



Factors Affecting the Performance of the Beef Value Chain in the Zambezi Region of Namibia

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Abstract: The purpose of the study was to measure factors affecting the performance of the beef value chain in the Zambezi region to identify ways through which the value chain can be improved. The study adopted a mixed research method. A total of 71 beef value chain actors were sampled using a non-probability sampling technique. Self-administered questionnaires were developed and administered by the researcher. Collected data was analyzed using Statistical Package for Social Sciences (SPSS) version 2.0, Microsoft Excel, and Amos Graphics software, using a Confirmatory Factor Analysis (CFA). The study found that veterinary extension services and market information were statistically significant while animal diseases and beef trade policies were statistically insignificant. In conclusion, the beef value chain in the Zambezi region of Namibia is faced with market constraints. The livestock market has been closed for a considerable amount of time because of the ongoing FMD outbreaks in the region. The study suggests that value chain actors, particularly farmers, improve animal husbandry by making sure there are effective disease control and extension services available. While improved dissemination of market information through various possible mass media was also recommended. Another recommendation was made for policymakers to consider including the commodity-based trade policy in their domestic beef trade policy as it seems to be the best approach that can allow beef produced in the Zambezi region of Namibia access to beef markets.

Keywords: Foot and mouth disease, Value-Chain

1. Introduction

Globally, the beef value chain is a critical component of the livestock industry, contributing significantly to food security, income generation, and employment. Beef production is a multi-billion-dollar industry, with major players like the United States, Brazil, and Australia dominating the global market (OECD, 2021). The global beef industry is highly interconnected, with complex supply chains linking producers, processors, and consumers across continents. However, the sector faces several challenges, including fluctuating global demand, environmental concerns, and rising input costs such as feed and labour (FAO, 2020). Climate change and related environmental pressures have also led to calls for more sustainable practices in beef production (Thornton et al., 2020). Despite these challenges, the demand for beef remains high, particularly in emerging markets like Asia, where rising incomes have driven increased consumption (OECD, 2021).

In Namibia, the beef industry is a cornerstone of the agricultural sector, contributing significantly to the country's GDP and serving as a primary livelihood source for many rural communities. Namibia is globally recognized for its high-quality, grass-fed beef, which is exported to international markets, including the European Union and China (Meatco, 2019). The beef value chain in Namibia is well-developed in certain regions, with established processing and marketing systems, yet it remains underdeveloped in others (Kapuire and Shilunga, 2020). The country's semi-arid climate, coupled with recurring droughts, poses significant challenges to livestock production, impacting both the quality and

quantity of beef produced (Namibian Agronomic Board, 2021). Namibia's beef sector also faces issues related to disease control, particularly in regions prone to Foot-and-Mouth Disease (FMD) (Schutz, 2019). Despite these hurdles, Namibia continues to be a key player in global beef exports due to its high production standards and strategic focus on premium markets.

The Zambezi Region in northeastern Namibia presents a unique case within the national beef value chain due to its geographical location and environmental conditions. Unlike the more arid southern and central regions of Namibia, Zambezi enjoys a higher rainfall, making it more suitable for livestock farming (Mendelsohn and Obeid, 2020). The region is strategically located, bordering Zambia, Zimbabwe, Botswana, and Angola, providing opportunities for cross-border cattle trade and regional market access (Kapuire and Shilunga, 2020). However, despite these advantages, the beef value chain in Zambezi is underdeveloped, with limited infrastructure and market linkages (Department of Veterinary Services, 2019). Veterinary restrictions aimed at controlling FMD further complicate the movement of cattle, hindering access to lucrative export markets (Ramatala, 2021). This region's potential within Namibia's beef value chain remains largely untapped due to these logistical, regulatory, and infrastructural challenges.

Market access in the Zambezi Region is a critical factor influencing the performance of the beef value chain. Smallholder farmers, who make up the majority of the region's cattle producers, often face high transaction costs and limited access to formal markets (Ramatala and van Rooyen, 2020). The lack of processing facilities such as abattoirs near farming areas exacerbates this issue, forcing farmers to sell their cattle at lower prices or transport them over long distances (Schutz, 2019). Additionally, the absence of cooperative structures limits farmers' collective bargaining power, making it difficult to secure better prices or negotiate favourable market terms (Mendelsohn, 2020). Despite the challenges, there are ongoing efforts to improve market access and infrastructure in the region through government and donor-supported initiatives (Agricultural Trade Forum, 2021). Enhancing market linkages and processing capacity could significantly improve the livelihoods of smallholder cattle farmers in Zambezi.

Furthermore, institutional support and policy frameworks play a significant role in the performance of the beef value chain in the Zambezi Region. The Namibian government, through the Ministry of Agriculture, Water, and Land Reform, has implemented various programmes aimed at improving livestock health, disease control, and market access (Department of Veterinary Services, 2019). However, the implementation of these policies in the Zambezi Region has been inconsistent, with farmers reporting inadequate support in areas such as veterinary services and market information (Kapuire and Shilunga, 2020). Additionally, the lack of training and capacity-building programmes for smallholder farmers further limits their ability to participate effectively in the value chain (Mendelsohn and Obeid, 2020). Strengthening institutional support and aligning policies with the specific needs of farmers in the Zambezi Region could greatly enhance the overall performance of the beef value chain.

2. Research Questions

The study addressed the following questions

- a. What is the effect of animal diseases on the performance of the beef value chain in the Zambezi region?
- b. What is the effect of veterinary extension services on the performance of the beef value chain in the Zambezi region?
- c. What is the effect of beef trade policies on the performance of the beef value chain in the Zambezi region?
- d. What is the effect of market information on the performance of the beef value chain in the Zambezi region?
- e. What are the major constraints and opportunities experienced by beef value chain actors in the Zambezi region?

