AN INVESTIGATION INTO THE ECONOMIC IMPACT OF CREATING A FOOT AND MOUTH DISEASE FREE ZONE IN THE CENTRAL NORTH OF NAMIBIA

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ABSTRACT

The purpose of this study was to investigate into the economic impact of creating a Foot and Mouth Disease (FMD) free zone in the central north of Namibia. A Veterinary Cordon Fence (VCF) is a large-scale fence-line constructed for the purpose of controlling livestock contagious diseases such as FMD. Lucrative international meat export markets are the main reason countries come up with and protect FMD free zones. Namibia has VCF running across the country from east to west almost dividing the country in the middle. The beef products from the Northern VCF (NVCF) are not allowed to cross the VCF to the Southern parts of the country because the Southern VCF (SVCF) area is regarded as a FMD free zone while the NVCF area is regarded as a FMD infected zone. Currently, Namibia international beef markets do not buy beef products from the NVCF-FMD infected zone. As a result, farmers from the NVCF are complaining that the current situation prevents them from benefitting from the lucrative export beef market as compared to farmers in the South. This study adopted the explanatory research design focusing on desk research. The results of the study showed a statistically significant increase ($P<0.05$) on average price and revenue for the proposed new FMD free zone compared to maintaining the FMD protection zone. Based on the result, it can be concluded that creating a new FMD free zone in the central north is economically viable, with the economic benefits outweighing the costs over the long term. Since this study was limited to the economic impact of creating a new FMD free zone confined to the direct income from selling cattle and excluded other monetary and non-monetary benefits such as milk, hides, employment creation, contribution to GDP and levy; a comprehensive study is further recommended to include these aspects so as to arrive at a better conclusion.

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LIST OF ACRONYMS

BCR	Benefit-Cost Ratio
CAP	Common Agricultural Policy
CBA	Cost-Benefit Analysis
CBPP	Contagious Bovine Pleuropneumonia
CBT	Commodity Based Trade
CGE	Computable General Equilibrium
CIV	Common Industry Vision
DAPEES	Directorate of Agriculture Production, Extension and Engineering Services
DCFROR	Discounted Cash Flow Rate of Return
DVS	Directorate of Veterinary Service
EIA	Environmental Impact Assessment
EU	European Union
FAO	Food and Agricultural Organisation of the United Nations
FMD	Foot and Mouth Disease
FMDV	Foot and Mouth Disease Virus
GDP	Gross Domestic Product
IFAD	International Fund for Agricultural Development
IFRC	International Federation of Red Cross and Red Crescent Societies
IRR	Internal Rate of Return
LITS	Livestock Identification and Traceability System
LMCs	Livestock Marketing Cooperatives
MAWF	Ministry of Agriculture, Water and Forestry
MAWLR	Ministry of Agriculture, Water and Land Reform
MBN	Meat Board of Namibia
MCA	Millennium Challenge Account
MCC	Millennium Challenge Corporation
MEATCO	Meat Corporation
MF	Meatco Foundation
NAD	Namibian Dollar

NAMSIP	Namibia Agricultural Mechanisation and Seed Improvement Project
NAU	Namibian Agriculture Union
NBS	Namibia Business School
NCAs	Northern Communal Areas
NDP5	Fifth National Development Plan
NNFU	Namibia National Farmers' Union
NPC	National Planning Commission
NPV	Net Present Value
NRMPS	National Rangeland Management Policy and Strategy
NSA	Namibia Statistic Agency
NUST	Namibia University of Science and Technology
NVCF	Northern Veterinary Cordon Fence
OIE	World Organisation for Animal Health
PANAFTOSA	Pan American Foot-and-Mouth Disease Centre
PBP	Payback Period
ROR	Rate of Return
RSA	Republic of South Africa
SAAFI	Sumbawanga Agricultural and Animal Food Industries Limited
SIAPAC	Social Impact Assessment and Policy Analysis Corporation
SPSS	Statistical Package for the Social Sciences.
SPV	Special Purpose Vehicle
STDF	Standards and Trade Development Facility
SVCF	Southern Veterinary Cordon Fence
TMB	Tanzanian Meat Board
UNAM	University of Namibia
USA	United States of America
USD	United States Dollar
VCF	Veterinary Cordon Fence
WTO	World Trade Organisation
ZAR	South African Rand
ZRBI	Zambezi River Basin Initiative

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DECLARATIONS

I, Kuniberth Mashendju Shamathe, hereby declare that this study is my own work and is a true reflection of my research, and that this work, or any part thereof has not been submitted for a degree at any other institution.

Kuniberth Shamathe		23/04/2021
Name of Student	Signature	Date

CHAPTER 1: INTRODUCTION

1.1 Introduction

The agricultural sector is considered as the backbone of the Namibian economy. Vision 2030 emphasises the importance of Agriculture as a tool for reducing poverty and income disparities in Namibia. Under the Fifth National Development Plan (NDP5), Agriculture plays an important role in the enhancement of economic progression in Namibia. Livestock, particularly cattle, contributes enormously to the Agricultural sector and the Namibian economy. Cattle ranching and small stock farming is carried out on 58.5 million hectares of land in Namibia, contributing 59% towards the Gross Domestic Product (GDP) (Mendelsohn, 2006). Foreign beef sales in 2010 amounted to N$2.2 billion, representing around 7 percent of Namibia's total merchandise exports, with beef and cattle accounting for almost 70% of the Agricultural sector's exports. A study by the Namibian Agriculture Union [NAU] (2018) in which Namibian Agriculture Production Value was estimated, found out that cattle had the highest production value for both 2016 and 2017 with N$2,047,200,946 in 2016 and N$3,403,613,974 in 2017 (Refer to Table 1.1).

Namibia is one of the very few African countries that accesses the lucrative beef markets of Norway, Britain, the European Union (EU), China and more recently the United States of America (USA). The overall combination of different livestock types of production values has outweighed other agricultural products. In 2016, livestock production contributed about 57.99 percent of the estimated Namibian Agriculture Production Value, while crops contributed 42.01 percent of the total agricultural output (Mushendami, Biwa & Goamab II, 2018).

Furthermore, Common Industry Vision [CIV] (2015) findings show that the livestock sub-sector accounts for 80% of Agricultural production in Namibia. In addition, the

sub-sector also accounts for 80% of the export trade in the Agricultural sector (CIV, 2015). Therefore, livestock is an important role player in the Namibian economy. Table 1.1 presents the estimated Namibian agricultural productivity value for 2016 to 2017.

Table 1.1: Estimated Namibian Agriculture Production Value

DESCRIPTION	2016 (N$)	2017 (N$)
Cattle	2,047,200,946	3,403,613,974
Sheep	577,977,003	705,464,949
Goats	109,518,022	130,665,020
Agronomy	267,208,677	408,181,874
Dairy	142,723,955	141,838,062
Pigs	114,268,583	124,245,405
Grapes	770,000,000	818,537,625
Poultry	735,965,000	850,653,292
Fresh Produce (veg and fruit)	150,000,000	210,832,000
Sub total	**4,914,862,186**	**6,794,034,218**
Charcoal	168,000,000	184,800,000
Trophy hunting	540,000,000	540,000,000
Total	**5,622,862,186**	**7,518,834,218**

Source: NAU (2018)

Despite Namibia's reliance on the Agricultural sector, the contribution of the Agricultural sector towards the country's economy, particularly livestock subsector has been declining in the last 29 years (National Planning Commission [NPC], 2007). Historical data of Namibia's 10-year agriculture GDP statistics show a steady increase for the first five (5) years from 2008 to 2012, before a consistent decrease in the last 5 years, from 5 percent GDP contribution in 2008 to 3.5 percent in 2017 (Food and Agricultural Organisation [FAO], 2020). Furthermore, a study done by the NAU in

2015 revealed that agriculture inflation is growing on average by 10.8% per annum while normal inflation for the study period was 6.7% per annum. The cost of maintaining the livestock value chain was increasingly becoming a burden to livestock producers (NAU, 2015). Since the manifestation of Covid-19 in 2020, the socioeconomic conditions of the country have worsened, especially those of rural communities that were reliant on agriculture in the livestock sub-sector for survival. Support services were limited due to lockdown restrictions and emergency rules. The support systems and trade interactions were also limited. Some family members in urban areas lost their jobs and returned to rural areas. This situation was adding pressure on rural societies who are into cattle farming since a significant proportion of the population dependent on income from subsistence farming has been increasing. On the other hand, productivity has been deteriorating due to climate change impacts. Farmers have had to sustain their livestock with cut-and-mill bushes, or on expensive grain and hay, which were often imported (NAU, 2015; FAO, 2020).

The analysis of export abattoirs capacity and their utilisation for over 5 years showed that the abattoirs were underutilised, with the slaughter quantities decreasing over time (Meat Corporation of Namibia [Meatco], (2018). This signifies a decline in the number of livestock for abattoirs. Meatco as the leading export abattoir in Namibia has closed several abattoirs and retrenched staff citing declining cattle supplies as the main reason for scaling down operations at its abattoirs (Meatco, 2018). Livestock farming contributed 2.8% to GDP in 2017, declining to 2.6% in 2018 (Meat Board of Namibia [MBN], 2019). Real value addition in livestock farming was estimated to have contracted by 21.8 percent in 2019, from a small decline of 0.8 percent in the previous year, mainly due to the drought (Bank of Namibia, 2019).

The reasons for declining performance of the livestock subsector are many with the main one being the declining trend in the availability of marketable cattle in Namibia. Over a 30-year period, real time data shows that there was an upward trend in the number of cattle up to 2015 before a sharp decline in the years that followed (MAWLR, 2020). Figure 1.1 below shows the 30 years of cattle data in Namibia.

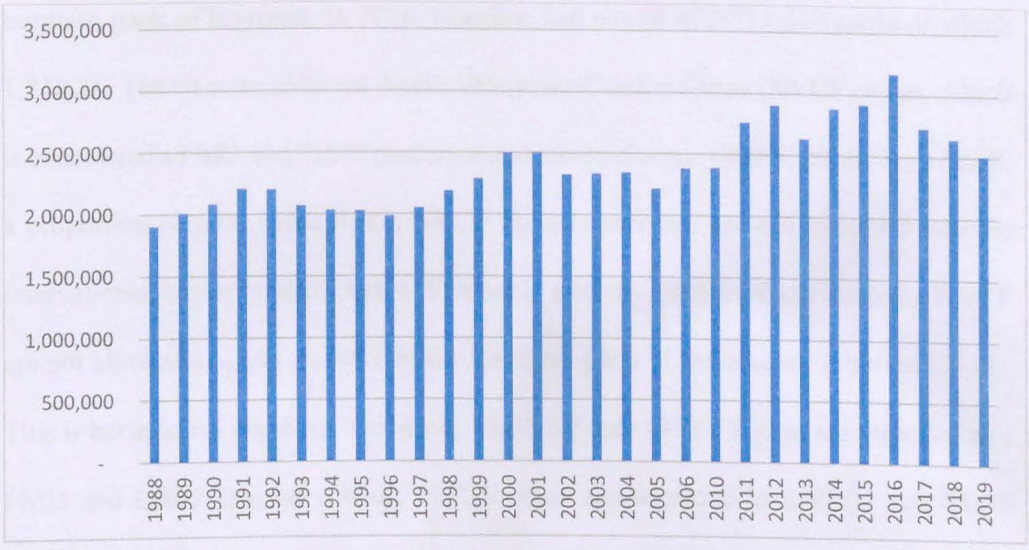

Figure 1.1: 30 years of cattle data in Namibia

Source: MAWLR (2020)

The decline in available marketable cattle numbers is attributed to a number of factors, amongst others, drought and disease as the most profound causes. In terms of the drought, the Ministry of Agriculture, Water and Forestry (MAWF) data shows that in 8 months only (October 2015 to May 2016) farmers reported more than 160 000 drought related livestock mortalities to the Directorate of Veterinary Services (DVS) (MAWF, 2016a). Recent statistics show that 97 854 animals died from drought between October 2018 to September 2019 (MAWF, 2020). However, drought is not

the only factor which impeded productivity and performance in the agricultural sector. Livestock diseases present equally challenging problems for the sustainability of the meat sub-sector (MAWF, 2020).

The outbreaks of Foot and Mouth Disease (FMD) and Contagious Bovine Pleuropneumonia (CBPP) diseases necessitated the creation and erection of the Veterinary Cordon Fence (VCF) which poses trade restrictions for livestock from the northern parts of Namibia. In 2016, Namibia had a total of 2,713,349 cattle of which 1,738,211 (64%) were from the North Veterinary Cordon Fence (NVCF) areas, which is considered a FMD and CBPP protected and infected zones (MBN, 2016). As a result, a proportion of 64% cattle in the NVCF do not enter and are not exported into the international lucrative beef market. The cattle and any beef products from the NVCF are not allowed to cross the VCF to the Southern parts of the country (Herbert, 2012). This is because the Southern Veterinary Cordon Fence (SVCF) areas are regarded as a FMD and CBPP free zone while NVCF areas are regarded as a FMD and CBPP protection and infected zones. Furthermore, Namibia's international beef markets do not buy meat from NVCF-FMD protection and infected zones as implied in the above discussion (Namibia National Farmers Union [NNFU], 2019; MBN, 2019).

The third challenge contributing to low numbers of cattle that can be slaughtered and exported in Namibia is the high numbers of live weaners that Namibia exports to the Republic of South Africa (RSA) as shown in Figure 1.2 below (Mouton, 2012). These weaners are not taxed as a product; hence they are not contributing foreign currency into the nation's foreign currency account as compared to beef products exported to the international markets.

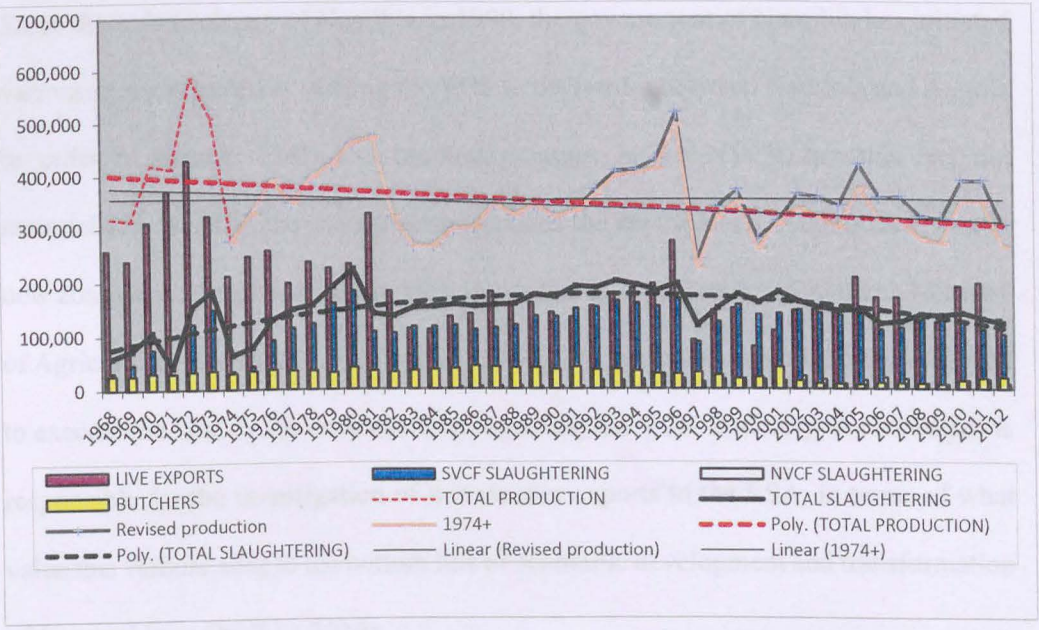

Figure 1.2: Statistics of cattle marketing and production from the Southern part of Namibia

Source: Mouton (2012)

The combination of drought, VCF status and live weaner exports to SA are hampering the productivity and marketability of livestock in Namibia. As a result of this, the government of the republic of Namibia has initiated programmes and interventions aimed at addressing these anomalies (NNFU, 2019). These include donor and government funded rangeland and livestock projects aimed at addressing drought. The MAWF secured a loan of ZAR 1,420 billion (US$ 92,092,377.54) from the African Development Bank for the implementation (2018-2022) of the Namibia Agricultural Mechanisation and Seed Improvement Project (NAMSIP). One component of NAMSIP focuses mainly on drought adaption and mitigation related to livestock and rangeland activities (NNFU, 2019; MBN, 2019).

Since the independence of Namibia in 1990, the government of Namibia has initiated various projects aimed at shifting the VCF to the border between Namibia and Angola in order to address FMD and marketing issues in the NVCF, but this has not materialised. In 2018, the government proposed the creation of a compartment and/or new zones as a way to address the VCF issues that had not been resolved. The Ministry of Agriculture, Water and Land Reform (MAWLR) as a custodian ministry was tasked to execute the land conference decision regarding the VCF. Similarly, the MAWLR is responsible for the investigation of live weaner exports to the RSA, in terms of what value this venture adds to the bottom line of economic development and transformation of farmers' lives (NNFU, 2019).

1.2 Background of the study

The veterinary cordon fence (VCF) is a large-scale fence-line constructed for the purpose of creating a livestock disease free zone by controlling livestock contagious diseases such as Foot and Mouth Disease (FMD) and Contagious Bovine Pleuropneumonia (CBPP) (McGahey, 2011). In Southern Africa, this is applicable in Namibia, South Africa, Botswana and Zimbabwe to facilitate the livestock movement within the country.

Although controlling contagious livestock diseases is cited as the main reason for erecting the VCF, literature review from various studies on the same subject reveals that the international export markets is the main reason countries protect FMD free zones (Otte, Nugent & McLeod, 2004; Leslie, Barozzi & Otte, 1997; Knight-Jonesa & Rushtonba, 2013; James and Rushton, 2002; Scoones & Woolmer, 2007; McGahey, 2011). This is because most of the lucrative beef international markets do not buy beef

products from areas with contagious livestock diseases hence most of the countries protect uninfected zones from infected zones. The Namibian VCF, which is commonly referred to as the Red-Line was originally created in 1896 by the imperial German administration to contain a Rinderpest outbreak in cattle (Schneider, 1994; Herbert, 2012). Since the 1960s it served to prevent the spread of FMD and CBPP from Namibia Northern Communal Areas (NCA) for the southern part of the country (Giorgio, 2012). The erection of the VCF started in 1961, the last part in the western Damaraland was completed in 1977, and the eastern part the south of Gam in 1982 (Schneider, 1994).

The Namibian VCF is approximately 1,347km running across the country from east to west almost dividing the country in the middle (Meatco Foundation [MF], 2019b). The regions comprising the Northern Veterinary Cordon Fence (NVCF) that are regarded as FMD and CBPP protection and infected zones are the Zambezi, Kavango West, Kavango East, Ohangwena, Oshikoto, Oshana, Omusati and Kunene-north while those in the Southern Veterinary Cordon Fence (SVCF) with FMD and CBPP free zone status are Otjozondjupa, Omaheke, Khomas, Hardap, //Karas, Erongo and Kunene south.

The beef products from the NVCF are not allowed to cross the VCF to the Southern parts of the country (Herbert, 2012) because the SVCF area is regarded as an FMD free zone while the NVCF area is regarded as FMD protection and infected zones. Furthermore, the current Namibia international beef markets do not buy beef products from the NVCF-FMD protection and infected zones (MAWF, 2014). As a result, farmers from the NVCF lament that the current situation prevents them from benefitting from the export to the lucrative beef market as compared to farmers in the

South. This is supported by Bishi and Kamwi (2008) stating that areas south of the veterinary cordon fence enjoy relatively unrestricted access to international markets, particularly to the lucrative markets of the EU, Switzerland and Norway (European Free Trade Area countries).

