BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF AGRICULTURE AND ENVIRONMENTAL SCIENCE

DEPARTMENT OF ANIMAL SCIENCE

Epidemiology Of Theileriosis In Centenary District, Mashonaland Central

BY

Munyaradzi Mudare

B1953344

Commented [U1]: BOLD

SUPERVISORS:

Dr ALLEN TAPIWA CHIKWANDA,Mr KIZITO KUNAKA

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE HONOURS DEGREE IN ANIMAL HEALTH AND PRODUCTION EXTENSION, BINDURA UNIVERSITY OF SCIENCE EDUCATION

December 2022

DECLARATION

I Munyaradzi Mudare, declare that this project hereby submitted for the Bachelor of Science Honours Degree in Animal Health and Production Extension at the Bindura University of Science Education, is entirely my original work and affirm that it has not been submitted anywhere for the award of a degree or otherwise.

Munyaradzi Mudare ……………………. Date ………..…

Supervisor(s)' declaration:

…………………………………………… Date………………………….

Dr A T Chikwanda(Major Supervisor)

…………………………………………… Date…………………………

Mr K Kunaka (Co- supervisor)

I certify that I have checked this Research Project and I am satisfied that it conforms to The Department of Animal Science Guidelines for Project Preparation and Presentation. I therefore, authorize the student to submit this dissertation for marking.

……………………………….. Date………………………………………

DEDICATION

To my loving wife, children and my mother whom I have deprived much of their time to have me around as the head of the family, when I spent days at college studying towards this degree, they have given me all the support that I needed, through and through the entire program.

ACKNOWLEDGEMENTS

I would like to offer my heartfelt gratitude to Dr. Allen Tapiwa Chikwanda and Mr Kizito Kunaka my supervisors, for their untiring supervision, valued guidance and recommendations as well as for his reassurance that I treasure so much in undertaking this project. My sincere gratitude goes to Mrs. Moyo from the Department of Veterinary Services (DVS), Centenary district, for their immense cooperation which greatly facilitated completion of my work. I would also want to express my sincere appreciation to the entire team from the Department of Animal Science at Bindura University of Science Education for their assistance and colossal contribution during all the time to improve this work.

Abstract

The study was conducted to assess the epidemiology of Theileriosis in Centenary district. A questionnaire was administered to 60 farmers that were randomly selected from cattle owners in ward 14. Data was analysed using statistical package for social sciences, (SPSS) Version 22.0 to generate summary statistics. The results showed that Theileriosis cases were high during the wet season that is between November and May and low during the dry months, that is June to December. However, Theileriosis cases were reported throughout the whole year. Theileriosis is rampant in all wards in the upper part of Centenary and there is no incidence of Theileriosis in the lower part of Centenary district. Dipping, season, acaricide availability, source of income and technical support significantly ($p<0.05$) affected control of Theileriosis. Herd size and level of education had no significant effect on control of Theileriosis in Centenary district. Theileriosis affected the livelihoods of farmers in Centenary district in so many ways. Many (42%) respondents indicated that Theileriosis affected their source of draft power where as some respondents (25%) indicated that their income was affected. In addition some (17%) respondents said that Theileriosis affected their diet since cattle are a source of meat and milk whilst others (8%) said that if affected growth of their crops since cattle are a source of manure. Few (8%) respondents were worried about their prestige. Theileriosis cases are high during the wet season and low during the dry months. However Theileriosis cases are reported throughout the whole year. The incidences of Theileriosis are rampant in all the wards in the upper part of Centenary and there is no incidence of Theileriosis in the lower part of Centenary district. It can be concluded that dipping, season, acaricide availability, source of income and technical support affects control of Theileriosis. Theileriosis affects the livelihoods of farmers. Farmers are recommended to adhere to regular dipping to avoid cattle losses. Government and partnering organisations must make sure that acaricides are in stock for communal dipping. Areas where Theileriosis is rampant must be prioritized.

Key Words: Centenary district, livestock mortality, Theileriosis

LIST OF TABLES

Table 4.2. Spatial distribution of Theileriosis in Centenary district ……………………….17

Table 4.3: Logistic Regression Results ……………………………………………………...18

LIST OF FIGURES

Figure 4.1. Temporal distribution of Theileriosis in Centenary district ……………………16

Figure 4.2. Effect of Theileriosis on the livelihoods of farmers in Centenary district……….19

LIST OF APPENDICES

Questionnaire

Table of Contents

DEDICATION iii

ACKNOWLEDGEMENTS iv

Abstract v

LIST OF TABLES vi

LIST OF FIGURES viviii

LIST OF APPENDICES viiix

Questionnaire viiiix

CHAPTER 1 12

INTRODUCTION ..... **Error! Bookmark not defined.**2

1.0 INTRODUCTION 12

1.2 Problem statement 34

1.3 Justification 45

1.4 Objectives 46

1.4.1 Specific objectives 56

1.5 Hypotheses 56

CHAPTER 2 68

LITERATURE REVIEW 68

2.1 The spatial distribution of Theileriosis 68

2.2 Factors affecting control of Theileriosis 79

2.3 Effect of Theileriosis on the livelihoods of farmers 911

2.3.1 Loss of a main livelihood source and related benefits 1012

2.3.2 High cattle mortality signifies erosion of wealth and income 1012

2.3.3 Insecurity and loss of 'estate' and future socioeconomic wellbeing 1113

CHAPTER 3 1215

MATERIALS AND METHODS 1215

3.1. STUDY SITE 1215

3.2. RESEARCH DESIGN 1215

3.3. POPULATION AND SAMPLING PROCEDURE 1316

3.4. RESEARCH INSTRUMENTS 1316

3.4.1 Questionnaire 1316

3.4.2 Household demographics 1316

3.4.3 Interviews 1417

3.4.4 Pre-testing the questionnaire 1417

3.5. Data analysis 1417

CHAPTER 4 1517

RESULTS 1517

4.1 Spatial and temporal distribution of Theileriosis in Centenary district 1517

4.2 Factors affecting control of Theileriosis in Centenary district .... 16~~19~~
4.3 Effect of Theileriosis on the livelihoods of farmers in Centenary district .... 18~~20~~
CHAPTER 5 .... 19~~22~~
DISCUSSION .... 19~~22~~
5.1 Spatial and temporal distribution of Theileriosis in Centenary district .... 19~~22~~
5.2 Factors affecting control of Theileriosis in Centenary district .... 20~~23~~
5.3 Effect of Theileriosis on the livelihoods of farmers in Centenary district .... 23~~26~~
CHAPTER 6 .... 25~~28~~
CONCLUSION AND RECOMMENDATIONS .... 25~~28~~
6.1 CONCLUSION .... 25~~28~~
REFERENCES .... 26~~29~~

