The Effect of Training on Cattle Farmers' Productivity and Efficiency: A Case of Kunene region, Namibia

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DECLARATION

I, Emilie Mekondjo Abraham hereby declare that I wrote this thesis. I have not previously submitted it in its entirety or part to any University or other institutions of higher learning for the award of a degree.

Signature_____ Date_____

ABSTRACT

Despite the importance of cattle and the enormous economic contribution to the country, communal cattle farmers seldom earn increased return on investment because of their adherence to their traditional system of farming. Such as outdated animal husbandry practices, high stocking rate, high breeding ratio or no bull in the herd and the sale of old stock (10 years and above) instead of younger cattle (heifers and tollies) that have potential to fetch premium price from the market. The use of traditional animal husbandry practice is due to the lack of appropriate farming knowledge and skills. Sometimes, there are financial limitations to source required production inputs that can enhance productivity and efficiency. Therefore, this impact not only on farmer's sustainability but on meat supply in the country. However, this compromises the country's food security agenda. To this end, Developmental projects funded by Germany Government (GIZ) and Agribank of Namibia amongst others have implemented capacity building for farmers to complement the Directorate of Agricultural Production Engineering and Extension Services (DAPEES). The project aim was to enhance farmer's skills and knowledge to enable them to upscale their farm productivity and efficiency as well as strengthen their capacity to withstand climate change challenges (E.g. drought). Thus, this study investigates whether training intervention improved farm productivity and efficiency and identify ways in which the cattle farmers can improve. The study shows that a significant number of cattle farmers that received training adopted the best cattle husbandry practices such as appropriate tagging, castration, proper deworming and vaccination amongst others. Thus, the result shows that the calving percentage and offtake rate (number of heads sold per annum) for trained farmers exceed that of their peers (untrained farmers). This paper used a treatment effect model to determine the causal relationship between training and farm productivity. Estimators such as Regression Adjustment (RA), Inverse-Probability Weighted (IPW) regression, the Augmented Inverse Propensity Weighted (AIPW) estimator and Inverse Probability Weighted Regression Adjustment (IPWRA) estimator were used to estimate the treatment effects of training on offtake rate). Estimation was based on survey data obtained by interviewing 212 cattle farmers from various districts of Kunene Region, Namibia. One treatment level used for this study was training (Treatment is coded as one if a farmer is trained, zero otherwise). The result shows that farmers who were trained had Potential Outcome Mean (POM) sales of 176 cattle per annum compared to the untrained farmers who had a POM of 92 cattle. In addition, a Stochastic Frontier Analysis model (SFA) was fit to determine the factors that contribute to inefficiencies in cattle production. The study shows that as farmers get older, they get more experience and efficient in cattle production. However, farm type (full time or part-time) and family size also reduce inefficiencies in cattle production. This was attributed to the fact that; full-time farmers spend more time on the farm and could closely supervise and monitor their farming enterprises. In addition, large household size tends to complete farm activities on time using less man/days. The constant return to scale was as well determined using capital and labour as factors of production. However, for labour, it was accepted, and reject that of capital (capital invested in production cost) as the coefficient for capital is less than one. This could be attributed to the multi-purpose of farming observed in Kunene region other

than for commercial reasons. Thus, family members are utilised as farmworkers, and farmers do not attach value/cost to this factor of production. Thus, farm capital could be used for other personal reasons, other than just production.
Overall, the study found that as farmers age, they get more experienced, and become more productive and efficient in their cattle production ceteris paribus.

Key words: Training, cattle farmers, productivity, efficiency, treatment effect, production frontier.

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LIST OF ACRONYMS AND ABBREVIATIONS

GAPs	Good agricultural practices
AASD	Agri Advisory services division
ATE	Average Treatment Effects
AAS	Agricultural Advisory Services
CBPP	Contagious Bovine Pleuropneumonia
GVPs	Good Veterinary Practices
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
NPC	National Planning Commission
NSA	Namibia Statistical Agency
GSIARS	Global Strategy to Improve Agricultural and Rural Statistics
SVCF	South of Veterinary Services
FSP	Farmer Support Programme
SFA	Stochastic Frontier Analysis
GDP	Gross Domestic Products
NAMLITS	Namibia Livestock Identification and traceability system
NNFU	Namibian National Farmers Union
AMTA	Agro-Marketing and Trade Agency
DAPEES	Directorate of Agricultural Production, Extension and Engineering Services
BSE	Bovine Spongiform Encephalopathy
SQF	Safety Quality Foods
IFS	International Food Standards
SDGs	Sustainable Development Goals

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DEDICATION

This paper is dedicated to my husband Johannes Alugodhi and my Kids. I hope this work will be a source of inspiration and challenge to our children.

CHAPTER ONE

INTRODUCTION

1. Background

The agriculture sector is a major contributor to the Gross domestic product of many countries across the world. From the Namibia perspective, in 2014, the agriculture sector and its related industries contributed 3.7 per cent to GDP and grew by 9.6 percent (National Planning Commission (NPC), 2011). However, in the past decades, the Agricultural sector's contribution to GDP has declined at an alarming rate (Namibia Statistical Agency (NSA), 2017). This is unexpected because the agriculture sector is reported to be the highest employer with 172 530 people employed in this sector in 2012, which represented 27.4 percent of total employment (NSA, 2017). Farming is a business, and it should be treated as such; thus, the traditional method of farming is not encouraged because it impairs food security and reduces employment opportunities for unskilled, semi and skilled people.

Farm productivity and efficiency are the key concerns that guide agricultural policy formulations and agricultural development agenda around the globe (Global Strategy to Improve Agricultural and Rural Statistics (GSIARS), 2017). The emphasis on agricultural productivity and efficiency by Sustainable Development Goals (SDGs) underlines the reasons why additional information on farming productivity and efficiency in developing countries is needed (GSIARS, 2017). According to the GSIARS (2017), several countries have introduced policies and measures to improve farming productivity and efficiency. Enhancing agricultural productivity is particularly important to a developing country like Namibia because of its contribution to poverty reduction, food security, and increased farm income. To end, hunger in Africa by 2025, there is a need for improvement in agricultural productivity (GSIARS, 2017).

Musemwa, Mushunje, Muchenje, Aghdasi and Zhou (2013) suggests that technical and allocative efficiency are two components of farm efficiency. Musemwa et al. (2013) study revealed that secondary education is positively related to farmers' economic efficiency in Shamva district in Zimbabwe, while good production knowledge affected allocative efficiency. Musemwa et al. (2013) also observed that farmers age, excellent product knowledge and level of specialization affected technical efficiency. Their study, however, focused mainly on the factor that affects the efficiency of field crop production in Zimbabwe. This is entirely different from the current study in that the focus will be on analyzing the effect of training on cattle farmers' productivity and efficiency, focusing on cattle farmers in the Kunene region. In Namibia context, the agricultural sector plays a significant role in the economy of the country. According to the Namibia Agriculture Policy (2015), about 70 percent of Namibia's population is dependent directly or indirectly on the agricultural sector for a livelihood. Although farming is a dominant

land use activity in Namibia, farming is characterized by low production, poor quality produce and high risk due to infertile soils, arid conditions, and poor rangeland use practices.

According to Tilley (2011), there is limited knowledge among many small farmers were finding it challenging to understand relevant financial information required in decision-making relating to cost. The failure to use and interpret financial information increase farming business risks (Halabi & Carroll, 2015). Lack of knowledge among farmers has its own consequences according to (Halabi & Carroll, 2015; Van Auken & Carraher, 2011), for example, farmers tend to make uninformed business decisions, and may not be in high position to recover from farm loss due to misplaced, misallocated and or mismanaged limited financial resources (Halabi & Carroll, 2015; Van Auken & Carraher, 2011). According to Mogues et al. (2009), two-third of the world's poor people live in rural areas, and most of them depend on agriculture for their livelihoods. Therefore, without proper training, many farmers and their families will suffer due to lack of required knowledge to effectively manage farm business.

A major factor contributing to agriculture's relatively lower performance has been observed to be lack of farming knowledge and skills to sufficiently produce quality and marketable outputs as well as the expertise to navigate through farming risks/challenges to minimize the farming enterprise exposure to risks such as droughts and floods, which occur due to climate change. Namibia's agricultural sector is dominated by livestock farming, followed by crop farming. The difference, however, had been huge in the 1980s but reduced significantly since 1996. Indeed, between 2001 and 2005, crop farming contributed more to the GDP than livestock farming (NSA, 2017). The decline in livestock population affected the Namibia economy hugely (Meatco, 2016). This is because Namibia is a net exporter of beef, lamb and mutton and beef is said to be the principal commodity amongst others (Meat board, 2015). Namibia enjoys a revealed comparative advantage in exporting on hooves cattle, beef in the regional markets (Angola and South Africa), and is one of the very few African countries that meet the strict import regulations in the international lucrative markets such as in European Union market, Norway and Hong Kong (Meat board, 2015).

According to Meatco Namibia (2018), the total cattle population in Namibia is approximately 2.3 million. However, the number of cattle slaughtered for the reporting year 2018, was 81,984 cattle south of the veterinary services (SVCF). The year 2016/17 cattle slaughtered was 91,558 head of cattle, which is 9,574 less than the previous year, representing a decrease of 10.4 per cent. It is also 15.3 per cent lower than the budgeted number of 96,811. Despite the market opportunities that exist, the continuous declining trend in annual cattle marketing affected the production and supply of beef in the world in general, and Namibia in particular, such that the rising consumer demand cannot be met in both local and international markets To ensure continuity in beef supply, all efforts should be made from all beef value chain members to increase productivity and off-take rate from the communal farmers to enable them to compete in the local, regional and international markets.

According to Wandofa and Sassi (2017), in developing countries, agricultural advisory services (AASs) are regarded as a key component of economic development strategies in terms of improving productivity and livelihoods. Thus, to enhance livestock productivity in rural communities, better farm management practices should be adopted. Thus, the conducting of specialized training courses for the benefit of livestock farmers can enhance their productivity and efficiency. In Namibia, Farmers Support Project was implemented since 2010, which seek to capacitate farmers to upscale their farm productivity, and eventually, increase food security as per the fifth Namibia Development Plan of 2017/18 and Harambee Prosperity Plan. One of such projects is the Farmer Support Project (FSP) currently known as the Agri Advisory Services Division (AASD).

FSP functions in almost all regions across the country to impart farm management knowledge and skills to communal livestock farmers. One of the main aims of the FSP is to develop entrepreneurship among the rural farmers and manage their farming businesses profitably and sustainably. Thus, the proposed study intends to investigate whether the training intervention influences the cattle farm output and efficiency, and in return persuade more funders or donors to finance the implementation of more capacity-building projects to enhance agricultural growth in Namibia. The Kunene region will serve as a study area.

1.2 Problem statement

It is generally observed that farmers in the communal areas of Namibia, particularly in the proposed study area, lack the required experience and skill to operate livestock enterprises profitably and sustainably. As a result, they do not know how to allocate and manage resources efficiently. This result in poor quality livestock with low price premium in the market, particularly in the formal markets resulting in low-profit margins, low productivity. This eventually translates into a few number of livestock produced and low off-take rate. It is reported that communal farmers lack competitiveness in the markets, approximately 66% or more of communal livestock sold to abattoirs are C grades and below (Meatco Namibia, 2018). Unfortunately, farmers in communal areas in Kunene Region, for example, do not have the necessary skills to cope with the ever-changing environment and to operate as a business.

This concern has led to various intervention programmes, one of which is the Farmer Support Programme (FSP). This project commenced in 2010 and ended on 30 March 2017. From 1 April 2017, Agribank incorporated the FSP into its strategic plan and renamed it Agri Advisory Services Division (AASD) to continue where the FSP ended. The main objective of the FSP (new AASD) is to capacitate farmers with the necessary skills, knowledge and behavioural change to upscale their farm productivity and efficiency. To the best of the researcher's knowledge, no study was carried out in Namibia to evaluate the effect of training on productivity. Thus, this study aims to analyse the effects of training intervention on cattle farmers who benefited from the FSP in terms of farm productivity and efficiency. The study will serve as feedback to both the farmers and the stakeholders of the project.

1.3 Research objectives

1.3.1 Main objective

- The main objective of the study is to evaluate the effect of training intervention on farmer's productivity and efficiency.

1.3.2 Specific objectives

- To determine whether farmers who received training are more productive and efficient than those who did not.
- To evaluate whether a farmer's productivity and efficiency were due to training and the degree to which training affected output.

1.4 Research questions

- Do farmers who receive training more productive and efficient than those who did not?
- To what extent training affected farm productivity and efficiency?

1.5 Research hypothesis

- H≠0: There is no statistically significant difference between training and cattle farm productivity and efficiency.
- H=1: There is a statistical difference between training and cattle farm productivity and efficiency.

1.6 Significance of the study

This study is an important step in policy formulations by policymakers who may adopt a better policy by complementing the research findings. Stakeholders involved in the capacity building can also use the research results to enhance their capacity-building platforms in a manner that will meet the farmers' needs. The study would again add to the body of knowledge and literature for other researchers. With the issues, therefore, this study will be not only relevant but also necessary for contributing to sustainable farming in the study area. It may also be used as reference material for those who want to carry out studies in a similar area.