Areas north of the VCF only have restricted access to the domestic and RSA markets. Moreover, many see the VCF as a symbol of continued apartheid in an independent Namibia. This is based on the view that during apartheid, the VCF was used to control movements of the human population (Bishi and Kamwi, 2008; MAWF, 2014). Based on this, there is also a strong political incentive to remove or at least shift it. Hence, it was proposed that the government should create a new free zone or compartment in the low-risk block north of the current VCF (MF, 2019b; NNFU, 2019; Norval, & Walton, 2007). However, the above proposal is highly opposed by SVCF farmers who argue that creating a new FMD free zone in the central north of Namibia is not economical beneficial and will pose risks for the whole country and may result in loss of international markets (MAWF, 2014).

The approach suggested for zoning is either through creating a new FMD free zone into the low-risk block north of the current VCF or by shifting the VCF between the borders of Namibia and Angola. The second option of shifting the VCF to the border between Namibia and Angola received resentment from the majority of farmers and stakeholders arguing that shifting VCF to Angola border will pose a risk for the whole country to lose international markets (MAWF, 2014).

There is much movement of livestock between the border of Angola and Namibia, which will be difficult to control since some of the farmers in Namibia take their cattle for grazing into Angola during drought periods and might cut the fence for that

purpose. Cattle herds in Angola are in constant contact with Buffaloes that are carriers of FMD. Therefore, NVCF farmers and stakeholders such as NNFU, MF, MAWF, Livestock Cooperatives, Regional Council and Traditional Authorities (TAs) from the Northern Communal Areas (NCAs) have supported the approach of creating FMD free zone instead of shifting VCF to the border between Namibia and Angola.

MAWF (2018) also supported the zoning approach during the second land conference justifying that the zoning approach is regarded as safer as it allows for piloting small-scale areas, especially starting with the low-risk blocks. NNFU (2019) and MF (2019b) conducted stakeholder consultations, which recommended shifting the VCF by establishing compartments in low-risk areas north of the current VCF or creating new zones. The NVCF farmers and promoters of the proposed project argue that the zoning approach will allow implementers to learn from and observe how it works out, before implementing it in other areas.

The implementation of the zoning will contribute to curbing of FMD and CBPP and improve the socioeconomics of the communal farmers in the area and Namibia at large (MAWF, 2018). This approach will allow more cattle to access Namibia's international markets such as the European Union (EU), Norway and South Africa (MBN, 2012). It is further justified that creating new non-infected areas will allow the reopening of Meatco abattoirs that were closed due to lack of throughput of cattle supply that comply with the export market standards. Reopening abattoirs would create livestock market and employment opportunities, hence contributing to the socio-economic benefit of the country. This study investigated the potential economic impact of creating a new FMD free zone in the low-risk block of the current VCF in the central north of Namibia.

1.3 Statement of the problem

There is a disagreement between farmers in the NVCF and SVCF on the proposal to create a new FMD free zone in the central north of Namibia (MAWF, 2014). Beef products from the NVCF are not allowed to cross the VCF to the southern parts of the country (MBN, 2018). This is due to the fact that the SVCF areas are considered an FMD free zone while the NVCF areas are regarded as an FMD protection and infected zone (MAWF, 2014). In addition, Namibia's international beef markets do not buy meat products from the NVCF-FMD protection and infected zones. Farmers from the NVCF feel that the current situation excludes them from the accruable benefits of exporting beef products as compared to farmers in the South (NNFU, 2019), leading to suggestions that a new FMD free zone be created in the central north.

In an attempt to address the above problem, the possibility of moving the VCF or creating a new FMD free zone has been a subject of consideration since Namibia's independence in 1990, but there has been no solution in sight to date (MAWF, 2014). Many studies (Anon, 1993; Forman, 1999; Norval & Walton, 2007; SIAPAC, 2000; NNFU, 2019) have been carried out and four Cabinet decisions which all supported the idea of creating a new FMD free zone in the central north were made. However, divergent opinions regarding the state of the VCF persisted (SIAPAC, 2000).

The supporters (NVCF farmers and MAWF) of a new FMD free zone further argue that NVCF areas have more cattle (64% of the national herd) hence creating a new FMD free zone in the central north will generate more revenue for farmers and the country at large as this will allow more cattle to access international markets with better prices. This argument is opposed by farmers in the SVCF who argue that

creating a new FMD free zone in the central north is not economically beneficial but will pose risks for the whole country and may make the country lose international beef markets (MAWF, 2014). Despite these counter arguments from the two groups, to the researcher's knowledge there has been no formal study carried out to validate the economic impact of creating a new FMD free zone in the central north.

Although aspects of economic impact for creating an FMD free zone were included in some of the previous VCF studies in Namibia (MBN, 2019; NNFU 2019), the quantification of the results, in terms of the economic impact of creating a new FMD free zone in the central north of Namibia were marginal. As detailed in the literature, the previous studies in Namibia and promoters for creating a new FMD free zone cited the potential economic impact of creating a new FMD free zone in their statements and proposals, yet there was no detailed study conducted to validate the claims they made. Therefore, there was a gap in knowledge which needed to be filled and perhaps provide solutions to the impasse between the farmers in the FMD free zone and those in the FMD infested zone. Lack of scientific evidence resulted in interested parties not agreeing on the way forward regarding creating a new FMD free zone in the NCA. Therefore, this study focused on the economic impact of creating an FMD free zone in the central north of Namibia.

1.4 Objectives of the study

The research objectives for this study were divided into the main objective and sub-objectives.

1.4.1 Main objective

To carry out an investigation into the economic impact of creating an FMD disease free zone in the central north of Namibia

1.5.2 Sub-objectives

- To carry out a cost benefit analysis (CBA) of creating an FMD free zone in the central north of Namibia
- To compare cattle prices and the revenue realised between the proposed new FMD free zone areas against maintaining the FMD protection zone in the same area
- To compare funding options of creating FMD free zone, between the first option of the full amount of capital investment to be repaid by farmers against the second option of capital investment to be shared among the government (50%), donors (20%) and 30% loan repayment by farmers

1.6 Hypotheses of the study

Null Hypotheses (H_0) and Alternative Hypotheses (H_1):

H_0^1: The Benefit - Cost-Ratio (BCR) of a new FMD free zone will be 1.

H_1^1: The BCR of a new FMD free zone will be greater than 1.

H_0^2: The Net Present Value (NPV) of a new FMD free zone will be zero.

H_1^2: The NPV of a new FMD free zone will be significantly positive.

H_0^3: The Internal Rate of Return (IRR) of a new FMD free zone will be equal to a minimum required rate of return of 10%.

H_1^3: The IRR of a new FMD free zone will be significantly higher than the minimum required rate of return.

H_0^4: The Payback Period (PBP) of a new FMD free zone will be equal to breakeven point.

H_1^4: The PBP of a new FMD free zone will be significantly shorter.

H_0^5: There will be no significant difference in the average cattle price and revenue between the proposed FMD free zone compared to maintaining FMD protection zone.

H_1^5: The average cattle price and revenue for the proposed FMD free zone will be significantly higher compared to maintaining FMD protection zone.

H_0^6: There will be no significant difference between the two funding options proposed for the creation of new FMD free zone.

H_1^6: The first funding option for the creation of new FMD free zone will be more affordable and repayable by farmers compared to the second funding option.

1.7 Significance of the Study

This study is expected to contribute to resolving the impasse between the two groups having divergent opinions about the creation of a new FMD free zone in the central north of Namibia. It is expected to contribute to resolving the arguments for and against the creation of a new FMD free zone between farmers in the NVCF and farmers in the SVCF. Furthermore, this thesis will be shared with the MAWF and other stakeholders as it can assist in contributing to decision making, on whether to proceed with the project or not.

This study is also expected to complement the existing body of knowledge on this contentious issue (MAWF, 2000). It is expected that the knowledge generated in this study might be used in lobbying for change in government policy-making regarding the Namibian VCF issue that has not been solved since independence of Namibia in 1990.

1.8 Limitations of the study

Since it is a desktop review study, the study relied on secondary data, which is sometimes not entirely consistent with the need of the study's data. Secondary data is often not presented in a form that exactly meets the researcher's needs, and so the researcher may be forced to seek other sources of data to augment the secondary data which might be outdated (Wilson, 2010). The published data may always not be reliable and not exactly as per the needs of the study being undertaken. The researcher had to make careful scrutiny of the data before using it. Some of the secondary data collected seemed general and vague and was not really helpful to the researcher in making a conclusive finding of the study, and therefore the sources of the data were cross-referenced to verify the authenticity and validity of the data.

Some of the secondary data were old and outdated and required careful scanning, identification, and arrangement to get the complete needed data. Any missing pieces of data had to be replaced with similar data from other qualified sources. Outdated information in most cases offered little value if not corrected, especially in a research area with a fast-changing environment or market. It could be that the sample used to generate secondary data was small, which could affect the reliability of the data. It

required a lot of effort, patience, extreme care, and skill by the student to dig out useful information.

1.9 Delimitations of the study

The study focused on the economic impact of creating a new FMD free zone excluding aspects such as Environmental Impact Assessment (EIA) aspects, feasibility study, risk assessment and cause of the impasse, which could help in conclusive decision regarding the study. These aspects were excluded because they were already included in previous studies while the economic impact aspect of creating a new FMD free zone was marginalised in previous studies.

Furthermore, the income used for economic analysis of this study was limited to the direct income from selling cattle, but not their products such as milk and hides. The study further excluded the quantification of other monetary and non-monetary benefits such as employment creation, contribution to national GDP and the Meat Board of Namibia levy. The exclusion of these aspects was mainly due to longitudinal effects of the nature of collecting and analysing data for these aspects, which is appropriate for a flexible and long-term timeframe research as opposed to limited timeframe for academic purposes. In addition, there was a need to devote time and focus the study to the main problem highlighted by the affected parties, which was lower cattle price and general lack of market for cattle due to FMD status in the NVCF. Therefore, the results and recommendations for this study were limited to the economic impact of creating an FMD free zone in the central north of Namibia, with a focus on the capital investment and maintaining costs of creating and maintaining an FMD free zone as compared to direct income from selling cattle.

1.10 Chapter summary

This chapter gave a brief overview of the study starting with the introduction, background of the study, statement of the problem, the objectives of the study, hypotheses of the study, significance of the study, limitations of the study, delimitations of the study, and ending with this relevant chapter summary. The introduction highlights the importance of the livestock sub-sector within the Agricultural sector and related economics of Namibian agricultural sector, specifically cattle farming. It further highlights how aspects of livestock diseases have affected the sub-sector's contribution to the economy. The background of the study narrates issues that developed overtime related to this study. These include NVCF farmers and the Namibian government facilitating an attempt to remove the VCF over 30 years but not succeeding up to now. The statement of the problem highlights the current disagreement between farmers in the NVCF and SVCF on the proposal to create a new FMD free zone in the central north. It stated and provided evidence regarding the problem which necessitated this study, which is the identified gap in knowledge regarding the economic impact of creating an FMD free zone and lack of evidence for the claims made by opposing parties. Furthermore, the economic impact aspect of creating a new FMD free zone in the central north was marginalised in previous studies. The limitation of the study highlights the constraints of using secondary data, which was the case for this study while the study is delimited to the economic impacts of creating a new FMD free zone in the central north.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter reviews existing empirical literature and theoretical foundations which present a broad literature review on the economic impact of creating a new FMD free zone in the central north of Namibia. Firstly, a clarification of zoning as a concept for creating a new FMD free area, before presenting studies and findings related to the economic impact of creating an FMD free zone, was undertaken. Since one of the objectives of this study was to analyse the cattle sale prices and revenue between the proposed FMD free zone areas against maintaining an FMD protection zone in the same area, a review of the beef market situation in the NVCF areas was conducted. The chapter also presents a literature review on the risks of shifting the VCF since this was one the main bone of contention of the opposing group. In addition, the literature review also covered a cost-benefit analysis (CBA) as a conceptual framework guiding the analysis of the major components of this study. The chapter ends with a summary of the highlights of the chapter.

2.2 Definition and description of a zone

Zoning is defined as a procedure implemented by a member country under the provisions of chapter 4.3 and article 4.3.1 of the World Organisation of Animal Health (OIE) terrestrial code with a view to defining a subpopulation of distinct health status within its territory for the purposes of disease control and/or international trade (OIE, 2014). Zoning applies to an animal subpopulation defined primarily on a geographical basis (Amuthenu, 2015). At the 72nd Aquatic Animal Health Code of the World Organisation of Animal Health (OIE) General Session of 2004, the General Assembly adopted the concept of zoning as a means of creating a FMD free zone. This same

procedure can be used to define and manage the specified animal health status of an animal subpopulation in accordance with the recommendations in the Terrestrial Animal Health Code and the Aquatic Animal Health Code (OIE, 2018). Zoning can be used as a tool in the prevention, management, or eradication of animal diseases, and to provide the basis for continued exportation of animals and their products after a country experiences an outbreak of a disease such as FMD.

The objective of a disease-free zone is to make sure the contagious diseases and their carriers are not introduced to the other countries via importation of animals and animal products (Häsler, Queenan, Rushton, Mlangwa, Mghwira & Madege, 2017). Following the adoption of the zoning concept, the OIE developed guidelines on its application such as the process for certification. There are many examples of importing countries (Norway, United Kingdom, United States of America, European Union, South Africa, China, Republic of Korea, Viet Nam, Russian Federation and Saudi Arabia) that consider zones of beef exporting countries for trade purposes and this has probably made the use of zoning a more attractive option (FAO, 2019). In addition, the OIE has continued to adopt other concepts and approaches that member countries can use to facilitate international trade, such as the definition of safe commodities.

As indicated in the Animal Health Regulations published under the Government Notice No. 358 of 28 December 2018 (Animal Health Act 1 of 2011), Namibia is divided into FMD control zones, namely: the FMD infected zone, the FMD protection zone, the FMD free zone and the surveillance area which is within the FMD free zone. Namibia has utilised the FMD free zone to the SVCF which the country is enjoying an FMD free status. The Zambezi region and the eastern parts of the Kavango East region

are classified as an FMD infected zone. Kunene north, Omusati, Oshana, Oshikoto, Ohangwena, Kavango West and the western parts of the Kavango East regions are classified as protection zone. Cattle in both the FMD protection zone and infected zone are vaccinated periodically in their respective zone. Meat products and livestock from the FMD protection zone and infected zone are not accepted for export in most lucrative international beef markets (Animal Health Act 1 of 2011).

2.3 Economic impact of creating a new FMD free zone in the north central of Namibia

International and local case studies provide examples of the economic impact of creating a new FMD free zone. Firstly, the studies are arranged according to international level (international studies beyond Africa and those at the African level) and then local studies at the Namibian level. The studies are further indicated and expounded per country under each category described above.

2.3.1 International studies beyond Africa

Under this section, international studies under the topic under investigation are discussed. These studies include the Uruguay case study, the Philippines case study, and the Cambodian case study. Furthermore, the global level case study is further elucidated and discussed under this section.

2.3.1.1 The Uruguay case study

Otte et al. (2004) conducted a case study for Uruguay on the economic impact of creating a disease-free zone and the institutional responses to transboundary animal diseases. Findings of the study showed that Uruguay is an example of a country that

gained access to high-value markets after the eradication of the FMD in 1996 (Leslie et al., 1997). Uruguay has been officially recognised by the OIE as a country free from FMD practicing vaccination since 2003. As a result, Uruguay has been able to take advantage of its export quota to export 20 000 tons of beef to the USA on a yearly basis. In addition, exports by weight (in terms of tons of beef) increased over 100% and by value, 52% (in term of monetary gain) after freedom from the FMD declaration. The higher price obtained by Uruguay's beef in the USA compared to the selling price on the domestic market was more than double in the case of chilled meat. This increase was estimated to rack in an additional revenue of US$20 million per year to the country (Leslie et al., 1997). Before the creation of free a FMD zone, Uruguay was spending between US$8 and US$9 million annually on FMD vaccinations, which was very expensive. The control costs were as low as 10% of revenues from exports alone after FMD freedom was declared (Leslie et al., 1997).

2.3.1.2 The Philippines case study

Randolph, Perry, Benigno, Santos, Agbayani, Coleman, Webb and Gleeson (2002) evaluated the economic impact of FMD control and its eradication in the Philippines using CBA. The scenario assessed included options of no exports; low-value exports only; high-value exports only; and, both low and high-value exports. The assumptions in place were as follows:

a) Low-value exports begin once a FMD freedom ascertainment without vaccination is officially recognised nationally (2 years after eradication is achieved), with 1,250 tonnes of meat products exported the first year, 2,500 tonnes the second year, 3,750 tonnes the third year, and 5,000 tonnes every year thereafter.

b) High-value exports begin, once FMD freedom ascertainment is officially recognised nationally without vaccination (2 years after eradication is achieved); with 1,250 tonnes of meat products exported the first year, 2,500 tonnes the second year, 3,750 tonnes the third year, and 5,000 tonnes every year thereafter.

c) In both of the export scenarios described above, a FMD freedom is achieved nationally, with a total of 10,000 tonnes of meat products being exported 4 years after official FMD.

Under these varying assumptions regarding the development of exports of livestock products following the eradication of the FMD, the study estimated benefit cost ratios (BCR) for the investment in eradication of FMD ranged from 1.6 BCR (2010, no exports) to 12 BCR (2005, export of 5,000 tonnes of beef, each of low-value and high-value livestock products annually), indicating that the eradication of the FMD, is an economically viable investment. The commercial pork pig industry sector was estimated to capture 84% of the benefits generated by the public investment in the eradication of the FMD as compared to 4% by backyard pork/pig producers (Randolph et al., 2002).

2.3.1.3 The Cambodian case study

Young, Suon, Rast, Nampanya, Windsor and Bush (2014) conducted a study on the CBA regarding FMD control in large ruminants in Cambodia. The literature review from health and husbandry sector were used for analysing the three-phase analysis framework. The objective of the study was to evaluate the impacts of the FMD spread in Cambodia using Monte Carlo simulation modelling to analyse CBA and value chain

for large ruminant FMD vaccination programme. The finding of the study showed a BCR of 1.40 based on an expected annual incidence of 0.2 ratio. Since most of the large ruminants were owned by rural small-scale farmers, and most of them were employed under agricultural sector, the study finding showed that Cambodia's successful implementation of an FMD control programme was anticipated to avoid projected losses of USD 135 million; equivalent to 10.6 percent of the 2010 farm-gate value (Young et al., 2014).

2.3.1.4 Global level case studies

A study by the Knight-Jonesa and Rushtonba (2013) assessed the economic impacts of FMD at the global level. The study projected that the yearly impact of FMD related to visible production and vaccination losses in endemic regions was in the middle of US$6.5 and US$ 21 billion. Furthermore, outbreaks in FMD free countries and zones caused losses of more than US$1.5 billion a year.

The economics of FMD study at the global level by James and Rushton (2002) found that, where FMD eradication is feasible, it is the least-cost policy option, even allowing for the costs of prevention, emergency preparedness and the risk of outbreaks. Where eradication is not feasible, it is economically beneficial to protect high producing livestock by vaccination. Vaccination of lower-producing animals may also be justified, especially where these animals produce milk or are used for traction power, or where this would serve to protect high-producing livestock from diseases (James & Rushton, 2002).

