activities were performed as planned.

Effects, outcomes, or impacts – these are the changes that come about as a direct or indirect effect of the activities.

Using these components, a logic model was drawn for anthrax control as depicted in Figure 4.15.

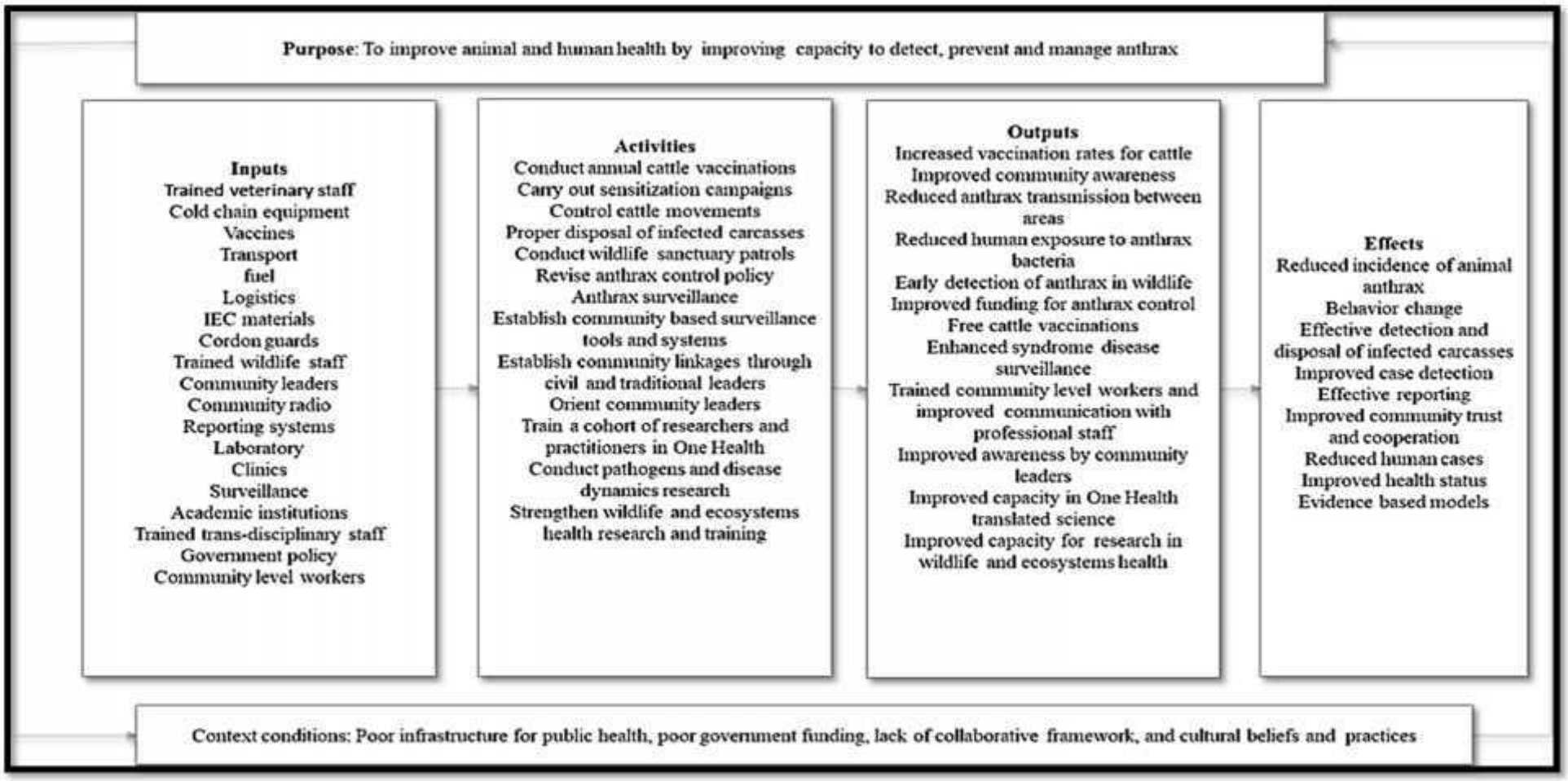


Figure 4.15: Proposed logic model for anthrax control

CHAPTER FIVE: DISCUSSION

5.1 Overview of findings

The study explored the socio-economic and political determinants of human anthrax transmission in the Western Province and Chama District of Muchinga Province. Notably, the study found that socio-economic, cultural, gender, political factors and geographical remoteness influenced the transmission of anthrax. These determinants affected transmission and persistence of the disease in the affected communities through various pathways; 1) compromising the socio-economic status of communities thereby limiting access to resources available for communities and professional staff to invest in vaccination of cattle, 2) shaping cattle rearing and meat consumption practices, 3) influencing perception of risk of contracting anthrax and health education messages, 4) prescribing gender responsibilities that increase exposure to anthrax, and 5) limiting access to vaccination and veterinary services.

5.2 Socio-demographic characteristics of respondents

Foremost, demographic characteristics were analyzed because they help in understanding the people's living conditions and how these impact on the people's social and economic situation (Living Conditions Monitoring Survey, 2010). Most of the respondents in the study were aged between 18-49 years. This age range was comparable to the Census of Population and Housing Report (2012) that indicated that most household heads were aged between 25-44 years (Central Statistical Office, 2012). A lower age limit found in the study could be attributed to the fact that the survey was conducted in rural areas where individuals tend to marry earlier than those who live in cities (Central Statistical Office, 2015).Cherlin (1992) and Oppenheimer (1997) indicate that education is strongly associated with postponement of marriage to an older age

(Sabbah-Karkaby & Stier, 2017). Most of those interviewed in the Western Province were married though Muchinga Province had almost equal proportions of married and single persons. Married household heads are more likely to have larger families than single-headed households because most children are conceived within marital unions (Central Statistical Office, 2015). The average number of household members found among those interviewed was higher than the one found in the census of population and housing report (2012). The greater number of family members found in the study could also be attributed to the fact that the majority of respondents married at an early age and were peasant farmers. Farmers tend to have larger families because household members are likely to be used as a source of labor on the fields (Olayemi, 2012). Also, early marriage extends a woman's childbearing capacity leading to large households (UNICEF, 2001).

Overall, there were more male than female respondents in the study. However, Muchinga Province had almost equal proportions of men and women. This finding was similar to the one reported by the census of population, and housing report (2012) that showed that there were more male than female-headed households in Zambia.

The survey results showed that the majority of respondents in both provinces had never attended school. Similar observations were made by Tebug *et al.,* (2015) in their study of cattle farmers' awareness and behavior regarding prevention of zoonotic diseases in Senegal. The authors established that 58% of household heads had no education. Education is a strong determinant of future employment and income and shapes one's socio-economic status in society (Commission on Social Determinants of Health, 2007).This finding, therefore, implies that the majority of interviewees are likely to be of low socio-economic status. The ecological model argues that education operates at the first level of influence. The model considers education to be an individual level factor that acts to modify certain attitudes, beliefs, and behaviors in a person (Scott & Wilson, 2011). These beliefs and attitudes in turn influence how one perceives and utilizes health education messages. On the other hand, the theories of social production of disease argue that education is a determinant

of socio-economic status as it influences one's level of income and occupation (Feldacker *et al.,* 2010).

5.3 Socio-economic characteristics of respondents

5.3.1 Employment status of respondents

It was also established that only a few of those interviewed were paid employees in both provinces, the rest were farmers. The social production of disease theory considers unemployment as one of the causes of health inequalities in society.

According to the theory, unemployment defines one's social positioning because it provides the means through which one acquires resources to meet their basic needs of life (Feldacker *et al.,* 2010). The ability to purchase goods and services determines the quality of life and ultimately influences health. Equally, in the ecological model, unemployment is believed to affect an individual's behavior at the superstructural level as it affects one's ability to purchase goods and services (Sweat and Denison, 2011).

