IMPACT OF BRUCELLOSIS ON SOCIO-ECONOMIC WELL-BEING OF CATTLE FARMERS IN THE WESTERN AND SOUTHERN PROVINCES OF ZAMBIA

BY

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DECLARATION

I, Mwinyi Omary Mwinyi, do hereby declare that the work presented in this thesis is entirely my own and carried out with the help of those people mentioned in the acknowledgements. It has not been previously submitted to this or any university for the award of a degree of Doctor of Philosophy or any other qualifications.

Signature: ……. Date: .....……

CERTIFICATE OF APPROVAL

This thesis submitted by **Mwinyi Omary Mwinyi,** is approved in fulfilling the requirements for the award of the degree of Doctor of Philosophy in Public Health (One Heath) of the University of Zambia.

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ABSTRACT

Brucellosis is a highly contagious zoonotic and devastating disease that affects households' potential to improve their well-being through trade in livestock and livestock commodities. Despite the disease being endemic in Zambia, there is inadequate information, on its socio-economic impact on the well-being of households rearing cattle. Therefore, a cross-sectional study was conducted in the Western and Southern provinces of Zambia to determine the impact of brucellosis on socio-economic well-being of cattle farmers at household level. The specific objectives of the study were to determine losses and costs associated with brucellosis in cattle; determine socio-economic well-being levels at the household; evaluate the linkages between brucellosis and socio-economic well-being status; assess the extent to which the current health policies are implemented to support One Health approaches in brucellosis control; develop a framework for collaboration between veterinary and medical experts in controlling brucellosis and other zoonoses. Structured questionnaires, focus group discussions and key informant interviews were used to collect both quantitative and qualitative data in this research. Furthermore, both descriptive and inferential statistics were used to analyse quantitative data using IBM-SPSS 22® while qualitative data was analysed using Nvivo® and content analysis. All costs and monetary losses were estimated in Zambian Kwacha (ZMW) and the equivalent international currency (USD); the exchange rate was 1 USD to 11.45 ZMW. The overall total loss attributed to brucellosis-related calf mortality, in the studied households was 1,536,000 ZMW equivalent to USD 134,148.47; 77,700 ZMW equivalent to USD 6,786.02 was due to milk losses, 18,000 ZMW equivalent to USD 1,572.05 was due to mortality among seropositive cattle and 52,960 ZMW equivalent to USD 4,626.37 was due to veterinary interventions. Lack of money to pay for livestock health services was significantly associated with poor household socio-economic well-being ($p = 0.003$), while the level of education of household heads was associated with the highest positive brucellosis impact ($p = 0.005$) on household socio-economic well-being. Further, the results also show that there was a big difference in the levels of socio-economic well-being in the study areas with, 59.0% of households being classified as poor and only 2.0% of households were classified as rich. Consequently, the null hypothesis was rejected in favour of the alternative hypothesis, which stated that socio-economic well-being levels differ significantly where there is less impact of brucellosis in cattle and where such impact is higher($F = 11.268$, $p = <0.001$). It was also found that more than two-thirds of the respondents from the Ministry of Health (MoH) and Ministry of Fisheries and Livestock (MFL) (73.1%) agreed that there was no policy support which directly facilitated One Health in terms of collaboration. The findings show that the overall attitude towards One Health collaboration among medical and veterinary personnel was favourable. On the basis of these findings, it can be concluded that reduced cost of disease prevention and losses due to brucellosis can improve socio-economic well-being of cattle farmers in the Western and Southern provinces of Zambia. Accordingly, in order to reduce costs and losses attributed to brucellosis, livestock services and surveillance systems for brucellosis should be prioritised and a One Health collaboration framework should be adopted by the Government in order to protect farmers from losses attributed to brucellosis and other zoonoses.

DEDICATION

This work is dedicated to my beloved wife Odilia, my daughters, Nadine and Inara for their constant love and patience during my absence from home while I was pursuing my PhD studies in Zambia. I would also like to dedicate this work to my beloved parents Mr. Omary Mwinyi and Mrs. Mwansiti Mwinyi who laid a valuable foundation for my education.

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LIST OF ABBREVIATIONS

AHEAD	Animal Health for the Environment and Development
ANOVA	Analysis of Variance
BSE	Bovine Spongiform Encephalitis
CBPP	Contagious Bovine Pleuropneumonia
CDC	Centres for Disease Control
CFSP	Centre for Food Security and Public Health
CI	Confidence Interval
CL	Calves Lost
CSO	Central Statistics Office
CVI	Cost of Veterinary Intervention
DALYs	Disability Adjusted Life Years
DMO	District Medical Officer
DVO	District Veterinary Officer
FAO	Food and Agriculture Organization
FC	Framework for Collaboration
FGDs	Focus Group Discussions
FMD	Foot and Mouth Disease
FVE	Federation of Veterinarians of Europe
GDP	Gross Domestic Product
GMA	Game Management Area
HAT	Human African Trypanosomiasis
HH	Household Head

IBM	International Business Machines
IDRC	International Development Research Centre
ILRI	International Livestock Research Centre
KIIs	Key Informant Interviews
LMD	Losses due to Morbidity
LMT	Losses due to Mortality
LRB	Losses due to Repeat Breeding
MDGs	Millennium Development Goals
MFL	Ministry of Fisheries and Livestock
ML	Milk Loss
MoH	Ministry of Health
NPs	National Parks
OH	One Health
OIE	Office International des Epizooties
OWOH	One World One Health
SARS	Severe Acute Respiratory Syndrome
SDG	Sudanese Pound
SLA	Sustainable Livelihood Approach
SPSS	Statistical Package for Social Sciences
SSA	Sub Saharan Africa
TB	Tuberculosis
TEL	Total Economic Losses
US	United States
USA	United States of America

UTH	University Teaching Hospital
USD	United States Dollar
WCS	Wildlife Conservation Society
WHO	World Health Organisation
ZMW	Zambian Kwacha

CHAPTER ONE

1.0 INTRODUCTION

Brucellosis is consistently ranked among the most economically important zoonoses globally and is a multiple burden disease with economic impacts on human, livestock and wildlife (ILRI, 2012). The epidemiology and economic impacts of brucellosis vary by geography and livestock system (Perry *et al*., 2002). Low income countries tend to report the greatest number of outbreaks and animal losses (World Bank, 2011). Economic impacts vary depending on the main livestock species, management systems, and on the capacity of the country's veterinary and medical systems. In low-income countries, brucellosis is endemic and neglected, with large disease and livelihood burdens in animals and people and almost no effective control (Mangen *et al*., 2002).

In global terms, the majority of human and animal brucellosis is found in sub-Saharan Africa (Ghanem *et al*., 2009). With large pastoral communities, and the demand for meat and livestock products expected to double by 2050, brucellosis poses a major threat to sub-Saharan Africa and serious control efforts must be implemented (Racloz *et al*., 2013). It is estimated that the infection rates can reach higher than 10% in human populations in some developing countries, making it a serious public health disease (ILRI, 2013). Humans are almost exclusively exposed to brucellosis through contact with infected animals and consumption of contaminated food of animal origin. The disease can also be transmitted to humans through contact with animals secretions, predominantly during calving and abortion (Racloz *et al*., 2013). Brucellosis can also be

spread through consumption of contaminated, unpasteurised dairy products. The disease is characterised by febrile illness in humans and is often difficult to diagnose solely from the clinical picture as a result of similarities to other febrile diseases such as malaria or typhoid fever (WHO, 2007). Although brucellosis in livestock and its transmission to human population has significantly decreased following the instigation of effective vaccination based control and prevention programmes in developed countries, it still remains an uncontrolled problem in regions of high endemicity such as the Sub Saharan Africa, Mediterranean, Middle East, Latin America and parts of Asia (Smith and Kadri, 2005). Moreover, transmission from human to human, mainly mother to child, has been reported but is very rare (Ruiz-mesa *et al*., 2005).

In livestock, brucellosis results in reduced productivity, abortions and weak offspring and is a major impediment for trade and export (Najibullah *et al*., 2014). This, in many ways, condemns the endemic communities (usually resource poor) to further poverty because of the losses and limited market opportunities, thereby depriving the farmers of the much needed household income, food availability for consumption and limited economic growth at national level (Perry, 1984). As a part of sub-Saharan Africa (SSA), Zambia has a potential to improve socio-economic well-being of livestock farmers through trade in livestock and livestock commodities. However, such potential is hampered by the presence of numerous disease challenges such as brucellosis. Brucellosis is endemic in many parts of Zambia, including in the Western and Southern provinces, thereby hindering the economic exploitation of livestock resource by failing to trade livestock products due to the disease. In these resource poor communities, more than 70 percent of the population are dependent on agriculture for their livelihood

(Anonymous, 2011). There is therefore a need to assess the socio-economic impact of brucellosis at the household level and also design a framework for collaboration among the major players in the control of the disease to increase the effectiveness of interventions. It is envisaged that doing the above will improve the socio-economic well-being of the cattle farmers in Zambia.

1.1 Problem Statement

Brucella infections affect cattle leading to abortions, milk loss, prolonged calving intervals and higher costs of animal health services, resulting in decreased cattle production and affecting the livelihood of cattle farmers in Zambia (Munang'andu, 2000; Muma *et al*., 2007). In Zambia, brucellosis is estimated at 16% and 42% for individual animal and herd level prevalence, respectively (Muma *et al*., 2006b). However, its empirical impact on the socio-economic well-being at the household level among Zambian cattle farmers is not known. Most of the available literatures in Zambia (Pandey *et al*., 1999, Muma *et al*., 2006a, 2007, 2009, 2011, 2012, 2013 and Chimana *et al*., 2010 and Chimana, 2012) are concentrated on the magnitude, prevalence and risk factors of the diseases in humans and animals populations with none on the socio-economic impact of the disease at the household level.

1.2 Study Justification

The presence of brucellosis in livestock herds in the Western and Southern provinces contributes to reduced livestock productivity and also prevent farmers from gaining access to both regional and foreign markets for cattle and cattle products which negatively impacts on household income (Sinkala *et at*., 2014). According to a human development report for Zambia (2013), 47% of population in the Southern province live

in extreme poverty, worse still, 67% of the population in the Western province live in extreme poverty (MDGs progress report, 2013). Since these communities are largely dependent on livestock, knowledge about the monetary values of costs and losses due to abortions; milk loss, costs of veterinary intervention, and prolonged calving to conception interval will provide useful information on how brucellosis affects household socio-economic well-being. There was therefore a need to carry out a study on the impact of brucellosis on socio-economic well-being of cattle farmers in Zambia. In addition, a new framework of collaboration between the Ministry of Health and the Ministry of Fisheries and Livestock at a higher organisational level and, between medical doctors and veterinarians at district level need to be developed in order to increase the effectiveness of interventions to control brucellosis and other zoonoses for better socio-economic well-being of livestock farmers.

1.3 Study Objectives and Hypotheses

1.3.1 General objective

To determine the impact of brucellosis on the socio-economic well-being of cattle farmers in the Western and Southern provinces and explore whether One Health approaches could be used to control such zoonotic diseases in Zambia.

1.3.2 Specific objectives

(i) To determine losses associated with brucellosis and costs incurred in prevention and control of the disease in cattle;

(ii) To determine levels of socio-economic well-being at the household level;

(iii) To determine linkages between brucellosis and socio-economic well-being at household level;

(iv) To assess the extent to which the current health policies are implemented to support One Health approaches in brucellosis control;

(v) To develop a framework for collaboration between veterinary and medical experts for controlling brucellosis and other zoonoses.

1.3.3 Hypotheses of the research

Null hypothesis: Socio-economic well-being levels do not differ significantly between households where there is less impact of brucellosis in livestock and those where the impact is higher.

Alternative hypothesis: Socio-economic well-being levels differ significantly where there is less burden of brucellosis in livestock and where such burden is higher.

1.4 Conceptual Framework

A conceptual framework is a narrative outline presentation of variables to be studied and hypothetical relationships between and among the variables. The conceptual framework of this study (Fig. 1.1) shows household socio-economic well-being as the dependent variable that is affected directly by independent variables. The conceptual framework was informed by insights gained from the review of pertinent literature and theories. Generally, the conceptual framework shows the impacts of brucellosis on socio-economic well-being. Socio-economic impact of brucellosis was measured directly by asking respondents how the people would be affected by livestock diseases which impinge on households' well-being and economic losses were determined using economic model. The variables which directly affected household socio-economic well-being were in seven categories: (1) Lack of good veterinary health services; (2) Losses

due to abortions; (3) Costs incurred due to vaccination; (4) Milk loss; (5) Losses due to still birth; (6) Time spent in seeking health services for livestock; and (7) Poor surveillance system. These of variables had reciprocal relationships with the One Health initiative as a central focus and policy on health services delivery for zoonoses, livestock specific diseases and human specific diseases. Overall, it is the outcome of these mutual relationships which determined the household socio-economic well-being. Apart from the direct relationships, there were also indirect relationships between independent variables which are presented in the left box of Figure 1.1 and the household socio-economic well-being. Household headship indirectly influenced the household expenditure depending on the economic activities which the household head was engaging to; and household main economic activities determined household expenditure and the likelihood of a household to have better socio-economic well-being or not. Household composition by sex and age, marital status, diagnostic and surveillance, advocacy and information as well as the theory of well-being and theory of sustainable livelihood approach indirectly influenced house socio-economic well-being.

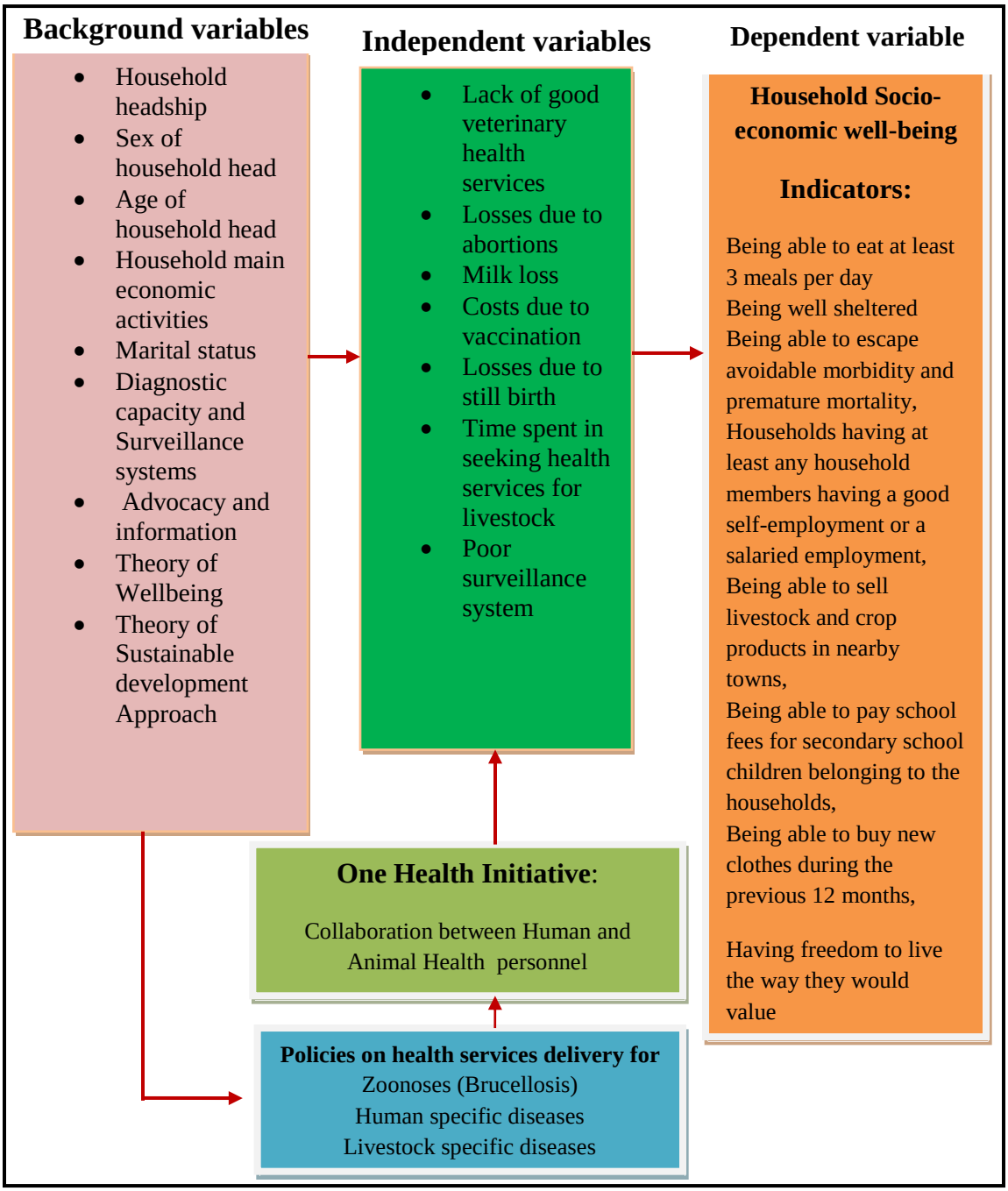

Figure 1.1: A conceptual framework of the study on the impact of brucellosis on household social economic well-being of households.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Geographical Overview of Zambia

Zambia is a landlocked country covering 752,610 km^2 between latitudes 8^o and 18^o South of the Equator and longitudes 22^o and 34^o East of the Greenwich Meridian. The agriculture land is estimated at 352,890 km^2 (47.5 percent of total land), of which 300,000 km^2 (85 percent of agriculture land) is under pasture (Sinkala, 2015). As such, the country has more grazing than arable land (FAO, 2005; World Bank, 2011). A large portion of over 400,000 km^2 is forest, national parks and game management areas (FAO, 2014). Zambia has wetlands which are suitable for survival of both wild and domestic animals. Notable is the Kafue flats in the Southern province; Bangweulu swamps in Luapula province; and the Barotse, Liuwa and the Simahala floodplains in the Western province. Zambia is comprised of three agro-ecological regions with aunimodal annual rainfall averaging 600 mm in region I, 600 to 1000 mm in region II and >1000 in region III (Nyemba and Dakora, 2010). The rainy season is between November and April with December and January usually being the wettest months (Mumba and Thompson, 2005). Regions I and II are resident to about 60 percent of the estimated 3.4 million cattle, 40 percent of one thousand sheep and 40 percent one million goats (Anonymous, 2006). Region II which includes parts of the Central, Southern, Eastern, and Lusaka provinces has the most favourable rainfall, soil quality, and absence of tsetse fly that allow for a diverse mix of crop and livestock enterprises

(Nyemba and Dakora, 2010). Because of its suitability to support ungulates, sharing of grazing land between wildlife and livestock is also common, especially around the park boundaries and areas immediately surrounding National parks (NPs) and other game management areas (GMAs) (Muma *et al*., 2006b).

2.2 Human Demographical Parameters

Zambia is regarded as one of the least urbanised countries in Africa. It has an estimated total human population of 13.04 million, with the majority (60 percent) living in rural areas (CSO, 2010). Traditional farmers occupy the communal areas, owning 85 percent of the estimated 3.4 million cattle, 68 percent of the one thousand sheep, 97 percent of the one million goats and 90 percent of the 1.5 million pigs (Anonymous, 2011). The commercial farmers own about 15 percent of the livestock (Muma *et al*., 2012). The country's human population growth averages 2.1 percent per annum with the majority being below 35 years (CSO, 2012). Maize is the main staple crop grown in most parts of the country and produced mainly using animal draught power (Muma *et al*., 2011). Livestock further supports the rural communities as a reserve bank, symbol of wealth, transport to move agriculture produce to markets, bridal price, source of manure and animal protein (Perry *et al*., 1984). Therefore, outbreaks of animal diseases such as brucellosis adversely affect livelihoods of Zambian communities (Scoones *et al*., 2010; Ferguson *et al*., 2013; Miguel *et al*., 2013). The life expectancy of Zambians is estimated at 57 years (World Bank, 2014), while poverty is at an average of 60.5 percent. In rural areas, poverty levels are estimated to be 77.9 percent compared to urban areas where they are estimated at 27.5 percent (CSO, 2012).

2.3 Socio-economic Status of Zambia

Zambia's economy has historically depended on copper mining (Anonymous, 2006). Despite posting a relative growth since 1999 with the latest real Growth Domestic Product (GDP) of 7.3 percent for 2012, the growth has not translated into poverty reduction which has remained persistently high (Human Development Report, 2013). In addition, 40.8% of the country's population is living in extreme poverty, 54.4% of country's population is poor, while 13.6% of population is moderately poor (CSO, 2015). The economic growth has been attributed to mining, construction and tourism sectors (Anonymous, 2006). However, agriculture, upon which 80 percent of the population depends, has declined recording relatively low average growth rates, mainly due to inadequate infrastructure and poor market access (Anonymous, 2006). Agriculture contributes about 20 percent to the national GDP, out of which 28 percent is from the livestock sector (Muma *et al*., 2009; Anonymous, 2010). Therefore, the livestock sector has been identified as one of the change movers of the anticipated economic growth that is required to reduce poverty (World Bank, 2011). Zambia's national per capita income is one of the lowest in the world estimated at 1,700 USD for 2012 (Anonymous, 2013).

2.4 Livestock Production System in Zambia

The livestock production system can broadly be categorised into traditional and commercial sectors (Perry *et al*., 1984). The sectors are described below.

2.4.1 Traditional cattle

The traditional cattle system in Zambia has been described as the largest system and it involves a big percentage of farmers (Perry *et al*., 1984; Muma *et al*., 2006; Munyeme *et*

al., 2009). Cattle are raised on communal land under extensive grazing system. In areas such as Kafue flats and Zambezi basin, three linked herding patterns exist: Village resident herds (always in the village), transhumant herds (move between village and the floodplains) and interface herds (permanently stay on the floodplains) (Muma *et al*., 2006a; Munyeme *et al*., 2009). In the rest of the country, cattle are grazed in the communal areas as village resident herds and the distance covered are dependent on season and availability of pasture and water (Perry *et al*., 1984). However, there is substantial problem with abortions in traditional cattle with *Brucella spp*. playing a significant role in abortions (Muma *et al*., 2007). Most abortions are reported to occur between October and June which is also the calving season for Zambian traditional cattle (Perry *et al*., 1984). Further, cattle brucellosis, especially that caused by *Brucella. abortus*, tends to have similar manifestations to those seen in the reproductive performance record of Zambian traditional cattle. Therefore, *Brucella* has been assumed to be a main causative agent of abortions in Zambian traditional cattle (Muma *et al*., 2007). Among the traditional farmers, cattle density is highest in the Eastern, Southern, Central, and Western provinces of Zambia with herd size averaging forty (ten to fifty) in most provinces except, Southern province where herd sizes average 100 (Perry *et al*., 1984; Muma *et al*., 2009; Munyeme *et al*., 2009).

2.4.2 Commercial cattle

The commercial farms are usually private business enterprises keeping exotic breeds of beef and dairy cattle and are characterised by high production efficiency and high offtake rates to the market. Commercial farms are concentrated along the rail line

between the Southern, Copperbelt and Central provinces and are the largest suppliers of milk and beef to urban areas (Muma *et al*., 2006a; Chimana *et al*., 2010).

2.5 Description of Brucellosis

Brucellosis is a zoonotic disease with a major impact on public health, even though successful eradication and control programmes for the disease in domestic animals have been established in many countries around the world (Al Dahouk *et al*. 2013). More than 500,000 human cases are reported worldwide each year (Pappas *et al*., 2005), but the number of undetected cases is believed to be considerably higher. This alarming situation can be attributed to the non-specific clinical picture of human brucellosis, low awareness of the disease in non-endemic countries and shortcomings in laboratory diagnosis (Al Dahouk *et al*., 2003). Vaccines such as *Brucella abortus* strain 19 can cause disease in humans through accidental injections (Berkerlman, 2003). Symptoms for brucellosis in humans are similar to those associated with many other febrile diseases like malaria and typhoid (Colmenero *et al*., 1996). The duration of the disease varies from a few weeks to months or even years (Sauret and Vilissova, 2002). However, the incidence of paravertebral and/or epidural abscess which may imitate disk herniation, the neurological involvement and the high rate of important functional disabilities as well as cervical spondylitis constitute a very severe complication of the disease (Colmenero *et al*., 1996).

The number of human cases is directly correlated with the amount of disease in animal populations within a defined region (Al Dahouk *et al*., 2013). Effective countermeasures to reduce the incidence of human brucellosis are therefore based on surveillance and control of the disease in livestock and pasteurisation or cooking of contaminated food

products. Once the disease has been transmitted from its animal reservoir to humans, only early diagnosis and adequate antibiotic therapy can prevent serious sequelae in patients (Scholz *et al*., 2008). The disease can be reduced through a joint effort from stakeholders comprising health professionals (medical and veterinary), social, economic, agricultural, environmental and other interested parties. With resource scarcity in terms of number of staff, skills and disease control facilities in low-income countries, participatory multi-sectoral and multidisciplinary approaches in limiting the burden of zoonotic diseases could be worthwhile (Mbugi *et al*. 2012).