1.6.1 Cattle farmers in Kunene region

Cattle farmers need to have information on farm productively, efficiently and produce quality animals that can fetch premium price from both formal and informal markets. It is practically observed that farmers are neglecting critical husbandry practices due to lack of knowledge and skills; this resulted in reduced calving rate and offtake rate. Therefore, this study seeks to provide farmers with information on the benefits of receiving training and good livestock husbandry practices that can be adopted to upscale their cattle enterprise productivity.

1.6.2 Training providers.

The study will provide the training providers and funders with a clear picture of how best the capacity-building platforms can be designed to suit the needs of the farmers. It will further

enable training providers to gain insights into whether the training provided is worth investing or not and, whether training yielded fruits or not.

1.6.3 Policy Makers

The investigator seeks to enable policy makers to gain insights into whether the training of farmers can contribute significantly to Agriculture sector transformation and development. it will also facilitate extension services and capacity building to the farmers if food security is to be achieved at the household and national level.

1.7 Limitations of the study

The investigator faced some financial challenges, which limited the enumeration to a lesser sample unit than expected. In addition, the research was limited due to the willingness to participate by the respondents in the targeted area. The study was restricted to farmers who received training from the FSP/AASD from 2010 to date and those who did not receive training to serve as a dummy. Thus, Unavailability of farmers had a significant influence on the sample size targeted for the analysis.

1.8 Research Design

The study determined whether there is a quantifiable causal relationship between farmers' training and farm output. The degree of output change for the farmers who received training in comparison to those who did not. Creswell (2014) suggests that mixed-method yield a more comprehensive analysis and both the qualitative and quantitative complement each other. Therefore, a mixed qualitative and quantitative research approach will be adopted. The researcher will use qualitative research for exploring while generalization of findings to a large population will be done through quantitative research. According to Creswell (2014), mixed-method (qualitative and quantitative) is both a method and methodology for conducting research, which involves the collection, analysing and integration of qualitative and quantitative research in one research study. Using of mixed-method will be a better method for this study because combining qualitative and quantitative approach will provide the researcher with more evidence and a better understanding of a research problem than when using either of the approaches alone (Creswell, 2014).

A survey was conducted to determine whether training enhances the productivity and efficiency of cattle farmers. Two research tools instruments were utilised, a questionnaire and face-to-face interviews with the farmers. Secondary data were obtained from the Agri Advisory services (AASD) and literature review. The AASD provided the sample frame where the respondents were sampled. Two hundred and fifty (250) farmers sample size was targeted out of 500 farmers trained, and the simple random probability sampling methods were used to determine the respondents to be interviewed. Also, two hundred and fifty farmers (250) who did not receive the FSP training were included in the research to serve as a control.

1.9 Data Collection procedure

The sample size was calculated using the formula by Yamane (1967) was used to determine the total sample size which includes the trained and non-trained population:

$$n = N \quad (1 + N(e)^2) \qquad (1)$$

Where (N) is the population; (e) is the assumed margin of error of 5%. A sample size of 222 was calculated using this formula. To compensate for errors and missed appointments during the survey, 250 samples were targeted.

1.10 Data Analysis

In other to analyze productivity and efficiency, a Stochastic Frontier Analysis (SFA) model was fit using the Cobb-Douglas production function. The aim of using the SFA was to examine the various production frontiers of the participants and determine the best frontiers among the farmers who participated in the training. This will be averaged to determine the mean frontier. The result was compared to to the frontier facing the non-participants.

In addition, a logistic regression model was fit to analyse the treatment effect of the farmers' training on their output. Aigner, Lovell and Schmidt (1977), introduced SFA, Meeusen and van Den Broeck (1997) first used stochastic production frontier models. Aigner et al. (1977) and Meeusen and van Den Broeck (1997) stated that the inefficiency effect could be expressed as a linear function of explanatory variables. This will be calculated to determine the degree of efficiency between the two sets of farmers. The research study used SPSS and Microsoft Excel to analyse the data. Charts and tables were used to describe how training can affect farm productivity and eventually the efficiency of the farming business.

1.11 Ethical considerations

The following ethical safeguards were considered during the study, this includes.

- Anonymity: will be maintained by identifying research participants' codes (letters) which are not traceable back to their names.

- Confidentiality: the data obtained from this study will be kept in stricter confidentiality and will not be disclosed to anyone except to the research Supervisor.

- Informed consent: participants will be given as much information as possible pertaining the study, so that they will be able to make an informed decision to participate or not to participate in the study. Therefore, verbal consent will therefore be sought from the participants.

- Non- maleficence: during this study, the researcher will try not to cause any harm or hurt to the participants either physical or by the questions that the researcher will pose to the participants/farmers in the questionnaire.

- Privacy: the researcher will ensure the privacy of the participants by ensuring that no one will be allowed or access the answered questionnaire except the researcher or the supervisor. The participants will be ensured that no private information will be shared without an individual's knowledge or against his or her will.

CHAPTER TWO

LITERATURE REVIEW

2. Introduction

This section provides some background, theories, concepts and principles that are related to the study. These form the basis for the theory in the literature. The understanding of the research gap can be validated by discussing the theory and empirical literature that explains the phenomena under study. For the chapter organization, the flow shall start with the definition of farm productivity and efficiency and then deepen to discuss the theoretical literature on how capacity building and education can affect the farmers' output and efficiency. The literature constitutes the scholar's contribution in the concept of farmer's capacity building, Farm efficiency and statistical model applied as well as related studies on training conducted in Namibia and researchers diverse of views on the topic.

2.1 Capacity building in Africa

GSIARS (2017), reported that several countries had introduced policies and measures to improve farming productivity and efficiency. The initiative is prevalent in countries where agriculture is a major economic sector, and with a wider productivity gap between primary sector and other industries. GSIARS (2017), further alluded that enhancing agricultural productivity is particularly important to a developing country like Namibia, because of its active contribution to poverty reduction through food security as well as higher farming income.

2.1.1 Effect of training on farm Productivity and efficiency

Wordofa and Sassi (2017), analyzed the impacts of farmers training center on household income in the Eastern Ethiopia, and the result shows that, there is statistically significant difference for farmers that received training. Wordofa and Sassi (2017), further alluded that level of education, household size, asset ownership, experience in farming, and organizational membership are significant predictors of participation in modular training.

Similarly, Dessale (2019) conducted a study on the analysis of technical efficiency of smallholder wheat-growing farmers of Jamma district, Ethiopia. The study results show that the majority of Ethiopians, mostly poor living in rural areas depend on agriculture for a living, and their farming productivity was very low. Dessale (2019) study findings also show that inefficiency existed among the farmers, and this was attributed to lack of knowledge and other factors. Dessale (2019) further argued that training, age, education, improved seed, and credit had a negative and significant effect on technical inefficiency. According to Dessale (2019), inefficiency in farming production comes from inefficient use of scarce resources. Measurement and understanding of efficiency in farming production is a key component for agricultural

development, and it provides vital information for making useful and relevant decisions on the use of limited resources and reformulation of agricultural policies (Dessale, 2019, p. 2). Mussa, Obare, Bogale and Simtowe (2012) states that to increase crop production and productivity of small farmers requires a good knowledge of the existing efficiency or inefficiency level inherent in the agricultural sector. Based on the literature, there was less evidence to determine the effects of training on productivity and efficiency of cattle production.

Similarly, a study was conducted to test the impact of the Farmer Support Programme (FSP) on household income and sustainability in smallholder crop and livestock production in the Eastern Cape and KwaZulu-Natal (Sikwela & Mushunje, 2013). Key challenges identified for smallholder farmers are lack of access to information, lack of technical skills, and great marketing and transaction costs. The results show that the FSP significantly contributes to better incomes of smallholder farmers. In this regard, the FSP and collective marketing of smallholder farmers have a positive effect on output and income. Therefore, the welfare of smallholder farmers is improved by the FSP (Sikwela & Mushunje, 2013).

Wordofa and Sassi (2017) provided strong evidence that farm output is positively correlated with training. The analysts, through their estimation, found that the average effect of training on farm income is positive and highly significant, ranging from 9557 Birr per year to 10,388 Birr per year. Another study seeking evidence of the impact of participation in training and mentoring programs found that mentoring services offered to soybean farmers in Ghana had a greater impact on technical efficiency than income. Based on the study, participation in mentoring programs improved the efficiency of farmers by providing training, information, and extension on input application (Edward, 2015).

Agribank of Namibia (2016), evaluated the repayment ability of the bank clients who benefited from FSP mentorship and training since 2010. The results show that there is no correlation between training and repayment of loans. Agribank (2016), further argued that the negative correlation could be attributed to the fact that the FSP mentorship and training model, was not designed to enhance repayment of loans but rather for upscaling farm output and income. In this regard, improved production and income may not necessarily translate into prompt repayment of loans as farmers willingness to repay the loan can be influenced by many factors (Agribank, 2016). Thus, to enhance farm efficiency and productivity tailor-made extension services is required (NNFU, 2019).

2.1.2 Education level and farm output

Musemwa, Mushunje, Muchenje, Aghdasi and Zhou (2013) study revealed that secondary education is positively related to farmers' economic efficiency in Shamva a small district in Zimbabwe, while good production knowledge affected allocative efficiency. Musemwa et al. (2013) further observed that farmers age, excellent product knowledge and level of specialization affected technical efficiency. Their study, however, focused mainly on the factor

that affects the efficiency of field crop production in Zimbabwe. This is entirely different from the current study in that the focus was on analyzing the effect of training on cattle farmers' productivity and efficiency, focusing on farmers in Kunene region. Edward (2015) revealed that Income levels are only raised over the longer-term through continuous use of the knowledge provided by the mentoring services. Stochastic frontier model, under Cobb-Douglas function, was used to analyze the data for this study. The authors indicated that providing tailor-made services to farmers on a needs-basis is necessary to improve farm productivity and incomes (Edward, 2015). In the same manner, several authors highlighted indirect contributions to economic growth made by agricultural development.

2.1.3 Impact Assessment Approaches and Model Application

According to Imas and Rist (2009), research studies that assess the effect or impact of treatment seek to address the descriptive, normative and cause-and-effect questions. Imas and Rist (2009) further argued that descriptive questions aim at determining what is happening to the relationship among variables. While cause-and-effect questions assess whether the outcome is being realized as a result of training intervention and the difference that these outcomes have on the targeted population (Imas & Rist, 2009). As such, effect analysis seeks to answer a cause-and-effect relationship. According to Gertler et al. (2011), impact evaluation is structured around the impact of a program or treatment on an outcome of interest. In this study, the outcome of interest is calving rate, and offtake rate of the cattle farmers.

Regarding unobserved technical inefficiency, Aigner, Lovell and Schmidt (1977) proposed a stochastic frontier analysis (SFA) technique by presuming non-negative technical inefficiency in the statistical noise of the traditional production function. The SFA method has since then been extensively applied in the literature to explore producers' technical inefficiencies (Katuwal, Calkin & Hand, 2016). Following this trend, this study applied the SFA method to explore technical inefficiency in cattle enterprise for farmers in Kunene region.

CHAPTER THREE

LIVESTOCK INDUSTRY OVERVIEW

3. Introduction

Livestock plays a vital role in the Namibian economy and the life of its people. The chapter ends with a short discussion of how a successful capacity building can transform livestock farmers to eradicate extreme hunger and poverty through provision of food and employment as per the Millennium Development Goals Report of 2015 that has set out to achieve eight goals, the first of which is to "eradicate extreme hunger and poverty" (United Nations, 2015). In addition, The United Nations Educational, Scientific and Cultural Organization (UNESCO) (2015), lists seventeen Sustainable Development Goals (SDGs), the first of which is to ensure "no poverty" and the second "zero hunger" (UNESCO, 2015). Therefore, Price Waterhouse Cooper (PWC) (2012), stated that Namibian agricultural sector is the second largest primary industry after mining and, among all the agricultural sub-sectors livestock stood to be a major source of employment. It is estimated that the commercial farming sector, mainly based on cattle and sheep farming, is the private sector largest employer in Namibia, employing between 25,000 and 30,000 farm labourers and the dependents (Millennium Challenge Account (MCA), 2008). It is against this framework of poverty and hunger that the world is aiming to supply adequate food to feed the growing population and the next generations (PWC, 2012). Thus, this could be achieved through capacity building of farmers.

3.1 Livestock production

According to Van Wyk and Treurnicht (2013), In terms of livestock output, beef production contributes mainly to the economy and is distributed through the various geographical regions of Namibia. Van Wyk and Treurnicht (2013), further argued that the Namibia livestock industry is divided into two sectors, communal and commercial livestock farming. Most communal farmers fall beyond North of the Veterinary Condon fence (well known as Redline), and Commercial farmers fall within the South of the Codon fence (Van Wyk & Treurnicht, 2013). According to Namibian National Farmers Union (NNFU) (2019), the Livestock production in communal areas is low, due to poor livestock farming practices such as conservative stocking rates, overgrazing and poor rangeland management amongst others. To this end, livestock indicators such as calving rate, offtake rate etc. that defines productivity are significantly low. This is in contrast to the commercial sector, where farmers have full ownership of the farmland and the farm areas are divided into fenced ranches, and further subdivided into several camps (NNFU, 2019). NNFU (2019), further alluded that demarcated farming setups make it easy for farmers to practise rotational grazing. Meatco (2019) reported that a total of 1 521 cattle was slaughtered north of the veterinary cordon fence (NVCF) 2017 /2018, in contrast to 62 086 cattle sourced south of cordon fence.