5.3.2 Income of respondents

The majority of respondents in both provinces had an average monthly household income of less than ZMW 1000 (USD 100). Only 22% (Western Province) and 10% (Muchinga) of families had another working family member apart from the household head. Qualitative narratives showed that respondents in the Western Province mostly earned their income from selling cattle and crops like rice, cassava, and fish, while those in Muchinga Province mainly earned their income from the sale of crops, such as cotton, maize, rice, and sunflower. The LCMS (2015) reported that the average monthly income for rural households was K334 (US$34) after considering assets and own produce. The average income found in this study was calculated without taking into account

income received in kind and that from own production. Also, participants could not accurately estimate their household earnings because their revenue flows were not consistent due to lack of employment. Their income was seasonal, mostly, at the time of harvest and when they sold livestock or poultry. Because these communities used traditional farming methods, their yields depended on natural rain cycles. The off-take rates from livestock and poultry keeping were equally low due to dependence on traditional farming methods.

Monthly income was found to be associated with anthrax. Those who had no monthly income were three times more likely to suffer from anthrax than those who earned some income. Income is a significant variable that determines a person's socio-economic position in society. The differential social positions and roles generate different opportunities and vulnerabilities to disease exposure and consequences of health (Feldacker *et al.,* 2010). Individuals who have low socio-economic status are regarded as poor or living in poverty. Poverty leads to an inability to purchase necessities of life such as food (Central Statistical Office, 2015).

Further, poverty leads to limited access to preventive measures such as cattle vaccinations. When one is poor, they are more likely to engage in unhealthy life adjustments including buying and eating cheap, contaminated meat and failing to meet cattle vaccination costs.

5.3.3 Ownership of assets

Because rural households tend to use more income received in kind and own-produce, asset ownership was analyzed to measure the well-being of the communities. Apart from cash earnings, household assets contributed towards family welfare and living conditions. In most of the focus group discussions held, participants indicated that their income was mostly from sale and utilization of assets such as livestock and poultry. The assets that were considered in the study included land, residential buildings, electrical equipment, telecommunication equipment, agricultural machinery and equipment, draught

animals, and livestock. The majority of those interviewed in both provinces owned land. However, most of the land was non-titled traditional land. In the Western Province, all land was regarded to be symbolically held in trust by the *Litunga* (Sumbwa, 2000).

5.3.4 Ownership of livestock and poultry

The majority of respondents in the Western Province owned domestic livestock such as cattle, goats, and pigs but few did so in Chama District. The difference could be attributed to the fact that Chama is situated within a Game Management Area where rearing of domestic animals is difficult due to the presence of predatory wildlife. However, most of households in Chama kept poultry, mostly chickens. In the Western Province, the majority of the respondents owned cattle. Qualitative narratives demonstrated that cattle were important economic assets for the people of the Western Province. Animals were used for draught power, source of manure for crop fields, transport, and, as a source of income and livelihood. Therefore, loss of livestock due to anthrax or other conditions deprived families of the source of manure to fertilize their crop fields, draught power to cultivate their fields, ox-drawn transport for their sick, or to go to town, food for their families, and medical and school fees for their children. It meant therefore that loss of cattle plunged these communities into further poverty and adversely affected their livelihoods. It can be concluded therefore that animals affect the socio-economic, health and educational status of families which are fundamental social causes of disease distribution. Similarly, in Muchinga Province, interviewees elaborated that their livelihoods were mostly dependent on the sale of crops and poultry.

Other studies (Opare *et al.,* 2000;Coulibaly & Yameogo, 2000) have equally shown that cattle were a crucial source of livelihood for communities affected by anthrax. However, these studies did not give a detailed description of the context in which cattle were utilized in the affected communities. Though this study cannot claim that it provides a full understanding of the context, it provides a more explicit context of the socio-economic dynamics of the communities

concerned.In Zambia, crop and livestock production are listed as the two most important sources of income, the two contributing almost half of the total income earned by rural households (FAO, 2008).

5.3.5 Ownership of farm equipment and transport

Half of the respondents in the Western Province owned farm equipment such as a plow, though few participants did so in Chama District of Muchinga Province. Also, majority owned ox-carts in the Western Province but not in Muchinga Province. The lack of ox-carts in Muchinga could be explained by the fact that most households in Muchinga Province did not own oxen. However, most respondents in Muchinga Province owned a bicycle, but fewer respondents did so in the Western Province. Because the two regions were located in remote geographical areas, it was vital for them to have some form of transport to enable them access social services which were often located far from most villages. Therefore, lack of ownership of transport could lead to reduced access to social services and consequently poor health outcomes of disease. Owning a plow or ox-cart also provided a source of income to households when they hired out these assets to plow fields or provide transport, ultimately contributing to their socio-economic status.

5.3.6 Access to media information

A small proportion of respondents (2%) had access to health and veterinary information from professional staff or radio in both provinces. The majority (39.7%) of respondents in Muchinga Province received health and veterinary information from friends. Though the majority of respondents owned a cell phone in both areas, professional staff indicated that they did not commonly use phones as a medium for communicating health information with communities.

Access to information influences health behavior as most public health messages are conveyed through radio and television. Therefore, poor access to health information is likely to interfere with dissemination of public health messages. The Demographic and Health Survey report (2014) showed that about 60% and 41% of the people in the Western and Muchinga Provinces, respectively, did not have access to any form of media information.

Specifically, the Census of Population and Housing Report (2012) indicated that only 36% of the population had access to TV, radio or internet in the Western Province. This could suggest that the majority of participants received information from non-authentic sources such as community rumors.Though there were no studies that discussed access to media information among affected communities, a number of them conducted in rural areas found that farmers lacked awareness of anthrax transmission (Chirundu *et al.,* 2009; Chakraborty *et al.,* 2012;Tebug *et al.,* 2015; Hassan *et al.,* 2015).This poor knowledge could be associated with reduced access to media information which is common in rural communities. However, the study did not explore other means of access to information such as use of institutions of worship which are common means in rural communities.

5.3.7 Household expenditure

Household spending is closely related to household poverty, well-being, and living standards (Central Statistical Office, 2015). Economically, families are assigned a particular family status based on their expenditure on goods and services (Central Statistical Office, 2015). Since the most basic household expenditure is on food, the variable was regarded in the assessment of poverty levels for this survey. The study found that about half of those interviewed in both provinces spent less than ZMW 500 (USD 50) on food per month. However, the study did not consider food from own produce, and the Figure were obtained through respondents' recall. Therefore, the value got only provided an estimate of actual expenditures. Despite this limitation, the proportion of people who can be considered to be poor is lower than that

reported in the Living Conditions Monitoring Survey. After taking into account food from own produce and expenditure on food, the Living Conditions and Monitoring Survey report (2015) showed that 84% of the population lived in poverty and that, of those that are poor, 65% of families lived in extreme poverty. The Centre for Theological Reflections basic needs basket for a family of five in Luapula Province in May 2017 stood at K2, 147.92 (Siame, 2014).The value was used to compare with the study findings because Luapula Province is similar in most of its socio-economic characteristics with the Western Province.Taking into account this figure, it could be concluded that the majority of respondents could be living below the poverty line, more so that their family size is larger than the national average. The World Health Organization defines poverty as people living on less than $1.25 a day (UNDP, n.d.).Considering this criteria, it can be concluded that the majority of households could still be considered poor. Further, household food expenditure was found to be significantly associated with anthrax. Those who spent less on food were more likely to suffer from anthrax than those who spent more. The odds of suffering from anthrax reduced with increased expenditure on food. This may be because those who have a higher expenditure on food are likely to be economically better off and so are not likely to engage in risky behaviors such as buying cheap meat from moribund animals.

5.4 Living conditions of respondents

5.4.1 Housing characteristics

Housing characteristics and the extent to which populations have access to amenities can be used to measure poverty (Central Statistical Office, 2015). The majority of respondents owned houses though they were constructed of low-cost materials, commonly wooden poles and mud walls with grass thatched roofs. This finding was also reflected in the Living Conditions Monitoring Survey Report (LCMS) (2015) that indicated that 91% of rural areas occupy traditional housing units. The LCMS further said that the Western Province had the highest number of traditional homes. Less than 30% of those interviewed in both areas

had access to electricity, mostly solar power. When people are of low socio-economic status, they are likely to use low-cost housing materials for their habitation.

5.4.2 Water and sanitation

Only 6% of those interviewed had access to piped water. Most of the interviewees in the Western Province drank water from either shallow wells or open surface river water. Though 43% of respondents in Muchinga had access to borehole water, a majority (51%) still drank water from unsafe sources (shallow wells and open surface river water).