In infected cows, unborn calves are usually aborted at about seven months and in case of birth, they are weak and die shortly afterwards (Corbel, 1997). In terms of milk production, a severe drop is experienced as a result of infection in the herd (Bishop *et al*., 1994; Bandara and Mahipale, 2002). Brucellosis mainly affects sexual organs with serious results of endometritis and epididymitis (Huebner, 1998; Bandara and Mahipale, 2002). Bulls may exhibit sterility and orchitis and the infected herd may also exhibit disabilities such as discospondylitis, bursitis or arthritis (McDermott *et al*., 1994; Traboulsi *et al*., 2007). In infected cows, there are large swellings observed in the joints of limbs called hygromas (Geering *et al*., 1995; Huebner, 1998). Pigs are affected most commonly by *B. suis* (Godfroid, 2002; Pappas *et al*., 2005). However, pigs may also be affected by *B. abortus* in cases where they come in contact with infected cattle (Stuart *et al*., 1987). Sexual contact and ingestion of infectious agent may be the modes of transmission (Godfroid, 2002). Abortion and other reproductive disorders may occur in sows. In boars, orchitis and less commonly arthritis, spondylitis or abscesses in various organs may occur (Pappas *et al*., 2005). In sheep and goats, *B. melitensis* is the

classical species affecting females of both animal species (Thimm, 1982; Diaz-Aparicho *et al*., 1994). In cases where infected cattle or pigs come in contact with small ruminants, infections with *B. abortus* and *B. suis* can occur (Stuart *et al*., 1987). *Brucella melitensis* infections are acquired primarily by ingestion (Alton, 1990). Abortion and mastitis usually occur in infected goats (Corbel, 1997). Dog brucellosis is most commonly caused by *B. canis* (Foster and Smith, 2008). However, infections by *B. abortus*, *Brucella suis* and *Brucella melitensis* may occur occasionally when dogs eat placentas from infected farm animals. The disease is most commonly transmitted sexually and bitches abort at 40 to 60 days of gestation (Foster and Smith, 2008).

2.6 Socio-economic Aspects of Brucellosis

Animal diseases have considerable impact on socio-economic development and continue to be a major public and animal health problem in many regions of the world (Robinson, 2003). The Agriculture Organization of the United Nations (FAO) and the World Organisation for Animal Health (OIE) (2011) emphasize the importance of brucellosis as not only having direct public health implications, but also posing a potential barrier to international trade of animals and animal products. Such a barrier could seriously impair socio-economic development, especially for the livestock farmers (WHO, 1997). In livestock, illness may cause reduction in productivity, in numbers of live animals (reduced fertility) and reduced meat and milk production. Seropositive animals often have higher rates of abortion, stillbirth, infertility and calf mortality, as well as reduced growth and longer calving to conception intervals (McDermott *et al*., 2013). Brucellosis has considerable impact on the economy through loss of milk, meat and by diminished animal and human working power (Unger *et al*., 2003). Some of the

major impacts of the diseases in the recent past have been the losses in trade and the reaction of consumers due to the risk or presence of disease (Rushton, 2013). Such losses in trade and consumers' reactions are summarised in Figure 2.1.

However, endemic brucellosis in low-income countries of sub-Saharan Africa and South Asia has multiple economic implications across agriculture and public health and broader economic and social development sectors. Efforts to control the disease in low-income countries must take a different approach simply because replicating past successes in brucellosis control and eradication in high-income countries will not work. Low-income countries have at least a ten-fold higher burden of infectious diseases from a wide variety of pathogens (McDermott and Grace, 2012). In most low-income countries including Zambia, there is much less public investment in veterinary and health services, with weaker surveillance and operational capacity (McDermott *et al*., 2013).

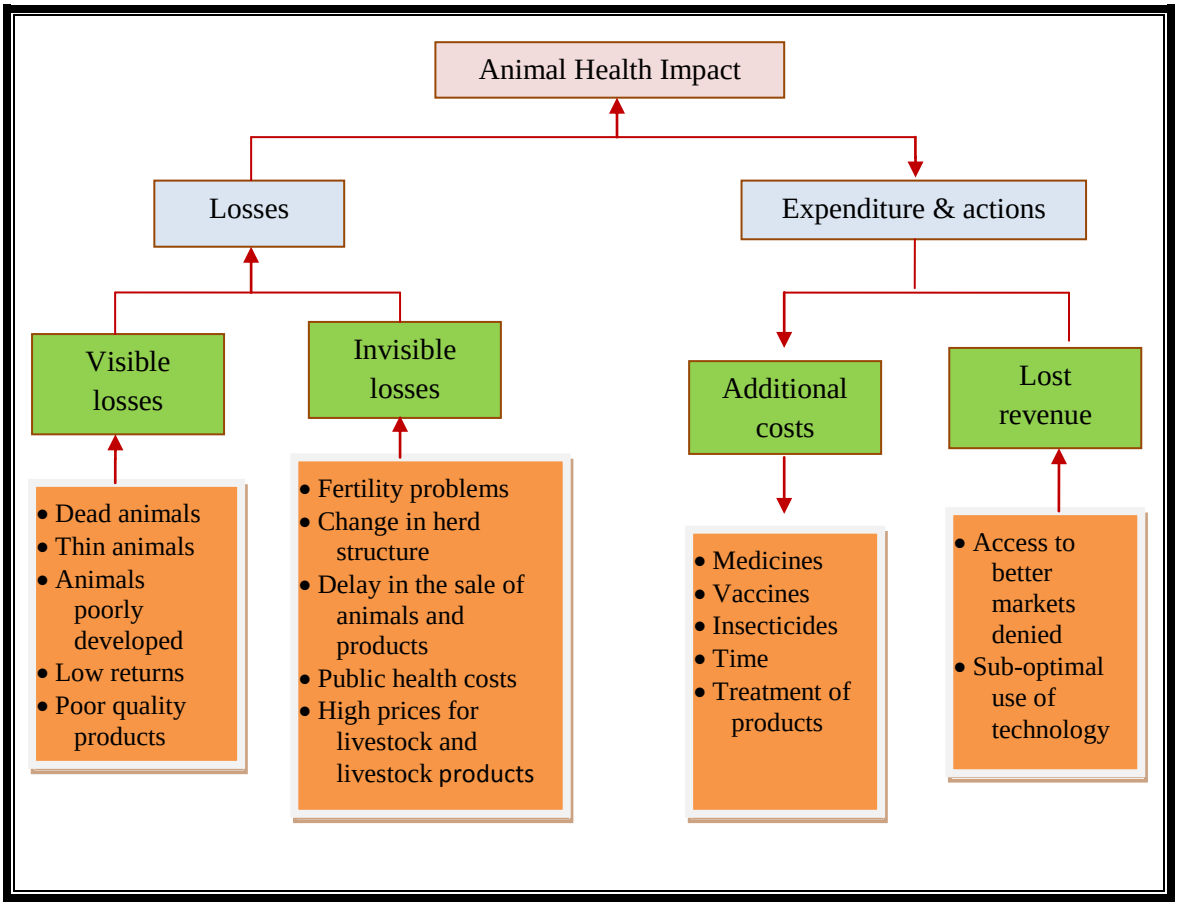

Figure 2.1: Losses and human reaction to disease (adapted from Rushton, 2013)

In Figure 2.1 above, the aspects on the left are losses caused by the disease; the aspects on the right are the impacts due to human reactions to disease. The reason for representing this as a balance is that the more resources are spent on reactions, the more losses caused by disease are reduced. There will be an equilibrium point which is often not the eradication of disease, but the acceptance of managing the disease. Shifting this point requires changes in technology and public investments to capture public goods created by disease management.

2.7 Disease Aetiology

The etiologic agent of brucellosis are small, aerobic Gram-negative rods of the genus Brucella. To date, ten species are recognized within the genus Brucella. The genus Brucella consist of six classic species which include; *B. melitensis*, *B. abortus*, *B. suis*, *B. ovis*, *B. neotomae* and *B. canis*. The *B. melitensis biovars (bvs)* 1-3 (mainly isolated from sheep and goats), *B. abortus* bvs 1-6 and 9 (from cattle and other bovidae), *B. suis* bvs 1-3 (from pigs), bvs.4 (from reindeer) and bvs.5 (from small rodents), *B. canis* (from dogs), *B. ovis* (from sheep) and *B. neotomae* (from desert wood rats). This classification is based mainly on differences in pathogenicity and host preference (Oreno *et al*., 2002). In the last decade, several 'new' marine species have been described including *B. pinnipedialis* (isolated from seals) and *B. ceti* (from whales and dolphins) (Foster *et al*., 2007), *B. microti* (isolated from the common voles (*Microtus arvalis*) and red foxes (*Vulpes vulpes*) (Scholz *et al*., 2008; Scholz *et al*., 2009) and lastly *B. inopinata* (isolated from a human breast implant wound and an as-yet-unknown animal reservoir) (Scholz *et al*., 2010). *B. inopinata* is the only specie that has not been isolated from any animal reservoir. The disease in cattle is usually caused by *Brucella abortus* and occasionally by *Brucella melitensis* and *Brucella suis*.

The Brucellae are small, non-motile, non-sporulating, non-toxigenic, non-fermenting, facultative, intracellular, Gram-negative coccobacilli parasites that may, based on DNA homology, represent a single species (Grimont *et al*., 1992; Moreno, 2002). The bacterium is 0.5-0.7µm in diameter and 0.6-1.5µm in length and it is oxidase, catalase and urease positive (Mantur *et al*., 2007). Brucella may produce urease and may oxidize nitrite to nitrate. Species and biovars are differentiated by their carbon dioxide

requirements; ability to use glutamic acid, ornithine, lysine, and ribose; production of hydrogen sulfide; growth in the presence of thionine or basic fuchsin dyes, agglutination by antisera directed against certain lipopolysaccharide epitopes, and susceptibility to lysis by bacteriophage (Alton *et al*., 1988).

Brucellae pathogens resist killing by neutrophils, replicate inside macrophages and in non-professional phagocytes and maintain a long lasting interaction with host cells (Donald *et al*., 2002). Target cells and tissues include throphoblasts, fetal lung, macrophages and the male and female reproductive organs (Adams, 2002). Historically, Brucellae are differentiated by host tropism, pathogenicity and phenotypic traits. A unique feature of this organism, unlike most pathogenic bacteria, is the lack of many classical virulence factors, such as exotoxins, capsule, flagella, fimbriae, plasmids, lysogenic phage, antigenic variation, cytolysins, pathogenic islands, or type I, II, or III secretion systems, making characterization of pathogenic mechanisms in this organism highly challenging (Boschiroli *et al*., 2002). Brucella virulence relies on the ability to survive and replicate in the vacuolar phagocytic compartments of macrophages. Many brucella virulent factor, such as Lipopolysaccharide (LPS) (Lapaque *et al*., 2005), Type IV Secretion System (T4SS) and the BvrR/BvrS two component system (Guzman *et al*., 2002), have been identified to be critical in the intracellular process of brucella inside macrophages (Xiang *et al*., 2006).

2.8 Manifestation of Brucellosis

2.8.1 Infection in cattle

The disease in cattle is usually caused by *Brucella abortus* and occasionally by *Brucella melitensis* and *Brucella suis*. The incubation period varies widely depending on exposure dose, previous vaccination, species, age, sex, stage of gestation, and susceptibility (Nicoletti and Gilsdorf, 1997). Brucellosis is characterised by late term abortion, infertility and reduced milk production as a result of retained placenta, endometritis and a varying degree of sterility in the males and cows (Radostitis *et al*., 2000). Cattle abortions due to *Brucella* usually take place at between six and eight months of gestation (Vandeplassche, 1982; Enright, 1990). Abortion is usually experienced at the first gestation in the third trimester period. Often, infected females will abort only once, although they may remain infected for their entire life (Foster, 2007).

In ruminants, *Brucella* organisms bypass the most effective host defences by targeting embryonic and trophoblastic tissues. In cells of these tissues, the bacteria grow not only in the phagosome but also in the cytoplasm and the rough endoplasmic reticulum (Anderson and Cheville, 1986). In the absence of effective intracellular microbicidal mechanisms, these tissues permit exuberant bacterial growth, which leads to foetal death and abortion. In fully susceptible herds, abortion rates may vary from 30% to 80% (Karimuribo *et al*., 2007). Chronic orchitis and fibrosis of the testicular parenchyma of infected bulls are frequently followed by impairment of semen production, and partial or permanent infertility (Rankin, 1965). In bulls, brucella infections may also be characterized by unilateral or bilateral enlargement of testicles resulting in decreased

sexual desire (libido) and infertility. Sometimes the disease is characterized by testicular atrophy resulting from fibrosis and adhesions (Musa and Johans, (1990), Geering *et al*., 1995). Generally, in most sub-Saharan countries, cattle seroprevalence estimates have been observed to range between 3 and 15% (Ghanem *et al*., 2009; Haileselassie *et al*., 2010; Jergefa *et al*., 2009; Muma *et al*., 2006b). Thereby, the organism may have propagated to remain either as latent infection or it may cause clinical manifestation of the disease (Kazi *et al*., 2005).

2.8.2 Infection in humans

Half a million cases of brucellosis are reported worldwide each year, but according to the WHO, these numbers greatly underestimate the true incidence of the disease in humans (WHO, 1997). Although human brucellosis is the most common bacterial zoonotic infection worldwide, it is still a neglected disease in Sub Saharan Africa where there is no much investment towards combating it (Pappas *et al*., 2006). In addition, human brucellosis is often misdiagnosed in developing countries due to its similarities with other febrile diseases such as malaria and typhoid (Paul *et al*., 1995) resulting in under reporting of cases. *Brucella melitensis* is more infectious to humans than *B. abortus* and in general is the dominant causative agent of human brucellosis. Disease caused by infection with *B. abortus* is generally indistinguishable from that caused by *B. melitensis* and may be equally severe (Dokuzoguz *et al*., 2005). The incubation period of the disease varies greatly, ranging from weeks to months. The clinical onset of human brucellosis is insidious and *Brucella* infections often develop as fever of unknown origin. The disease may be abrupt or insidious in onset, with an incubation period of 3 days to several weeks. Patients usually complain of nonspecific symptoms such as fever,

sweating, fatigue, anorexia, and muscle or joint aches. Acute brucellosis is characterized by non-specific systemic signs and clinical symptoms consistent with a flu-like or septicaemic illness, i.e. fever, fatigue, malaise, weight loss, headaches, arthralgia, myalgia, chills and sweating (Poiester *et al*., 2010). It is probable that diseases in both wildlife and cattle, if unchecked, could have serious repercussions for human health (Oloya *et al*., 2008; Cleaveland *et al*., 2007; Mwacalimba *et al*., 2013). Zoonoses such as brucellosis cause human illness, permanent disability and death (Zinsstag *et al*., 2007a). Economic impacts exist beyond the cost of control, including direct decreases in household income due to reduction in livestock/product sales, consumption impacts due to reduced food security, increased household vulnerability where livestock is used as a risk-coping mechanism and effects on household wealth which influence savings and gender equality (Birol *et al*., 2010).

2.8.3 Epidemiology of the disease

2.8.3.1 Disease transmission in humans

Human brucellosis is normally associated with the consumption of milk and other animal products contaminated with brucella organisms from infected animals, primarily ruminants such as cattle and goats (CDC, 2000 a,b). The people at risk are usually laboratory workers, veterinarians, farmers and slaughterhouse workers (Young, 1995). Among the four *brucella* species known to cause disease in humans (*Brucella abortus, Brucella melitensis, Brucella canis, Brucella suis*), *Brucella melitensis* is thought to be the most virulent and causes the most severe and acute cases of brucellosis; it is also the most prevalent worldwide (Galinska and Zagorski, 2013). *Brucella melitensis* may be acquired via exposure to animals or animal products or, in the case of laboratory

technicians, to specimens from animals (including humans) whose tissues are operated upon or submitted for culture or pathologic analysis (Bouza *et al*, 2005).

Brucella abortus is more widely distributed throughout the world than *B. melitensis* is, but it is less pathogenic for both animals and humans (Galinska and Zagorski, 2013). It has, however, been the most common cause of brucellosis in North America (Bouza *et al*, 2005). This species gives rise to mild-to-moderate sporadic disease that rarely causes complications. *Brucella suis* has been the second most common cause of brucellosis in North America. Infection with this species gives rise to a prolonged course of illness, often associated with suppurative destructive lesions. *Brucella canis* infection has a disease course that is indistinguishable from that of *Brucella abortus* infection. Its infection has an insidious onset, causes frequent relapses, and does not commonly cause chronic brucellosis. Although *Brucella pinnipediae* and *Brucella cetaceae* typically affect marine animals, they are now known to be capable of causing disease in humans (mainly neurobrucellosis). Ingestion of unpasteurized goat milk and related dairy products is the main route by which *Brucella melitensis* is transmitted to humans. Slaughterhouse workers, primarily those in the kill areas, become inoculated with brucellae through aerosolization of fluids, contamination of skin abrasions, and splashing on mucous membranes (Alizadeh *et al*., 2015). Farmers and shepherds have similar exposure risks, and they also have exposure to aborted animals. Veterinarians are usually infected by inadvertent inoculation of animal vaccines against *Brucella abortus* and *Brucella melitensis.* Laboratory workers (microbiologists) are exposed by processing specimens (aerosols) without special precautions (Abdalla, 2011). Occupational exposures tend to be isolated. A large-scale outbreak of the infection

should raise suspicion that a biologic weapon has been released, most likely via an infectious aerosol.

2.8.3.2 Disease transmission in animals

In animals, *Brucella* infections are widely distributed in domesticated animals, especially in the developing world (Corbel, 1997; Godfroid, 2002). Cattle infections are commonly caused by *B. abortus* (Corbel, 1997). In cases where cattle come in contact with infected pigs or goats, *B. suis* and *B. melitensis* infections may take place (Corbel, 1997; Godfroid, 2002). However, the two strains usually cause less severe disease in cattle (Chimana, 2012). Infection is most commonly through ingestion, contact with foetal and placental contents. *Brucella abortus* can also be transmitted through coitus (Foster and Smith, 2008).

2.8.4 Geographical distribution of brucellosis

Brucellosis is named after Sir David Bruce, who in 1886 isolated the causative agent from a soldier in Malta where the disease caused considerable morbidity and mortality among British military personnel. During the 19th century, brucellosis was thus known as Malta or Mediterranean fever (Charters, 1980). However, brucellosis has very old history, as organisms resembling *Brucella* had been detected in carbonized cheese from the Roman era (Capasso, 2002). Brucellosis is found worldwide but it is well controlled in most developed countries (Refai, 2002). Clinical disease is still common in the Middle East, Asia, Africa, South and Central America, the Mediterranean Basin and the Caribbean (Capasso, 2002). *Brucella* species vary in their geographic distribution. *B. abortus* is found worldwide in cattle-raising regions except in Japan, Canada, some

European countries, Australia, New Zealand and Israel, where it has been eradicated (Halling and Boyle, 2002). Eradication from domesticated herds is nearly complete in the U.S (Cheville *et al*., 1998). *Brucella abortus* persists in wildlife hosts in some regions, including the Greater Yellowstone Area of North America (Jacques and Kasbohrer, 2002). *Brucella melitensis* is particularly common in the Mediterranean. It also occurs in the Middle East and Central Asia, around the Persian Gulf (also known as the Arabian Gulf) and in some countries of Central America (Cheville *et al*., 1998). This organism has been reported from Africa and India, but it does not seem to be endemic in northern Europe, North America (except Mexico), Southeast Asia, Australia or New Zealand (Guzman, *et al*., 2002).

In the past, *B. suis* was found worldwide in swine raising regions. This organism has been eradicated from domesticated pigs in the U.S., Canada, many European countries and other nations (Halling and Boyle, 2002). However, it persists in wild or feral swine populations in some areas, including the U.S., Europe and Queensland, Australia. Sporadic outbreaks are reported in domesticated herds or humans due to transmission from this source. *B. suis* continues to occur in domesticated herds in some countries of South and Central America (including Mexico) and Asia. *B. suis* biovars 1 and 3 are found worldwide, but other biovars have a limited geographic distribution (Mangen *et al*., 2002). Biovar 2 occurs in wild boar in much of Europe. Biovar 4 (rangferine brucellosis) is limited to the Arctic regions of North America and Russia including Siberia, Canada and Alaska. Biovar 5 (murine brucellosis) is found in the former USSR. *B. canis* probably occurs throughout most of the world; however, New Zealand and Australia appear to be free of organism. Although its distribution is

worldwide, brucellosis is more common in countries with poorly standardized animal and public health programme (Capasso, 2002).

The routes of infection are multiple i.e., food-borne, occupational or recreational, linked to travel and even to bioterrorism. New *Brucella* strains or species may emerge and existing *Brucella* species adapt to changing social, cultural, travel and agricultural environment (Godfroid *et al*., 2005). The incidence of reactors in newly established cattle farms may be more than 30%, however, the highest rate (72.9%) of infection till now has been reported in the Palestinian Authority (Shuaibi, 1999). It is interesting to note that the second highest prevalence (71.42%) of brucellosis has been reported in mules from Egypt (WHO, 2007).

2.9 Theories of Well-being and Sustainable Livelihood Approach on Brucellosis

This study was guided by theories of well-being and the sustainable livelihood approach (SLA) in order to conceptualize the impact of brucellosis on household livelihood, well-being and poverty due to decrease of household income caused by a decrease in cattle and livestock products. These theories were applied in this study in order to link the socio-economic well-being of household and other variables which could have direct impact on household socio-economic well-being such as “stress” and “shock” which may hinder sustainable development within households due to losses caused by brucellosis.

2.9.1 Sustainable livelihood approach (SLA)

Chambers and Conway (1992) defined a sustainable livelihood as a livelihood comprising the capabilities, assets as activities required for a means of living. A

livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource.

Chambers and Conway (1992) discussed the complexity and diversity of individual livelihoods as well as social and environmental sustainability livelihoods. They suggest a measure of 'net sustainable livelihoods', which encompasses 'the number of environmentally and socially sustainable livelihoods that provide a living in a context less their negative effects on the benefits and sustainability of the totality of other livelihoods everywhere. It could also be argued that extrapolating the idea of 'net sustainable livelihoods', to the global level, captures far more of the political trade-offs that would be entailed in the creation of sustainable livelihoods for all (Mdee, 2002). As it is, the idea of sustainable livelihoods has been reduced to a more benign conception of the way in which individuals or households manage their resources (Beall, 2001). However, Cowen and Shenton (1998) defined sustainable development by describing two forms of development as *immanent development* (or what people are doing anyway) and *intentional* (or interventionist) development. Thus, immanent development denotes a broad process of advancement in human societies driven by a host of factors including advances in science, medicine, arts, communication, governance etc. while intentional development is a focused and directed process whereby government and non-government organisations implement developmental projects and programmes (typically a set of related projects) to help the poor. An asset may not necessarily be owned by a household for it to be an important contributor to livelihood. As long as the household has access to it then it will help. On one hand there is a requirement for a sustainable

livelihood to be able to recover from “stress and shocks” but it must also be able to “maintain and enhance” capabilities and assets into the future. A central element in this ‘resilience’ to stress and shocks may well be the diversification of elements that comprise ‘livelihood’. Hence, a more diverse livelihood base could arguably be seen as more sustainable shocks since one or more components can be compensated for by an enhancement of others. But this is conjecture and may not always be the case.

2.9.2 Theories of well-being

Well-being is, by definition, what is good for a person. If a person achieves well-being in life, one may not have lived a morally perfect life and his life may not have made any great contribution to art, world peace or progress, but a person will have lived a life that is good for his satisfaction (Brandt, 1979). Even though a good life in this sense is not the same as a perfect life, well-being is still an ideal. It is something all persons strive for and certainly do not all achieve it. The well-being may be diminished by health problems, low productivity, bad financial luck, the death of a loved one, poor planning, or many other factors (Brandt, 1979).

There are a variety of different theories of well-being in philosophy and in psychology that take well-being to be an ideal to different degrees. Some theories define well-being in terms of people’s psychology to a much greater degree than others. Theories that define well-being in terms of psychology directly keep the ideal down to earth. Other theories define well-being in terms of objective values or the perfection of human nature and these theories let the ideal move farther away from people’s actual psychological perspective. These two approaches present us with a trade-off. The more

well-being is defined in terms of people's subjective psychological states, the less ideal it seems and the less it looks like something of value that could be an important aim of human life. On the other hand, the more we define a person's well-being in terms of objective features of the world that do not have to do with his or her psychological state, the less it looks like something with which a person should obviously be concerned or something he or she has a reason to promote.