2.3.2 The African level studies

This section focused on the African level studies such as the Tanzanian case study, the Zimbabwe case studies, and the Ethiopia case studies.

2.3.2.1 The Tanzanian case study

Häsler et al. (2017) conducted a CBA study for establishing an FMD Free Zone in Tanzania. The aim of the study was to assess the costs and benefits of establishing an FMD-free zone and provide recommendations to the policy makers regarding the economic justification for investing in the large-scale project for establishing an FMD free zone.

The Häsler et al. (2017) CBA included appraisal of the diseases for agro-pastoralists, pastoralists and ranch farmers, the outbreak control costs, costs of vaccination and supportive surveillance, and the benefits from avoiding disease costs. Based on the findings, the income gained from export was projected to be USD 28.59 million to match the negative NPV of the same amount. The study concluded that the proposed FMD programme was not viable, due to the lack of market opportunities, the uncertainty of Sumbawanga Agricultural and Animal Food Industries Limited (SAAFI)'s future involvement in the in-country value addition and the low off-take of cattle and the perceived low impact of FMD by farmers. There was also a land use issues between pastoralists, agro-pastoralists and wildlife adding to the challenges.

Based on the outcomes of the study, it was recommended to explore the option of Commodity Based Trade (CBT) as was done in Namibia. Further recommendations included addressing major data gaps and enhancement of the national control plan with

reference to the surveillance strategy. Research to understand better acceptable incentives for farmers to increase off-take rates was also recommended. The study proposed public private partnerships for Livestock Identification and Traceability System (LITS) as the bases for FMD control and suggested to refine the logistically element of it. It was recommended to explore and develop markets to provide opportunities for suppliers. Moreover, institutional capacity building was identified as an important aspect to improve disease management and synergies (Hasler et al., 2017).

2.3.2.2 The Zimbabwean case studies

A case study of FMD in Southern Zimbabwe by Scoones and Woolmer (2007) showed that until 2007, Zimbabwe exported meat to the EU with reduced import tariffs. These beef exports brought in US$50 million per year up to 2001. Zimbabwe had a zonal FMD control programme based on wildlife control and vaccination, the same as the one practiced in Botswana, Namibia and South Africa currently. This study showed that the economic benefits of a FMD free status for livestock farming areas was commendable. However, the breakdown of the FMD control in Zimbabwe after the land reforms of 2000 led to a loss of US$50 million per year that was earned from EU beef export markets (Scoones & Woolmer, 2007).

Perry, Randolph, Ashley, Chimedza, Forman, Morrison, Poulton, Sibanda, Stevens, Tebele and Yngström (2003) also conducted a CBA study to evaluate the existing and alternative FMD control strategies in Zimbabwe, and in particular the contributions that FMD control made to poverty reduction. Using a Computable General Equilibrium (CGE) model, the larger impact of beef exports on the Zimbabwe national

economy were studied. The BCA considered possible future trends in the international beef market, particularly from the EU, based on the revised Common Agricultural Policy (CAP) and the World Trade Organisation (WTO) trend (Perry et al., 2003).

The findings of the study showed that FMD control actions were beneficial to Zimbabwe's national economy. This was firstly demonstrated by a comparison between the baseline scenario and the pessimistic FMD control scenario 3 which showed that for every US$ 1 that Zimbabwe disinvests in the FMD control programme, a further US$ 5 is lost by the country. Secondly, the results show that if Zimbabwe were to invest further in the fences and the veterinary service infrastructures required to create a much larger and much more secure export zone that was internationally recognised as an FMD free by the OIE, there would be returns of approximately US$ 1.5 for every US$ 1 invested (Perry et al., 2003).

FMD control in Zimbabwe was largely funded by the taxpayer and external donors. Although FMD control measures impacted on all livestock owners, the benefits were largely received by a relatively wealthy minority involved in the commercial beef sector. FMD control made very positive contributions to the commercial farmers, but very limited contributions to the communal farmers. If the FMD free status was regained, it would take time to re-establish a beef industry capable of supplying a sufficient quantity of export quality beef (Perry et al., 2003).

2.3.2.3 The Ethiopian case studies

Jemberu, Mourits, Rushton and Hogeveen (2016) conducted a CBA on the FMD control in Ethiopia. The objectives of the study were to estimate the annual costs of

FMD in the cattle production systems of Ethiopia, and to conduct an ex-ante CBA of potential control alternatives. The ring vaccination, targeted vaccination, and preventive mass vaccination control strategies were compared with the baseline scenario of no official control program. Based on these estimates, the incidence of the disease was simulated stochastically for 10 years. Preventive mass vaccination was the most efficient control strategy by reducing the national outbreak incidence below 5% with a median time interval of 3 years, followed by targeted vaccination strategy with a corresponding median time interval of 5 years. On average, all evaluated control strategies resulted in positive NPV. The targeted vaccination strategy was the most economic strategy with a median benefit cost ratio of 4.29. The study indicated that FMD has a high economic impact in Ethiopia. Its control was predicted to be economically profitable even without a full consideration of gains from export (Jemberu et al., 2016).

The above findings by James and Rushton (2002) are supported by Jemberu, Mourits, Woldehanna and Hogeveen's (2014) study regarding the economic impact of FMD outbreaks on smallholder farmers in Ethiopia. Jemberu et al. (2014) findings indicated the economic losses of FMD due to milk loss, draft power loss and mortality were on average USD 76 per affected herd and USD 10 per head of cattle in the affected herds in a crop-livestock mixed system; as well as USD 174 per affected herd and USD 5 per head of cattle in the affected herds in the pastoral system. The herd level economic losses were statistically significantly higher for the pastoral system than for the crop-livestock mixed system ($P < 0.001$). The major loss due to the disease occurred as a result of milk losses and draft power losses whereas mortality losses were relatively low. The study concluded that although the presented estimates on the economic losses

accounted only for the visible direct impacts of the disease on herd level, these conservative estimates signify a potential socioeconomic gain from a control intervention viewpoint (Jemberu et al., 2014).

2.3.3 Namibian level studies

In 1992, a mission supported by the International Fund for Agricultural Development (IFAD) undertook a study on the VCF, with a view to gradually translocating the VCF to the border between Angola and Namibia (Anon, 1993). Eight options were analysed with respect to the viability, marketing, animal health and sociological implication. These options are described below and were evaluated in light of the development over the ensuing seven years:

2.3.3.1 Option 1 - VCF as it is at present

This option described the VCF at present and confirmed its essential role in maintaining the FMD and CBPP free status of the southern parts of the country and allowing access to international beef markets. Long-term maintenance of the fence as it was at that time was not considered an acceptable option, for sociological and political reasons. However, it was recognised in the short term as a barrier, although measures could be taken to improve livestock production and marketing in the NCA. With this option, it was concluded that it was necessary to maintain the VCF in the short term while finding an alternative in the long term. There were still interventions that could lessen the impact of the VCF (Anon, 1993).

2.3.3.2 Option 2 - Northern relocation in the Mangetti area

The VCF was relocated in the north in the early 1970s (Mangetti East) and late in the

1980s (Mangetti West). Option 2 proposed further relocation, to encompass an additional 140, 000 hectares, with either depopulation or CBPP eradication from the 11, 000 cattle in the area. The option was determined to have a negative economic impact. Therefore, this study concluded that based on this option, it may be wise to relocate the VCF further north in some areas. This would have to be subjected to a detailed feasibility study, taking into account attitudes of the current occupiers of the land. In any event, it could be dependent on the enactment of the Communal Land Bill and subsequent formalisation of ownership of the land (Anon, 1993).

2.3.3.3 Option 3, 4, 5 and 7

Option 3, 4, 5 and 7 and 8 all involved a relocation of the VCF, partially or completely, to the border between Namibia and Angola. The proposal was to have a second fence at a minimum distance of 10km south of the border to a buffer zone, with the area south of that fence being a free zone. This was regarded as unrealistic option, at least for as long as transhumance remains a way of life in the area. It would serve to divide the communities within Namibia in a way that would be unacceptable (Anon, 1993). Disruption of trade would be the other impediment. Farmers in the buffer zone would be no better off from a marketing point of view than they were before relocation of the VCF. Access to water would be a major problem in the area where Kunene and Okavango Rivers form the border. Without a high level of community support, the maintenance of any fence would become an impossible task. For this reason, none of the options, as expressed in IFAD report was regarded as feasible. It was concluded that option 3, 4, 5 and 7, which involved securing the border with Angola and placing another fence below the border to define a buffer zone, was considered unworkable. The buffer zone fence would not be accepted by local communities (Anon, 1993).

2.3.3.4 Option 6 - Removal of the VCF with no replacement fencing

Although this was presented as an option in IFAD report, it was summarily dismissed as being unrealistic. Such an action would immediately alter Namibia's international livestock export trade access. It was concluded that the removal of the VCF with no replacement fencing, by the time of IFAD report, was unrealistic. At that stage, the VCF could not be removed unless an alternative acceptable to international trading partners was developed (Anon, 1993).

2.3.3.5 Option 8 - Regional animal health project

This option was regarded as the most attractive in IFAD study of 1993. The objective would be to eradicate FMD and CBPP in the NCAs and also in the southern part of Angola. The border would be fenced, and another fence would be required in Angola to separate free and infected areas. Perceived difficulties in implementation were seen due to uncertain political situation in Angola. Also, since Angola was not a meat exporting country, FMD freedom was deemed not to be a high priority. While this option was arguably enabling the NCAs to become FMD free zone without the need for a second fence to define a buffer or surveillance zone, removing that requirement to Angola, north of the border, could only be seen as an even more difficult plan. This option was regarded as achievable in short to medium term but was reasonably considered a long-term objective. It was concluded that a regional animal health project involving disease control in the southern provinces of Angola was an appealing option, but it needed to be regarded as long-term goal (Anon, 1993).

Forman (1999) conducted a technical study on livestock improvement in the Northern

Communal Areas of Namibia. The study included the following important findings and recommendations; an option to control the Namibia-Angola border for the purpose of controlling the FMD; inclusion of the northern Kunene region in the FMD free zone; and relocation of the VCF to the north to include farms in the southern parts of the Oshikoto and the Kavango regions. The study concluded and recommended the following important aspects of FMD control measures:

- Control of the border between Namibia and Angola, with the ultimate rezoning of most of the NCAs (except for Caprivi) was the only viable long-term option. However, rezoning would be unlikely to be completed in less than a decade. The feasibility of implementing this option was regarded as open to question.
- Construction of a new VCF to include northern Kunene region in the FMD free zone had technical merit and could be reconsidered as a short-term initiative. However, while objectives of improving social equity would be advanced and there may also be economic benefits, resistance from the Ovambo communities was probably going to be a major obstacle.
- Relocation of the VCF to the north to include farms in the south of Oshikoto region should be considered. This should be justified on economic ground. However, unless attitudes have significantly changed in the past few years, there would be a high risk of failure due to potential vandalism of a new fence.

Norval and Walton (2007) was contracted by the Millennium Challenge Corporation (MCC) to develop a strategic plan to acquire freedom from the FMD and CBPP throughout the Republic of Namibia (GRN), except for the Caprivi Region. The plan included the construction of a physical barrier, and a VCF at the border between Namibia and Angola; a potential FMD and actual CBPP infected zone, to augment an

existing natural geographic barrier of the Kunene River and associated mountain ranges and the Okavango River to prohibit and stop the movement of livestock, other ruminants and porcine wildlife as well as meat from these species. The study was conducted by collecting field data and conducted stakeholders' consultations through workshops. The results of the stakeholders' consultation recommended the relocation of VCF to the border, although there was reservation expressed by some members in the northern areas of Namibia (Norval & Walton, 2007).

MBN (2019) modelled 4 scenarios related to improving livestock market penetration and productivity in the NVCF. Scenario 1 showed that an increase of 50 000 marketable animals in the NVCF and a 10% price increase could add N$269 million to the livestock sector's contributions to the GDP. Scenario 4 showed that contributions to the GDP would be N$914 million. MBN (2019) indicated that 60% (1.6 million) of cattle in Namibia were from NVCF, hence shifting VCF to the north would probably allow more cattle to access international markets. The result of the model implied that shifting VCF would increase GDP contribution from the livestock sector.

NNFU (2019) estimated that 50% of the cattle from the NVCF would have access to lucrative international markets if the VCF was shifted to the north and this was expected to hasten Meatco to reopen its abattoirs that were closed due to the outbreak of FMD in 2015. More than 150 Meatco employees were retrenched in 2015 (Meatco, 2019), hence reopening abattoirs would create much needed employment.

2.4 The NVCF beef market

Several studies indicate lack of livestock and beef product markets in the northern

communal areas (NCAs) of Namibia due to the FMD status. Key findings of the Millennium Challenge Account [MCA] (2013) study on informal trade of beef in the NCA showed that 62.1% cattle consumption per annum in the NCA was for weddings and funerals. Ten percent (10.9%) of the cattle were traded through open markets and roadside stalls and 27% was consumed through formal business market outlets. This statistic shows that about 73% of cattle are sold at low prices at informal markets or given for free during weddings as a gift. This was necessitated by a lack of available formal beef markets due to the FMD status in the NCA (MCA, 2013).

A consumer survey in the NCA (MCA, 2013) undertaken with formal business outlets showed that 42.2% of formal consumer outlets indicated that they sourced all their beef from the south of the VCF because they felt it was preferred by their clients due to its FMD free status. These studies showed that NCA cattle lacked a market hence more than 70% of consumed beef was not marketed via formal markets, hence not contributing to GDP. This showed a forgone opportunity for the country to improve its GDP from livestock sales, particularly beef. This was the situation despite FAO's (2015) study which indicated that 79.4% of the GDP contributions by agriculture were from livestock. Therefore, improving the marketing situation for 64% of the national herd in the NCA could further improve livestock producers' contributions to the Namibian GDP (MCA, 2013).

The Meatco Foundation (2019b) study to develop the NCA strategy for the beef sector indicated that the NCA despite being a good market consuming over 112,460 cattle per annum, 47% of NCA's consumption was imported from producers and meat processors south of VCF. This study discovered that 52% of this consumption was

sourced from the informal markets while 1% was supplied by local abattoirs. The retail sector or formal market in the NCA is dominated by international distribution cartels linked to producers SVCF or in countries of origin. Additionally, while retailers and distributors are compelled to source regulated quotas locally, they tend to procure beef products exclusively from the well-established local commercial farmers. This arrangement effectively excludes farmers from the NCA who are historically predominantly disadvantaged small-scale farmers. The study concluded that the NCA is a net importer of Meat and Meat Products hence does not consume beef products from locally produced cattle.

The continuation of the status quo from the above studies is backed up by the Meat Board of Namibia statistics (MBN, 2018) which showed that in 2018, abattoirs of the SVCF slaughtered 75,887 cattle (64% of total output) while abattoirs of the NVCF only slaughtered 1,584 (about 1% of total output). Butcheries slaughtered 41,672 cattle in 2018 which is equivalent to 35% of national beef output for the year. The NCA only contributed 1% on formal abattoir market despite a statistic indication of NCA having 1,738,211.00 (64%) of the national herd (MBN, 2018). This situation disadvantaged NCA farmers in terms of a lack of a viable market and thus affected their income and livelihoods.

The lack of preference by local and international markets for NCA cattle was further supported by NNFU (2019) livestock value chain study findings which indicated that some 20,000 plus live cattle and cattle equivalents in the form of fresh meat products were traded from south of the VCA to the NCA annually, and there was no international livestock market for the NCA by then. A NNFU (2019) study recommended relocating

the Namibian VCF further north to improve the marketing situation in FMD infected zone which could eventually improve socio-economic benefits of the NCA.

2.5 The risk of creating a new FMD free zone

Despite potential economic benefits of creating a new FMD free zone, available literature indicates that shifting or removing the VCF from the infected FMD zone was a high risk and should be done properly (Otte et al., 2004) to avoid causing outbreaks of contagious diseases such as the FMD and the CBPP in the free zone. Such a move may pose the risk of losing the lucrative international beef markets for the country. For instance, the introduction of the CBPP in Ngamiland in Botswana resulted in the immediate closure of the export meat processing plant, which employed over 200 people before cattle were destroyed (Townsend & Sigwele, 1998). Exports came to a standstill. A survey of the business sector after the eradication campaign showed that business turnover had generally declined by an average of 15%, which was attributed to the loss in disposable income from cattle production. The indirect effects of this move were further estimated to be more than seven times the amount attributed to direct losses experienced (Townsend & Sigwele, 1998).

A two-year study by McGahey (2011) which assessed the impact of veterinary cordon fences on pastoralists found out that there was an overall positive rating of fencing by pastoralists. The study concluded that the VCF represent the lynchpin of the southern African disease control system as its expansion facilitated secured access to lucrative export markets. Hence, the removal of VCF poses a risk of losing these international markets. This was supported by community consultations conducted by Social Impact Assessment and Policy Analysis Corporation [SIAPAC] (2000) on VCF relocation options in Namibia, which was rejected by some of the communities. The SIAPAC

(2000) study concluded that the community objections to the relocation of the VCF was partly due to lack of understanding regarding the benefits of translocating VCF.

Additionally, an investigation by Conradie and Damaseb (2013) supported the relocation of the Namibia VCF but pointed out that the discounted payback period of the border VCF depended on the implementation timeframe for achieving disease free status and cautioned that there is a risk that Namibia's export status could be lost if not done properly. Moreover, Marcos and Perez (2019) suggested the importance of having in place a FMD trade barrier to avoid risk of illegal trade in beef products.

Argentina is divided into five zones associated with disparate epidemiological situations and control strategies. Two zones are free from FMD due to vaccination while three are without vaccination. Quantitative risk assessment was used to estimate the risk of the introduction of FMD virus (FMDV) into the Argentine FMD-free zone without vaccination via legal or illegal trade of bone-in beef and non-vaccinated live animals from the FMD-free zone with vaccination of the country. The trade of those commodities between those two zones is banned in Argentina, just like Namibia. The analysis helped in evaluating the impact of relaxing such prohibition in the national regulation and the impact of illegal trade (Marcos & Perez, 2019).

Results suggested that the risk of introducing FMD into the FMD-free zone without vaccination through bone-in beef, sheep, goat, and pigs with certain requirements, such as serological testing, is most negligible. If legal trade was allowed, the incoming risk may even be lower, compared to the existing scenario of prohibiting its introduction. Consequently, results suggest that a policy of incentive and facilitation of good

practices may be more effective in preventing FMD introduction into a free zone than the prohibition of trade (Marcos & Perez, 2019).

2.6 The impasse between NVCF and SVCF farmers in shifting the VCF

Strategies employed to try to attempt to resolve the impasse between NVCF and SVCF farmers on removing or shifting VCF, comprised community consultation through stakeholders' workshops (Anon, 1993.; Forman, 1999; Norval & Walton, 2007; SIAPAC, 2000; MAWF, 2014; NNFU, 2019), and a national land conference (MAWF, 2018). There was also a change in focus to the initial suggestion which was to translocate the VCF to the border of Namibia and Angola (SIAPAC, 2000; MAWF, 2014). The current and most recent decision and focus has been to create a new FMD free zone further north of the low-risk blocks in the NCAs (NNFU, 2019).