Open surface water sources are easily contaminated due to water runoff especially during flooding in the rain season. This is likely to cause contamination with anthrax bacteria especially if animal carcasses were not properly disposed. Therefore, apart from eating contaminated meat or handling animal carcasses, community members might be ingesting anthrax bacteria through drinking contaminated water (Mongoh, 2008; Hassan *et al.,* 2015) One of the key targets to achieving sustainable development (SDG) is to ensure universal, equitable access to improved and affordable drinking water for all (SGD 6).Therefore, poor access to improved water is not consistent with the realization of sustainable development goal number six.

The majority of households in both provinces practiced open defecation. Garbage disposal in both regions was 100% by dumping. This situation is contrary to the goal of achieving access to adequate and equitable sanitation and hygiene for all and end open defecation, which is a target under SDG number six. Poor access to water and sanitation is indicative of poor living conditions.

These findings seem to confirm the observations made by the Food and Agriculture Organization (World Health Organization, 2008) which indicates that anthrax was linked to rural poverty that is characterized by poor socio-economic conditions and weak veterinary and public health services. The report

further concludes that outbreaks are common in regions where vaccination programs are challenging to sustain. The report links anthrax to poverty which resulted in livestock owners slaughtering moribund animals and selling meat to villagers at reduced prices to recover at least part of their financial losses.

Considering the socio-demographic variables, socio-economic characteristics and living conditions of the study subjects, it is suggestive that most of them were of low socio-economic status and could be living in poverty. Link & Phelan (1995) noted that socio-economic resources of a person directly shape health behaviors by influencing whether people know about, have access to, can afford, and are motivated to engage in health-enhancing behavior.

5.5 Knowledge, attitudes, and practices of respondents towards anthrax and control measures

At the core of animal-human transmission of anthrax is human behavior. The knowledge, attitudes, and practices of communities influence the perceptions and interpretation of health messages by communities (Sitali *et al.,* 2017).These beliefs later on shape community behaviors and responses to control measures.

5.5.1 Knowledge about anthrax

The survey results showed that the awareness levels of anthrax were high in both provinces. However, qualitative findings showed that there was a poor understanding of anthrax among low prevalence communities. Published literature on knowledge levels among affected communities is inconclusive. Some studies have shown that knowledge levels among anthrax affected communities are high (Opare 2000; Gombe *et al.,* 2010; Chikerema *et al.,* 2013; Mebratu *et al.,* 2015). On the contrary, other studies have reported that knowledge levels were poor among those not affected by the disease (Chirundu

et al., 2009; Chakraborty *et al.,* 2012; Tebug *et al.,* 2015). These variations in findings could be explained by different approaches used to assess knowledge and differential contextual factors. In regions where outbreaks had occurred, and awareness campaigns had been conducted, knowledge levels seemed to be higher than those communities that had not been sensitized. Further, studies which were carried out in areas where outbreaks had occurred before appeared to have higher knowledge levels. These findings seem to be consistent with earlier findings that the majority of respondents had low access to health and veterinary information through radio or professional staff. It is suggestive that public health information is only disseminated to communities when there is a disease outbreak.

The majority of respondents in both provinces knew that anthrax infects cattle and hippos; and that human beings get infected by eating contaminated meat. However, few respondents in both regions knew that anthrax could be transmitted by participating in slaughtering moribund animals or handling contaminated animal products. Respondents in Chama District explained that human anthrax originated from eating contaminated hippo meat and those in the Western Province identified cattle as the origin. This finding in the two regions was consistent with local published literature from outbreak investigations, editorial comments and review articles which indicate that anthrax in Zambia originates from cattle in the Western Province and wild game in Muchinga (Mwambi *et al.,* 2017).

Studies conducted outside the country suggest that human anthrax cases are common among pastoral communities and are associated with bovine cases (Opare 2000; Chirundu *et al.,* 2009; Gombe *et al.,* 2010; Chikerema *et al.,* 2013, Tebug *et al.,* 2015; Hassan, 2015). Unlike most studies, this study was able to compare regional differences in the origin of anthrax by investigating different provinces affected by the disease in the country. This finding implies that cause -specific interventions need to be designed for different regions to control the disease effectively. The results further suggest that health education messages should include all modes of transmission rather than just emphasizing on not eating contaminated meat. Eating contaminated meat seemed to be the most commonly known mode of transmission by respondents.

Further to the above, the majority of participants were able to identify signs of anthrax in animals and humans. For human cases, respondents mostly identified signs of cutaneous anthrax rather than the other forms. Though few participants discussed the signs of gastrointestinal anthrax, no mention of inhalational or injectable anthrax was made.

These findings are consistent with published literature which reported that cutaneous anthrax was the most prevalent form of anthrax (World Health Organization, 2008; Chirundu *et al.,* 2009; Gombe *et al.,* 2010; Chakraborty *et al.,* 2010; Siziya, 2017; Mwambi, 2017 and Munang'andu, 2012). Some studies specifically indicated that majority of cutaneous cases of anthrax were associated with participating in slaughtering and skinning sick animals (Chirundu *et al.,* 2009; Gombe *et al.,* 2010; Chakraborty *et al.,* 2012). These findings underscore the importance of emphasizing the fact that handling infected animals carry a higher risk of contracting anthrax.

Lastly, the majority of respondents in the Western Province knew that cattle vaccination is an effective control measure. However, only 30% of respondents in Muchinga Province knew about cattle immunization against anthrax. This finding could be attributed to the fact that Chama District had never experienced bovine anthrax and because few people in this district kept domestic animals. Awareness of cattle vaccination was found to be associated with anthrax. Those who had never heard about anthrax were three times more likely to suffer from anthrax than those who did.

Health literacy influences people's health behaviors. Those with a good understanding of health issues are more likely to engage in health-promoting behaviors than those who are not (Amzat & Razum, 2014). It was therefore assumed that respondents in this study would have positive attitudes and behaviors towards anthrax prevention if they knew about anthrax transmission.

5.5.2 Attitudes and beliefs of respondents

Despite having good knowledge of anthrax, most respondents had a negative attitude towards preventive measures. The majority of participants were of the view that eating meat from sick animals was not risky to their health. They believed that meat from dead cattle could be consumed since there were no graves designated for animals. Similar findings were reported by Kasese-Chanda (2017) in her outbreak investigation report. The majority of respondents in the Western Province also had a negative attitude towards cattle vaccination. Similarly, a study in Ghana revealed that farmers were used to receiving free vaccinations in the past and were not willing to pay for anthrax vaccinations (Opare, 2000).

In the Western Province, the majority of respondents expressed satisfaction with the quality of veterinary services that they received while their counterparts in Muchinga Province did not. However, qualitative narratives revealed that respondents in the Western Province did not trust veterinary staff because they suspected that they practiced Satanism and were working with a named meat processing company to wipe out their cattle. Respondents were also disappointed with the lack of response by veterinary staff when they called them for assistance.

Generally, community members did not think it was wrong to eat contaminated meat because they knew that they could receive treatment if they fell ill. A similar finding was made by Chikerema et al. (2013). The authors reported that 58% of respondents in their study ate contaminated meat because of the good efficacy of treatment. In Chama District, participants did not trust the health education messages from professional staff because they believed that professional staff denied them meat so that they could take it for themselves. This information may imply that community members did not trust information from professionals, hence the misconceptions. It is therefore vital that professional staff conduct themselves professionally and maintain effective communication with the community members. Therefore, professional staff needs to be aware of rumors and myths that compromise public health

messages and have skills on how to avert them. Generally, personal attitudes influence how one perceives health messages and behavior. If an individual's attitude is negative, they are unlikely to engage in health-promoting behaviors (Sitali *et al.,* 2017).

5.6 Cattle rearing and meat consumption practices of respondents

It was found that respondents were involved in some practices that were associated with anthrax transmission. Those included male communal participation in slaughtering sick animals, preparation of meat and cooking, eating meat from animals that died of unknown causes, preservation, and use of animal products and the *mafisa* traditional system.

