The rapid transformation of the animal feed ingredients sector: a case study of the South African beef sector

by

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DECLARATION

I, Eugine Kaango, declare that this dissertation, which I hereby submit for the degree MSc in Agricultural Economics at the University of Pretoria, is my work and has not previously been submitted by me for a degree at this or any other tertiary institution.

SIGNATURE: 

DATE: 14/08/2021

DEDICATION

This dissertation is dedicated to my mum and dad, for all the sacrifices they have made to make for me reach this far. Through your continuous support, I have reached this far. I promise to carry on the determination you have in helping others attain a better tomorrow.

ACKNOWLEDGMENTS

I want to thank God for the gift of life, and for opening doors, full of opportunities, for me to choose from. It is because of your mercies that are new every morning that I can stand and say I have obtained a master's degree. Indeed, you are a faithful God and all I can say is thank you and halleluiah. I will forever be indebted to you.

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ABSTRACT

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Food systems are transforming globally, from the upstream through the midstream to the downstream components. Despite the transformations throughout the food systems, research has focused more on the upstream (farm gate) transformations and paid less attention to the midstream and downstream (off-farm) transformations. These transformations have led to the increased demand for different agricultural commodities, including animal feed.

Globally, the demand for animal feed is rising and is expected to keep rising. This is because the appetite for value-added food, including all forms of meat, is growing among the middle-income class population in developing countries. The growing middle-class income households are transitioning from starchy diets to beef and poultry diets, processed foods, vegetables and fruits. Worldwide dietary consumption patterns are changing due to population growth, socio-economic factors, rapid urbanisation, increased disposable income among households, and

better food distribution.

The change in consumption patterns is also evident in southern Africa, particularly in South Africa, where meat is concerned. Between 2010 and 2017, the per capita consumption of beef in South Africa increased from 17.8 kgs to 21.3 kgs. The increased demand for beef has led to the rise in demand for animal feed in South Africa.

Researchers have assessed the evolution of the southern African animal feed industry and trade, but have paid less attention to the transformations occurring along the value chain for the animal feed ingredients trade. Also, research has paid little attention to the transformations occurring within the South African animal feed industry. The transformations along the animal feed ingredient value chain are important for analysis. This is because the transformations along the value chain have motivated on-farm growth through commercialisation and technology change. In this regard, this study analysed the changes that have occurred over the two decades along the southern African animal feed ingredient value chain, with a specific focus on the South African feed sector. The purpose of the study was to quantify the transformations that have occurred along the southern African feed ingredients value chain, and those occurring within the South African animal feed industry. Furthermore, the study aimed to identify the drivers of the flow of feed ingredients towards the South African feed manufacturing sector.

The study employed a functional analysis method and Porter's diamond framework model to achieve this. Quantitative and qualitative data analysis methods were used to analyse the data collected from the firms involved in the industry. The study surveyed 53 firms in the total population of about 100 firms involved in the animal feed industry in South Africa. Of the 53 firms surveyed, 47 firms completed the survey online, and six firms were interviewed via phone call to help map the chain of feed ingredients. Furthermore, 16 firms involved in the supply of feed ingredients in Zambia were surveyed online. Zambia was identified from the literature as the main exporter of feed ingredients in southern Africa. A total of 10 firms in Zambia completed the online survey, and six were interviewed via phone to help map the feed ingredients chain. Zambia has less than 25 firms involved in the animal feed trade on a large scale.

The study analysed the trade of five main feed ingredients imported by South Africa. These are maize grain, whole soybean, maize bran, soybean oilcake and sugarcane molasses. Imports of

these products by South Africa from other southern African countries between 2010 and 2019 increased by 211%, 302%, 179%, 564% and 7%, respectively.

The study also finds that the South African animal feed industry has experienced rapid transformation along the value chain. The number of feed manufacturers has increased by 6%, suppliers of animal feed ingredients increased by 73%, suppliers of feed premixes and feed additives increased by 89%, and the firms offering laboratory services increased by 400%, although their total number is still below ten.

Through analysis of the transformations in the animal feed industry, the study has contributed to the value chain management knowledge base on the literature on the southern African animal feed industry by providing a detailed analysis of the South African animal feed industry. With these transformations occurring along the chain, the dissertation concludes by making recommendations to ensure the sustainability of the animal feed value chain. There is a need for the government to increase its support to the industry to boost its competitiveness, both locally and internationally, by facilitating trade policies between nations that promote increased international trade.

Since South Africa is driving investments in the region, there is a need for the South African animal feed industry firms to increase their investments in other southern African countries into grain crop market development and contract farming. These investments will directly benefit the local farmers in those countries through increased access to markets. This, in turn, will increase grain crop production, leading to increased availability of animal feed ingredients. The increase in grain crop availability will help to cushion the deficit of feed ingredients in South Africa through the increased movement of feed ingredients to the South African feed manufacturing sector.

Keywords: Animal feed ingredients, international trade, beef, value chain, transformations.

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ACRONYMS

AFMA	Animal Feed Manufacturing Firms
BFAP	The Bureau for Food and Agricultural Policy
DAFF	Department of Agriculture, Forestry and Fisheries
DTIC	Department of Trade Industry and Competition
FAO	Food and Agriculture Organization
ITAC	International Trade Administration Commission
PACRA	Patents and Companies Registration Agency
SA	South Africa
SADC	Southern Africa Development Community
SAFA	South Africa Feedlot Association

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND INFORMATION

The Food and Agricultural Organization (FAO) estimates that over nine billion people will be alive, globally, by 2050 (Baldi and Gottardo, 2017). The estimated human population expansion will be associated with a 70% global expansion in animal product demand, with developing nations taking the lead in this demand (Baldi and Gottardo, 2017). In the previous few decades, the global agricultural sector has been profoundly transformed to meet the needs of the global population (Lassaletta et al., 2014; Liverpool-Tasie et al., 2017; Reardon et al., 2019). Changes to agricultural production practices started in the eighteenth century (Coffey et al., 2016). Some changes include the shift from extensive livestock production to intensive livestock production systems and crop diversification. Around the nineteenth century, the focus on better ways of feeding animals started (Coffey et al., 2016). The significant expansion of the worldwide feed and food trade is one of the more significant changes in the international agricultural system (Lassaletta et al., 2014). For example, in the last five decades, the international trade of feed products and food has expanded, with a few countries being stable as exporters, while many countries have risen as importers (Wang et al., 2018). The transformations in the food systems[1] associated with the increased international trade of food include the proliferation and concentration of actors and products along the value chain[2], change in technology use, and commercialisation of most segments of the food systems.

Despite the transformation in the entire food system, research and policy debates have focused on the transformation in the farm segment of the food system, and limited attention has been given to the transformation of off-farm segments (midstream and downstream) (Reardon et al., 2019; Reardon, 2015). The midstream segment includes storage, logistics, wholesaling, and processing, while the downstream segment includes restaurants and retail stores (Reardon, 2015). The midstream and downstream segments are, however, important because 40% to 70%

1 Food systems involve all the categories of actors and their interrelated activities throughout the system, from production, aggregation, processing, distribution, consumption to food products disposal. All food products that come from livestock and crop production, aquaculture and fisheries, forestry and the societal, economic and natural environments, which merge the various production systems together, define the food systems. Various food value chains emanate from a food system.

2 A food value chain consists of all actors involved in the interlinked activities of production and value-addition that are required to make the product ready for consumers.

of food costs and food value addition occur in these streams (Reardon et al., 2019). Furthermore, the midstream and downstream parts of the supply chain account for a higher percentage of the foods consumed at the individual and household levels. In Asia, for example, the midstream and downstream food supply chain account for 50% to 70% of the food consumed in Asia (Reardon et al., 2014b).

Similar to the situation in Asia, research in Africa has paid less attention to the transformations in the midstream and downstream segments of the value chains (Liverpool-Tasie et al., 2017). Limited data availability is the main factor that hinders extensive value chain analysis in Africa (Liverpool-Tasie et al., 2017).

Since many nations in both Asia and Africa are classified as developing nations, the transformations occurring in the food systems for both continents might be similar. The transformations in the downstream and midstream segments of the value chains in African countries also need closer attention for analysis. This is because the transformations in all segments of the value chain have an impact on food supply. To determine the impact of innovation in farm products and technology on the profitability of agricultural products, research strategies need to take into account the entire food system and its transformations (Reardon et al., 2019).

The animal feed industry is also experiencing these rapid transformations. Globally, the demand for animal feed is rising and is expected to keep rising (Alltech, 2019). This is because the appetite for value-added food, including all forms of meat, is growing among the middle-class in the developing countries as they are diversifying towards beef and poultry diets, vegetables and fruits, as well as more processed foods (Trostle and Seeley, 2013; Hofmeyr, 2013). The worldwide dietary consumption patterns are changing due to population growth, socio-economic factors, rapid urbanisation, increased dispensable income among households, and better food distribution (Drewnowski and Poulain, 2018). Engel's law and Bennett's law explain the cause of the changes in consumption patterns. Engel's law reflects a component of food consumption that is fixed and not dependent on income and is also required for life maintenance (Clements and Si, 2018). Engel's law expresses that when the household income rises, the share of household budget expenditure on food diminishes (Drewnowski and Poulain, 2018). Bennetts's law is related to Engel's law as it links the rise in income and fall in consumption of staples. Bennett's law states that when income increases, the consumption of

starchy staple foods declines (Bennett, 1941). As predicted by these two theories, as of late, typical diets containing calorie-dense starchy crops, for example, rice and cassava, are slowly being substituted by more varied diets that have an abundance of animal products, vegetables and fruits, and processed nourishments having added fats and sugars (Drewnowski and Poulain, 2018).

South Africa is also experiencing similar changes in consumer preferences, which have led to transformations in the different food production systems, of which the beef production system is not an exception (Hall et al., 2015). Similar to the global pattern, beef production through the grain-fed production system has increased in South Africa because it allows cattle farmers to efficiently respond to the demands of consumers (Hall et al., 2016a). Grain-fed production systems enable the production of beef from young animals with optimal characteristics within a short period, as compared with a grass-fed system. In a grass-fed system, it takes longer for young animals to reach the required optimal characteristics of between 1 and 3 mm of fatty level, according to the carcass classification of South Africa (Hall et al., 2016a). Apart from the production of beef from young animals, the older animals that spend most of their lives on a grass-fed system are sent to feedlots for fattening for a short period to allow them to achieve the required fatness before slaughter (Hall et al., 2016a). The older animals are usually breeding animals that are to be culled, and are taken to feedlots before slaughter.

The increase in livestock grain-fed production, together with the emergence of a significant poultry sector, has led to an increased demand for animal feed in South Africa. This has left South Africa with the highest demand market for animal feed in southern Africa over the past two decades (Samboko et al., 2018). Notwithstanding this, the South African animal feed industry does not always have a sufficient local supply of maize and soybeans, which are the main ingredients in compound animal feed (DAFF, 2018b). Droughts are the main causes of the shortages in the local supply of these crops used as main ingredients in compound animal feed (AFMA, 2019). To meet the shortfall in the local supply, the South African animal feed industry imports feed ingredients from overseas and countries in the southern African region (AFMA, 2019). In this regard, several researchers (Arndt and Roberts, 2018; Ncube et al., 2017; Samboko et al., 2018) have indicated an increase in southern African trade of animal feed ingredients, with South Africa leading demand in this landscape. However, in this field, researchers have focused more attention on the theoretical aspect of the evolution of the trade of animal feed ingredients to South Africa, and have paid less attention to the transformations

occurring within the chain of trade.

Hernandez and Pedersen (2017) expressed the need for future research to be done to scrutinise the changes in firms' value chain configurations and the factors contributing to the changes. The particular configuration of a value chain may reveal certain transformation processes that might influence the way in which firms build or degrade their capabilities (Hernandez and Pedersen, 2017).