The possibility of moving or removing the VCF has been a subject of consideration since Namibia's independence in 1990, but there has been no solution in sight to date (MAWF, 2014). Many studies (Anon, 1993.; Forman, 1999; Norval & Walton, 2007; SIAPAC, 2000; NNFU, 2019) have been carried out and four Cabinet decisions which all supported the idea of shifting VCF were made. However, divergent opinions regarding the state of VCF persisted (SIAPAC, 2000). Furthermore, the divergent opinions among stakeholders regarding FMD eradication measures and economic benefits versus the risks associated with an attempt to move the VCF was not only the cause of an impasse among groups and stakeholders in Namibia but was also worldwide issue. James and Rushton (2002) advocated the importance of FMD eradication approach, which included a gradual shifting of VCF until FMD was completely eradicated. In their study, Marcos and Perez (2019) also supported the

foregoing indicating that FMD related trade barriers could promote an impasse that could cause illegal beef trade amongst farmers in FMD infected zones and hence alternatives for trade had to be provided instead of the prohibition of trade in beef products.

2.7 Conceptual framework of the study

The study applied and utilised conceptual frameworks of CBA, which focus on net present value (NPV), internal rate of return (IRR), benefit - cost ratio (BCR) and payback period (PBP) (Ginés, 2010). A BCR greater than 1 shows that the benefits accruable in the project exceed the costs of coming up with the project. Interventions with higher BCR are preferred, and there is a strong presumption that interventions with BCR less than 1 should be rejected. The IRR rule states that if the IRR on a project or an investment is greater than the minimum required rate of return, typically the cost of capital, then the project or investment should be pursued (Jenkins & Harberger, 1992). The NPV principle states that positive and higher NPV is worthwhile to be pursued while lower NPV is undesirable. The negative NPV is to be rejected. A shorter payback period is preferred. However, Bruin (2011) argued that sometimes the evaluation of a project would not be in terms of cost and income but in terms of non-monetary value as well.

Belli, Anderson, Barnum, Dixon and Tan (1998) described CBA as the analysis appropriate for projects whose benefits are measurable in monetary terms and whose output has a market price that is relatively easy to assess. There is a vast array of projects whose benefits either do not have a readily accessible market price or are not easily measurable in monetary terms. If the benefits of the project are measured using

non-monetary unit, the NPV criterion for deciding whether a project can be financed cannot be used (Belli et al., 1998).

Table 2.1 adopted from Knight-Jonesa and Rushtonba (2013) provides a summary of CBA studies of FMD control and eradication programmes at global level. Table 2.1 indicates the names of countries involved, comments on the returns to control, type of analysis used for the study and author(s) for the study.

Table 2.1: Cost benefit analysis studies of FMD control and eradication programmes

Country	Returns to control	Analysis	Author
Australia	A 6-month outbreak would reduce GDP by 0.6%.	Simulation	Garner, Fisher and Murray (2002)
Bhutan	Positive when control focused on endemic areas, negative if unfocussed.	Data analysis	Tshering (1995)
Bolivia	Positive, but with a short intensive vaccination campaign in the endemic areas.	Data analysis	Pan American Foot-and-Mouth Disease Centre [PANAFTOSA] (1997)
Botswana	Positive with exports, negative without exports.	Data analysis	Oarabile (1994)
France	Rapidly regaining export market access is key, this is best achieved by stamping out	Simulation	Mahul and Durand (2000)
India	Positive due to the large returns in the milk sector.	Data analysis	Ellis and James (1976)
New Zealand	An outbreak could cost $NZ10 billion, with eradication by slaughter being preferable to vaccinate to live sector.	Simulation	Belton (2004)
Philippines	Benefit-cost ratio of 1.6–12 depending on level of exports.	Data analysis	Randolph et al. (2002)

Sudan	Positive with increased food security. Benefit-cost ratio of 11.5 with successful vaccination.	Data analysis	Barasa, Catley, Machuchu, Laqua, Puot, Tap Kot and Ikiror (2008)
Taiwan	Returns on eradication are large with costs of eradicating the 1997 outbreak estimated to be US$378.9 million, but with potential export losses of approx. US$1.2 billion.	Data analysis	Yang, Chu, Chung and Sung (1999)
UK	Vaccination may not be the most effective way of controlling an outbreak, however, speed of regaining export market access is not the only consideration.	Data analysis	Rushton, Taylor, Wilsmore, Shaw and James (2002)
USA	Vaccination based eradication provides the best return when the vaccine is effective.	Simulation	Bates, Carpenter and Thurmond (2003)
Uruguay	Control brings strong positive returns based on the access to export markets.	Data analysis	Leslie et al. (1997)

Southern Africa	Positive benefit, particularly for commercial farms, less so for the poor. Every dollar saved on control leads to $5 lost to the economy.	Data analysis	Perry et al. (2003); Randolph, Morrison and Poulton (2005)

Source: Adopted from Knight-Jonesa and Rushtonba (2013)

Although there were limited CBA studies on the FMD free zone in Namibia, FMD CBA studies in Namibia include those of livelihood CBA (International Federation of Red Cross and Red Crescent Societies [IFRC], (2016); and rangeland management and livestock management (Humavindu, Barnes, Nott, de Klerk & Kruger, 2011). A CBA study by IFRC (2016) in the Zambezi region analysed livelihood preparedness interventions and was funded through the Zambezi River Basin Initiative (ZRBI). In their findings, a BCR of 3.7 was achieved for the period 2009 to 2014. This demonstrated a positive net impact and economic return on resources invested in the ZRBI for Namibia. The findings also showed that the project created job opportunities and improved food security and livelihoods. This demonstrated a positive net impact and economic return on invested resources. Humavindu et al. (2011) ten years CBA investment models of beef cattle production in the Savanna areas indicated that the introduction of sound range management practices, incorporating the National Rangeland Management Policy and Strategy (NRMPS) principles, increase the average carrying capacity for stock and is expected to be financially profitable and economically efficient.

Furthermore, five community wildlife conservation and utilisation initiatives, or conservancies, established on communal lands in Namibia were analysed using CBA (Barnes, MacGregor & Weaver, 2001). The conservancies were found to be economically efficient and able to contribute positively to national income and the development processes. The initiatives also provided a channel for attracting donor grants (wildlife non-use values) as income and generate very attractive financial returns for communities (Barnes et al., 2001).

In a related study, Barnes and Humavindu (2003) analysed the economics of the primary land uses possible in the area occupied by the Gondwana Cañon Park in Karas Region, Namibia. The study discovered three types of land use: traditional small-scale livestock production, large-scale commercial livestock production and nature-based tourism. These were analysed using financial and economic budget/cost-benefit models. Empirical data on the physical and financial characteristics of potential land uses was assembled and analysed. Their findings indicated that by far tourism contributed most of the profits, community income, economic growth, and employment, and should be the preferred type of land use. The lower economic and financial returns associated with the small-scale livestock system make it the least desirable system from a development point of view.

2.8 Chapter summary

The reviewed literature and theoretical foundation presented a broad literature review on the economic impact of creating a new FMD free zone. The literature review showed that the benefits of creating a new FMD free zone was not only in the form of monetary benefits but also came in other forms such as food security (e.g., milk, meat, and draft power) and employment creation. Most of the literature pointed out that if FMD eradication was feasible, it was the least-costly option than the option of vaccination, hence creating a new FMD free zone falls under FMD eradication control measures rather than a vaccination programme.

Furthermore, literature provided a conceptual framework that was used for this study. The literature review covered cost-benefit analysis (CBA) as the main conceptual framework that guided the analysis of data in this study. Despite the potential positive

economic impact for creating a new FMD free zone, the literature review showed the risk associated with shifting the VCF if not done properly (Otte et al., 2004). In addition, the literature review indicated lack markets for livestock and beef products in the Northern Communal Areas (NCAs) of Namibia due FMD status.

Although aspects of economic impact for creating a FMD free zone were included in some of the previous VCF studies in Namibia (MBN, 2019; NNFU 2019), the quantification of the results, in terms of economic impact of creating new FMD free zone in the central north of Namibia were marginal. Previous studies in Namibia and promoters for creating a new FMD free zone cited the potential economic impact of creating a new FMD free zone in their statements and proposals, yet there was no detailed study conducted to validate the claims they made. Therefore, there was a gap in knowledge which needed to be filled, and perhaps find solutions to the impasse between the farmers in the FMD free zone, and those in the FMD infested zone. Lack of scientific evidence resulted in interested parties not agreeing on the way forward regarding creating a new FMD free zone in the NCA. However, the divergent opinions among stakeholders regarding the FMD eradication measures versus the risks associated with attempts to do what they thought was right and beneficial to the farmers and ultimately to the national GDP, were not the only factors at play which caused the impasse among groups and stakeholders in Namibia. Literature indicates that it is a worldwide issue as well as a political issue.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter starts by briefly describing the study area since this study was based on a defined and demarcated area upon which all the analysis was based. The chapter further describes the proposed FMD free zone project as per the government of Namibia (MAWLR) information for a better understanding of the costs associated with the study. The chapter then presents the research design, research philosophy, and research approach, strategy, and data collection methods used including the theoretical framework of statistical analyses. The latter includes applied software, models, statistical test packages and the conceptual models used for data analysis. This demonstrates that chapter three provides the methodology and theoretical framework used as it also dwelt on the ethical aspects considered in this study.

3.2 Area of study

This study focused on an identified and demarcated area within the FMD protection zone in the central north of Namibia, mainly the areas covering small scale farms in parts of the Kavango East, the Kavango West, the Oshikoto and Ohangwena regions. Facilitated by the MAWLR, the specific study area was identified by stakeholders through consultation. As part of the land conference resolutions, MAWLR was tasked with creating compartments and/or zones in the NCA in order to contribute to addressing livestock and meat products marketing challenges. It is the intention of MAWLR to create zones in these areas, but to the knowledge of the researcher, no study has been conducted before regarding the economic viability of the proposed project. According to the MAWLR, the targeted parts of the regions have a lower FMD risk and

have significant economic potential due to many commercial farms in those areas. The Government of the Republic of Namibia has demarcated farms in commercial units and provided lease holds to farm owners and facilitated access to financial support from financiers (MF, 2019a).

Namibia's VCF is approximately 1,271,264 km running across the country from east to west dividing the country almost in the middle (MF, 2019b). The target specific area for the proposed project and the area of this study is about 949km. It covers a total area of 3,047,954 hectares. The study area is characterised by sandy soils falling in the geological division of the Kalahari group of Namibia (Mendelsohn & El Obeid, 2005) and the area lies within the tree savanna and dry woodlands (Mendelsohn & El Obeid, 2005). The study area is predominantly cattle ranch farming by small scale commercial farmers, with sporadic crop cultivation adjacent to homesteads or specific parts of the farm.

Figure 3.1 shows the proposed new FMD free zone in a blue line north of the existing VCF (redline). The small map in the left-hand bottom of Figure 3.1 shows the full map of Namibia and the position of the existing VCF and the proposed new FMD free zone in a blue line.

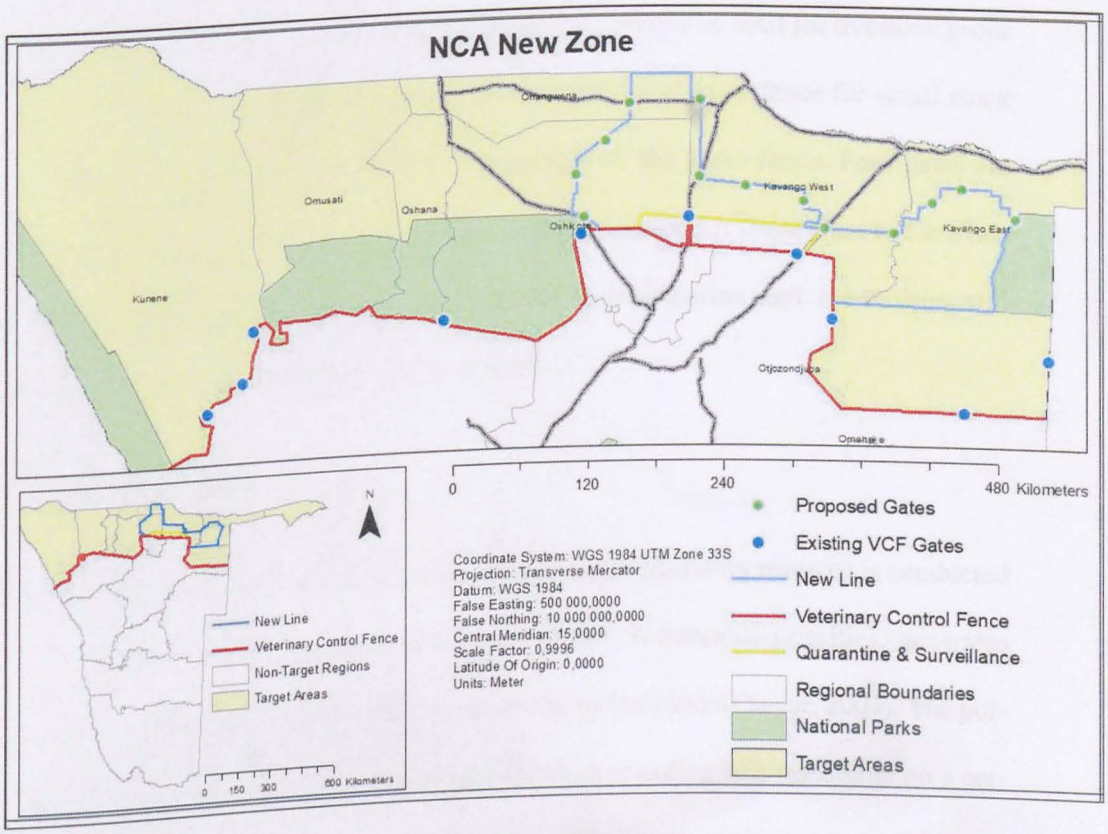

Figure 3.1: Map showing the study area

Source: MF (2019b)

3.3 Project description

As per the MAWF (2019) description, the creation of a new FMD free zone in the NCA would follow the international standard of constructing the fence and clearing the status to be approved by OIE and qualify for the international markets. The methodology and materials to be utilised were the same as those used in the current FMD free zone in the southern parts of the country. The demarcated area for the proposed new FMD free zone would be fenced off with two fence-lines (double fencing) running parallel, 10m apart from each other. One line would be for game proof while the second one would be livestock proof. The game proof fence would be outside and 2.4m high, while the livestock proof fence would be inside and 1.5m high. Winch wire

would be used for the game proof fence. Steel wires would be used for livestock proof fence, while mesh wire would be used for both game and stock fence for small stock prevention. The use of electric fence is proposed for the game fence. Four gates are proposed for the project. It is proposed for both inner and outer fence-lines to have two trail roads inside and outside for easy inspection by veterinarian staff. De-bushing will be required for both fence lines and trail roads.

3.4 Research design

This study adopted the explanatory research design. Explanatory research is conducted for a problem that was not well researched before, it demands priorities, generates operational definitions and provides a better-researched model (Sayer, 2003). The purpose of explanatory research is to increase the understanding of a researcher on a certain subject (Winch, 2008). It does not provide conclusive results because of the lack of its statistical strength, but it makes the researcher determine how and why things happen (Reiter, 2017). Explanatory research design has an advantage regarding the flexibility of sources. Robert (2011) states that secondary sources, such as published literature or data, are commonly used in the explanatory type of research. Care ought to be taken to choose a scope of fair-minded sources to give a wide and balanced comprehension of the subject.

The researcher opted for the explanatory research design because the study sought to have a detailed understanding of the phenomenon under study. Although aspects of economic impact for creating a FMD free zone were included in some of the previous VCF studies in Namibia (MBN, 2019; NNFU 2019), the quantification of the results, in terms of economic impact of creating a new FMD free zone in the central north of

Namibia were marginal. Previous studies in Namibia and promoters (MAWF and NVCF farmers) for creating a new FMD free zone cited the potential economic impact of creating a new FMD free zone in their statements and proposals, yet there was no detailed study conducted to validate the claims they made. As stated by Winch (2008), the purpose of explanatory research design is to increase the understanding of a researcher on a certain subject. Lack of scientific evidence regarding the economic impact of creating a new FMD free zone contributed to interested parties not agreeing on the way forward.

The explanatory research design has advantages and disadvantages. Although the design does not aim to draw definitive conclusions due to lack of statistical strengths, the explanatory research design allows the researcher to explain the research with a varying level of depth and helps in understanding the problem more clearly and provide better conclusions (Shields & Rangarjan, 2013). Moreover, an explanatory research design is well suited for this study as it allows the use of secondary data, which was the case for this study.

3.5 Research philosophy

Research philosophy outlines the beliefs and values that guide choice of the research design, data collection methods and methods of analysis of data (Howell, 2013). The three commonly known philosophical paradigms in research are positivism, interpretivism and critical theory. The chosen paradigm should guide research methods and analysis (Ryan, 2018). Since this is a scientific study using quantitative methods, a positivist philosophy was deemed suitable hence it was chosen and used. Positivism adheres to the view that only factual knowledge gained through data collection and

measurement, is trustworthy (Dudovskiy, 2019). In positivism studies the role of the researcher is limited to data collection and interpretation in an objective way. In these types of studies, research findings are usually observable and quantifiable.

The above description is supported by Macionis and Gerber (n.d) who stated that positivism is the term used to describe an approach to the study of society that relies specifically on scientific evidence, such as experiments and statistics, to reveal the true nature of how society operates. Positivism often involves the use of existing theory to develop hypotheses to be tested during the research process. The theory asserts that all authentic knowledge allows verification, and that all authentic knowledge assumes that the only valid knowledge is scientific (Jorge, 1979). Commonly associated with experiments and quantitative research, positivism is considered a form of progression of empiricism which is adhered to in this study (Phillips & Burbles, 2000). Bryman (2008) further suggested four key characteristics of positivism:

- Phenomenalism - only knowledge confirmed by the sciences can genuinely be warranted as knowledge.
- Deductivism - the purpose of theory is to generate hypotheses that can be tested for laws to be proven or disproven.
- Objectivity - science must be conducted in a way that is value free; and
- Inductivism - knowledge is gained through gathering of facts that provide the basis for laws (Phillips & Burbles, 2000; Bryan, 2008).

Therefore, positivism description and these four characteristics are well suited for this study, hence, they were incorporated in this study and used to justify the use of positivism as a research philosophy for the study (Bryan, 2008).

3.6 Research approach

There are two main types of reasoning (research approaches), namely: inductive and deductive (Ryan, 2018). The inductive approach starts with observation, experimentation and measures, generalisation and finding patterns in the data and then theory development to describe the situation (Bryman, 2008). This process would consist of making repeated measures and observations until the researcher is confident that the findings describe the wider situation, or the problem being researched on.

Deductive reasoning follows the reverse process, finds a theory, makes predictions (hypotheses) based on this and then observes, experiments and measures to prove or disprove the hypotheses (Bryman, 2008). Furthermore, Crowther and Lancaster (2008) argue that as a rule, positivist studies usually adopt the deductive approach, whereas inductive research approach is usually associated with the phenomenology philosophy. Therefore, the deductive approach was chosen for this study as the study aimed to confirm or reject the stated hypotheses. As suggested by Crowther and Lancaster (2008) the deductive approach is associated with positivism, which is the philosophy adopted for this study.

3.7 Research strategy

The study focused on desktop research as a strategy by collecting existing information (secondary data) and comprehensive literature reviews. There are several research strategies that could be applied in empirical investigations and they include experiments, ethnographic studies, observation, and surveys (McCaston, 1998). However,

since most of the required data for this study was already existing within various organisations, collecting primary data would have longitudinal effects for this study. Secondary data was considered well suited for this study.

Desktop review is one of the fastest and least expensive means to confirm or reject hypotheses and provides information about the subject being studied (Louis & Antonio, 2007). There is an enormous amount of information available on the internet and libraries for this purpose. The literature search may include magazines, newspapers, trade literature, and academic literature. Secondary sources of data such as published literature or databases, are commonly used in the explanatory type of research and this research was no exception (McCaston, 1998).