Some theories of well-being in philosophy and in psychology define people's well-being as to live well and getting what you want, feeling satisfied, experiencing pleasure, or the like (Arneson, 1999). Other theories take well-being to be something that is not defined by psychology rather define well-being in terms of objective values or the perfection of human nature (Diener, 2006). According to Diener (1984), many psychologists think that well-being consists in life satisfaction with more pleasant feelings than painful ones. Some philosophers agree that well-being should be defined in terms of mental states such as pleasure and pain. According to hedonism about well-being, the good life for a person is a life that has the most pleasure and the least pain (Crisp, 2006; Feldman, 2004). Other philosophers and economists think that desires or preferences are the right psychological state to focus on. According to the desire satisfaction theory of well-being, the good life for a person consists in getting the most of what he/she ultimately wants over the course of his/her lifetime (Heathwood, 2006; Heathwood, 2005). According to eudaimonism, for instance, the good life for a person is the one in which he/she fulfils his/her human nature, where what counts as a person's nature has much to do with what is normal for members of the human species not with what this particular person happens to like (Foot, 2001). Objective list theories of well-

being noted that a good life for a person is one in which he/she achieves certain objective goods such as friendship, knowledge and pleasure (Arneson, 1999 and Finnis, 1980).

2.10 Burden of Disease and Poverty

Poverty in its most general sense is the lack of necessities. Basic food, shelter, medical care, and safety are generally thought necessary based on shared values of human dignity. However, what is a necessity to one person is not uniformly a necessity to others. Needs may be relative to what is possible and are based on social definition and past experience (Sen, 1999). Valentine (1968) observed that "the essence of poverty is inequality. In slightly different words, the basic meaning of poverty is relative deprivation." A social (relative) definition of poverty allows community flexibility in addressing pressing local concerns, while objective definitions allow tracking progress and comparing one area to another. According to Michael Darby (1997), poor health contributes to poor life and therefore he aimed to benchmark the progress of poverty programs for the war on poverty in USA. However, Kayunze (2014) argued that healthier people are more productive and that wealthier people can obtain things that make them healthier. According to Savedoff and Schultz (2000) reduced exposure to disease was positively associated with the health of adults and also with greater individual income-generating capacity. With respect to animal health, the burden of disease affects not only livestock keepers but also consumers of livestock products (Kayunze *et al*., 2012). Besides the problem of market imperfections, livestock diseases affect much the ability of livestock farmers through low productivity and mortality of their livestock and thus, animal diseases contribute to impoverishing them (Kayunze *et*

al., 2012). According to Otte *et al*. (2009) 42% of the poor, worldwide, are dependent on livestock for their livelihoods but that imperfect or missing markets often trap them in low income equilibriums, preventing them from benefiting from the increased demand for animal protein. In view of this, it has been contended that if poverty alleviation is a policy goal, then policy makers should identify, design and implement public actions that would allow poor livestock producers to take advantage of the increasing demand for meat, milk, and eggs (Cooker *et al*., 2011).

2.11 One Health Practice and Infectious Diseases Control

The term 'One Health' could be defined as the interdisciplinary approaches and actions involving strong cooperation primarily between physicians and veterinarians so that the health of people and animals could be ensured including the safety of the environments through with improved cooperation between the two (Pal *et al*., 2014). The concept of 'One Health' represents a unique and significant opportunity for veterinary medicine to be in a leadership role and to work collaboratively for ecosystem health (a community of humans, animals, and plants interacting with one another and with their physical environment) for the greater good of society (Chaddock, 2012). According to Templeton *et al*. (1988), about 75% of the emerging human infectious diseases are directly or indirectly linked to animals, i.e. zoonotic in nature. This phenomenon highlights the importance of health scientists (veterinarians, physicians, etc.) working together in co-equal teams. Dealing with the implications of this information requires nothing less than a holistic, collaborative approach among all scientific disciplines involved.

The One Health approach attempts to recognize that numerous disciplines across many sectors are required to solve the complex problems facing public health. It takes a

holistic approach to address human, animal, and ecosystem health. It emphasizes on multi-sector, transdisciplinary action across professions to ensure well-being within human, animal, and ecosystem interfaces (Papadopoulos, 2011). It is a modern global movement to promote collaborative efforts between different health related professionals, including medical doctors, veterinarians and many other scientific, health, environmental and other related disciplines. Although there is not an agreed One Health definition, a useful one is; "the collaborative effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals and our environment (Bousfield and Brown, 2011).

One of the major issues in the control of infections transmissible to man and animals is the lack of or limited joint approach to improve the situation. Thus, the need for joint action with a combination of technologies and collaboration between both medical and veterinary professionals must be looked into (Mbugi *et al*., 2012). It is estimated that the direct cost of zoonotic diseases control in 2000's has been estimated to be more than USD 20 billion, with over USD 200 billion worth of indirect losses to affected economies as a whole (World Bank, 2010). Successful investment in zoonoses control requires assessment of the cost of disease and the cost-effectiveness of proposed interventions, in addition to adaptation of the interventions to the local context (Narrod *et al*., 2012). Given that 70% of the world's rural poor depend on livestock and working animals for their livelihoods, animals cannot be left out of the solutions (FAO, 2002).

Zoonoses control is unique in that effective interventions may lie outside the health sector because transmission often does not occur between humans, but only from

animals to human, as it occurs in rabies or brucellosis. In addition, WHO (2006) proposes the framework given in Figure 2.2. The framework is good as it takes forward the ambitions of One Health to application. However, thinking about it critically, one finds that it overlooks the social ecosystem and the roles of socio-economic and cultural aspects. For instance, people's behaviour such as hunting and consuming bush-meat or close interaction with domestic animals that is generally popular in the developing world, and Zambia in particular, may be a source of pathogens that may increase the risk of exposure to zoonotic diseases.

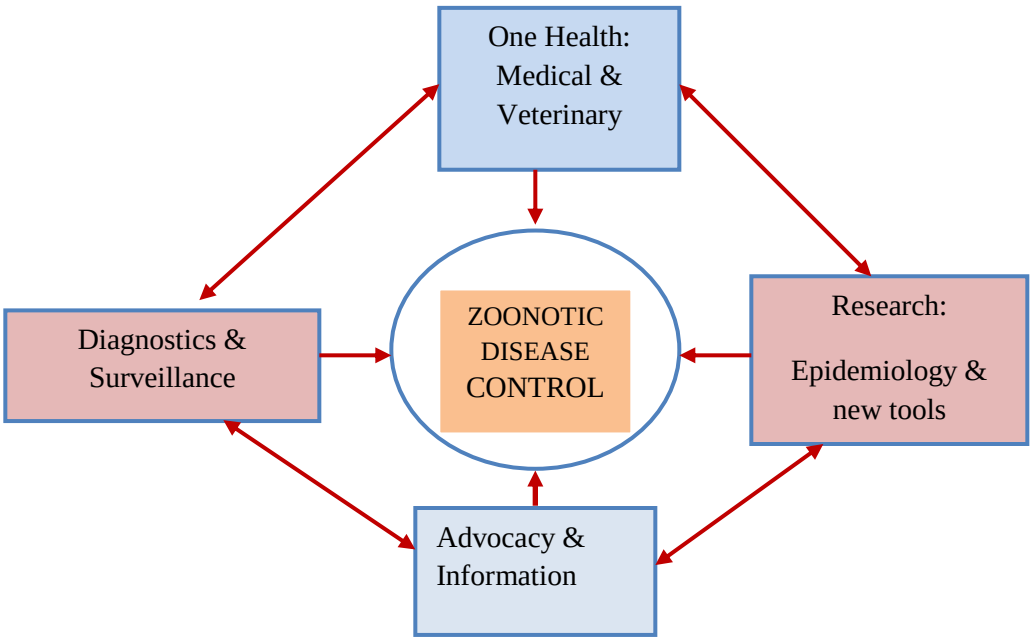

Figure 2.2: A Framework proposed by WHO (2006) for collaboration to stem zoonoses

2.12 Livestock and humans interactions

Interactions between livestock and humans can favour the spread of the pathogens either directly to people through contact with livestock, contact with contaminated livestock products, or consuming livestock products, including meat (Kayunze *et al*., 2012).

Interactions among the members of the natural ecosystems (e.g. human encroachment and land use) food and agriculture systems (e.g. expanding agricultural production); and human living environments (including increasing population density and growth) can lead to disease occurrence or infection spread. In their analysis of trends, Jones *et al.* (2008) concluded that the majority of emerging infectious diseases of humans (71.8%) originate from animals.

Interactions among wildlife, livestock, and humans are also explained by two theories: the Island biogeography theory (MacArthur and Wilson, 1967) and the parasite-stress theory of human sociality (Reperant, 2010). The former states that pathogens that lead to disease occurrence are identified at three levels of interactions within species sources of pathogens, interactions between recipient host species and species sources of pathogens, and interactions within recipient host species (MacArthur and Wilson 1967). The latter states that humans' ontogenetic experiences with infectious diseases as well as their evolutionary historical interactions with these diseases exert causal influences on human psychology and social behaviour (Thornhill, 2010). This theory emphasizes the causal role of non-zoonotic parasites, which are characteristic of disease transmission from one person to another one, rather than zoonotic parasites which transmit diseases from vertebrate animals to humans.

2.13 Common Infectious Diseases

It is well known that an infectious disease is one that is caused by pathogenic micro-organism, such as bacteria, viruses, parasites or fungi. Infectious diseases may be grouped into re-emerging (lingering) and emerging (relatively new) zoonoses that affect both animals and humans, and re-emerging and emerging non-zoonotic diseases, which

are specific either to animals or to humans (Kayunze *et al*., 2012). According to WHO/FAO/OIE (2004), an emerging zoonosis is defined as "a zoonosis that is newly recognized or newly evolved, or that has occurred previously but shows an increase in incidence or expansion in geographical, host or vector range".

Some examples of emerging zoonoses are avian influenza, Bovine Spongiform Encephalitis (BSE) and the Nipah virus. Unlike such relatively new diseases, some ancient diseases are re-emerging as public health problems for a number of reasons. They are known as lingering or neglected zoonoses. WHO (2006) lists seven of them and is concerned about the tendency that they seem to attract less public awareness. The seven diseases on the list are anthrax, bovine tuberculosis, brucellosis, cysticercosis/neurocysticercosis/cystic echinococcosis or hydatid disease, rabies, zoonotic sleeping sickness or Human African Trypanosomiasis (HAT), and food-borne zoonoses including *Salmonella* (Salmonellosis), *Campylobacter* (Campylobacteriosis), and *Escherichia coli* infections of animal origin affecting millions of people annually. About 60% of human pathogens are zoonotic in the sense that they are a species infectious to, and capable of causing disease in, humans under natural transmission conditions (Shaw, 2009). The same authors also reported that nearly three-quarters of zoonoses are emerging and re-emerging diseases, including avian influenza, severe acute respiratory syndrome (SARS), West Nile virus, and Nipah virus.

2.14 Measuring the Burden of Disease in Humans and Livestock

Efforts to control diseases are meant to reduce or obliterate the burden of disease, which is a measure of financial cost, mortality, morbidity, or other indicators for human and

animal health at the individual, community, herd/flock, farm, national, or global level due to diseases (Shaw, 2009).

2.14.1 Measurement of burden of disease in humans

Disease burden in humans is normally measured in terms of Disability-Adjusted Life Years (DALYs). A DALY is equivalent to the loss of one year of ‘‘healthy’’ life and allows the burden of disease in a population to be measured as the gap between current health and an ideal situation where everyone lives to old age, free of disease and disability (Mathers *et al.,* 2001).

2.14.2 Measurement of burden of disease in livestock

Different from humans where monetary values to people’s losses of life complicates calculation of burden of disease, in animals the calculation is directly linked to direct losses due to illness and death which have objective monetary values (Kayunze *et al*., 2012). However, the calculation is somehow complicated due to various roles of animal species to humans in the society (Muma, *et al*., 2014). In spite of the complexities in calculating burden of disease in animals, Table 2.1 below suggests how this could be done.

Table 2.1: Ways of calculating burdens of disease in livestock

Affected livestock	Direct losses due to ill health or death		Costs of treating and caring for affected livestock and costs of prevention	
	Non-monetary losses	**Monetary losses**	**Animal keepers**	**Veterinary services**
Livestock	Society values farming and the presence of livestock, particularly breed and species diversity	The steps involved in calculating the losses due to disease in livestock (valuing mortality and the components of morbidity)	Livestock keepers' costs consist of expenditure on veterinary pharmaceuticals, veterinary care and, often very substantial, investments of livestock keepers' time	Veterinary public health services are involved in diagnosis, treatment, prevention (e.g. vaccination) and in food hygiene (e.g. abattoir inspections). Such costs are usually recorded
Companion animals	People derive psychological and health benefits from keeping companion animals, some of which could be quantified in DALYs	• Some companion animals, such as guard dogs, actually fulfil an economic role which could be quantified • Companion animals are bought and sold, and so have an economic price	In affluent countries substantial sums of money are spent on caring for companion animals. Owners' time and costs could thus be estimated	Public services are involved in dealing with zoonoses in companion animals. Such costs are usually recorded

Source: Rushton (2009)

2.15 Knowledge Gaps of Socio-economic Impact of Brucellosis in Zambia

Despite the knowledge of prevalence and risk factors associated with brucellosis in Zambia, gaps on the socio-economic impact of the disease on cattle farmers' well-being still exist (Muma *et al*., 2011). These may have significant impact on productivity in both humans and animals as well as on the livelihood of the farmers. In summary, the gaps include:

- Lack of information on the monetary value of calves lost due to abortions which are caused by brucellosis in cattle;
- Lack of information on the monetary value of milk lost which is attributed to brucellosis;

- Lack of information on the monetary value of prolonged calving to conception interval which is caused by brucellosis;
- Inadequate knowledge of the different socio-economic well-being levels between farmers household level; and
- Lack of understanding of the One Health initiative and its application as a framework under which control measures for brucellosis and other zoonoses can be implemented.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Description of the Study Area

This study was carried out in the regions of Zambia that are known to be endemic for brucellosis in livestock, these included Mongu and Senanga districts in the Western province and Namwala and Monze districts in the Southern province (Figure 3.1).

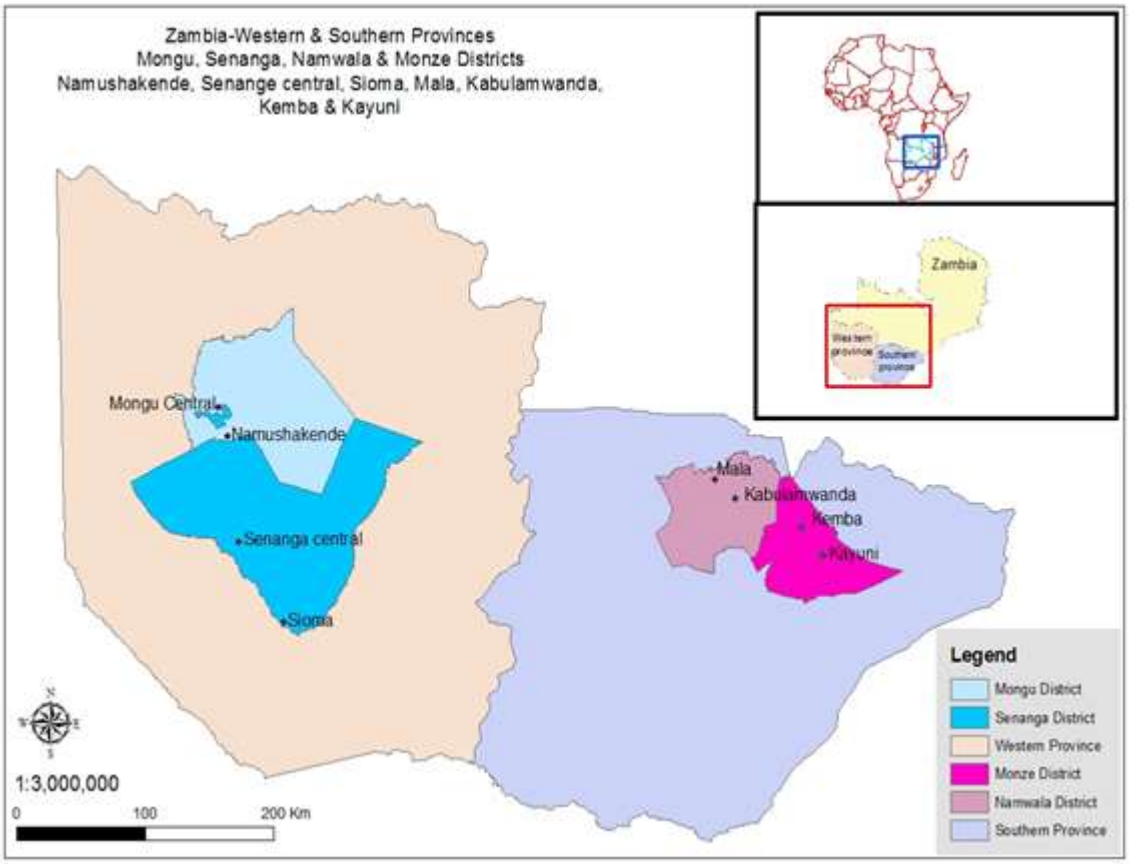

Figure 3.1: Map of Zambia showing study provinces (A) and districts of research (B)

3.1.1 Western province

The Western province has seven districts namely; Kalabo, Kaoma, Lukulu, Mongu, Sesheke, Senanga and Shang'ombo. The province covers an area of about 126, 386 km^2. The Barotse flood plain of the Zambezi River and the sandy soils are the prominent physical features. The province lies between the latitudes 14^0S and 17^0S and longitudes 22^0E and 25^0E (Sinkala, 2015). The province borders with Angola and Namibia. The main economic activity for the people of the Western province is livestock production, especially cattle rearing, followed by fishing and crop production. Apart from paddy (rice) which is produced in most parts of the province, cassava and maize are other crops produced. Out of the seven districts in the Western province, two were purposely selected for this research i.e. Mongu and Senanga. The choices of the province and districts was based on the fact that the Western province is one of the major livestock producing provinces and brucellosis has been reported (Muma *et al*., 2012). A study conducted in the Western province by the District Veterinary Office in 2015 showed that the overall seroprevalence of brucellosis was 16%. Moreover, Western province has had the highest incidence of extreme poverty in the country over the years (64%), putting the levels of poverty in the province above the national average (MDG's progress report, 2013).

3.1.2 Southern province

The Southern province covers a total land surface area of 85,283 km^2 and shares borders with Zimbabwe, Botswana and Namibia. Within the country, the province shares boundaries with the Central, Lusaka, North Western and Western provinces. Choma is the new provincial administrative capital after it moved from Livingstone and is

moderately urbanised. The province lies between the latitudes 16^0S and 30^0S and longitudes 27^0E and 00^0E. The main economic activity for the people of the Southern province is livestock keeping, especially cattle rearing and crops production, with maize being produced in most parts of the province. Cassava and sugar cane are the other crops produced in the province. Out of the thirteen districts; two were purposely selected for this research i.e. Namwala and Monze. The choice of the province and districts was based on the fact that the Southern province is one of the major livestock producing provinces. Also, the incidence of brucellosis, at animal level, has been reported to vary between 14% and 22% (Muma *et al*., 2013). According to Human Development Report (2013), almost half (47.3%) of the population in the Southern province is living in extreme poverty. Brucellosis has been shown to be present in both traditional and commercial sectors, but is more prevalent in the former (Sinkala, 2015). Generally, *Brucella* infections contribute significantly to abortions in traditional cattle in both Western and Southern provinces, where it was assumed that 74% of the herds were infected (Muma, *et al*. 2013).

3.2 Study Design

The research used a mixed methods cross-sectional design. A key feature of mixed methods research is its methodological pluralism or eclecticism, which frequently results in superior research compared to mono-method research (IDRC, 2003). Further, the cross-sectional design was chosen because collecting data at a single point in time, is economical in terms of time, financial resources and nature of the study objectives (Kothari, 2004).

3.3 Study populations, Sampling Units, and Sampling Procedures

3.3.1 Populations for the research

The study population was household heads and 400 households were included in the four districts. In the absence of household heads, one family member who was eighteen years and above was selected by the household head to be interviewed. The inclusion criteria used was all households with current and previous history of brucellosis in cattle herds. The exclusion criteria used was all households with no cattle and those with cattle but had no history of brucellosis.

3.3.2 Sampling units and sample size for the questionnaire survey

The households sample size was estimated based on the formula by Eng (2003) for estimation of a sample size for a proportion:

$n = 1.96^2 p\,(1- q)/d^2$

Where n = sample size;

Standard normal deviation set at 1.96, corresponding to 95% confidence level

p = estimated prevalence (Estimated to be 15 percent)

q = 1-p, and

d = the desired absolute precision of the estimate (Assumed desired absolute precision was 5 percent.

Therefore, $n = \frac{(1.96)^2\ 0.15(1- 0.15)}{(0.05)^2}$

This gave an estimated sample size of 196 households for each province making a total of 392 households for the two provinces to be included in the questionnaire survey.

The sampling frame (list of households in each village) was drawn using District Veterinary Officers (DVOs) and local leaders in the districts. Questionnaires were administered to obtain information about the history of occurrence of brucellosis in cattle in each household and other variables under investigation. A household was described as having had brucellosis if there were confirmed reports of abortions occurring during the third trimester periods in the cattle within a herd and was diagnosed as such by the district veterinary officer. Therefore, all information that was collected on presence or absence of the disease for each household were cross-checked with the data at the district veterinary offices. Other information collected in the questionnaire included household losses and expenditures, socio-economic well-being levels, attitude towards using livestock health services, extent to which livestock health services were affordable, household size and education levels of household heads and sex of household head.

3.3.3. Sampling procedures

3.3.3.1 Sampling districts

Four districts, two from each province, were purposively selected because of their livestock production system, which was mainly traditional and also the history of brucellosis in cattle herds. In the Western province, Mongu and Senanga were selected while in the Southern province Namwala and Monze were included in the study.

3.3.3.2 Sampling households, and focus group discussions' participants

Households were purposively selected based on the confirmed history of brucellosis in their herds by the District Veterinary Officers. Participants for focus group discussions

were selected through the pre-determined numbers of farmers in the communities where questionnaire-based data were collected.

3.4 Data Collection

Data collection began in the second week of November 2014 and was completed after seven months (i.e. June 2015). Qualitative as well as quantitative data collection was preceded by a pilot study that was conducted by the researcher and three trained research assistants one month before the actual data collection started to test research tools. After the pilot study, some adjustment were done to the household questionnaire in order to make it more accurate and relevant.

3.4.1 Methods of data collection

Both primary and secondary data were collected. For primary data, three methods were used i.e. household questionnaire, focus group discussions and key informant interviews. Secondary information was obtained through literature review in order to widen the knowledge of a researcher on the topic.

3.4.2 Instrument for data collection

A structured questionnaire was the main instrument for the research. All questionnaires were administered by the principal investigator with the assistance of three (3) research assistants. For the household questionnaire, interview schedules were used whereby the questionnaire copies were held by the researchers who read the questions to household heads or adult household members authorised by the household heads. Other instruments used to collect data were; a focus group discussions guide for the focus group discussions (FGDs) with community members in order to have information that

complimented the one obtained from the household questionnaire and an interview guide for key informant interviews in order to make sure that information about One Health collaboration was well captured and useful for analysis. The FGD guide was handled by the principal investigator with assistance of a local language translator. An interview guide was also used to collect data from the respondents in the policy departments of Ministry of Health, and Ministry of Fisheries and Livestock to collect information about One Health policy establishment and its implementation.

3.4.2.1 Economic model used to estimate losses and costs due to brucellosis

Costs and losses due to brucellosis at household level were estimated using economic model adapted from Angara *et al*, (2016). The information about households costs and losses were obtained by asking the household heads to estimate the losses and expenditures that they had incurred during the past 12 months (one year). The information used in the calculation of losses and costs included the number of abortions, quantity of milk lost due to brucellosis, prolonged inter-calving period, and costs of veterinary intervention. Costs and losses were estimated in domestic currency; the Zambian Kwacha (ZMW) and the equivalent international currency (USD); the exchange rate was 1 USD to 11.45 Zambian Kwacha (ZMW). However, the model was modified to fit the traditional livestock management system as follows.

Total Economic Losses = LMT + LMD

Whereas;

TEL (Total economic loss) = LMT (Economic loss due to mortality) = number of cow died due to metritis x average price of mature cow

LMD (Losses due to Morbidity) = Economic loss due to morbidity

LMD = ML + CL+LRB+ CVI

Whereas;

ML (value of milk lost) = (Milk losses of aborted cows + milk losses of non- aborted cows) x price of milk/kg.

CL (value of calves lost) = (number of mature females x abortion rate of seropositive) x average price of weaning calf.

LRB (Losses due to repeat breeding) = number of repeat breeders x cost of repeat breeding per cow.

CVI (cost of veterinary intervention) = number of seropositive aborted cows x cost of veterinary intervention.

Information about the effect of a disease on productivity parameters were obtained from the field survey. In their absence, the necessary parameters were estimated from the secondary information such as district veterinary reports.

3.4.2.2 Evaluation of attitude towards using livestock health services

In order to determine attitude towards using livestock health services, a questionnaire incorporating a 60-point Likert scale was used, which comprised 12 statements, 6 of which had positive connotations while the other 6 had negative connotations. One would score a minimum of 12 points, if one replied strongly disagree (1 point) to all the statements, and one would score a maximum of 60 points if one replied strongly agree (5 points) to all the statements. The other alternative answers were disagree (2 points), undecided (3 points) and agree (4 points). However, in order to make analysis more

accurate, only three options were used by collapsing strongly disagree and disagree into disagree, leaving undecided intact and collapsing agree and strongly agree into agree. Overall, 12 to less than 35 points scored denoted unfavourable attitude, 36 points scored denoted neutral attitude and more than 36 points scored denoted favourable attitude.