1.2 PROBLEM STATEMENT

South African consumers' meat consumption patterns are changing with time, being influenced by urbanisation, class mobility, and the evolution in consumer preferences (Vermeulen et al., 2015). To meet consumer preferences, the quality of meat has to be improved. Meat quality includes characteristics such as tenderness, juiciness, taste, and health attributes, which are all determined by breed manipulation and feeding practices (Hall et al., 2016b). For successfully producing the required quality of meat, activities that prompt changes include feed control, proper breed selection, changes in the age for animal slaughter, and the weight of the carcass (Hall et al., 2015). Similar to the global situation, South Africa has embraced the technology of fat and lean content control in meat through controlled livestock breeding and feeding (Sillence, 2004; Hall et al., 2016a). Controlled breeding and feeding facilitate the management of meat quality. The advantages of controlled feeding have led to the intensification of the livestock sector through feedlot livestock production in South Africa. About 75% of beef in South Africa is produced under the feedlot system (SAFA, 2019). As a result, South Africa has the highest demand for animal feed in the southern region of Africa (Samboko et al., 2018; Ncube et al., 2016). Considering South Africa's high demand for animal feed, many authors have established the fact that there has been an increase in the flow of animal feed ingredients to South Africa, from other countries in the southern region of Africa, with Zambia taking the lead (Ncube et al., 2016; Ncube et al., 2017; Samboko et al., 2018).

Despite the noticeable increase in the trade in animal feed ingredients to South Africa, details regarding the transformation, in terms of structure and conduct in the flow of the southern African animal feed trade to South Africa, are not well known. Furthermore, limited knowledge exists on the structural and conduct changes within the South African animal feed industry. A structural change can be defined by the concentration of products and actors within or over the value chain segments (Hernandez et al., 2018). Regarding structural changes, there is limited

information available on the following points: changes in terms of volumes traded; changes in the numbers of actors; sizes of firms, trade organisations and orientation; frequency of trade; and the chain of the feed ingredients trade. Conduct correlates with the way in which actors behave in each value chain segment regarding the inputs acquired and output produced, and the output they sell (Belton et al., 2017). The changes in terms of technology use among actors are not known with certainty.

Literature has shown that conduct and structural changes have an impact on aspects such as farmer inclusion or exclusion, nutrition status, off-farm employment, household income, expansion of volumes traded and elongation of the supply chain[3], food security, and national economic development (Reardon et al., 2015; Belton et al., 2017; Reardon et al., 2019).

Against this backdrop, the dissertation presents the case that the transformations in terms of structure and conduct are at the centre of the increased flow of animal feed ingredients to South Africa but have been given little attention for analysis. This study aims to quantify these structural and conduct changes. The analysis will help inform the interested stakeholders on the changes that have occurred and their implications for policy and management.

In this study, the analysis of the structural and conduct changes is linked to the South African beef sector. The link to the South African beef sector is examined because of its size and capacity, as compared with other countries in southern Africa, and its significance to the southern African feed industry. South Africa's beef value chain has become increasingly vertically integrated (DAFF, 2018a). Through vertical integration, the feedlots have expanded both in the number of animals and holding capacity, moving towards the wholesale level (Harding et al., 2017). South Africa has approximately 100 commercial feedlots (DAFF, 2018a). With the presence of large feedlots, the beef industry in South Africa produces about 1 million tons of beef per annum (DAFF, 2018a). South Africa imports and exports about 15 thousand tons and 32 thousand tons, respectively (DAFF, 2018a). It is the main exporter of beef in the southern African region. It is also worth noting that South Africa has a high demand for beef, with a per capita consumption of about 18.46 kilograms and about 55 million consumers (DAFF, 2018a). To sustain this high demand for beef through commercial production, the main ingredients in compound animal feed must be in constant supply. Maize

3 Supply chain elongation is the stretching of the chain to reach the required materials regarding the importing country, or to reach the demand market regarding the exporting country.

and soybean[4] are the two main ingredients used (Arndt and Roberts, 2018). The availability and accessibility of these key ingredients to beef producers are fundamental for sustaining the product's competitiveness (Ncube et al., 2016). The demand for the key ingredients of animal feed in South Africa provides an opportunity for nations in the southern region of Africa to boost their exports and positively benefit from trade. Therefore, analysing the structural and conduct changes in the southern African animal feed industry, with the main emphasis on South Africa's feed sector, is important, as South Africa stands out as the main driver of trade in southern Africa.

1.3 CONCEPTUAL FRAMEWORK

The conceptual framework presented in Figure 1.1 illustrates the linkages among variables that were considered important in this dissertation. The rationale for the use of the framework is that there have been rapid transformations in most segments of the animal feed sector, leading to the increased demand for and trade in animal feed. The study was conceptualised on the fact that food systems have transformed rapidly over the past few decades (Reardon et al., 2019). The main factors driving these transformations include (1) population growth, (2) urbanisation, (3) growth in income, and (4) policy liberalisation and privatisation (Drewnowski and Poulain, 2018; Reardon et al., 2019). The policy liberalisation and privatisation of the 1980s and 1990s led to the minimum involvement of governments in controlling food systems. Both domestic and foreign firms that operate on a large scale, such as supermarkets, food processors, fast food stores, and large-scale input suppliers, entered the food markets (Reardon et al., 2019). This has had a direct effect on market expansion. In the presence of expanding global markets, the growing population has continued to experience a shift from rural to urban areas. At the same time, household incomes experienced a rise. The study conceptualised from the literature that the rapid transformations in food systems were associated with a shift in consumption patterns from calorie-dense foods to meat and other meat products, fast foods, fatty foods, vegetables and fruits (Reardon et al., 2014b). The increase in meat demand directly affects the demand for animal feed (FAO, 2009). Consumers have different meat quality demands. The increase in meat demand and the differences in consumer preferences lead to an increase in the demand for animal feed. Animal supplementary feeding is necessary to produce the required quantity and quality of meat in a short period (Hall et al., 2016a). The rise in animal feed demand leads

[4] The rising demand for chicken has supported the trade in soybeans.

to increased international trade of animal feed ingredients and compound animal feed in some instances. Different nations have different grain crop production capabilities. Some nations are constrained in producing grain crops, such as maize and soybean used as animal feed ingredients. These nations have to engage in the international trade of feed ingredients to cover the deficit in their local production.

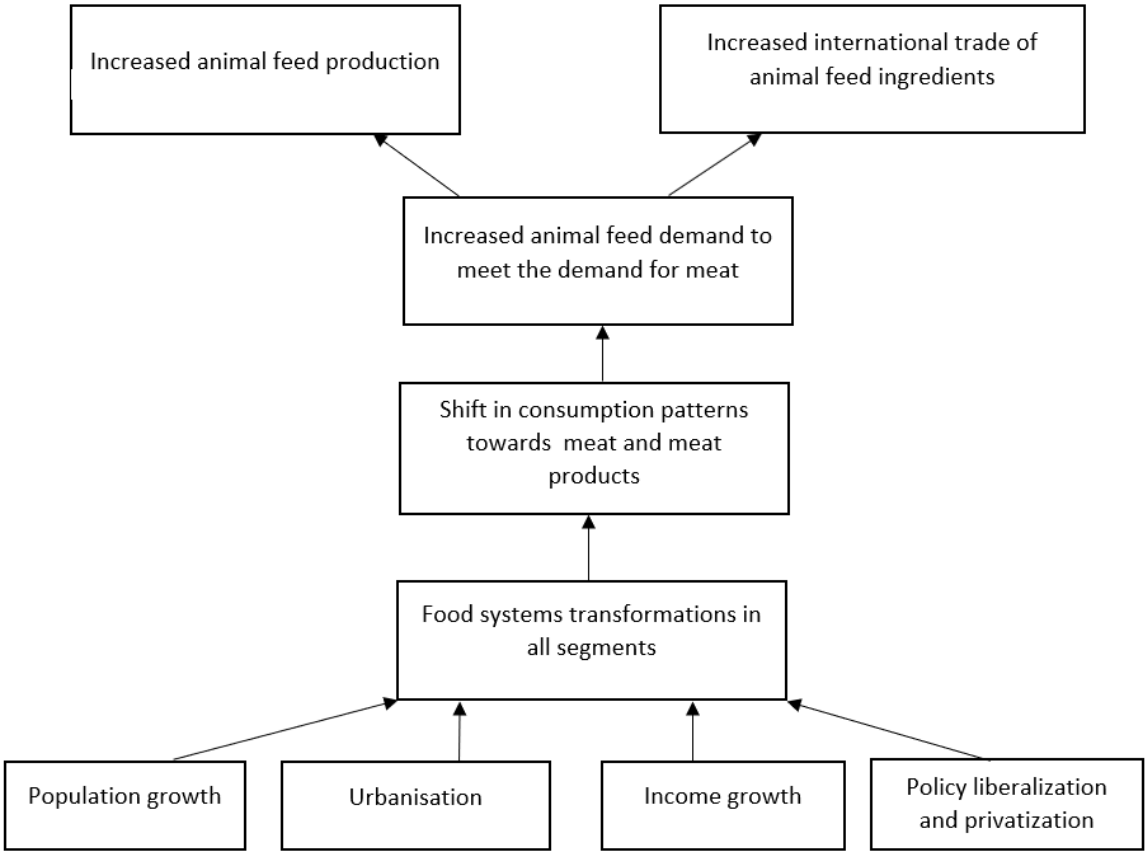

Figure 1.1: Conceptual framework

Source: Own illustration (2020)

The conceptual framework above in Figure 1.1 elaborates the link between the food systems transformations and the expansion of the animal feed industry in South Africa. Factors such as population growth, urbanisation, income growth and policy liberalization and privatization were the drivers of the rapid transformations in the food systems. The transformations are at the centre of the shift in consumption patterns from starchy foods to meat and meat products, vegetables and fatty foods. Changes in consumption patterns are then linked to the increased demand for animal feed to meet the demand for meat. Due to the increased demand for meat, feedlots become an important aspect of livestockproduction as it allows for the intensive

finishing of livestock. The feedlot segment allows for the controlled finishing of livestock in an intensive setting near to abattoirs and urban consumers.

The conceptual framework has a direct link to the problem statement, objectives, and propositions of the study as it illustrates how the transformations in the food systems in terms of structural and conduct changes come about. It further speaks to the causes of increased animal feed demand which has led to the competitiveness of the animal feed industry firms in international markets. The conceptual frameworkconceptualizes the full transformation and all of the contributory transformations occurring along the beef value chain, including its lateral segments and the framework develops the overall landscape within which this thesis is positioned. This thesis only considers the transformation in the supply of raw materials of animal feed, a sub-segment of the overall beef value chain. Whereas the extent of the transformation in the beef value chain stretches across many segments, the scope of this thesis is limited to the single segment as a building block in the consideration of the overall picture of the transformation in the value chains.

1.4 STUDY OBJECTIVES

The main objective of this study is to analyse the transformations in terms of structure and conduct in the South African animal feed value chain.

The specific objectives that the study aims to address are:

1. Mapping and quantifying the South African animal feed value chain.
2. Identifying the actors involved in the trade of animal feed ingredients to the South African feed manufacturing sector.
3. Analysing the competitiveness of the South African animal feed industry.
4. Characterising and quantifying the changes in the trade of animal feed ingredients to the South African feed manufacturing sector.
5. Identifying and quantifying the transformations within the South African animal feed sector.

1.5 RESEARCH PROPOSITIONS

This dissertation addresses the objectives with both quantitative and qualitative research methods. To contextualise and structure the arguments in the study, some prepositions were formulated. The propositions are based on the fact that, in the presence of globalisation, food systems have continued to experience rapid transformations in all segments, from upstream to downstream, leading to the increased local and international trade of agricultural products.