Despite the advantages of desktop research indicated above, care ought to be taken to choose a scope of fair-minded sources to give a wide and balanced comprehension of the subject under study (Winch, 2008). Furthermore, secondary data is often not presented in a form that exactly meets the researcher's needs. The published data may not always be reliable and exactly as per the needs of the study undertaken. The researcher had to make careful scrutiny of the data before using it. Some of the secondary data collected seemed general and vague and would not really help the researcher to make conclusive findings of the study hence the source of the data was checked for reputation and authenticity (Winch, 2008).

Some of the secondary data was old and outdated hence data had to be carefully searched, identified, and arranged to get complete data as required. Outdated information may offer little value if not corrected, especially in a research area with a fast-

changing environment or market. Any missing piece of data had to be replaced with similar data from other qualified sources. It required a lot of effort, patience, extreme care and skill by the student to dig out useful information (Winch, 2008).

3.8 Research method choice

The research considered and opted for the quantitative method as suitable for the study. This is so because quantitative information was available and suitable for data analysis in this study. Few experts as key informants were engaged for their inputs, but his was mainly to validate assumptions and some data. The data analysis and results for this study relied on numerical data that was collected from the secondary sources. Quantitative evaluation seeks to understand a given research problem or topic from the perspective of the local population it involves. It is particularly effective in obtaining culturally specific information about the values, opinions, behaviours and social contexts of specific populations (Dentz, 2014).

Quantitative evaluation usually has a standard set of questions in a specific order and the assessor does not deviate from the survey or ask for detailed explanations of a topic. In order to produce different types of data, qualitative and quantitative research tend to employ different methods. To help describe the quantitative method, Garbarino and Holland (2009) distinguished quantitative research as producing data in the form of numbers while qualitative research tends to produce data that is stated in prose or textual forms. Many researchers explain quantitative evaluation by comparing it to qualitative evaluation as indicated in Table 3.1 and 3.2 (Dentz, 2014; Center for Civic Partnerships, 2014; Johnson & Christensen, 2008; Lichtman, 2006; Kanbur, 2003; Hentschel,1999).

Table 3.1: Differentiation between quantitative and qualitative techniques

Quantitative Techniques	Qualitative Techniques
– Surveys/Questionnaires	– Observations
– Pre/post Tests	– Interviews
– Existing Databases	– Focus Groups
– Statistical Analysis	– Non-statistical (methods vary)

Source: Adopted from Dentz (2014)

In general, evaluators (Johnson & Christensen, 2008; Lichtman, 2006; Kanbur, 2003; Hentschel, 1999) agreed that qualitative and quantitative methods and data have different strengths, weaknesses and requirements that affect decisions about which methodologies are appropriate for which purposes. Below are some strengths and limitations of quantitative methods and data.

Table 3.2: Strengths and limitations of quantitative methods and data

Strengths	Limitation
– Findings can be generalised if selection process is well-designed and sample is representative of study population. – Relatively easy to analyse. – Data can be very consistent, precise and reliable. – Data collection is usually cost efficient	– Related secondary data sometimes not available, or accessing available data is difficult/impossible. – Difficult to understand context or programme activities. – Data may not be robust enough to explain complex issues

Source: Adopted from Johnson and Christensen (2008)

In addition to the above comparison, quantitative methods produce data that can be aggregated and analysed to describe and predict relationships while qualitative research can help to probe and explain those relationships and to explain contextual differences in the quality of those relationships. Garbarino and Holland (2009) strongly associate qualitative research within non-economic social science disciplines, while quantitative research has an economics leaning. Since this study focused on economics leaning and dealt with numerical instead of descriptive data, quantitative methods were deemed suitable for the study.

3.9 Data collection procedure

Procedures on secondary data collection as suggested by Kabir (2016) and Johnston (2014) were followed. Secondary data from agricultural government mandated institutions (Directorate of Agriculture Production, Extension and Engineering Services (DAPEES) and Directorate of Veterinary Service), government agencies (Namibia Statistic Agency [NSA], Meat Board of Namibia [MBN] and Meatco) and private sector institutions' such as libraries and websites for University of Namibia (UNAM) and Namibia University of Science and Technology (NUST) were collected by visiting the premises and searching on internet in libraries and databases of respective institutions (Andrews, Higgins, Andrews & Lalor, 2012).

In some instances, the use of letters, emails and conversations was made to request secondary data from the identified organisations listed above. Some inputs and data such as assumptions for computation of CBA were gathered from a few individuals (experts) who were conveniently and purposefully sampled as key informants (Clarke

& Cossette, 2000). The internet was utilised to access some information such as that related to the World Organisation for Animal Health (OIE) specification and requirements such as double fencing, height of the fence and material types (Dale, Arbor & Procter, 1988; Glaser, 1963). The data collection took 60 working days to complete.

3.10 Data procedure and analysis

3.10.1 Procedures, inputs, and assumptions for data analysis

Variables measured for this study were BCR, NPV, IRR; and PBP, cattle prices, and revenue. These were divided into two components namely, CBA which covered BCR, NPV, IRR and PBP, while the second component was on cattle prices and revenue. The inputs, assumptions and data analysis per component are presented below.

a) Number of cattle in the study area

The number of cattle in the study area as provided by MAWF data (MAWF, 2020) was 177,500 by 2020. The over 30-year-old data shows that cattle numbers grew by 3% on average in Namibia. The data further showed that an average carrying capacity for the proposed FMD free zone was 10 hectares (ha) per LSU. The total area size for the proposed new FMD free zone was 3 047 955 ha (MAWF, 2020). However, the available rangeland for cattle within the proposed new FMD free zone area was estimated to be 2,227,119 ha. The other area within the proposed new FMD free zone is for roads, settlements, and few crop fields. Therefore, the maximum total number of cattle to be accommodated per annum was 222,712 (2,227,119 ha available rangeland and 10 ha carrying capacity). This showed that the area could accommodate 222,712 cattle but was only having 177,500 cattle. Farmers in the proposed area had less cattle than the land could accommodate due to lack of available beef markets in the NVCF. The farmers kept the production in line with what a market can absorb. It was assumed

that farmers would increase their cattle stocks to the full carrying capacity of the land if markets were available as a result of FMD free zone status establishment.

Since an average increase for cattle per annum was 3%, it was assumed that the cattle population in year 1 of the project would increase by 2% since the market would be established and available. The population would increase by 3% in year 2 to year 7 before decreasing to 2% increase in year 8 and 1% in year 9, reaching the maximum carrying capacity of their land of 222,712 cattle. Thereafter, the farmers would not increase the numbers of cattle but rather maintain the 222,712 cattle maximum thresh-old. Farmers would by then apply commercial farming principles and know that by exceeding the maximum carrying capacity numbers, would damage their rangeland and consequently, their farming business prospects. The above assumption is in line with Tietenberg and Lewis (2009) guidelines in formulating assumptions related CBA of livestock projects.

b) Offtake percentage

An average offtake percentage was used to determine the number of cattle to be sold yearly. Literature has information on the determination of the marketable cattle percent based on offtake rates method (Zimmermann, 2016; Negassa & Jabbar, 2008; Enkono, Kalundu & Thomas, 2013). As per inputs from Meat Board representatives in the NCA, Livestock Marketing Cooperatives in the NCA and Meatco representatives in the NCA, it was estimated that the current small-scale commercial farms under the proposed FMD free zone had an average of 15% annual offtake. It was assumed that the offtake percent would increase if lucrative cattle and beef products markets were created in the newly proposed FMD free zone. It was also assumed that an average

offtake percent would increase from 15% in year 1, to 25% in year 5 depending on the level of success achieved with the new FMD free zone. The 25% offtake would remain constant going forward. This was based on the benchmark showing that an average offtake percentage in the FMD free zone in the southern parts of Namibia was about 25% (MBN, 2019). Given that the target project area in the NCA was already farming in a semi-commercial way, establishing better markets by creating FMD free zone would incentivize farmers to increase their offtake by 25% in 5 years similar to farms in the SVCF. As per the above data, the 15% offtake for year 1 would be 26,625 cattle (15% × 177,500) while 25% the offtake for year 5 and onwards would be 55,678 cattle (25% × 222712) (MBN, 2019; Zimmermann, 2016; Kalundu & Thomas, 2013).

c) Cattle weight

The average cattle weight used was 400kg. This was based on data from Meatco, which has shown that cattle bought from the proposed new FMD free zone, were 400kg on average (Meatco, 2020). In addition, this is the recommended conservative Namibia national average commercial weight per cattle (Stehn, 2007).

d) Cattle price and income for the project

As indicated under delimitation, the income used for economic analysis of this study was limited to the direct income from selling cattle, but not their products such as milks and hides. The 10-year series data on prices per kg for live cattle was obtained from Meatco and Livestock Marketing Cooperatives (LMCs) operating in the FMD protection zone in the NCA. The prices from the SVCF FMD free zone were obtained from Meatco and Meat Board. The calculations showed that the price from FMD protection zone on average increased by 8% while those from the SVCF FMD free zone increased

by 11%. The information on average increase for prices was used to determine the increase projection into the future for both FMD protection zone and FMD free zone (Tietenberg & Lewis, 2009).

e) Project capital investment

The proposed project initial investment cost was based on proposed budget by the MAWF for the proposed zone. The cost included the construction cost of the veterinary cordon fence including roads and houses for staff while maintenance cost included inspection and fixing of the damaged fence. Since the budget was very high, it was assumed the government alone would not be able cover the total costs. Therefore, two options were offered. The first option was for the government to obtain a loan for the whole capital investment of the project including the maintenance costs. The repayments of the loan were to be levied from the farmers. The second option was for the cost to be shared among government (50%), donors (20%) and then obtain loan for 30% that would be repaid by farmers through a levy.

f) Repayment arrangements

The repayment of the loan obtained from a financing institution was to be borne by farmers through an introduced levy specifically for that purpose. A Special Purpose Vehicle (SPV) was to be formed to manage the fund. This is similar to FMD CBA study in Tanzania which proposed and recommended public private partnerships for Livestock Identification and Traceability System (LITS) as the bases for FMD control and suggested to refine the logistically element of it (Hasler et al., 2017). In the case for this study, farmers stationed in the new FMD free zone would be beneficiaries for the project. As per data from Meatco, LMCs and MBN, farmers would be required to

pay a levy of between N$1.00 and N$3.00 per kg for any cattle sold from the new FMD free zone.

g) Project projections period

Projections period for the project was 20 years. The initial target projection was ten years but was not found viable, hence was extended to 20 years. The analysis for CBA was done for 10, 15, and 20 years, respectively.

h) Inflation and interest rates

It is assumed that the inflation rate would be 6%. The CBA was tested at 4%; 6%; and 8% interest (Namibia Marco-economic Outlook, 2020) so as to check at which interest rate would be gainful to the stakeholders.

3.10.2 Analysis of data

The data were entered and analyzed quantitatively using Excel spreadsheets (Microsoft Corporation, 2019) and SPSS Version 26 to perform statistical analyses and produce graphs. The CBA data was analyzed using Excel spreadsheets (Microsoft Corporation, 2019) while price and revenue data was analyzed using both Excel (graphs and tables) and SPSS Version 26 (statistical tests). The formulae for computation and analyzing per variable is provided below.

a) Net Present Value (NPV)

The NPV method is the best CBA method to utilise because the NPV affords importance to the time value of money; and determines how much cash flow would flow in as a result of the investment and compares that against the cash that would flow out

in order to make the investment (Ondrej, 2014; Ginés, 2010). Although the analysis was conducted using the excel program, the computations, and the formula for the NPV was as follows:

$$\textbf{NPV:}-\textbf{Cost}+\frac{\textbf{Year 1 Value}}{\left(1+\frac{r}{100}\right)}+\frac{\textbf{Year 2 Value}}{\left(1+\frac{r}{100}\right)^{2}}+\cdots\ldots+\frac{\textbf{Year n Value}}{\left(1+\frac{r}{100}\right)^{n}}$$

b) Payback period

Payback period is the time period it requires to reach the break-even point of an investment based on cash flow (Calvin, Walter & Stephen, 2006). This is the point at which positive cash flows and negative cash flows equal each other, resulting in zero. As a rule of the thumb, the shorter the payback period, the better. Any investments with longer payback periods are generally not enticing because they tend to be less accurate and not attractive to investors (Ardalan, 2012;). The payback period is expressed in years and fractions of years. It is important to note that the Payback period does not account for the time value of money, which is a theory that states that money received today is worth more than money received tomorrow. As a result, the payback period is best used in conjunction with other metrics (Jonathan, DeMarzo & Harford, 2012; Brealey, Myers & Marcus, 2012). Therefore, the following formula was used:

$$\textbf{Payback Period} = \frac{\text{Initial investment}}{\text{Cash flow per year}}$$

c) Internal Rate of Return (IRR)

IRR is the interest rate at which the NPV of all the cash flows from a project or investment that is equal to zero (Carlo, 2011). In other words, it is the expected compound

annual rate of return that will be earned on a project or investment. It is a rate of return used in capital budgeting to measure and compare the profitability of investments. It is also called the discounted cash flow rate of return (DCFROR) or the rate of return (ROR) (Hartman & Schafrick, 2004). The IRR on an investment or project is the "annualized effective compounded return rate" or "rate of return" that makes the net present value (NPV as NET*1/ (1+IRR) ^year) of all cash flows from a particular investment equal to zero (Athanasios, n.d.). IRR formula as per (Lin, 1976) was used for this study as follows:

$$\textbf{IRR}= \text{Net PV of Cost} = \frac{\text{Year 1 Value}}{(1+r)} + \frac{\text{Year 2 Value}}{(1+r)^2} + \cdots \ldots + \frac{\text{Year n Value}}{(1+r)^n}$$

d) Benefit-Cost Ratio (BCR)

A benefit-cost ratio (BCR) is a ratio used in a cost-benefit analysis to summarize the overall relationship between the relative costs and benefits of a proposed project (Boardman, Greenberg, Vining & Weimer, 1996). BCR can be expressed in monetary or qualitative terms. If a project has a BCR greater than 1.0, the project is expected to deliver a positive NPV to a firm and its investors (Shively, 2012).

As stated by Tietenberg and Lewis (2009), the BCR is calculated by dividing the proposed total cash benefit of a project by the proposed total cash cost of the project. Prior to dividing the numbers, the NPV of the respective cash flows over the proposed lifetime of the project, taking into account the terminal values, including salvage costs, are calculated. For this study, the BCR was calculated by dividing NPV of income with NPV cost (Tietenberg & Lewis, 2009).

e) Price and revenue

The prices "with" and "without" the project scenarios were compared. The "with" the project scenario refers to the new FMD free zone while "without" the project refers to maintaining of FMD protection zone. Using past trends, the future prices for "with" and "without" project scenarios were compared, both by projecting and comparing annual trends and overall mean for the two scenarios (Brigham & Ehrhardt, 2011).

Revenue was also analysed by comparing "with" and "without" the project scenarios. For both scenarios ("with" and "without" the project) the revenue to the farmers was determined by multiplying an average annual marketable cattle number with (offtake percent) an average weight of a cattle multiplied by an average price per kg (Negassa & Jabbar, 2008; Enkono et al., 2013). The formulae for calculating revenue is provided below:

Revenue = Average annual marketable cattle number × Average weight of a cattle × Average price per kg

A t-test was performed to determine the statistical difference of both price and revenue by comparing "with" and "without" the project scenarios. A t-test is generally used for comparing the means of two independent samples (Rochon, Gondan & Kieser, 2012). Under the null hypothesis, a t-test assumes that the two samples arise from the same normally distributed population with unknown variance. Adequate control of the Type I error requires that the normality assumption holds, which is often examined by means of a preliminary Shapiro-Wilk test. The following two-stage procedure is widely accepted. If the preliminary test for normality is not significant, a t-test is used; and if

the preliminary test rejects the null hypothesis of normality, a nonparametric test is applied in the main analysis (Rochon et al., 2012).

For this study, the normality of the data was checked with histograms and boxplots confirmed by Shapiro-Wilk test using IBM SPSS statistic 26 package. The data were found to be normally distributed with P-values less than 0.05. A t-test was then performed to determine significant difference between the means (Rochon et al., 2012).

3.11 Research ethics

A letter granting permission to conduct research on this topic was obtained from the Namibia Business School (NBS). Individual experts that provided data and inputs were guaranteed the respect of anonymity and given the freedom to withdraw from the study as they were asked to participate in the study on their volition. The data gathered was used for academic purposes only, and this was emphasised to the participants. The MAWLR was informed about the intent to conduct this study and that the thesis was to be shared with the organisation.

3.12 Chapter summary

This chapter provided the detailed methodology utilised for the study including relevant information such as the study area and proposed project activities by the government of Namibia. It presented the research design, research philosophy, and research approach, strategy, and data collection methods used. The latter includes applied software, models, statistical test packages and the conceptual models used for data analysis. In other words, chapter three provided the methodology and theoretical

framework used as it also dwelt on the ethical aspects considered in this study. The chapter provided procedures, inputs, and assumptions for data analysis, and the formula used in analysing each variable of the study. It ended with a description of research ethics followed for the study.

CHAPTER 4: RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presented and discussed the results of the study. The presentation of the results was divided into two components, namely: the results cost-benefit analysis (CBA), and the analysis of cattle prices, and revenue. The first component on CBA addresses objective one, while the second component on price and revenue addresses objective two. Each component first presents the results and interpretation thereof, including discussion. The results are presented in graphs and statistical test outcomes. After results presentation, the chapter provides a detail discussion section. Both under results and discussion sections, the results are discussed and compared to the findings in the literature review, to confirm whether there was corroboration between what previous researchers discovered and the findings of this study. In addition to this, after the analysis and the discussion of the results, the researcher provides confirmation on whether each of the objectives of the study was achieved or not. The chapter ends with a chapter summary providing a snapshot of the chapter review and outcomes.

4.2. The display and arrangement of CBA results

As described in the methodology section, two funding options were pursued. The first funding option was for the government to obtain a loan from the bank for the total capital investment of the project including the maintenance costs that would be repaid by the farmers through a levy per cattle sold in the project area. The second funding option was for the costs to be shared among the stakeholders such as the government (50%), the donor (20%) and obtain loan (30%) that would be repaid by the farmers

through a levy. The variables measured for CBA were BCR, NPV, IRR, and PBP. The analysis for both options was done for 10, 15, and 20 years respectively. The levy per kg per cattle was tested on N$1.00, N$2.00, and N$3.00 respectively. Similarly, the CBA variables were calculated at different interest rates (4%, 6%, and 8%) based on inflation rate in Namibia at the time when the study was conducted (Namibia Macro-economic outlook, 2020). Therefore, the results for the two funding options are presented below. The first funding option is presented under section 4.3.1 on the CBA for the full amount of capital investment to be repaid by farmers, and the second funding option is presented under 4.3.2 on the CBA option for capital investment to be covered by government (50%), donors (20%) and farmers (30%).

Table 4.1 and 4.2 illustrates the outcomes of the NPV, the BCR and the IRR for the two funding options. The first column for both Tables (4.1 & 4.2) on the left shows the outcomes of the NPV, the BCR and the IRR at NAD1.00, the second and middle columns shows the outcomes of the NPV, the BCR and the IRR at NAD2.00 while the last column on the right shows the outcomes of the NPV, the BCR, and the IRR at NAD3.00. The first row shows the outcomes of NPV, BCR and IRR at 10 years, the second and middle row shows the outcomes at 15 years, while the last row on the bottom shows the outcomes at 20 years.