CHAPTER 1

1.0 INTRODUCTION

Livestock contribute significantly to the livelihoods of the majority of the rural populace. Majority of cattle owners in Africa are resource-constrained communal farmers (Sungirai *et al*., 2016) and their herds are frequently affected by parasites and tick-borne diseases. Parasites and diseases are among the most severe factors that affect livestock productivity (Lamy *et al*., 2012) and continue to impede growth of the livestock sector in Zimbabwe. The country recorded a 9% mortality rate in the national beef herd in 2019 (Ministry of Lands, Agriculture, Water, Fisheries & Rural Resettlement, 2020) and more than 50,000 cattle died of tick-borne diseases in the year 2018 chief among them being Theileriosis (Global Press Journal, 2019). The Zimbabwean national beef cattle herd was estimated to be around 5.5 million heads (Bennett *et al*., 2019) with the majority (90%) of them in the hands of the smallholder farmers. The control of Theileriosis in Zimbabwe is based primarily on the control of its vector through dipping using various methods and acaricides on the market. According to Food & Agriculture Organization of the United Nations (2004) there is a wide spread of some tick species that are resistant to organophosphates, one of the acaricide groups commonly used in the control of ticks.

The spread and increase in the number of Theileriosis cases are generally attributed to lack of adherence to cattle dipping routines or the shortage of acaricides and drugs (DVS, 2021). Ticks differ in their morphology; hence, various families exist. Ticks are classified under the phylum Arthropoda, class Arachnida and order Acarina (Nicholson *et al*., 2019). According to Oundo (2019), Acarina has three key economically important families namely Argasidae (soft ticks), Ixodidae (hard ticks) and Nuttalliellidae. In the Ixodidae genera, groups of veterinary significance are the Amblyomma, Hyalomma, Rhipicephalus and Ixodes. However, there are fourteen (14) Ixodidae genera (Guglielmone *et al*. (2010). Genus Rhipicephalus has eighty-two (82) species (Guglielmone *et al*., 2010); examples are Evertsi, Appendiculatus and Decoloratus (International Centre of Insect Physiology & Ecology, 2019). The brown ear tick, main vector of Theileriosis disease, is in the R. appendiculatus grouping. Ticks suck blood from their host, which they locate by responding to cues associated with host odors, breath, body heat and the vibration of the victim (Hussain *et al*., 2021).

Therefore, following routine dipping is the only effective way for reducing brown ear tick populations as the animals will be going to grazing lands and bring the ticks to the dip tank for culling. Methods of tick control in use currently are chemical, biological and cultural control methods (Nicholson *et al*., 2019). Physical methods are also carried out (Nath *et al*., 2018), and use of herbal plants has been practiced in some parts of Zimbabwe (Nyahangare *et al*., 2019). Chemical method involves the use of acaricides available such as organophosphates, amidines, synthetic pyrethroids, mixtures or macrocyclic lactones (Rodriguez-Vivas *et al*., 2017). Dipping cattle is regarded as the most effective method for preventing high incidences of Theileriosis and associated losses (Shahardar *et al*., 2019). Inadequate dipping cycles due to the shortage of acaricides has exacerbatedthe situation (Shekede *et al*., 2021). Controlled burning of paddocks and rotational grazing are examples of cultural methods. However, their applicability in communal set-up is a challenge as communities share grazing lands (Levin, 2020).

Tick control thus can either be on host or off host with holistic integrated ecto-parasite management being practiced (Nath *et al*., 2018) to reduce selection pressure in favor of acaricide-resistant individuals (Rodriguez-Vivas *et al*., 2017). . There has been a rise in cattle mortalities mainly due to tick-borne diseases, particularly January disease (Lawrence &

Waniwa, 2020, Ministry of Lands, Agriculture, Water, Fisheries & Rural Resettlement, 2020). Despite the fact that the department of veterinary services had increased the surveillance and disease control measures to curb the spread of tick-borne diseases, high incidences of cattle mortalities due to January disease are still on the rise. This is evidenced by high mortalities reported to be attributed to tick-borne diseases since the onset of the tick challenge in 2017: 3,430 head died of tick-borne diseases in 2018; 1,133 in 2019; 1,903 in 2020; 2,772 in 2020 and 1,478 died in 2021 (Chikwati, 2021; NewZimbabwe, 2022).

Holistic approach on investigation of the reasons why the cases are still high is critical so as to advice the policy- and decision-makers on the way forward. The current study investigates the epidemiology of Theileriosis in the smallholder farming sector of Centenary district.

1.2 Problem statement

Outbreaks of tickborne diseases have claimed a lot of cattle in Zimbabwe in the last five years. This has left a lot of famers impoverished and food insecure as cattle have been their source of wealth and draft power. The infamous Theileriosis has been cited as the major cause of cattle deaths in Mashonaland central province. This has been attributed to erratic dipping sessions compounded by lack of farmer's knowledge on dipping and disease control. Such cases are typical of the smallholder farmers in the resettlement and communal areas of Mashonaland Central. Government efforts to deal with Theileriosis have been mulled by inadequate resources both in terms of purchasing acaricide and equipment to support the veterinary worker on the ground. In addition, both acaricide and antibiotics have been expensive beyond the smallholder farmers reach. Therefore, this study seeks to analyse the incidence, distribution and possible control of Theileriosis in Mashonaland Central with special emphasis on Centenary district.

1.3 Justification

Cattle are an important source of food, income and employment for many citizens of Zimbabwe. However, cattle diseases pose a threat to benefits that is brought by rearing this type of livestock. Such a threat may be controlled by providing information through research. Information on the epidemiology of a disease is critical for the design of effective and sustainable disease control priorities and strategies. Findings of this research will be useful to extension officers, government and farmers in advisory/ extension; policy formulation and improvement in production, respectively It will also form a basis for training programmes for small scale beef producers about cattle diseases and their control. Through findings of this research and the recommendations made, small-scale beef producers may get to understand the importance of dipping and related tick borne disease control so that they can improve their production and realise good returns and earn a living.

1.4 Objectives

The main objective of the study was to analyses the incidence, distribution and possible control of Theileriosis in Mashonaland Central with special emphasis on Centenary district.

1.4.1 Specific objectives

i. To assess the spatial and temporal distribution of Theileriosis in Centenary district

¡¡. To analyse the factors affecting control of Theileriosis in Centenary district

¡¡¡. To evaluate the effect of Theileriosis on the livelihoods of farmers in Centenary district

1.5 Hypotheses

i. H_0: Theileriosis is not widely distributed in Centenary district

¡¡. H_0: There are no factors affecting control of Theileriosis in Centenary district

iii. H_0: Theileriosis has no effect on the livelihoods of farmers in Centenary district

Commented [U2]: What numbering is this

CHAPTER 2

LITERATURE REVIEW

2.1 The spatial distribution of Theileriosis

Spatial epidemiology is a subfield of epidemiology focused on the study of the spatial distribution of health outcomes; it is closely related to health geography. Specifically, spatial epidemiology is concerned with the description and examination of disease and its geographic variations.