In light of the rapid transformations in all segments of the food systems, the dissertation analyses the rapid transformations that have occurred in the southern African animal feed ingredients sector, with a specific reference to the South African animal feed sector. The analysis is done by considering certain specific propositions. The following propositions address the objectives of the research.

Proposition 1: The demand for a product plays a major role in influencing the flow of a product, as well as the volumes involved during the trade. Product demand is also one of the drivers of value chain transformations. This was evident in the Bangladesh aquaculture value chain, where demand, infrastructure improvements, and other investments by the actors were the main drivers of the value chain transformations (Hernandez et al., 2018). With demand as the main driver, Morocco, Saudi Arabia, Iran, and other countries in both the Middle East and North Africa are likely to continue importing animal feed to sustain their growing livestock sectors (Nigatu and Motamed, 2015). In regions with expanding populations, the demands for protein-rich food and the decreases in expenses and the generalised international liberalisation measures have been the significant drivers of the increased international trade of agricultural products (Lassaletta et al., 2014). The evaluation of this proposition is an important component of this dissertation for understanding the changes in demand for animal feed ingredients by the South African animal feed sector over the past decade. This proposition is explored in Chapter 4, which quantifies the volumes of different animal feed ingredients imported by South Africa over the past decade.

Proposition 2: As trade increases, a proliferation and concentration of actors develops along the chain of trade. The expansion of the industry or sector involves the change in the number of actors involved. This is evident from literature where, as trade increased, a proliferation and concentration of actors and products emerged in all segments of the value chain (Belton et al., 2017; Hernandez et al., 2018). The exploration of this proposition is a vital component of this

dissertation. It aims to understand the transformations that have occurred in all segments of the South African animal feed sector. The proposition is explored in Chapter 4, which details the structure and conduct transformations that have occurred in the South African animal feed sector over the past two decades.

Proposition 3: The competitiveness of the industry enables the firms within the industry to become competitive in international markets (Porter, 1999). The more competitive a firm is, the more likely it is to gain access to international markets. Firms compete in international markets through organisational resilience, market intelligence, and a firm's entrepreneurial ability and creative use of imitations (Tallman et al., 2018). This proposition is fundamental to the further understanding of the expansion of the South African animal feed industry and the increased access to international markets by the industry firms. The proposition is explored in Chapter 4, where the competitiveness of the South African animal feed industry is analysed, linking it to the increased flow of animal feed ingredients from other southern African countries to the South African feed manufacturing sector.

1.6 STUDY CONTRIBUTIONS AND JUSTIFICATION

The transformations in structure and conduct in the chain of the southern Africa animal feed ingredient trade might be at the centre of the recently accelerated development of the animal feed industry and trade in southern Africa, yet it is overlooked as a component of that development. In similar studies, the transformations in structure and conduct in value chains were found to be at the centre of booms in the domestic development of aquaculture in India and Bangladesh (Belton et al., 2017; Hernandez et al., 2018).

The analysis of the structural and conduct changes associated with the boom in the flow of animal feed ingredients to South Africa is important to the South African beef industry, and to the entire southern African region. This study will contribute theoretically to the knowledge base of value chain management. The study will contribute to the literature on the southern African animal feed industry by providing a detailed analysis of the South African animal feed industry. The analysis of the animal feed industry supplying the beef sector is a major contribution from this study. Previous research (Ncube, 2018; Ncube et al., 2016; Ncube et al., 2017; Samboko et al., 2018) on the southern African animal feed industry was biased towards the poultry sector in its role as the main driving sector, but neglected animal feed demand from other booming sectors such as the beef sector, especially in South Africa.

Further, the study will contribute to the knowledge on regional value chains and their transformations. First, with the constraint of local supply of some critical animal feed ingredients in some periods in South Africa, understanding the transformation in the trade of these ingredients is important to the southern Africa animal feed industry regarding the maintenance and sustainability of feed supply. This will be crucial for meeting the beef demands of the rising human population.

Second, as the supply chain becomes longer, it becomes more vulnerable to shocks such as climate crisis, energy cost increases, water cost increases, and food safety threats (Reardon et al., 2014b). Therefore, understanding the changes along the supply chain enables the implementation of innovations that would help reduce the vulnerability of the supply chain to these shocks. With the analysis of the competitiveness of the animal feed industry, the study will also state whether there is a need for increased direct and indirect government support[5] to help reduce supply chain vulnerability.

The information from this study will help interested stakeholders in the animal feed industry to put in place both micro- and macro-policy strategies that will help boost the trade of feed ingredients.

1.7 ORGANISATION OF THE STUDY

This dissertation has six chapters. **Chapter 1** covers the introduction. The introduction contains the following subsections: background information, problem statement, conceptual framework, study objectives, and study justification. **Chapter 2** contains a detailed literature review. The first part reviews the literature on global value chains. The second part explains the transformations in food systems. The third part looks at animal feed demand and animal feed production. The fourth part reviews the literature on meat demand. The fourth part looks at the southern African trade of animal feed and future perspectives of animal feed demand and trade. The last part summarises the literature by identifying the gaps in the literature. **Chapter 3** explains the methodology for the study. That is, a description of the study area, study design, sampling procedure, data collection and data analysis. In **Chapter 4**, the results of the study

[5] Direct government support refers to government providing direct help to the industry firms such as funds to boost their performance. Indirect government support may include government trade policy regulation such as import and export regulation, and import and export subsidies.

are analysed and discussed. This chapter involves mapping the animal feed ingredient value chain, and quantifying the changes in volumes of feed ingredients traded over the past ten years. The competitiveness of the South African animal feed industry is also analysed under Chapter 4. **Chapter 5** analyses the structural and conduct transformations in all segments of the South African animal feed sector, and **Chapter 6** contains the conclusion and recommendations arising from the study results**.**

CHAPTER 2: REVIEW OF RELATED LITERATURE

This chapter reviews the literature on global value chains, and on the transformations of food systems and meat demand. We then review the literature on how meat demand has changed regional value chains and the demand for animal feed. The chapter ends with a summary of the literature.

2.1 GLOBAL VALUE CHAINS AND THEIR SIGNIFICANCE

A value chain is a network of activities or interdependent systems connected by linkages (Porter and Millar, 1985). According to Inomata (2017), who referred to Gereffi et al. (2005), a global value chain analysis is focused to answer the following questions: What forms of rules are present? Is it a collaborative or competitive game? What creates opportunities for winning? In handling these questions, regarding global value chains, the focus is on transaction forms arranged between partners (Inomata, 2017). This is because the way in which exchanges occur mirrors the structure of power relations between partners, which eventually decides the degree and size of the value appropriations within the interplay (Inomata, 2017).

The examination of global value chains gives an understanding of the organisation of global industries through the analysis of the structure and dynamics of various participants engaged in a particular industry (Gereffi and Fernandez-Stark, 2011; Fernandez-Stark and Gereffi, 2019). Due to its comprehensiveness, global value chain analysis helps policymakers respond to questions that previous policymakers were not able to answer (Gereffi and Fernandez-Stark, 2011; Fernandez-Stark and Gereffi, 2019). For example, when some actors in a value chain have more power than others do, the analysis of the governance structure helps to understand how the chain is coordinated and controlled (Fernandez-Stark and Gereffi, 2019). Global value chain frameworks explain the organisation of industries by analysing the structure and dynamics of the involved actors (Bamber et al., 2017).

Global value chain analysis, at the industrial level, seeks to gain an understanding of the size of the firm, the ownership of the main manufacturing firms, the suppliers of materials to the firm, and the geographical location of the firm (Goger et al., 2014). The mapping of the shift of global industries in terms of geographical orientation derives a great contribution from the global value chain analysis (Gereffi and Fernandez-Stark, 2011). Furthermore, to understand the governance structure of an industry, it is imperative to recognise the firms engaged in the

business, their ownership status, whether they are private- or government-owned, whether the firm is global or domestic, and the size of the firm, whether small, medium, or large (Gereffi and Fernandez-Stark, 2011; Gereffi and Lee, 2012).

According to Goger et al. (2014), the literature on value chains shows that the industries consist of a mixture of the governance structures in various segments of the chain, which are subject to change with time in various regional and national settings. The authors further indicated that a detailed case study on governance mapping is required to identify the input and output structures of value chains, thereby establishing the link of goods and services. Value chain mapping helps to quantify the changes that have occurred along the chain over time (Frederick, 2019). Value chain mapping also helps to understand bottlenecks, opportunities and relationships along the chain (Adeoye et al., 2013). Further, value chain mapping is crucial to the determination of the contribution of a commodity to economic development (Adeoye et al., 2013). Similarly, Gereffi and Lee (2012) indicated the need for researchers to map the global value chain structures, such as captive production systems, relational production systems, competitive markets, and modular and hierarchical systems. Through governance structure mapping, opportunities and barriers to entry are identified, which are significant for the lead firms and their suppliers in understanding the competitive strategies within the industry, as well as the transformations in the value chain (Gereffi and Lee, 2012). Lead firms are the large firms that are driving the competitiveness of, as well as the transformations within, the industry.

Competitiveness of the firm is defined as the ability of the firm to attain sustainable growth through social and economic factors (Safeer et al., 2019). Porter and Millar (1985) described a value chain as an interdependent activity system associated with linkages. In his book, Porter and Advantage (1985) noted that product differentiation and better costing are the main approaches for a firm to achieve a comparative advantage. In terms of costing, Porter and Advantage (1985) indicated that a firm has a comparative advantage if it can produce a product at a lower cost compared to its competitors.Although Porter's writing and contribution towards the science of management through the comparative advantage book was accepted by many scholars, his point of view did not go without critiques (Mekić and Mekić, 2014). Some scholars critiqued based on the fact that in the presence of globalization, the world economy is restructuring with international competition through improved telecommunication and better transportation systems as well as trade liberalization being the main drivers (Bamber et al., 2017)In his writings, Porter contends that for a firm to be fruitful, it ought to compete based on

one strategy; product differentiation, focus, or cost leadership (Mekić and Mekić, 2014). According to some scholars, this statement does not have to be taken as accurate (Mekić and Mekić, 2014). Datta (2009) critiqued Porter's endorsement of the heavy investment of a company in modern-day equipment if it is to achieve cost leadership. He argues that making huge investments in modern-day equipment when the company is not sure of the profits accrued to that investment may be disastrous and hence may not give the company a cost leadership advantage.

Also, Wright (1987) contended that small companies have a decision of effectively contending only through the strategy of product focus while bigger company decisions of either differentiation or cost leadership won't get the job done or be sufficiently appealing. Furthermore, McGrath (2013) in his book titled "the end of competitive advantage", argues that within the industry, competition is not realistic in the evolving world, and that competition is about arenas, not industry. Instead, he argues that in many markets, industries compete with other market industries, even business models compete with other business models within a particular industry. The competitiveness of the firms has a contribution to the value chain transformations.

2.2 TRANSFORMATIONS IN VALUE CHAINS

With the development of global value chains, food systems have transformed rapidly over the previous two decades (Reardon et al., 2019). A food system is a cluster of value chains that connects actors from the upstream, through the midstream, to the downstream actors (from farmers to wholesalers and processors, through retailers, to consumers) (Reardon et al., 2019). The food systems, from the producer input suppliers to the consumers, have abruptly transformed through restructured trade and international production and industry organisation, as well as changes in the economies of nations (Gereffi, 2013; Reardon et al., 2019). Factors, such as technological improvements, investment policies, and international and national trade, as well as changes in demand, are constantly changing the structure of food systems (Bamber et al., 2017). Transformations in a food system have also been facilitated by policy changes that led to the entrance of foreign and certain local firms, for example, large-scale input firms, processors, fast food chains, and supermarkets that operate on a large scale (Reardon et al., 2019). From the 1980s through to the 1990s, policy liberalisations initiated by the transformations in Vietnam and China, and then the Indian de-reservations, led to transformations in the food systems for Latin America, Africa, and Asia (Reardon et al., 2019).