3. Literature Review

3.1 Value Chain Governance

Governance in value chain refers to the relationship between firms and institutional mechanisms which coordinates non-market activities (Bair, 2008), while Global Value Chain (GVC) analysis is focused on the rules, laws and regulations which are set to determine the functional and coordination in a value chain. GVC is further connected to the existence of barriers of entry and the dominance of a certain agent (e.g. Farmers, traders and consumers). The World Trade Organization (2012) opined that GVC is more about the contractual and information relationship between the various actors in the chain which ensures that businesses operate efficiently and ultimately absorbs and disseminate knowledge, technology and competencies. Kaplinsky and Morris (2001), on the other hand pointed out that value chain

governance includes four stages which are: making rules; giving support and help other actors within the chain with the aim of ensuring that they adhere to the rules; monitor adherence to the rules by actors; and sanctioning those who violate the rules, while Purnomo *et al.*, (2009) argued that a well governed value chain ensures that interaction between firms within the value chain are efficient and effective.

3.2 Value Chain Mapping

In a beef value chain, the value chain map indicates the movement of beef cattle and their products from the areas of production in the study area up to the end markets, as well as the operation of the whole beef cattle sector. UNIDO (2012) described the value chain map as a visual depiction of the whole value chain structure as well as its main actors. Herr and Muzira (2009) on the other hand, described value chain mapping as a means of visually representing the connections between actors within the value chain. They further pointed out some practical implications which are involved in mapping out the value chain initiatives such as those which helps in illustrating and understanding the whole process through which a product moves from production until it reaches the final customer, which then is used to identify bottlenecks which might be hindering the achievement of certain targets within the value chain. Mapping a value chain also serves to identify and categorize key market actors thereby making it easier to engage such actors in important decision making with regards to the market. Furthermore, a value chain map also illustrates supporting organizations such as government, non-governmental organizations and associations, as well as identifying as to which level their services are within the value chain. Equally when it happens that there is a need to explore market opportunities through a value chain initiative, a value chain map is usually consulted to indicate the channels through which products and services move until they reach the final customer. Finally, a value chain map can also be of great assistance to companies intending to invest in emerging markets as with the help of the map such companies can identify different stakeholders, possible markets, or supply channels, competing firms, weaknesses in the chain for the activities they might be interested in engage into.

3.3 Factors Affecting Performance of the Beef Value Chain

3.3.1 Animal Disease

Foot and Mouth Disease (FMD) has remained as one of the most important diseases affecting livestock throughout the world, given its highly infectious nature, the economic impact of the disease on the wellbeing of animal and productivity as well as the implications that the disease brings about towards successful access to both domestic and export markets for livestock and products (Perry and Rich, 2007). As much as the FMD impact is different from one country to the next a study by (Perry *et al.*, 2002b) ranked the disease as one of the top 10 diseases constraining efforts of poverty alleviation in many developing countries, attitudes towards the disease differs even between people within the same country depending on the perceptions of the incentives and need for its control and eradication. Thornton *et al.* (2002) pointed out that FMD is well distributed in most developing parts of the world such as Africa, South America, Asia, and these are parts supporting over 75 percent of the poor people in the world. Many times, due to poor infrastructure, lack of human resources as well as having livestock movement controls in most of the developing countries makes livestock producers to be vulnerable to the spread as well as lack of control of the disease even though livestock keeping is part of an integral component of the poor people's livelihoods.

Thus the disease continues to provide a burden on the livestock production in the developing parts of the world as well as a continuous risk to the whole livestock industries of the developing countries, a situation which presents both a challenge and an opportunity for many developing countries livestock producers, there is a challenge in meeting the high and costly standards of having access to developed livestock and products markets but yet on the other hand these well-developed livestock commodity markets offer high rewards in terms of higher prices attainable for livestock products, which can be a good opportunity for small-scale producers to have access for their livestock products (Gulati *et al.*, 2005). For the Zambezi region the impact of FMD is visible in terms of the suspension and closure of beef markets as well as the export approved abattoir the region had since 2012, a region whose majority's livelihoods depends on livestock production and when it happens that their livestock do not have access to markets then more poverty is created. Equally due to the existence and promotion of community tourism in the region even in cases where there is no FMD outbreaks occurring, the risks of the disease continue to have an impact on livestock producers and the society at large as there are required to adhere to preventative measures of ensuring that their livestock are separated from wild animals a situation which has proved to be difficult due to sharing of grazing areas and water points. With the above literature, the researcher agrees with (Perry and Randolph, 2003) who pointed out that from the global perspective, the risk of FMD has a greater impact than the disease itself.

Therefore, the researcher hypothesizes that:

H1: Animal diseases have a negative effect on the performance of the beef value chain.

3.3.2 Veterinary Extension Services

The delivery of veterinary extension services is a very important aspect of animal husbandry and management of animal health. In Namibia, the government through the directorate of veterinary services under the Ministry of

Agriculture, Water and Forestry is largely the provider of cattle veterinary extension services to the farmers. However, the veterinary extension services delivery remains limited due to budgetary constraints and a limited number of human resources, which hampers the whole delivery process especially for areas such as Zambezi region which has a high prevalence of FMD due to co-existence of livestock and wild animals which then requires constant vaccination campaigns. Food and Agriculture Organization of the United Nations (2002) opined that the growing demand for livestock products which is brought by population growth in the world, urbanization and an increase in buying power as more people in the middle and developing countries are joining the middle income class as well as the need to meet standards of beef trade agreements means that most governments are expected to improve animal health in their respective countries especially that which relates to control of infectious diseases and animal welfare. It was further pointed out that infectious diseases seem to be a continuous constraint to sustainable international exports of livestock products from most developing countries and there was need to institute sanitary measures in these countries to reduce the burdens caused by the diseases (Ibid).