3.4.2.3 Evaluation of attitude towards One Health practice in Zambia

In order to determine attitude towards One Health practice in Zambia, a questionnaire incorporating a 100-point Likert scale, which comprised 20 statements, 10 of which had positive connotations while the other 10 had negative connotations was used. One would score a minimum of 20 points, if one replied strongly disagree (1 point) to all the statements, and one would score a maximum of 100 points if one replied strongly agree (5 points) to all the statements. The other alternative answers were disagree (2 points), undecided (3 points) and agree (4 points). However, in order to make analysis more accurate, three options were used by collapsing strongly disagree and disagree into disagree, leaving undecided intact and collapsing agree and strongly agree into agree. Overall, 20 to less than 60 points scored denoted unfavourable attitude, 60 points scored denoted neutral attitude and more than 60 points scored denoted favourable attitude.

3.4.2.4 Determining the socio-economic well-being levels of households

Socio-economic well-being was determined by using eight indicators of capabilities that were: being able to eat 3 meals per day; being well sheltered; being able to escape avoidable morbidity; households having at least a member having a self or salaried employment; being able to sell livestock and or crop products whenever one liked; being able to pay school fees for secondary school children belonging to the households;

having been able to buy new (not second-hand) clothes during the previous 12 months; and having the freedom to live the way they would value, so long as they do not break the laws. On meals eaten per day, one would score 1, 2, or 3 if one's household members had the ability to eat 1, 2, or 3 meals per day, respectively. On each of the other indicators of capability, one would score 0 or 1 depending on whether one's household lacked or had the relevant ability, respectively. The eight indicators of human capabilities were used to compose an index with 10 points, which were subsequently grouped into five categories of 2 point-intervals, the first one being that of the very poor (1 to 2 points). The other categories were for those who were poor (3 to 4 points), neither poor nor rich (5 to 6 points), rich (7 to 8 points), and very rich (9 to 10 points) (Kayunze, 2014).

3.4.2.5 Ranking opportunities for and challenges towards the One Health practice

A self-administered questionnaire and a checklist guide were used to collect data from the respondents in the MoH and MFL. Information was collected on the One Health policy formulation and implementation, collaboration between veterinary and human health personnel from the ministerial level to districts using a pair wise ranking method. Therefore, fourteen statements of opportunities for and another fourteen statements of challenges between medical and veterinary officers in dealing with zoonotic diseases were compiled to determine the extent to which each statement held by using pair-wise ranking method. The ranking was done by mentioning two factors at a time and asking the respondents which of them presented a more important opportunity or a more serious challenge, according to their views. The procedure was done repeatedly until every opportunity was compared with all the other opportunities and every challenge was

compared with all other challenges. Each opportunity and challenge was mentioned by every respondent at most 13 times, thus the score for each one of them ranged from 0 to 13. The average number of times out of 13 that every opportunity or challenge was mentioned was expressed as a percentage over 13.

3.4.3 Focus group discussions

Eight focus group discussions (FGDs) were conducted with 96 participants, i.e. 12 (6 males and 6 females) in each of the eight villages selected in order to supplement and qualify the information obtained through the questionnaire interview. Participants were invited two days in advance. In each district (Namwala, Monze, Mongu, and Senanga), a session of group discussion was held. The groups comprised of youths and adults who were livestock farmers. The groups were also combined according to age and sex. Each group was made up of 8 to 12 participants. In some sessions, participants sat on chairs, while in other sessions participants sat in a circle under a tree. The principal researcher and one research assistant facilitated the discussions. The principal researcher served as the moderator while the research assistant was a recorder of the discussions. The principal researcher introduced himself and then introduced the recorder/note taker. The local languages (Tonga and Ila in Southern province and Lozi in Western province) were used during discussions. The moderator introduced the topic and allowed the group to discuss. All the discussions were recorded by a voice recorder and later transcribed into English language (Figure 3.2 and 3.3).

Figure 3.2: One of the focus group discussion sessions with communities in Mongu, Western province on the impact of brucellosis on household well-being.

Figure 3.3: One of the focus group discussion sessions with communities Namwala, Southern province on the impact of brucellosis on household well-being.

3.4.4 Key informant interviews

A maximum number of ten key informant interviewees were selected from four districts of research and two ministries. Therefore, two persons were selected in each of the four districts, namely DVO and District Medical Officer (DMO) and other two key informants were selected from the Ministry of Health and Ministry of Fisheries and livestock. The key informant interviews were guided by a semi-structured checklist. Information collected included the most common zoonotic livestock diseases in the district, awareness about the One Health approaches among medical, livestock and wildlife officers, factors which could hinder or enhance collaboration among medical, veterinary, and wildlife officers, number of dip tanks which are accessible in the district, average prices for livestock products in their districts, the extent to which they thought brucellosis was a problem in the district as compared to other zoonoses and most common human diseases in the district, and whether medical personnel used veterinary databases, and vice versa; and to identify factors which could enhance or hinder the establishment of policy which may support the One Health practice.

3.5 Data Analysis

Both quantitative and qualitative methods of data analysis were employed. For quantitative methods, descriptive and inferential statistics were used. In descriptive statistical analysis, frequencies, percentages, means, standard deviations, minimum and maximum values of individual variables were computed. In inferential analysis, Independent Sample t-test, Cross tabulations and Ordinal logistic regression were computed to determine the relationship between and among variables, and ANOVA was used to test the hypotheses of the study.

Qualitative data from the FGDs and key informant interviews were analysed thematically using Nvivo software version 10 and codes were created and assigned to categories according to the themes that emerged in order to examine the relationships and trends in the data. To illustrate the views and perceptions reflected in the FGDs and key informants interviews, the data were presented in the form of anonymous quotes, selected on the basis of their representativeness, appropriateness and revealing quality.

3.5.1 Data analysis, editing, coding and processing

Questionnaire-based data was analysed using the Statistical Package for Social Sciences (IBM-SPSS, New York.) programme version 22. Descriptive statistics were generated for all variables under study. One-way analysis of variance (ANOVA) was used to determine whether households with lesser or higher costs and losses of brucellosis had different socio-economic well-being level. Furthermore, the null hypothesis was tested using ANOVA. The null hypothesis was that socio-economic well-being levels do not differ significantly between households where there is less impact of brucellosis in livestock and those where the impact is higher; and the second hypothesis was socio-economic well-being levels differ significantly where there is less burden of brucellosis in livestock and where such burden is higher. However, the ordinal regression model (Hosmer and Lemeshow, 2000) was used to determine which set of variables were predictors of the socio-economic economic well-being of a household. The predictor variables that were considered were education level of household head, household size, household monetary costs and losses due to brucellosis, attitude towards using health care services for livestock, household per capita losses, affordability of livestock health

services and lack of money to pay for livestock health services. The signs of the regression coefficients (estimates) were used to interpret the model (Chen and Hughes, 2004). All statistical tests were considered significant at $p \leq 0.05$.

Qualitative data from FGDs and the key informant interviews were analysed using Nvivo version 10 to summarise contentions, agreements and disagreements among members of various groups. Their arguments were compared with those given by individuals from structured interviews using the three questionnaire sets.

3.6 Ethical Considerations

Ethical clearance was sought from ERES Converge IRB research committee, Zambia (Ref. No. 2015-May-010). A written informed consents were read and given to participants for their signatures before the research was conducted. Participation was voluntary and those who were not willing to participate were free to do that. The names of the respondents were not included in this study and their contributions remained anonymous. Privacy was observed and unauthorized persons had no right to access data collected. Respondents were informed that their responses would be treated confidentially and that the data collected would only be used for academic purposes. Consent was also obtained from questionnaires respondents, key informants and those who were involved in the focus group discussions.

CHAPTER FOUR

4.0 RESULTS

4.1 Socio-Demographic Characteristics of the Respondents

The research was conducted in the Southern and Western provinces of Zambia. The Southern province has a total human population of 1,589,926 while the Western province has a population of 902,974 (CSO, 2010). Therefore, 220 households were selected from the study areas in the Southern province and 180 households from the Western province to make a total of 400 households included in the questionnaire survey. Information on some socio-demographic characteristics namely age, sex, education level, marital status and household size was obtained. Table 4.1 provides a summary of the results about ages of the respondents. In total, 72% (95% CI: 66.8% to 77.2%) of the interviewed respondents were aged between 22 and 50 years, 26% were between 51 and 68 years while 2% were above 68 years. The average age was 44.3 years (95% CI: 43.2 to 45.4 years). The sample of the respondents interviewed comprised 94.5% men and 5.5% women. About two-fifths (40.3%) of the respondents had completed primary school educational level, 36.7% had attained secondary education and 14.5% had tertiary education. However, 8.5% of respondents had not gone to school at all (Table 4.1).

In terms of marital status, about 80% of the respondents were married, while only 11.3% were separated. Others were 7.2% and 1.5% were widowed, and not yet married, respectively.

The number of persons in the household ranged from 3 to 25, with an average of 10 (95% CI: 10 to 11). About three-fifths (59.8%) of the households had 3 to 10 members.

Table 4.1: Socio-demographic characteristics of the households in Western and Southern provinces of Zambia (n = 400)

Variable	Categories	Percentage	95% CI (%)
Age in years	22-39	38.6	33.8 to 43.4
	40-49	33.4	28.8 to 38.0
	50-59	18.8	14.9 to 22.6
	60-68	8.1	5.4 to 10.8
	>68	3.1	1.4 to 4.8
Level of education	None	8.5	5.8 to 11.2
	Primary	40.3	35.5 to 45.11
	Secondary	36.7	31.9 to 41.4
	Tertiary	14.5	11.0 to 17.9
Sex	Male	94.5	92.3 to 96.7
	Female	5.5	3.3 to 7.7
Marital status	Single	1.5	0.3 to 2.7
	Married	80.0	76.0 to 83.9
	Separated	11.3	8.2 to 14.4
	Widowed	7.2	4.7 to 9.7
Household size	3-9	55.3	48.4 to 58.1
	10-19	36.8	32.0 to 41.5
	>20	7.9	5.3 to 10.5

4.2 Costs and Losses due to Brucellosis at Household Level

It was observed that losses due to mortality among brucella seropositive cattle was only 0.1% and the loss was estimated at 1,8000 ZMW equivalent to USD 1572.05. Moreover, 31% of infected cows had experienced abortions attributed to brucellosis. The monetary losses due to abortions was estimated to be 1,536,000.00 ZMW equivalent to USD 134,148.47 with an average annual loss of 4,351.2 ZMW per household per year which is equivalent to USD 380.01. An estimated 27,750 litres of milk was discarded due to

confirmed brucellosis infection in cattle herds. The total monetary value of milk discarded by the households per year was estimated to be 77,700.00 ZMW equivalent to USD 6,786.02. Only 13.5% of all households spent 52, 960.00 ZMW equivalent to USD 4,625.32 per year for veterinary intervention against brucellosis. It was also revealed that 86.5% of livestock farmers in the area did not vaccinate their livestock against brucellosis (Table 4.2) due to either lack of money to buy the vaccines and poor access to livestock services.

Table 4.2: Estimated annual economic losses and costs incurred due to brucellosis (n = 400)

Indicators	Quantity	Unit cost (ZMW)	Monetary value (ZMW)	USD-Equivalent
Losses due to mortality among seropositive cattle	6 cows in 6 HHs	3000	18,000	1572.05
Aborted cows	1,024 in 353 HHs	1,500	1,536,000.00	134,148.47
Milk lost	27,750 litters in 24 HHs	2.8	77,700.00	6,786.02
Veterinary intervention	662 bottles (S19) Vaccines	80	52,960.00	4,625.32
Prolonged inter-calving period	45 cows in 45 herds	1,500	67,500.00	5,895.19
Total		**100**	**1,711,740.00**	**153,027.05**

4.3 Linkages Between Impact of Abortions, Milk Loss, Prolonged Inter Calving Period and Vaccination and Socio-Economic Well-Being at Household Level

Linkages between household costs and losses and socio-economic well-being were determined using cross-tabulation and chi-square analysis to find whether the two variables were associated. The results are shown in Table 4.3.

Table 4.3: Association between household costs and losses and socio-economic well-being (n = 400)

Well-being levels	Household costs and losses			P-value
	Low (%)	Moderate (%)	High (%)	
Poorest	2.5	2.75	23.5	< 0.001
Poor	6.75	3.0	29.0	
Neither poor nor rich	18.5	3.75	0	
Rich	7.75	0.75	0.5	
Very rich	1.0	0.25	0	

The cross tabulation show that there was a significant association between costs and losses and socio-economic well-being at the household level. Further, it was observed that 52.5% of the households which were classified as the poorest and poor had more costs and losses compared to households classified as neither poor (22.3%), nor rich, rich (9.0%) and very rich (1.25%).

4.4 Socio-Economic Well-Being Levels at Household in Terms of Costs and Losses due to Brucellosis

Socio-economic well-being was determined by using eight indicators of human capabilities as mentioned earlier in the methodology section (Subsection 3.4.2.4). The eight indicators of human capabilities were used to compose an index with 10 points, which were subsequently grouped into five categories of 2 point-intervals, the first one being that of the very poor (1 to 2 points). The other categories were for those who were poor (3 to 4 points), neither poor nor rich (5 to 6 points), rich (7 to 8 points), and very rich (9 to 10 points). ANOVA was used to determine whether there was significance difference in the socio-economic well-being levels in the households, where costs and losses due to brucellosis were high and where the costs and losses were low (Table 4.4).

Table 4.4: ANOVA results on costs and losses according to well-being levels of households (n = 400)

Socio-economic well-being level	n	Costs and losses (ZMW)	95% Confidence Interval		F	P-value
			Lower Bound	Upper Bound		
Very poor	33	10924.24	8816.36	13032.12		
Poor	237	8267.89	7454.71	9081.07		
Neither poor nor rich	89	4902.58	4103.10	5702.07	11.268	<0.001
Rich	36	4788.33	3466.54	6110.12		
Very rich	5	4562.00	-329.97	9453.97		
Total	**400**	**7378.78**				

The comparison results show that there was significant difference in costs and losses due to brucellosis among very poor, poor, neither poor nor rich, rich and very rich households ($F = 11.268$, $p = <0.001$). Therefore, the null hypothesis was rejected.

4.4.1 Households' well-being levels in Western and Southern provinces

The results in (Figure 4.1) shows different levels of well-being of households within the two provinces. Further, it was observed that Western province had more poor households than Southern province.

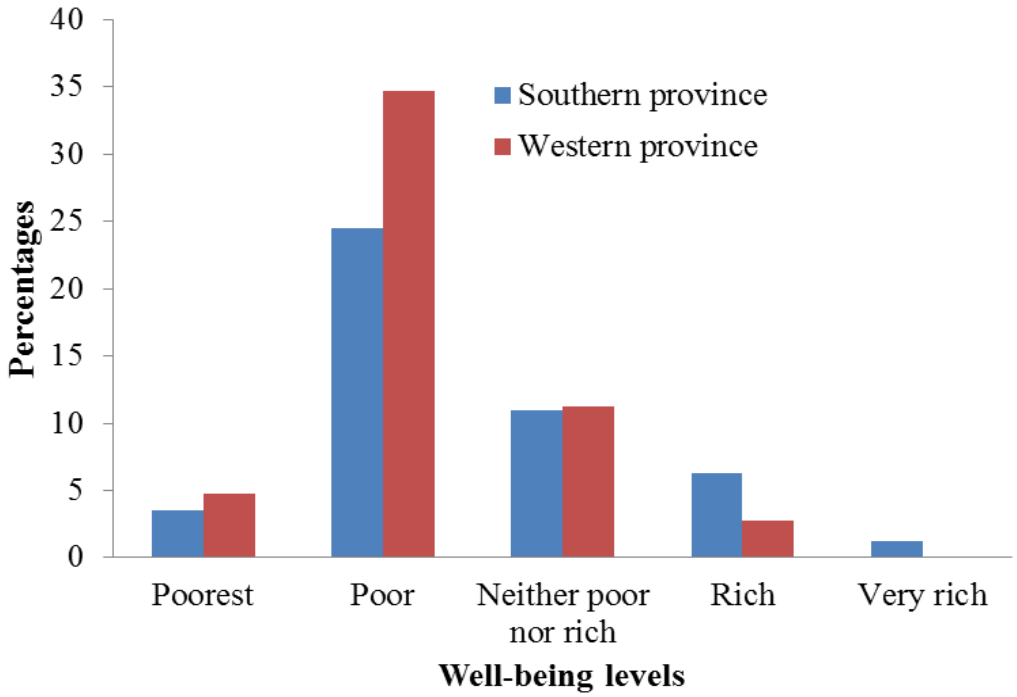

Figure 4.1: Households socio-economic well-being levels in Western and Southern provinces of Zambia: 2015-2016

4.4.2 Impact of Brucellosis on Socio-economic Well-being

The ordinal regression model (Hosmer and Lemeshow, 2000) was used to determine which set of variables were predictors of the socio-economic economic well-being of a household (Table 4.5). It was found that lack of money to pay for livestock health services, household per capita losses and household costs were the variables which had a negative impact on households socio-economic well-being. The variables which had a

positive impact on socio-economic well-being of a household were: household heads education level, household size, attitude towards using livestock health care facilities and the extent to which the livestock health services were affordable. The other variables were not significant predictors of the socio-economic status of a household (Table 4.5).

Table 4.5: Ordinal logistic regression results on the impact of brucellosis on socio-economic well-being (n = 400)

Variable		Estimate	Std. Error	Wald	df	P-value
Threshold	[SOCIOECNMLEVELS = 1]	.659	.616	1.143	1	0.285
	[SOCIOECNMLEVELS = 2]	4.795	.670	51.164	1	0.000
	[SOCIOECNMLEVELS = 3]	6.697	.708	89.518	1	0.000
	[SOCIOECNMLEVELS = 4]	9.366	.867	116.798	1	0.000
Location	Household size	.133	.032	17.325	1	**<0.001**
	Household costs	-.000	3.509E-5	27.606	1	**<0.001**
	House per capita losses	-.001	.000	17.399	1	**<0.001**
	Lack of money to pay for livestock health services =1]	5.980	.751	63.476	1	**<0.001**
	Lack of money to pay for livestock health services =2]	1.956	.359	29.621	1	**<0.001**
	Lack of money to pay for livestock health services =3]	-1.719	.588	8.559	1	**0.003**
	Lack of money to pay for livestock health services =4]	0[a]	.	.	0	
	[EDCATION=1]	2.155	.517	17.395	1	**<0.001**
	[EDCATION=2]	.506	.427	1.408	1	0.235
	[EDCATION=3]	1.129	.404	7.796	1	**0.005**
	[EDCATION=4]	0[a]	.	.	0	.
	[AFFORDABILITY=1]	.521	.335	2.416	1	0.120
	[AFFORDABILITY=2]	.667	.267	6.225	1	**0.013**
	[AFFORDABILITY=3]	0[a]	.	.	0	.
	[ATTITUDE=1]	.139	.411	.115	1	0.734
	[ATTITUDE=2]	.045	.299	.022	1	0.882
	[ATTITUDE=3]	0[a]	.	.	0	.

4.4.2.1 Households attitude towards using the available livestock health services available

The results revealed that the average score by all the respondents on the 12 statements about utilising the available livestock health services was 37.4; while the minimum point scored was 33 (1.8%) and the maximum was 42 (1.0%). Since the average score was more than 36, it can be said that the respondents had an overall favourable attitude towards using livestock health services.

The scores by all the respondents on all the statements are presented in Table 4.6. All the respondents were of the view that it was important to take samples for correct diagnosis of livestock diseases to know which medicines to use. All respondents (100.0%) also agreed with the statements that " Private and Government animal health workers provide scientific treatment unlike traditional healers of livestock diseases " while 99.0% agreed with the statement that " Although traditional livestock services providers charged low amounts of money, their services were not reliable ", and 100.0% of the respondents agreed with the statement that " Most livestock diseases could be cured by modern veterinarians, and not traditional healers of livestock diseases". The respondents also had reasonable responses to the statements that had negative connotations. For example, some of them responded negatively to the statements that "No need of getting livestock treated because fake medicines are used" (100.0%); "No need of getting livestock dipped/treated because the costs are very high" (88.2%), and “Livestock health services are too far from home" (96.0%). The other proportions of the respondents, who disagreed, were neutral or agreed with the statements of the Likert scale used are as shown Table 4.6.

Table 4.6: Households' scores on the items of utilization of livestock health services (n = 400)

Attitudinal statement	Disagree (%)	Undecided (%)	Agree (%)
1. No need of getting livestock treated because fake medicines are used	100.0	0.0	0.0
2. No need of calling veterinarians because traditional livestock services treat livestock better	100.0	0.0	0.0
3. No need of getting livestock dipped/treated because the costs are very high	88.2	11.8	0.0
4. Livestock diseases are not very serious	100.0	0.0	0.0
5. No need of going to the Veterinary Investigation Centre and other Government services because there are poor facilities	86.7	13.3	0.0
6. Livestock health services are too far from home	96.0	3.0	1.0
7. It is important to take samples for correct diagnosis of livestock diseases to know which medicines to use	0.0	0.0	100.0
8. Private and Government livestock health facilities provide scientific treatment unlike traditional treatment of livestock diseases	0.0	0.0	100.0
9. Although traditional livestock services charge low amounts of money their services are not reliable	0.0	1.0	99.0
10. Most livestock diseases are cured by modern veterinarians, and not traditional healers of livestock diseases	0.0	0.0	100.0
11. Traditional healers guess diagnoses of livestock diseases	0.0	0.0	100.0
12. Traditional healers claim to know even livestock health problems which they don't know about	0.0	0.0	100.0

4.5 Assessments of Health Policies for the One Health Practice in Zambia

More than two-thirds (73.1%) of the respondents from both the Ministry of Health, and the Ministry of Fisheries and Livestock agreed that there were no policies which directly facilitated the One Health practice in Zambia. However, the key informant at the Ministry of Health had positive comments on the possibility of having a policy for collaboration in the future while their counterpart from the Ministry of Fisheries and Livestock had negative comments on the One Health collaboration between the two ministries.

4.5.1 Ranking Opportunities for and Challenges to the One Health Practice

The respondents from both ministries were asked whether there were policies or guidelines which facilitated One Health, and if the policy making process involved stakeholders. Majority (71.3%) of the respondents agreed that there was no policy for the One Health collaboration in Zambia.

4.5.1.1 Respondents' responses on the extents to which opportunities for collaboration hold

Using the procedure described in the methodology section (Sub-section 3.4.2.5), the 67 respondents interviewed responded to all the 14 opportunities that were evaluated in the research. It was found that the most important opportunities for collaboration were adequate funding (71.3%), advocacy for control of neglected zoonotic diseases (68.2%) and the One Health policy formulation guiding applied research in health (65.5%). The extents to which the other opportunities held are as shown in Table 4.7.

Table 4.7: Responses on the opportunities to enhance collaboration between medical and veterinary officers (n = 67)

Factors enhancing collaboration	Scores out of 13			Extents to which factors are important (%)
	Min.	Max.	Mean	
1. Networking in research and disease control activities	1	10	4.22	32.5
2. Community-based prevention and control of zoonoses	1	10	5.10	39.2
3. Having early warning systems for detection and control of zoonoses diseases	0	8	3.96	30.5
4. Collaboration through professional associations	3	11	6.85	52.7
5. Sufficient money in budget (s)	4	13	9.27	71.3
6. One Health approach to health financing	3	11	5.82	44.8
7. Common training in zoonotic diseases for both veterinary and medical doctors, and fieldworkers	3	9	5.99	46.1
8. Appropriate veterinary public health	2	9	5.87	45.2
9. Dual benefit: gains for animal and human health	0	8	4.24	32.6
10. Demand-driven, problem-led research	3	12	6.27	48.2
11. One Health policy formulation guiding applied research in health	5	12	8.52	65.5
12. Advocacy for control of neglected zoonotic diseases	4	12	8.87	68.2
13. Planning to choose in the context of the One Health	3	11	7.10	54.6
14. Adequate transport facilities for medical, veterinary and wildlife officers	4	11	7.94	61.1

4.5.1.2 Respondents' responses on the extents to which challenges to collaboration hold

Using the procedure described in the methodology section (Sub-section 3.4.2.5), the 67 respondents interviewed responded to all the 14 factors of challenges to collaboration. It was found that the most serious challenges to collaboration between medical and veterinary officers were lack of resources (81.5%), inadequate transport facilities for medical and veterinary officers (66.9%) and inadequate resources for dissemination of results and raising public awareness (63.4%). These results imply that resources are key factors to enhance collaboration between these two fields; to working together in detecting and controlling zoonotic diseases. Furthermore, lack of collaborative research

and dissemination of results between medical and veterinary health officers was identified as a serious challenge, which could impede effective collaboration. Researching on the commonest zoonotic diseases which affect both humans and animals seems to be a very effective way of detecting and controlling zoonotic diseases in both humans and animals in a holistic way. However, lack of adequate resources put such reality in jeopardy (Table 4.8).