The food systems in China and Vietnam experienced rapid transformations in the early 1980s (Waldron et al., 2015). These transformations were driven by economic liberalisation during the 1980s and interventionist policy in the 1990s which to a rapid expansion of the Chinese beef industry (Waldron et al., 2015). Population and income growth in the early 1980s were also the major drivers of the transformations in the food systems of China and later in Vietnam (Reardon et al., 2019). Population increase associated with urbanization and the rise in income were associated with shift consumption patterns from calorie-dense foods to meat and meat products, vegetables and other fatty foods (Hansen, 2018). The increase in meat consumption globally was associated with the rise in chronic diseases and other non-communicable diseases (Daniel et al., 2011; Godfray et al., 2018b). This led to the increase in demand for quality meat globally which required a shift in production systems, especially for cattle, from grass-fed system to grain-fed system to control the quality of meat produced (Gwin, 2009; Capper, 2012). The large investments in infrastructure by government in Latin America and Asia in the early 1980s and some African countries also contributed to the rapid transformations in the food systems (Reardon et al., 2019). These transformations are categorized as structural and conduct transformations (Hernandez et al., 2018).

According to Reardon et al. (2019), structural and conduct changes in a food system have occurred at different times, even in zones within the countries, across countries within regions, and across products. The authors described the food system transitions in structural and conduct changes in three main stages: traditional, transitional, and modern systems. The authors explained the three main stages as follows. The traditional system seems to be localised and divided into structures that utilise advancements with more labour and minimal capital, without any formal measures and agreements, and with all segments connected by spot markets. The transitional stage is still fragmented but has the largest catchment area and is, therefore, spatially long. In this stage, public quality standards emerge, with actors in the chain utilising both capital- and labour-intensive technologies. However, the spot market still occupies large shares in this stage. The modern stage, which is the advanced stage regarding the structural and conduct transformations, has, according to the authors, well-differentiated segments, including supermarkets and retail shops. The authors further indicated that the modern stage has fewer intermediaries, with farmers supplying directly to wholesalers, and processors supplying directly to supermarkets. Also incorporated with the modern stage are features such as demand for safety and quality control measures, intensification of capital, higher worker wages, formal contracts, and the emergence of private standards (Reardon et al., 2019).

The impacts of the structural and conduct changes include longer food supply chain vulnerability, especially in developing nations where a trade-off between supply risk reduction and efficiency exists (Reardon et al., 2019). The structural and conduct changes also impact upon off-farm employment in rural areas, exclusion or inclusion of small-scale farmers, nutrition changes, and expansion in supply chain length and volume, and constant supply of required items (Reardon et al., 2019). Furthermore, as a result of infrastructure development and urbanisation, agrifood systems within the country or within the region have become longer and longer in order to supply emerging intermediate and large cities that are rapidly expanding (Reardon, 2015). This implies that value chain spatial elongation expands in parallel with the wholesale sub-segments of urban and rural areas and transport/logistics (Reardon, 2015).

Globally, some scholars have analysed the structural and conduct changes and their impacts in different value chains. Belton et al. (2015) analysed the transition in Myanmar aquaculture value chains and the contributions to food security. The authors conducted interviews with randomly selected participants in all segments of the value chain. They used key informative interviews to estimate the growth and the structural changes in the value chains. The results indicated the existence of rapid structural and conduct changes in all value chain segments. The authors noted that the transformations in the value chain had a positive impact on food security among those involved in the value chain.

Reardon et al. (2014b) analysed the changes in Asian diets, urbanisation, and the supply chain. The authors observed an increase in urbanisation, with rural-urban supply chains at the centre of food security. The study results indicated changes in diets with the increased consumption of fruits and vegetables and animal proteins. The authors observed a rapid transformation of the Asian agrifood supply chain, from the farm to the town places. This was accompanied by a rapid transformation in wholesale markets, including wholesalers in general, fast food chains, supermarkets, cold storage firms, and logistics firms. One of the key implications identified by the authors is that the transformations in the supply chain provide opportunities for increasing the quantities traded, while increasing product diversification and product quality.

Reardon et al. (2014a) noted rapid transformations in the Asian rice value chains, with farmers becoming more capital intensive on the upstream of the value chain. According to the authors, the midstream was also experiencing a quick evolution in Asia, with China taking the lead in wholesaling and milling. The study identified China as taking the lead in the supermarket

evolution. The authors indicated that the transformations in the rice system improved the food security status for cities through the differentiated rice varieties and quality improvement, reduced margins, and lowering of consumer rice prices.

In another study, Reardon et al. (2015) analysed the special case of the transformations in agrifood systems of Indonesia, going beyond rice into many other established horticultural crops in the country. The authors indicated that the rise in urbanisation and income had led to the rapid growth in the animal protein and the horticulture sectors. The authors further noted that Indonesia's rural and urban areas were being transformed through new emerging actors and market channels. According to the authors, the new entrants into the value chains on the downstream include fast food markets and supermarkets. The midstream new entrants include modernising and specialised wholesalers, and processors. Belton et al. (2017) conducted a quick evaluation of the Andhra Pradesh aquaculture value chain in crop boom[6] development by analysing the structural and conduct changes. Their results indicated that the interlinked sequential transformations in the agricultural commodity value chain, in terms of structure and conduct, were at the centre of all changes, but ignored drivers of the booms in crop production.

Hernandez et al. (2018) used a multi-layered methodology to analyse the Bangladesh aquaculture value chain, focusing mainly on the structure and conduct changes. The results from their study indicated that actors had tripled in all sectors of the value chain in the past decade. The results further indicated the significant changes in investments by actors in terms of machinery, among many other significant investments. The authors noted significant changes in all segments of the value chain.

Liverpool-Tasie et al. (2017) analysed Africa's food system transformation and growth, based on evidence from the poultry sector of Nigeria. The evidence showed the existence of rapid transformations that were led by the rise in urbanisation and income, as well as by population increase. The results from the study also identified tremendous variations between northern and southern Nigeria in conduct, structure, performance, and type of coordination. The reasons for this were not identified, as there was limited information about actors' behaviour along the value chain (Liverpool-Tasie et al., 2017). Similar to the challenges in data that most researchers face in Africa, the authors noted a large gap in data for the Nigerian poultry-sector

[6] Agricultural booms refer to rapid agrarian transformation driven by domestic demand (Belton et al., 2017).

field surveys. The study was, therefore, challenged by limited information concerning actors' behaviour in all segments of the value chain. According to the authors, for rigorous analysis to occur, there is a need to conduct stacked surveys along the whole value chain with a representative sample, and the data must be collected systematically. This is one of the very few studies in the African sector. Anecdotal evidence suggests that our food systems are transforming in a way similar to those of Asia. Further research is needed to understand the situation in Africa, especially in sub-Saharan Africa.

Evidence shows that sub-Saharan Africa is confronted with a lack of competitiveness in export markets, and there is a need for producing exports with added value (Banga et al., 2015). One way to trigger this transformation is to enhance competition among countries in the region that have abundant natural resources to produce and export the manufactured items (Banga et al., 2015). Exporters have a vital role in determining how consumer demand is met, as they stand as intermediaries and coordinators in the value chain for agrifood (Lee et al., 2012). The significant steps to take towards enhancing this competition include creating regional value chains through the pooling of resources and capabilities, and regional integration (Banga et al., 2015). This could enable many countries in the region to experience a shift towards improving their product manufacturing activities through value addition in exported products (Banga et al., 2015).

Through regional value chains, regional countries have opportunities for moving up the value chain by improving their competitiveness through the production and export of high-priced value-added items (Banga et al., 2015). In Africa, well-developed regional value chains could give regional countries opportunities to connect profitably, thereby increasing their bargaining power through lead firms (Banga et al., 2015).

Recent case studies of the global value chain policy strategies of sub-Saharan Africa and Central America depict endeavours to arrange territorial integration (Gereffi, 2013). Territorial integration gives the capacity to enhance the national positioning for exports in the region by acquiring feed ingredients from neighbouring nations (Gereffi, 2013). Value chain vertical integration is strengthened by quality-based competition among solidified retailers (Lee et al., 2012).

The above literature regarding transformations in food systems has a direct link to the global increase in meat consumption. The transformations in the food systems are associated with a

change in meat consumption patterns that are driven by socio-economic factors.

2.3 GLOBAL MEAT CONSUMPTION PATTERNS

Globally, meat consumption patterns have changed over the past few decades (Sans and Combris, 2015). From 1961 to 2011, meat consumption per person per kg rose internationally, from 23.1 kg/capita in 1961 to 42.20 kg/capita in 2011 (Sans and Combris, 2015). According to FAO statistics, between 2015 and 2019, global meat consumption increased by 1.3% to about 1114449.3 million kilograms in 2019.

In response to consumer needs, internationally, agribusinesses have become the centre of food categories such as meat, eggs, milk, fruits, and vegetables (Ali and Pappa, 2015). Some of the factors that have led to increased consumer demand for high-value agricultural products, in both developed and developing nations, have included: rises in income, consumers' desires to try new flavours and products, changing lifestyles and expanded urbanisation (Ali and Pappa, 2015; Godfray et al., 2018a). Other factors include: increases in the number of women working in formal employment, and consumers' desire for convenience, coupled with diets moving from consumption of calorie-dense staples to diversified foods, meat, and other high-value agricultural products (Lee et al., 2016; Ali and Pappa, 2015; Godfray et al., 2018a).

The new patterns of meat consumption suggest that quality is one factor that derives the demand for meat (Henchion et al., 2014). A shift is seen, globally, from a grass-fed livestock production system to a grain-fed livestock production system, which is required to meet the rising population demand for more amounts of quality meat (Williams and Droulez, 2010; Hall et al., 2016b).

These changes in meat consumption patterns are also seen in Africa. Similar factors driving the changes in global meat consumption patterns are also seen to be driving the changes in meat consumption patterns in Africa (Drewnowski and Poulain, 2018). In southern Africa, the change in meat consumption patterns is more noticeable in South Africa. Similar to the global situation, the demand for quality meat has increased in South Africa (Hall et al., 2016b). With the pressure arising from consumer demand for quality in South Africa, the composition of beef, especially in terms of fat content, has changed over time (Hall et al., 2015).

Non-communicable diseases, such as diabetes, cancer and cardiovascular diseases, are associated with livestock meat consumption (Hall et al., 2015; Barendse, 2014). Although other scholars, such as Chowdhury et al. (2014), have critiqued this perception against meat consumption, consumers have continued to demand low-fat meat, globally, including South African consumers (Hall et al., 2016a). As a result of the expanded demand for meat with low fat, the lipid content in beef has diminished generously over time in South Africa because of feeding and breeding practices (Hall et al., 2016b). The further trimming off of visible fats makes beef comparable, regarding lipid content, with other lean animal meats, such as trimmed pork, trimmed lamb, and skinned chicken (Hall et al., 2016b). The percentage decrease in total lipid content in meat obtained through controlled feeding and breeding practices is driven by consumer demand for tender and lean meat (Hall et al., 2016b).

With the increased demand for meat, the beef production system in South Africa is experiencing a shift to a grain-fed production system from a grass-fed production system (Hall et al., 2016a). Relatively smaller space is needed for cattle feedlot production, as compared with the grass-fed production system. Since they require little space for production, feedlots are closer to urban markets, and this saves on transport costs. Feedlots provide an economic alternative for producing cattle closer to the urban centres and this, therefore, reduces transport costs. Another important reason that is contributing to the shift in the production system in South Africa is the difference in fat content between beef produced from grass-fed system and that from a grain-fed system (Hall et al., 2016a).