2.3 Cost -Benefit Analysis (CBA) results

4.3.1. CBA for the full amount of capital investment to be repaid by farmers

The results for the first funding option show that BCR was less 1 at NAD1.00 and NAD2.00 for all three interest rates except an option of levying farmers based on NAD3.00 at the 4% interest rate over 20 years, which showed a positive BCR of 1.12

as shown in bold under Table 4.1. The BCR greater than 1 shows that the benefits exceed the costs of implementing the project (Tietenberg & Lewis, 2009). Interventions with higher BCR are preferred, and there is a strong claim that interventions with BCR less than 1 should be rejected (Boardman et al., 1996; Cohn, 1972; Gittinger, 1982). This implies that every NAD1.00 invested in creating a new FMD free zone results in a gain of N$ 1.12 at 4% interest rate (Tietenberg & Lewis, 2009), but this is only achievable in 20 years and afterwards. However, other options showed negative results for BCR, for example, an option of levying farmers NAD1.00 at 6% interest over 10 years will result in a loss of N$ 0.18 for every NAD1.00 spent for the project.

Furthermore, the results for the first funding option showed that NPV was negative at NAD1.00 and NAD2.00 for all three interest rates except one option of levying farmers NAD3.00 at 4% interest over 20 years, which was positive with an output of NAD 83,773,538.49 (Table 4.1). Other options showed negative results, such as an option of levying farmers NAD1.00 at 6% interest over 10 years results in a loss of NAD 525,279,392.65. The NPV principle states that positive and high NPV is worthwhile to be pursued while lower NPV is undesirable. Therefore, the negative NPV needs to be rejected (Jenkins & Harberger, 1992). The repayment of the NAD1.00 levy by farmers at the three different interest rates over the three-category period (10;15;20 years respectively) generated a negative IRR. With the NAD2.00 repayment, the IRR was positive over 20 years. The NAD3.00 generated positive IRR for 15 and 20 years. However, these positive IRRs were small with the highest one being 5% at 20 years. The IRR rule states that if the IRR on a project or an investment is greater than the minimum required rate of return, typically the cost of capital, then the project or

investment should be pursued (Jenkins & Harberger, 1992). Since this project was for developmental purposes and not for profit making, the inputs from experts and proponents of the project suggested 10% as the minimum required rate of return. Therefore, the results of the first funding option show the IRR was not viable as all options had a rate of return less than 10%. In general, the results of the first funding option show that the CBA for full costs of creating an FMD free zone outweighs the benefits accruable if the repayments range between NAD1.00 to NAD3.00 at the interest rate of 6%; and 8% over a period of 20 years or less.

The results for this first funding option show that farmers would not be able to repay the full initial capital investment of the project and needed assistance from the government and donors. BCR was less than 1 at NAD1.00 and NAD2.00, NPV at NAD1.00 and NAD2.00 were negative (Table 4.1). Although one of the options of levying farmers NAD3.00 at 4% interest over 20 years showed positive results for CBA variables, the expectation for farmers to repay NAD3.00 per kg per cattle seem unrealistic, given that some farmers entirely depend on cattle for their livelihoods, and they were hard hit by the drought which almost wiped their entire herds of cattle (MAWF, 2020). Furthermore, it will not be easy to get financiers offering loans at a lower interest rate of 4% as investors prefer higher interest rate (Anat, 2016). This is confirmed by Anat (2016), and Holt and Laury (2002)'s indication that investors prefer higher interest rate. In addition, the current situation is unattractive to investors until the impasse between NVCF and SVCF is resolved (Conradie & Damaseb, 2013).

The first funding option demonstrates that creation of a new FMD free zone whose loan is to be repaid entirely by farmers would be a big challenge. Unless farmers are

prepared to pay more than NAD3.00 per kg per cattle, the project cannot repay the full amount of the investment in the given time it is to be repaid. This is confirmed by the literature review, which indicates that the creation of FMD free zone is expensive and that it would require government intervention to be a success (Knight-Jonesa & Rushtonba, 2013).

The first sub-objective for this study was to carry out CBA of creating FMD free zone in the central north of Namibia. The result for this first funding option partly addressed objective one indicating that CBA for creating new FMD free zone was not viable if the full initial capital investment is to be repaid by farmers alone without contribution by other stakeholders such as government and donors. This is confirmed by the results shown in Table 4.1 and as described above, which shows negative NPV and IRR lower than 10% while BCR less than 1 if the repayment by farmers at NAD1.00 and NAD2.00. Therefore, it is best to maintain FMD protection zone status if the government and other stakeholders are not willing to core finance the creation of new FMD free zone.

Table 4.1: The outcomes of NPV, BCR and IRR for full capital investment from loan to be repaid by farmers

	NAD 1.00			NAD 2.00			NAD 3.00		
10 years									
	8%	6%	4%	8%	6%	4%	8%	6%	4%
NPV	-523120256.8	-525279392.6	-525801480	-420010532.9	-407926345.2	-391607532.5	-316900809	-290573297.8	-257413584
BCR	0.16	0.18	0.20	0.33	0.37	0.41	0.49	0.55	0.(
IRR	-19%			-10%			-4%		
15 years									
	8%	6%	4%	8%	6%	4%	8%	6%	4
NPV	-488503666.5	-480421467.7	-467342811.6	-347256647.7	-313648188.8	-268744615.9	-206009629	-146874909.9	-70146420.
BCR	0.22	0.26	0.30	0.45	0.52	0.60	0.67	0.77	0.
IRR	-10%			-2%			3%		
20 years									
	8%	6%	4%	8%	6%	4%	8%	6%	
NPV	-464944196.8	-446901016.7	-419294047.4	-297741576	-243198065.9	-167760254.4	-130538955.2	-39495115.05	-8377353
BCR	0.26	0.31	0.37	0.53	0.63	0.75	0.79	0.94	1
IRR	-5%			1%			5%		

4.3.2. CBA option for capital investment to be shared among the government (50%), donors (20%) and 30% loan repayment by farmers through levy

The cost-benefit-analysis for the second funding option on the repayment of 30% of the capital investment by farmers is illustrated in Table 4.2. The results in Table 4.2 shows that the project generates a positive NPV with desirable IRR for all the three different interest rates (4%; 6%; and 8%) from 15 years and above if the repayment by farmers is NAD2.00 and above. The result further shows that the project is bound to generate a positive NPV even if the repayment of the loan by farmers is NAD1.00 per kg per cattle provided the interest rate is 4% and over the period of 20 years.

However, the result shows that the NPV of the project would be negative for the 3 periods under discussion if the repayment is NAD1.00 and the inflation rate ranges from six (6) to eight (8) percent. As explained by Schach (2000), borrowers struggle to replay loan if the interest rate is very high. Therefore, the results for this option collaborate with Schach (2000) showing that farmers will not be able repay the 30% of the capital investment if the repayment rate is NAD1.00 per kg per cattle at 6% interest rate and above.

The IRR for 10 years at a repayment of NAD3.00 is projected to be 18% which is higher than the 10% minimum required rate of return for the project (Table 4.2). At 15 years, the IRR is 14% higher than 10% with a repayment of NAD2.00, which increases to 22% of the repayment at NAD3.00 (See Table 4.2). The IRR is even higher at 20 years, with an IRR of 15% at NAD2.00 repayment and 23% at NAD3.00 repayment. This shows a desirable IRR, and the repayment is more viable in the long run than short run. The results of this study collaborate with Dentons (2013) and Keimpema

(2017) whose findings indicate that projects with large start-up capital are mostly viable in the long-term but not in the short-term.

The analysis also shows that the project generates positive the BRC for all the three different interest rates (4%; 6%; and 8%) from ten years and above if the repayments by the farmers is NAD2.00 and above. The findings show that the BCR will be positive if the repayments by farmers is NAD1.00 per kg per cattle, provided the interest rate is 4% over 20 years. The BCR is projected to be negative at NAD1.00 repayment if the interest rate is six (6) percent and 20 years or above. Moreover, the BCR is expected to be negative for all three-inflation rates (4%: 6%; and 8%) from 15 years and below if the repayment is at NAD1.00 (Table 4.2). The result for the 30% of the costs to be repaid by farmers on creating FMD free zone shows that the benefits accruable outweigh the cost if the repayment is NAD2.00 and above at an interest rate of 4%; 6%; and 8% over a period of 10 years and above.

The CBA for the second funding option proved to be economically viable, especially if farmers accept to repay NAD2.00 per kg per cattle. It shows that farmers could repay the 30% initial investment contribution within ten years even if the interest rate was higher at 8%. The BCR, NPV and IRR were all desirable. The foregoing is similar to the finding of Randolph et al. (2002), which estimated the BCR for the investment in eradication of FMD to have ranged from 1.6 BCR to 12 BCR, indicating that the eradication of FMD, will be an economically viable investment. The above further findings tally with those of Perry et al. (2003), which have showed that FMD control measures were beneficial to the national economy of Zimbabwe. This was demonstrated by the finding, that for every US$ 1 that Zimbabwe disinvested in the

FMD control programme, a further US$ 5 was lost by the country. This is a clear indication that if Namibia invested in the creation of a new FMD free zone, it would enjoy some good and positive return on investment. Secondly, Perry et al. (2003) results showed that if Zimbabwe was to invest further in fences, veterinary services and infrastructure required to create a much larger and much more secure export zone that was internationally recognised as FMD free by the OIE, there would be returns of approximately US$ 1.5 for every US$ 1 invested (Perry et al., 2003).

The results for the second funding option also addressed first sub-objective for this study, which was to carry out CBA of creating FMD free zone in the central north of Namibia. As shown in Table 4.2 and as described above, the second funding option is feasible even in ten years if farmers are charged NAD2.00 per kg per cattle. This finding can assist the NVCF farmers, government, and other promotors of new FMD free zone in deciding the financing structure of the project. The findings can be used in seeking funding from financing institutions.

The BCR, NPV and IRR results of the first and second funding options also partly address the third objective of this study, which compared funding options of creating an FMD free zone. From the results above, it is clear that the first option is the best option as farmers will be able to afford the repayment. The farmers can repay the loan with NAD2.00 per kg per cattle.

Table 4.2: The outcomes of NPV, BCR and IRR for capital investment to be covered by government, donors, and loan to be repaid by farmers

	10 years								
	NAD 1.00			NAD 2.00			NAD 3.00		
	8%	6%	4%	8%	6%	4%	8%	6%	
NPV	-92467193.03	-84148855.77	-73698291.35	10642530.9	33204191.65	60495656.19	113752254.8	150557239.1	19468960
BCR	0.53	0.58	0.65	1.05	1.16	1.29	1.58	1.75	1
IRR	-4%			9%			18%		
	15 years								
	8%	6%	4%	8%	6%	4%	8%	6%	
NPV	-57850602.68	-39290930.82	-15239622.91	83396416.07	127482348.1	183358572.7	224643434.8	294255627	3819567
BCR	0.71	0.81	0.93	1.42	1.62	1.86	2.13	2.43	
IRR	3%			14%			22%		
	20 years								
	8%	6%	4%	8%	6%	4%	8%	6%	
NPV	-34291132.95	-5770479.784	32809141.3	132911487.8	197932471	284342934.2	300114108.6	401635421.8	5358767
BCR	0.83	0.97	1.15	1.66	1.94	2.30	2.49	2.92	
IRR	6%			15%			23%		

4.3.3. Payback period

Microsoft Excel was utilised to calculate the payback period. The results in Table 4.3 show that it would take 18 years before a positive cash flow is realised if the full capital investment and maintenance costs were to be recouped by the project at NAD2.00 per kg per cattle. The year when the payback period starts is shown in bold in Table 4.3 below. The amount of NAD1.00 or less was unlikely to generate positive cash flow for 20 years and below (Table 4.3). This shows the payback period for the first funding option of full repayment by farmers is not preferable.

The results of this study collaborate with Dentons (2013) and Keimpema (2017) whose findings indicate that projects with large start-up capital are mostly viable in the long term but not in the short-term period. Therefore, the first funding option is not attractive based on this finding. Any investments with longer payback periods are generally not enticing because they tend to be less accurate and not attractive to investors (Ardalan, 2012). The payback period findings are in agreement with BCR, NPV and IRR which shows first funding option is not viable.

Table 4.1: Cash flow for full capital investment loan to be repaid by farmers at NAD2.00

Year	Cash flow	Cumulative Cash flow
0	-475675884.1	
1	-203861093.2	-679536977.3
2	24797336	-654739641.3
3	30212758.76	-624526882.5
4	35928938.88	-588597943.6
5	38698674.01	-549899269.6
6	39921314.23	-509977955.4
7	41180633.66	-468797321.8
8	42045366.33	-426751955.4
9	42486379.99	-384265575.4
10	42486379.99	-341779195.4
11	42486379.99	-299292815.4
12	42486379.99	-256806435.4
13	42486379.99	-214320055.5
14	42486379.99	-171833675.5
15	42486379.99	-129347295.5
16	42486379.99	-86860915.47
17	42486379.99	-44374535.48
18	42486379.99	-1888155.482
19	42486379.99	40598224.51
20	42486379.99	83084604.51

The payback period for the repayment of the loan based on what the three stakeholders in the project contribute (Government 50%, donors 20% and farmers 30%) towards the repayment of the loan for the capital investment shows that the positive cash flow is achievable in the 6th year by repaying NAD2.00 (Table 4.4). The year when the payback period starts is shown in bold in the Table 4.4 below. The payback period based on NAD2.00 per kg per cattle shows that the project gains positive cash flow by 6th year as compared to 18 years for the full investment.

The results show that a shorter payback period could be realised in fewer years if capital investment is covered partly by government and donors (70%), and then a 30% loan to be repaid by farmers. As a rule of the thumb, the shorter the payback period,

the better (Ardalan, 2012). However, it is important to note that the payback period does not account for the time value of money, which is a theory that states that money received today is worth more than money received tomorrow. As a result, the payback period is best used in conjunction with other metrics (Jonathan et al., 2012; Brealey et al., 2012). Therefore, this result of payback period should be read together with results of BCR, NPV and IRR. Nevertheless, the payback period results for this study are consistence with BCR, NPV and IRR.

Together with BCR, NPV and IRR, payback period addressed first sub-objective for this study, which was to evaluate cost benefit analysis (CBA) of creating FMD free zone in the central north of Namibia. The combined results of these variables (BCR, NPV, IRR and PBP) addressed the third objective, which shows that the first funding option for farmers to repay the whole loan was not viable while the second funding option to repay 30% of the loan was viable.

Table 4.2: Cash flow for capital investment to be covered by government, donors, and farmers at NAD2.00

Year	Cashflow	Cumulative Cashflow
Year 0	-142702765.2	
Year 1	-61158327.96	-203861093.2
Year 2	24797336	-179063757.2
Year 3	30212758.76	-148850998.4
Year 4	35928938.88	-112922059.5
Year 5	38698674.01	-74223385.53
Year 6	39921314.23	-34302071.3
Year 7	41180633.66	6878562.354
Year 8	42045366.33	48923928.68
Year 9	42486379.99	91410308.68
Year 10	42486379.99	133896688.7
Year 11	42486379.99	176383068.7
Year 12	42486379.99	218869448.7
Year 13	42486379.99	261355828.7
Year 14	42486379.99	303842208.6
Year 15	42486379.99	346328588.6
Year 16	42486379.99	388814968.6
Year 17	42486379.99	431301348.6
Year 18	42486379.99	473787728.6
Year 19	42486379.99	516274108.6
Year 20	42486379.99	558760488.6

Figures 4.1 and 4.2 are presented below to show how the cash flow including the initial investment, maintenance costs and revenue from the levy influences the payback period. The cash flow for the full investment as shown in Figure 4.1 is compared with the 30% capital investment in Figure 4.2 for the period of 10 years at NAD2.00 repayment. It can be seen that the full investment (Figure 4.1) starts with high investment amounts, which affect the period the project recoups the investment. The project with large start-up capital is not preferred, unless the revenue is very high so that repayment can be shorter (Keimpema, 2017). The high start-up capital for first funding option justifies why the payback period is longer for this option.

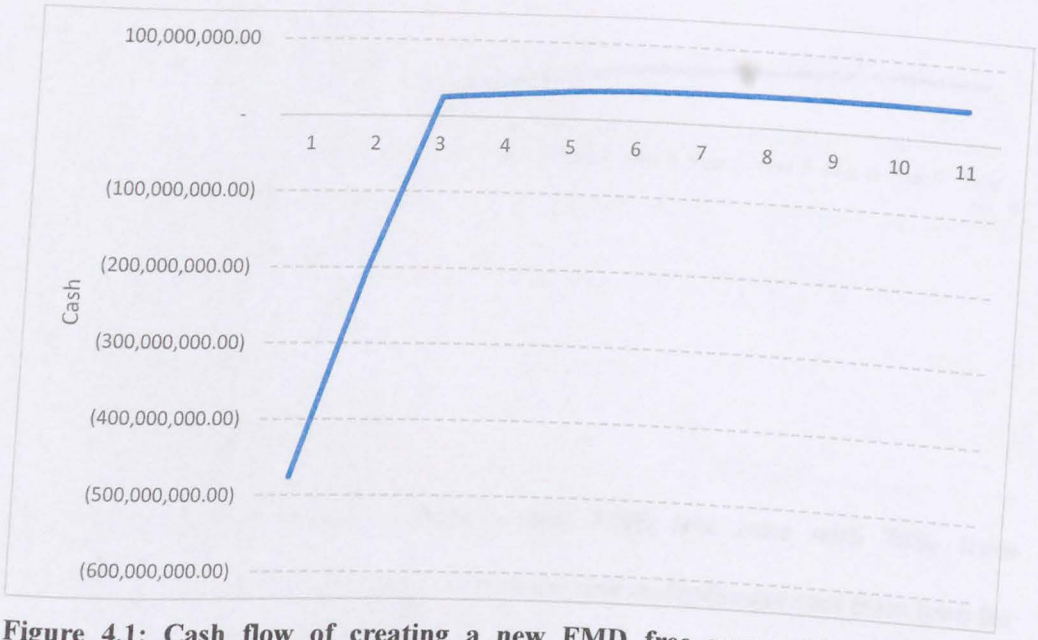

Figure 4.1: Cash flow of creating a new FMD free zone with full capital investment and maintenance costs from loans for farmers at NAD2.00 repayment over 10 years

The cashflow for the second funding option shows the start-up amount is not high compared to first funding option, hence it influences the shorter payback period (Dentons, 2013; Keimpema, 2017). Since the repayment rate is NAD2.00, which is the same for both options (Figure 4.1 & 4.2), the inflow does not have significant influence between the two options. The influence and difference between the options is mainly the amount to be repaid, with option one having high start-up amount that has to be repaid by farmers while in the second option only 30% will be repaid by farmers. Based on this finding, cash flow of creating a new FMD free zone with 30% loan repayment from farmers at NAD2.00 over 10 years is attractive and viable. The project will not struggle with cash flows.