5.6.1 Meat consumption practices of respondents

Participating in animal slaughter and eating contaminated meat were found to be associated with anthrax. Those who participated in slaughtering infected carcasses were four times more likely to suffer from anthrax than those who did not. Also, the study found that those who did not consume contaminated meat were less likely to suffer from anthrax. Participation in the slaughtering of animals has been found to be highly associated with cutaneous anthrax in many studies (Chirundu *et al.,* 2009; Gombe *et al.,* 2010; Chakraborty *et al.,* 2012; Chikerema *et al.,* 2013). This finding is in tandem with what other studies in Zambia have found. The studies associated human anthrax with eating or handling infected meat from sick animals (Munang'andu *et al.,* 2012; Siziya, 2017; Moraes 2017; Kasese- Chanda *et al.,* 2017; Mwambi *et al.,* 2017). Munang'andu et al. (2012) revealed that some cases of cutaneous anthrax were as a result of exposure to animal hides that were processed for making sleeping mats and drums.

A small percentage of respondents in both regions indicated that they used animal products to make drums, mats or stools for sale. These were either used by local communities or sold in urban areas. This implies that there was a potential for anthrax to be transmitted to other regions as spores can persist in hides for a long time. Studies conducted in other areas have reported similar results. Chakraborty et al. (2012) revealed that eating infected meat was a common practice among anthrax- affected communities in Bangladesh. Though the survey results showed that the majority (85%) of interviewees in the Western Province reported cattle mortalities to veterinary authorities, less than 2% had the carcasses buried or incinerated. Often, the remains of disposed carcasses were exhumed and eaten to avoid economic losses. Generally, participants attempted to render the meat safe by boiling it for hours. A study conducted in Ghana also showed that respondents cooked their meat with herbs that they believed prevented anthrax (Opare *et al.,* 2000).

5.6.2 Cattle rearing practices

Another risky practice identified in this study was low rate of cattle vaccination against anthrax. Those who did not vaccinate their cattle against anthrax were twice more likely to have their livestock infected compared to those who did.

Though the survey results showed that the majority of respondents in Western Province vaccinated their animals, qualitative narratives and provincial vaccination records revealed that less than 10% of farmers vaccinated their cattle against anthrax in the Western province. A similar observation was made in studies conducted in other settings that showed that low vaccination rates were partly responsible for the persistence of anthrax outbreaks (Chirundu, 2009; Chakraborty *et al.,* 2012; Hassan *et al.,* 2015). This observation may suggest that most low-income countries are faced with inadequate anthrax vaccination. Animal vaccination is one of the most effective measures for anthrax control. It was further observed that group or family ownership of cattle also posed a problem for vaccinations. It was common for a herd of cattle to be owned by several members of a kinship, some of whom lived in urban areas,

and sometimes out of the country. Therefore, collective decisions had to be reached to sell some of the cattle to raise revenue for purchasing vaccines. Since some of the owners lived far off, the decisions took some time to conclude. Even if this reason was not mentioned in the survey, it could have been one of the contributing factors as a similar practice obtained among the communities in the Western Province. Addressing anthrax by targeting the animal reservoir can deliver a double benefit.

This is because improved animal health will result in a reduced risk of human infections as well as improved livelihoods (Welburn *et al.,* 2015).

Qualitative data showed that the *mafisa* traditional practice was sometimes associated with anthrax transmission in the Western Province. This is because, if animals under this agreement died of disease, the herder needed to prove that he did not sell the animal. Therefore, the herder was expected to dry the meat and send it to the owner. The skin and horns were also preserved for the owner's inspection. Chanda et al. (2017) identified *mafisa* as a cultural practice that had contributed to the persistence of anthrax in the Western Province of Zambia. Similarly, a study conducted in the Western Province by Munang'andu et al. (2012) found that meat, horns, and skins were dried and presented to the owner to prove that their animal was not sold but died of disease. This implies that, if cattle died of anthrax, the disease was then transmitted to other areas through the dried meat or animal products. Anthrax spores have been isolated in dried cattle skins in the past (World Health Organization, 2008).However, findings by Munang'andu *et al.,* were generated by reviewing data from medical and veterinary records while the report by Kasese - Chanda et al. (2017) was an investigation report. The current study used informant interviews and focus group discussions to generate the findings. This approach enabled a better understanding of the history and context in which the practice occurs. The above- mentioned attitudes and practices were not consistent with the levels of knowledge that the respondents had. This means that there were other factors influencing respondents' behavior.

Marmot (2017) argues that knowledge alone is not enough to compel people to make healthier choices. Marmot postulated that the circumstances in which

people find themselves influences their life choices. This implies that the living conditions in which the people of the Western and Muchinga provinces find themselves had a more significant influence on their daily decisions than the knowledge they possessed. Also, the theory of political economy argues that the conditions in which people live affects their choices rather than what they know (Marmot, 2017).

The ecological model postulates that beliefs, values, attitudes and one's practices influence their health. According to the theory, these factors operate at the individual level to exert influence on one's health. Furthermore, these individual traits are shared among relations and later on, among community members through interactions. Therefore, communities tend to manifest common behaviors and attitudes due to influence through relations and operate at the relational level of the ecological model. It is therefore essential to involve influential local community members if behavior change has to be effective.

5.7 Cultural, socio-economic, and gender influences on practices and attitudes

5.7.1 Socio-economic reasons

Study participants in both provinces explained that they ate contaminated meat because of their poverty status which was worsened by lack of employment and inconsistent sources of income. In Chama District, village game scouts sold or exchanged game meat for maize in their local communities during anthrax outbreaks. Community members would then dry the meat and transport it for sale to urban cities where game meat fetched a higher price. The LCMS report shows that 83% of the population in the Western Province is poor. Other studies (Opare *et al.,* 2000; Chakraborty *et al.,* 2012; Coffin *et al.,* 2015) also cited poverty as a major contributing factor to anthrax transmission. Poverty may lead an individual to engage in unhealthy life adjustments such as eating contaminated meat. The study further established that participants sold, or exchanged the meat for other goods and services to salvage the economic

losses incurred due to loss of cattle. Some studies done in limited resource settings have made similar findings (World Health Organization, 2008; Chakraborty *et al.,* 2012; Chikerema, 2013). A study in Uganda reported that participants indicated that the economics of poverty influenced responses to disease (Coffin *et al.,* 2015).

5.7.2 Culture and gender influence

Qualitative narratives established that certain roles and responsibilities associated with meat handling exposed men and women to the risk of contracting anthrax. Handling contaminated raw meat is also associated with cutaneous anthrax as bacteria penetrates the skin in case one has a skin lesion. A study in Bangladesh found that human cutaneous cases of anthrax in fourteen outbreaks were associated with participation in slaughtering of anthrax-infected animals and that 60% of the cases affected males (Chakraborty *et al.,* 2012).

Another study conducted in Zimbabwe showed that while women were responsible for preparation and cooking of meat, men were responsible for slaughtering, skinning, and butchering of animals. Another study in Kazakhstan showed that more than 50% of the cases of anthrax were recorded in males (Woods *et al.,* 2004).

It was also found that butchering was associated with developing anthrax. These findings may suggest that males are more likely to suffer from cutaneous anthrax than females. This is because they handled large quantities of meat and used sharp equipment; hence a higher likelihood of cuts and bruises which lead to penetration of anthrax spores. Some respondents also explained that it was common practice for men to roast some meat for consumption while they dressed animals in the bush. This practice exposed men to gastrointestinal anthrax since the roasted meat which may not be adequately cooked to kill the anthrax bacteria.

Results also revealed that cattle rearing and meat consumption practices of the respondents were primarily influenced by cultural traditions that had been handed down through their generations. Majority of participants ate meat from moribund cattle or wild game because this was a practice that had persisted in their culture. Because eating meat from moribund animals was practiced for a long time, communities perceived such a practice not to be risky. Similar findings were made by Gombe et al. (2010) who found that respondents ate meat from moribund animals in their communities because this was a practice that was handed down to them over the years. It was equally culturally appropriate for the owner of the dead animal to share out the meat to all members of the community who participated in slaughtering the animal. This practice spread the disease to other community members who did not own cattle. Chakraborty et al. (2010) also found that community participation in slaughtering and processing sick animals was common in Bangladesh. These findings suggest the importance of cultural influence on community practices.