The production and classification system of meat for consumption in South Africa gives a unique situation that is different from other countries such as the USA (Hall et al., 2016a). Using the South African production and grading system, Hall et al. (2016a) analysed the beef cuts from both grain-fed and grass-forage-fed animals. The results indicated that beef cuts from grain-fed animals had low total fat content, when compared with the grass or forage-fed animals. The evidence of low fat in beef from grain-fed cattle, as opposed to beef from grass-fed cattle, has contributed to the increased demand for animal feed, leading to increased animal feed production (Hall et al., 2016a).

2.4 GLOBAL ANIMAL FEED PRODUCTION

Global animal feed production has been increasing, from an average of 954 million metric tons in 2013 (Alltech, 2014) to 1.103 billion metric tons in 2018 (Alltech, 2019). The only time that

the global feed production witnessed a decline was in 2019, because of the African swine fever outbreak, which resulted in a decrease in pig feed production (Alltech, 2020b). However, while feed production for pigs went down in affected countries, Alltech observed an increase in feed production for other species, required to meet the protein demand (Alltech, 2020b).

The top ten feed manufacturing nations include China, the United States of America (USA), Brazil, Russia, Japan, India, Mexico, Germany, Turkey and Spain (Producer, 2020). These nations hold 57% of the total global feed manufacturing sites. They collectively produce an average of 58% of the total world feed production and, therefore, can be seen as the overall agricultural trend indicators (Producer, 2020). The Asia-Pacific territory is home to some of the best of the top ten feed manufacturing nations, such as Japan, India, and China (Alltech, 2019). Of the total average of about 31 000 feed mills estimated to be established globally, those in Asia and the USA constitute more than half the total number (Coffey et al., 2016). Therefore, the Asian region is the largest contributor to the aggregate world feed production, and its production as a region accounts for one-third of the total world feed supply (Coffey et al., 2016). At the national level, China maintains its position as a worldwide pioneer in animal feed production, with about ten million metric tons lead over the USA (Alltech, 2019).

Feed manufacture has often followed the pattern of requiring a start in monogastric production before extending to ruminants (Dolberg, 2007). The poultry industry, for example in China and South America, led to the development of the feed industry (Escribano, 2018). The Poultry industry is the main driver of feed demand globally (Escribano, 2018; Arndt and Roberts, 2018; Samboko et al., 2018). The booming of the poultry demand leading to the increased demand for poultry feed led to the expansion of the feed industry in Africa too (Ncube et al., 2016; Samboko et al., 2018).

In Africa, Morocco, South Africa, Algeria, Nigeria and Egypt are the top five feed manufacturing nations, and they represent 75% of total feed produced in Africa (Alltech, 2020b). South Africa is by far the largest animal feed producer in Africa. In terms of production growth over the years, Africa has witnessed the fastest growth in animal feed production (Alltech, 2014; Alltech, 2018; Alltech, 2019; Alltech, 2020a). The fastest growth in Africa was noted in terms of feed tonnage and the number of feed mills (Alltech, 2015). The following table shows Africa's total animal feed production from 2013 to 2017.

Table 2.1: Africa's total number of feed mills and compound feed production in metric tons, from 2013 to 2017

	2013	2014	2015	2016	2017
Total compound feed production	30.97	34.57	36.13	39.5	39.14
Poultry feed	17	21.1	21	20.1	22.35
Cattle feed	10.7	11	8.64	10.9	12.1
Pig feed	0.4	1.1	2.3	2.1	2.2
Number of feed mills	806	1150	1210	2081	2068

Source: Cadiou (2018)

The number of feed mills has been increasing in Africa, following the increased demand for animal feed. Between 2013 and 2017, feed mills increased by over 156%. With the increase in the number of feed mills, the total compound animal feed production for Africa has risen from 30.97 million metric tons in 2013 to an average of 39.14 million metric tons in 2017 (Cadiou, 2018). Furthermore, in 2019, Africa witnessed a 7.5% increase in total animal feed production (Alltech, 2020b).

In the southern region of Africa, the main animal feed manufacturing companies for South Africa, Botswana, and Zambia are interrelated and spread across the region (Ncube et al., 2016). South Africa's animal feed industry is by far the largest in southern Africa (Samboko et al., 2018). The South African animal feed industry came into existence after the droughts in the 1930s that hit South Africa and greatly affected both livestock and crop production (DAFF, 2018b). Since then, the industry has expanded and currently can produce 3.5 thousand metric tons, annually (DAFF, 2018b). The main animal feed manufacturers in South Africa include AFGRI, Bokomo Voere, Epol, KK Animal Nutrition, Meadow Feeds, Noordwes Voere, Brenco Feeds, and Senwesko Voere (DAFF, 2018b). Most of these feed producers belong to the Animal Feed Manufacturers Association (AFMA). The top five producers of animal feed in South Africa are members of AFMA, and they produce 50% of the total feed produced (Ncube et al., 2016). In the aggregate, AFMA members produce up to 60% of the total feed produced in South Africa (Ncube et al., 2016). The rest of the compound animal feed is produced by feedlots and other producers (Ncube et al., 2016). Compound animal feed is made

from various agricultural products such as maize, groundnuts, soybean, sunflower, canola meals, and other feed ingredients that are mainly used as ingredients in the animal feed (DAFF, 2018b). Among these, maize and soybean are the major ingredients in compound animal feed (Arndt and Roberts, 2018). These ingredients are highly demanded for the making of compound animal feed. Feedlots are one of the major sources of demand for animal feed ingredients.

2.5 HISTORY OF FEEDLOTS IN SOUTH AFRICA

A few entrepreneur cattle farmers initiated the South African feedlot sector in grain-producing areas during the 1960s. This was mainly driven by the shortage of quality cattle grazing areas during dry winter periods as well as the need to control the cost of cattle production (SAFA, 2018). Cost control has a positive relationship to profitability(Frylinck, 2013). Due to the dry winter periods, farmers were forced to feed their animals with by-products from potato and grain crops. However, unreliable and primitive methods were used for feeding practices, procedures, and facilities. In light of the latter, production performance was not satisfactory (Kahl, 2018). To improve production performance, human resources experienced in both animal health knowledge and nutrition skills were brought in from foreign countries such as the USA (Kahl, 2018). Similarly, construction and feeding technologies, as well as new milling equipment, were imported and thereafter adapted to suit the South African environment (Kahl, 2018). The South African animal feed sector lacked the necessary technology to produce cattle optimally (Kahl, 2018).

The feedlot owners controlled all financial statements, cattle breeding, and purchasing of feed and breeding animals. However, in the early 1970s, the feedlot owners came together with a common interest and established the South African Feedlot Association (SAFA) (Kahl, 2018). This was after the feedlot owners had experienced common problems with the bureaucratic structures and opposition from other extensive cattle producers, as well as statutory bodies, that saw them as competitors (Kahl, 2018). Despite facing several obstacles, SAFA has thrived and has progressively become well established. Through the feedlot production of cattle, the South African red meat industry became vertically integrated during the 1990s by means of wholesaling and retailing, as the feedlots slaughtered the industry's animals (Frylinck, 2013). South Africa has at least 100 commercial feedlots, in total (IDC, 2018). The South African feedlot industry is now flourishing, with a one-point cattle holding capacity of over 620 000

head and in the region of about 1.8 million head per annum (IDC, 2018). South African feedlots are of economic importance to the beef industry, the nation at large, and the region. With the population growth associated with increased demand for beef, the pressure is on to increase productivity profitably (Royal, 2017). Animal feeding is essential for reaching the required live weight for slaughter in the shortest period (Oduniyi et al., 2020). Cattle feedlot owners have an economic incentive to increase productivity and beef quality in a shorter period, while fetching high selling prices (Royal, 2017). To consistently supply quality meat products to the markets, a precise prediction of the tenderness of the meat is significant, since so much money is at stake from the producers' point of view, if meat quality is compromised (Frylinck et al., 2015).

Through their increased efficiency, feedlots have been seen to provide more economical methods of production (animals reach marketable weights much quicker), which complement grass-fed livestock production (Royal, 2017). Feedlots have environmental benefits, including fewer emissions of carbon, fewer land requirements, reduced production of methane, and lower water requirements (Royal, 2017). Feedlots play a significant role in both the development and support of communities and regional economies because they are a major source of rural employment (Royal, 2017).

Feedlots are however somewhat constrained by the animal health regulations in southern Africa which sometimes restricts the movement of animals from one area to another within the country or outside the country. These restrictions are made to control livestock export arrangements and to avoid the spread of livestock diseases (McGahey, 2011). These restrictions constrain the availability of young animals for feedlot production, especially in South Africa.

As can be seen from the history of feedlots, South Africa has been facing droughts in some years since the 1960s. These droughts are still persistent, even in recent years. The persistence of droughts in South Africa is important to understand. This is because a direct relationship exists between favourable weather conditions for grain crop production and the availability of local grain crops for animal feeding in a particular farming season.

2.5.1 Droughts and the availability of feed ingredients in South Africa

South Africa often experiences poor rainfall patterns (Botai et al., 2016). The average rainfall in South Africa is about 450 mm per year (Botai et al., 2019). This is far lower than the global average rainfall, which is about 860 mm per annum (Botai et al., 2019). South Africa is,

therefore, being challenged by droughts that constrain the local production of the grain crops that are used as main animal feed ingredients, which therefore implies a decline in the availability of animal feed ingredients from crop production (Botai et al., 2016). Droughts negatively impact price and availability leading to food insecurity (Austin, 2008). In the presence of droughts, the prices of essential grains such as maize become very volatile (Austin, 2008). This affects the availability of grains to the animal feed industry as it becomes costly to produce livestock and poultry.

The North West and Free State provinces of South Africa are faced with droughts and were declared drought disaster provinces in the 2015/2016 farming season (Botai et al., 2016). The two provinces make a significant contribution to the South African animal feed industry and the agricultural sector at large (Botai et al., 2016). The North West province is the largest producer of cereals, oilseeds and sheep, as well as being the second-largest cattle producer in South Africa (Botai et al., 2016). On the one hand, the Free State is the highest cattle-producing province, and the second-highest producer of cereals, oilseeds and sheep (Botai et al., 2016). The presence of droughts in the two provinces affects the livestock sector through poor growth of pastures and through the decline in the supply of animal feed from crop residues (Botai et al., 2017).

Adisa et al. (2019) analysed the impacts of droughts on maize production and yield in four provinces in South Africa, namely Mpumalanga, KwaZulu-Natal, North West, and Free State, from 1990 to 2015. The findings indicated that droughts affected maize yields in all four provinces, although the impacts differed according to provinces (Adisa et al., 2019). The North West and Free State provinces were severely affected (Adisa et al., 2019). The effects of droughts on maize production are channelled down to the animal feed industry, as maize is one of the main ingredients in compound animal feed (DAFF, 2018b). Among other factors, droughts in South Africa constrain the local production of grain crops required for animal feeding. With constrained local production of grain crops, South Africa encounters deficits in animal feed. The deficit in the production of grain crops required for animal feed in South Africa has led to the increased involvement by South Africa in importing animal feed ingredients in the form of grain crops or by-products from grain processing for animal feed production. South Africa is driving the trade of animal feed ingredients in southern Africa (Arndt and Roberts, 2018).

2.6 SOUTHERN AFRICAN REGIONAL TRADE OF ANIMAL FEED

Southern Africa is a key market for grain crops and animal feed products for many nations in the region, including South Africa, Zimbabwe, Namibia, Mozambique, Zambia, Botswana, and Malawi (Ncube et al., 2016; Arndt and Roberts, 2018). In the southern region, South Africa remains consistently the largest exporter of maize, and in recent years, Zambia has shifted from being an importer to an exporter due to the excess supply of maize in the country (Davids et al., 2016). Furthermore, only Zambia and South Africa in the southern region have been involved in the export of soybean, soybean meal, and maize on a large scale (Ncube et al., 2017).