Bovine Theileriosis is considered the most important tick-borne disease (TBD) and transboundary animal disease (TAD) of cattle in sub-Saharan Africa (Minjauw & McLeod, 2003). Outbreaks of the disease can result in debilitating economic losses, particularly in beef production-oriented communities not only through mortalities which can reach 90% but also through the cost of treatment and control measures (Lawrence *et al*., 2004; Moyo *et al*., 2017).

Bovine Theileriosis (caused by Theileria parva) is the most important tick-borne transboundary animal disease endemic to Zimbabwe, yet its distribution dynamics data in the country remain scant and outdated. A retrospective study was conducted to determine high-risk areas of bovine Theileriosis and associated risk factors in Zimbabwe. Records on bovine Theileriosis spanning 23 years (January 1995 to December 2018) were obtained from the Epidemiological Unit of the Division of Field Veterinary Services of Zimbabwe (DVSZ). Seven out of the country's ten provinces and 36 of its 59 districts were affected. Bovine

Theileriosis was observed to lose seasonality when cases rose exponentially in 2018. Five and four high-risk clusters of bovine Theileriosis were detected using one-year and one-month time aggregate, respectively, all within the last eight years of the study (2011-2018). Two potential risk factors (province and farming system) were significantly ($p < .050$) associated with bovine Theileriosis occurrence. Bovine Theileriosis was found to be rampant and if left unchecked will spread and adversely affect the whole country. Improved Theileriosis surveillance and control is warranted. Recommendations for control and prevention strategies revolve around better farmer awareness about the disease, correct and consistent use of acaricides, and cattle movement control and disease surveillance among others.

A survey of the occurrence of antibodies to Theileria parva in Zimbabwe revealed that the parasite occurred throughout the country although the prevalence of positive serological reactors was generally low (Mtembo, 2021). Outbreaks of Theileriosis in high rainfall areas of the country were attributed to Theileria parva bovis transmitted from cattle to cattle by Rhipicephalus appendiculatus. Outbreaks in high and low rainfall areas in the south and west of the country were attributed to Theileria parva lawrencei transmitted from buffalo to cattle by Rhipicephalus zambeziensis or R. appendiculatus. R. appendiculatus was not uniformly distributed in Zimbabwe. It occurred very commonly in foci in the commercial farming areas but was rare in most overgrazed communal farming areas. Outbreaks of disease attributed to T. parva bovis were recorded in some but not all the R. appendiculatus foci. The disease was present in areas infested with R. zambeziensis but it did not cause cattle deaths in these areas (Ruzvidzo, 2021).

2.2 Factors affecting control of Theileriosis

Methods of tick control in use currently are chemical, biological and cultural control methods (Nicholson *et al*., 2019). Physical methods are also carried out (Nath *et al*., 2018), and use of herbal plants has been practiced in some parts of Zimbabwe (Nyahangare *et al*., 2019). Chemical method involves the use of acaricides available such as organophosphates, amidines, synthetic pyrethroids, mixtures or macrocyclic lactones (Rodriguez-Vivas *et al*., 2017). Dipping cattle is regarded as the most effective method for preventing high incidences of tick-borne diseases and associated losses (Shahardar *et al*., 2019). Inadequate dipping cycles due to the shortage of acaricides has exacerbated the situation (Shekede *et al*., 2021). Controlled burning of paddocks and rotational grazing are examples of cultural methods. However, their applicability in communal set-up is a challenge as communities share grazing lands (Levin, 2020). Tick control thus can either be on host or off host with holistic integrated ecto-parasite management being practiced (Nath *et al*., 2018) to reduce selection pressure in favor of acaricide-resistant individuals (Rodriguez-Vivas *et al*., 2017). Use of dipping chemicals is the most commonly practiced control method. Animal Health (Cattle-Cleansing) Regulations of 1993 in Zimbabwe have made it compulsory that cattle should dip (Makuvadze *et al*., 2020), and this regulation dates back to 1914 when intensive dipping of cattle became mandatory for the control of East Coast Fever, a virulent form of Theileria parva infection (Norval & Deem, 1994). The dipping guideline is that in summer cattle dip weekly and in winter fortnightly (Sungirai *et al*., 2018) as informed by tick populations. In most critical cases, a 5-5-4 dipping regime is recommended in tick infested areas. A 5-5-4 dipping regime is a strategic dipping practice where animals are dipped every 5 days and then at 4-day intervals to ensure that there is effective tick control. The basis of the 5-5-4 dipping regime is to cut the life cycle of the ticks before they are engorged (Walker, 2011). This strategy is most suitable considering the short period in which the ticks engorge (Sekkin, 2017). Regardless of application method, efficacy of acaricides can be reduced by improper calibration and presence of mud or organic substances in the plunge pool. It therefore follows that dipping water must be regularly changed to maintain high efficiency of the acaricide.

Use of footbaths at the entrance, which are at least 3 meters long, helps to reduce siltation rate as the hooves of animals are socked and cleaned in the footbaths (Sungirai *et al*., 2018). This may prolong the efficacy of dip wash and reduce mortalities as a result of tick-borne ailments.

2.3 Effect of Theileriosis on the livelihoods of farmers

Theileriosis as a financial burden to the farmers and government. The lived experiences of Theileriosis in communal areas of Zimbabwe revealed high levels of financial burden being borne by the communal farmers. This is occurring in a context where the farmers (in both communal and resettlement areas) are already bearing the brunt of diverse production constraints and poverty (Mazwi, 2020). Most of the communal farmers are already living in poverty. Moreover, the farmers reported that most of the livestock vaccines are charged in United States dollars, yet most of the farmers are paid in Zimbabwe dollars for selling crop produce to the Grain Marketing Board (GMB). The local currency is used in most local markets. When the Zimbabwe dollar equivalent is accepted for purchasing the vaccines, the rate is inflated. In this context, Theileriosis has increased the farmers' financial outlay on livestock health against a context where the farmers cannot sustain the cost of the vaccines. The problem is aggravated by the low chances of recovery in affected cattle. The financial burden of the disease is not only experienced by the farmers but also by the Government of Zimbabwe. Instead of channelling financial resources to other community development problems, these are being directed to addressing the disease. January disease is a burden to the government and other development partners. The United Nations through the Food and Agriculture Organisation (FAO) with support of the Japanese Embassy in Zimbabwe is working with Government to implement a US$300 000 emergency response project. This money could have been directed to other pressing community development projects (FAO, 2020).