Lubroth *et al.* (2007) alluded to the fact that along with having vaccines and vaccination there was need for other complementing aspects of disease prevention and control such as having legislations, surveillance, diagnostic proficiency, quick response, transportation, availability of market regulations, compliance as well as clear public communication while (Food and Agriculture Organization of the United Nations, 2004) pointed out that there was need to control trans boundary animal diseases through veterinary vaccines as these diseases have significant economic, trade and food security importance for a number of countries in the world and at the same time most of these diseases were known to spread easily from one country to the next and then their control and management requires working together between neighbors, be it local, provincial, national or regional. Despite the fact that vaccination against FMD by the veterinary extension services has proven to be an effective way of controlling and eliminating the disease in certain parts of the world such as Western Europe and parts of South America, it is a bit difficult in most parts of Southern Africa including Namibia due to high costs involved in vaccination and the continuous interaction between livestock and wildlife especially in places with community conservation areas like the Zambezi region. On the other hand, FMD vaccines are very expensive as most of them are developed by multinational biopharmaceutical companies who usually produce them for profits instead of disease control or eradication reasons (European Food Safety Authority, 2006).

H2: Veterinary extension services have a negative effect on the performance of the beef value chain.

3.3.4 Beef Trade Policies

The beef trade policy in Namibia just like those found in other southern African countries with parts of the country not free from FMD due to existence of African buffaloes, which are well known endemic carriers of the disease is practicing strict international conventions that are translated into export and import policies with the aim of limiting the spread of FMD while trading livestock and livestock products (Van Rooyen, 2016). African buffaloes found in and around conservation areas of southern Africa are well known endemic carriers of FMD, a potentially contagious epizootic disease which affects most large domestic animals as well as those found in the wild (Thomson *et al.*, 2003). Countries in southern Africa are using export and import policies to contribute to the limitation of the FMD disease. These policies are guided and recommended by the World Organization for Animal Health (OIE), an international standard setting body under the World Trade Organization (WTO) with the mandate of setting rules with regards to animal health and trade in animal and animal products. According to the OIE practices and standards there is a requirement of livestock and livestock products to be derived only from countries or zones which are free from FMD better known as the geographic-based disease control standards, a practice which has proved not to be in favor with most of the areas in southern Africa including the researchers study area of Zambezi region due to wildlife-livestock interface especially the African buffaloes (Scoones *et al.*, 2010).

Due to non-existence of cordon fences in the Zambezi region, both livestock and wildlife share the available grazing land and water points which have led to continuous incidences of disease transmission and competing for both grass and water (Nyambe, 2013). Van Rooyen (2016) opined that since most households in Zambezi region are relying on livestock and crop production for their livelihoods along with the fact that there is a great global as well as regional demand for beef, with access to reliable and formal markets livestock owners from the region could benefit significantly and that there was need to identify strategies which could allow for compatible production of both livestock and wildlife conservation in order to ensure that the rural communities put their available natural resources to good use. In southern Africa the commonly used strategy in reducing the risks of livestock contracting FMD is by separating the interaction of livestock and wildlife which is done physically or through cordon fences in some areas, a situation which has proved not to yield the best results. However not all is lost though for southern and eastern Africa when it comes to beef trade policies as well as the Zambezi region as recently the OIE adopted a new standard which is known as commodity-based trade (CBT) and unlike the geographic-based disease control approach, CBT is most favorable to Africa's livestock production.

The Phalakane Declaration (2012) pointed out that the CBT approach came up through a request by the Southern Africa Development Community (SADC) which was prompted by the potential of having non-geographic disease control policies in mitigating the barriers of developing both productions of livestock and conservation of wildlife in southern Africa. According to the CBT approach, instead of not getting livestock and livestock products from areas not free from FMD appropriate disease risk mitigation intervention requirements are rather implemented along the beef value chain with the aim of producing beef commodities with certified acceptable levels of disease risk for the buyers. Under CBT, the geographic disease status of the commodity's origin is overlooked, while more focus is rather on the steps which are taken from the commodity's point of production until point of consumption with the aim of managing any possible food health and safety risks requirement. Van Rooyen (2016) pointed out that no country has so far officially adopted the CBT approach in their policies for animal health control, an approach which can open markets for beef produced in southern Africa and Zambezi region while at the same time allow for compatible production of both livestock and wildlife conservation.

H3: Beef trade policy has a negative effect on the performance of the beef value chain.

3.3.5 Market Information

Market information is important to value chain actors as it helps them to make decisions such as what time to sell to the farmers as well as whether to buy or sell for the traders. Ramatu *et al.* (2000) pointed out that information must be relevant, timely and a reflection of all sectors of the whole market, especially that which has to do with consumer demand. Livestock farmers can use relevant and accurate information to move their cattle to other markets where there are favorable prices. Mukhebi (2004) urged that the effective market information system reduces risk between value chain actors in their daily activities. Comomtn (2010) opined that without proper market information farmers are forced to accept prices offered by traders and buyers for their animals, many times without even knowing whether such prices are reasonable or not. The researcher recommended that there was a need to establish price information which benefits both producers, buyers as well as policy makers from government with the aim of collecting, analyzing, assembling and disseminating market information.

The importance of having accurate market information is that both farmers and other value chain actors like traders receive information which empowers them in making sound livestock marketing decisions based on local and regional prices in the markets. Eggleston *et al.* (2002) pointed out that having an accurate market system can lead to promotion of economic development, as well as the alleviation of poverty in agricultural production. It was further pointed out that information can lead to improvements in bargaining positions by allowing for direct sales and doing away with unnecessary middle persons in the markets and thus there is a need for development of consumer market information systems in developing countries which will help in guiding farmers' marketing decisions. Information plays a great role in providing coordination and efficiency, with coordination of information involving bringing consumers and producers in one place using price as the vehicle to facilitate the coordination whereas efficiency is about reducing transaction costs and market thinness. The market is thin when it has few sellers and/or buyers, strict barriers to entry, some forms of government interventions and a lack of accurate market information. This study enquired from the targeted respondents as to how they perceived access to market information within the study area and how it affects the performance of the beef value chain.

H4: Market information has a negative effect on the performance of the beef value chain.

3.4 Empirical Review

This section presents related empirical studies.