In the case of Zambia, southern Africa is an important market for its exports of animal feed, with 65% of feed being exported to Zimbabwe, and the other feed to Namibia, South Africa, and Botswana (Samboko et al., 2018). Among the southern African countries, Zambia is the main exporter of animal feed ingredients to South Africa (Arndt and Roberts, 2018). The nearly central geographical location of Zambia and its abundant land offer it a great opportunity for the trade of both feedstocks and biofuels (Samboko et al., 2017). Unlike South Africa and Zambia, countries like Mozambique, Botswana, and Zimbabwe are mainly importers of soybean and maize, as they do not have significant exports and have been running on trade deficits (Ncube et al., 2016).

Grain crops, especially maize and soybeans, seem to be promising enough to be sufficiently used for animal feeding. This is because most nations in the southern region, including Zambia, Malawi, Tanzania, Angola and Zimbabwe, have the great potential to improve agricultural production of grain crops due to good rainfall patterns in most parts of these countries (Arndt and Roberts, 2018).

As indicated earlier, South Africa is mainly constrained by low rainfall in soybean production, as well as other feed-related items, for example, oilcake which is mainly imported from South America (Ncube et al., 2016). However, in recent years, overseas imports of soybeans have slowly been substituted by regional imports (AFMA, 2019). For example, Argentina, the main supplier of soybean meal to South Africa, experienced a decline in exports, to 384 000 tons in 2018 from 485 000 tons in 2017, representing a 21% decline (AFMA, 2019). On the other hand, soybean meal exports from Malawi and Zambia witnessed an increase to 78 000 tons in 2018 from 65 000 tons in 2017, representing a 19% increase (AFMA, 2019). In light of the

increase in the flow of feed ingredients to South Africa, many scholars have analysed the evolution of the southern African animal feed industry and trade.

Ncube et al. (2016) assessed the development of the animal feed industry in southern Africa for Botswana, South Africa and Zimbabwe, linking it to the poultry value chain. They indicated that strong cross-country investments exist, indicating the increase in regional integration by large poultry companies. They further noted that the across-region investments by large firms create linkages, symbolising a well-developed regional poultry value chain, with South Africa taking the lead with huge investments.

Samboko et al. (2018) also analysed the Zambian animal feed industry, linking it to the poultry value chain, by using both quantitative and qualitative methods of analysis. The authors identified the main animal feed manufacturers in Zambia and explained that most of the animal feed manufacturers have multinational linkages, with footprints in South Africa. The authors further established the fact that Zambian animal feed manufacturers export to countries such as South Africa, Zimbabwe, Botswana, the Democratic Republic of Congo, Namibia, Burundi, Rwanda, and Malawi. However, the authors mentioned that the current production of animal feed in Zambia is still too low to fully replace South Africa's overseas imports of animal feed.

In another research study, Ncube et al. (2017) noted a significant trade in the animal feed segment of the poultry value chain. Their work identified SADC opportunities for value chain growth, linking animal feed to the poultry value chain within the southern African region. The authors identified Zambia's acceleration as a net exporter of oilcake, mainly to Zimbabwe, with the rest of exports going to Namibia, South Africa and Botswana. According to the authors, the significant change in animal feed production in Zambia gives the prospect of reversing the southern Africa trade deficit in poultry and animal feed, which is mainly attributable to South Africa's imports from overseas.

2.7 FUTURE OUTLOOK OF ANIMAL FEED DEMAND IN DEVELOPING NATIONS

To satisfy the rising demands for animal and animal products, developing nations rely on trade, both directly through animal and animal product imports and indirectly through the import of oilseeds and cereals for animal feeding (Guyomard et al., 2013). In the coming decades, the possibilities are that developing nations will keep driving the global demand for agricultural

products, including animal products (Guyomard et al., 2013). Therefore, agricultural trade must increase in parallel with the increase in demand for agricultural products (Guyomard et al., 2013). The future possibilities bring on the problem of how to guarantee access to both territorial and global markets for agricultural products, and to also maintain food price stability (Guyomard et al., 2013).

Similar to what Guyomard et al. (2013) explained in their article, Tian (2017) noted that expanded demand for animal feed, especially cereal grain, should be observed in the coming three decades, globally and especially in developing nations. Tian (2017) explained that greater amounts of animal feed would be required because pasture does not have enough capacity to stand as the main source of animal feed to cater for the expanded demand for animal products in the coming years. Likewise, mixed livestock–crop production systems will not have sufficient capacity to expand the production of animal products; hence, industrial intensive livestock production systems will have an expanding share in the production of livestock, Tian (2017) explained. The author noted a more than double-speed increase in intensive livestock production growth, compared with the traditional mixed farming, and an above-six-times faster growth compared with grazing systems. Therefore, the author indicated that greater quantities of feed grain would be required to cater for the increased intensification of livestock production. The author further noted that, despite the increased demand for feed materials, especially feed grains, it seems that only limited research has been done in this area that has arisen as a result of the increased demand for animal protein products. Supplying the demand for feed grains, within a wider range of general grain demand, was indicated to be of importance, according to the author. In developing countries, the expansion in demand for domesticated animal feed is a profound shift in the demand structure (Nedumaran et al., 2015).

In this regard, Coffey et al. (2016) has further indicated that the feed industry's future focal point is to confirm its capacity to satisfy customer needs of well-being and manageability, while becoming progressively effective and profitable to serve the world population of an estimated nine billion by 2050.

2.8 SUMMARY

From the above literature, this dissertation contends two main issues. First, very little research has been done on the analysis of regional agricultural value chains in Africa (Liverpool-Tasie et al., 2017). There is limited knowledge to be gained from the literature on the agricultural

value chains and their transformations in Africa, and specifically, southern Africa. Regional value chain analysis is important, as regional value chains play a significant role in boosting international trade. This was seen in Asia, where the analysis of regional value chains identified the development of longer supply chains to reach the market (Hernandez et al., 2018).

Second, structural and conduct changes in the evolution of the southern African animal feed industry have not been given close attention for analysis. The literature notes that the South African animal feed industry is the largest in the southern African region, but does not pay much attention to structural and conduct changes within the South African animal feed industry (Arndt and Roberts, 2018; Samboko et al., 2018). The concentration of actors and proliferation of segments are not known with certainty. Furthermore, less is known in the available literature on the southern African animal feed industry about the factors that drive the competitiveness of the South African animal feed industry (Arndt and Roberts, 2018; Ncube, 2018; Ncube et al., 2016; Ncube et al., 2017; Samboko et al., 2018). These are, however, important to know in order to help understand the current position of the industry, as well as the prospects of the industry.

Apart from the above two identified gaps in the literature, the existing literature focuses on trade flows and trade potentials among nations, with a bias towards the poultry value chain (Samboko et al., 2018; Ncube et al., 2016; Ncube, 2018). This is mainly because the regional trade in food is seen more in the poultry industry, as it is one of the largest agro-processing sectors (Arndt and Roberts, 2018). Furthermore, in South Africa, which is the leading animal feed market, poultry stands out as the main source of protein (Ncube, 2018). The importance of the analysis of the southern African animal feed industry to other value chains, especially the South African beef value chain, cannot be overemphasised. In South Africa, the feedlot industry is of importance (Lombard et al., 2018), as 75% of beef in South Africa is derived from feedlot producers (SAFA, 2019).

In view of the above-identified gaps in the literature, this study focuses on structural and conduct changes in the southern African animal feed sector, with specific reference to the South African feed sector and the South African beef value chain.

CHAPTER 3: METHODS AND PROCEDURES

3.1 INTRODUCTION

This chapter explains the methods and procedures used for this study. The chapter is outlined as follows: study design and study area, sampling procedures, data collection, and data analysis.

3.2 STUDY DESIGN AND STUDY AREA

This dissertation is a case study that focuses on the South African animal feed value chain that feeds into the South African beef value chain. In this study, quantitative data was collected through an online survey to quantify and characterise the changes that have occurred along the value chain.

The study used import and export quantities to identify the nations in southern Africa and the rest of the world that are the main exporters of animal feed ingredients to South Africa. In southern Africa, Zambia was identified as the main exporter of most feed ingredients to South Africa. In this regard, this study was carried out in Zambia and South Africa. South Africa was taken as the main importing country of the main animal feed ingredients. This is because, in the southern region, South Africa is established to have the highest demand for animal feed. Moreover, South Africa has well-established feedlots, producing 75% of total beef production in South Africa. On the other hand, Zambia has been identified as one of the nations that are experiencing accelerated growth in the export of animal feed ingredients. Many researchers, including Arndt and Roberts (2018) & Ncube et al. (2016), have established this fact. Zambia is characterised by increased agricultural production in crops used in animal feed rations, such as maize, soybeans, and sugar cane, the by-product of which, molasses, is used as animal feed (Chapoto et al., 2015; Samboko et al., 2017; Munguzwe, 2014). Given the potential development possibilities for its agricultural sector, Zambia is now seen as having great potential for animal feed production, locally (Ledger, 2017).

3.3 SAMPLING PROCEDURES

This study aimed to identify and extract a research sample from animal feed industry firms for both Zambia and South Africa. The firms targeted for the sample were all involved in manufacturing and/or processing animal feed, in trading animal feed and feed ingredients, in

supplying animal feed ingredients, and in transporting animal feed and feed ingredients, as well as those offering any other services to the animal feed industry(for example, laboratory services). A random sampling method was used to determine the sample size for the data collection exercise. The sample sizes were calculated by using the formula set out below:

$$S = PS * CL\ (\%) * ME\ (\%)$$

where:

S is the size of the sample; PS is the population size (number of individual firms); CL = 99%, which is the confidence level in percentages; and ME = 10%, representing the margin error.

The participants in South Africa and Zambia were selected randomly. From South Africa, firms were randomly selected from the list of the South African animal feed manufacturing firms provided by AFMA. AFMA has both full members and associate members. The full members are manufacturers of animal feed in South Africa, while the associated members are input suppliers and service providers to the full members. The AFMA full members are feed manufacturing firms. The associate members are grouped according to the role they play. These include laboratory and other services, suppliers of equipment, traders, transporters, suppliers of feed ingredients, suppliers of other mixtures, and suppliers of premix, feed additives and veterinary services. From Zambia, feed millers and animal feed manufacturers were surveyed in this study. These firms were identified with the help of the central statistics office in Zambia and the key stakeholders in the industry. Due to the small number of firms in the Zambian industry, the survey was sent to all the identified firms to increase participation.

Out of about 100 individual firms listed by AFMA that represent the South African animal feed industry, 90 firms were randomly selected to participate in the survey. Table 3.1 outlines the statistics of survey participation

Table 3.1: Survey participation

Country	Sample targeted	Incomplete Attempts	Refusal	Complete Attempts
South Africa	90	27	10	53
Zambia	25	7	3	16

Source: Own survey illustration (2020)

The incomplete survey results from the respondents were not used for analysis. This is because most of the incomplete responses were those that did not want to continue just after attempting the very first few questions. Since the questions were linked, incomplete responses were not very useful for analysis.

A total of 53 firms were surveyed through using online platforms. This represented 53% of the estimated total population. These firms were engaged as follows: 47 firms completed the survey online, while six firms were interviewed telephonically to help map the chain of feed ingredients that South Africa and Zambia are linked to. Zambia has less than 25 individual firms that supply animal feed ingredients. Out of the estimated 25 firms, 16 firms in total were surveyed from Zambia. This represented 64% of the estimated total population. These participated as follows: 10 firms completed the survey online, while six were interviewed telephonically to help map the chain of feed ingredients to the South African feed manufacturing sector. Table 3.2 shows the categories of firms interviewed.