Table 4.8: Challenges to impede collaboration between medical and veterinary officers (n = 67)

Factors impeding collaboration	Scores out of 13			Extents of important of the factors (%)
	Min.	Max.	Mean	
1. Institutional separation (e.g. between Ministry of Health, and Ministry of Fisheries and Livestock and wildlife authorities)	1	11	3.75	28.8
2. Bureaucracy in making decisions regarding human and animal health issues	2	9	5.34	41.1
3. Control of zoonotic diseases being based under only one authority	0	10	2.06	15.8
4. Lack of clarity about roles of the public and private sector partners	1	8	4.67	35.9
5. Lack of resources to support collaboration	3	13	10.60	81.5
6. Budgetary separation: veterinary and medical costs not pooled	2	8	5.36	41.2
7. Low emphasis on zoonotic diseases to human health personnel during training	3	10	6.21	47.8
8. Weak veterinary/human public health infrastructure	3	11	7.18	55.2
9. Difference of emphasis: medics focus on individual patients, vets on populations	2	10	6.18	47.5
10. Research not being demand-driven but donor-led	3	11	7.63	58.7
11. Applied research is not recognized or rewarded as being important as basic research	3	10	5.79	44.5
12. Inadequate resources for dissemination of results and raising public awareness	3	12	8.24	63.4
13. Lack of consensus on priority-setting	3	11	6.90	53.1
14. Inadequate transport facilities for medical and veterinary officers	3	13	8.70	66.9

4.5.2 Attitude of the Respondents in the Ministry of Health and Ministry of Fisheries and Livestock towards the One Health Practice

Almost all the respondents (98.5%) said that they would support it to a large extent and 1.5% said that they would just support it. No one said he/she would not support it. In addition, the key informants interviewed during the research also said they would support the institutionalisation of the One Health practice. These results indicate that the respondents would be willing to support institutionalisation of the One Health practice.

The other way by which the attitude towards One Health practice was determined was by using a Likert scale, which comprised twenty (20) statements, ten of which had positive connotations while the other ten had negative connotation, as described in the methodology section (Sub-section 3.4.2.3) of this thesis. The results showed that the average score by all the respondents on the 20 statements was 62.2 over 100; while the minimum points scored was 55 and the maximum point scored was 72. Since 60 points denoted a neither negative nor positive attitude and the respondents mean score was higher than that, it can be concluded they had a favourable attitude towards the practice of the One Health concept in both ministries.

All the respondents were of the view that the collaboration would help relieve more people of the impacts of zoonoses through detection and dealing with zoonoses in a holistic manner. In addition, almost all of the respondents also agreed with the statements that "Collaborative monitoring of infectious diseases by medical and veterinary officers would enhance early detection of diseases" (98.5%), while 97.0% agreed with the statement that "Medical and veterinary officers having more positive attitude towards one another's field of specialization could greatly enhance collaboration

among them." And 86.5% of the respondents agreed with the statement that "Collaboration among medical and veterinary officers should start by joint training on some common aspects e.g. neglected zoonoses." The fact that so many respondents agreed with those statements implies that they had a favourable attitude towards collaboration.

The respondents also had reasonable responses to the statements that had negative connotations. For example, some of them responded negatively to the statements that "Medical and veterinary officers could not research together on zoonoses because of the lack of an institutional framework for their collaboration" (25.0%); "Medical and veterinary officers could not diagnose and survey on zoonoses together because of lack of an institutional framework for their collaboration" (23.9%), and "Incidences of diseases could not decrease due to medical and veterinary officers monitoring infectious diseases collaboratively" (22.4%) (Table 4.9).

Table 4.9: Respondents' score on the items of the Likert scale (n = 67)

Attitudinal statement	Disagree (%)	Undecided (%)	Agree (%)
1. The collaboration among medicals, veterinary and wildlife officers would greatly facilitate detecting and dealing with zoonoses	0.0	0.0	100.0
2. The collaboration would help more relieve people of zoonoses	0.0	0.0	100.0
3. The collaboration would ensure better access to health inputs by poor people and their livestock	0.0	22.7	77.3
4. Medical and veterinary officers can diagnose and do survey on zoonoses together by using effective surveillance systems	1.5	22.4	76.1
5. Medical and veterinary officers can research together on zoonoses with linkages to local public health systems	1.5	25.4	73.2
6. Medical and veterinary officers can change from single disease approach control measures to more integrated health promotion	23.9	3.0	73.1
7. Medical and veterinary officers sharing of data about diseases could be a of good way of collaboration	22.4	0.0	77.6
8. Medical and veterinary officers monitoring infectious diseases collaboratively would enhance early detection of diseases	1.5	0.0	98.5
9. Collaboration among medical and veterinary officers should start by them being trained on some common aspects e.g. neglected zoonoses	6.0	7.5	86.5
10. Medical and veterinary officers having more positive attitude towards one another's field of specialisation can greatly enhance collaboration among them	0.0	3.0	97.0
11. Collaboration between medical and veterinary officers would add nothing to detection and dealing with zoonoses	91.0	7.5	1.5
12. Collaboration would hardly relieve people of zoonoses	92.5	6.0	1.5
13. Collaboration would benefit better-off people who can pay for medical and veterinary services	97.0	3.0	0.0
14. Medical and veterinary officers cannot diagnose and survey on zoonoses together because of a lack of an institutional framework for their collaboration	76.1	0.0	23.9
15. Medical and veterinary officers cannot research together on zoonoses because of lack an institutional framework for their collaboration	75.0	0.0	25.0
16. Medical and veterinary officers cannot research together on zoonoses because of a lack an institutional framework for their collaboration	75.0	0.0	25.0
17. Changing from single diseases approaches control measures to more integrated health promotion is impossible because of scepticism between medical and veterinary officers	74.6	4.5	20.9
18. Medical data are too confidential for sharing with veterinary officers	89.6	10.4	0.0
19. Incidences of diseases cannot just decrease due to medical and veterinary officers monitoring infectious diseases collaboratively	70.1	7.5	22.4
20. There is no way medical and veterinary officers can be trained on common aspects of diseases	92.5	7.5	0.0

4.5.2.1 Comparison of mean points scored by both Ministries on the Likert scale

The overall points scored (62.2) on the statements of Likert scale were compared across the two Ministries using the independent samples t-test to find whether respondents from the Ministry of Health, and Ministry of Fisheries and Livestock had significant differences in attitude towards the One Health practice (Table 4.10). The comparison results showed that there was a statistically significant difference in attitude towards the One Health practice between respondents from the Ministry of Health and the Ministry of Fisheries and Livestock ($t = 3.564$, $p = 0.001$).

Table 4.10: Independent sample t-test results comparing attitude using the points scored by ministries on the Likert scale (n = 67)

Attitude	Ministry	n	Mean points	SD	t	P-value
One Health	Ministry of Health	28	64.00	2.762	3.564	0.001
	Ministry of Fisheries and Livestock	39	60.87	4.008		
Total		**67**				

The findings displayed in Table 4.10 also show that the respondents from the Ministry of Health had a significantly higher mean score on attitude towards One Health (64.0) than those from the Ministry of Fisheries and Livestock (60.8). Therefore, respondents from the Ministry of Health had more favourable attitude towards One Health practice.

4.5.2.2 Comparison of mean points scored by both Ministries across education levels of respondents

The overall points scored (62.2) on the statements of the Likert scale were also compared across the education levels of respondents in the two ministries using ANOVA to find out whether respondents with different levels of education had differed significantly in relation to attitudes towards establishment of the One Health policy. The comparison results showed that the points scored on the Likert scale used did not differ significantly among the respondents with different levels of education ($F = 0.822$, $p = 0.486$) (Table 4.11). Also this finding indicate that if the One Health practices were institutionalised, levels of education would not be a barrier; staff with different levels of education in the Ministry of Health and those in the Ministry of Fisheries and Livestock would collaborate in the implementation.

Table 4.11: ANOVA results on the comparison of points scored on the Likert scale with education levels of respondents in the MoH and MFL (n = 67)

Levels of Education*	n	Mean points scored	95% Confidence Interval		F	p-value
			Lower Bound	Upper Bound		
Diploma	13	61.0	60.14	64.94		
First Degree	41	62.2	60.92	63.47		
Master's Degree	11	62.5	59.09	63.09	0.822	**0.486**
PhD	2	65.5	33.73	97.27		
Total	**67**					

*PhD = Doctor of Philosophy

4.6 Qualitative Results

4.6.1 Focus group discussions results

Randomly selected individuals who met the criteria were included until the required number was met. Eight (8) focus group discussions (FDGs) were conducted, whereby four (4) FGDs were conducted in the Western province and the other four (4) in the Southern province. Respondents were grouped according to age and gender (female and male separately). FDG 1: Was for participants from 22- 39 years. FGD 2: was for participants from 40-49. FGD 3: was for participants 50-59 and FGD 4: was for participants from 60 and above years. All discussions made were recorded on a digital recorder and transcribed by the researcher using verbatim transcription in order to capture what, how and why such aspects from the participants. The facilitator was assisted by a research assistance to ensure good implementation and follow up of the study. A total of 96 participants took part in the eight Focus Group Discussions and six key informants were interviewed. Four main themes were generated from the narratives as follows;

- Awareness of participants on brucellosis
- Cultural practices and transmission of brucellosis
- Socio-economic impacts of brucellosis
- Affordability and accessibility of livestock health services

Key informant interviews (KIIs) were conducted according to a guide prepared by the researcher whereby the first interview was for Namwala district medical doctor; Second was district veterinary officer; Third was Mongu district veterinary officer; Fourth was

Senanga district veterinary officer; the fifth interview was conducted with the director of livestock in the Ministry of Fisheries and Livestock and last key informant was conducted with the coordinator of infectious diseases on behalf of the director in the Ministry of Health. The discussions were conducted with a varying degree of openness using open ended questions. Consequently the notes were taken and interviews were recorded as described above.

4.6.1.1 Awareness of participants on brucellosis

4.6.1.2 Definition of brucellosis

4.6.1.3 Participants on human brucellosis

The majority were not able to define human brucellosis and were also not aware if brucellosis affected humans as well. However, few participants were able to associate cattle abortions with Brucella infections.

"*Cattle abortions are caused by brucellosis"* [Middle age male in Kabulamwanda-March 2016]. Similarly, 35% of the participants were able to mention symptoms of brucellosis in animals such as abortion, still birth, weak calf born, retention of fetal membranes, prolonged calving, signs of infection in the membranes, swollen testicles in bulls. An example of an answer from one of the participants is;

"I experienced abortions and still births in my herd for the past two years. I went directly to the vet office where they identified brucellosis infection" [Young age male in Mala-April 2016]

This illuminates that few participants were aware of the symptoms of brucellosis and the importance of consulting veterinary personnel. Some of the participants were able to

relate symptoms of human brucellosis with the symptoms of the other medical conditions as follows**;**

"Brucellosis presents signs like those of Malaria" [Young female in Mala-March 2016].

Table 4.12: Knowledge of the participants on human brucellosis (n = 96)

Brucellosis in humans						
Sub themes	**22-39 years**		**40 - 49 years**		**>50 years**	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
Brucellosis is the disease that presents with signs like those of Malaria		V			V	V
Brucellosis presents with fever, chills, sweats, weakness, fatigue, joint, muscle and back pain, poor appetite, weight loss	V		V	V		V
Brucellosis is the disease caused by a virus			V		V	V
Symptoms of Brucellosis in humans		V		V		V
Loss of appetite and loss of weight, loss of sleep	V	V	V	V	V	V
Night sweating, weakness, fatigue,	V			V		V
Joint, muscle and back pain		V				V

V= theme and sub themes most mentioned in groups 22-39 years, 40-49 years and >50 years

4.6.1.4 FGD Participants' view on animal brucellosis

The majority of the persons interviewed in the study (Table 4.13) defined animal brucellosis as a disease that is caused by drought as below;

"*Brucellosis is the disease caused by too much drought that can be transmitted through animals coming in to contact with other animals*" [Old group male in Mongu-2015].

Although the above explanation is not correct but it suggests that during dry season animals are grazed in the flood plains where they can come in to contact with infected wild or domestic animals as a result brucellosis can be easily transmitted.

When further probed to define animal brucellosis the majority of FGD participants were able to define brucellosis as the disease which can abortion, still birth, weak calf born, retention of fetal membranes, prolonged calving, signs of infection in the membranes and swollen testicles in bulls.

"Some cows could present abortions and prolonged calving because of brucellosis and as a result we are losing a big number of calves"
[Old group male in Namushekende-2015].

The above explanation indicates that respondents are aware of the manifestation of brucellosis to animals as well as the losses which attributed to brucellosis.

Table 4.13: Awareness of FGD participants on animal brucellosis (n = 96)

Brucellosis in animals						
Sub themes	**22-39 years**		**40 - 49 years**		**>50 years**	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
Animal brucellosis is caused by too much drought		V			V	V
Brucellosis presents with abortion, still birth, weak calf born and prolonged calving	V			V		V
Brucellosis is the disease caused by a bacteria			V			V
Symptoms of brucellosis in animals		V		V		V
Retention of foetal membranes, swelling of testicles in bulls	V	V	V	V	V	V
Milk loss		V	V			V

V= themes and sub themes most mentioned in groups 22-39 years, 40-49 years and >50 years

4.6.1.5 FGD participants responses to cultural practices and transmission of brucellosis

The majority of the FGD participants (Table 4.14) did not know if there is relationship between cultural practices and causes of human brucellosis. About two-third (64%) of participants thought unpasteurised sour milk could not be the cause of transmission of brucellosis from animals to humans;

"*We do take unboiled sour milk and it has got nothing to do with diseases unless it is stomach upset when milk stays for some time before being consumed. We have been doing that for the whole our lives*" [Young male in Mala-2016].

Despite being aware of brucellosis and how it is transmitted, respondents indicated that they still consume unpasteurised milk. Their argument was that, they had been doing

those practices for the whole their lives and nothing has happened. However, when further probed on the practices which may cause diseases transmission from animals to humans some participants were able to mention things like eating under cooked meat, taking unpasteurised (unboiled) milk, contact with animals without protective gears and that the above may cause transmission of TB from animals to humans as shown in the quote below:

"*TB can be transmitted from animals to humans by consumption of animal products such as unboiled milk, under cooked meat and meat from carcasses*" [Middle age group male in Mala-2016].

The explanation above indicates that some respondents were aware on the transmission of zoonoses.

One participants disputed the idea that coming into contact animals without protective gears may transmit the disease from animals to humans as shown in the quote below:

"*We have been coming into contact with our livestock without protective gears for years and years and there seems to be no problem at all, this cannot make us to be infected*" [Old age group male in Sioma-2015].

The above explanation illuminates that cultural beliefs can be a major contributor to transmission of diseases from animals to humans and vice versa.

Table 4.14: FGD participants responses on cultural practices/beliefs and transmission of brucellosis (n = 96)

Cultural practices and transmission of brucellosis						
Sub themes	**22-39 years**		**40 - 49 years**		**>50 years**	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
Contacting animals without using protective gears can transmit brucellosis from animals to humans		V			V	V
Unpasteurised milk can transmit brucellosis from animals to humans	V			V		V
Unpasteurised sour milk can transmit brucellosis from animals to humans			V			V
Consumption of raw meat can transmit brucellosis from animals to humans		V		V		V
Eating meat from carcasses can transmit brucellosis from animals to humans	V	V	V	V	V	V

V= themes and sub themes most mentioned in groups 22-39 years, 40-49 years and >50 years

4.6.1.6 Socio-economic impacts of brucellosis

A majority of the FGD participants (81%) were able to identify the monetary losses which could be attributed to brucellosis such as abortions, milk loss and cost due to veterinary intervention. Further, FDG participants were able to identify the indicators of well-being which applied to their households such as being able to eat at least 3 meals per day; being well sheltered; being able to escape avoidable morbidity and premature mortality; being able to sell livestock and crop products whenever they like; and being

able to pay school fees for secondary school children belonging to the households. In addition, 82% of participants thought indicators of well-being applied to their well-being to a larger extent.

"*Because of this money that we are losing due to abortions and cost of vaccinations, most of the families can only afford a maximum of two meals a day i.e. in the morning (breakfast*) *and in the evening*" [Middle age female in Mongu-2015].

"*Selling milk at milk collection center helps farmers to buy food for their households, but if your animal is confirmed to be infected, you won't be allowed to sell your milk unless the whole herd is diagnosed*"[Old age male in Sioma-2016].

The above results indicate that respondents were aware of how household well-being was affected by the losses attributed to brucellosis infections. Some of the households were not able to have three meals a day due to limited income as a result of losses due to abortions and cost of treatment. However, these results indicate that households income has been decreased due to failure to sell milk to the milk collection centers as a result of brucellosis infections. As such, households could not afford buying food, hence the number of meals reduced and households socio-economic well-being was affected.

Table 4.15: FGD participants responses on socio-economic impacts of brucellosis (n = 96)

Socio-economic impact of brucellosis						
Sub themes	**22-39 years**		**40 - 49 years**		**>50 years**	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
Household lost a significant amount of money due to abortions, milk loss and cost of vaccinations		V	V		V	V
Household not being able to eat at least 3 meals per day	V			V		V
Household not being well sheltered			V			V
Household not being able to escape avoidable morbidity and premature mortality		V		V		V
Household not being able to sell livestock and crop products whenever they like	V	V	V	V	V	V
Household not being able to pay school fees for secondary school children		V		V		V

V= themes and sub themes most mentioned in groups 22-39 years, 40-49 years and >50 Years

4.6.1.7 FGD participants on the affordability and accessibility of livestock health services

A majority of the participants (77%) were able to point out the extent to which livestock health services were affordable and accessible from the places where they kept animals. About 52% of the FGD participants pointed out that livestock health services were expensive and not easily accessible by everyone, especially those who stayed in the periphery of the villages (Table 4.16). Further, few (17%) of participants mentioned that they had used livestock health facilities sometimes back but the rest had not used the facilities.

"*There are no proper animal health services for our livestock except when you go to veterinary office to seek for advice when you fail to treat your animals. In most cases we do treat them ourselves and life goes on unless it is a complicated case*"

[Middle age male in Kabulamwanda-2016].

The quote above indicates that livestock health services are limited in terms of the number of animals that needs attention as compared to the number of veterinary personnel as well as the number of facilities as compared to the number of animals in the places where they come from. Also, most of veterinary services are private and a farmer should pay a certain amount of money to access these services. In most cases these services are not affordable.

Table 4.16: FGD opinions on affordability and accessibility of livestock health services in their areas (n = 96)

Affordability and accessibility of livestock health services						
Sub themes	**22-39 years**		**40 - 49 years**		**>50 years**	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
Livestock health services are not affordable by most households in the area		V			V	V
Livestock health services are not accessible by households in the periphery	V		V	V		V
Majority of households treat their livestock traditionally			V			V
Cost of buying vaccinations for brucellosis is very high and most of Agro-vet do not have them	V	V		V	V	V

V= themes and sub themes most mentioned in groups 22-39 years, 40-49 years and >50 years

4.6.2 Key informant interviews

4.6.2.1 Key informants results on the definition of One Health concept

During the interviews informants defined One Health as collaborative efforts between veterinary, wildlife and medical personnel and other disciplines in dealing with diseases which affect both humans and animals (Zoonoses). Such diseases include TB, Brucellosis, Ebola and Rabies as shown in the quote below:

"*One Health is a modern global movement to promote collaborative efforts between different health related professionals, including medical doctors, veterinarians and many other scientific, health, environmental and other related disciplines*" [MFL-November 2015].

Despite the fact that the key informants were aware about the One Health concept but still it could not be adopted in the Ministries due to lack of policy and institutional framework. In addition, the key informant from the Ministry of Health stressed that such collaboration has not been institutionalised in Zambia although there is a willingness by experts to come together to find solutions on diseases which affects both humans and animals. Such willingness has been shown and mentioned by the key informant at the Ministry of Health as detailed below:

"Policy for collaboration in disease detection and control between us and animal health people is still being streamlined. However, contingency plans exist for high profile diseases such as the recent outbreak of Ebola; it helped all of us to work together to make sure that the disease didn't get into the country. Nevertheless, no official policies exist for collaboration and control of zoonotic diseases" [MoH-October 2015].

The explanation above indicates that there is a willingness to collaborate among the people from different fields except that there is no policy guideline for control of zoonoses. Therefore, if such a policy framework will be put in place, people will be willing to collaborate.

4.6.2.2 Key informants opinion on the factors which may enhance One Health practice

Key informants from both ministries were able to identify issues which may enhance establishment of the One Health policy and its implementation. These include: collaboration through professional associations; sufficient money in budget allocations; common training in zoonotic diseases for both veterinary and medical doctors, and other fieldworkers; One Health policy formulation guiding applied research in health; adequate transport facilities for medical, veterinary and wildlife officers and advocacy for control of neglected zoonotic diseases. However, some challenges do exist as shown in the quote below:

"*One biggest challenge which may impede this policy establishment is insufficient budgeting. Most of the activities are not being done because of limited resources that we have as a nation, and from the look of the things, One Health implementation or whether policy formulation needs sufficient resources for it to be done in Zambia. Outside that it won't be possible*" [MFL- November 2015]

The statement above suggests that the respondent from the Ministry of Fisheries and Livestock was aware of the budgeting constraints at the ministerial level which may hinder the implementation of the One Health practice as well as policy formulation.

Therefore, in order for the same to be formulated and implemented sufficient budgeting would be an integral part.

4.6.2.3 Key informants opinion on the factors which may impede One Health practice

Key informants from both ministries were also able to identify issues which may impede establishment of the One Health policy and its implementation such as; institutional separation (e.g. between Ministry of Health, Ministry of Fisheries and Livestock, and wildlife authorities); bureaucracy in making decisions regarding human and animal health issues; control of zoonotic diseases being based only under one authority; lack of clarity about roles of the public and private sector partners; lack of resources; budgetary separation-veterinary and medical budgets not pooled; low emphasis on zoonotic diseases to human health personnel, weak veterinary/human public health infrastructure. The above is emphasized in the quote below:

"*Institutional separation, especially between humans and animal health may be a major hindrance in the future because it will be very difficult to make common decisions with regards to health matters unless there is a specific institutional integration before establishment of this policy*" [MoH-October 2015].

The explanation above indicates that institutions should not work separately in dealing with infectious diseases rather there should be an institutional framework which facilitate different institutions to come together.

4.6.2.4 Districts Veterinary Officer's opinions on collaboration and zoonoses

Districts veterinary officers were probed about issues regarding animal health such as extents to which livestock systems explain human disease occurrence in their districts; awareness about the One Health approach among medical, livestock and wildlife officers; disease surveillance and preventative exercises which have been done in collaboration between medical and veterinary personnel; aspects on which medical and veterinary personnel collaborate to treat zoonoses; factors which may hinder or enhance collaboration among medical, veterinary, and wildlife officers in their districts; accessibility to animal health services and facilities within the districts; number of dip tanks which are accessible in the districts and the extent to which brucellosis is a problem in the district as compared to other zoonoses; whether public education is available regarding the transmission of brucellosis between livestock, and between livestock and humans; type of recommendations made to farmers on preventing transmission of brucellosis and if animal brucellosis can be a determining factor for the well-being of livestock farmers in the district. The participants were able to respond on the very important issue mentioned above as follows:

"*In the district there are three major zoonotic diseases: TB, Brucellosis and Rabies*

[DVO in Namwala-April 2016].

"*In the district there are three major livestock diseases: FMD, brucellosis and Anthrax*"

[DVO in Monze- March 2016].

When further probed about the livestock systems that may explain human disease occurrence; they were also able to explain how different livestock systems could explain human diseases occurrence as shown in the quote below:

"*With regards to livestock systems, increasing livestock numbers seem to have a negative impact on human health due to the production systems in place. Particularly, TB seems to be affecting livestock production and putting human health at risk, as well as brucellosis, and may be even rabies*" [DVO in Monze-March 2016]

"*The production system for Namwala is the transhumant system whereby animals are moved into the Kafue flats during the dry season and they come into contact with wild animals, especially Kafue-lechwe, hence, the chances of diseases to spread become very high* " [DVO in Namwala-February].

Key informants also pointed out some of the cultural practices and beliefs which could facilitate transmission of diseases from animal to humans in their districts. Some practices such as consumption of unpasteurised milk, eating meat from carcasses were mentioned in quote below:

"*Most of the people in the Kafue flats are affected by the culture; herdsman will drink the milk directly from the cattle, therefore exposing themselves to both Brucellosis and TB. This is definitely a challenge for prevention. And since brucellosis presents as undulating fever and maybe headaches, most of the time it is considered as malaria hence it is difficult to treat/control brucellosis.*"

Further, the participants were able to talk about the little collaboration that exists between veterinary officers and medical officers in their districts as shown in this quote below:

"*There are disease preventive measures within the district council. This is in regards to the stray dog population control, to control dog bite cases and rabies. Meat inspection is done in collaboration between vet assistant and environmental personnel; same as diagnosing bovine TB, the medical personnel are involved.*"

Participants also mentioned factors which could hinder collaboration between veterinary and human health personnel;

"*The issue of resources probably hinders. When they (medical) have resources they are targeted at diseases that are not zoonotic. But here, since we are in animal and public health, we want to collaborate. But collaboration hasn't happened much since both sources don't have the same goals*" [DVO in Senanga-November 2015].