Meshack (2015) undertook a study on marketing efficiency of beef cattle value chain in Longido and Monduli districts of Tanzania. The purpose of his study was to analyze the beef value chain with the aim of identifying potential areas for intervention to improve livestock keepers' access to markets in Longido and Monduli districts of Tanzania. This study was conducted using a cross-sectional design with data collected from 191 respondents. The Statistical Package for Social Sciences (SPSS) and Microsoft Excel were used to analyse the collected data. The study found that farmers in the study areas needed education in terms of how to manage their livestock commercially and have access to market information for both farmers and other actors in the value chain to establish a sustainable value chain in the area. Apart from pointing out few factors which affect the beef value chain, Meshack's study was conducted outside the Namibian context. Also, Meshack's study concentrated in an area free from FMD and without an export abattoir.

Kadigi *et al.* (2013) undertook a study with the aim of assessing indigenous cattle and beef products value chain in the Mwanza region of Tanzania. Using a participatory market analysis and questionnaire, data was collected from 40 participants within the study area, while the data analysis was done with the assistance of frequency tables and descriptive statistics. The findings of the study indicated that the value chain in Mwanza region was generally operating inefficiently, and it was recommended that a tailor-made campaign and training be undertaken to encourage livestock producers specially to start keeping beef cattle for commercial purposes, while at the same time produce animals of

good quality. Like the first study, this study was equally done in an area without an export abattoir and without the challenges of FMD.

Komen (2010) conducted a study in Kenya to carry out economic analysis of the impact of livestock market information and its influence on beef cattle marketing behavior. Purposive and random sampling was employed by the study with primary data collected from 135 respondents while relevant websites and online sources were used to attain secondary data. Regression methods of analysis using Nerlove Supply Response model (NSR) and the Consumer Goods Characteristics Model (CGCM) were employed. The study findings indicated that there was a need to develop a better framework for reporting market information within the value chain actors.

Togarepi *et al.* (2016) undertook a study aimed at identifying cattle marketing constraints and opportunities facing cattle producers in north-central communal areas of Namibia, Ohangwena region specifically. This study gathered information from 50 farmers using a structured questionnaire. The data collected was analysed with the assistance of Statistical Package for Social Sciences (SPSS). The findings of the study uncovered that the study area was constrained by several factors among them are those of animals' diseases, insufficient veterinary extension services in the study area, drought and poor grazing, lack of market information as well as poorly allocated marketing infrastructures. Despite pointing to animal diseases as one of the constraints, this study did not clearly indicate as to what type of animal diseases are prevalent in the study area and the area does not have an export approved abattoir in place.

Cloete (2018) conducted a research study regarding the impact of value addition in the agricultural sector with special reference to the Pork Market-Share Promotion Scheme (PMSPS). The study was aimed at investigating the impact of value addition in Namibia's pork industry with the target of developing the local industry. The study used a mixed research method in both quantitative and qualitative research design. The sample size involved was 23 respondents consisting of importers and retailers. However, due to the poor rate of return, the researcher decided to reduce the number to 12, making the final sample size to be twelve which consisted of two pork producers, seven importers and retailers, as well as three policymakers. Questionnaires were used to collect primary data from the targeted respondents while the Meat Board of Namibia provided the secondary data. Thematic analysis was used for qualitative data while excel and descriptive statistics were used to analyse quantitative data. The findings of the study showed that the PMSPS performed as expected in terms of market access and profitability. However, new entry into the scheme remained a challenge due to lack of capital, skills, knowledge, and high feeding costs. The study did not focus on the beef value chain; however, it brought up an important factor in its findings which is that of difficult to secure startup capital for new farmers.

Van Rooyen (2016) conducted a study of livestock production and management systems of animal health in communal areas with high interaction between wildlife and livestock in Southern Africa. The study was aimed at analyzing the production of beef while considering the health issues between wildlife and livestock interaction as well as having access to markets for beef products within an FMD protection zone. The study was further targeted at identifying challenges, risks and other issues which contributed to limits in complying with the commodity-based trade proposal which intends to allow livestock producers from FMD zones to participate in beef value chains, semi-structured interviews were used to collect data in the Zambezi region from 44 respondents. The analysis was done using excel to develop tables and pre-charts out of the quantitative data, which was collected, with study findings indicating that some of the major challenges within livestock farming were animal diseases, grazing competition, predation, stock theft and inevitable contact with wildlife. However, the study does not make recommendations as to how these factors can be attended to by the policy makers and other value chain actors to allow livestock producers in Zambezi region to have access to beef markets by improving their beef value chain in line with the community-based trade requirements.

Sarma *et al.* (2017) conducted a study in Bangladesh to analyse the value chain of beef cattle in selected areas of northern Bangladesh. In persuasion of their study 220 respondents were interviewed, comprising of beef producers, traders, brokers, butcher shops, supermarkets, meat processors, hotel owners as well as consumers. The data collected was analysed using descriptive statistics such as frequency, percentage, and tables, whereas analytical frameworks such as GTZ, ACDI/VOCA and M4P (Market for Poor) were used. The study findings revealed that beef value chains were creating livelihoods, incomes increased, there was promotion of economic growth from domestic industries, improved local markets and an expansion of export opportunities while there was identification of areas within the value chain where strategic policy and institutional reviews were thought to be undertaken. Parts of this study are somehow related to some of the objectives of the researchers' study as well as the value chain actors considered are closely similar, however some of the differences pointed out are those related to different locations and factors such as diseases does not seem to be a big challenge in Bangladesh like it is in most parts of southern Africa and the targeted study area.

4. Research Methodology - Materials and Methods

4.1. Research Approach

The study adopted a mixed-methods approach, incorporating both qualitative and quantitative data analysis. A sample of 71 beef value chain actors, including farmers registered with the Meat Corporation of Namibia (Meatco) and the Department of Veterinary Services (DVS), was selected using a non-probability sampling technique, which allowed for targeted selection of key stakeholders (Etikan et al., 2016). Data was analyzed using the Analysis of Moment Structure (AMOS) software version 18, alongside the Statistical Package for Social Sciences (SPSS), with results presented in tables and graphs for clearer interpretation. The study’s hypotheses were tested using Structural Equation Modelling (SEM), a statistical technique designed to evaluate relationships between multiple variables simultaneously (Kline, 2015). Additionally, Confirmatory Factor Analysis (CFA) was utilized to test the fitness of the data within the study’s theoretical constructs, ensuring that the model accurately represented the factors influencing the beef value chain (Hair et al., 2010).