Table 3.2: Firms surveyed

Category	Number of firms surveyed in South Africa	Number of firms surveyed in Zambia
Animal feed manufacturers	12	6
Feed millers	3	2
Lab & other services	3	0
Suppliers of equipment	1	0
Traders	9	1
Suppliers of premix, feed additives	14	0
Suppliers of feed ingredients / animal feed wholesalers	3	1
Suppliers of other mixtures	1	0
Transporters	1	0
Random Stakeholder phone call interviews	6	6
Total	53	16

Source: Owner's illustration (2020)

3.4 DATA COLLECTION

In this study, both primary and secondary data were used. Before the primary data collection commenced, the research ethics committee for the Faculty of Natural and Agricultural Sciences approved the research. To collect the primary data, an online survey was sent out to firms in the animal feed industry. The survey was done via online platforms such as emails and WhatsApp. Direct phone calls were also made to encourage participation and also to validate unclear responses. Animal feed producing companies and importing companies were surveyed to gain an understanding of the flow of trade of animal feed ingredients. The key information gathered included the main actors involved, quantities produced and traded, determinants of prices, trade agreements between parties, challenges faced by actors, prospects of the business, transaction costs involved, and trade frequency. To quantify the animal feed ingredients that South Africa imports from other southern African countries, TradeMap statistics were used.

3.5 DATA ANALYSIS

The data analysis that flowed from the data entailed a functional analysis and an assessment of the forces that drive competitiveness in the value chain. A functional analysis tool, descriptive statistics, and Porter's competitive diamond framework were used to achieve each one of the objectives.

3.5.1 Functional analysis method

The functional analysis method uses a value chain map to help align actors and activities along the value chain. Actors are the people or firms that participate in the value chain. A value chain map is a visual tool that gives a proper overview of how a given industry works, as it illustrates graphically the relationships that exist among the actors in all components of a given value chain (Mmasa and Msuya, 2012). Apart from identifying relationships, the map will also help in identifying transformation steps and capacities in the chain, as well as support services. The value chain map is classified as a functional, analytical tool. According to Mmasa and Msuya (2012), a functional analysis shows the following:

a) The main activities performed within the chain.

b) The firms/agents and characteristics of the firms/agents performing these activities.

c) The main product of the chain and the different forms in which this item is changed throughout the value chain.

Several authors have used a functional analysis method to map actors in various value chains. For example, Mmasa and Msuya (2012) used the functional analysis method to map the linkages between actors, activities, and processes in the sweet potato value chain in Michembe and Matobola, Tanzania. Sarma et al. (2017) analysed the beef value chain of some selected Northern Bangladesh areas by using the functional analysis method. Furthermore, Masamha et al. (2018) used functional analysis to map the value chain for cassava food in smallholder farming in Tanzania, basing the analysis on gender dynamics.

The functional analysis method gives a clear picture of trade, as it involves all key stakeholders in a particular value chain. Despite its good usage, the value chain map has limitations. One of the limitations is that the value chain map does not accurately predict the future end-market dynamics and structures because markets are dynamic and evolve with time. Value chain mapping ought to be a dynamic and ongoing process. In this regard, this study combines value chain mapping with certain descriptive statistics, which makes the results more valid and gives a clear picture of the trends of trade.

To follow and break down the commitments and contributions of the actors, the value chain examination requires market mapping (Zamora, 2016). In this study, the firms in Zambia and South Africa involved in exports, imports and those involved in facilitating trade by offering support activities were interviewed, as they are the main actors in this field. The firms were mapped according to where they fell in the flow of the feed ingredients, from producer to the end-user, in this case, the feedlots. On the map, the firms were mapped according to the activity they perform to facilitate the transaction.

3.5.2 Porter's diamond framework of competitiveness

The Porter (1990) model was used to analyse the competitiveness of the firms in the animal feed industry for South Africa. In the context of this dissertation, Porter's model helped to gain an understanding of the factors that drive the competitiveness of the South African animal feed industry firms. The dissertation perceived that the competitiveness of the South African animal feed industry firms has led to their increased access to the international market, thereby driving the animal feed trade in southern Africa. The competitiveness of the industry was also

perceived to have been facilitating the rapid transformations in the South African feed sector over the past two decades.

The firms were asked to indicate their levels of agreement or disagreement on several factors as drivers of competitiveness[7]. In this study, Porter's diamond framework is applied through using the approach adopted by Esterhuizen et al. (2001). Esterhuizen et al. (2001) used Porter's diamond framework to analyse the competitiveness of fibre complex and agro-food in South Africa. According to Esterhuizen et al. (2001), the Porter (1990) diamond framework model seeks to answer the following questions; When does an industry become competitive internationally? Why does the industry seek international competitiveness? and, How sustainable is the industry's international competitiveness position? To find answers to these questions, a third question asked by Porter (1990) must be answered (Esterhuizen et al., 2001): In what way is international success achieved? As indicated by Porter, the response lies in six broad factors or attributes that shape the conditions under which firms contend and advance their competitive advantage creation (Esterhuizen et al., 2001). The six broad attributes (Esterhuizen et al., 2001) are set out below.

a) **National factor conditions:** these refer to the position of the nation with regard to natural resource endowments, production factors, and production cost levels. The variables measured here include the availability of skilled labour, cost of skilled labour, quality of skilled labour, availability of unskilled labour, cost of unskilled labour, quality of unskilled labour, costs of production, administration costs associated with labour matters, location of the firm, natural resources, availability of infrastructure, costs of infrastructure, quality of infrastructure, availability of knowledge, cost of knowledge, quality of knowledge, availability of capital, costs of capital, availability of production technology, costs of production technology and quality of production technology.

b) **Conditions of demand**: these refer to the nature of local demand for the products and services for the industry, and the capacity to estimate the demand. The variables measured here include the size of local market demand, the size of international market

[7] 1=Strongly disagree; 2=Disagree; 3=Slightly disagree; 4=Indifferent; 5=Slightly agree; 6=Agree; 7=Strongly agree.

demand, availability of market information, costs of market information, quality of market information, quality of product, and market growth.

c) **Related and supporting industries**: these refer to the existence or nonexistence of internationally competitive industries as nation suppliers, including related industries. The variables measured here include transport industries, research institutions, financial institutions, electricity supplies, suppliers of packaging materials, the competitiveness of agricultural suppliers, sustainability or consistency of agricultural suppliers, and linkages among agricultural suppliers.

d) **Firm strategy, structure, and rivalry**: these are national conditions that govern the creation, organisation, and management of firms, as well as the kind of domestic rivalry. The variables measured here include culture, adaptation to national conditions on creation and management of firms, firm structure, flexibility to national conditions on the firm management and operations, managerial capabilities, the market power of suppliers, the market power of buyers, the threat of substitute goods, and the threat of new entrants to the market.

e) **Government policy and attitude**: through operational capacity and policy, the government can positively or negatively influence the above determinants of firm competitiveness. The government, therefore, plays a vital role in allowing industrial competitiveness to thrive. The variables measured here include direct government support, indirect government support, fiscal policy, trade policy, labour policy, trade bans, and land reform policy.

f) **The role of chance**: these comprise occurrences that are far beyond the control of the firm. The variables measured here include political stability, economic stability, price stability, crime/theft, and global pandemics such as the current Covid-19 pandemic.

Apart from Esterhuizen et al. (2001), other scholars have found Porter's diamond framework to be useful in analysing the competitiveness of a particular industry. Tongzon (2007) used Porter's diamond framework to analyse the competitiveness of international logistics. Tongzon (2007) mainly examined competitiveness by analysing the factors associated with the increased international trade flows in Asia and Pacific areas. Furthermore, Sinngu and Antwi (2014) used Porter's competitive diamond framework to analyse and determine the factors affecting the

competitiveness and success of the South African citrus fruit industry.

These scholars used this model because it is a good measure of competitiveness. Porter's diamond framework measures many variables, which help to give a clear picture of an industry's competitiveness. However, the model has limitations. Some scholars have despised it based on the fact that Porter's diamond framework is not completely applicable in the presence of globalisation. The world economy is restructuring, with the main drivers being enhanced international competition, achieved through improved telecommunication and better transportation systems, and trade liberalisation, (Bamber et al., 2017). Porter's diamond framework is limited, as it does not capture all the drivers of competitiveness in this era of globalisation.

3.6 SUMMARY

This study used both qualitative and quantitative methods to achieve the individual objectives. Descriptive statistics, such as percentages, frequency, and means, were used to quantify the changes experienced over the past two decades in terms of the trade of feed ingredients between South Africa and other southern African countries. Descriptive statistics were also used to quantify the rapid transformations (structural and conduct transformations) experienced within the South African animal feed industry.

Two analytical methods were used: the functional analysis method and Porter's diamond framework. The functional analysis method was used to map the chain of animal feed ingredients reaching from Zambia to South Africa. It was also used to identify the actors involved in the international trade of animal feed ingredients between South Africa and other southern African countries. The functional analysis method is a good fit, as it depicts a clear picture of the activities carried out along the chain, the actors involved, and the interactions along the chain.

Porter's diamond framework was used to analyse the competitiveness of the South African animal feed industry. Literature (Arndt and Roberts, 2018; Ncube et al., 2016; Ncube et al., 2017) indicated that the South African animal feed industry had expanded in demand for animal feed ingredients, but little is known about the competitiveness of the industry. Porter's diamond framework was used to analyse the competitiveness of the South African industry to justify the increased demand for animal feed and increased access to international markets.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter seeks to analyse South Africa's imports of feed ingredients. The main focus is placed on the trade between South Africa and other southern African countries. The analysis is based on the five main ingredients that are traded for use in animal feed. These comprise maize grain, soybean, maize bran, soybean oilcake and cane molasses. These were selected since they are extensively used for making compound animal feed.

In this chapter, the main actors involved in the trade of animal feed ingredients will be identified. Furthermore, the main exporting countries per ingredient will be identified. The identification of the main suppliers of feed ingredients will give an overview of supply chain elongation. As trade increases, the supply chain is likely to become elongated, both geographically and in terms of the actors involved and their concentration. The research done by Reardon et al. (2019) on the rapid transformations of food systems in developing regions found that, as cities grew, the food supply chains became longer and longer in order to meet the enormous needs of the people in cities. In this regard, this chapter will elaborate on whether this is also happening in the animal feed ingredient supply chain in southern Africa. This chapter seeks to discuss the underlying drivers of the increased flow of feed ingredients towards the South African feed manufacturing sector, and the transformations that have occurred.

The remainder of the chapter is divided into four main sections. Section 4.2 maps the chain of feed ingredients from other southern African countries to South Africa. Section 4.3 analyses the volumes of feed ingredient imports by South Africa, and identifies the main exporting countries per feed ingredient, focusing on southern African countries. In Section 4.4, the main drivers of the flow of feed ingredients to the South African feed manufacturing sector are identified and explained. Section 4.5 summarises the key findings of this chapter.

4.2 MAPPING THE CHAIN OF FEED INGREDIENTS

For business managers, value chain analysis is a powerful instrument that can be used to recognise key activities inside the firm, which will then give a framework of the value chain for the firm and thus give the firm the potential to achieve sustainable competitive advantage (Mmasa and Msuya, 2012). Value chain analysis entails examining the activities of the firm

and the contribution of each activity to the added value of the business (Mmasa and Msuya, 2012).

Various actors are involved in the trade of animal feed ingredients. These actors interact with each other as they transact. Figure 4.1 below maps the flow of feed ingredients from Zambia to South Africa through the various actors who are linked in the chain (Figure 4.1).