2.3.1 Loss of a main livelihood source and related benefits

Decimation of cattle has direct and indirect effects on rural livelihood sources and the associated benefits. Zimbabwe's Ministry of Lands, Agriculture, Fisheries, Water and Rural Resettlement (2020) reported that agriculture is a major source of rural livelihoods and the national economy. The Zimbabwe Democracy Institute (2020) also emphasise the importance of agriculture to livelihoods and development in Zimbabwe. Cattle and other livestock are pivotal sources of income, food and related benefits. Crop production in communal areas is primarily based on cattle draught power. Other household activities also require draught power. Given that about 90 per cent of the country's nearly 5.5 million cattle are owned by small-scale farmers in both communal and resettlement areas (Mtembo, 2021), the decimating impact of Theileriosis is largely compromising the main livelihood sources of the communal farmers. Overall, both the main and related livelihood sources are being threatened by the disease against a context of intensifying poverty induced by enduring macroeconomic underperformance.

2.3.2 High cattle mortality signifies erosion of wealth and income

Cattle is a major wealth and income generation asset for the communal areas. The importance of large livestock such as cattle as a form and measure of wealth to Zimbabwe's farmers, along with sale of small livestock in facilitating a sustainable flow of income are documented (Chibwana, 2016). Cattle and other livestock are therefore an important dimension of sustainable rural livelihoods. Threats to this livelihood base due to Theileriosis imply a detrimental impact on the wealth base of the communal farmers. Cattle are our major source of wealth, food and income for school fees, clothing and meeting household needs. The disease has claimed approximately 75 per cent of cattle in this village. Everyone is in a panic mode, and some are selling their cattle for as little as US$40 each or less. They consider this to be better than losing the cattle to the disease. We are poorer than we were before the disease. We are fast losing our wealth and the government is not assisting us. It will take us many years to accumulate cattle.

2.3.3 Insecurity and loss of 'estate' and future socioeconomic wellbeing

Deriving livelihoods from cattle (and other livestock), and inheritance have been, and continue to be practiced in most African countries (Freeman *et al* 2008). In rural Zimbabwe, cattle are an asset for current use, an 'estate' and an inheritance asset. These livelihood dimensions were unanimously emphasised by the communal farmers. Yet, they argued that Theileriosis has eroded the sustainability of livelihoods based on cattle. Bearing on Chambers' (2019) conceptualisation of the sustainability of a livelihood as when it can cope with and recover from stress and shocks, and provide sustainable livelihood opportunities for the next generation, and which contributes net benefits to other livelihoods at the local and global levels and in the short and the long term, the situation of the study sites shows serious livelihood challenges due to the disease in the current and future.

CHAPTER 3

MATERIALS AND METHODS

3.1. STUDY SITE

The study was done in Nyamanetsa ward 14 of Centenary district which lies on GPS coordinates -16.77014 latitudes and 31.44682 longitudes and approximately 165km from the capital city, Harare to Centenary communal areas. It is found in agro-ecological region IIb. The region receives an annual rainfall of 750 – 1000mm. The ward comprises of resettled farmers where the majority of the farmers are under A1 resettlement model with a total of 20 villages different in land size and population. It also has the highest number of farmers who are in beef production.

3.2. RESEARCH DESIGN

A descriptive survey was employed in this research through observation and use of questionnaire (Cortein and Manion, 1989), descriptive survey methods includes; observation interview and questionnaires. Observation were made as the researcher moved in and around the area of study. A questionnaire for data collection was used to solicit information from farmers in the area.

3.3. POPULATION AND SAMPLING PROCEDURE

In the light of this study, population refers to all resettled farmers in ward 14. The area under study had 20 villages with 575 farmers. A large number of farmers (85%) in this ward are into beef production. Simple random sampling was used, out of 20 villages in ward 14, three farmers were randomly chosen per village representing each village. This resulted in a sample size of 60 farmers whom were randomly selected. The researcher wrote three cards with ‘yes’ whilst the rest will be ‘no’. Those who picked the ‘yes’ card represented the village. This was done for 20 villages in the ward to get a sample of 60 farmers for the study.

3.4. RESEARCH INSTRUMENTS

3.4.1 Questionnaire

A questionnaire provides answers that are easy to classify and quantify. Babbies (1992) acknowledged that closed ended questions are very popular because they provide a greater uniformity of response and are more easily processed. The questionnaire helped the researcher to gather the following information among others;

3.4.2 Household demographics

The questionnaire gathered information on demographics details such as name of the village, name of the ward, age and sex of household head information on the level of education of the household head and household age distribution.

3.4.3 Interviews

An interview guide was used to obtain information, the researcher asked question in vernacular language to enable the less literate to respond.

3.4.4 Pre-testing the questionnaire

The questionnaire was randomly presented to ten farmers in the area who are not part of the sample from another ward. The results of the interview led to adjustments of the questionnaire.

3.5. Data analysis

Data was analysed using statistical package for social sciences, (SPSS) Version 22.0 to generate summary statistics. Frequencies, means and p-values were used to analyse data and presented in form of graphs, tables and pie charts.

CHAPTER 4

RESULTS

4.1 Spatial and temporal distribution of Theileriosis in Centenary district

The study sought to find the spatial and temporal distribution of Theileriosis in Centenary district. The results are shown below, Figure 4.1 and Table 4.2.

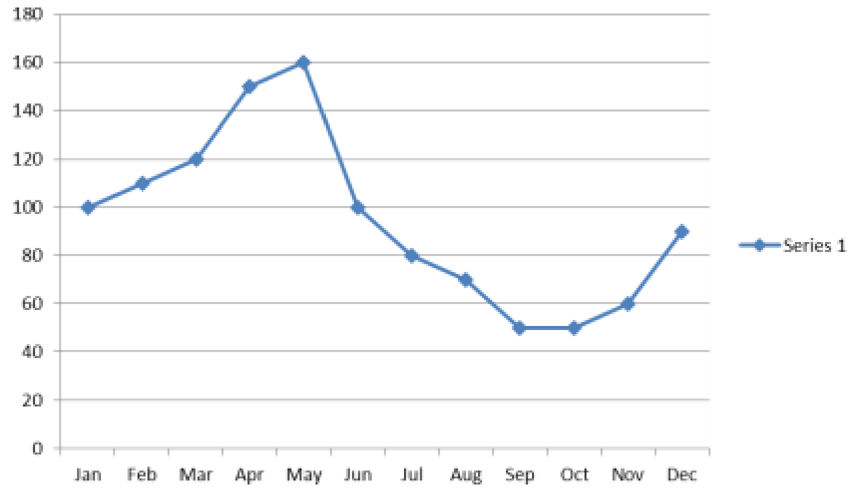

Figure 4.1. Temporal distribution of Theileriosis in Centenary district

The study revealed that Theileriosis cases were high during the wet season that is between November and May and low during the dry months, that is June to December. However Theileriosis cases were reported throughout the whole year.

Table 4.2. Spatial distribution of Theileriosis in Centenary district

Location	Coverage (%)
Upper Centenary	100
Lower Centenary	0

The study showed that the incidence of Theileriosis is rampant in all the wards in the upper part of Centenary and there is no incidence of Theileriosis in the lower part of Centenary district.