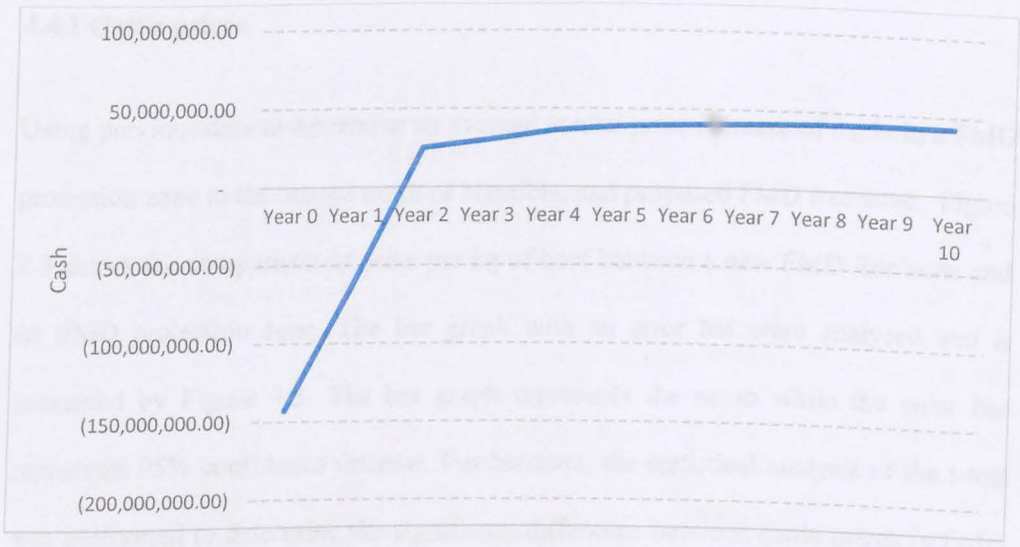

Figure 4.2: Cash flow of creating a new FMD free zone with 70% from government and donors and 30% investment and maintenance cost from loan for farmers at NAD2.00 repayment over 10 years

The cash flow projections for Figure 4.1 and 4.2 complements the results of BCR, NPV, IRR and PBP in addressing first sub-objective one. It shows that first funding option is not preferred as it require large start-up capital which will affect cash flow of the project, while the second funding option is preferred as it require reasonable start-up capital amount that will allow easy cash flow for operation. First funding option might result in halting the project operation due to lack of cash flow at some points (Al-Joburi, Raid, & Mohammed, 2016; D, Stice., E, K, Stice., & J, D, Stice, 2017).

4.4 Cattle prices and revenue

This section discusses the results that relate to the differences in cattle prices and revenue between the FMD free zone as compared to the FMD protected zone. The results are presented below.

4.4.1 Cattle prices

Using previous data to determine an average annual price increase of cattle in a FMD protection zone in the central north of Namibia, and proposed FMD free zone. Figure 4.3 shows the comparison of price per kg of beef between a new FMD free zone and an FMD protection zone. The bar graph with an error bar were analysed and is presented by Figure 4.3. The bar graph represents the mean while the error bar represents 95% confidence interval. Furthermore, the statistical analysis of the t-test was performed to determine the significant difference between cattle prices in FMD protection zone and the proposed new FMD free zone. The error bar confirmed by the t-test results showed that the cattle prices were not significantly different ($P>0.05$) within ten years but would become significantly different ($P<0.05$) from 15 years onwards, with FMD free zone having high price. This is similar to CBA results that shows that the benefit of creating FMD free zone is to be achieved in long term run but not in short term.

The results in Figure 4.3 and its description above shows the benefits of achieving high price if the proposed project area is successfully converted to a FMD free zone. This is confirmed by literature review from various studies on the same subject which reveals that the high paying international export markets are the main reason countries create and protect FMD free zone (Otte et al., 2004; Leslie et al., 1997; Knight-Jonesa & Rushtonba, 2013; James and Rushton, 2002; Scoones & Woolmer, 2007; McGahey, 2011). Anon (2002)'s study highlighted the issue of the VCF in the northern region of Namibia, low prices and lack of marketing information as further curtailing market accessibility and utilisation in the NCA. Leslie et al. (1997)'s study showed that Uruguay's gains from livestock increased by 52% in terms of monetary gain after

freedom from the FMD declaration.

The results are further complemented by Bishi and Kamwi, (2008) indication that the formal marketing system in the NCA is beset by a number of institutional inadequacies that relate to lack of market information and low prices veterinary restrictions such as pre- and post-slaughter quarantine. Nugent and McLeod (2004) study for Uruguay on the economic impact and institutional responses for transboundary animal diseases showed that after the FMD eradication, there was higher price obtained by Uruguay's beef in the USA compared to the selling price on the domestic market, which was more than double in the case of chilled meat.

Moreover, the result correlate with data provided by Meatco and Meat Board that showed that cattle price per annum in the FMD free zone increases by 11% while in the FMD protection zone with 8%. This shows a difference of 3% between the FMD protection zone and FMD free zone.

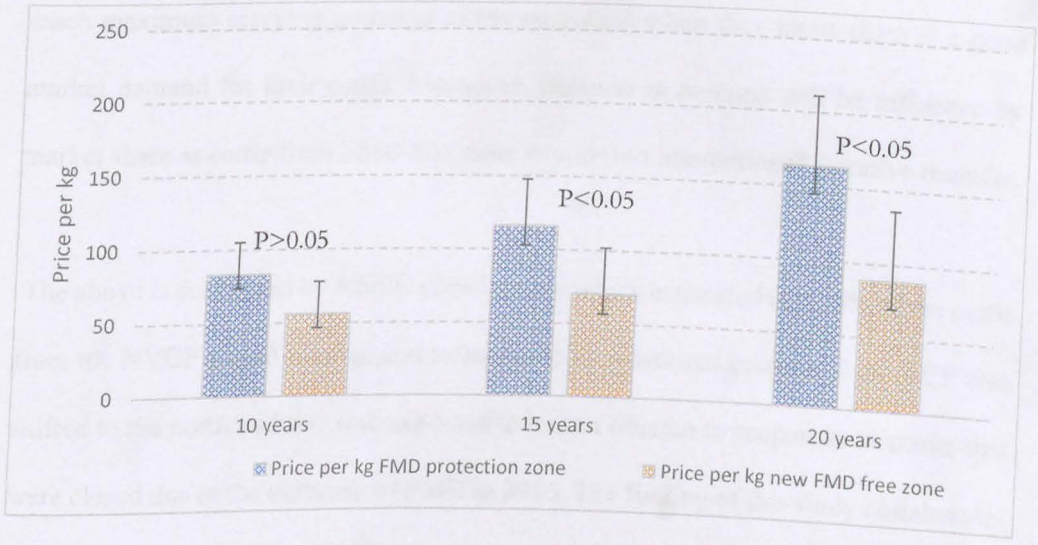

Figure 4.3: Comparison of price per kg beef between a new FMD free zone and FMD protection zone

4.4.2 Revenue from cattle sales

Figure 4.4 shows the comparisons of revenue from cattle in the proposed new FMD free zone and the FMD protection zone. As shown in Figure 4.4, the error bar and t-test statistical results show that there is no significant difference ($P>0.05$) for revenue derived from cattle sales between the FMD protection zone and the proposed new FMD free zone in 15 years and less. However, the revenue difference will be significant ($P<0.05$) by the 20^{th} year of the project. The revenue result is in consistence with CBA and price which shows that benefits of creating FMD free is not short term but long term.

The increase in revenue in FMD free zone is influenced by increased cattle prices as demonstrated earlier under section 4.4.1. The increase in revenue is further influenced by an increase in the number of cattle in the FMD free zone as compared to conditions of maintaining the FMD protection zone. Farmers will increase their cattle stocks to reach maximum carrying potential of the rangeland when they know there is a good market demand for their cattle. Moreover, increase in revenue will be influence by market share as cattle from FMD free zone would find international lucrative markets.

The above is confirmed by NNFU (2019) study which estimated that 50% of the cattle from the NVCF would have access to lucrative international markets if the VCF was shifted to the north and this was expected to hasten Meatco to reopen its abattoirs that were closed due to the outbreak of FMD in 2015. The finding of this study collaborates with Leslie et al. (1997) study findings which estimated an increase of an additional revenue of US$ 20 million per year for Uruguay after creating FMD free zone.

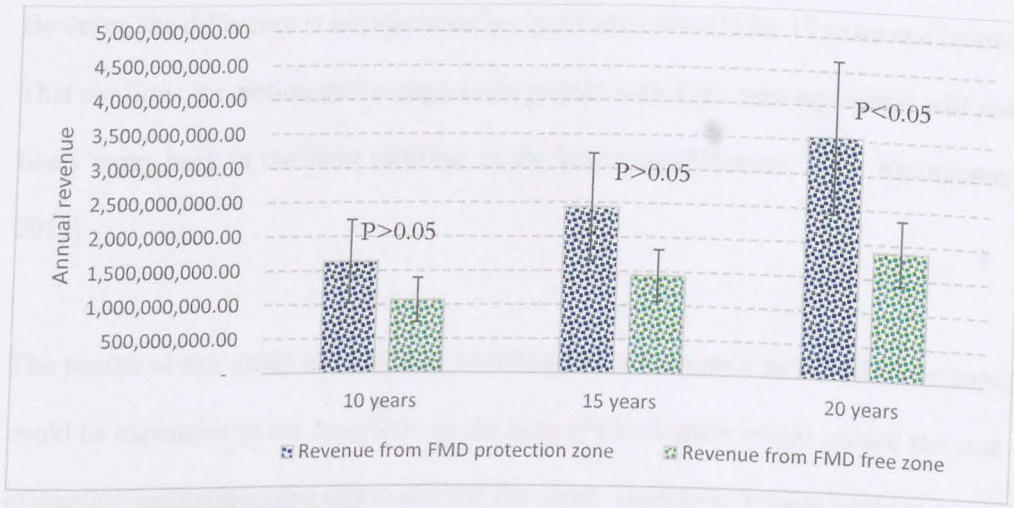

Figure 4.4: Comparisons of revenue from cattle in a new FMD free zone and the FMD protection zone

Figure 4.5 shows that a comparison of the cost of establishing a new FMD free zone versus the cost of maintaining an FMD protection zone. The cost of creating a new FMD free zone includes the construction cost of the new zone, the cost of clearing the zone to be accepted by the OIE as FMD free zone, and the cost of inspection and maintenance (OIE, 2018). The cost of maintaining an FMD free zone includes the vaccination costs, which the government is currently undertaking in the FMD free zone. As per international standards and requirements by the OIE, the government is required to vaccinate cattle in FMD protection zone 3 times a year (OIE, 2018). The information provided by the DVS, a department within MAWRL revealed that the cost of vaccination per cattle was N$117.00 per cattle, including labour, medicines, and operational costs such as fuel.

Figure 4.5 shows the bar error and P values from t-test comparing the cost of maintaining the FMD protection zone versus the cost of creating a new FMD free zone. The cost of creating a new FMD free zone is significantly much less ($P<0.05$) in the long run for 20 years compared to the cost of maintaining FMD protection zone.

However, the difference is not statistically significant (P>0.05) for 15 years and below. This confirms the notion that a large-scale project with high start-up capital will not likely repay back in the short term but in the long term (Dentons, 2013; Keimpema, 2017).

The results of this study showed that neglecting to not create a new FMD free zone could be expensive in the long term as the cost of vaccination would exceed the cost of creating and maintaining of a new FMD free zone. Therefore, it is advisable to create a new FMD free zone. This is also supported by a similar study by Otte, et al. (2004) which indicated that, Uruguay was spending between US$8 and US$9 million annually on FMD vaccinations to manage the eradication of the FMD, which was very expensive. The control costs of FMD were as low as 10% of revenues from exports alone after FMD freedom (Leslie et al., 1997). However, James and Rushton (2002) argued that where eradication of FMD is not feasible, it is economically beneficial to protect high producing livestock through vaccination. Vaccination of lower-producing animals could also be justified, especially where such animals produced milk, and were used for traction power, or where this would serve to protect high-producing livestock from diseases.

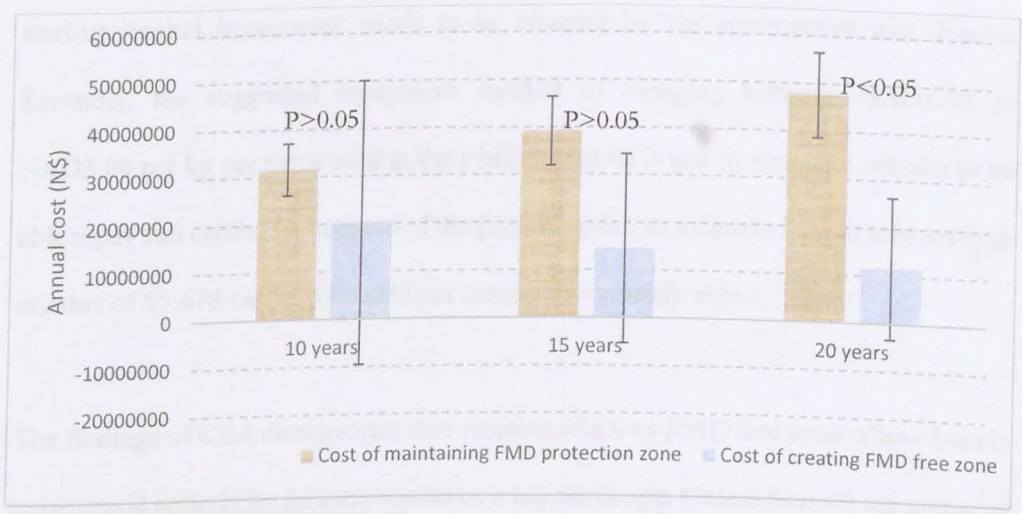

Figure 4.5: Maintenance costs of a FMD protection zone versus costs of creating a new FMD free zone

The second sub-objective of this study was to compare cattle prices and the revenue realised between the proposed new FMD free zone areas against maintaining FMD protection zone in the same area. Therefore, section 4.4 achieved this objective. The results under this section showed cattle prices and the revenue in FMD free zone will be statistically significant high ($P<0.05$) compared FMD protection zone. Similarly, the cost of creating a new FMD free zone is significantly much less ($P<0.05$). However, this difference is in long term, 15 years and above.

4.5 Discussion of the results

The CBA results for the second funding option show the creating of a FMD free zone is economically viable as opposed to the first funding option which is not be viable. The main reasons for this are as follows: Firstly, the first funding option requires that the full capital investment needs be repaid by farmers, which is expensive. While the repayment by farmers for the second funding option is lower (30%) as 70% of the

start-up capital investment needs to be covered by the government and donors. Secondly, the suggested repayment method of charging between NAD1.00 to NAD3.00 per kg per cattle sold in the FMD free zone is not an adequate amount to be able repay full capital investment of the project, given an estimated maximum average number of 55,678 cattle to be sold per annum in the study area.

The findings of CBA demonstrate that creation of a new FMD free zone whose loan is to be repaid entirely by farmers would be a big challenge. Unless farmers are prepared to pay more than NAD3.00 per kg per cattle, the project cannot repay the full amount of the investment in the given time. This is confirmed by the literature review, which indicates that the creation of a FMD free zone is expensive and that it would require government intervention to be a success (Knight-Jonesa & Rushtonba, 2013).

The second funding option shows that the creation of a FMD free zone is viable, provided other stakeholders cover 70% of the costs so farmers only repay 30% of the capital investment, and the repayment is at NAD2.00 per kg per cattle. Alternatively, the interest should be 6% or less if the farmers are to pay NAD1.00 per kg per cattle. The finding is confirmed by Schach (2000)'s indication that borrowers struggle to repay loans if the interest rate is very high. Therefore, the results for this option collaborate with Schach (2000) showing that farmers will not be able repay the 30% of the capital investment if the repayment rate is NAD1.00 per kg per cattle at 8% interest rate and above. Furthermore, the finding of the study shows repayment for the second funding option is viable in the long term but not in the short-term. The results of this study collaborate with Dentons (2013) and Keimpema (2017) whose findings indicate that projects with large start-up capital are mostly viable in the long term. The

lower the interest rate, the higher the earnings and vice versa (Keimpema, 2017).

The results of cattle prices and revenue show that it is worth creating a new FMD free zone despite CBA findings, which indicated that the full investment capital cannot be entirely repaid by farmers alone within 20 years. The findings show that the creation of a new FMD free zone in the central north of Namibia would bring significant benefits of increased cattle prices, which would eventually lead to increased revenue for farmers. This finding is confirmed by various studies, which also discovered that the benefits of good prices and revenue from international export markets is the main reason countries create FMD free zones (Otte et al., 2004; Leslie et al., 1997; James & Rushton, 2002; Scoones & Woolmer, 2007; McGahey, 2011).

The above is supported by Otte, et al. (2004)'s study on Uruguay on the economic impact and institutional responses for transboundary animal diseases. After the FMD eradication, the study showed that the higher price obtained by Uruguay's beef in the USA compared to the selling price on the domestic market was more than double in the case of chilled meat. This increase was estimated to provide an additional revenue of US$ 20 million per year to the country (Leslie et al., 1997).

The results of this study further showed that neglecting to create a new FMD free zone could be expensive in the long term as the cost of vaccination would exceed the cost of creating and maintaining of a new FMD free zone. This was also supported by a similar study by Otte et al. (2004) which indicated that, Uruguay was spending between US$8 and US$9 million annually on FMD vaccinations to manage the eradication of the FMD, which was very expensive. The control costs of FMD were as

low as 10% of revenues from exports alone after FMD freedom (Leslie et al., 1997). James and Rushton (2002) argued that where eradication was not feasible, it was economically beneficial to protect high producing livestock through vaccination. Vaccination of lower-producing animals could also be justified, especially where such animals produced milk, and were used for traction power, or where this would serve to protect high-producing livestock from diseases.

The above findings tally with those of Perry et al. (2003), which showed that FMD control measures were beneficial to the national economy of Zimbabwe. This was demonstrated by the finding, that for every US$ 1 that Zimbabwe disinvested in the FMD control programme, a further US$ 5 was lost by the country. This is a clear indication that if Namibia invested in the creation of a new FMD free zone, it would enjoy some good and positive return on investment. Secondly, the results showed that if Zimbabwe was to invest further in fences, veterinary services and infrastructure required to create a much larger and much more secure export zone that was internationally recognised as FMD free by the OIE, there would be returns of approximately US$ 1.5 for every US$ 1 invested (Perry et al., 2003).

As indicated under delimitations and methodology, the income used for economic analysis of this study was limited to the direct income from selling cattle, but not their products such as milk and hides. It also excluded the quantification of other monetary benefits of the project such as contribution to national GDP and levy to the Meat Board of Namibia. Therefore, this indicates the potential holistic benefits that can be maximised from an FMD free zone if these other incomes are quantified.

However, it is important to caution on the risk of an outbreak of FMD within the FMD free zone if care is not taken after creating an FMD free zone. In this case, the government, farmers, and any investors for the project will lose. The introduction of CBPP in Ngamiland in Botswana resulted in immediate closure of the export meat processing plant, which employed over 200 people before cattle were destroyed (Townsend & Sigwele, 1998). Exports came to a standstill. A survey of the business sector after the eradication campaign showed that business turnover generally had declined by an average of 15%, which was attributed to the loss in disposable income from cattle. The indirect effects were further estimated to be more than seven times the amount attributed to direct losses (Townsend & Sigwele, 1998). Similarly, the breakdown of the FMD control in Zimbabwe after the land reforms of 2000 led to a loss of US$50 million per year that would have been earned from EU beef export markets (Scoones & Woolmer, 2007).

This study had three sub-objectives. The first objective was to carry out a CBA of creating an FMD free zone in the central north of Namibia, the second objective was to compare cattle prices and the revenue realised between the proposed new FMD free zone areas against maintaining an FMD protection zone in the same area while the third objective was to compare funding options of creating an FMD free zone. The first and third objectives were achieved by CBA which presented BCR, NPV, IRR and PBP while the second objective was achieved by the results presentation for cattle prices and revenue.