3.1.1 Commercial farming

According to the Namibia Training Authority (NTA) (2014), Commercial farmland in Namibia covers approximately 44% of the total land area, and it houses 10% of the population. NTA (2014) further stated that the commercial sector which is well developed, capital-intensive and market-oriented, (including exports), is found south of the Veterinarian Gordon Fence, (red line), which comprises the southern two-thirds of the country. NTA (2014) Further stated that presently commercial sector consists of approximately 4 500 farmers on title deeds land. Meat Board of Namibia (2012) indicated that approximately 37 million ha of land was in the form of title deeds ownership, of which previously disadvantaged individuals and the state-owned 25 %, (amounting to approximately 9,400,000 ha). The livestock production in Commercial area accounts for almost 70% of national agricultural output and comes from 52% of the farming/grazing land (Meat board, 2012). NTA (2014) also stated that red meat production is the most significant contributor to commercial farming income. This means that commercial farmers benefit from the lucrative export market and farming is taken as a business in comparison to communal farmers where the majorities farm for various traditional reasons.

3.1.2 Communal farming

According to NTA (2014), the Communal farmland encompasses 41%, of Namibia`s landmass. It is referred by many as a residential area. Communal areas differ from the commercial areas in terms of the production systems, farming objectives and property rights. Communal areas individual households are allocated with cropping areas normally demarcated by a fence, while the grazing areas are shared by members of a community or village (NTA, 2014). There are 12 emerging trends of large illegal fenced off exclusive ranches being established in the communal areas where a group of large and wealthy communal farmers are developing (NTA, 2014). Overall, the communal sector is associated with subsistence farming enterprises, such as small fields of cereals, some vegetable gardens and small numbers of cattle and goats used mainly for own household consumption (NTA, 2014). NNFU (2019) stated that communal farmers practice low input - low output livestock production system (NNFU, 2019). Production factors such as labour, is mainly family labour other inputs used are limited. It is worth noting that communal farmers that have substantial herds of cattle do not treat the enterprise as business and derive their income from non-farming sources (NTA, 2014). NNFU (2019), indicated that there is a need for a paradigm shift by livestock producers regarding traditional reasons for keeping livestock towards more commercially oriented objectives. To this end, promoting this transformation should be supported by information and education campaigns focusing on recognizing livestock farming as a business for generating wealth.

3.1.3 Livestock farming efficiency

The main inputs for the cattle enterprise include supplemental feeds and licks, veterinary medicines, amongst others (Meat board, 2015). Cattle production inputs are available in various veterinary shops across the country (NNFU, 2019). According to NTA (2014), farmers complain

that some animal medicines are very expensive to small scale farmers. Thus, the cost of vaccines heavily depends on the active ingredients, several diseases and number of dosages such as supavax can be classified as a 3 in 1 vaccine that can prevent three diseases such as anthrax, botulism and black quarter (Van Wyk & Treurnicht, 2013). According to NNFU (2019) farmers should know which veterinary medicine/ remedies should be used at what time. Thus, farmers with better knowledge in farming use these drugs efficiently by purchasing in organized groups to share the cost of vaccines (NNFU, 2019). Inputs to formulate feed are quite very high, and this translate to high feed cost and thus, efficiency is compromised, mainly when the feed is utilized wrongly (NNFU, 2019). This means, with a lack of know-how and limited inputs for cattle in remote areas, it is difficult for farmers to follow the proper vaccination or feeding program to enhance their productivity.

3.2 Livestock marketing, Meat Safety and Traceability

According to NNFU (2019) Namibia Export beef to the European Union countries (EU), however, there are stringent sanitary standards to be met. Van de Brug, Lucas, Cnossen, and Houben (2014), concerns about meat safety and quality have increased recently as the consumers are very health conscious of what they consume daily. Meat board (2015) states that marketing livestock is interlinked with consumers' requirements and needs. Meat board (2015) further stated that the maintenance of Namibian animal health status is of crucial importance in accessing the lucrative market of the European Union, Norway and South Africa. Thus, Namibia has Namibia livestock traceability system (NAMLITS) in place that tracks and trace livestock back to the farm of origin (Meat board, 2015). Traceability system involves capturing livestock movements, giving unique animal identification; this makes it easy to control disease outbreaks and enhance meat safety (Meat board, 2015). Van der Brug et al. (2014) stated that repeated occurrences of food safety incidents involving the health of humans and animals had devastated the world on several occasions.

3.2.1 Meat and meat products safety

Food for household consumption needs to be socially acceptable, and the food must be safe (Connolly-Boutin & Smit, 2015). According to Pereira and Vicente (2013), beef contains several nutrients necessary for a balanced diet. Beef nutritional elements include, zinc, iron, selenium, vitamin B12, amongst others and are popularly known as a vital source of protein (Pereira & Vicente, 2013). Thus, beef forms part of a balanced meal; nevertheless, over seven billion people today lack access to meat as part of a balanced diet (Pereira & Vicente, 2013). Jin et al. (2004), stated that meat sectors such as poultry sector suffered the dioxin crisis, the pork sector suffered Medroxy Progesterone Acetate (MPA) crisis and the beef sector in question suffers from Bovine Spongiform Encephalopathy (BSE) (Jin et al., 2004). It is against this background that food safety became an increasingly important issue (Hilton & Hunt, 2011). Hilton and Hunt (2011), further argued that there had been food safety scares in the world in the past decade, and consumers not only distrusted governments but in most cases overreacted, partly caused by over-hyped media attention. Thus, Meat board (2015), states that there are standards prescribed by the FAN Meat Scheme based on Namibian legislation, these are standards to

which all beef producers in Namibia must comply with. Meat board (2015) further stated that the standards also contain basic principles of animal welfare, veld management, and storing of chemicals, making the scheme both attractive and necessary for international trade. Several Initiatives to improve food safety were undertaken globally such as Global Food Safety Initiative (GFSI) and Food Safety Modernization Act (FSMA) of 2011 initiatives driven by retailers to improve food management systems, this system attempt to reduce duplication and consolidate private food safety standards (Hobbs, 2014). According to Ndou (2012) the FSMA act was passed 2011 to amend the Federal Food, Drug, and Cosmetic Act of 1938; and the GFSI was launched in 2000. The key to GFSI priorities is to set a benchmark for food safety standards such as the British Retail Consortium, Safe Quality Foods (SQF) and International Food Standards (IFS), improving cost efficiency throughout the food supply chain (Ndou, 2012).

3.2.2 Traceability of animals

Mogensen et al. (2015) stated that the importance of traceability of animals and animal products has grown as meat consumers require the information of the meat and meat products from the farm of origin to the fork. Meat board (2015) stated Namibia introduced the Namibia livestock identification and traceability system (NamLITS) 2004, to remain an exporter of meat to the EU and other countries. According to Meat board (2015), NamLITS involves ear-tagging as well as branding of the animal. This system helps to prevent stock theft by tracing the legitimate owner of the animal on the database. Dahlborn et al. (2013), indicated that ear-tags could be made either from metal or plastic. They are pre-numbered, available in different sizes, and inserted with specific pliers to an animal (Dahlborn et al., 2013). According to Meat board (2015), the Radio Frequency Identification (RFID) ear-tags used are placed on both ears, and the information is read into the NamLITS database. Meat board (2015) further explained that the system captures owner details and provides the farmer with a specific animal branding symbol. Thus, the centralized database tracks the animal movements and ensures that the relevant requirements for European Union exports are met (Meat board (2015).

Meat board (2015) also states that Namibia has strict legislation in place to regulate livestock producers to brand their animals as per the Stock Brands Act 24 of 1995 that focus on registration, branding, transfer and cancellation of ownership, investigations, prohibitions and offences, and penalties. Schultz (2013) similarly stated that Livestock traceability systems assisted farmers to adhere to quarantine measures for specific regions and enabled them to export to other countries.

3.2.3 Livestock marketing

According to Meatco (2019), Namibian meat producers are alert to the three international markets such as the Norwegian, UK and European Union markets which accounted for 74.68 per cent of the total revenue, of the Meatco Company representing nearly three-quarters of Meatco's overall income. Meat board (2018), revealed that China could be an important market for Namibia as it imports approximately 6.5 million tons of beef, 250,000 tons of mutton, 2.3 million tons of pork and 1.7 million tons of poultry per annum. However, despite the lucrative

niche markets available to the producers, livestock farmers, particularly in communal areas, keep cattle for numerous reasons beyond just commercialization such as security in numbers and the perception of being rich when own large flock (NNFU,2019). According to Meatco (2015) the low supply of cattle from the communal farmers in the northern communal areas (NVCF) led to the decline in net income of the company. As a result, Meatco found the business no longer viable in the north of veterinary cordon fence (NVCF) and shut down their operation since the end of 2014. Thus, according to NNFU (2019) the current main markets for communal farmers includes informal markets such as open markets, weddings & funeral. NNFU (2019) also revealed that the Opuwo abattoir in Kunene region needs to be rehabilitated and expanded for the large stock farmers from the region to market their livestock and save transport costs. They further argued that some 20,000 plus live cattle and cattle equivalents in the form of fresh meat products are traded from south of the VCA to the NCA annually (NNFU, 2019). This is mainly because of the unwillingness of farmers to market their livestock in the communal areas as compared to commercial farmers, who perceive farming as a business. Thus, NNFU (2019) further argued that awareness through training and other capacity-building platforms is highly required to sensitize farmers to recognize farming as a business. This begins by selling young animals in good condition that have tender meat in order to high price from the market.

3.3. Contemporary pressure on the livestock industry

Bharucha (2013), stated that the agricultural sector is under constant pressure to fulfil the basic need of enough food for the world's populace. According to Population Reference Bureau (2015), the agricultural sector had the immense task of feeding more than 7.3 billion people in 2015, a number estimated to reach 9.19 billion in 2050 (Thornton, Jones, Ericksen, & Challinor, 2011). Therefore, agriculture sector faces a three-fold challenge, which includes the need to increase in agricultural production, and it should be done sustainably, without causing resource degradation (Bharucha, 2013). However, low annual rainfall (Drought) combined with other factors such as animal diseases, urbanizations limit much of agricultural activities, including livestock farming (Bharucha, 2013).

3.3.1 Drought

Van Loon (2015) defined drought as a complex phenomenon considered to be a natural hazard causing several environmental, societal, and economic problems. Thus, McFerron, Almeida, and Davison (2016), indicated that the effect of the worst drought in 50 years is devastating the agricultural sector in Sub-Saharan Africa. Ildikó and Rădulescu (2015), similarly argued that the agriculture sector is facing several challenges, with climate change at the top of the list. Thornton (2011), indicated that the average world temperature is increasing by as much as 4°C, an increase that will reach its full impact by 2050, but likely to happen even sooner. Garnett et al. (2013), stated that climate change has an undeniable effect on livestock farming, and this include, decrease in animal welfare particularly in areas where there is insufficient feed or poor health. In addition, Devendra (2012) believed that enough is not being done to address the issues of heat stress on the animals, insufficient availability of feed resources and control of disease outbreaks, in order to salvage the situation, particularly in developing countries.

However, drought is a global concern, not only limited to Africa (Cheeseman, 2015; Kampragou et al., 2015). Leroy, Ruel, Frongillo, Harris, and Ballard, (2015) similarly argued that climate variations exaggerated extremely to various communities, households and individual level.

3.3.2 Animal health and diseases

Nowadays, consumers are health conscious and prefer to purchase meat from the animal that is free from disease and other health conditions (Connolly-Boutin & Smit, 2015).However, animal welfare decreases in areas where there is insufficient feed or poor health caused by diseases, and certain selective breeding practices result in "congenitally harmed animals" (Garnett et al., 2013). NNFU (2019) reported that common cattle diseases in Namibia include Contagious Bovine Pleuropneumonia (CBPP), Foot and mouth diseases (FMD), Brucellosis, Anthrax, Botulism, lumpy skin, pasteurellosis to amongst others. CBPP and FMD are defined as diseases of economic importance amongst others and are prevalent in the northern part of Namibia due to free-roaming buffalos in the southern part of Angola. Meat board (2015) indicated that on hooves animal (cattle, sheep, and goats) and their products are restricted to move from the Northern part of the Veterinary Cordon Fence (Northern part of the country) to the south of the veterinary Condon fence (NVCF). On the other hand, they can move from the South to the North of Namibia. According to Hubschle (2005) Namibia is divided into three disease zones, namely, Infected, protected and free zones (Figure 3.1.).

Figure 3.1: shows the VCF as well as the high-risk areas for foot-and-mouth disease.