4.2 Factors affecting control of Theileriosis in Centenary district

The study sought to analyse the factors affecting control of Theileriosis in Centenary district, the findings are shown in Table 4.3 below. Seven variables were used and out of the seven, 5 variables were found to have a significant effect on control of Theileriosis in Centenary district.

Table 4.3: Logistic Regression Results

Dimension Factor	B	S.E	Wald	df.	Sig.	Exp(B)
Herd size	-.241	0.57	0.182	1	0.297	0.785
Dipping	1.32	0.71	3.48	1	0.028*	0.267
Acaricide availability	2.25	0.66	11.610	1	0.001*	9.44
Season	0.58	0.26	4.86	1	0.014*	1.787
Level of education	0.465	0.3	2.485	1	0.115	1.592
Source of income	−4.50	2.62	2.96	1	0.041*	0.011
Technical support	1.145	0.54	4.486	1	0.033*	3.141
Constant	1.77	0.57	9.517	1	0.002*	5.85

**Notes: ***Variables are significant at $p<0.05$

A number of factors significantly affected ($p<0.05$) control of Theileriosis in Centenary district. Such factors are dipping, season, acaricide availability, source of income and technical support. Surprisingly, in this study herd size and level of education had no effect on control of Theileriosis in Centenary district as shown in Table 4.2.

4.3 Effect of Theileriosis on the livelihoods of farmers in Centenary district

The study also sought to evaluate the effect of Theileriosis on the livelihoods of farmers in Centenary district. The results are shown in Figure 4.3 below.

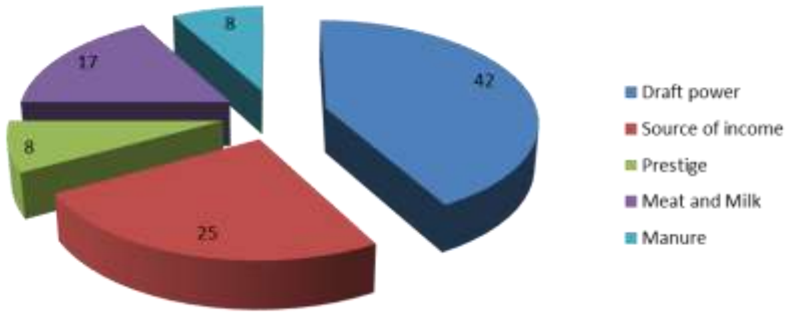

Figure 4.2 Effect of Theileriosis on the livelihoods of farmers in Centenary district

The study revealed that Theileriosis affected the livelihoods of farmers in Centenary district in so many ways. Many (42%) respondents indicated that Theileriosis affected their source of draft power where as some respondents (25%) indicated that their income was affected. In addition some (17%) respondents said that Theileriosis affected their diet since cattle are a source of meat and milk whilst others (8%) said that if affected growth of their crops since cattle are a source of manure. Few (8%) respondents were worried about their prestige as shown by Figure 4.2 above.

CHAPTER 5

Commented [U3]: Too much space left out

DISCUSSION

5.1 Spatial and temporal distribution of Theileriosis in Centenary district

The study revealed that Theileriosis cases were high during the wet season that is between November and May and low during the dry months, which are from June to December. This concurs with the findings of Mtembo, 2021 who observed high incidences of Theileriosis in during the wet season. However Theileriosis cases were reported throughout the year. Bovine Theileriosis was observed to lose seasonality when cases rose exponentially in 2018 (Ruzvidzo, 2021). The study showed that the incidences of Theileriosis are rampant in all the wards in the upper part of Centenary and there is no incidence of Theileriosis in the lower part of Centenary district. This is contrary to what was observed by Mtembo (2021) who posited that the occurrence of antibodies to Theileria parva in Zimbabwe revealed that the parasite occurred throughout the country although the prevalence of positive serological reactors was generally low. Outbreaks of Theileriosis in high rainfall areas of the country were attributed to Theileria parva bovis transmitted from cattle to cattle by Rhipicephalus appendiculatus (Ruzvidzo, 2021).

5.2 Factors affecting control of Theileriosis in Centenary district

A number of factors significantly affected ($p<0.05$) control of Theileriosis in Centenary district. Such factors are dipping, season, acaricide availability, source of income and technical support. Surprisingly, in this study herd size and level of education had no effect on control of Theileriosis in Centenary district.

5.2.1 Dipping

The study revealed that dipping significantly affected control of Theileriosis in centenary district. Dipping cattle is regarded as the most effective method for preventing high incidences of tick-borne diseases and associated losses (Shahardar *et al*., 2019). Animal Health (Cattle-Cleansing) Regulations of 1993 in Zimbabwe have made it compulsory that cattle should dip (Makuvadze *et al*., 2020), and this regulation dates back to 1914 when intensive dipping of cattle became mandatory for the control of East Coast Fever, a virulent form of Theileria parva infection (Norval & Deem, 1994).

5.2.2. Season

The study showed that season significantly affected control of Theileriosis in Centenary district. The dipping guideline is that in summer cattle dip weekly and in winter fortnightly (Sungirai *et al*., 2018) as informed by tick populations. In most critical cases, a 5-5-4 dipping regime is recommended in tick infested areas. A 5-5-4 dipping regime is a strategic dipping practice where animals are dipped every 5 days and then at 4-day intervals to ensure that there is effective tick control. The basis of the 5-5-4 dipping regime is to cut the life cycle of the ticks before they are engorged (Walker, 2011). This strategy is most suitable considering the short period in which the ticks engorge (Sekkin, 2017).

5.2.2 Acaricide availability

Acaricide availability significantly affected control of Theileriosis in Centenary district. Inadequate dipping cycles due to the shortage of acaricides has exacerbated the situation leading to cattle deaths due to Theileriosis (Shekede *et al*., 2021). Use of dipping chemicals is the most commonly practiced control method. Regardless of application method, efficacy of acaricides can be reduced by improper calibration and presence of mud or organic substances in the plunge pool. It therefore follows that dipping water must be regularly changed to maintain high efficiency of the acaricide. Use of footbaths at the entrance, which are at least 3 meters long, helps to reduce siltation rate as the hooves of animals are socked and cleaned in the footbaths (Sungirai *et al*., 2018). This may prolong the efficacy of dip wash and reduce mortalities as a result of tick-borne ailments.

5.2.3 Source of income

The study showed that source of income had a significant effect control of Theileriosis in Centenary district. This was expected since one has to have some form of capital in order to buy acaricide and antibiotics meant to control Theileriosis. Nicholson *et al*., (2019) noted that farmers who did not rely on government dipping and bought their own dipping chemical suffered little to no cattle losses due to Theileriosis.