According to Helman (2007), food is more than just a source of nutrition but is deeply entrenched in the social, religious and economic domains of people's lives. Therefore, every culture has a set of clear rules as to who prepares and serves the food, and which individuals eat what food, on what occasions and the place and manner of eating the food. Helman further argues that, because of the central role that food plays in people's lives and social relationships, dietary beliefs are difficult to change even when they interfere with nutrition or health. He, therefore, argues that, before beliefs and practices can be modified, it is important to understand the way in which each culture views its food.

Another practice that was culturally constructed was *mafisa.* The *mafisa* system was a common risk management practice among African cattle keeping communities. The *mafisa* system has therefore persisted through the generations. Kasese-Chanda (2017) equally observed that *mafisa* was one of the factors that contributed to anthrax outbreaks in the Western Province. Similar observations were made by DingWall (2015) in his international debate over the Ebola outbreak in Guinea and Sierra Leone. The authors argued that 60-80 percent of Ebola cases were associated with burial customs. Cultural practices and beliefs may affect health negatively or positively. Every culture

has beliefs concerning the causes of disease, their cure, and who should be involved (Helman, 2007). Culture influences perception of health messages and determines communities' compliance to health messages. Communities are not likely to comply with health messages if they perceive that they are not culturally relevant to their beliefs and practices. DingWall (2015) argues that "When technical solutions cross purposes with entrenched cultural practices, culture always wins." Culture also influences the construction of gender roles and responsibilities. These gender roles and responsibilities shape the vulnerability and exposure of men and women to disease pathogens or risk factors as well as disease outcomes. In the ecological model of disease causation, culture is considered as a structural factor that influences community responses to public health messages (Sweat and Denison, 2014). The ecological model postulates that the cultural context of a particular society will affect the practices and beliefs of its members and ultimately affect health. This finding implies that professional staff must be aware of the context and cultural realities that exist in the communities they operate. Therefore, professional staff involved in the control of anthrax need to have the cultural competence to handle the cultural realities entrenched within the communities.

Professional staff must also understand the social factors patterning the construction of anthrax. The staff also needs to have the cultural competence to disseminate public health messages and handle community resistance. Different sectors must work as an interdisciplinary entity to tackle the complex issues surrounding anthrax transmission. The interventions must be broadly focused to address cultural issues and poverty rather than be narrowly focused on biological measures. Anthrax is, therefore, a case example for the application of the One Health concept. The concept must be strengthened in Zambia, and a framework and policies supporting its implementation must be strengthened.

Apart from culture, myths and misconceptions about health issues influence compliance of communities to carry out disease (anthrax) control interventions. This study found that the affected communities had certain misconceptions about cattle vaccinations and eating meat from sick animals that influenced their perception and compliance to health messages. These misconceptions

appeared to have been conceived partly from the manner in which the Zambian Government, through the Department of Veterinary Services, handled cattle vaccinations. The Government only released free anthrax vaccines when there were disease outbreaks involving human subjects. Since free cattle vaccinations were done during outbreaks, this led to the communities to believe that the vaccine made their animals to be sick because some herds would have already been infected and therefore still died after vaccination. The literature recommends that cattle vaccination should be undertaken annually before outbreaks of anthrax occur (World Health Organization, 2008).Vaccinations of cattle after an outbreak has occurred is discouraged because some herds could already have been infected and may not benefit from the protective effect of the vaccine.

Previous studies that have been conducted to determine an association between time of vaccination and occurrence of anthrax have indicated that cattle that were vaccinated during an outbreak period were seven times more likely to be infected with anthrax compared to those which were vaccinated before the outbreak (Mongoh, 2008).

5.8 Political and infrastructure barriers affecting anthrax control

The study observed that there were barriers faced by professional workers and the community in the control of anthrax. These barriers were considered in the survey because they compromised the control of anthrax and therefore perpetuated its transmission. These barriers included logistical challenges, staffing shortages, and poor accessibility to vaccines, geographical remoteness, and poor infrastructure.

5.8.1 Logistical challenges

The study established that the Government did not provide funding for routine anthrax control because the disease was not considered to be of economic importance to the country. Therefore, under the Statutory Instrument number 24 of the Animal Health Act of 2010, farmers were responsible for vaccinating their animals against anthrax. Lack of funding impaired the ability of veterinary staff to reach out to the communities for extension services. It meant therefore that veterinary officers were not able to provide adequate extension services. Neither could they carry out sensitization campaigns, post-mortem inspections when cattle died, or give support to Community Livestock Workers.

Muuka et al. (2012) explained that reduced funding to the Veterinary Department after the Structural Adjustment Program in the 1990s affected the delivery of extension services needed by most farmers. Also, the study observed that the Department of Veterinary Services had a critical shortage of transport, specifically motorcycles in most of the districts. It was reported that the province only had eight motorbikes for all the thirteen districts in the region, compromising the delivery of services to the communities. The department of veterinary services annual report shows that there is a shortage of transport in the districts, including motorcycles for frontline staff (National Livestock Epidemiology and Information Centre, 2015)(NALEIC).Equally, the Department of National Parks and Wildlife) indicated that they had a shortage of transport to conduct wildlife patrols. This compromised their ability to detect wildlife morbidities and mortalities. The findings above suggest that a good transport fleet is necessary for successful anthrax control.

Apart from inadequate transport, it was found that some veterinary camps had no staff, compelling the few veterinary officers that were available to manage two veterinary camps.

Additionally, there was lack of office space and accommodation for some of the veterinary camp officers. Poor accommodation for camp officers and inadequate staffing levels are reflected as some of the challenges experienced by the department of veterinary services (NALEIC, 2015). Considering that

these were remote rural areas, these infrastructural shortages affected the efficient delivery of services to the communities. Also, in the Western Province, it was found that most veterinary camps were too vast for the veterinary officers to manage effectively. Staff motivation is essential for efficient delivery of services. Apart from salaries, comfortable accommodation and office space are key motivators for workers to be effective. If the staff is demotivated, they will not execute their duties efficiently.The study also established that the Zambia Wildlife Authority was equally faced with a shortage of manpower to monitor wildlife welfare effectively. Therefore, they used village game scouts who were not paid up workers. A similar situation obtained in the health sector where it was observed that some rural health centers were managed by Classified Daily Employees (CDEs).This meant that the ability to detect, diagnose, and report anthrax cases was compromised. It could also mean that some anthrax cases were being missed because of lack of competence by the staff serving the health centers to diagnose the disease and report it accurately.

The study also found that poor access to the vaccine and lack of cold chain facilities also seemed to hamper the ability of farmers to have their cattle vaccinated. The vaccine was only available in Lusaka, increasing its cost and making it difficult for people who live in remote rural areas to access it. There were equally no cold chain facilities in the veterinary camps to maintain vaccine potency. These findings were comparable to what Hassan (2015) reported in Bangladesh. This study established that shortage of vaccines; inadequate veterinary services, as well as workforce, were responsible for non-vaccination of animals.

The study by Chikerema et al. (2013) also found an association between cessation of vaccinations by the government in Zimbabwe with anthrax outbreaks. He further reported that an increase in outbreaks was attributed to vaccinating in the face of disease outbreaks. These findings suggest that cattle vaccination could still be an effective control measure if well implemented. Literature shows that developed countries have eliminated anthrax because of effective control measures including vaccinations (Turnbull *et al.,* 1991 in Chikerema *et al.,* 2013).Therefore, the Government must consider providing free anthrax vaccines to farmers in the Western Province since control of

anthrax is public health good. Anthrax is a disease of both public health and economic importance and Government policies concerning control of this disease need to be re-aligned accordingly. Providing free anthrax vaccination to farmers will not only imply good public health practice but will also help the country to contribute to the mitigation of the threat of bioterrorism. Cattle vaccinations must be conducted before disease outbreaks occur to avoid misconceptions about the vaccine by the communities.

In the Western Province, burying of carcasses when an animal died was the standard practice (Figure 4.1a). This control measure was not very helpful as some community members later exhumed the carcass (Figure 4.1b) and sold or consumed the meat. During the survey, it was observed that the floodplains were characterized by poor tree growth, making firewood a scarce source of energy. Moraes (2017) pointed out that incineration of carcasses in the floodplains was often difficult due to lack of firewood. WHO recommends that burning of carcasses is the most effective measure for anthrax control, and burying is a less satisfactory intervention (World Health Organization, 2008).