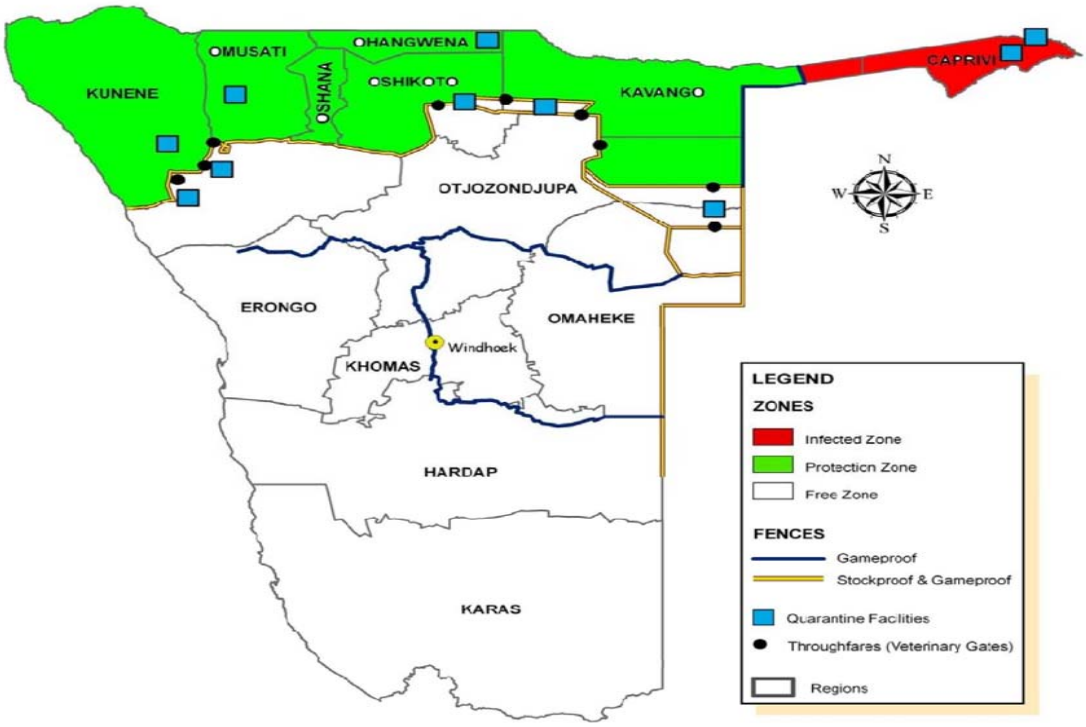


Figure 3.1. Foot-and-mouth disease zones and fences in Namibia (Adopted and adapted from Hubschle (2005).

The free zone has been free of FMD outbreaks for the past 60 years and is the only zone recognized by the OIE from where meat and meat products could be exported globally (Ministry of Agriculture, Water and Forestry (MAWF), 2017). The quality and value of livestock products can be impacted by animal health in many ways and this including reduced feed conversion rate (FCR), high mortality and morbidity, resulting in reduced calving and offtake rate (MAWF, 2017). Therefore, MAWF (2017) further indicated that the full implementation of the animal disease control programme/ vaccination calendar is vital in livestock production.

According to Schultz (2013), Namibia is at high risk of FMD outbreaks, due to exposure from Angola, Zambia and Botswana, where buffalo cross the borders and are the carriers of FMD. Exposure to buffalo is challenging to restrain (Schultz, 2013). In addition, Fourie (2013), indicated that If a buffalo is spotted in the North East of Namibia, that area is quarantined for twenty-one days. If the disease further transmitted to other game or livestock, the area can be quarantined for up to six months (Fourie, 2013).

3.3.3 Urbanization

It is popularly believed that urban areas have better infrastructure, employment opportunities, better education and access to health services (Nchuchuwe & Adejuwon, 2012), this made urban areas more attractive to younger people. According to Muhammed (2007), governments are not investing as sufficiently in agriculture as they should, but rather in agricultural trade,

resulting in the primary agricultural sector being in decline. This compromises the food security in the country and challenges the healthy diets for the poor (Saghir, 2014). This means that when the young people /youth leave farms to the city, this challenge the ability of the country future food production as youth are not exposed to farming.

3.3.4 Insufficient knowledge on farming

The Directorate of Agricultural Production, Extension and Engineering Services (DAPEES's), Under the Ministry of Agriculture, Water and Forestry (MWAF) is the custodian in ensuring the agriculture extension service is provided to farmers to upscale their farm production (MWAF, 2017). In support of this, AASD under Agribank of Namibia, offers training-related services to farmers, to enhance their knowledge and skills in farming practices, and ensure they utilize and manage their resource efficiently and sustainably. Thus, Training helps them to realize a better return on investment. Most of the training is conducted in collaboration with DAPEES (Agribank, 2019).

Training related services provided to farmers include the hosting of Farmer's Information Days (FIDs), Evening / Day Lectures) Practical sessions; and Short Training Courses (Agribank, 2019). Provision of training assists farmers in understanding the complexity of the farm as a viable business enterprise and enable them to manage the available resources efficiently and sustainably (NNFU, 2019). Thus, due to financial constraints, DAPEES and AASD, some farmers could not be reached for farming advice.

CHAPTER FOUR

METHODOLOGY

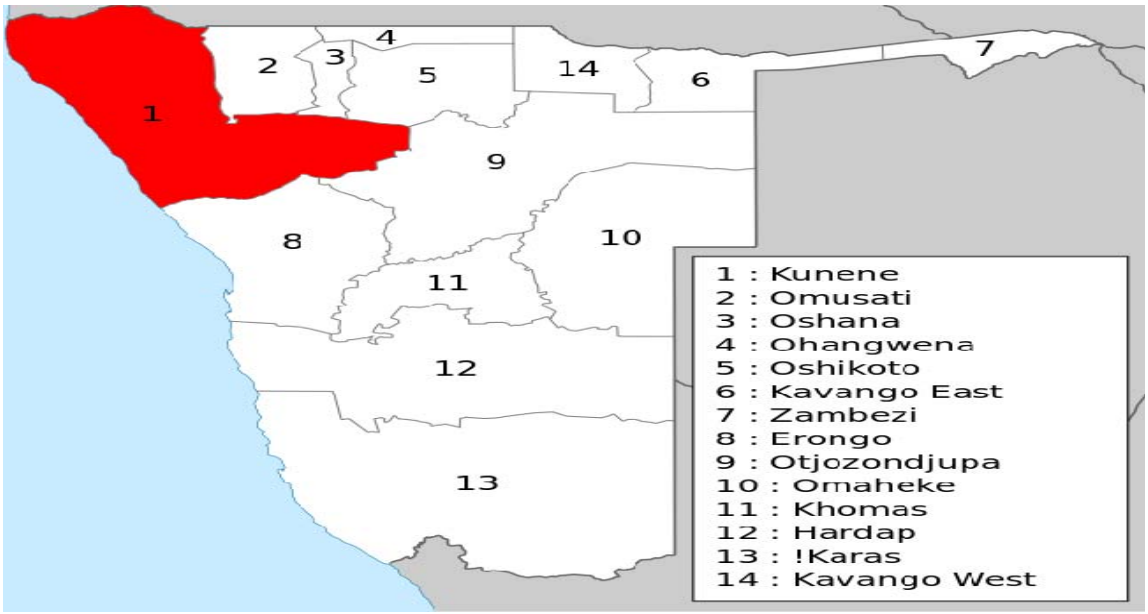
4. Introduction

This chapter discusses the research methodology, which was applied to answer the research questions. It explains the research design, sampling technique, data analysis and presentation methods.

4.1 Scope

In this study, the target population is the Kunene region cattle farmers, including, the farmers in the communal and commercial areas. Five hundred (500) farmers benefited from the training offered by FSP/AASD since inception till today. Thus, the study focused on 250 farmers that benefited since inception to determine the effect of training on their farm output. It is from this population (250 farmers) that a sample was taken for the study (see Figure 4.1). This region is characterized by mountains with few areas suitable for crop production such as Sesfonteins amongst others; thus farmers commonly keep livestock for livelihood. The annual average rainfall ranges between 250-450 mm. This can be highly variable due to climate changes. According to the Namibia meteorological office (NMO) (2019), the temperature ranges between 29 °C – 31 °C, however this varies as well with climate variations.

Figure 4.1: Namibian map - Kunene region in red



Source: Ministry of urban and rural development (2018)

4.2 Sample & sampling

The data for the study was collected through a survey conducted in the Kunene region (see Figure 4.1). A consultative meeting was held with Directorate of Agricultural Production, Extension and Engineering Services (DAPEES) and Kunene regional Mentor before the survey. During the meeting, an arrangement was made with District DAPEES officials and Kunene Agribank Mentor who notified farmers of the ongoing survey exercise, as they work closely with farmers on the ground. The respondents who own cattle, and who were willing to volunteer information were interviewed and the confidentiality of their information and anonymity thereof was guaranteed. Information was gathered using a semi-structured open-ended and closed questionnaire. A total of two hundred and twenty-two cattle farmers were interviewed and they completed the questionnaires successfully.

Since the research study is a case study, a random sampling technique was used to draw the research sample. The sample constituted only cattle farmers who received training since 2010 in Kunene region; however, non-trained farmers were involved in the study to serve as dummy or control variables. For the random sampling, the list of trained farmers (sampling frame) was obtained from FSP/Agribank Agri Advisory services (AASD) database, the farmers were numbered and put in the box and selected randomly. Kunene Regional mentor and DAPEES officials assisted the researcher in conducting the interviews and completing the questionnaires thereof. The list of untrained farmers was obtained from the district DAPEES office. The reason for untrained farmers is to serve as control or dummy in this study. Thus, cattle farmers trained were able to give their opinions about the training, and their productivity indicators were compared with non-trained farmers. The sample size targeted was 250 cattle farmers; however, due to incomplete data and unavailability of farmers, the sample size was reduced to two hundred and twelve farmers.

4.3 Data collection

Data for the study were collected through interviewing the cattle farmer is with the aid of a semi-structured questionnaire. The information collected was on their perception on training, cattle production factors relating to them, cattle marketing as well as their socio-economic characteristics.

4.4 Data analysis

Stata version 13 statistical package was used to analyse the data. Treatment effect analysis was employed to determine the causal effect on treated (trained farmers) in comparison to non-treated (not trained farmers). The adjusted regression model was fit to determine the potential outcome of the training. In addition, the Stochastic Frontier Analysis (SFA), was applied to determine the production frontier and compare the technical inefficiency of the farmers.

4.4.1 Treatment effects Framework

The critical concern for this study is to identify and analyse the effects of training on cattle productivity and efficiency. Thus, the Potential outcome mean (POM), Average Treatment Mean (ATE) and Average Treatment Mean for the treated (ATET) approaches were used for this study.

4.4.2 Average Treatment Mean (ATE)

Wooldridge (2002), defined ATE as the average partial effect for a binary variable. This means the ATE compares mean outcome if the entire population had received treatment to the mean outcome if the entire population had not received treatment. Therefore, If the impact of treatment on individual *i* is denoted by *δ i*, then the equation can be written as:

$$ATE = E(y_{1i} - y_{0i}) \quad (2)$$

Where y_1 is the outcome in case of treatment and y_0 is the outcome in the absence of treatment. The ATE has impact across individuals.

The Potential Outcome Mean (POM) for the treated t is the average potential outcome for that treatment level.

$$POM = E(y_t) \quad (3)$$

The Average Treatment effects for the treated ATET is the average treatment effects among those that received treatment.

$$ATET = E(y_1 - y_0 / t = 1) \quad (4)$$

Where E denotes the average or expected value. In this study, the investigator was interested on the training effect on the individuals who participated, which is the Average Treatment Effect on the Treated (ATT). The POM ATE and ATET methods were used to explain the causal effects of training.

4.5. Stochastic production frontier framework

In addition to treatment effect, inefficiency and constant return to scale for cattle farmers was evaluated using stochastic frontier model. The Cobb Douglas Production function gives the maximum possible output with a given set of inputs. This is different from its traditional regression counterpart, which specifies the conditional mean of output. The production function defines a boundary or "frontier", deviations from which can be interpreted as inefficiency. The econometrics of stochastic frontier analysis (SFA) provides techniques for modelling the frontier concept within a regression framework so that inefficiency can be estimated. The SFA model was used by Parikh and Shah (1994), which was derived from the composed error model of Aigner et al. (1977). Meeusen and Broeck (1977), and Forsund et al. (1980) also applied it. The Cobb-Douglas production function was linearized in the form:

$$\ln y_i = \beta_0 + \beta_1 \ln x_1 + \beta_2 \ln x_2 + \beta_3 l \ln x_3 + v_i - \mu_i \quad (5)$$

Where, $\ln y_i$ is the log of output (calving percentage), x_1 is the herd size, x_2 represents the man labour measured in man days and x_3 is the cost of production inputs measured in Namibian Dollars (N$).

The y_i represent the cattle output, for this study the output is calving percentage (Dependent variables). The independent variables include the production cost of inputs (Capital used to purchase feed, vaccine and medicines), herd size (The number of cattle) and Labour (in man/days). The v_i represent random disturbance due to factors outside the scope of the farmers which is assumed to be identically and normally distributed with a mean of zero and constant variance of $v \sim N(0, \delta^2 v)$ and it is independent of μ_1 which is a non-negative random variable associated with technical efficiency in production. μ_1 is assumed to be independently identically and normally distributed. The inefficiency model is specified as:

$$\mu_1 = \delta_0 + \delta_1 D_1 \qquad (6)$$

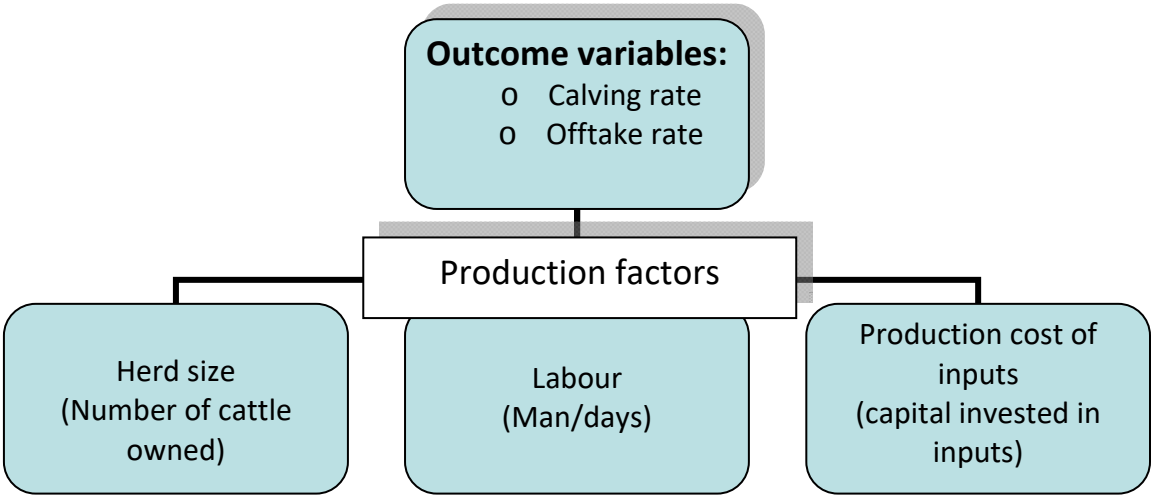
Where, D is a vector of variables that could influence inefficiency.