5. Results and Discussions

5.1 Primary Occupation of the Respondents

The respondents were asked to state their primary occupation to get an account of how fully involved they are in the beef value chain. Table 1 below demonstrates the various occupations which were used in the study varying from wage employment, cattle keeping, self-employed/small business owner, and other types of occupation which might not have been covered.

Table 1: Primary Occupation of the Respondents

Primary Occupation	Frequency	Percentage
Wage Employment	49	69
Cattle Keeping	13	18
Self-employed/Small business owner	9	13
Other	0	0
Total	71	100.0

Source: Field data, (2019)

The results as presented in table 1 above indicate that 49 respondents (69 percent) are employed full time and their source of income is derived from wage employment, whereas 13 respondents (18 percent) are involved in cattle keeping as their primary occupation while 9 respondents (13 percent) are self-employed or running a small business. These results suggest that over 60 percent of the respondents involved in the beef value chain in the Zambezi region of Namibia are not fully involved and entirely depend on cattle keeping and production but rather doing it on a part-time basis, while only 13 respondents, translating into 18 percent of the respondents indicated that their primary occupation was that of cattle keeping while 9 respondents, which translates to 13 percent indicated that they were self-employed/small business owners of which most are involved in trading cattle and cattle products within the value chain.

5.2 Value Chain Actors Category of the Respondents

Table 2 below demonstrates the various types of value chain actors, among them, livestock farmers, small-scale livestock traders, policymakers, and abattoir livestock traders.

Table 2: Value Chain Actors Category of the Respondents.

Category	Frequency	Percentage
Livestock farmer	53	75
Small-scale livestock trader	6	8.5
Policy maker	11	15.5
Abattoir livestock trader	1	1
Total	71	100.00

Source: Field data, (2019)

The findings show that 53 respondents (75 percent) were part of the Zambezi region beef value chain as livestock farmers, while 6 respondents (8.5 percent) represented small-scale livestock traders, with 11 respondents (15.5 percent) representing policymakers from the Ministry of Agriculture, Water and Forestry, Directorate of Veterinary Services (DVS), Zambezi Regional Council (ZRC) and the Meat Board of Namibia, Zambezi region branch whereas 1 respondent, translating to 1 percent represented the abattoir livestock traders, Zambezi Meat Corporation (ZAMCO) even though it is not operational yet due to delays in upgrades. Herr and Muzira (2009) pointed out that the importance of identifying and categorizing key market actors is that by making it easier to engage them in pertinent decision-making regarding the markets.

5.3. Structural Model Results

Path coefficient analysis was done using Amos graphics software version 18 to test the hypotheses proposed in the study. The path coefficient was used to compare the causal weights of predictor variables to get the outcome variables. The significance of a path coefficient is given by its critical ratio (CR) whereby according to Cramer and Howitt (2004), a CR greater than 1.96 confirms that the coefficient is significant at a probability of less than 0.05. Concerning hypotheses, the results are presented as follows.

5.3.1 Animal Diseases Harm the Performance of the Beef Value Chain

The results on animal diseases were found to be statistically insignificant with a path coefficient of 0.157, a critical ratio of 1.532, and a probability of 0.125, thereby rejecting H1. However, these findings are contrary to other studies such as Perry and Rich (2007) who pointed out that animal diseases affect livestock throughout the world, and it brings implications in accessing both domestic and export markets for livestock and livestock products. Thornton *et al.* (2002) further supported the effect of animal diseases on the performance of the beef value chain by pointing out that animal diseases such as FMD are well distributed in most developed parts of the world such as Africa, South America, Asia and these are parts of the world which supports over 75 percent of the poor people. Both these studies found that animal diseases had a significant effect on the performance of the beef value chain.

5.3.2. Veterinary Extension Services Harm the Performance of the Beef Value Chain

The findings on veterinary extension services show a positive influence on the performance of the beef value chain in the Zambezi region of Namibia, as it is statistically significant in explaining the effect of veterinary extension services on the performance of the beef value chain with a path coefficient of 0.218, the critical ratio of 2.084 and a probability of 0.037. This means the performance of the beef value chain is influenced by veterinary extension services. Thus, not having access to reliable veterinary extension services will negatively affect the performance of the beef value chain. H2 was accepted based on the presented outcomes. These findings are supported by Lubroth *et al.* (2007) who explained that along with having vaccines and vaccination there was a need for other complementing aspects of disease prevention and control such as legislation, quick response, and availability of market regulation as well as public communication. The findings are further consistent with those of the Food and Agriculture Organization of the United Nations (2004) which alluded to the fact that there was a need to control transboundary animal diseases through veterinary vaccines as these diseases have a significant effect on economic, trade and food security for several countries in the world.

5.3.3 Beef Trade Policies Harm the Performance of the Beef Value Chain

The results of beef trade policies were found to be statistically insignificant with a path coefficient of -0.182, a critical ratio of -1.659, and a probability of 0.097. Therefore, rejecting H3. However, these findings are contrary to studies such as that of Scoones *et al.* (2010) who urged that the geographic-based trade policy under the World Organization for Animal Health (OIE) is not favorable in most areas in southern Africa including the Zambezi region due to wildlife-livestock interface especially the interaction between livestock and the African buffaloes which are well-known carriers of FMD. Van Rooyen (2016) on his part suggested that areas found in southern Africa should rather consider using commodity-based trade (CBT) policy instead of a geographic-based trade policy which is not compatible with the production of both livestock and wildlife conservation being practiced in many parts of southern Africa.