5.2.4 Technical Support

In this study technical support was seen to significantly affect control of Theileriosis in Centenary district. Many farmers fail to identify some cattle diseases hence can not find remedies to such diseases resulting in high cattle mortalities. lmproved diagnosis is a prerequisite for effective management of endemic cattle diseases in sub-Saharan Africa (Sekkin, 2017).However this is currently constrained by the limited availability of suitably trained professional staff, field-level diagnostic tests and a general lack of knowledge about disease among livestock owners (Shahardar *et al*., 2019). Current thinking in terms of veterinary service provision favours pen-side diagnostic tests of Theileriosis and decision support technology suitable for use by farmers, extension workers and agro-veterinary traders; i.e. those who most often make the diagnosis and treatment decisions in rural African settings (Makuvadze *et al*., 2020).

5.2.5 Herd size

The study revealed that heard size had no significant effect on control of Theileriosis. Herd size was expected to have affect control of Theileriosis as noted by Nyahangare *et al*., (2019) who posited that Theileriosis control in a larger cattle herd requires dedicated financial commitment in terms of acaricide supply and trained personnel. The bigger the herd size the more finance needed to purchase acaricides for effective regular dipping. Nath *et al*., (2018), noted that Theileriosis if difficult to control in a large cattle herd if proper management is not adhered to.

5.2.6 Level of education

Surprisingly in this study, level of education had no significant effect on the control of Theileriosis in Centenary district. Level of education was expected to have a significant effect on control of Theileriosis since it is expected that one has to be educated to tell the signs and symptoms of Theileriosis and also to read acaricide labels and understand the mixing ratios. Rodriguez-Vivas *et al*., (2017) also noted that farmers who attained a certain level of education where better able to combat Theileriosis and avoid cattle losses.

5.3 Effect of Theileriosis on the livelihoods of farmers in Centenary district

The study revealed that Theileriosis affected the livelihoods of farmers in Centenary district in so many ways. Decimation of cattle has direct and indirect effects on rural livelihood sources and the associated benefits. Zimbabwe's Ministry of Lands, Agriculture, Fisheries, Water and Rural Resettlement (2020) reported that agriculture is a major source of rural livelihoods and the national economy. The Zimbabwe Democracy Institute (2020) also emphasise the importance of agriculture to livelihoods and development in Zimbabwe. Cattle and other livestock are pivotal sources of income, food and related benefits. Many (42%) respondents indicated that Theileriosis affected their source of draft power where as some respondents (25%) indicated that their income was affected. Cattle and other livestock are pivotal sources of income, food and related benefits. Crop production in communal areas is primarily based on cattle draught power. Other household activities also require draught power. Given that about 90 per cent of the country's nearly 5.5 million cattle are owned by small-scale farmers in both communal and resettlement areas (Mtembo, 2021), the decimating impact of Theileriosis is largely compromising the main livelihood sources of the communal farmers. Theileriosis is a financial burden to both farmers and government. The lived experiences of Theileriosis in communal areas of Zimbabwe revealed high levels of financial burden being borne by the communal farmers. This is occurring in a context where the farmers (in both communal and resettlement areas) are already bearing the brunt of diverse production constraints and poverty (Mazwi, 2020). Another farmer was quoted as saying, "Everyone is in a panic mode, and some are selling their cattle for as little as US$40 each or less. They consider this to be better than losing the cattle to the disease. We are poorer than we were before the disease. We are fast losing our wealth and the government is not assisting us. It will take us many years to accumulate cattle". Most of the communal farmers are already living in poverty. The financial burden of the disease is not only experienced by the farmers but also by the Government of Zimbabwe. Instead of channelling financial resources to other community development problems, these are being directed to addressing the disease. January disease is a burden to the government and other development partners. The United Nations through the Food and Agriculture Organisation (FAO) with support of the Japanese Embassy in Zimbabwe is working with Government to implement a US$300 000 emergency response project. This money could have been directed to other pressing community development projects (FAO, 2020).

In addition some (17%) respondents said that Theileriosis affected their diet since cattle are a source of meat and milk whilst others (8%) said that if affected growth of their crops since cattle are a source of manure. Sungirai *et al*., (2018) postulated that one must not underestimate the importance of cattle manure in improving crop production of rural communities. Cattle manure has been used in community nutritional gardens and lately in the pfumvudza/intwasa concept. . Few (8%) respondents were worried about their prestige. Cattle are our major source of wealth, well-being, food and income for school fees, clothing and meeting household needs. The importance of large livestock such as cattle as a form and measure of wealth to Zimbabwe's farmers, along with sale of small livestock in facilitating a sustainable flow of income are documented (Chibwana, 2016).

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

Formatted: Left

6.1 CONCLUSION

Commented [U4]: We don't make a document long by creating empty spaces but instead by filling them with sense

Theileriosis cases are high during the wet season and low during the dry months. However Theileriosis cases are reported throughout the whole year. The incidences of Theileriosis are rampant in all the wards in the upper part of Centenary and there is no incidence of Theileriosis in the lower part of Centenary district. A number of factors significantly affect control of Theileriosis in Centenary district. Such factors are dipping, season, acaricide availability, source of income and technical support. Surprisingly, herd size and level of education have no effect on control of Theileriosis. Theileriosis affects the livelihoods of farmers in so many ways, ranging from draft power, household income, diet, crop growth and farmer's prestige.

6.2 RECOMMENDATIONS

Since Theileriosis cases are high during the wet season farmers must regularly dip their cattle to avoid cattle losses. Government and partnering organisations must also make sure that acaricides are in stock for communal dippings. Areas where Theileriosis is rampant must be prioritized and also farmers who have lost their cattle due to the disease must be supported in order to maintain or improve their livelihoods. Future studies should look at how best farmers can be helped when affected by Theileriosis and also the feasibility of moving animals to hotter climates where there is little to no incidence of Theileriosis.

REFERENCES

A Faqih and S Aisyah, 2019 Communication in agricultural extension services toward farmer empowerment, Journal of Physics: Conf. Series 1360 (2019) 012016

and Technology 19–20 November 2018, Cirebon, Indonesia

Arun Balamatti and Nagaratna Biradar, 2016 Modern Media in Agricultural Communication, Conference Paper Lead paper submitted to the 8th GCRA International Conference on “Innovative Digital Applications for Sustainable Development”, 5 – 7, January 2016, UAS, Bengaluru.

Bennett, B., Figue, M., Vigne, M., Chakoma, C., & Katic, P. (2019). Beef value chain analysis in Zimbabwe. European Commission.

Chikwati, E. (2021). Zimbabwe: 1,478 Cattle die of tickborne diseases. The Herald. https://allafrica.com/stories/202102020454.html

DVS. (2020). Animal health annual report. Division of Veterinary Services. Ministry of Lands, Agriculture, Water, Fisheries and Rural Resettlement

DVS. (2021). Animal health quarterly report for March 2021. Division of Veterinary Services. Ministry of Lands, Agriculture, Water, Fisheries and Rural Resettlement.