Thus, SFA analyses and estimate inefficiency in cattle farmers that received training and those that did not. According to Horrace and Schmidt (1996), SFA provides post estimation routines to compute both inefficiency and efficiency scores, as well as their confidence intervals. The SF model is motivated by the theoretical idea that no economic agent can exceed the ideal "frontier", and deviations from this extreme represent individual inefficiencies. The emphasis for this study will be on technical efficiency. Thus, a farmer is technically efficient if it uses the minimal level of inputs given output and the input mix or produces the maximal level of output given inputs. Thus, for this study, the two production factors (Capital and Labour) were used to determine the constant return to scale.
Thus, the production function can be expressed as follows:

$$y = \alpha K^A L^B \qquad (7)$$

where A, α and β are known parameters to be estimated and K and L represent capital and labour, respectively. The Assumptions is $0 \leq (\alpha, \beta) \leq 1$, meaning that the value of each of the coefficient must be less than 1 and the sum of the coefficients must be equal to 1 to achieve a constant return to scale. This means doubling the identified production factors, in this case, Capital and Labour, a farmer will double the output that is, realize a constant return to scale. The schematic representation of the production function is shown in Figure 4.2

Figure 4.2: Stochastic production frontier framework



Source: Own compilation (2019)

CHAPTER FIVE

EMPRICAL RESULT & DISCUSSION

5 Introduction

The data analysis chapter is organized in the same manner as the questionnaire structure starting with demographic data, Husbandry practices application, and finally, productivity and efficiency demonstrated in the statistical models used (Treatment effect and the SFA model). The following table shows the demographic distribution from the data collected from cattle farmers at Kunene region.

5.1 Descriptive statistics

5.1.1 Socio-economic characteristics of respondents

The major characteristics discussed were the distribution of respondents by sex, age, family sizes, educational status, farmer type, years of experience and years of schooling.

i) Gender distribution of respondents

Table 5.1, presented below shows a male to female ratio of the cattle farmers in the study area. There are 75 percent male and 25 percent female in the sample. This implies that cattle farming is more tasking and energy consuming, thus cattle farming in this study area is done mostly by males. This result is consistent with Munavar (2011) findings.

ii) Age distribution of respondents

The survey shows that more respondents fall between the age ranges of 61-70 years (i.e. 44.81 per cent). This is followed by age range 51-60 years; this translated to about 25.53 per cent of the cattle farmers and respondents that are less or equal to 40 years were 8.96 per cent. From the outcome of the age ranges, it was observed that those respondents between ages 51-70 years are most experienced to run the cattle farms and still in their active ages. Hence, they can afford to withstand the stress in cattle farming. This result was in line with Muhammad et al. (2013) findings. It was not surprising for the low percentage of the youth cattle farmers (i.e. between 0-40 years). This is because most of them are not financially stable to invest in cattle farming and have the desire for white-collar jobs than those that demand rigorous task and energy.

iii) Distribution of respondents according to the number of years of experience

From table 5.1. 30.66 per cent of the respondents are in the cattle farming business for less than or equal to 30 years. Farmers having 11-20 years of experience constitute 29.72 per cent; those with 6-10 years of experience are 21.70 percent and 1-5 years of experience are 8.02 per cent. It

is expected that the more the number of years farmers spent on their farm operations, the more experience they should have. Thus, the findings show that many of the respondents in the study area are experienced in cattle farming. This could mean that most of the farmers grew up doing cattle farming and believed in it as a source of food and income. This result is consistent with NNFU (2019) report.

vi. Distribution of respondents according to number of years in formal school

Table 5.1 shows that 53.3 percent of the cattle farmers had no formal education. This shows a moderate level of illiteracy among the cattle farmers. As expected, most of the farmers with more experience spent their entire life on the farm and did not go to school. Thus, the findings confirm the result on the farm experience explained previously. It is expected that the literacy level determines the rate and extent of technology adoption (Mburu, Ogutu & Murwa, 2014). However, contrary to this, the findings show that not many of the respondents have formal education. This could mean that most of the farmers are in the farming business since birth and their vast experience could help them to make a worthwhile farming decision as well as improve on the efficient use of their farm resources.

vii) The family size distribution of respondents

The findings show that 44.34 percent of the cattle farmers in the study area have a household size of eight members. This is true since cattle farming is labour-intensive, it has therefore required a sizeable number of families. This is obtainable in rural settings where household labour is used for farming. This result is consistent with Israel (2014).

viii) Distribution of respondents according to their farming type

The study showed that 86 percent in the study area are full-time farmers and had cattle farming as their primary occupation. Fourteen percent are part-time farmers, meaning they had other occupations. This implies that most of the cattle farmers in the study area depend on farming as a source of income and few have another source of income. it is expected that non-farm income earned by part-time farmers could augment their cattle farming business financially. In contrast, the result shows that most of the farmers in the study area are fulltime farmers and depend in cattle farming for their livelihood. This could mean full-time farmers, can manage their cattle farming meticulously and sustainably.

Table 5.1.: Socioeconomic characteristics of the respondents

Characteristics	Frequency	Percent (%)
Gender		
Female	53	25
Male	159	75
Total	**212**	**100**
Age categories		

30-40	19	8.96
41-50	33	15.57
51-60	52	25.53
61-70	95	44.81
71-80	12	5.66
81+	1	0.47
Total	**212**	**100**
Years of experience		
No experience	1	0.47
1-5	17	8.02
6-10	46	21.70
11-20	63	29.72
21-30	65	30.66
31-40	20	9.43
Total	**212**	**100**

Table 5.1 continued

Characteristics	**Frequency**	**Percent**
Years of schooling		
Adult learning	9	5.09
No formal education	113	53.30
Primary	13	6.13
Secondary	46	21.70
Tertiary	31	14.62
Total	**212**	**100**
Family size		
One	1	0.47
Six	63	29.72
Eight	94	44.34
Ten	42	19.81
Twelve	12	5.66

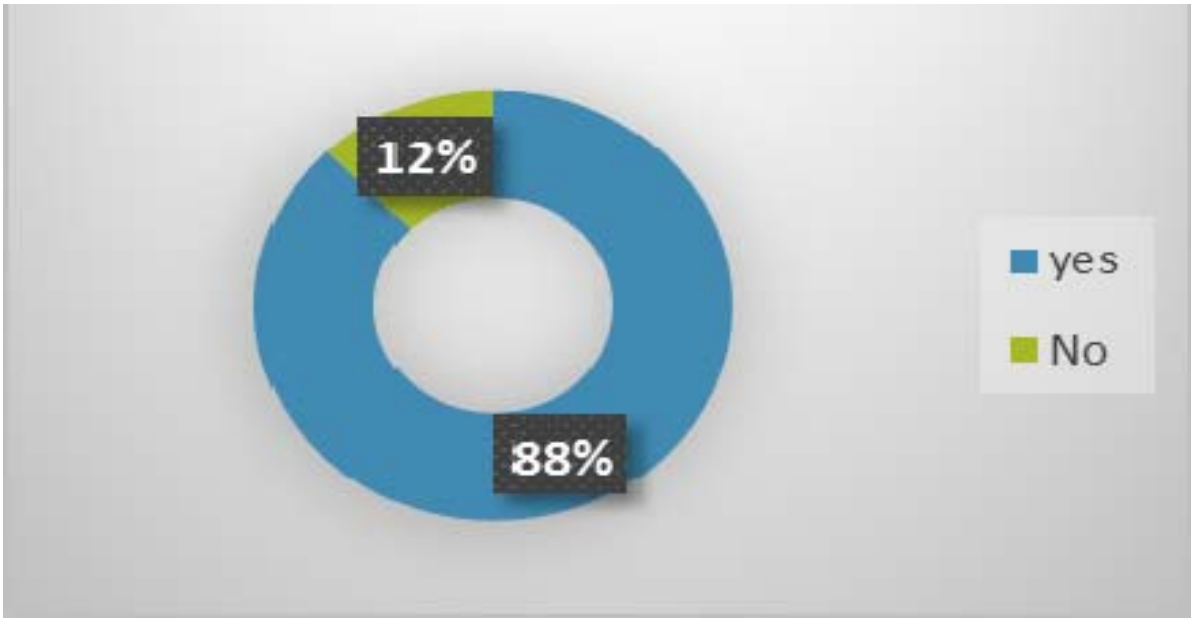
Total	**212**	**100**
Farmer type		
Full time	182	86
Part time	30	14
Total	**212**	**100**

Source : Own compilation from the survey data, (2019)

5.1.2 Cattle husbandry practices

Cattle husbandry practices involve all the mandatory processes carried out on a cattle farm. This practice includes dehorning, castration, lick supplementation, deworming and tagging operations. According to NNFU (2019), best husbandry practices can enhance productivity and efficiency in cattle farming. Thus, the study assessed the extent of the knowledge of cattle farmers regarding best animal husbandry practices and whether the adopted practices are scheduled properly.

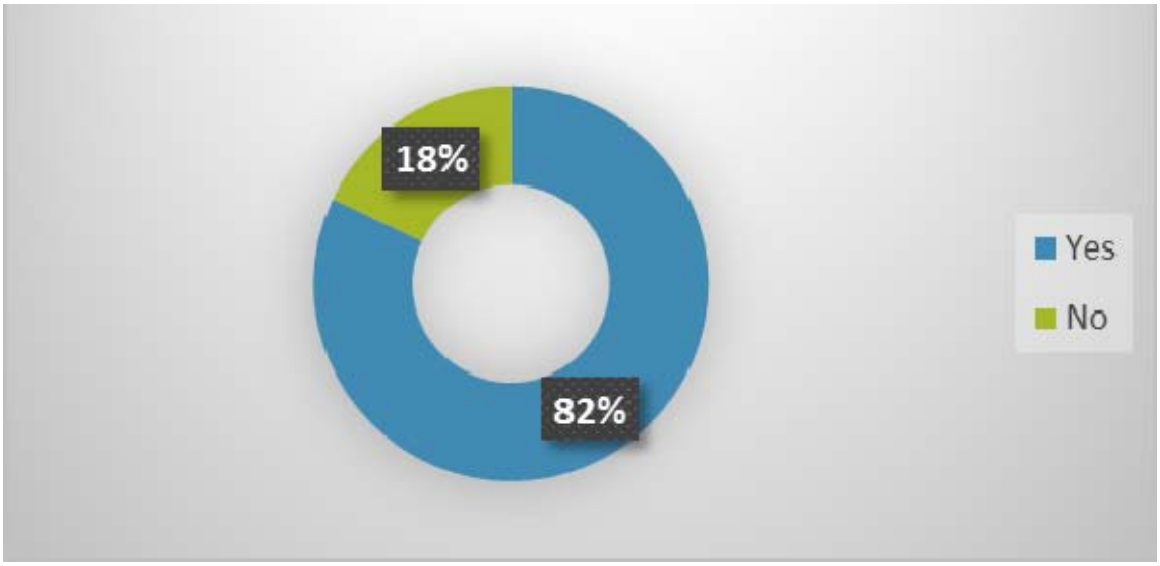
Figure 5.1: Dehorning practice for respondents that received training



Source: Own compilation from the survey data, (2019)

Findings showed that 88 per cent of the cattle farmers that received training dehorn their cattle and 12 percent do not dehorn. This implies that still, some trained cattle farmers in the study area believe in the cattle with horns as a symbol of wealth, as indicated in NNFU (2019). However, the majority adopted the Good husbandry practices imparted by the training. Moreover, they do minimize injuries to maximize quality output, and as dehorned cattle will not cause any injuries to other cattle, which may lead to bruises and condemnation of meat in the market.

Figure 5.2: Dehorning practice for respondents that did not receive training



Source: Own compilation from Research survey, (2019)

From the result in Figure 5.2, it can be seen that 82 per cent of the cattle farmers that did not receive training do dehorn their cattle, and 18 per cent do not dehorn their cattle. Comparing the two statistics for trained and untrained, there is a significant difference. This could attribute to the fact that; Most of the respondents are experienced (see Table 5.1). However, dehorning alone do not add value to an animal quality, but the time of the practice could improve the efficiency and quality of an animal.