The theory of social production of disease postulates that the political context is an important determinant of illness. The allocation of resources by government and the policies designed create an environment that places people at advantage or disadvantage (Feldacker *et al.,* 2014). According to the theory of social production, the government creates an enabling environment for individuals to make healthy choices the easier choices. This is done through policy formulation, legislation and resource allocation. The ecological model equally postulates that political factors operate at the structural level to influence decisions that are made by individuals (Sweat and Denison, 2014).

Furthermore, the current study findings further suggest that the local communities are not involved in the control of the disease. Participants indicated that interventions had no support of their local leaders due to lack of involvement. Participation of communities not only promotes acceptance of interventions but also creates a sense of ownership and sustainability of interventions. If local leadership or gatekeepers are involved, medical experts are likely to meet less community resistance because local community

members are more trusted than professional staff (DingWall, 2015).Therefore, community engagement is a key factor to the success of public health interventions.

5.8.2 Infrastructure and political factors

Regarding infrastructure, the study observed that both provinces under investigation were remote areas which were characterized by poor road infrastructure. Most of the areas were inaccessible, especially during the rainy season. The areas had poor access to electricity, implying that most families could not afford to store the vaccines within their homes.

Road infrastructure was absent; most roads were small tracks that were passable by motorcycles. Social services were mostly absent in both areas. Most of the areas were located far from the central towns where most social services could be accessed. The areas were geographically isolated.

Only a few houses located near health centers had access to solar power and borehole water. The districts were void of any industries which could add value to local products. Most cash crops and products found in the areas were exported out of the two areas in their raw forms without value addition. This created low returns for the local communities. Furthermore, there were no organized market systems in the two regions leading to exploitation of local produce by private businesspersons. According to WHO (2008), most neglected diseases are found in marginalized populations that are characterized by poverty and inadequate social services and infrastructure. Hassan (2015) also observed that anthrax outbreaks were confined to rural and very remote areas in Bangladesh. Such, are the factors which the theory of the social production of disease postulates that they place people in low socio-economic positions that in turn limit their resources and restrict access to health conditions. This, in turn, shapes disease construction and distribution among communities. These findings suggest that anthrax is not only a biological disease but is also shaped by prevailing social conditions.

5.9 Operational factors

The study established that there was collaboration among veterinary and health staff whenever there were outbreaks of anthrax. However, these collaborations were not sustained outside disease outbreaks. In Zambia, collaboration is faced with challenges including lack of policy frameworks and inadequate funding (Mwinyi *et al.,* 2015). The concept of “One Health” advances that collaboration among disciplines should be sustainable for programs to be proactive rather than reactive to disease outbreaks (Kahn, 2011). Furthermore, these collaborations were not holistic as they only involved health and veterinary disciplines. It is evident from the study findings that anthrax is not only biologically determined but is also influenced by socio-economic, cultural, ecological and political factors. It is therefore important that interventions take a holistic, trans-disciplinary approach if they are to be effective. The “One Health” concept is best suited for this purpose because the concept operates on the values of community participation, holistic approach, Intersectoral cooperation and gender inclusiveness ((Bardosh *et al.,* 2014).These values are necessary in the effective control of anthrax in Zambia. Specifically, the involvement of social science must be acknowledged and considered. This is because the involvement of social scientists will enable an in-depth understanding of the social causes that shape disease distribution. The involvement of social scientists will also help to design culturally appropriate public health messages and handle community rumors and misconceptions more effectively. This is likely to result in greater acceptability of interventions by local communities. Syme in Marmot (2017) said, “*Just because you have a medical degree it does not mean that you can understand health. If you want to understand why health is distributed the way it is, you have to understand society.”* Therefore, the understanding of social factors is important for effective anthrax control.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The study findings suggest that most of the respondents are in low socio-economic positions and probably living below the poverty line. The study also established that most of the practices of respondents predisposed them to anthrax and that these practices were influenced by poverty, culture and gender, and socio-economic factors. Moreover, government policy on anthrax control and poor political investment and allocation of resources for anthrax control has constrained its control.

Lastly, lack of community engagement and poor collaboration between sectors further compromised the sustainable implementation of control interventions. Therefore, the study concludes that anthrax transmission is perpetuated by interplay of complex rather than linear, socio-economic, cultural, and political factors. These factors are the ones postulated to be responsible for the creation of social inequalities and shaping distribution of anthrax disease according to the theory of social production of disease. The same factors are postulated to be exerting influence at different levels of individuals, and the environment and influence health as argued by the ecological model of disease.

6.2 Recommendations

Based on the findings in this study, the following recommendations are made to enable prevention and effective control of anthrax in the study areas:

6.2.1 Health and Veterinary sectors

a) Health education campaigns need to be intensified to increase awareness, improve community perceptions and minimize misconceptions.Health

education campaigns must be sustained during and outside outbreaks. Public health messages must be culturally appropriate and utilize local resources and technologies such as folk media and local community radio stations.

b) There is need to involve local communities in the control of the disease rather than view them as passive recipients of control measures. Local traditional, religious and civic leaders must be involved to enhance trust and cooperation. Training and retraining of Community Livestock Workers using the local languages must be considered to enhance community cooperation and trust.

c) The Department of Veterinary Services must consider carrying out anthrax vaccination outreach activities in collaboration with the health sector in the Western Province.

This will not only provide access to cold chain facilities but will reduce costs incurred by the farmers as well. Vaccine availability must be decentralized and cold chain facilities made available in local veterinary camps.

d) Extension services must be re-introduced, and old Veterinary infrastructure like cordon lines and cordon guards must be restored. This will help in controlling animal movements.

e) There is need to demarcate some vast Veterinary camps to make them easily manageable.

f) A holistic approach with the involvement of other disciplines like social science must be adopted. Due to the complexity of factors that influence transmission of anthrax, there is a need for transdisciplinary efforts to resolve them. Therefore, the One Health approach becomes a relevant strategy to control the disease. Therefore, government through the National Public Health Institute should design a framework for “One Health.” This will provide a working framework that will attract funding for zoonosis control including anthrax. Furthermore, collaboration between disciplines must be sustainable rather than episodic.

g) There must be policy formulation for the formation of “One Health” to support structural formation for its function. There must be a realization of the need

to create structures that will allow the effective functioning of the One Health concept.

h) There is need to establish communication platforms and protocols for joint problem identification, outbreak investigations and analysis, reporting, response planning, implementation and evaluation, and for effective communication across sectors and with the public.

i) More evidence-based research must be generated to guide practice. Surveillance activities must be strengthened, and these must utilize local technologies to improve reporting systems.

Local communities must be involved in disease surveillance and reporting to improve efficiency of disease detection.

j) The Veterinary department must provide appropriate compensation and important social support when animal populations must be culled, and offer vaccines and other veterinary services to reward early reporting.

6.2.2 Government

a) The government must create an enabling environment for professional staff and communities. Funding for logistical support such as transport and fuel must be made available to the Veterinary Department to enable them to function effectively about control of anthrax transmission and outbreaks.

b) The government must reduce the levels of poverty by improving peoples' living conditions. The Government should also work in close collaboration with Non-governmental Organizations that aim to alleviate poverty. Organized market systems must be provided for farmers to sell their cattle and crops at competitive prices. Poverty alleviation is not only key to reducing anthrax disease, but will also contribute to the attainment of sustainable development goals number one and two, which are to eradicate poverty and reduce hunger in the world. Increased incomes will enable households to

afford meat protein hence abandonment of the current practice of eating meat from sick animals.

c) Social services must be made more accessible to the communities.
Government must upgrade the road networks in the two provinces. This will attract private investors and open up markets for the local communities including access to veterinary and health services, including butcheries. Government must also establish organized market systems where communities can sell their agricultural products at competitive prices. This will reduce poverty levels and ultimately reduce risky meat consumption practices.

6.2.3 Department of National Parks and Wildlife

a) For Muchinga Province, the wildlife department must find innovative ways of involving local communities in wildlife conservation. For example, local communities should be allowed to invest in wildlife conservation. This will create a sense of ownership and may reduce human-animal conflicts as well as the consumption of contaminated game meat that predisposes to anthrax.

b) Revenue from tourism activities must be re-invested into the local communities to improve peoples' lives. This may avert poverty and reduce human-animal conflicts and the consumption of infected game meat that predisposes to anthrax.