Food & Agriculture Organization of the United Nations. (2004). Module 1. Ticks: Acaricide resistance: Diagnosis management and prevention. Guidelines resistance management and integrated parasite control in ruminants.

Galiè, A., Mulema, A., Benard, M. A. M., Onzere, S. N., & Colverson, K. E. (2015). Exploring gender perceptions of resource ownership and their implications for food security among rural livestock owners in Tanzania, Ethiopia, and Nicaragua. Agriculture & Food Security, 4(1), 2. https://doi.org/10.1186/s40066-015-0021-9

Ganie, Z.A Shahardar, R. A., Maqbool, I., Bulbul, K. H., & Allaie, I. M. (2019). An overview of bovine theileriosis. International Journal of Veterinary Sciences and Animal Husbandry, 4(1), 9–13. https:// www.researchgate.net/publication/344426577

Global Press Journal. (2019). https://globalpressjournal. com/africa/zimbabwe/disease-threatens-livestocklivelihoods- zimbabwe/

Guglielmone, A. A., Robbins, R. G., Apanaskevich, D. A., Petney, T. N., Estrada-Peňa, A., Horak, I. G., Shao, R., & Barker, S. C. (2010). The Argasidae, Ixodidae and Nuttalliellidae (Acari: Ixodida) of the world: A list of valid species names. Zootaxa, 28(2528), 1–28. https://doi.org/10.11646/zootaxa.2528.1.1

Deloitte & Touche, 2015, Reducing Food Loss Along African Agricultural Value Chains

Gary Mullen, Lance Durden: Academic Press.Norval, R. A. I., & Deem, S. L. (1994). The development and application of models in the planning and implementation of reduced and strategic-minimal tick control strategies in Zimbabwe. Modelling of vector-borne and other parasitic diseases (pp. 283295). (283295). (B. D. Perry & J. W. Hansen, eds.). ILRAD.

Helliker, K. & T. Murisa., 2020. Zimbabwe: continuities and changes. *Journal of Contemporary African Studies* 38(1): 5-17. https://doi.org/10.1080/02589001.2020.1746756

Krantz, L., 2011. *The sustainable livelihood approach to poverty reduction: an introduction*. London: SIDA.

Hussain, S., Hussain, A., Ho, J., Li, J., George, D., Rehman, A., Zeb, J., & Sparagano, O. (2021). An epidemiological survey regarding ticks and tick-borne diseases among livestock owners in Punjab, Pakistan: A one health context. Pathogens, 10(361), 361. https://doi.org/10.3390/pathogens10030361

International Centre of Insect Physiology & Ecology. (2019). Ticks and tick borne diseases. http://www. icipe.org/research/animal-health/ticks-and-tickborne- diseases

Irvin, A. D., Mcdermott, J. J., & Perry, B. D. (Eds.). (1996). Epidemiology of ticks and tick-borne diseases in Eastern, Central and Southern Africa. International Livestock Research Institute.

Kothari, C. R. (2004). Research methodology: Methods and techniques (2nd ed.). New Age International Pvt Limited.

Lamy, E., van Harten, S., Sales-Baptista, E., Guerra, M. M. M., & de Almeida, A. M. (2012). Factors influencing livestock productivity. Springer. https:// www.researchgate.net/publication/233426652

Lawrence, J. A., & Waniwa, E. (2020). Theileriosis Today A National Crisis. Division of Veterinary Services. http://www.livestockzimbabwe.com/Publications

Levin, M. L. (2020). Tick control. Rickettsial zoonoses, Centers for Disease Control and Prevention.

Maiyaki, A. A. (2010). Zimbabwe's agricultural industry. African Journal of Business Management, 4(19), 4159–4166. https://academicjournals.org/article/ article1380553915

Makuvadze, F. T., Hove, T., Makaya, P., Waniwa, E., & Nemaungwe, T. (2020). Resistance of ticks on cattle to amitraz in Zimbabwe. Tropical Animal Health and Production, 52(6), 3323–3330. https://doi.org/10. 1007/s11250-020-02364-w

Ministry of Lands, Agriculture, Water, Fisheries & Rural Resettlement. (2020). Second round crop and livestock assessment report 2019/2020 season. https://

fscluster.org/sites/default/files/documents/2nd_round_assessment_report_2020_draft_26_may.pdf

Mkuhlani, S., Mupangwa, W., Macleod, N., Gwiriri, L., Nyagumbo, I., Manyawu, G., & Chigede, N. (2018). Crop–Livestock integration in smallholder farming systems of Goromonzi and Murehwa, Zimbabwe. Renewable Agriculture and Food Systems, 1–12.https://doi.org/10.1017/S1742170518000558

Mugandani, R., Wuta, M., Makarau, A., & Chipindu, B. (2012). Re-classification of agro-ecological regions of Zimbabwe in conformity with climate variability and change. African Crop Science Journal, 20(Suppl. s2), 361–369. https://www.ajol.info/index.php/acsj/arti

cle/view/81761

Muvhuringi, P. B., Chigede, N., & Moral, M. T. (2021). Trends in production and consumption of selected biofortified crops by rural communities in Zimbabwe. Cogent Food & Agriculture, 7(1), 0–13. https://doi.org/10. 1080/23311932.2021.1894760

Nath, S., Mandal, S., Pal, S., Jadhao, S., Ottalwar, N., & Sanyal, P. (2018). Impact and management of acaricide resistance- pertaining to sustainable control of(10), 46–60. https://doi.org/10.5455/ijlr. 20180402121612

NewZimbabwe. (2022, April 18). Zimbabwe loses 15000 cattle to tickborne diseases. New Zimbabwe. https:// allafrica.com/stories/202204180073.html

Nicholson, W. L., Sonenshine, D. E., Noden, B. H., & Brown, R. N. (2019). Ticks (Ixodida). In Medical and veterinary entomology (pp. 603–672).

Nyahangare, E. T., Mvumi, B. M., McGaw, L. J., & Eloff, J. N. (2019). Addition of a surfactant to water increases the acaricidal activity of extracts of some plant species used to control ticks by Zimbabwean smallholder farmers. BMC Veterinary Research, 15(404), 1–7. https://doi.org/ 10.1186/s12917-019-2078-3

Nyangiwe, N., Yawa, M., & Muchenje, V. (2018). Driving forces for changes in geographic range of cattle ticks (Acari: Ixodidae) in Africa: A review. South African Journal of Animal Science, 48(5), 829–841. https://doi. org/10.4314/sajas.v48i5.4

Mazwi, F., 2020. Sugar production dynamics in Zimbabwe: an analysis of contract farming at Hippo Valley. *Review of African Political Economy*. Online first. https://doi.org/10.1080/03056244.2020.1832022

Mtembo, S., 2021. *Hundreds of cattle die under new wave of January disease.* https://masvingomirror.com/hundreds-of-cattle-die-under-new-wave-of-january-disease/

Musisi, F. L. & J. A. Lawrence. 1995. Prospects for control of tick-borne diseases in cattle by immunization in Eastern, Central, and Southern Africa. *Agriculture and Human Values* 12: 95-106.