Table 5.2: Dehorning stage for the sampled respondents

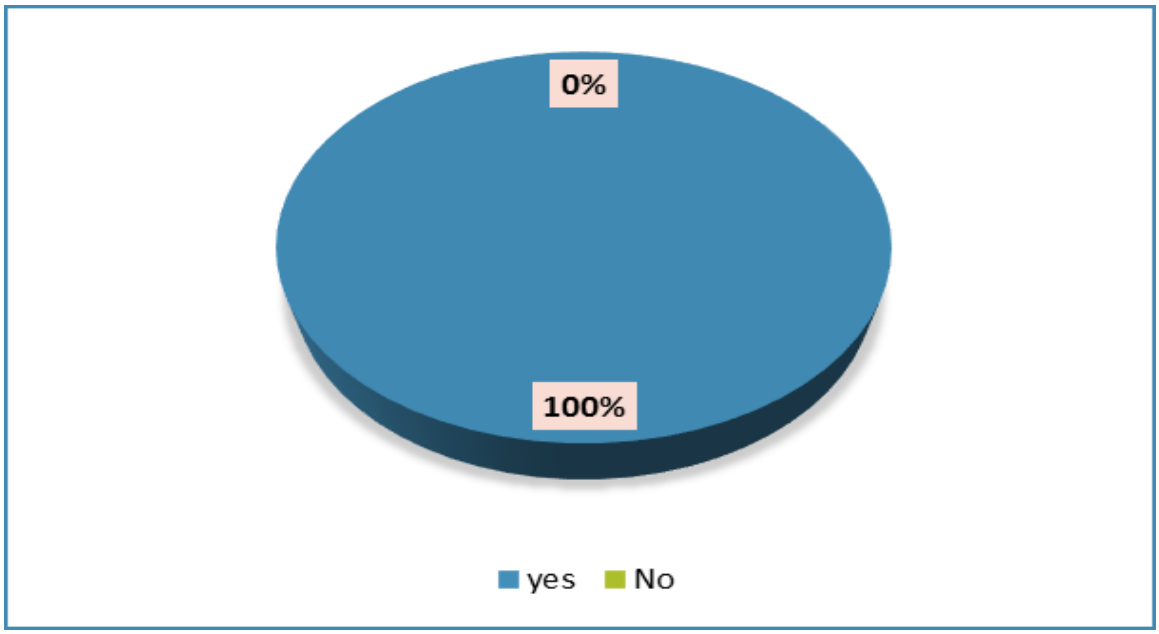
Trained			Untrained		
Stage	**Frequency**	**Percentage**	**Stage**	**Frequency**	**Percentage**
2-4 weeks	92	86.8	2-4 weeks	5	2.36
2 months	10	4.72	2 months	4	1.87
3 months	3	1.41	3 months	1	0.47
4 months	1	0.47	4 months	96	90.57
Total	106	100	Total	106	100

Source: Own compilation from the survey data, (2019)

The findings show that 80 per cent of the cattle farmers that received training dehorn their cattle at 2-4 weeks. In contrast to 82.89% of their peers that did not receive training who dehorned late at 4 months. This is not the correct age of dehorning, it is difficult to handle animals at this age, besides it is painful and stressful to the animals. It means that training can enhance quality and marketable animals in the livestock enterprise. This result is consistent with the findings by Brettschneider (2005).

The other key husbandry practice that enhances quality is castration (Figure 5.3). According to Rodriguez (2012), castration can increase the marbling, tenderness, and overall grade quality of the meat. Similarly, Retana (2012) argued that in the past ten years the Costa Rican consumer has also shown an increased demand for improved tenderness and their willingness to pay higher prices for more tender subprimal and retail cuts. This means that tenderness in cattle defines the quality of the meat.

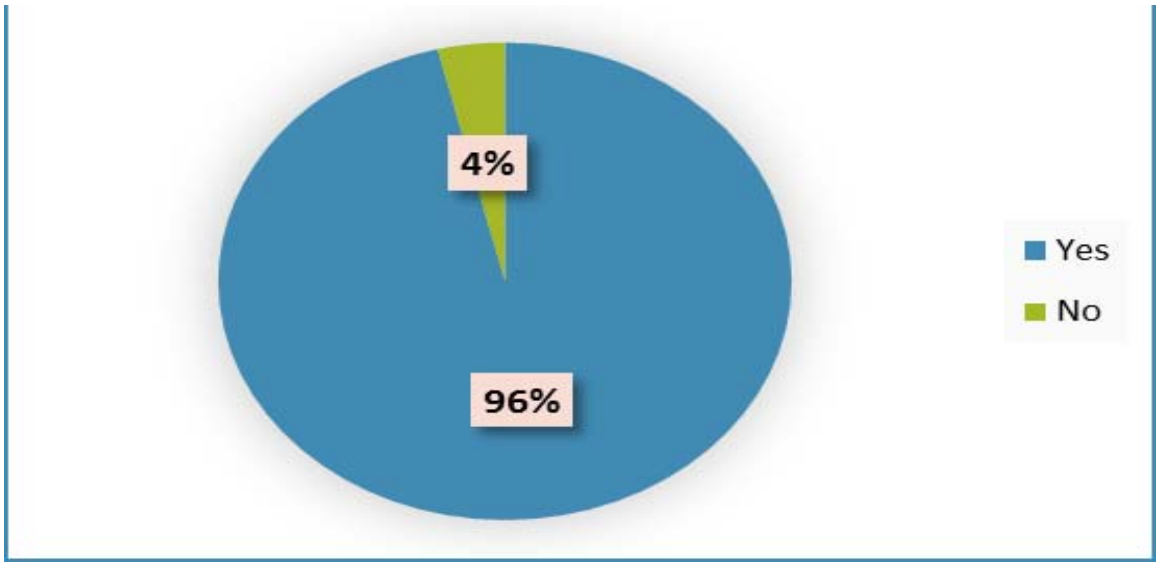
Figure 5.3 Castration of the respondent that received training



Source: Own compilation from survey data (2019)

The study showed that 100 per cent of the trained farmers in the study area castrated their cattle. This implies that most of the cattle farmers in the study area have adopted the castration husbandry practices imparted to them by training. This could be attributed to the fact that uncastrated cattle are aggressive, risks inbreeding and passing of unwanted characteristics to calves. This result is confirmed by Brettschneider (2005).

Figure 5.4 Castration for respondents that did not received



Source: Own compilation from Research survey, (2019)

As presented in figure 5.4, most of the respondents castrated their cattle. About 96 per cent are in this category, while only about 4 percent did not castrate their livestock. This could be because it is expected that farmers should castrate their cattle to prevent unwanted bulls. However, the lack of information could result in some farmers not castrating as they are not aware of the benefits associated with castration. Comparing these statistics to trained farmers, there is no considerable difference. However, castrating alone does not guarantee the benefits that come with it. The correct time of castration is required. Thus, this study assessed the stage at which the cattle farmers in the area of study castrate their animals.

Table 5.3: Castration stage for the sampled respondents

Trained			**Untrained**		
Stage(mths)	**Freq**	**%**	**Stage (mnts)**	**Freq**	**%**
6 >	100	94.34	6 >	0	0
7- 8	12	11.32	7- 8	5	4.72
39 - 10	0	0	9 - 10	81	76.42
11- 12	1	0.94	11- 12	20	18.87
Total	106	100	Total	106	100

Source: Own compilation from the survey data, (2019)

From the statistics presented in table 5.3, 94.34 percent of the trained cattle farmers castrate their cattle at 6 months or earlier. In contrast, 76.42 per cent of their peers castrate late at 9-10 months. This is not good, as late castration can result in stress, and unwanted bulls. It means cattle farmers that received training castrate early and have an advantage of controlling inbreeding and unwanted bulls to mate with their replacement heifers. In other words, training improves the farm management and quality of animals for farmers. In addition to dehorning and castration, tagging could be vital to enhance the buyer's safety.

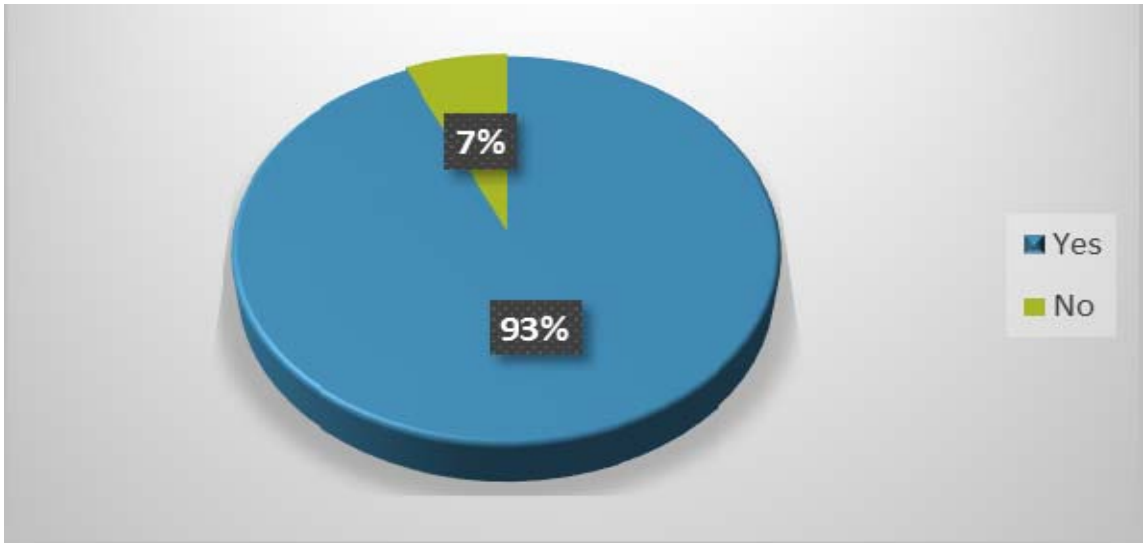
Table 5.4: Tagging for the sampled respondents

Trained			**Untrained**		
	Freq	**%**		**Freq**	**%**
Yes	106	100	Yes	106	100
No	0	100	No	0	100
Stage (mths)			**Stage(mths)**		
6 >	100	94.34	6 >	0	0
7- 8	12	11.32	7- 8	5	4.72
9 - 10	0	0	9 - 10	81	76.42
11- 12	1	0.94	11- 12	20	18.87
Total	106	100	Total	106	100

Source: Own compilation from the survey data, (2019)

Table 5.4 above shows that all cattle farmers in the study area irrespective of whether they received training or not do tag their cattle. However, the result indicates that the majority of cattle farmers (94.34%) that received training tag their cattle while younger. In contrasts to their peers whom most of them tag their cattle at 9 – 10 (76.42 %). This is not good, as, by law, all cattle should be tagged at six months or younger as per Animal health act 1 of 2011 (MAWF, 2011). Tagging is required to identify cattle and make it easier to control animal diseases and ensure the traceability and safety of livestock and livestock products. Traceability of livestock and livestock products is becoming increasingly important in the areas of public health and consumer protection (Meat board, 2015).

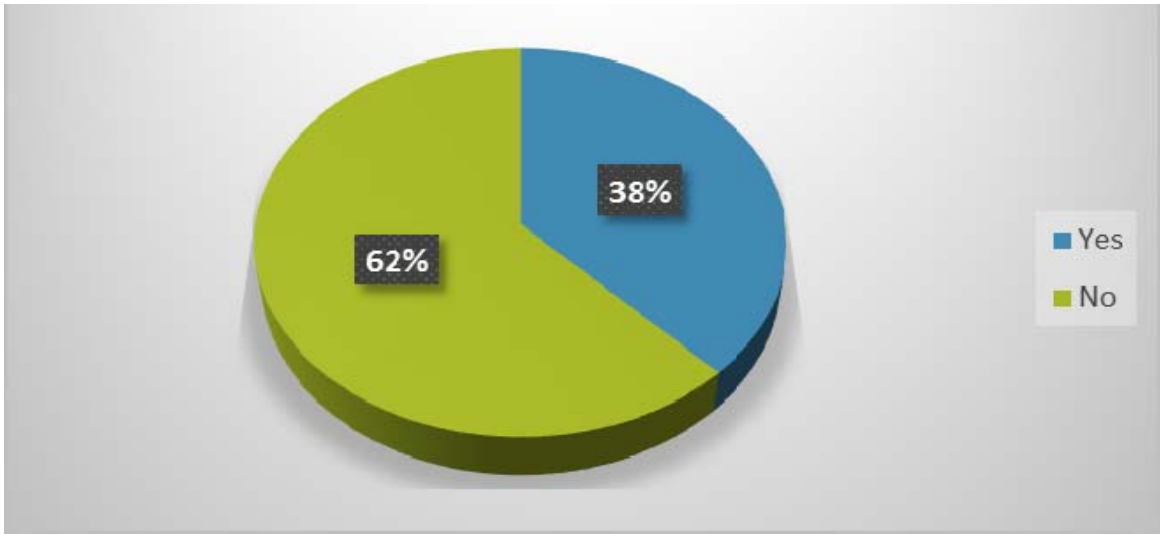
Figure 5.5 Lick supplementation for trained farmers



Source: Own compilation from the survey data (2019)

Figure 5.5 shows that 93% of the sampled cattle farmers that received training on livestock production by AASD give supplementary feed to their animals. This means that the trained farmers are better equipped, and supplementation is given to the cattle at the right time. It is expected that cattle should be supplemented during summer and winter to supplement what is lacking in the grazing pasture that period. Therefore, supplementation timing is vital to ensure that cattle achieve desirable body condition.