Livestock facilities such as deep tanks were also discussed by some of the key informants, especially from the Southern province. They admitted that there were no enough facilities compared to the number of animals in the province as elaborated in this quote below:

"*According to the 2015 annual report, out of the 17 dip tanks in the district, only 2 were functional. We have advertised for the renovations of 6 of these, and the construction of 13 new ones. So there should be 19 new ones coming. As for private dip tanks, there were 40 functional dip tanks at the end of 2015 (belonging to the farmers, not communal, not governmental*" [DVO in Namwala- April 2016]

Key informants also ranked the livestock diseases which they thought had more negative impacts in their areas as elaborated in the quote below:

"*If ranking the top three zoonoses, (brucellosis and TB often found in the same areas), brucellosis should be number one. When testing milking herds, we are testing for both, but they find more brucellosis than TB. This can be confirmed by the number of late-stage (3rd trimester) abortions in cattle. At one time, we even had a challenge with carrying out FMD vaccinations because farmers attributed abortions to the vaccine instead. The second round of FMD vaccination is around October-December, which is around the 3rd trimester or calving. But when we went to test the animals, we found that it was actually brucellosis*" [DVO in Namwala-April 2016].

4.6.2.5 District Medical Officer's opinion on collaboration with veterinary personnel with regard to zoonoses

Districts medical officers responded on the issues regarding human and animal health such as most common human diseases in the district; whether human living environment explains human disease occurrence, (e.g. increasing population density and growth, increasing human mobility, growing poverty and inequality, increasing susceptibility, changing dietary habits, and lack of infrastructure). Awareness about One Health approaches among medical and livestock officers, zoonotic diseases which medical and veterinary personnel have collaboratively participated in; if there are human health objectives that should be improved or made redundant; how they diagnosed human brucellosis; how they treated a patient with brucellosis; and if districts had the capacity to diagnose and treat zoonotic diseases in humans. They were able to respond on some important issues mentioned above as follows:

"*Often we have learned about the way to diagnose brucellosis at some point in our training, but since we do not see it often, our ability to diagnose it is minimal. If there were to be a human brucellosis diagnosis, then the surveillance for it in humans may be increased*" [DMO in Monze- March 2016].

The explanation above indicates that people from the medical field are have reduced ability to diagnose brucellosis since it is not common in their areas compared to other zoonoses such as aw rabies and TB.

"*Clinical signs of brucellosis are similar to malaria: fever, rash, diarrhoea. Most common is fever*" [DMO in Monze- April 2016].

When asked about the ability of districts hospitals to diagnose human brucellosis and other zoonoses using hospital laboratory, some informants admitted that there were no equipment for diagnosing human brucellosis and other zoonoses using district hospital labs as elaborated in the quote below:

"*I do not believe that we have the capacity to diagnose zoonoses. Without being able to produce statistics about the cases of zoonoses, the financial capacity to diagnose is minimal. If we were able to give such statistics it would prove to people that they should have an interest in such diseases and therefore put funding towards diagnostic infrastructure*" [DMO in Namwala- March 2016].

The statement above indicates that the respondent was aware that there was limited diagnostic capacity for zoonoses in the district's facilities due to limited financial resources.

"*Regarding brucellosis, I do not believe that the laboratory at the district hospital has the ability to diagnoses brucellosis from tissue samples, and instead it would need to be sent to Lusaka*" [DMO in Namwala- March 2016].

The above district Medical doctor's expression indicates that there was no facility to diagnose brucellosis in the district hospital.

4.7 Proposed One Health Framework for Collaboration in Zambia

Collaboration between animal and human health personnel was assessed using both quantitative and qualitative approaches in this study. Quantitative approaches used were structured questionnaires which were administered to 67 respondents from the Ministry of Health, and Ministry of Fisheries and Livestock. Qualitative approaches used were checklist items for key informants that were used to interview two key informants from the Ministry of Fisheries and Livestock, Ministry of Health, DVOs and DMOs.

Respondents from the two ministries listed opportunities and challenges which they thought could enhance or impede the collaborations between professionals from these sectors. About 71.3% of all responses made on pair-wise ranking analysis revealed that sufficient resources in budgeting could enhance the collaboration. Further, 68.2% of responses revealed advocacy for control of neglected zoonotic diseases may be the opportunity for collaboration. However, respondents also listed challenges which may impede collaboration; 81.5% of responses pointed out lack of enough resources as a major challenge for collaboration and 66.9% of responses revealed that inadequate transport facilities for medical and veterinary officers in the field as a second major challenge for collaboration. Furthermore, two key informants from the Ministry of

Health, and Ministry of Fisheries and Livestock pointed out three major key ways for collaboration;

(i) Joint problem analysis by all ministries in charge (Ministry of Health, Ministry of Fisheries and Livestock and Ministry of Local Government)

(ii) Resource mobilisation (Government, donors, private sectors)

(iii) Identification of implementing agency (Ministry of Health, Ministry of Fisheries and Livestock and wildlife authority).

Based on the above three major keys responses from respondents and the line ministries, in-depth interviews and literature review on whether animal and human health policies address collaboration of different professions on treating and controlling zoonoses and other infectious diseases in Zambia, a framework of collaboration was constructed. It was revealed that identifying problems together between the Ministry of Health, Ministry Fisheries and Livestock and The Ministry of Local Government was a key way of ensuring collaboration because it would involve experts at the ministerial level to come together and discuss the problem with possible solutions on health perspective; while the Ministry of Local Government would help with coordination activities in the districts where collaboration takes place. Therefore, it would help experts to have a common perception of the problem which would also help medical and veterinary personnel at the district and village levels to work together in dealing with the same problem according to the policy directives provided by the respective ministries. Further, both ministries should identify reliable sources of resources which should be used in the implementation phase; it would also help to have a sustainable and soft implementation

phase. As pointed above, inadequate resources was one of the biggest challenges mentioned by respondents from both ministries as well as key informants from the districts, and since government funding was not enough, a holistic approach is inevitable.

Based on the above, it is very important to identify implementers on the ground so as to simplify monitoring and evaluation of the activities. Therefore, the districts have a major role to play since most of the beneficiaries of these collaborative efforts are found in their areas. It was also observed that at the district level, there was some minimal collaboration between veterinary and medical personnel, especially when dealing with stray dogs. However, that collaboration was not institutionalised, therefore, the study proposes an institutionalised collaboration framework for medical and veterinary professionals in Zambia as highlighted in Figure 4.2.

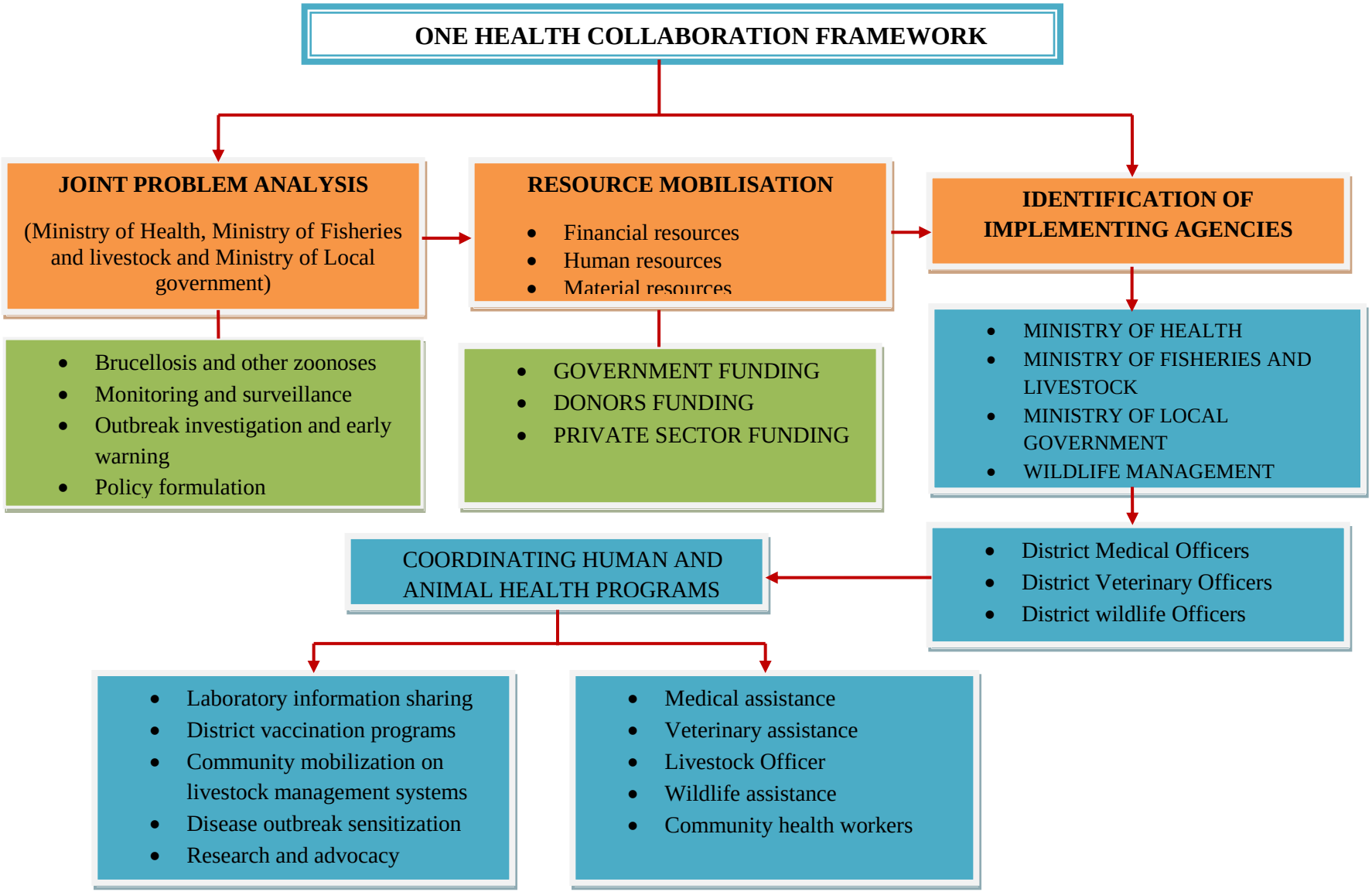

Figure 4.2: Proposed One Health collaboration framework for Medical and Veterinary personnel in Zambia's central and local governments.

CHAPTER FIVE

5.0 DISCUSSION

5.1 Impact of Brucellosis at the Household Level

This study was conducted in the Western and Southern provinces of Zambia to determine the impact of brucellosis on socio-economic well-being of cattle farmers at the household level. The study has revealed that brucellosis had an impact on the socio-economic well-being of cattle farmers' households and consequently leading to loss of income due to abortions, milk loss, cost of vaccination, mortality, and prolonged inter-calving period. The highest estimated amount of money lost was due to abortions accounting for ZMW 1,536,000 equivalent to USD 134,148.47. These results are also comparable to those obtained by Ajogi *et al*. (1998) who estimated abortion losses due to brucellosis of 12.6 million Nigerian naira (equivalent to USD 63,300.67) in the grazing reserves of Wase and Wawa-Zange of Nigeria. Further, Angara *et al*. (2016) estimated economic losses due to the number of aborted calves to be Sudanese Pounds (SDG) 303,348.3 (Equivalent to USD 65,945.5). In addition, this result may be attributed to the fact that a big proportion of surveyed households did not vaccinate their cattle against brucellosis. The main reason that was advanced by the farmers for not vaccinating their cattle was lack of money to buy vaccines. Further, the losses due to abortions may be attributed to the kind of management system the animals were exposed to. Most of the herds were classified as either transhumant, whereby they moved between the villages and the floodplains or interface herds whereby livestock stayed permanently on the floodplains.

A few of them permanently grazed in communal lands within the village homesteads and were never taken to the flood plains (Sinkala, 2015). Therefore, when livestock move from being village residents to floodplains herds, there are higher chances of being infected in the flood plains where cattle are likely to come into contact with those with higher prevalence of the disease (Muma *et al*., 2006a). Losses due to discarded milk from infected herds at household level were the second highest (77,700.00 ZMW equivalent to USD 6,786.02). Similar results have been reported in Sudan by Angara *et al*. (2016) who estimated the quantity of milk lost due to brucellosis to be Sudanese Pounds (SDG) 30,302,212.2 (Equivalent to USD 6,587.4).

The study further revealed that there was a statistically significant relationship between costs and losses and a household's socio-economic well-being. Those households that were classified as the "*poorest and poor*" had higher costs and losses due to brucellosis compared to households classified as "*rich*" and "*very rich*." This situation may be attributed to the fact that most of the households in the Western and Southern provinces did not have enough resources to spend on diseases prevention since most of the households do not rear cattle for commercial purposes rather as a symbol of prestige. Similar observations were made by Kayunze *et al*. (2014) whereby he observed that households in the lower quintiles (poorest) were much affected by the burden of diseases in Ngorongoro, Tanzania than the ones in the fifth quintile (very rich). Therefore, the more one is poor, the more burden on socio-economic well-being of the household they experienced.

5.2 Socio-economic Well-being Levels of Households

The study revealed that there were differences in levels of socio-economic well-being among the households, with the majority of them being classified as poor. This result could be explained by the fact that most of the traditional livestock farmers keep livestock for social status in the community and they only sell livestock to meet necessary expenditures such as paying school fees, buying food or health attention(Angara *et al*., 2016). Furthermore, it was observed that Western province had more poor households compared to Southern province and the reason for that could be due to the presence of devastating livestock diseases in the Western province such as contagious bovine pleuropneumonia (CBPP), Anthrax, and Brucellosis, which hindered people from harnessing the full benefits of keeping cattle.

In addition, the Zambian government's ban on livestock movement from Western province to other parts of the country because of CBPP may further contributed to stifling livestock trade, thereby resulting in increasing household poverty in the Western province (Sinkala, 2015). This restriction to market access could be contributing to low productivity and consequently low investment incentives in the livestock sector in the province (Bronsvoort *et al*., 2008). Consequently, this, in many ways, condemn endemic households to further poverty because of limited market access opportunities, thereby depriving the farmers of the much needed household income, food availability for consumption and limited economic growth at the national level (Sinkala, 2015). This result is similar to what has been reported by Millenium Development Goals progress report (2013) that 64% of people in the Western province live in an extreme poverty compared to other provinces of Zambia.

5.3 Linkages between Impact of Brucellosis and Households' Socio-economic Well-being Status

The study revealed that lack of money to pay for livestock health services such as vaccination, diagnosis and veterinary consultations had a highest negative impact on households' socio-economic well-being. The above suggests that households which were not able to pay for livestock health services were likely to be more affected by the impact of brucellosis than those which had money to pay for such services. This situation could also be attributed to the fact that the Government does not provide free vaccine for brucellosis, hence most of the farmers failed to have their animals vaccinated.

A study conducted in Kirghizia by Zhunushov and Kim, (1991), showed that free brucellosis vaccination campaign had the potential to reduce loses due to the disease. Similar results reported by Domenech *et al*. (1982), showed that vaccination had potentially increased profitability of cattle rearing in brucellosis endemic areas. This study also found that increased household size had a positive impact on socio-economic well-being of a household. One of the explanations to this could be that the sampled households were mostly rural people producing livestock and crops using members of households as labourers. This means that the more members a household had the more work they did and were likely to produce more. This is in agreement with results obtained in Tanzania by Kayunze (2000), who reported that larger households were economically better-off than smaller ones in Mbeya Region. In this study by Kayunze (2000), poverty was measured in terms of net household product, which was defined as total value of products produced and services provided, minus total costs incurred to

produce the products and provide the services in a year. Kamuzora (2001) also found less poverty in larger households in Kagera Region.

It was also observed that the respondents had favourable attitude towards using livestock health services available in their areas. These results may imply that if the Government invested in the control the disease by increasing accessibility to animal health services such as vaccinations, livestock farmers were more likely to reduce the burden of animal diseases by increasing the number of animals and animal products. As such, diseases like brucellosis would easily be controlled, hence improving the well-being of cattle farmers. Moreover, a study conducted in Kirghizia by Zuhnushov and Kim (1991) shows that brucellosis vaccination campaign has the potential to reduce losses of the disease considerably In addition, studies conducted in Chad and Cameroon by Domenech *et al*. (1982) indicated that control of brucellosis with vaccination potentially increased profitability of cattle rearing in disease endemic areas in Chad and Cameroon.

5.4 Health Policies for the One Health Practice in Zambia

Based on the study findings the majority (73.1%) of the respondents from the Ministry of Health and Ministry of Fisheries and Livestock agreed that there was no policy which directly facilitated collaboration between medical and veterinary personnel, and thus it would be very difficult for human and animal health sectors in Zambia to adopt the One Health practice in detecting and controlling of zoonotic diseases unless a relevant policy was put in place. Similar results have been reported by Cardona *et al*. (2015) that policy for One Health practice implementation plays an integral roles, especially in adopting the concept by multi disciplines. Further, Galaz *et al*. (2015) argued that a policy framework should be very specific in order to have successful adoption of the One

Health practice by multiple disciplines because of the disparities amongst them. It was also revealed by the participants from both ministries that sufficient budgeting was a key factor for collaboration, especially in disease detection and control. From this study, the main opportunities found that could enhance collaboration were availability of funds for collaborative work, presence of zoonotic diseases which necessitated human and animal health researchers and trainers to pool their expertise together, and instruction from upper levels in the ministries.

An institutional framework which could facilitate the flow of information between ministries and departments was very crucial for effective collaboration. It is therefore argued that, in order to increase the practice of One Health, various stakeholders should embrace the factors enhancing collaboration and putting much effort to control factors which may impede collaboration. Similar results have been reported by Zinsstag *et al*. (2007b) who pointed out that poor surveillance programmes, limited institutional capacity and without donor assistance, developing countries could not successfully invest in zoonoses control. Moreover, Kayunze *et al*. (2014) observed that sufficient budgeting and instructions from upper levels within ministries were the most important opportunities towards collaboration in Ngorongoro and Kibaha Districts, Tanzania. Therefore, these opportunities to enhance collaboration are also very important determinants of collaboration among medical and veterinary officers in detecting and controlling zoonotic diseases in a holistic way in Zambia. Furthermore, key informants from both ministries also identified these opportunities which could enhance establishment of a One Health policy and its implementation in Zambia.

These results also suggest that the implementation of the One Health in Zambia is very crucial in order to make sure that it addresses both economic and public health concerns. Moreover, challenges which could impede establishment of the One Health policy and its implementation such as institutional separation (e.g. between the Ministry of Health; Ministry of Fisheries and Livestock and wildlife authorities); bureaucracy in making decisions regarding human and animal health issues; control of zoonotic diseases being based under only one authority, lack of clarity about roles of the public and private sector partners, lack of resources, budgetary separation, veterinary and medical costs not pooled, low emphasis of zoonotic diseases to human health personnel, weak veterinary/human health infrastructures. Therefore, the One Health as a collaborative effort between veterinary, wildlife and medical personnel and other disciplines in dealing with diseases which affect both humans and animals (zoonoses) is an important measure towards dealing with zoonoses. In addition, what has been stressed by the key informant in the Ministry of Health that such collaboration was not institutionalised in Zambia although, there was willingness by experts to come together to find solutions to zoonotic diseases was a pertinent concern considering that brucellosis is endemic in Zambia.

The study further found that the overall attitude towards the One Health practice in both ministries was positive. However, the staff in the Ministry of Health had a more positive attitude towards One Health practice compared to respondents from the Ministry of Fisheries and Livestock and thus they could cooperate more with experts from other ministries. This result is contrary to what was found in India by Chaddock, (2012) that medical doctors tend to be a bit reluctant to collaborate with veterinary doctors in

dealing with zoonotic diseases because medical doctors think they are more superior than veterinary doctors in India. In addition, it was revealed through one key informant interviewee that human health and animal researchers had collaborated during the 2014 Ebola outbreak, whereby some suspected Ebola samples from the University Teaching Hospital (UTH) were transferred to the Veterinary laboratory at the University of Zambia for diagnosis; and an Ebola task force was formed which included medical and veterinary health experts who worked together in order to prevent/ control Ebola. Joint collaboration among medical and veterinary experts in dealing with human and animal health is very crucial, especially in developing countries considering that resources are limited (Zinsstag *et al*., 2007a). In addition, more positive attitude from respondents in the Ministry of Health suggest a successful collaboration with other fields in dealing with brucellosis and other zoonoses.

The study established that majority of the FGD participants were not able to define human brucellosis and even its symptoms in humans. However, some of the respondents were knowledgeable about the symptoms of brucellosis in animals and modes of disease transmission. However, the knowledge they had on brucellosis could still not influence them to vaccinate their livestock against brucellosis and consequently household lost a significant amount of money due to abortions, milk loss, and prolonged inter calving. Similar result were reported by WHO (2006) and Muma *et al* (2013) that brucellosis is one of the widely distributed zoonoses, especially in economically disadvantaged livestock keeping communities yet majority are unaware of it. Consequently, livestock farmers are still living with high poverty instead of enjoying their lives through trading livestock and livestock products.

From the interviews conducted, it was observed that contact with animals without preventive gears, drinking unpasteurized milk and eating not-well cooked meat from brucellosis infected cattle were the possible ways leading to brucellosis transmission. However, majority of the respondents were not able to associate unpasteurised sour milk with the transmission of brucellosis from livestock to humans. The above results are in agreement with a study which was carried out in Sudan which found that most farmers (61%) had appropriate knowledge of transmission, diagnosis and prevention of brucellosis (Angara *et al*., 2016).

Majority of participants who participated in the discussions in this study were able to identify the losses attributed to brucellosis such as abortions, milk loss and costs due to vaccinations. Furthermore, participants were able to identify the indicators of well-being which applied to their households. Therefore, majority of the participants agreed that indicators of poor well-being applied to their well-being to a larger extent despite the fact that some farmers had large numbers of cattle. Majority of households were classified as poor. Similar results were reported by FAO and World Bank in 2014 that 67% of traditional livestock farmers in Sub Saharan Africa lived on less than US$ 1.25 per day; which defines the extremely poor ranges among households. In addition, the issue of livestock services being expensive to most of the livestock farmers can be attributed to lack of enough infrastructures in the remote areas where most farmers can are found. Therefore, most livestock farmers cannot afford to build their own infrastructures such as dip-tanks considering the cost involved. In this study, most farmers expressed ignorance of the brucellosis implying that both farmers and livestock were at risk of being infected.

Despite the that fact professionals from human and veterinary health were aware about the One Health concept, collaboration among them was scanty due to absence of policy directives and institutional framework. A similar situation was observed in Tanzania by Kayunze *et al*., (2012) whereby experts in the different ministries were aware of the One Health practice but lack of institutionalised framework hindered them from adopting the One Health practice in their respective ministries. Nonetheless, disease surveillance and preventive exercises which have been jointly done in the past by medical and veterinary personnel was a good sign that collaboration between the two professionals was possible. However, budget constraints seemed to be a major hindrance for such collaborative activities, partly because of joint planning.

At the district level, there seems to be some joint collaborative activities such as control of rabies. However, the scope and scale of operation was also minimal and would benefit from availability of a legal and institutional framework in the implementation of the One Health concept in Zambia. In some countries in Europe where such has been implemented have recorded great success in community public health (Monath *et al*., 2010).

5.5 Framework of Collaboration (FC)

Based on the findings from this study, a framework of collaboration in Zambia has been proposed. The collaborative frame work is based on the three major pillars; which are:

i) Joint problem analysis: Identification of problems by the responsible agencies at ministerial level. It is important to get commitment from the top management (Ministers

and Permanent secretaries) if the One Health Concept is to be actualised. The top management need to appreciate the problems of zoonoses so that they can approve budget allocations to such collaborative activities. Experts at the ministerial level need to come together and discuss the problem caused by brucellosis and come up with possible solutions. Therefore, it will help experts to educate and convince higher senior officers in the ministries to have a common perception of the problem which will also help medical and veterinary personnel in the districts and village-level field workers to work together in dealing with the same problem according to the directives provided by the ministries.

ii) Resource Mobilisation: Resources that include human, infrastructure, equipment and financial are critical in applying interventions. Therefore, identification of reliable sources of such resources which will be used in the implementation is important. This will help to have a sustainable and easy implementation phase. Inadequate resource was one among the major challenges mentioned by respondents from both ministries as well as respondents from districts considering the fact that government funding was not enough, hence, a holistic approach is inevitable.

iii) Identification of implementing agencies: This aspects entails defining the institutional framework on the implementation of the One Health concept. It is very important that both ministries jointly identify implementers on the ground so as to avoid duplication of roles; ensure efficiency in resource use; simplify monitoring and evaluation of the activities. Therefore, institutions at district level should have a major

role to play since most of the beneficiaries of these collaborative efforts are found in their areas.