Based on the findings of the study, the null hypotheses (hypotheses 1 to 4) for CBA (BCR, NPV, IRR and PBP) are rejected while their alternative hypotheses are accepted.

This is based on the results that the BCR for the first funding option was less than 1, the NPV was negative, IRR was lower than the 10% minimum required rate, while PBP was longer. The BCR for the second funding option was greater than 1, the NPV was positive, IRR was higher than the 10% minimum required rate, while PBP was shorter. In each case, the null hypotheses are rejected.

The study's finding further reject the price and revenue null hypothesis (hypothesis 5) and accept its alternative hypothesis stating that there is significant difference in the average cattle price and revenue between the proposed FMD free zone and maintaining an FMD protection zone. The results show a statistically significant increase ($P<0.05$) on an average price and revenue increase for the proposed new FMD free zone compared to maintaining the existing FMD protection zone.

The researcher furthermore rejects the null hypothesis for the 6th hypothesis which stated that there will be no significant difference between the two funding options proposed for the creation of a new FMD free zone. The combined results of these variables (BCR, NPV, IRR and PBP) shows that the second funding option was better than the first option. The results showed that farmers will be able to repay the loan using the second option.

4.6 Chapter summary

Chapter 4 provided detailed findings of the study. Firstly, the chapter described the structures and arrangement of the presentation of the results for the chapter. Thereafter the results were presented and discussed. A detailed discussion was provided at the end of the chapter. The chapter clearly presented the results and provided literature review that confirms and differs with the results. The CBA results for second funding option

show that creating a new FMD free zone is economically viable as opposed to the first funding option which showed not to be viable. The results of cattle prices and revenue collection show that it is worth creating a new FMD free zone as the project can increase prices and revenue for farmers. The findings of chapter 4 show that first the objective was achieved by CBA which presented BCR, NPV, IRR and PBP while the second objective was achieved by the results presentation for cattle prices and revenue. Under discussion, the chapter provided the acceptance and rejection of hypotheses.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This study investigated the economic impact of creating a new FMD free zone versus maintaining the existing FMD protection zone. Besides, a cost-benefit analysis, price and revenue analysis were conducted to determine the impact of creating a new FMD free zone as compared to maintaining the already existing FMD protection zone. Considering the data analysis, and findings of previous researchers, conclusions were reached. Thereafter, recommendations were given.

5.2 Conclusions

Although the results showed that creation of a new FMD free zone would not be able to repay full costs of the capital investment of creating a new FMD free zone within a reasonable timeframe, the findings of the study suggest that a new FMD free zone in the central north of Namibia has a positive economic impact in many aspects over the long term. This conclusion was reached on the basis of tangible evidence, that a new FMD free zone would increase livestock prices and generate revenue for farmers as well as provide an opportunity for the government to reduce the cost of vaccinations over the long term.

The CBA result indicated that the creation of a new FMD free zone is better than maintaining the FMD protection zone because there were more benefits to be derived by the government and farmers in the form of employment creation which would reduce the high employment rate in Namibia as alluded to earlier on. Therefore, it can be concluded that creating a new FMD free zone is economically viable, with the economic benefits outweighing the costs incurred in creating a new FMD free zone

over the long term, particularly when government and donors contribute 70% of the investment capital and maintenance costs.

However, the results of this study cannot be generalised and the conclusions are limited to the cost related to capital investment and maintenance of the proposed FMD free zone project while the revenue is limited to the direct income from selling cattle.

5.2 Recommendations

The study demonstrated that the creation of a new FMD free zone would positively impact on the economic statuses of the farmers in the proposed area of the project, the central north of Namibia. However, specific recommendations as per the findings of this study were listed below and can be considered for implementation in any order.

- It is recommended that the government and donors co-fund the project so that the high burden of full payback is not placed on the farmers who are already under severe pressure and are suffering because of the persistent droughts which have wiped out entire herds of cattle in Namibia, and the farmers are in the process of re-stocking.
- The risk element of the project should form part of a detailed study by government or other researchers, as part of the assessment and implementation of the project by the proponents. If care is not taken in the implementation of the project, the foreseen positive economic impact might not be realised. For example, if the fence is not properly constructed, the FMD outbreak might still penetrate the new FMD zone, hence the status of a FMD free zone will be compromised.

- Since the income used for economic analysis of this study was limited to the direct income from selling cattle, but not their products such as milk and hides; a comprehensive study is further recommended to include these aspects and conduct a detailed CBA. This CBA should include the quantification of other monetary and non-monetary benefits, including socioeconomic aspects of the project such as employment creation, contribution to national GDP and levy to the Meat Board of Namibia. Furthermore, the recommended comprehensive study should also include and model the control cost during FMD outbreaks to determine potential saving by the government. Furthermore, the study could also compare the economic impact of various options such as compartment, creation of a zone and shifting of VCF to the border between Namibia and Angola.

5.3 Chapter Summary

Chapter 5 provided the conclusions and recommendations for the study. The conclusions were concise mainly indicating that the FMD free zone is viable and briefly the main reasons for that. The recommendations focused on study findings, although a few of them considered other aspects that could make the FMD free zone viable in a holistic way.

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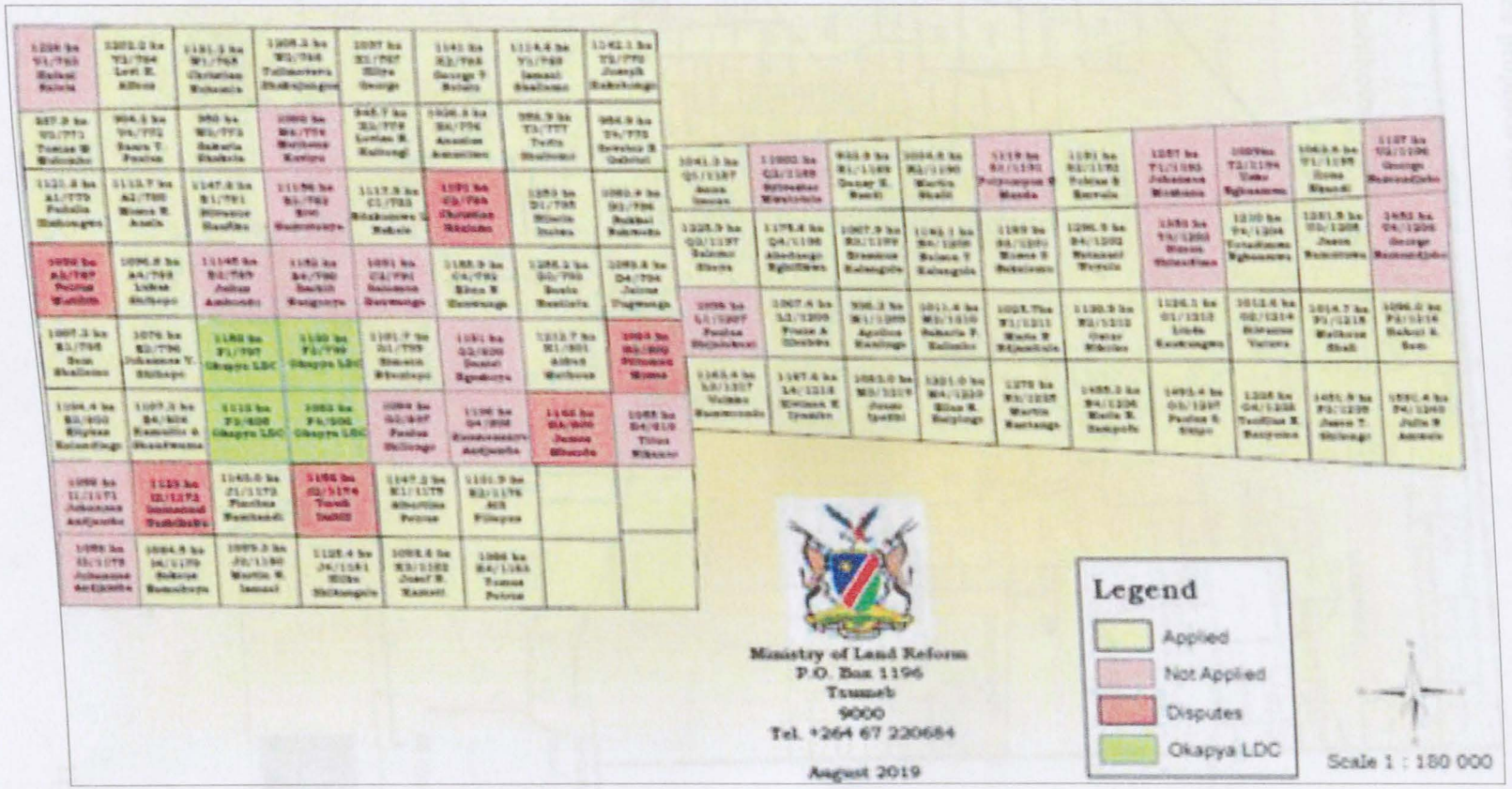
APPENDICES

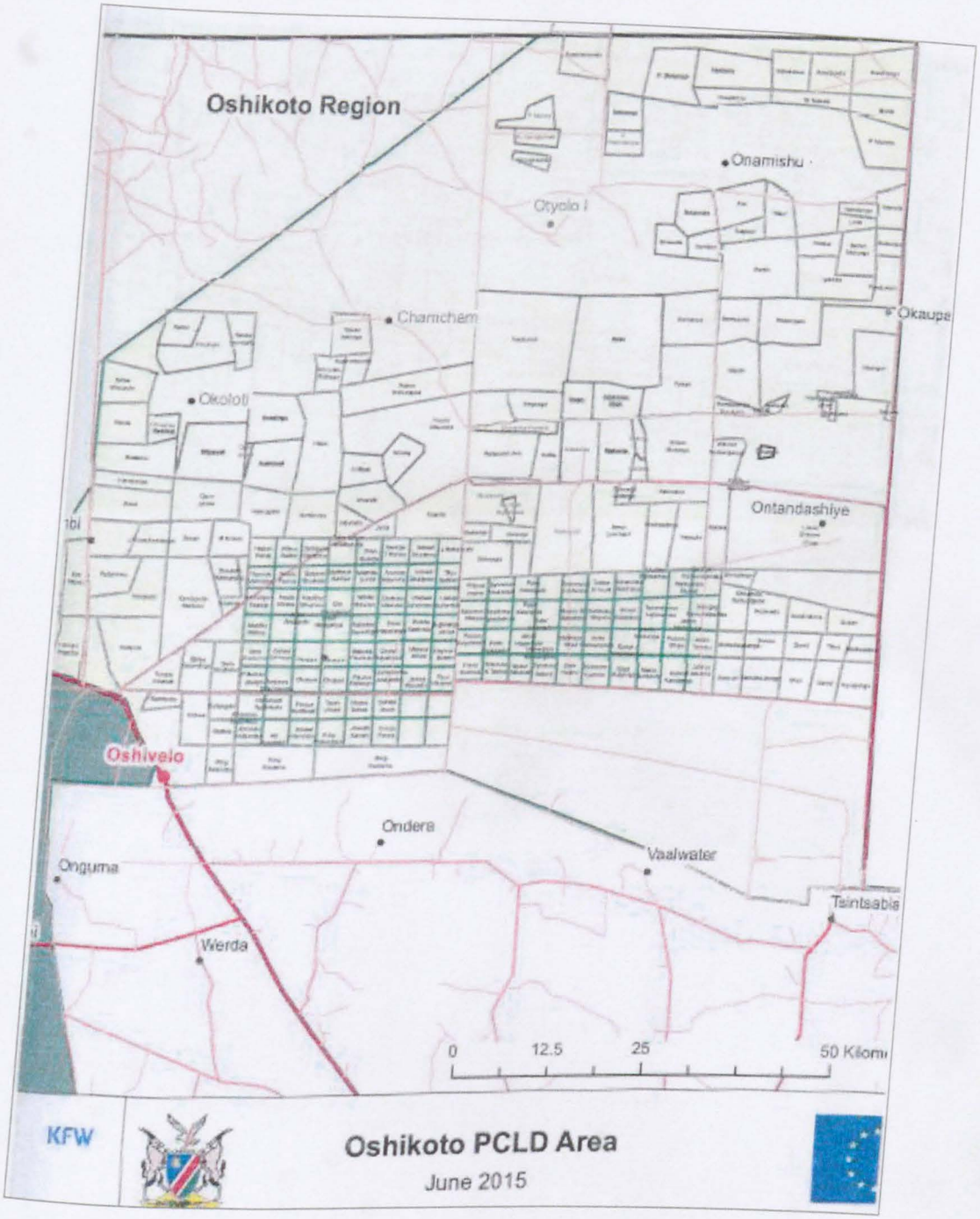
Appendix 1: Summarised cattle population in the proposed new FMD free zone areas

Region/Area	Number of farms	Average number of cattle per farm	Total number of cattle
Kavango West - Designated area	218	200	43600
Kavango West - undesignated area	30	150	4500
Kavango East - Designated area	293	200	58600
Kavango East - undesignated area	50	150	7500
Oshikoto - Designated area	104	200	20800
Oshikoto - undesignated area	100	150	15000
Ohangwena - Designated area	100	200	20000
Ohangwena - undesignated area	50	150	7500
TOTAL	945		177,500

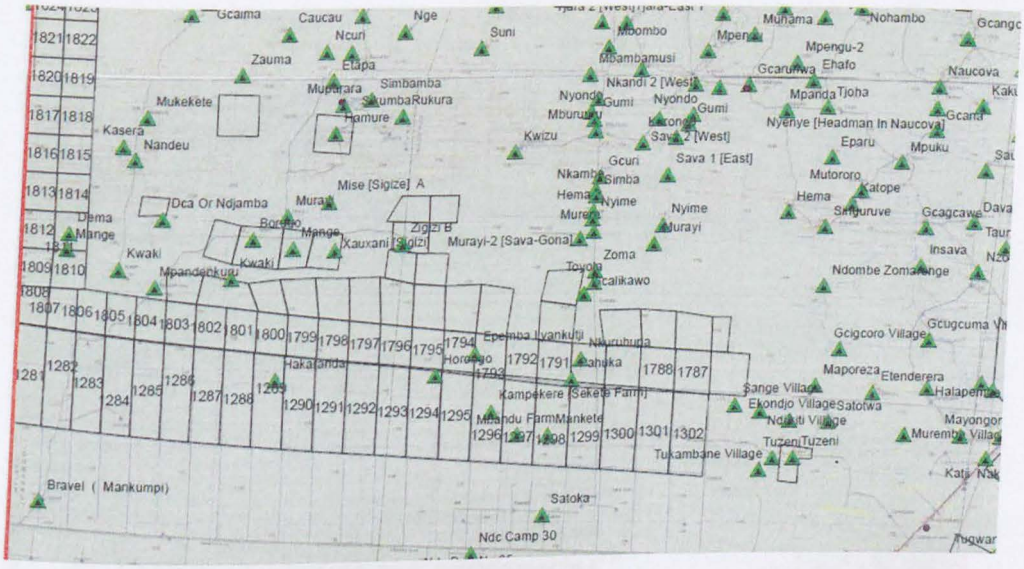
Appendix 2: Government gazetted farming units in the Mangetti block and official occupants for Oshikoto region, which is part of the proposed new FMD free zone



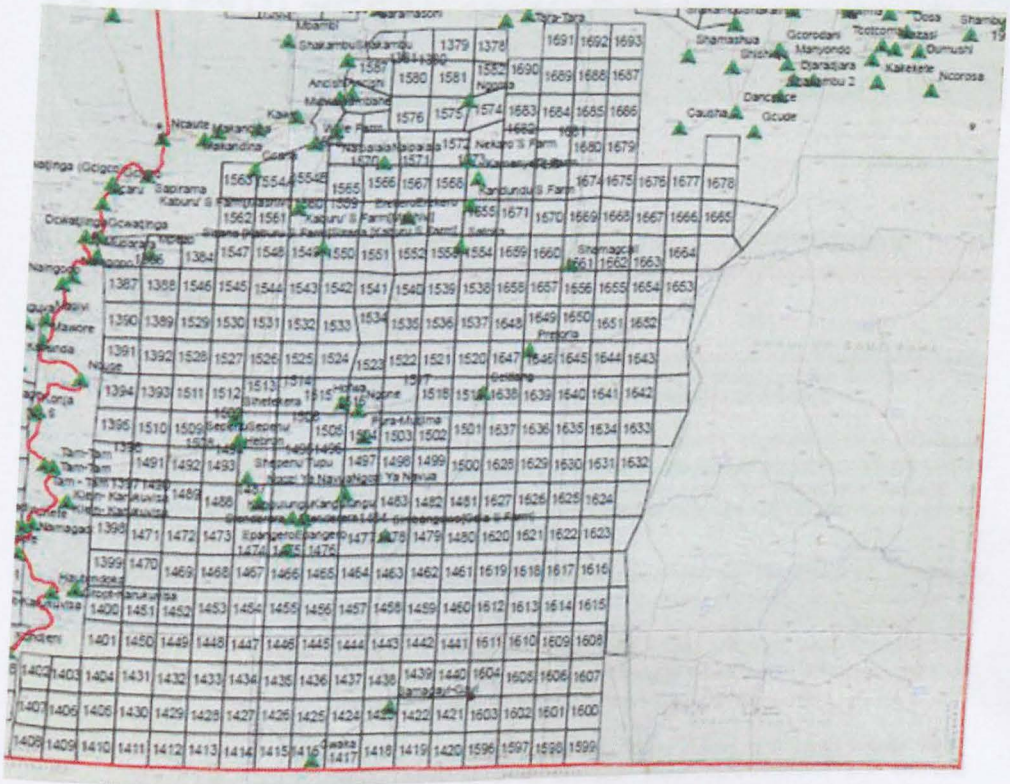
Appendix 3: Farming units including ungazetted farms in Oshikoto region, which is part of the proposed new FMD free zone



Appendix 4: Small scale commercial farms in Kavango West region from designated and undesignated areas, which are part of the proposed new FMD free zone



Appendix 5: Small scale commercial farms in Kavango East region from designated and undesignated areas, which are part of the proposed new FMD free zone



Appendix 6: Language Editing Certificate

Dr.GM

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LANGUAGE & COPY-EDITING CERTIFICATE

18th December 2020

RE: LANGUAGE, COPYEDITING AND PROOFREADING OF KUNIBERTH SHAMATHE's THESIS FOR THE MASTER OF BUSINESS ADMINISTRATION DEGREE OF THE NAMIBIA BUSINESS SCHOOL OF THE UNIVERSITY OF NAMIBIA

This certificate serves to confirm that I copyedited and proofread **KUNIBERTH SHAMATHE's** Thesis for the **MASTER OF BUSINESS ADMINISTRATION DEGREE** entitled: **AN INVESTIGATION INTO THE ECONOMIC IMPACT OF CREATING A FOOT AND MOUTH DISEASE FREE ZONE IN THE CENTRAL NORTH OF NAMIBIA**

I declare that I professionally copyedited and proofread the thesis and removed mistakes and errors in spelling, grammar, and punctuation. In some cases, I improved sentence construction without changing the content provided by the student. I also removed some typographical errors from the thesis and formatted the thesis so that it complies with the University of Namibia's guidelines.

I am a trained language and copy editor and have edited many Postgraduate Diploma, Masters' Thesis, Dissertations and Doctoral Dissertations for students studying with universities in Namibia, Zimbabwe, Eswatini, South Africa and abroad. I have also copy-edited company documents for companies in the region and abroad.

Please feel free to contact me should the need arise.

Yours Sincerely,

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