Figure 5.6 Lick supplementation for untrained farmers



Source: Own compilation from Research survey, (2019)

The statistics on figure 5.5 above illustrated that 62% of the sampled cattle farmers that did receive training on livestock production by AASD are supplementing their cattle whereas 38%

did not. The implication of this is that the farmers that are not trained are not equipped, and could not attach benefits on lick supplementation, other than just financial burden. This could be attributed to a lack of finance to purchase commercial supplementary feeding. Moreover, cattle are left to graze on the pasture.

This is not good, as lick supplementation could make up for what is not available in the grass that season. Therefore, knowing when to supplement and what to supplement is very important to a farmer (Faulkner, 2016).

Table: 5.5 Lick supplementation for the sample respondents

Trained			Untrained		
Stage(months)	**Freq**	**%**	**Stage**	**Freq**	**%**
Oct - March	28	26.42	6 >	56	52.83
April-Sept	4	3.77	7- 8	16	15.09
Throughout	74	69.81	9 - 10	34	32.08
Total	106	100	Total	106	100

Source: own compilation from the survey data, (2019)

The result shows that there is a positive effect of a training intervention in imparting farm husbandry practices, which is vital to boost cattle production and efficiency in cattle farming operation. Table 5.5 shows that 69.81% of the trained farmers, supplement their cattle throughout the year. In contrast, to their peers that did not receive training. Overall, the margin is not too wide as feed supplementation could be done more frequent due to lack of grass or forage materials as a result of drought (Meatco, 2016). Lick supplementation could be required to supplement the nutrients content of the natural grazing (e.g. dry grass have only 3.5% of protein, below that of the green grass which can be up to 30% depending on the grass type).

Table 5.6 Deworming program for the sample respondents

Trained			Untrained		
	Freq	**%**		**Freq**	**%**
Yes	106	98	Yes	45	42
No	0	2	No	61	58
Timing			**Timing**		
N/A	2	1.89	N/A	62	58
Once	19	17.92	Once	36	33.03
Twice	85	80.19	Twice	8	8
Total	106	100	Total	106	100

Source: Own compilation from the survey data (2019)

Table 5.6 above shows deworming program for trained and untrained farmers. The statistics show that 98 percent of the farmers trained do deworm their cattle and mostly twice a year. In contrasts, 42 percent of the counterparts who have not receive training deworm their animals, however, the majority deworm once a year. This could be attributed to financial constraints that limit farmers to purchase appropriate production inputs, including dewormer. It is expected that deworming enhances efficiency and quality in cattle production. Worms suck nutrients and blood from animals, the condition that can lead to economic losses owing to mortality as well as condemnation of carcasses in the slaughterhouse (Konold et al. 2010).

Similarly, Perez-Pardal et al. (2010) stated that gastrointestinal parasitism can be more severe in livestock such as goats, sheep and cattle and clinical signs include anaemia, weight loss and bottle jaw. Thus, for deworming to be effective, it should be done twice a year. The 1st dewormer application should be made immediately after the first rain, and the 2nd dewormer application should be made after the end of the rainy season before winter. Therefore, this study revealed that lack of awareness on the benefit of dewormer application could result in the majority of untrained farmers not to deworm their livestock (see table 5.6 above).

Table 5.7 Vaccination for the sample respondents

	Trained		**Untrained**		
	Freq	**%**		**Freq**	**%**
Yes	106	101	Yes	80	75
No	5	4.7	No	27	25
Types of vaccine			**Types of vaccine**		
N/A	5	5	N/A	28	25
Supavax	37	34.9	Supavax	10	9.4
Brucella	0	0	Brucella	0	0
Lumpy vax	4	3.77	Lumpy vax	62	58.5
All three	60	56.60	All three	6	5.7
Total	106	100	Total	106	100

Source: Own compilation from the survey data (2019)

The table below 5.7 shows that the majorities (56.60%) of the trained cattle farmers vaccinate their cattle with Supavax, brucella, and lumpyvax than their peers that were not exposed to training. The table shows that 34.90 percent vaccinate with supavax which is a three in one vaccine (botulism, anthrax and black quarter). In contrary, most cattle farmers that did not receive training do vaccinate their cattle with lumpy vax. This could be attributed to the fact that in the event of an outbreak the Ministry of Agriculture, Water and Forestry, under the Directorate of Veterinary Services (DVS) assist farmers with lumpy skin vaccination campaigns. Thus, Farmers with training background are aware of the health benefits associated with vaccination and invest in different types of vaccines to safeguard their animals for diseases.

5.1.3 Cattle farming productivity

Key production indicator for cattle enterprise includes mortality rate, calving percentage amongst others (NNFU, 2019). It is expected that for farmers to achieve good calving percentage and eventually better offtake percentage, the bull to cow ratio should be appropriate. Therefore, this study assessed the bull to cow ratio, calving and offtake percentages for the cattle farmers in the study area.

Table: 5.8 Cattle farming performance indicators

Trained			Untrained		
Breeding (ratio)	Freq	(%)	Breeding (ratio)	Freq	(%)
1:25	55	52	1:25	3	3
1:30	31	29	1:30	7	7
1:35	19	18	1:35	85	80
No bull	1	1	No bull	11	10
Calving (%)			Calving (%)		
20	22	20.75%	20	67	63.22%
50	42	39.62%	50	26	24.53%
70	29	27.36%	70	29	27.36%
80	13	12.26%	80	0	0%
0	0	0%	None	5	4.72%

Table 5.8 Continued

Trained			Untrained		
Offtake (%):	Freq	(%)	Offtake (%)	Freq	(%)
0	25	25.58	0	1	0.94
12-20	20	18.87	12-20	0	0
30-40	9	8.49	30-40	0	0
50-60	25	23.58	50-60	0	0
70-80	25	23.58	70-80	6	0
90-100	2	1.89	90-100	93	87.74
Marketing age (Months):			Marketing age (Months):		
7-12	20	18.87	7-12	0	0
13-24	60	56.60	13-24	5	4.72
25-36	16	15.09	25-36	23	21.70
48 >	10	9.43	48 >	78	82.26

Source: Own compilation from the survey data (2019)

i) Calving percentage

Overall, the result shows that farmers who received training have high calving percentage than those who did not. Thus, the distribution shows that the calving percentages for those that benefited from the training range between 50% - 70%. In contrasts, the majority of farmers that did not receive training have 20% calving percentage. This could be attributed to the fact that majorities of cattle farmers that did not receive training, has incorrect bull to cow ratio (80%) and some have no bulls at all in the herd. This is undesirable, as placing more cows on one bull results in most of the cows being unmated, depending on the age of the bull. Low calving percentage could be attributed to traditional ways of keeping cattle and prevailing of different diseases as most of the farmers that could not benefit from the training, lack information on disease and vaccination to be used. These findings are in support of Regassa and Ashebir (2016).

ii) Breeding ratio (bull: cow)

Table 5.8 shows that 52 percent of the trained cattle farmers are more efficient in the utilization of bulls. This is because the correct number of cows to bulls 1: 25% are used by 29% of the farmers and 1:30 bull to cow ratio was used by 18%. The correct bull to cow ratio enhances effective mating and conception in each season. In contrasts, 80% of untrained farmers have higher ratios of 1:35 bull to cow ratio, followed by a 10 % of farmers who do not have a bull at all. This can be attributed to a lack of resources to purchase quality bulls. It means there is a high likelihood that untrained farmers may fail to achieve the required conception rate and eventually, poor calving percentages**.**

iii) Cattle Offtake (Marketing)

Table 5.8 shows that trained cattle farmers adopted the correct farm management techniques imparted to them. This is because they can select a suitable animal for the market. The distribution shows that 56.6 percent of trained farmers sell cattle at the age of 13-24 months. The younger the animals, the higher the grade and market price (Meat board, 2016). This is because a younger animal has soft and tender meat in comparisons to older ones. Cattle farmers that did not receive training sell their cattle at 48 months and above. This is a bad practice since the meat price is determined by the fat grading (fat proportion in the meat) and juiciness. Selling old animals could be influenced by the targeted market and consumer preferences, such as informal markets which include wedding ceremonies, funerals, and open, informal markets. Often the market may prefer oxen to tollies.

5.2 Empirical analysis and discussion

The data were analyzed using three methods: a) Ordinary least square (OLS) model, b) Treatment Effect (TE) estimators and c) the Stochastic Frontier Analysis (SFA).

5.2.1 Ordinal Least Square (OLS)

An Ordinary Least Square (OLS) regression was applied to determine whether changes in the levels of the training can influence the levels of the outcome variable (offtake and calving rate). The outcome variables are continuous whereas, training is categorical, taking the value of 1, if a farmer was trained, otherwise zero. Another variable of interest included in the regression was farmertype, which takes the value of 1 if a farmer is full-time, zero otherwise. Two OLS regression models were fit: model I is a linear OLS regression of Offtake on training and farmertype, Model II is an OLS of calving rate on training and farmertype. The OLS regression is shown in Table 5.9.

The result in Table 5.9 shows that there is a positive significant statistical relationship between offtake rate and training. This means that an increase in training intervention increases the number of cattle sold per annum. The result also revealed that an increase in time spent on the farm (full time), can result in increased in offtake rate. This is because fulltime farmers solely depend on cattle farming as a source of income, compared to part-time farmers who have other sources of income. The result also shows that training increases calving rate. Nevertheless, the result of the OLS showed a poor fit because of the low value of R^2, in other words, OLS is not a good estimator of the relationship between training, offtake rate and calving percentage.

Table 5.9 Ordinary Least square estimates of treatment effect on outcome

	Model 1	Model 2
Variables	Coefficient	Coefficient
Training	98.536***	20.7926***
	(0.000)	(0.000)
Farmertype	67.690**	-3.7387
	(0.0480)	(0.3590)
Constant	26.468	33.5033***
	(0.4690)	(0.0000)
Observation	212	212
F(2,209)	8.6900	31.6
Prob>F	0.0002	0.000
R2	0.0768	0.2322

Note: Figures in parenthesis are p-value. The ***, ** & * represents 1%, 5% & 10% levels of significance

5.2.2 Treatment Effect (TE) Models

Treatment effect model was used to calculate the average effect of treatment (training) on the outcome of interest (offtake rate). Four estimators were used to investigate Treatment Effects, and this includes: Regression Adjustment estimator (RA), Inverse-Probability Weighted (IPW) estimator, Augmented Inverse Propensity Weighted (AIPW) estimator and Inverse Probability Weighted Regression Adjustment (IPWRA) estimator. The differences in the estimators are the way the ATE, ATET and the POM are calculated. The RA use means of the predicted outcomes for each treatment level to estimate each POM. The ATEs and ATETs are the differences in the estimated POMs. IPW estimator use weighted averages of the observed outcome variable to

estimate the means of the potential outcomes. The AIPW estimator model both the outcome and the treatment probability. The IPWRA estimators combine models for the outcome and treatment status. A typical property of these models is that they are doubly robust; that is, the modelling strategy of one estimator can be combined with the treatment modelling strategy of another estimator to get a consistent estimate[1]. The aim of using various estimators is to compare results across different estimators.

Table 5.10 shows the POM for both the trained and untrained farmers. The results show that farmers who were trained had potential mean sales of 176 cattle per annum compared to the untrained farmers who had a POM of 92 cattle. Therefore, the results indicate that training influences cattle farmer's offtake. The results are highly significant at 1% level.

5.10 Potential Outcome Means (POM)

Variable	Training	Mean	Std.Err	[95% Conf Interval]	
POM	Untrained	91.6038	8.9571	73.9470	109.2606
	Trained	175.4528	21.2280	133.6067	217.2989

Table 5.11 Average Treatment Effect

Models	Treatment	RA	IPW	AIPW	IPWRA
ATE	Trained	129.313* (0.062)	179.856*** (0.0020)	98.671* (0.0870)	116.959 (0.1130)
Pom	Untrained	92.112*** (0.0008)	76.574*** (0.0000)	91.583*** (0.0000)	80.102*** (0.0000)

Figures in parenthesis are p-values. The ***, ** & * represents 1%, 5% & 10% levels of significance

Table 5.12 Average Treatment effects on the Treated

Models	Treatment	RA	IPW
ATET	Trained	82.832** (0.0480)	113.038*** (0.0000)
Pom	Untrained	92.621** (0.0130)	62.415*** (0.0010)

Figures in parenthesis are p-values. The ***, ** & * represents 1%, 5% & 10% levels of significance

The results for the various estimators of treatment effects is shown in Table 5.11 and Table 5.12. In Table 5.11, the ATE for RA, IPW, AIPW & IPWRA shows that training causes the offtake of farmers per annum to be increased significantly by 129, 180, 99 and 117 cattle per annum respectively from the average offtake of farmers who did not attend the training, who had on average 92, 77, 92, 80 cattle per annum respectively.

[1] Details about the estimator can be found in STATA 13 documentation (2014).

The result of ATET is shown in Table 5.12. The estimates from the RA and IPW show that amongst trained farmers, the average treatment resulted in increased offtake of 83 and 113 cattle per annum respectively. The results differ slightly from estimator to estimator, but on average there was a confirmation of the previous results obtained. However, these findings conform to that obtained by NNFU (2019).

5.2.3 Cattle farm productivity and efficiency

This study applied stochastic frontier analysis using Cobb-Douglas production function. The model estimates the coefficients of the parameters of the production function. Technical efficiency was then determined from the inefficiency scores by fitting the inefficiency model using covariate that may contribute to the inefficiencies of the cattle farmers in the area of study.