5.6 Theories of Well-being

On the theories of well-being which was applied in this research, it was observed that taking a middle path between well-being as an "ideal" and well-being as "people's psychology to much greater degree" was a right direction for this research since it entails an ideal as something valuable but an ideal that is anchored in peoples' psychology. However, there are other theories which have taken this path. Full information theory, for instance, defines well-being in terms of idealized psychological states, namely the desires that we would have if we were fully informed (Arneson, 1999). It is therefore believed that such theories are on the right track, but they can also be improved upon. Idealised subjective theories in general have the problem that we do not have ideal psychologies to work with, which means that there are special difficulties for applying such theories of well-being. If one doesn't have access to what our psychological states would be like ideally, it may be challenging to understand how the well-being can be defined in terms of such states. Therefore, it is important to articulate a different way that a theory of well-being can be helpful. Instead of providing us with a detailed picture of all the elements of an ideally good life, it can be argued that, a theory of well-being can give us practical guidance about how to change a person's life so that it improves. In other words, a theory of well-being can fulfil its practical function by instructing about the process of improving people's lives rather than by giving us a sharp picture of the ultimate goal (Crisp, 2006; Feldman, 2004). Therefore, this study established that better well-being at the household level is not a result of having resources only but also the

psychology of household members plays a major role towards improving or declining household socio-economic well-being.

5.7 Sustainable Livelihood Approach (SLA)

On the sustainable livelihood approach which was applied in this study, it was observed that human development is a process of enlarging people's choices. In principle, these choices can be infinite and change over time. But at all levels of development, the three essential ones are for people to lead a long and healthy life, to acquire knowledge and to have access to resources needed for a decent standard of living. If these essential choices are not available, many other opportunities remain inaccessible. The developmental process should meet the needs of the present generation without compromising the options of future generations (Beall, 2001). However, similar situation was observed by Cowen and Shenton (1998) who pointed out that sustainable development is much broader than the protection of natural resources and the physical environment which includes the protection of human lives in the future. However, in this study, sustainability of household well-being was directly affected by factors attributed to brucellosis such as lack of money to spend on human and livestock health services, losses which were caused by livestock abortions, discarded milk, prolonged inter calving and costs of veterinary intervention. Therefore, livestock as a major resource for the households are predetermined factor for the future generation in the Western and Southern provinces.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

This study has established that brucellosis is an important livestock production constraint that results in farmers losing a significant amount of income due to losses and costs attributed to the disease such as abortions, milk loss, costs of vaccination and livestock mortality. Considering the role played by livestock in the well-being of farmers in the Western and Southern provinces of Zambia, it is concluded that brucellosis had significant impact on socio economic wellbeing of cattle farmers and affect households well-being, hence contributing to increased poverty among the cattle farmers.

This study has also described levels of well-being at households in both provinces and established that there were different levels of socio-economic wellbeing among households whereby poor households had higher costs and losses than the rich ones were such costs and loses very low. In addition, majority of households were classified as poor despite being in provinces considered to be high cattle producing areas in Zambia.

This study was also established factors which were associated with negative brucellosis impact on socio-economic well-being to be household costs, household losses due to brucellosis and lack of money to pay for livestock health services.

Since there is currently no policy nor institutional framework to guide the joint activities between personnel from the Ministry of Health, and Ministry of Fisheries and Livestock, it would be difficult for the health sector in Zambia to operationalize the One Health

concept in the management of zoonotic diseases. However, stakeholders were willing to collaborate and implement the One Health approach to the control brucellosis and other zoonoses.

The main factors that could further enhance collaboration were; joint identification of problems related to one health; joint mobilisation of resources for activity implementation; and identification of agencies within the competent authorities who should be mandated to operationalize the activities. Other challenges that impeded collaboration were lack of communication among potential collaborators, lack of network for collaboration, and potential collaborators having quite different fields of specialization. It is therefore concluded that a robust institutional framework which can facilitate the flow of information between ministries/departments be put in place.

It can further be concluded, the fact that human health and animal researchers have collaborated in the past during the 2014 Ebola outbreak, suggest that such collaboration is possible and implementation of the One Health policy in Zambia can be realized. It is however important to engage key stakeholders at higher management levels to secure a buy-in from policy makers. Inter-sectoral experts should also have the common understanding of the problems which will also help medical and veterinary personnel in the districts and villages level to work together in dealing with the same problem according to the directives provided by the ministries.

Further, this research has attempted to capture some of the major issues that emerge from a broad sweep of the theories dealing with sustainable livelihoods and household socio-economic well-being of cattle farmers. It is evident that many questions remain

unanswered about the practical complexities and contradictions of the sustainable livelihoods approach. In clarifying where sustainable livelihood approach fits with other new approaches to development on household well-being, it is necessary to consider it in relation to development theory. However, livelihood of livestock farmers in Southern and Western provinces of Zambia depends on livestock keeping, and since there is high losses due to brucellosis, most of households are in "stress and shock" resulting in absence of sustainable livelihood due to the fact that majority of the households depend on livestock as the main driver for their livelihood.

In addition to well-being theory towards household wellbeing, it is concluded that to live well is to succeed in terms of values. The best life cattle farmers can live (in terms of their own well-being) is the one in which they get the most value fulfilment overall, and what is good for them to do and whatever contributes to living a life that is closer to this ideal. Since, well-being is both ideal and psychological it is concluded that cattle farmers in Southern and Western provinces has been affected since most of households objectives have not been achieved due to losses and costs attributed to brucellosis.

6.2 Recommendations

In order to reduce the impact of brucellosis on livestock and improve the socio-economic well-being of farmers in Southern and Western provinces, the following recommendation are made:

1. Government should put in place measures to control brucellosis and other zoonoses in order to prevent farmers from losses and costs they incurred in preventing and controlling of disease so that socio-economic well-being of cattle farmers is

improved and maintained; Provision of free brucella vaccination, as a public good, should be considered.

2. Government should improve livestock health services delivery in order to eliminate/reduce brucellosis related losses by investing more in livestock health facilities to maximize livestock production and improve well-being levels of households;

3. The Ministry of Health, and Ministry of Fisheries and Livestock should come up with a policy framework to guide collaboration between medical and veterinary personnel (One Health practices) in order to manage zoonoses.

4. Government should adopt the One Health collaboration framework as a road map for departments to coordinate collaborations at the ministerial levels in order to enhance collaborative activities between human and animal health personnel, especially on researches and surveillance in the districts.

6.3 Study Limitations

One of the shortcomings is that the study did not establish the prevalence of brucellosis in the affected communities in order to confirm the infections in herds, instead the study used the report of the surveys which were done by the District Veterinary Offices. Therefore, some information might not be accurate since there was no confirmation test done to validate the DVO's report. Therefore, further research to ascertain the extent of the problem in herds should be undertaken. In addition, the study findings may not be generalised to the whole Zambia due to limited number of provinces and districts which were included in this research. In addition, the study did not establish the socio-

economic impact of brucellosis from human infections due to lack of information with regard to human brucellosis on the medical side. Therefore, further research to ascertain the extent of the problem in humans should be undertaken.

Some of the information about productivity parameters used in the economic model was not obtained in the survey hence it was estimated from secondary information available in the District Veterinary Reports which in some districts could not be found hence generalisation of assumptions was made in order to fit in the model. As such, some results could not be realistic due to lack of accurate information needed.

Language was a limitation because the principal investigator did not speak any of the local languages (Tonga, Ila and Lozi) which were used during the households interviews and focus group discussion sessions, hence reasonable amount of money was used to pay translators who facilitated the discussions. It is possible that some information was lost or error was introduced as result of interpretation.

Some of the respondents were not aware about the disease "brucellosis" in local languages. Therefore, the translator had to spend a lot of time describing it. This prolonged the sessions of interview in some focus group discussions. Unfavourable weather, considering that this study was conducted during the rainy season interfered with some appointments for interviews. In some areas such as Senanga, it was not possible for respondents to gather for FGD discussions according to schedule. This in the end prolonged the period of stay in the field, resulting in extra expenditure.

6.4 Areas for Further Research

Based on the findings of this study, it is worth suggesting that further studies can be conducted in the areas such as the impact of brucellosis on humans and applications of DALYs to determine how cattle farmers have been affected as well as the their animals by the presence of brucellosis.

In addition, indicators used to determine socio-economic well-being at the households can be expanded to include more household economic indicators in order to have a detailed information of the losses and costs within a single household. Further research should also include other types of livestock other than cattle and to establish their contribution towards household well-being.

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8.0 APPENDICES

Appendix 1: Publications

Published papers

Mwinyi, M.O., Muma, J.B., Kayunze, K.A., Simmunza, M.C. (2015). 'Policy Concerns, Opportunities, Challenges, and Attitude towards One Health Practice in Zambia', *Journal of Health, Medicine and Nursing*. (Published)

Mwinyi, M.O., Muma, J.B., Kayunze, K.A., Doreen, S., Simmunza, M.C. (2016). 'Socio-economic Impact of Brucellosis on Livestock Farmers in Southern and Western Provinces, Zambia', BMC *Journal of Infectious Diseases of Poverty* (Under review).

Doreen, S.C., Mumba C., Skjerve E., Oliver M., Consolata K., **Mwinyi, M.O.**, Luke N., Muma J. B. (2017). "*Awareness and Attitudes towards anthrax and Meat Consumption Practices among Affected Communities in Zambia*" PLOS *Journal of Neglected Tropical Diseases.* (Published)

Appendix 2: Household questionnaire

A Household Questionnaire for Research on:

Impacts of Brucellosis on Socio-economic Well-being of livestock farmers in Western and Southern Provinces, Zambia.
A Case Study of Monze, Namwala, Mongu and Senanga Districts

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Serial Number

Purpose and importance of the study
Your household has been selected randomly to participate in a research that is on-going in this district about the impacts of brucellosis on socio-economic well-being. The main purpose of the research is to generate information on the impact of brucellosis on socio-economic well-being and to assess One Health practices. All the responses you will give will be treated confidentially, and the research results will be used only for academic purposes. Therefore, you are kindly requested to respond to all questions openly and truthfully.

A. HOUSEHOLD SOCIO-DEMOGRAPHIC ATTRIBUTES

1. Province (1=Southern, 2=Western)
2. District (1. Monze, 2. Namwala 3. Mongu 4. Senanga)

3. Village of residence……..

4. Name of farmer (optional)		**Code**
5. Sex	1= Male, 2 = Female	
6. Age		
7. Marital status	1= Single, 2= Married, 3= Divorced, 4=Widow(er)	
8. Level of education	1=None, 2= Primary, 3= Secondary, 4= Tertiary	
9. Household size		
10. Number of cattle		
11. Number of goats and sheep		
12. Number of pigs		
13. Place where cattle kept	1=Village resident, 2=Flood plains, 3=Both	

B. INTERACTIONS AMONG WILDLIFE, LIVESTOCK AND HUMANS, AND DISEASE OCCURRENCE

14. Is there any nearby forest/national park/game reserve	1=Yes 2=No	
15. Mention the name of the forest/national park/game reserve	1=blue lagoon NP, 2=Kafue NP	
16. If yes to Q14, which wild animal types are available in the nearest forest/national park/game reserve	1=Impala 2=Zebra 3= Wildebeest 4=Buffalo 5=Lechew	
17. Do you wear rubber gloves when you contact livestock	1= Yes 2= No	
18. Do you help animals when they are getting birth?	1= Yes 2= No	
19. Do you help in Slaughtering/skinning animals?	1= Yes 2= No	
20. Do you herd animals?	1= Yes 2= No	

C. ABOUT BRUCELLOSIS IN HUMANS

21. Did you or any member of your household have the following symptoms?

Symptoms	**Response**	**Code**
Fever	1=Yes 2=No	
Chills	1=Yes 2=No	
Sweats	1=Yes 2=No	
Weakness	1=Yes 2=No	
Fatigue	1=Yes 2=No	

Joint, muscle and back pain	1=Yes 2=No	
Poor appetite	1=Yes 2=No	
Weight loss	1=Yes 2=No	

22. Did you or any member of your household consume the following livestock products?

Products	**Response**	**Code**
Unpasteurised milk	1=Yes 2=No	
Unpasteurised sour milk	1=Yes 2=No	
Raw meat	1=Yes 2=No	
Meat from dead livestock	1=Yes 2=No	

23. Do you know any health risks/diseases that can be due to drinking unpasteurised milk or eating raw meat

Diseases	**Response**	**codes**
Brucellosis	1=Yes 2=No	
Tuberculosis	1=Yes 2=No	
Anthrax	1=Yes 2=No	
Cysticercosis	1=Yes 2=No	

D. IMPACTS OF BRUCELLOSIS IN HUMANS

24. Costs of prevention, diagnosis, control, treatments and caring for ill members of household per year

Losses and costs at the household level	ZMK	Costs for medical services	ZMK
Income lost when seeking treatment and correct diagnosis for brucellosis		Costs incurred on brucellosis prevention	
Income lost when convalescing from brucellosis		Money paid for consulting medical personnel for brucellosis	
Income lost due to forgone revenue due to the illness			
Income lost by other household members accompanying and caring for the patients having brucellosis problems		Costs incurred on transport, food and other items when seeking medical care for brucellosis	
Income lost when seeking treatment and correct diagnosis for other illnesses		Money spent on diagnosis and medicine for brucellosis	
Income lost when convalescing from other illnesses		Costs incurred on prevention of other diseases	
Income lost by other household members accompanying and caring for the patients having problems with other illnesses		Costs incurred on transport, food and other items when seeking medical care for other illnesses	
Total			

E. About Brucellosis in Livestock

25. Did your livestock have the following symptoms of Brucellosis?

Symptoms	Response	Code
Abortion	1=Yes 2=No	
Still birth	1=Yes 2=No	
Weak calf born	1=Yes 2=No	
Retention of fetal membranes	1=Yes 2=No	
Signs of infection in the membranes	1=Yes 2=No	
Swollen testicles in bulls	1=Yes 2=No	

F. IMPACTS OF BRUCELLOSIS IN LIVESTOCK

26. Direct losses due to ill-health or death per year

Non-monetary losses	Responses	Monetary losses	
Effect		**Losses**	**ZMK**
Did you experience death of your livestock due to brucellosis	1= Yes 2=No	Monetary value of animals which died due to brucellosis	
Did you vaccinate your livestock for brucellosis	1= Yes 2=No	Monetary value of vaccination for brucellosis	
Did you discard milk due to brucellosis	1= Yes 2=No	Monetary value of milk which had to be discarded because of brucellosis	
Did you discard milk because of application of drugs against other diseases	1= Yes 2=No	Monetary value of milk which had to be discarded because of application of drugs against other diseases	
Did you spend much of your time taking care of affected animals	1= Yes 2=No	Monetary value of time spent for caring the sick animal	
Did you experience prolonged calving	1= Yes 2=No	Monetary value of wasted due to prolonged calving	
Did you lose any calve due to abortion in the last trimester period)	1= Yes 2=No	Monetary value of the calves lost due to abortion which caused by brucellosis	
Total	-	-	

27. Costs of treating and caring for affected animals and costs of prevention per year

Non-monetary losses	Monetary losses	ZMK
Days livestock keepers spent caring for sick animals including obtaining veterinarians	Cash paid for veterinary consultation with respect to brucellosis	
	Cash paid for buying preventive gears for protection	
Days livestock keepers spent procuring veterinary pharmaceuticals	Cash paid for diagnosis against brucellosis	
	Cash paid for preventive and curative drugs against other diseases (including vaccines, antibiotics, acaricides, antihelminthetics, etc)	
	Food hygiene costs incurred (e.g. abattoir inspections)	
Total		

F. SOCIO-ECONOMIC WELL-BEING STATUS

28. To what extents do the following items apply as indicators of well-being in your household?

Item	Applicability as an indicator of well-being (1=Applicable, 2=Not applicable)	The situation in your household
Being able to eat at least 3 meals per day		Number of meals
Being well sheltered		1=Yes, 2=No
Being able to escape avoidable morbidity and premature mortality		1=Yes, 2=No
Households having at least any household members having a good self-employment or a salaried employment;		1=Yes, 2=No
Being able to sell livestock and crop products whenever they like		1=Yes, 2=No
Being able to pay school fees for secondary school children belonging to the households		1=Yes, 2=No, 3=Not Applicable
Having been able to buy new (not second-hand) clothes during the previous 12 months		1=Yes, 2=No
Having freedom to live the way they would value, so long as they do not break the laws		1=Yes, 2=No

29. Crops produced from last farming season and inputs used

Crop	**Seeds** 1. Local 2. Improved 3. Others (Specify**)**	**Fertilisers** 1. Yes (Inorganic) 2. Yes (Organic) 3. No 4. Not applicable	**Herbicides** 1. Yes 2. No 3. Not applicable	**Agric.equipment and tools** 1. Hand hoe 2. Tractor 3. Ox-plough 4. Manual labourers 5. Zero tillage **6.** 6. Others	Reasons for not using the equipment/tools/inputs 1= Expensive 2= Works as good as the current tools/equipment 3= Lack of knowledge to use them
Maize					
Rice					
Cassava					
Sorghum/millet					
Beans					
Groundnuts					
Cow peas					
Pigeon peas					
Sweet potatoes					

30. What amounts of various crop products did you harvest from 1/1/2014 to 31/12/2014?

Crop	Amount harvested Kg	Amount needed per year for your household in Kg	Amount sold in Kg	Monetary value/ZMK
Maize				
Rice				
Cassava				
Sorghum/millet				
Beans				
Groundnuts				
Cow peas				
Pigeon peas				
Sweet potatoes				
Total				

31. Apart from crop production, what other economic activities did you and/or your household members do from 1/1/2014 to 31/12/2014? (Please list all the activities done by all household members).

Non-farm activities done by all household members	Who did the activities: 1. Father 2. Mother 3. Children	Costs incurred on the activities	Gross revenue from the activities

G. COLLABORATION AMONG MEDICAL AND VETERINARY EXPERTS IN DELIVERY OF HEALTH SERVICES

32. Do you know any collaboration that exists between/among the following categories of experts in preventing/controlling/treating diseases?

Categories of experts	Presence of any kind of collaboration (1 = Yes; 2 = No)	If yes, in which ways do they collaborate?
Medical and veterinary officers		
Medical and wildlife officers		
Veterinary and wildlife officers		
Medical, veterinary officers, and wildlife officers		

33. (a) If the collaboration exists, have you or any member of your household benefited from it? (1=Yes; 2=No)

(b) If you or any member of your household has benefited from it, what were the benefits?
……

34. (a) Do you think the collaboration existing among medical and veterinary experts is enough for effective prevention, control, and treatment of zoonotic diseases? (1=Yes, 2= No)
(b) If No, do you think there is a need for working towards improving it? (1=Yes, 2= No)
(c) If yes, how do you think it should be improved?

..…….....

H. THEORIES OF WELL-BEING AND SUSTAINABLE LIVELIHOOD APPROACH

35. To what extent can each of the following items prevent you from using modern livestock health services?

Items which may prevent people from using modern livestock health services	**Extent to which the aspects can prevent one from going for modern livestock health services (1=Cannot at all, 2=Cannot, 3=Undecided, 4=Can to a small extent, 5=Can to a large extent)**				
Lack of cash to pay for livestock health services					
Lack of information about livestock health services					
Belief in traditional livestock services being better than modern medicine					
Being convinced by relatives and friends about livestock health services					
Being not ready to spend many hours waiting for livestock health services					
Other constraints					

36. Would you kindly strongly disagree, disagree, agree or strongly agree with each of the following statements to reflect your attitude towards the behaviour of not using livestock health services

Attitudinal statements about using modern animal health facilities	**Levels of agreement and disagreement with the attitudinal statements (1=Strongly disagree, 2=Disagree, 3=Undecided, 4=Agree, 5=Strongly agree)**				
	1	**2**	**3**	**4**	**5**
1. No need of getting livestock treated because fake medicines are used					
2. No need of calling veterinarians because traditional livestock services treat livestock better					
3. No need of getting livestock dipped/treated because the costs are very high					
4. Livestock diseases are not very serious					
5. No need of going for Veterinary Investigation Centre and					

	other Government services because there are poor facilities					
6.	Livestock health services are too far from home					
7.	It is important to take samples for correct diagnosis of livestock diseases to know which medicines to use					
8.	Vets and Government livestock health facilities provide scientific treatment unlike traditional healers of livestock diseases					
9.	Although traditional livestock services charge low amounts of money and can be paid in kind, they are livestock health services are not reliable					
10.	Most livestock diseases are cured by modern veterinarians, and not traditional healers of livestock diseases					
11.	Traditional healers guess diagnoses of livestock diseases					
12.	Traditional healers claim to know even livestock health problems which they don't know about					

37. Approximately how much time do you use to get access to the nearest modern livestock health facility by the following means

	Means of going to health facilities	**Minutes/Hours**	**Extent of using the means (%)**
	Own vehicle		
	Public vehicle		
	Own motor cycle		
	Public motor cycle		
	Bicycle		
	On foot		
	Other means (Specify)		

38. To what extent are the livestock health services affordable at the place where you mostly get them?

	Level of affordability	**View (Explanation) of the cheapness or expensiveness of the human health services**
1.	Cheap	
2.	Affordable	
3.	Expensive, but affordable	
4.	Too expensive to afford	

THANK YOU FOR YOUR COOPERATION

Appendix 3: A checklist of items for focus group discussions with the community

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A Guide for Focus Group Discussions with Community Members for Research on

The impact of brucellosis on Socio economic well-being of cattle farmers in Western and Southern Provinces, Zambia.
A case study of Monze, Namwala, Mongu and Senanga Districts

By
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Dear Community Members,

You have been invited to hold discussions with me with respect to a research I am doing in Monze, Namwala, Mongu and Senanga districts about the impact of brucellosis on socio-economic well-being of cattle farmers at households in your area. The aim of the research is to generate information which may form a basis for advocacy for formulation of One Health policy to enhance more collaboration among medical and veterinary experts for more effective prevention, control and treatment of human, livestock infectious diseases, especially brucellosis which affect. The views you will give will be used only for that purpose, and there are neither wrong nor correct answers. Therefore, you are kindly requested to give your views openly and truthfully.

1. The names of your village, ward, and division
2. Types of livestock species kept in your district
3. Places where livestock kept (Village residence or Flood plains)
4. Is there any nearby forest/national park/game reserve
5. Mention the name of the forest/national park/game reserve \
6. Which wild animal types are available in the nearest forest/national park/game reserve
7. Do you wear rubber gloves when you contact livestock
8. Do you help animals when they are getting birth
9. Do you help in Slaughtering/skinning animals
10. Do you the symptoms of brucellosis to humans
11. Do you know the symptoms of brucellosis to livestock
12. How do you talk about the consumption of Unpasteurised milk
13. How do you talk about the consumption of Unpasteurised sour milk
14. How do you talk about the consumption of Raw meat
15. How do you talk about the consumption of Meat from dead livestock
16. What are the health risks/diseases that can be due to consuming unpasteurised milk or eating raw meat
17. What do you know about Brucellosis
18. What do you know about Tuberculosis
19. What do you know about Anthrax

20. Costs of prevention, diagnosis, control, treatments and caring for ill members of household per year
21. How frequently have you experienced abortion to your livestock
22. How frequently have you experienced Still birth
23. How frequently have you experienced Weak calf born
24. Monetary value of animals which died due to brucellosis
25. Monetary value of milk which had to be discarded because of brucellosis
26. Monetary value of the calves lost due to abortion which caused by brucellosis
27. Monetary value of wasted due to prolonged calving
28. Whether the following are indicators of wellbeing in their district:
    - All household members being able to eat at least 3 meals per day
    - Being well sheltered
    - Being able to escape avoidable morbidity and premature mortality
    - Households having at least any household members having a good self-employment or a salaried employment
    - Being able to sell livestock and crop products in nearby towns
    - Being able to pay school fees for secondary school children belonging to the households
29. Categories of well-being levels in which households of the village can be grouped on the basis of the indicators
30. Diseases transmitted from livestock to humans through milk and meat, how they are a threat or not to health, and precautions they take to avoid the infection
31. Environmental factors affecting human and livestock diseases occurrence and persistence
32. How the collaboration, if it exists, helps (or otherwise) reduces the burden of disease on well-being of livestock farmers
33. Which livestock diseases lead to impoverishment of people
34. Symptoms of brucellosis
35. There are some diseases which affect both humans and animals. Which of them do you know?
36. However, medical and veterinary experts hardly collaborate to control and treat them. Do you know any collaboration among medical and veterinary experts on detecting, controlling, and treatment of zoonoses?
37. Do you think if they collaborated they would control zoonoses more effectively? In which ways do you think they should collaborate?
38. In what ways are livestock health services provisions problematic?
39. How the better-off and the worse-off meet costs of health services for their livestock
40. Sources of water for livestock and for humans to drink, what are the problems?
41. Animal and crop products mostly produced and sold
42. Assets mostly bought using cash from livestock and from crop production
43. Proportion of income from livestock used to buy food and various consumer items

THANK YOU FOR YOUR COOPERATION

Appendix 4: Checklist of Items for Discussion with District Medical Officer

A Checklist of Items for Discussion with District Medical Officer for Research on

Impacts of brucellosis on Socio economic well-being of livestock farmers in Western and Southern Provinces, Zambia.
A case study of Monze, Namwala, Mongu and Senanga Districts

By
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Dear District Medical Officer,

In the first place, I thank you very much for sparing some of your precious time to assist me by giving me some insights about human disease policies, practices, and collaboration among medical and livestock experts in your district. The research is about the impacts of brucellosis on socio-economic well-being in Western and Southern Provinces, Zambia. The aim of the research is to generate empirical information on the impact of brucellosis on socio-economic well-being of livestock farmers and assessing One Health practice as a mechanism of controlling diseases. I earnestly promise that I will treat the information you will give me with high confidentiality and use it only for the aim stated above and academic purposes. Therefore, I plead with you to kindly respond to all the items for discussion openly and truthfully.