5.3.4 Market Information Harms the Performance of the Beef Value Chain

The findings on market information showed a positive influence on the performance of the beef value chain in the Zambezi region and it is statistically significant in explaining the effect of performance on the beef value chain with a path coefficient of 0.663, the critical ratio of 4.722 and a probability of 0.000. The variable is significant in explaining the effect of market information on the performance of the beef value chain. The findings are supported by Ramatu *et al.* (2000) who urged that market information must be relevant, timely, and reflect all sectors of the whole market. Having relevant and accurate market information helps farmers to move their cattle to other markets where the prices are favorable, while traders can also buy from markets with surplus cattle. While supporting the findings, Komen (2010) further pointed out that without proper market information farmers are forced to accept prices offered by traders and buyers for their animals, many times without even knowing whether such prices are reasonable or not.

Table 3: Regression Path Coefficient and its Significance

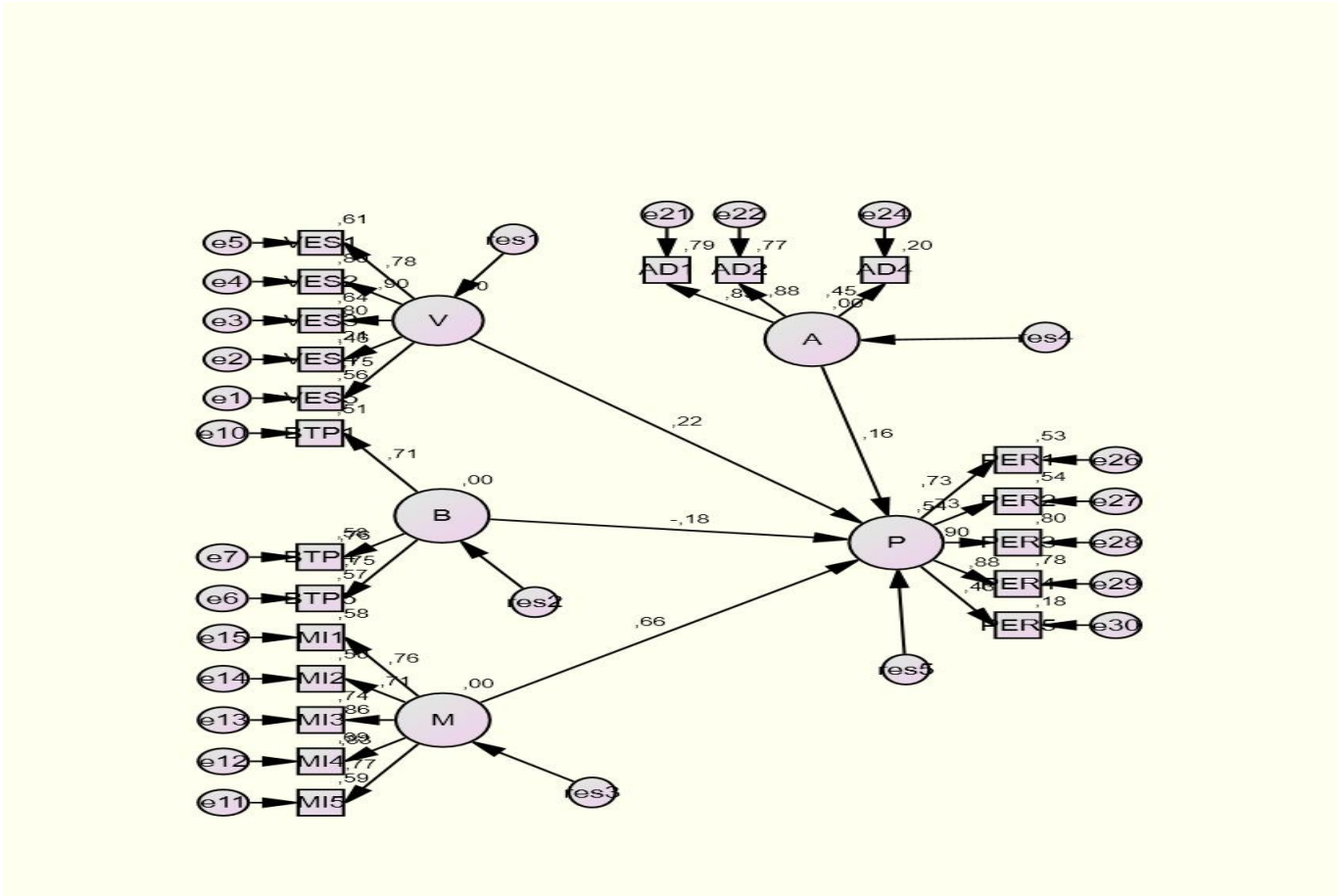
	Path	Item	S. Estimate	S.E.	C.R.	Probability	Results
P	<--- A	H1	0.157	0.087	1.532	0.125	Insignificant
P	<--- V	H2	0.218	0.109	2.084	0.037	Significant
P	<--- B	H3	-0.182	0.152	-1.659	0.097	Insignificant
P	<--- M	H4	0.663	0.130	4.722	0.000	Significant

Source: Field data, (2019)