6.3 Areas for further research

The following areas must be explored further to generate more evidence:

1. A study of the prevalence of human anthrax needs to be conducted to be able to estimate the actual prevalence of anthrax in humans. In Zambia, there is no known prevalence for human cases.

2. A study on the economic cost of treating anthrax against the economics of preventing anthrax must be conducted to provide evidence to policymakers that prevention of anthrax is much more efficient than cure.

3. There is need to conduct comparative studies between affected areas and those not affected within the provinces where anthrax is prevalent. This will provide an understanding of how different contexts affect transmission of the disease.
4. A similar study of social factors using mixed methods that will employ random sampling must be conducted to allow for generalization of findings.

5. More comprehensive research studies on the spatial prevalence, ecology and molecular and social studies must be conducted to have better understanding of the interplay of these factors in anthrax transmission.

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APPENDICES

Appendix 1: information sheet for participants - survey

PhD research study: social determinants of human anthrax transmission in Zambia.

Protocol number 013-08-15

Introduction

My name is Doreen Sitali, a student at the University of Zambia. I am doing research on the social determinants of human anthrax transmission, which is a common disease in animals and humans in this province. I am going to give you information and invite you to participate in the study. You need not decide to participate or not to participate today. You may need to discuss this issue with anyone you feel comfortable with about the investigation.

Should this consent form contain any words you do not understand, kindly stop me and l will clarify with you. If you have questions now or later, you are free to ask me or any member of the research team

What is the purpose of the study?

Anthrax is a common disease in animals and humans in this area. I want to find out what contributes to its transmission. I believe you can help me by telling me what you know both about anthrax and about local health practices in general. I want to learn what people who live or work here know about the causes of anthrax and why some people get it. I want to learn about the different ways that people try to stop anthrax and how it affects your lives. I also want to know more about local health practices because this knowledge might help us to learn how to better control the disease in this community.

What will participation involve?

You will be asked questions and given responses to choose from. Your responses will be filled in for you or you can fill it out yourself. There are about 45 questions for you to answer.

The session is meant for you to express your opinions concerning the socio-economic factors influencing transmission of anthrax. Your personal

information such as name or address will not be written on the questionnaire in order to keep your information confidential.

Procedures

I am asking you to help e learn more about anthrax in this community. I am inviting you to take part in this research project. If you accept, you will be asked to sign a form to indicate that you are willing to participate.

You will be asked to fill answer questions provided to you by one of my colleagues. If you cannot write, the person will assist you to do so. When you have completed the questions, the paper will be collected by the person. If you do not wish to answer any of the questions included in the paper, you may skip them and move on to the next question. The information recorded is confidential, your name is not being included on the forms, only a number will identify you, and no one else except myself and my assistants will have access to the paper.

Duration

The questions will take about thirty minutes to complete.

Risks

The investigation will not involve collecting anything from you for testing or measurement. Most of the questions that will be asked are general, however, there is a risk that you may share some personal or confidential information by chance, or that you may feel uncomfortable talking about some of the issues. However, I do not wish for this to happen. You do not have to answer any question if you feel the question(s) are too personal or if talking about them makes you uncomfortable.

Benefits

There will be no direct benefit to you as an individual. However, the information you will give me will help me find out more about how to control anthrax in your community.

Reimbursements

You will not be provided any incentive for taking part in the research.

Confidentiality

The research being done in the community may draw attention and if you participate you may be asked questions by other people in the community. I will not be sharing information about you to anyone outside of the research team. The information that we collect from this research project will be kept private. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key. It will not be shared with or given to anyone.

Sharing the Results

Nothing that you tell us today will be shared with anybody outside the research team, and nothing will be attributed to you by name. The knowledge that I get from this research will be shared with you and your community before it is made widely available to the public. Each participant will receive a summary of the results. There will also be small meetings in the community and these will be announced. Following the meetings, I will publish the results so that other interested people may learn from the research.

Right to Refuse or Withdraw

You do not have to take part in this research if you do not wish to do so, and choosing to participate will not affect your job or job-related evaluations in any way. You may stop participating in the [discussion/interview] at any time that you wish without your job being affected. I will give you an opportunity at the end of the interview/discussion to review your remarks, and you can ask to modify or remove portions of those, if you do not agree with my notes or if I did not understand you correctly.

Who to call for questions or problems?

- You can contact the principal investigator, Doreen Sitali on +260977892417 for any questions or complaints about the study.

•You can also contact the University of Zambia, Biomedical Ethics Committee (UNZABREC) office of the School of Medicine, University of Zambia, if there are questions about your rights or if you have any concerns. The contact information is:

The Chairperson,
UNZA Biomedical Research Ethics Committee,
P.O Box 50110, Lusaka, Zambia.
Telephone: 0211 256067.
Email: unzarec@zamtel.zm

CONSENT FORM

What does my signature (or thumb print/mark) on this consent form mean?

My signature (or thumb print/mark) on this form means:

- I have been informed about this study's purpose, procedures, possible benefits and risks.
- I have been given the chance to ask questions before I sign.
- I have voluntarily agreed to participate in this study.

_____ _____ _____

Name of participant Signature of participant Date

_____ _____ _____

Name of person obtaining Signature of person obtaining consent Date

Consent

Ask the participant to mark a "left thumb impression" in this box if the participant is unable to provide a signature above.

_____ _____ _____

Name of witness Signature of witness Date

(If the person giving consent cannot read and write)

Appendix 2: questionnaire

THE UNIVERSITY OF ZAMBIA SCHOOL OF VETERINARY MEDICINE DEPARTMENT OF DISEASE CONTROL STRUCTURED INTERVIEW QUESTIONNAIRE

TOPIC: SOCIAL DETERMINANTS OF HUMAN ANTHRAX TRANSMISSION

Serial Number ……..

Village:……

Date of interview: ……

Name of interviewer: ……...

INSTRUCTIONS FOR INTERVIEWER

1. Introduce yourself to the respondents.

2. Do not write the respondents' on the questionnaire.

3. Ask all questions in the order they are arranged.

4. Indicate the answers to the question by ticking in the box provided and write your responses to open ended questions in the space provided.

5. Assure the respondents that all information will be treated as confidential and used for the purpose it is intended for.

Section A: demographic characteristics **For official use**

1. Age of respondent in years:
……

2. Sex of respondent:

a) Male [ ]

b) Female [ ]

3. What is your marital status?

a) Married [ ]

b) Single [ ]

c) Widowed [ ]

d) Divorced [ ]

e) Separated [ ]

4. What is your highest level of education?

a) No education [ ]

b) Grade 1 to grade 7 [ ]

c) Grade 8 to grade 9 [ ]

d) Grade 10 to grade 12 [ ]

e) University education [ ]

5. What is the total number of household members including yourself?

a) 1 to 5 [ ]

b) 6 to 10 [ ]

c) 11 to 15 [ ]

d) 16 to 20 [ ]

6. What is the number of children below five years? ……

7. Number of males? ……

8. Number of females? …….

9. How long have you lived in this place?

a) Less than one year [ ]

b) More than one year but less than five years [ ]

c) More than five years but less than 10 years [ ]

d) More than 10 years [ ]

Section B: socio-economic status

10. What is your occupation?

a) Farmer [ ]

b) Craftsman [ ]

c) Teacher [ ]

d) Civil Servant [ ]

e) Others (specify) [ ]

11. What is your average monthly income per month?

a) Less than K1000 [ ]

b) Between K1000 and K4, 900 [ ]

c) Between K5, 000 and K9, 900 [ ]

d) More than K10, 000

12. What are the other sources of income for your family?

(Read all the options to the interviewee)

Source of income	**(Tick)**
Farming	
Animal husbandry	
Rental income	
Trading	
Allowances for elderly	
Assistance from NGOs	
Others (specify)	

13. Is there any other family member working in your household?

a) Yes [ ]

b) No [ ]

14. How much do you spend monthly for food? ……..

15. How much do you spend annually for children's school fees? ……

16. How much do you save yearly? ……..

17. How do you consider yourself in terms of material wealth?

a) Very poor [ ]

b) Poor [ ]

c) Middle income level [ ]

d) Rich [ ]

e) Very rich [ ]

18. Do you or any member of your family own land?

a) Yes [ ]

b) No [ ]