1. Describe the extents to which livestock systems explain human disease occurrence in the district?
2. What are the most common human diseases in the district?
3. Describe the extent to which human living environment explains human disease occurrence, (e.g. increasing population density and growth, increasing human mobility, growing poverty and inequality, increasing susceptibility, changing dietary habits, and lack of infrastructure).
4. Describe the awareness about "One health" approaches among medical and livestock officers
5. Describe ways in which medical, para-medical, veterinary and para-veterinary personnel have collaborated within the previous 12 months.
6. Describe factors which may hinder collaboration among medical and veterinary officers.
7. Describe factors which may enhance collaboration among medical and veterinary officers.
8. Describe any diagnosis of a zoonotic disease or a non-zoonotic disease that has been done in collaboration between medical and veterinary personnel.
9. Describe any disease surveillance and preventative exercises which have been done in collaboration between medical and veterinary personnel?
10. Describe aspects on which medical and veterinary personnel collaborate to treat zoonoses.
11. Describe any forms of reporting diseases containing both veterinary and medical data which have been used by medical and veterinary personnel.
12. Describe whether medical personnel have used veterinary databases, and vice versa

13. What research is present on zoonotic diseases which medical and veterinary personnel have collaboratively participated in?
14. Are there any animal diseases that medical personnel have learned about or have taught others about?
15. Are there any of the human health objectives that should be improved or made redundant and why?
16. Are there any new human health objectives that should be formulated and why?
17. What traditional, social, and economic factors affect the behaviour of humans seeking healthcare in the district? (eg: going or not going for health services, decision to seek the services, choices of where to go for the services, belief in modern health services, presence of traditional healers, lack of cash for the services)
18. What miscellaneous issues on human health provision are present in the district?
19. Describe the occurrence of cases of human brucellosis reported in the district.
20. How do you diagnose brucellosis?
21. How do you treat a patient with brucellosis?
22. To what extents is brucellosis fatal in your district?
23. What human diseases contribute to impoverishing people?
24. Do you think that the presence of zoonoses can be a determining factor for the well-being of the people in the district? Why or why not?
25. What do you think should be done to make collaboration between human and animal health officials effective?
26. Do you think increasing the number of animals can be the threat to human health in the district? Why or why not?
27. Apart from rabies, does the district have the capacity to diagnose and treat zoonotic diseases in humans? Why or why not?
28. What factors do you believe contribute to the continual problem of zoonoses in the district?
29. Considering the limitations of the district, what actions do you believe can be implemented to decrease the incidence of zoonoses?

THANK YOU FOR YOUR COOPERATION

Appendix 5: Checklist of Items for Discussion with District Veterinary Officers

Impacts of brucellosis on Socio economic Well-being of livestock farmers in Western and Southern Provinces, Zambia.
A case study of Monze, Namwala, Mongu and Senanga Districts

By
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Dear District Veterinary Officer,

In the first place, I thank you very much for sparing some of your precious time to assist me by giving me some insights about animal disease policies, practices, and collaboration among livestock and medical experts in your district. The research is about the impacts of brucellosis on socio-economic well-being in Western and Southern Provinces, Zambia. The aim of the research is to generate empirical information on the impact of brucellosis on socio-economic well-being and to assess One Health practices as a solution for controlling diseases. I earnestly promise that I will treat the information you will give me with high confidentiality and use it only for the aim stated above and academic purposes. Therefore, I plead with you to kindly respond to all the items for discussion openly and truthfully.

1. Describe extents to which livestock systems explain human disease occurrence in the district, (e.g. increase in stock numbers, globalization of production and supply, peri-urban livestock production, irregular use of drugs and vaccines, trade in live animals and animal products, mixing small, medium, and large scale production).
2. What biological, behavioural, socio-economic, cultural, and ecological factors for transmission of diseases among wild animals, livestock, and humans influence how people believe pathogens/parasites that infect/infest people?
3. What are the most common zoonotic livestock diseases in the district?
4. Describe the awareness about One Health approaches among medical, livestock and wildlife officers.
5. Describe ways in which medical, para-medical, veterinary and para-veterinary personnel have collaborated within the previous 12 months.
6. Describe any diagnosis of a zoonotic disease or a non-zoonotic disease that has been done with collaboration between medical and veterinary personnel.
7. Describe any disease surveillance and preventative exercises which have been done in collaboration between medical and veterinary personnel?
8. Describe aspects on which medical and veterinary personnel collaborate to treat zoonoses.
9. Describe any forms of reporting diseases containing both veterinary and medical data which have been used by medical and veterinary personnel.
10. What are factors which may hinder enhance collaboration among medical, veterinary, and wildlife officers? What factors enhance this collaboration?
11. Describe whether medical personnel have used veterinary databases, and vice versa.
12. What research is present on zoonotic diseases which medical and veterinary personnel have collaboratively participated in?

13. Are there any human diseases that veterinary personnel learn or teach others about? If so, what diseases?
14. Are there any livestock health objectives that should be improved or made redundant and why?
15. Are there any new livestock health objectives that should be formulated and why?
16. Describe the accessibility to animal health services and facilities within the district

17. How many dip tanks are accessible in the district?
18. What types of disinfectants are being used in the dip tanks?
19. To what extent is brucellosis a problem in the district as compared to other zoonoses?
20. What is the average number of animals (livestock) which infected with brucellosis in the past two years?
21. What is the recommended vaccine for brucellosis?
22. What are the available vaccines for brucellosis?
23. What public education is available regarding the transmission of brucellosis between livestock, and between livestock and humans?
24. What recommendations are made to farmers about preventing transmission of brucellosis?
25. Do you think animal brucellosis can be a determining factor for the well-being of the people in the district? Why or why not?
26. Do you think increasing the number of animals can be the threat to human health in the district? Why or why not?
27. Describe how brucellosis is impoverishing livestock farmers in the district?
28. What factors do you believe contribute to the continual problem of brucellosis in the district?
29. Considering the limitations of the district, what actions do you believe can be implemented to decrease the incidence of brucellosis?

THANK YOU FOR YOUR COOPERATION

Appendix 6: Questionnaire for Policy Makers and Planners

Impacts of brucellosis on Socio economic Well-being of livestock farmers in Southern Province, Zambia.

By
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Dear Sir/Madam,

By virtue of you being a Policy Maker/Planner at the ministerial level, you are kindly requested to spare some of your precious time to give your opinions about the issues for a research that is going on in Zambia under the University of Zambia, Zambia. The research is about human and livestock health policies, and the impacts of brucellosis on socio economic well-being. The main purpose of the research is to generate information on which advocacy may be based for the practice of one health approaches, at the heart of which there is collaboration among medical and veterinary officers in disease detection, prevention, control and treatment. All the responses you will give will be treated confidentially, and the research results will be used to draw policy recommendations about the practice of one health. Therefore, you are kindly requested to respond to all questions and give your opinions frankly to the items of the research.

A. PROFILE OF THE POLICY MAKER/PLANNER

1. Sex category of the policy maker/planner (1=Male. 2=Female)
2. Year of birth of the policy maker/planner…… …….
3. Highest level of education: (1=Certificate, 2=Diploma, 3=1st Degree, 4=Master's Degree, 5=PhD, 6=Others)
   Profession (e.g. MD, BVM, Bachelor's Degree in Animal Science, Bachelor's Degree in Wildlife, Diploma in Clinical Medicine, Diploma in Animal Production, Advanced Diploma in Wildlife, etc.)
   ……
4. Year of obtaining the highest professional qualification
   ……
5. Ministry where the policy maker/planner is based since
   ……..…(Year)
6. Department in the Ministry where the policy maker/planner is based since
   ……(Year)
7. Position held ……...since …..……..(Year)
8.

B. COLLABORATION AMONG MEDICAL AND VETERINARY EXPERTS IN HEALTH SERVICES PROVISION

9. There are various areas (e.g. dealing with zoonoses) where medical and veterinary officers could collaborate in disease detection, surveillance, prevention, and treatment/control. Does the ministry have any policies/plans to enhance such collaboration? Please circle one of the following options
   (1. Yes, 2.No)

10. Does human/animal health policy formulation processes involves community in the ground (1. Yes 2. No)

11. If yes, how do you do to make sure community is involved in the process…….
    ……

12. Is there any sort of collaboration between human and animal health experts in making policies regarding to health in general? (1.Yes 2. No)

13. If yes, which areas are they collaborating…….
    ……

C. COLLABORATION AMONG MEDICAL AND VETERINARY, WILDLIFE EXPERTS IN DELIVERY OF HEALTH SERVICES

14. One health is defined as the collaborative efforts of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals, plants and our environment. To what extent would you support its application? (1=Not at all, 2=Not, 3=No opinion, 4=Support, 5=Support to a large extent)

15. By pair-wise ranking, would you kindly respond by stating which of the following pairs of factor is a more important for enhancing collaboration among medical, veterinary, and wildlife officers in diagnosing, surveillance, prevention, control, and treatment of infectious diseases?

Factors which enhance or may enhance collaboration among medical, veterinary, and wildlife officers
1. Networking in research and disease control activities
2. Community-based prevention and control of zoonoses
3. Having early warning systems for detection and control of zoonotic diseases
4. Collaboration through professional associations
5. Sufficient money in budget(s)
6. One health approach to health financing
7. Common training in zoonotic diseases for both veterinary and medical doctors, and fieldworkers
8. Appropriate veterinary public health
9. Dual benefit: gains for animal and human health
10. Demand-driven, problem-led research
11. One health policy formulation guiding applied research in health

12. Advocacy for control of neglected zoonotic disease
13. Planning to choose in the context of one health
14. Adequate transport facilities for medical, veterinary and wildlife officers

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														

16. What other factors do you think could enhance or enhance collaboration among medical, veterinary, and wildlife officers in diagnosing, surveillance, prevention, control, and treatment of infectious diseases?……

17. By pair-wise ranking, would you kindly respond by stating which of the following pairs of statement are more important constraint to collaboration among medical, veterinary, and wildlife officers in diagnosing, surveillance, prevention, control, and treatment of infectious diseases?

Factors which constrain or may constrain collaboration among medical, veterinary, and wildlife officers
1. Institutional separation (e.g. between ministry of health, and veterinary and wildlife authorities)
2. Bureaucracy in making decisions regarding human and health issues
3. Control of zoonotic diseases being based on fire-fighting management
4. Lack of clarity about roles of the public and private sector partners
5. Lack of resources
6. Budgetary separation: veterinary and medical costs not pooled
7. Low emphasis on zoonotic diseases during training
8. Weak veterinary public health infrastructure
9. Difference of emphasis: medics focus on individual patients, vets on populations
10. Research being not demand-driven but donor-led
11. Applied research is not recognized or rewarded as being important as basic research
12. Inadequate resources for dissemination of results and raising public awareness
13. Lack of consensus on priority-setting
14. Inadequate transport facilities for medical, veterinary and wildlife officers

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														

18. What other factors do you think constrain or could constrain collaboration among medical, veterinary, and wildlife officers in diagnosing, surveillance, prevention, control, and treatment of infectious diseases?

.....……..…

.....……..…

19. (a) Do you think the collaboration existing among medical, veterinary, and wildlife experts is enough for effective prevention, control, and treatment of zoonotic diseases? (1=Yes, 2= No)

(b) If the answer to 14 (a) is no, how do you think the collaboration should be improved?

20. If yes to Question 8, please tell me whether there are plans/policies for collaboration in the areas listed in the following table

Possible areas for collaboration	**Whether there are plans/policies for officials of your ministry to collaborate with officials of the other two ministries (1=Yes, 2=No)**
Research on infectious diseases	
Disease detection/Diagnosis	
Disease surveillance	
Disease treatment and control	
Networking about diseases	
Financing collaborative activities	
Sharing/borrowing/lending equipment and tools	
Sharing/borrowing/lending facilities and premises	
Sharing/borrowing vehicles	
Sharing data/information	
Conducting campaigns against specific diseases	
Having common budgets for common health problems	

21. At the district, ward and village levels, some human health, animal health, and wildlife workers could be collaborating in some of the areas you have indicated that there are no plans/policies for collaboration. Would you encourage such collaboration? 1=Yes, 2=No.

22. One health is defined as the collaborative efforts of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals, plants and our environment. To what extent would you support its practice? (1=Not at all, 2=Not, 3=No opinion, 4=Support, 5=Support to a large extent)

23. Would you kindly state factors you think could facilitate the practice of one health if it were adopted nationally?

    ……

    ……

    ……

24. Would you kindly state factors you think could hinder the practice of one health even if it were adopted nationally?

    ……

25. Would you kindly agree or disagree with the following statements to reflect your attitude towards collaboration among medical and veterinary experts? (*Please show whether you just agree/disagree or you strongly agree/disagree*)

Attitudinal statement	**Level of dis/agreement with the statement (1=Strongly disagree; 2=Disagree; 3=Undecided; 4=Agree; 5=Strongly agree)**				
	1	**2**	**3**	**4**	**5**
1. The collaboration among medical, veterinary and wildlife officers would greatly facilitate detecting and dealing with zoonoses.					
2. The collaboration would help more relieve people of zoonoses.					
3. The collaboration would ensure better access to health inputs by poor people and their livestock.					
4. Medical and veterinary officers can diagnose and do survey on zoonoses together by using effective surveillance systems.					
5. Medical and veterinary officers can research together on zoonoses with linkage to local public health systems.					
6. Medical and veterinary officers can change from single disease approaches control measures to more integrated health promotion.					
7. Medical and veterinary officers sharing data about diseases could be one of good ways of collaboration.					
8. Medical and veterinary officers monitoring infectious diseases collaboratively would enhance early detection of diseases.					
9. The collaboration among medical and veterinary officers should start by they being trained on some common aspects, e.g. neglected zoonoses.					

10. Medical and veterinary officers having more positive attitude towards one another's field of specialisation can greatly enhance collaboration among them.					
11. The collaboration between medical and veterinary officers would add nothing to detection and dealing with zoonoses.					
12. The collaboration would hardly relieve people of zoonoses.					
13. The collaboration would only benefit better-off people who can pay for medical and veterinary services.					
14. Medical and veterinary officers cannot diagnose and survey on zoonoses together because of lack of an institutional framework for their collaboration.					
15. Medical and veterinary officers cannot research together on zoonoses because of lack of an institution framework for their collaboration.					
16. Changing from single disease approaches control measures to more integrated health promotion is impossible because of scepticism between medical and veterinary officers.					
17. Medical data are too confidential for sharing with veterinary officers.					
18. Incidences of diseases cannot just decrease due to medical and veterinary officers monitoring infectious diseases collaboratively.					
19. There is no way medical and veterinary officers can be trained on common aspects.					
20. There is no need for collaboration in disease detection, surveillance, treatment, and control among medical and veterinary officers.					

26. Curricula in animal health and human health colleges should have topics on infectious diseases that affect wild animals, livestock, and humans (zoonoses). Do you think such topics are adequately covered in the curricula? 1=Yes, 2=No

27. Wildlife health policies are not well documented vis-à-vis animal health and human health policies. What guidelines are in place to control wild animal diseases to human/livestock?

    ……

28. Are there any guidelines on collaboration between wildlife experts, animal health experts, and human health experts in controlling diseases, at least where wildlife-livestock-human interface is prominent? 1=Yes, 2=No

THANK YOU FOR YOUR COOPERATION

Appendix 7: Information Sheet

INFORMATION SHEET

Research Title: Impact of Brucellosis on Socio-economic Well-being in of livestock farmers in Western and Southern Provinces, Zambia

What is this study about?

This is the research project being conducted by Mwinyi Omary Mwinyi, a PhD student at the University of Zambia, School of Veterinary Medicine under the supervision of Prof J.B Muma and Dr. Martin Simuunza of the University of Zambia and Prof. K.A Kayunze of SokoineUniversity of Agriculture in Tanzania.

We would like to invite you to participate in a study whose aim is to investigate the impact of brucellosis on socio-economic well-being at household level. This is because your livestock had previousely diagnosed with brucellosis or because you live in an area where this disease is found. Your participation is completely voluntary. Before agreeing to take part in the study, we request you to read this form, or we will go through it with you. This form decribes the purpose of the study, the risks, benefit and your alternatives to participation in the study.

Brucellosis is one of major livestock disease in Western and Southern Provinces, Zambia. It is mostly affects animals but also humans can be affected by contacting the animals, eating raw meats and drinking unpersterised milk. Brucellosis is fatal disease for both animals and humans if left untreated. For humans it can manifests as fever, chills, night sweats,weakness, joint muscle and back pain, headache, poor appetite and weight loss.

In animals brucellosis causes the loose of culves through abortions. It is also affects socio-economic well-being of livestock farmers since it reduces the production of animals and their products like milk and beef. Since it is difficult for humans to be diagnosed with brucellosis in these areas, most of the farmers treated for Malaria hence the disease weakened them not to produce efficiently.

Your dristict has been selected as a model where this study will be conducted so that it gives a clear information on how this disease impacetd socio-economic well-being of the livestock famrmers in the area.

What will i be asked to do if I agree to participate?

Participants will be voluterily requested to participate in this study by answering questionnaire set for household head or his/her representative. The information collected from you will be used only for the purposes explained to you in this form.

Would my participation in this study be kept confidential?

We will do our best to keep your personal information confidetial. To help protect your confidentiality, will name will not appear with the information pertaining to the findings of research.

What are the risks of this research?

There is no risks concerning this research eccept that you will spent some little time to respond to questionnire.

What are the benefits of this research?

By participating in this study, you provide to gain more understanding on the impact of brucellosis. This may provide avenues for diagnostic test for humans that will be vital to control this disease. Your participation will therefore go long way towards reducing the burden of brucellosis to both humans and animals.

Do I have to be in this research and may I stop participating at any time?

Your participation in this research is completely voluntary. You have the right to choose whether or not to participate in the study.

Incentives/compensation

No incentives or compensation will be paid to you for participating in this study.

Sharing the data and the results

This research is for academic purposes and the information that will be obtained will be shared at the district offices. We will publish the results in journals and might present it in seminars. Feedback on the results will be made to you in a meeting involving all participants and local leaders.

What if i have questions?

This research is being conducted by Mwinyi Omary Mwinyi under the supervision of Prof. J.B Muma and Dr. Martin Simuunza of the University of Zambia, Zambia and Prof. A.K Kayunze of Sokoine University of Agricultre, Tanzania. Should you have any questions regarding this research and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please contact:

CHAIRPERSON
ERES CONVERGE
Tel: +260 955 155 633
+260 955 155 634
Cell: +260 966 765 503
Email: eresconverge@yahoo.co.uk

Appendix 8: Consent form

CONSENT FORM

This is the research project being conducted by Mwinyi Omary Mwinyi, a PhD student at the University of Zambia, School of Veterinary Medicine under the supervision of Prof J.B Muma and Dr. Martin Simuunza of the University of Zambia and Prof. K.A Kayunze of Sokoine University of Agriculture in Tanzania.

We would like to invite you to participate in a study whose aim is to investigate the impact of brucellosis on socio-economic well-being at household level. This is because your livestock had previously diagnosed with brucellosis or because you live in an area where this disease is found. Your participation is completely voluntary. Before agreeing to take part in the study, we request you to fill this form.

Name: I …….

Having been fully informed, on the purpose of this study and confidentiality. I have agreed to participate willingly.

Sign/Thumb Print ……

Date: ……..

Sign: ……

PI contacts: Mwinyi Omary Mwinyi
School of Veterinary Medicine
Disease Control Dpt.
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Email mwinyimwinyi@gmail.com

Committee Chairperson: Dr. E. Munalula-Nkandu
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Appendix 9: Operational definition of variables

Table 8.1: Operational definition of variables

Term	Operational definition	Level of measurement	Units/Indicators
Health	A state of complete physical, mental and social well-being, not merely the absence of disease or infirmity (WHO, 1946, cited by Scully, 2004).	**1.** Nominal **2.** Ordinal	**1.** Ill, healthy **2.** Healthy, healthier, healthiest
Disease	Any disturbance or anomaly in the normal functioning of the body that has specifically known biomedical causes and identifiable symptoms, is diagnosed by a physician or other medical experts using specific diagnosis techniques according to standardised and systematic diagnostic codes, and has known treatment and cure (Scully, 2004).	Nominal	Types of disease
Infectious disease	Diseases caused by pathogenic microorganisms, such as bacteria, viruses, parasites or fungi and which can be spread, directly or indirectly, from one person to another.	Nominal	Types of disease
Zoonotic disease	Infectious diseases of animals that can cause disease when transmitted to humans.	Nominal	Types of disease
One Health	Collaborative efforts of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals, plants and our environment	Nominal	Existence or lack of collaboration among health experts in dealing with human and animal diseases
Impact of brucellosis	Direct losses due to cattle abortions, milk los, costs of treating and caring for affected livestock, and costs of livestock disease prevention	Ratio	ZMW
Socio-economic well-being	Capabilities of: being able to eat at least 3 meals per day, being well sheltered, being able to escape avoidable morbidity and premature mortality, households having at least any household members having a good self-employment or a salaried employment, being able to sell livestock and crop products in nearby towns, being able to pay school fees for secondary school children belonging to the households, having been able to buy new clothes during the previous 12 months, and having freedom to live the way they would value	Nominal	Types of capabilities the households have, among the ones listed in the second column of this table against poverty

Appendinx 10: Ethical clearance

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I.R.B. No. 00005948
F.W.A. No. 00011697

22nd July, 2015

Ref. No. 2015-May-010

The Principal Investigator
Mr. Mwiyi Omary Mwiyi
C/o University of Zambia
School of Veterinary Medicine
Dept. of Disease Control
P.O. Box 32379,
LUSAKA.

Dear Mr. Mwinyi,

RE: THE IMPACTS OF BRUCELLOSIS ON SOCIAL ECONOMIC WELLBEING IN WESTERN AND SOUTHERN PROVINCES OF ZAMBIA.

Reference is made to your submissions. The IRB resolved to approve this study and your participation as principal investigator for a period of one year.

Review Type	**Ordinary**	Approval No. **2015-May-010**
Approval and Expiry Date	Approval Date: 22nd July, 2015	Expiry Date: 21st July, 2016
Protocol Version and Date	Version-Nil	21st July, 2016
Information Sheet, Consent Forms and Dates	• English	21st July, 2016
Consent form ID and Date	Version-Nil	21st July, 2016
Recruitment Materials	Nil	21st July, 2016
Other Study Documents	Instruments for Data Collection, FGD Guides.	21st July, 2016
Number of participants approved for study	384	21st July, 2016

Where Research Ethics and Science Converge

Specific conditions will apply to this approval. As Principal Investigator it is your responsibility to ensure that the contents of this letter are adhered to. If these are not adhered to, the approval may be suspended. Should the study be suspended, study sponsors and other regulatory authorities will be informed.

Conditions of Approval

- No participant may be involved in any study procedure prior to the study approval or after the expiration date.
- All unanticipated or Serious Adverse Events (SAEs) must be reported to the IRB within 5 days.
- All protocol modifications must be IRB approved prior to implementation unless they are intended to reduce risk (but must still be reported for approval). Modifications will include any change of investigator/s or site address.
- All protocol deviations must be reported to the IRB within 5 working days.
- All recruitment materials must be approved by the IRB prior to being used.
- Principal investigators are responsible for initiating Continuing Review proceedings. Documents must be received by the IRB at least 30 days before the expiry date. This is for the purpose of facilitating the review process. Any documents received less than 30 days before expiry will be labelled "late submissions" and will incur a penalty.
- Every 6 (six) months a progress report form supplied by ERES IRB must be filled in and submitted to us.
- ERES Converge IRB does not "stamp" approval letters, consent forms or study documents unless requested for in writing. This is because the approval letter clearly indicates the documents approved by the IRB as well as other elements and conditions of approval.

Should you have any questions regarding anything indicated in this letter, please do not hesitate to get in touch with us at the above indicated address.

On behalf of ERES Converge IRB, we would like to wish you all the success as you carry out your study.

Yours faithfully,
ERES CONVERGE IRB

Dr. E. Munalula-Nkandu
BSc (Hons), MSc, MA Bioethics, PgD R/Ethics, PhD
CHAIRPERSON