Therefore, Table 5.13 below tested constant return to scale using labour and capital invested as production inputs on total farm productivity (Total herd size). The result shows that labour and cost of capital can significantly be used to explain productivity in the cattle industry. However, the test of return to scale shows was rejected. Indicating that there is no constant return to scale amongst the farmers that were trained. The reasons are: (i) the period after the training was short as to get the desired full desired effects, (ii) The farmers are subsistence not business-oriented - these findings are in conformity with Van Rooyen (2016), (iii) Do to inefficiency farmers operate sub-optimally. In other words, there were inherent inefficiency effects in the data. Therefore, the inefficiency effects were investigated (see table 5.14).

Table 5.13. Stochastic production Frontier

Production factor	Coef.	Std.Err	t-value	P-value
lnLabour	61.53381	27.12453	2.27	0.023
lnAv. production cost	0.008238	0.003017	2.73	0.006
constant	374.3195	79.32786	4.72	0.000

Source: own compilation from the survey data, (2019)

Table 5.14 shows the estimates of the inefficiency model. The results show that full-time farming significantly reduces inefficiency. Farm experience, age and household size statistically and significantly reduce inefficiencies in the cattle farming enterprise. As farmers get older, they gain experience on how to allocate the resource efficiently. This agrees with Amwata (2016) findings, which states that older people in farming have accumulated many years of wisdom in farming and have developed coping strategies, which have made them survive in the farming business, despite farming challenges such as rainfall variability. In addition, full-time farmers, particularly with large family size, reduces inefficiency as a farm management practice, are promptly scheduled. This conforms with Amwata (2016), who alluded that large households provide more labour to ensure timely management of crop production, thus increasing farm productivity, and consequently increase return on investment.

Table 5.14. Testing inefficiency in cattle farming

Variables	Coef.	Std.Err	t-value	P-value
farmtype	89.24658	43.88921	2.03	0.045
farmertype	-51.8832	53.99581	-0.96	0.033
lnfarmexp	-106.561	35.45183	3.01	0.003
age	-26.2372	14.67896	-1.79	0.077
lnage	1715.063	867.4254	1.98	0.051
lnhhsize	-93.1356	49.44182	-1.88	0.063
constant	-4651.39	2669.598	-1.74	0.085

Source: Own compilation from Research survey, (2019)

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study analysed the effect of training intervention on cattle farmers in the Kunene region. It investigated whether farm productivity and efficiency were due to training or not. Descriptive statistics and two empirical methods were applied to determine the productivity and efficiency of sample respondents such as Treatment Effect (TE) and Stochastic Frontier Analysis (SFA). Overall, the findings of the study show that farmers who are trained perform well in their cattle farming business, relative to those who did not. Moreover, the statistics show that farmers that received training sell more cattle per year than those that did not. Also, the result shows that trained farmers adopted cattle husbandry practices imparted to them and perform them accordingly, in contrast to the untrained farmer.

The study further revealed that cattle enterprise performance indicators such as calving percentage and offtake rate for those that received training are higher than their peer who did not receive training. This means that trained farmers behaviours and mindset were changed while the untrained farmers still adopt the way of farming such as, keeping old cattle and investing less in animal health. It was also revealed that cattle farmers that received training prefer to market younger cattle (E.g. weaners, tollies and heifers etc.), that fetches high premium prices per kgs from the market. This is contrary to their counterparts who prefer to market oxen and cows that are older than ten years and unproductive.

Generally, farmers in the study area, irrespective of the training hardly had maximum calving rates because they are challenged by lack of land tenure and ownership. Despite the knowledge gained on sustainable utilization of rangeland resource, it is difficult for them to implement the concept successfully. This is because they operate on communal land with no room for expansion.

Moreover, the study revealed that training is the key to the transformation of farmers from the traditional way of farming to commercialization. As a result implies that farmers that received training, particularly those that have experience and full time were efficient in their cattle production.

The overall findings of the study show that farmer-targeted training courses offered by AASD promote good husbandry practices to farmers and majorities of farmers who benefited from the training adopted the skills. Thus, calving and offtake rate is high for training beneficiaries, and key husbandry practices are performed promptly and accordingly.

In summary, even though considerable efforts were made by Agribank and other various training providers in the training of farmers in different areas of livestock farming, there remains a gap which needs to be addressed. Therefore, the training providers must re-orient their training as well as increase the number of training based on these findings to reduce the existing animal husbandry adoption gap among the livestock farmers of the Kunene region and beyond.

6.2 Recommendations

Although the influence of training is considered in building up cattle farmers knowledge, skills, and confidence in farming, farmers need to employ farming strategies and best farming practices imparted to them to safeguard and improves farm productivity and efficiency. Also, more training should seek to enhance resilience in cattle farming operation during hard times such as drought and diseases outbreaks. Thus, the following recommendations are made to policymakers, cattle farmers in Kunene region as well as all value chain actors involved in the cattle value chain.

- Beef industry transformation: The beef industry transformation is highly required. This should begin with mindset change of key-value chain actors starting with farmers, who are at the bottom of the chain. Thus, aggressive awareness of Good Agricultural Practices (GAPs) for cattle enterprise should be done through training events and other farmers information sharing sessions. This will ensure Namibia continue to produce quality beef from all corners regardless of the farming categories as a quality animal does not only impress the end-users but fetches high price from the market.

- Cattle production: There is a need for a paradigm shift by cattle producers in Kunene region regarding traditional reasons for cattle farming towards farming as a business. Thus, training events and farm information days hosted for farmers should be focusing on farm entrepreneurship and behavioural change towards commercialization. It is also recommended that farmers should make a proper selection of quality breeding stock that can guarantee high calving percentage and eventually high offtake rate. in addition, the breeding ratio 1:25 should be adhered to achieve successful breeding season and high calving percentage.

- Rangeland and grazing management: Training should continue to sensitize communal farmers on good grazing management trough destocking, and increased sales on an annual basis. Thus, new policy /legislation is highly required to enable the management of communal grazing areas by allowing demarcation and registration of communal grazing areas/camps with fixed boundaries that are agreed with neighbours. This will not only enforce successful grazing management implementation in communal areas but enhance sustainable rangeland resources utilization by individual cattle farmers.

- Cattle marketing: There is a need for cattle farmers to adopt the strategy of selling younger cattle at most seven (7) months (i.e. heifers and tollies). At that age, cattle are in good condition, with tender & quality features and can fetch a high premium price per kgs. In addition, prolonged feeding of cattle for such a long time create inefficiency in the cattle farming business with a poor return. Therefore, it is recommended that cattle farming should be market-driven to achieve a good return on investment that can sustain their farming business. From Kunene region perspective, the government should consider rehabilitating Opuwo abattoir (meat processing plant) to create the market for both large and small cattle farmers at a reasonable transport costs within the region. This will eventually increase the profit margins for farmers. These recommendations agree with NNFU (2019).

- Cattle Farmer's capacity building and support services: Government and other training providers such as AASD amongst others should roll out further training events that promote value additions, this will create a market for farmers that are unable to access the market at the time of this study. The Ministry of Agriculture, Water and Forestry (DAPEES) should strengthen its extension services for farmers. Extension services should incorporate and consider key cattle husbandry practices such as vaccination and treatment, deworming, lick supplementation and other factors such as culling of unproductive cattle - cows and heifers that cannot conceive.

- Farm Efficiencies and inputs usage: Farmers tends to overlook efficiency and focus on productivity only. Productivity is nothing if the farming operation is inefficient. Therefore, it is recommended that inputs such as feeds and licks for supplementation, and veterinary medicines (vaccines and treatment) should be used efficiently to maximize farm profit. To this end, some medication can be expensive, but the number of doses can cater for more than two (2) herds of cattle for small scale farmers depending on the herd size. Thus, farmers are advised to pull resource together and share the cost of purchasing medication and vaccines from neighbours.

- Farmers' cooperative formation: It is also recommended that farmers should form organized groups to bargain for inputs and services such as cattle transportation to the market, purchasing of inputs and accessing various market options through bulk selling.

- Overall, a healthy animal is a productive animal. Thus, it is recommended that the government should strive for improved animal health and reduced animal disease. Aggressive vaccination campaigns in risky areas could achieve this. As diseases risk instigates disruption of livestock marketing and makes it difficult for farmers to meet sanitary requirements for export markets.

- Although the data samples only capture Kunene region, it is recommended that future researchers should include more regions in order to give accurate generalizations and policy measures on how far training intervention can benefit cattle farmers and other value chain actors.

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ANNEXURES:

Questionnaire

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Dear Sir/Madam

I am currently undertaking an academic research project entitled **"ANALYSING THE *EFFECT OF TRAINING ON CATTLE FARMERS PRODUCTIVITY AND EFFICIENCY IN KUNENE REGION".***

Thank you for taking the time to complete this survey. The survey aims to determine whether capacity building (training) add value to the farming operations and livelihood of the farmers. The information provided in this questionnaire will be treated with the utmost confidentiality and will only be used for this research analysis. You are requested to complete the questionnaire as honestly as is possible. The questionnaire comprises of three (3) sections that section A-C with a total of 40 questions.

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Note: Cattle Farmers who did not benefit from any training platforms should only answer section A & B.

SECTION A: DEMOGRAPHICS AND FARMER'S CHARACTERISTICS	
Family size	
Farm size (Ha) (commercial farmer only)	
Herd size	
Region of farming	
District	
Farming mode: Part-time/full Time	
Farming categories (e.g. communal)	
Gender: M/F	
Age:	
Years of schooling	
How long have you been farming?	

SECTION B: FARM PRODUCTIVITY

1. What are you farming with? (tick in the appropriate box)

Cattle		Sheep		Goats	

2. Animal husbandry (tick in the appropriate box)

a. Do you do dehorn?

Yes		No	

b. At what stage do you dehorn

>4wks	2mths	3 mths	4mths – 5mths

c. Do you castrate your livestock? (tick in the appropriate box)

Yes	No

d. At what age do you castrate your livestock?

6 mths	7 – 8 mths	9 – 10 mths	11 – 12 mths

e. At what age do you tag your livestock?

3 -6 mths	7 – 12 mths

f. Do you give lick & supplement to your livestock?

Yes	No

g. If yes, which time of the year do you give lick & supplement

Oct –March	April – Sept

3. Animal health (tick in the appropriate box)

a. Do you deworm?

Yes	No

b. If yes, how many times of the year do you deworm your livestock?

N/A	Once	Twice

c. Do you vaccinate your livestock at your farm? (tick in the appropriate box)

Yes	No

d. If yes, which type of vaccine do you vaccinate your livestock with?

Botuvax	Supavax	Athravax		Lumpy vax	Brucella

4. Breeding & reproduction

a) What is your breeding stock size?

a.

Cows:	Bulls:

b. What is your breeding gain (no. calves) you have per year?

5. Rangeland management

a. What is the size of your grazing camps?……

b. How many cattle do you keep?.....

c. Do you practice grazing management?

Yes	No

6. Livestock marketing and financial management

a) Do you market your livestock?

Yes	No

b) How many times do you market cattle per year?

Once	Twice a year	3 - 4 times a year	Throughout

c) Where do you sell your livestock?

Auction	Abattoirs	Informal market	Speculators

d) Type of animal sold and the average price per head?

a. Indicate total number sold	Weaners N$:	Oxen N$:	Cow N$:

you keep record of money - in and money – out? (tick in the appropriate box)

Yes	No

b. What is your farm expenditures per year? ……
c. What is your farm income (money inflow) per year?.....
d. Do you have non-farm income?.....
e. How much is your living expenditures per month?

Household groceries:	School fees:	Other bills:

f. Do you have farm credit?

Yes	No

i. If yes, how do you repay your farm credit?

Monthly	Quarterly	Yearly	Other…….

ii. Did you experience any farm challenges?

Yes	No

If yes, what are the challenges?

Drought	High input costs	Diseases	Other (specify):

SECTION C: TRAINING INTERVENTION

a) Did you benefit from any capacity building session?

Yes	No

If yes, which platform(s) did you benefit from? Please tick

One -one Mentorship	Training session	Farmers days	Evening lectures	Telephone consultations

b) Which training providers offered the training you benefited from?

AASD/FSP	CLDP	NNFU	MWAF(DAPEES)	Other:

c) Which aspect of farm management where you trained on? Please tick

Farm record keeping	
Financial management	
Grazing /range management	
Vaccination & treating animals	
Livestock lick & feed supplements	
Dehorning, weighing, castration & tagging	
Others (specify)……..	

d) How many livestock you had before and after training received?

Type of livestock (specify the number livestock)	Before	After
Cattle		
Sheep		
Goat		

e) What was your breeding gain before and after?

	Before	After
Calving		
Lambing		
Kidding		

e) How many livestock sold before and after training?

Type of animal	Before	Av. price	After	Av. price
Weaners (cattle)				
Kapters (goats)				
Weathers (sheep)				

f) How many farm workers /labours recruited before and after training?

	Before	After
Permanent workers		
Casuals		

g) Which type of production inputs used before and after training? (Indicate names)

	Before	Cost of inputs	After	Cost of inputs
Vaccines & Medicines				
Farmworkers				
Lick & supplements				
Others ……				

h) Do you perform farm management at you farm?

	BEFORE	AT WHAT AGE	AFTER	AT WHAT AGE
Record keeping				
Vaccination				
Lick & supplementation				
Dehorning & castration				
Ear Tagging				

m) How do you want training providers to improve their training services in future?……
…….