19. How many acres do you own/ cultivate? ……

20. How many animals do you have for each type listed below?

Type of animal	**Indicate number**
Cattle	
Goats	
Poultry	
Pig	
sheep	

21. Do you own cattle?

a) Yes [ ]

b) No [ ]

22. Is it for subsistence or selling? ……..

23. What is the ownership status of your house?

a) Owner of the house [ ]

b) Tenant [ ]

c) Company or government owned [ ]

d) Other (specify) …….. [ ]

24. What is the main building material of the house?

a) Brick and concrete [ ]

b) Wooden [ ]

c) Stone [ ]

d) Soil [ ]

e) Other (specify) ……. [ ]

25. What is the main source of drinking water?

a) In- house piped water [ ]

b) Borehole pump [ ]

c) Well water [ ]

d) Open surface river water [ ]

e) Others (specify) ……. [ ]

26. What type of toilet facility do you have?

a) Interior flushable toile t [ ]

b) VIP pit latrine [ ]

c) Traditional latrine [ ]

d) None [ ]

e) Others (specify) ……. [ ]

27. Do you have electricity in the house?

a) Yes [ ]

b) No [ ]

28. Do you have children who are in school?

a) Yes [ ]

b) No [ ]

29. What is the main source of your information? (Tick from the list)

a) Television [ ]

b) Radio [ ]

c) Internet [ ]

d) Friends [ ]

e) Local radio station [ ]

30. Which of the following assets do you own? (Tick where appropriate)

Asset	**Tick**
Hammer mill	
Borehole	
Oxcart	
House on rent/ building on rent	
Radio	
Bicycle	
Motorbike	
Car	
Sewing machine	
Wooden stove	
Electric pressing iron	
Land/mobile phone	
Computer	
Farm machinery	

Section C: knowledge on anthrax transmission

31. Have you ever heard of anthrax?

a) Yes [ ]

b) No [ ]

32. Who can get affected by anthrax?

a) Cattle [ ]

b) Man [ ]

c) Both man and cattle [ ]

d) Don't know [ ]

e) Others specify…….

33. How is anthrax transmitted from animals to humans? (Circle whichever is appropriate)

a) Eating infected meat [ ]

b) Touching infected meat [ ]

c) Slaughtering infected animal [ ]

d) Handling animal products such as hides [ ]

e) Touching infected cattle feces [ ]

f) Drinking infected milk [ ]

g) Other specify……. [ ]

Section D: attitude and practices

34. Do you vaccinate your animals against anthrax?

a) Yes [ ]

b) No [ ]

35. What do you do when one of your animals dies of an unknown disease? (Tick where appropriate)

a) Report to the local veterinary authorities [ ]

b) Report to the chief [ ]

c) Sell the meat fresh [ ]

d) Dry the meat for sale [ ]

e) Eat the meat within the family [ ]

f) Bury or burn the carcass [ ]

g) Distribute the meat among community members [ ]

h) Others specify…… [ ]

36. Do you participate in slaughtering cattle or wild animals in the community?

a) Yes [ ]

b) No [ ]

37. Which of the following activities do you participate in when an animal dies? (tick where appropriate)

a) Gutting [ ]

b) Skinning [ ]

c) Butchering [ ]

d) Cooking [ ]

e) Other specify…… [ ]

38. Do you think cattle vaccination can protect against anthrax?

a) Yes [ ]

b) No [ ]

c) Don't know [ ]

39. How do you treat an animal you suspect to have died of anthrax? (Tick where appropriate).

a) Report to local veterinary assistant [ ]

b) Butcher it and sell to the local people [ ]

c) Use the hide for making stools, mats or drums [ ]

d) Leave the animal for veterinary officers to handle [ ]

e) Eat the meat by sharing it among community members [ ]

f) Sell it to local butchery at a cheaper price [ ]

40. Do you think eating cattle that died on its own is safe?

a) Yes [ ]

b) No [ ]

c) Don't know [ ]

41. Do you think wild animals carry diseases that can affect humans?

a) Yes [ ]

b) No [ ]

c) Don't know [ ]

42. Do you think you can get sick by eating diseased game meat?

a) Yes [ ]

b) No [ ]

c) Don't know [ ]

43. Are you satisfied with veterinary services in your area?

a) Yes [ ]

b) No [ ]

44. If the answer to question above is no, state the reason why?

……
…

45. Have you lost any of your cattle to anthrax in the last two years?

a) Yes [ ]

b) No [ ]

46. Has any of your household members suffered or died of anthrax in the last twelve months?

a) Yes [ ]

b) No [ ]

Thank you for participating in the study

Appendix 3: information sheet for focus group discussions

PhD research study: Social determinants of human anthrax transmission in Zambia.

Protocol number 013-08-15

You are being invited to participate in this study. Before you decide to do so, you are encouraged to read the information below so that you understand what the study is about and what your participation involves. You are free to discuss this information with other members of your family. If you are not clear about anything, you can contact me on the address indicated below for any clarifications.

What is the purpose of the study?

The study is aimed to evaluate the social determinants of human anthrax transmission in Zambia. We would like to have an understanding of the social factors that are at play in influencing transmission of this disease.

Why have you been chosen?

You are being requested to take part in the study because you are considered as one of the community members who have been affected by this issue and therefore can offer expert opinions.

What will participation involve?

You will be interviewed at a place of your convenience. The interview will take place between 30-40 minutes. The session is meant for you to express your opinions concerning the implementation of the initiative. The interview will be audio recorded and notes will be taken down as we discuss with you. Another person will be in attendance to help me take down the notes. Recordings of the interviews will be transcribed later as well as the written text. After transcribing them, the recordings will be destroyed. You are free to ask for a written copy of the repot at the end of the project. At the presentation of results, your own words will be used but no identifiers linked to you will be used.

Risks and benefits

This study has no obvious risks to you physically or otherwise. Please note that no compensation will be made to you for participating in the study.

Please be informed that;

You can decide not to participate in the study without any consequences.

You can decide not to answer questions that you do not want to.

You can decide to withdraw from the study at any stage without consequences.

You can now decide whether to participate in the study or not. You are also free to withdraw from the interview at any time without giving reasons. If you decide to take part, this information sheet will be given to you and I will ask you to sign a consent form to affirm your participation.

If you have further questions please contact me or any of my supervisors using the under listed addresses:

Investigator
Doreen Sitali
Department of Public Health
School of Medicine
UNZA

Supervisors:
1. Dr. J Muma
Department of Disease Control
School of Veterinary Medicine
UNZA

2. Dr. L Ndonyo
Department of Public Health
School of Medicine
UNZA

3. Dr. O Mweemba
Department of Public Health
School of Medicine
UNZA

Consent form:

I have read, understood and been given a copy of the information sheet. I desire of my own free will to participate in the study.

Signature: ---------- Date: ----------

Appendix 4: focus group guide (community members)

As you may be aware, this community usually experiences cases of anthrax in animals and humans. We are here to hear your views on the social factors that influence this transmission and how it affects your lives,

1. How does livestock affect your lives?
2. What are the attitudes towards anthrax here?
3. What community activities are there to participate in anthrax control?
4. What issues do you face in keeping livestock?
5. How does the socio-economic and political situation influence your ability to keep livestock?
6. What are the livestock keeping practices (what is the role of men and women)
7. What do you make of animal disease control in this area?
8. Can you explain to me the seasonal changes that you have observed in terms of anthrax outbreaks? How are the public health services in this area?
9. What is people's attitude towards eating animals that died on their own?

Appendix 6: interview guide (professional personnel)

1. What issues surround the control of anthrax in this community?
2. How have you involved the community in the control programs?
3. What type of professionals participate in your task force teams?
4. What factors do you think influence the community's behaviors and perceptions in as far as anthrax is concerned?
5. In your opinion, how much funding does human anthrax receive from government?
6. How is anthrax diagnosed and treated?(for health workers only)
7. How much importance is attached to this disease in your ministry?
8. In your control measures, what are the levels of intervention and why?
9. What is people's attitude towards eating animals that died on their own?
10. Do think there is enough community awareness on the dangers of anthrax?
11. How is the relationship between public health providers and the community?
12. Do you think anthrax will ever be controlled in this areas/district? What is the reason for your answer?