5.4. Model Fitness

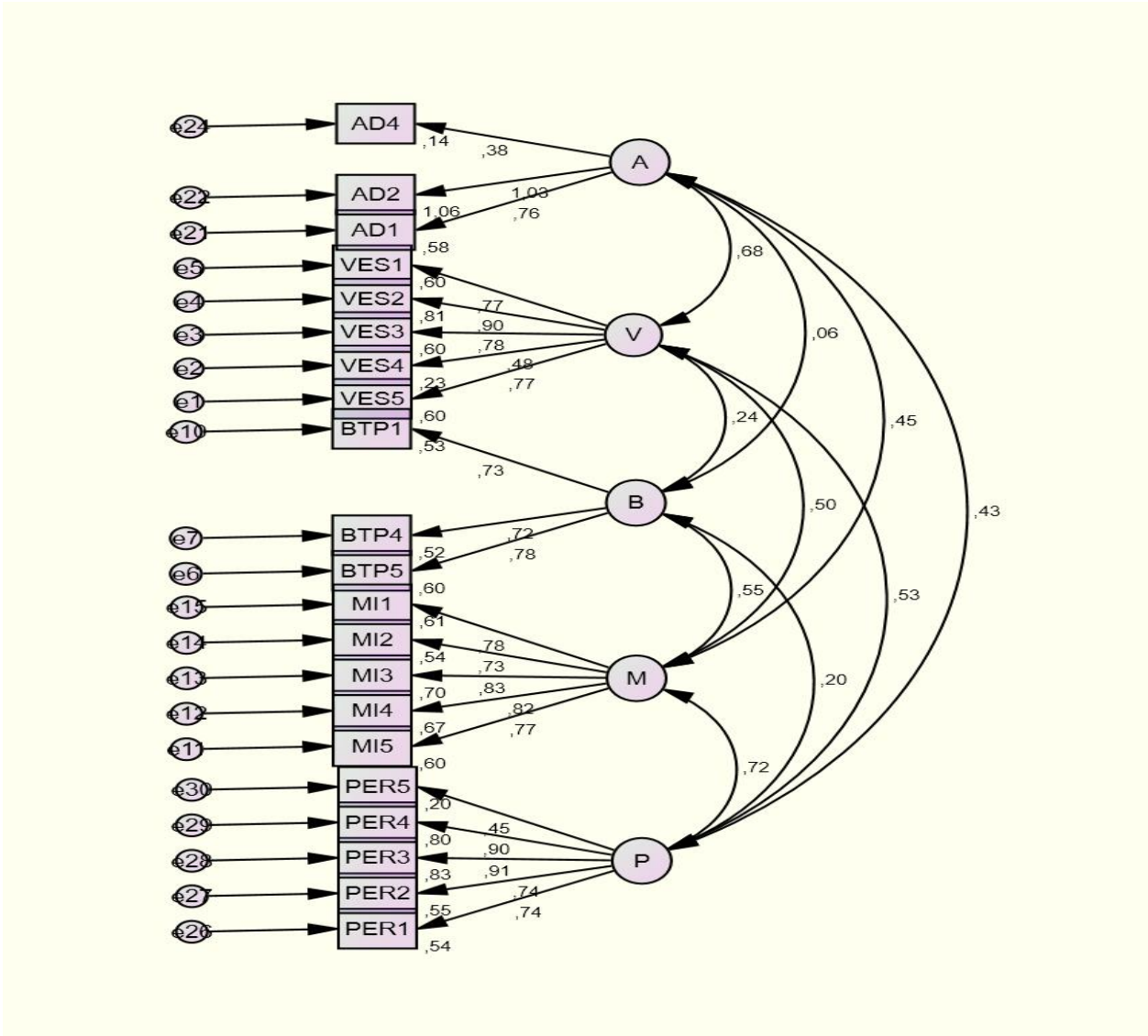
This study used a four-factor model, which was tested to see its goodness of fit using Amos graphics version 18. The results of the model evaluation showed a Chi-square = 2.672, Degree of freedom = 185, Probability = 0.000, and a Minimum Discrepancy = 2.672 which is within the threshold of 5. These results show that the proposed model is a reasonable fit for the data as shown in figure 1 below.

Figure 1: Model of Performance of Beef Value Chain in the Zambezi Region of Namibia



Notes: Chi-square = 494.246 (df = 185); CMIN/DF = 2.672; NFI = 0.595; CFI = 0.694; RMR = 0.2424; RMSEA = 0.138; PCLOSE = 0.000

Figure 2: Model of Factors Correlations



Notes: Chi-square = 416.686 (df = 179); CMIN/DF = 2.328; NFI = 0.659; CFI = 0.765; RMR = 0.1107; RMSEA = 0.138; PCLOSE = 0.000

Figure 2 above presents a correlation among factors. A correlation of >1.00 would mean that the factors involved are highly related. The model shows that all the factors correlate to the benchmark of 0.80 as pointed out by (Hair *et al*, 2010). Therefore, it is clear from the model that all factors measure different components in the model and most of the factor loadings are above the acceptable regression weight of 0.5 as suggested by (Fornell and Larcker, 1981).

5.5. Validity and Reliability of Factors

5.5.1 Reliability

Reliability is described by Kerlinger (2000) as the degree of consistency of an instrument, a reliable instrument is that which always gives identical scores it is used in testing. Factor reliability is determined by the measure of composite reliability (CR), McDonald (1970) suggested that composite reliability can be used as an alternative reliability index to coefficient alpha since composite reliability uses factor loadings and uniqueness from factor analysis to compute the results. Campbell (1988) suggested that composite reliability is less biased than Cronbach's Alpha. Composite reliability greater than 0.70 is therefore acceptable. Thus, the results in table 4.4 below show that there are no reliability concerns since all the composite reliability values of variables are above the threshold of 0.70.

Therefore.

$$CR = (\sum L)^2 / [(\sum L)^2 + \sum (1 - L^2)]$$

Where L = standardized loading $(1 - L^2)$ = error measurement

5.5.2 Convergent Validity

Convergent Validity is intended to see how big the indicators converge or share in a single construct. An indicator is said to converge if it has a factor loading value that is high and significant in addition to having a standardized factor loading estimate greater than 0.50 (Hamdan *et al*, 2011). If there are convergent validity issues, it means the variables do not correlate well with one another within their parent factor which further means that the latent factor is not well explained by its observed variables. Convergent Validity is determined by Average Variance Extracted (AVE), which is the degree to which a latent variable is explained by its observed variables. The AVE for a construct should be greater than 0.50. For the convergent validity of this study, AVE was calculated. All the retained items had an AVE greater than 0.50. For this reason, all the factors achieved convergent validity as per the results presented in table 4 below.

Therefore.

$$AVE = (\sum L^2) / [(\sum L^2) + \sum (1 - L^2)]$$

Where L = standardized loading $(1 - L^2)$ = error measurement

5.5.3 Discriminant Validity

Discriminant validity issues occur when variables correlate more highly with variables outside their parent factor than with the variables within their parent factor which means that the latent factor is explained better by some other variables than by its observed variables. Discriminant validity was achieved by comparing the square roots of AVE on the diagonal in the matrix below to all the inter-factor correlations. All factors showed adequate discriminant validity because diagonal values are greater than the correlations. All the retained factors achieved discriminant validity. The AVE for all constructs is greater than the Maximum Shared Squared Variance (MSV).