OAG. (2018). Preparedness in the prevention and control of cattle diseases. Report of the Auditor-General by the Department of Veterinary Servises. Ministry of Lands, Agriculture, Water, Climate and Rural Resettlement

Oundo, J. W. (2019). Pathogens and blood feeding patterns of questing ticks in Maasai Mara wildlife ecosystem, Kenya [Doctoral dissertation], University of Nairobi.

Oxfam., 2018. *The sustainable livelihoods approach: a toolkit for Wales.* London: Oxfam.

Parola, P., & Raoult, D. (2001). Ticks and tick-borne bacterial diseases in humans: An emerging infectious threat. Clinical Infectious Diseases, 32(6), 897–92. https://doi.org/10.1086/319347

Rodriguez-Vivas, R. I., Jonsson, N. N., & Bhushan, C. (2017). Strategies for the control of Rhipicephalusmicroplus ticks in a world of conventional acaricide and macrocyclic lactone resistance. Parasitology Research, 117(1), 3–29. https://doi.org/ 10.1007/2Fs00436-017-5677-6

Ruzvidzo, W., 2021. *January disease claims 1 000 cattle in Mash West*. https://www.sundaymail.co.zw/january-disease-claims-1-000-cattle-in-mash-west

Scott-Jones, J., 2020. *Research ethics in practice*. London: SAGE

Sekkin, S. (Ed.). (2017). Livestock Science. IntechOpen. 9789535128649 . 9789535128649 https://www.inte chopen.com/books/5345

Shekede, M. D., Chikerema, S. M., Spargo, M., Gwitira, I., Kusangaya, S., Mazhindu, A. N., & Ndhlovu, D. N. (2021). Spatial clustering of fourteen tick species across districts of Zimbabwe. BMC Veterinary Research, 17(1), 1–9. https://doi.org/10.1186/s12917- 021-02792-2

Sungirai, M., Moyo, D. Z., De Clercq, P., & Madder, M. (2016). Communal farmers' perceptions of tick-borne diseases affecting cattle and investigation of tick control methods practiced in Zimbabwe. Ticks and tick-borne Diseases, 7(1), 1–9. https://doi.org/10.1016/j.ttbdis.2015.07.015

Sungirai, M., Baron, S., Moyo, D. Z., De Clercq, P., Maritz- Olivier, C., & Madder, M. (2018). Genotyping acaricide resistance profiles of Rhipicephalusmicroplus tick populations from communal land areas of Zimbabwe. Ticks and tick-borne Diseases, 9(1), 2–9. https://doi.org/10.1016/j.ttbdis.2017.10.017

United Nations., 2019. *UN programmes in Africa 2019*. New York: UN.

World Bank Group., 2019. *Joint needs assessment for Zimbabwe: identifying challenges and needs.* New York: WBG.

Walker, A. R. (2011). Eradication and control of livestockticks: Biological, economic and social perspectives. Parasitology, 138(8), 945–959. https://doi.org/10.1017/S0031182011000709

APPENDIX

Research Questionnaire

My name is Munyaradzi Mudare. I am a student at Bindura University of Science Education, studying BSc Honors in Animal Health and Production Extension. I am carrying out a research study on the EPIDEMIOLOGY OF THEILERIOSIS IN CENTENARY DISTRICT, MASHONALAND CENTRAL. A case study of beef farmers, in Centenary District. To accomplish this, your assistance and cooperation is of great importance.

<u>NOTE</u>

- The information collected by use of this questionnaire is strictly for academic purposes and will be accorded high confidentiality.
- .
- Do not give your name.
- Put a tick where it is appropriate.

SECTION A: HOUSEHOLD DEMOGRAPHIC INFORMATION/ CHARACTERISTICS

1. Gender of household head	0. Male	1. Female	

2. Age of household head	0. 18-30yrs	1. 31-40yrs	2. 41-50yrs	3. 51-60yrs	4. 60+yrs

3. Marital status of household head	0. Single	1. married	2. Widowed	3. Divorced/ separation	

4. Household head’s level of education	

0. Primary	1. Secondary	2. Certificate	3. Diploma	4. Degree	5. Other (specify)……	

5. On average, at which range do you consider your annual income?

0. Less than 1000	1. 1000-2000	2. 2100-3000	3. above 3000

SECTION B: The spatial and temporal distribution of Theileriosis in Centenary district

6. What resources do you have?

Land size [ ] Arable area [ ] Grazing area [ ] cattle number [ ] income from beef cattle [ ]

Labour availability [ ]

7. How many beef cattle do you have?

0-5 [ ] 5-10 [ ] 10-25 [ ] above 25 [ ]

8. Have you heard about beef management technologies?

Yes [ ] No [ ]

9. Have adopted beef management technologies?

Yes [ ] No [ ]

10. Have you heard about breeding technologies?

Yes [ ] no [ ]

11. Which breeding technologies are you using?

AI [ ] Embryo transfer [ ] Sexed semen [ ]

12. Who does the pregnancy diagnosis?

Trained personnel [ ] Myself [ ] Vet Doctor [ ] Nobody [ ]

Have you heard about animal health technologies?

Yes [ ] no [ ]

13. Which animal health technologies are you using?

Vaccination [ ] Deworming [ ] Prophylaxis [ ] Dipping [ ]

14. Do you dip your cattle?

Yes [ ] No [ ]

15. How do you dip your cattle?

Plunge dip [ ] pour on [ ] injection [ ] some traditional herb [ ]

SECTION C: Factors affecting control of Theileriosis in Centenary district

16. Have you heard about animal management technologies?
Yes [ ]   No [ ]

17. Which animal health technologies are you practicing?
Castration [ ]   Dehorning [ ]

18. What are you using for identification?
Ear tags [ ]   tattooing [ ]   branding [ ]   freeze branding [ ] electronic ear tags []

19. Do you wean your beef calves
Yes [ ]   No [ ]

20. What weaning method are you practicing
Early [ ] Late [ ]

21. Do you practice hoof trimming
Yes [ ]   No [ ]

SECTION D: The effect of Theileriosis on the livelihoods of farmers in Centenary district

22. Have you heard about beef feeding technologies?
Yes [ ]   No [ ]

23. Which feeding technologies are you practicing?
Veldt [ ]   salt leaks [ ]   Protein Supplementation [ ]   Crop residues [ ]

Urea Stover treatment [ ]

24. When do you supplement your beef animals?
Winter [ ]   summer [ ]

Do you prioritize the different cattle categories

Yes   NO

THANK YOU FOR YOUR COOPERATION