Therefore, **MSV = Square of Max. Correlation Value in a Construct**

Furthermore, all the AVE for the constructs is greater than the Average Shared Squared Variance (ASV).

Therefore, ASV = the **average of all squared correlations in a construct** $\left[\frac{\sum corr^2}{n} \right]$

Table 4: below indicates that the variables retained during model modification achieved validity and reliability
Validity and Reliability Assessment

	CR	AVE	MSV	ASV	P	V	B	M	A
P	0,871	0,586	0,513	0,255	0,766				
V	0,863	0,567	0,468	0,265	0,533	0,753			
B	0,785	0,550	0,306	0,102	0,201	0,245	0,741		
M	0,891	0,621	0,513	0,318	0,716	0,500	0,553	0,788	
A	0,794	0,594	0,468	0,214	0,427	0,684	0,059	0,449	0,771

Source: Field data, (2019)

Table 4 below presents a list of factors in the model as well as their respective standardized loadings to the parent variable as indicated in figure 2 above. The results show that most of the variables have a loading greater than 0.5 which is the minimum acceptable loading as pointed out by (Mohajan, 2017).

Table 5: Standardized Factor Loadings

Factors		Estimates	
VES5	<---	V	0.749
VES4	<---	V	0.463
VES3	<---	V	0.803
VES2	<---	V	0.896
VES1	<---	V	0.782
BPT5	<---	B	0.754
BTP4	<---	B	0.764
BTP1	<---	B	0.714
MI5	<---	M	0.769
MI4	<---	M	0.829
MI3	<---	M	0.860
MI2	<---	M	0.706
MI1	<---	M	0.760
AD1	<---	A	0.888
AD2	<---	A	0.878
AD4	<---	A	0.449
PER1	<---	P	0.727
PER2	<---	P	0.734
PER3	<---	P	0.896
PER4	<---	P	0.881
PER5	<---	P	0.427

Source: Field data, (2019)

6. Conclusion

The study measured factors affecting the performance of the beef value chain in the Zambezi region of Namibia intending to identify ways through which the value chain can be improved. Specifically, the study identified and measured factors that affected the performance of the beef value chain in the Zambezi region, as well as explored major constraints and opportunities experienced by the beef value chain actors in the Zambezi region.

The first objective was to measure the effect of animal diseases on the performance of the beef value chain in the Zambezi region of Namibia. The findings indicated that the effect of animal diseases on the performance of the value chain in the Zambezi was statistically insignificant.

The second objective was to measure the effect of veterinary services on the performance of the beef value chain in the Zambezi region of Namibia. The findings indicated that the effect of animal diseases on the performance of the beef value chain in the Zambezi was statistically significant and thus the performance of the beef value chain was influenced by veterinary extension services in the Zambezi region.

The third objective was to measure the effect of the beef trade policy on the performance of the beef value chain in the Zambezi region of Namibia. The findings indicated that the effect of the beef trade policy on the performance of the value chain in the Zambezi was statistically insignificant.

The fourth objective was to measure the effect of market information on the performance of the beef value chain in the Zambezi region of Namibia. The findings indicated that the effect of market information on the performance of the beef value chain in the Zambezi was statistically significant and thus the performance of the beef value chain was influenced by market information.

The fifth objective was to explore major constraints and opportunities within the beef value chain. The findings show that the beef value chain in the Zambezi region of Namibia is faced with market constraints. The livestock market has been closed for a long time due to continuous outbreaks of FMD in the region which is very prevalent due to sharing of

grazing and wetlands between cattle and wildlife especially buffaloes which are well-known carriers of FMD. The findings further show that some of the opportunities identified are those which have to do with good grazing found in the region which is suitable for rearing cattle and the existence of large herds of cattle.

6.2 Recommendations

The findings of the study indicated that veterinary extension services and market information significantly affect the performance of the beef value chain in the Zambezi region of Namibia. Thus it will be best for those involved in improving such factors to act upon and ensure that there is a great improvement as pointed out by Lubroth *et al.* (2007) while commenting on veterinary extension services that along with having vaccines and vaccination there was a need for other aspects to compliment the fight against disease prevention and control such as having legislations, surveillance, quick response, transport, market regulations as well as clear public communication among other important aspects. Ramutu *et al.* (2000), while contributing to having access to market information pointed out that information must be relevant, timely, and present to all sectors of the market, especially that which is focused on consumer demand.

6.2.1 Recommendation to Beef Value Chain Actors

The findings of the study recommend that value chain actors make improvements in controlling animal diseases by ensuring that their livestock receives good animal husbandry through effective veterinary disease control and extension services. Furthermore, there is a need to improve the quality of cattle produced as well as promote commercialization of livestock keeping. The study also found that there is weak dissemination of market information on livestock markets and thus a recommendation was done in that dissemination of market information be improved using all possible mass media for the benefit of all beef value chain actors.

6.2.2 Recommendation to Policymakers

Based on the findings of the study, it is recommended that policymakers should consider implementing the beef trade policy which is compatible with the challenges faced by the Zambezi region farmers when it comes to livestock production and the need for conservation. The findings of this study, along with those of Thomson *et al.* (2013) and Van Rooyen (2016) are all suggesting that one of the possible approaches which can ease access to markets of beef products from the Zambezi region and many places in southern Africa is through the implementation of commodity-based trade (CBT) resolution as requested under the Phakalane Declaration (2012). However, despite receiving the go-ahead from the World Organisation for Animal Health in 2012 none of the affected countries has included the implementation of CBT in their domestic beef trade policy, a situation which is worrisome for the policymakers as so many opportunities are available for livestock farmers due to increase in the world population and demand for animal protein as pointed out by (Steinfeld *et al.*, 2006).

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