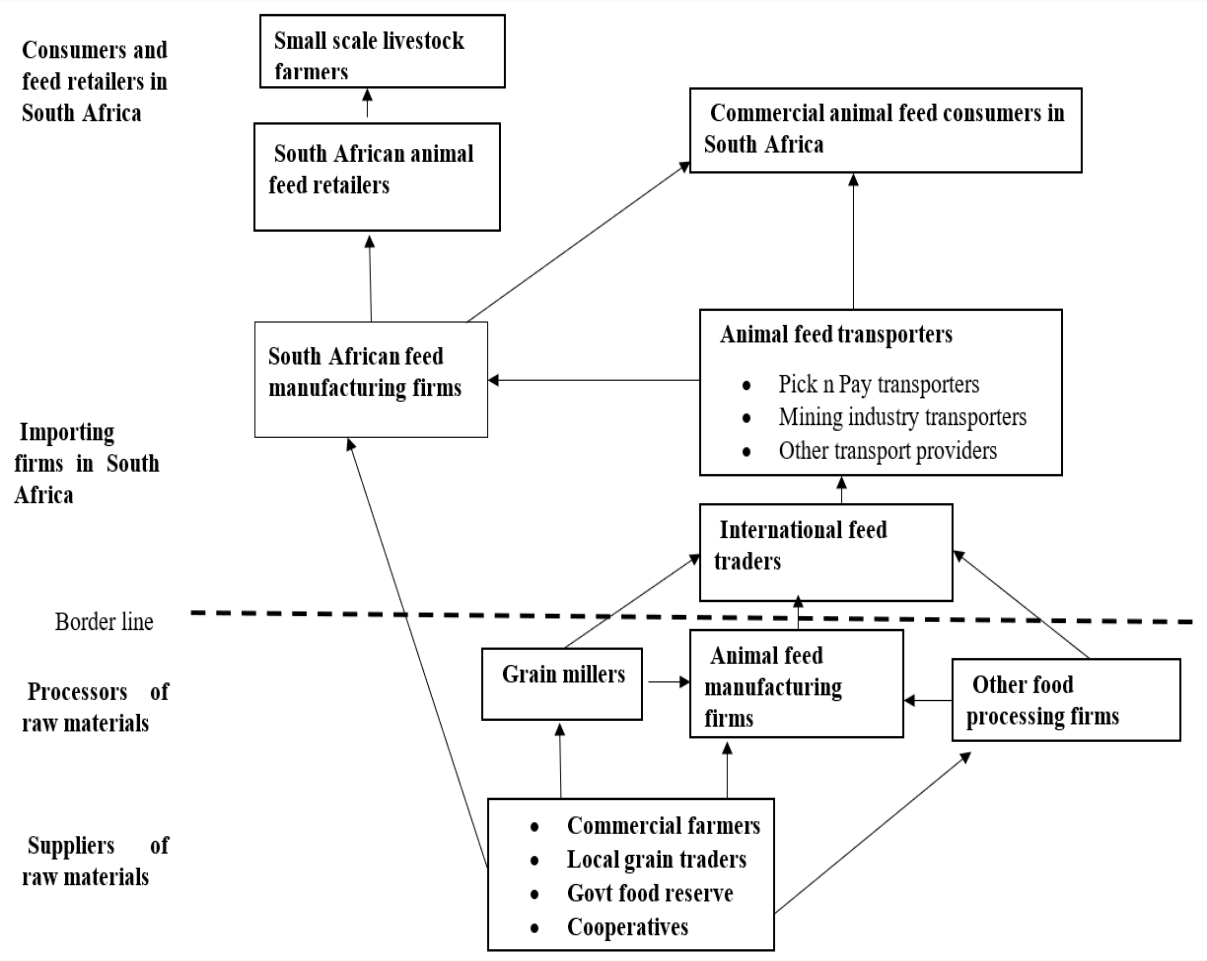

Figure 4.1: Animal feed value chain map

Source: Own survey illustration (2020)

4.2.1 Value chain key actors and their core functions

The following comprise the main actors along the animal feed ingredient value chain from Zambia to South Africa.

Animal feed exporters: These include grain millers, local animal feed manufacturers, and animal feed wholesalers. These may or may not also be grain crop producers. They source most of the grain crops from commercial farmers, national food reserve agencies, cooperatives, and small-scale producers. Grain millers and animal feed manufacturers usually export feed residues that cannot be absorbed by local markets due to the small size of the feed industries in most southern African countries. The feed residues include maize bran, sunflower cake and soybean oilcake. Among these, maize bran and soybean oilcake are major ingredients in compound animal feed. The two account for 50% of the total cost of compound animal feed (Arndt and Roberts, 2018).

Animal feed wholesalers export both unprocessed crop grains and feed residues derived from food processing. Not all animal feed wholesalers are exporters. Some animal feed wholesalers are not involved in the international trade of animal feed. It is also worth noting that some cooperatives and commercial farmers are also exporters of animal feed grain crops, especially maize and soybean.

International animal feed traders: As noted earlier, animal feed is exported directly to animal feed manufacturers in South Africa or through international animal feed traders, who then supply to animal feed manufacturers. These are mainly South African firms that are aggregate buyers of different animal feed ingredients. They are strongly linked to the exporters of animal feed in different southern African countries (backward integration). Most of these do not own a feed manufacturing firm. They act as suppliers of feed ingredients to the South African animal feed manufacturers. Moreover, most of the international animal feed traders transport

the feed ingredients through other transport service providers.

Transporters: Most animal feed transporters are not directly linked to the animal feed industry. For example, supermarket transporters play a key role in the transportation of animal feed ingredients to South Africa. Supermarkets have over the years become the main drivers of increased transportation of animal feed from other southern African countries to South

Africa. The presence of supermarkets across southern Africa has facilitated the increased availability of transport to the animal feed sector. Interactions between transport availability and market power of supermarket chains is an interesting aspect of the animal feed trade. However, supermarkets themselves are not directly involved in the animal feed business. They transport supermarket products to most southern African countries. When returning to South Africa, these transport vehicles are usually empty in most cases. The animal feed importers and exporters have taken advantage of available empty supermarket transport vehicles to move animal feed to South Africa at an affordable price. Furthermore, mining sector transport is playing a key role in the transportation of animal feed to South Africa. For example, copper-mine transport vehicles travelling from Zambia have assisted in moving feed ingredients from the Copperbelt province of Zambia to the Gauteng province of South Africa. These are usually small loads of animal feed ingredients, as the main purpose of this transport is to transport copper to South Africa.

The agreements between animal feed firms, supermarkets and copper mine transporters are usually once-off agreements due to the inconsistent availability of feed ingredients.

South African feed manufacturers: The feed manufacturers in South Africa are large firms with massive production and processing technology and capability. Some of the feed manufacturers have backward linkages with the exporters of feed ingredients. Although some feed manufacturers import animal feed ingredients without intermediaries, most of the feed manufacturers access the feed ingredients from other southern African countries through international feed traders. Most of these firms own feed milling factories. There are many activities involved at the animal feed manufacturing level. These include feed processing, feed transportation, feed retailing, and feed distribution to consumers.

Oilseed crushing firms: Most of the imported soybeans are channelled for crushing (AFMA, 2019). The main objective of soybean crushing is to supply to the feed market. There is little soybean oil extraction that occurs locally, as South Africa does not consume much soybean oil. Other imported grains channelled for crushing include sunflower, groundnuts and cottonseeds. Residues from oil extraction, including sunflower cake and cottonseed oilcake, are also supplied to the feed manufacturing sector for making compound feed.

South African animal feed retailers: There are very few animal feed, as most animal feed manufacturers have direct linkages with feed consumers. They mainly supply to small- and

medium-scale livestock farmers. Some large-scale farmers also buy certain components of animal feed ingredients from retailers. Animal feed retailers purchase bulk compound animal feed from feed manufacturers, and then sell feed in smaller quantities to small- and medium-scale livestock farmers, according to individual farmer demand.

Consumers: Animal feed consumers in South Africa fall mainly into two categories, namely bulk consumers and small- and medium-scale consumers. Bulk consumers of animal feed are those that produce livestock intensively, at a large scale. These are producers of cattle and sheep, poultry, layers, dairy, game, horses, ostriches and aquaculture. The bulk consumers mostly purchase animal feed in large quantities directly from feed manufacturing firms. The small- and medium-scale consumers include those who, in lesser quantities, also produce cattle and sheep, poultry, layers, dairy, game, horses, ostriches, aquaculture and dogs. The small- and medium-scale consumers produce livestock at a smaller scale and therefore, in most cases, do not buy directly from feed manufacturers, who prefer to sell in bulk, but rather from animal feed retailers who sell in smaller quantities, according to consumer demand.

4.2.2 Linkages among actors

The mapping of the southern African animal feed ingredients chain involved several functions and institutions. Both backward integrations (23%) and forward integrations (36%) exist along the chain[8]. For example, some South African firms access feed ingredients directly from commercial grain crop farmers in Zambia. Moreover, some farmers in Zambia supply feed ingredients (grain crops) directly to animal feed consumers in South Africa, such as feedlots, without passing through the traders. Furthermore, some firms have achieved a combination of backward and forward integrations, called balanced vertical integration (19%). Other firms have direct access to suppliers of animal feed ingredients and also direct access to consumers of feed ingredients.

About 80% of the imports by South Africa from southern Africa move from exporters (commercial farmers, local grain traders, government food reserve agencies, cooperatives) to

[8] Backward integration is a situation where a firm or actor has a direct link to or relationship with the suppliers of inputs. Backward integration may also include a situation where the firm acquires or owns a company that supplies feed ingredients or products required for further processing. Importers are linked to the feed ingredient suppliers (backward integration). Forward integration occurs where a firm directly interacts with customers without having any intermediaries. Some exporters are linked directly to feed consumers such as feedlots (forward integration).

South African grain international traders who then supplies to feed manufacturers in South Africa.The other 20% of the imported feed ingredients do not go through traders, but directly to feed manufacturers.

The traders transport the feed ingredients to the South African feed manufacturing firms through using the hired transport vehicles, mainly supermarket vehicles. The South African feed manufacturers then supply compound animal feed to commercial consumers and retailers. The retailers supply to small-scale livestock producers. All the above transactions are made under different trade agreements.

The trade agreements between feed exporters and feed importers differ, depending on the buyer and supplier relationship. These include verbal agreements (no written or signed agreement), written agreements each time a transaction occurs, and long-term agreements (agreement for a longer period – usually a written contract), as well as vertical integration arrangements (where a business is jointly run by both firms). Table 4.1 shows the types of agreements that facilitate the international trade of animal feed. Some firms use more than one type of agreement.

Table 4.1: Trade agreements

Type of agreement	**Percentage**
Verbal agreement	5.41%
Written agreement each time a transaction occurs.	78.38%
Long-term agreement	45.95%
Vertical integration	21.62%
Total number of respondents	37

Source: *Own survey illustration (2020)*

Most of the agreements used comprise written agreements concluded each time a transaction occurs. This is because there is no constant supply of the feed ingredients. In most cases, the feed ingredients are aggregated from different suppliers, at different times. This makes it hard for the trading firms to make long-term agreements.

The interactions among actors and the agreements between them are subject to change,

depending on the local demand for animal feed ingredients in South Africa and the availability of feed ingredients in the exporting countries in that particular year. Therefore, the linkages and frequency of the transactions among the actors depend on the deficit in South Africa and the ability of the other southern African countries to cover that deficit.

4.3 SOUTH AFRICAN ANIMAL FEED INGREDIENT SECTOR

To cover the deficit in animal feed ingredient production, South Africa sources feed ingredients from various countries, both in the southern region of Africa and overseas. The total imports are quantified in the subsections below. The deficit is mainly due to the increased demand for animal feed ingredients in South Africa. There is a link between the volume of feed ingredients imported and local crop production. The quantity produced locally determines the import requirements. Local grain production in South Africa is usually constrained by droughts in some years, as will be elaborated on later in this chapter. Therefore, to analyse the quantities traded, this section begins by giving an overview of South Africa's maize, soybean, and sugarcane production. As stated earlier, maize and soybean are important, as they are the main ingredients in compound animal feed. Sugarcane is the main source of cane molasses, which is used in livestock feeding, except for poultry.Maize, soybean and sugarcane production in South Africa

Figure 4.2 below shows the quantities of maize, soybean and sugarcane produced by SouthAfrica between 2001 and 2019. The quantities are measured in thousand metric tons (1000t).

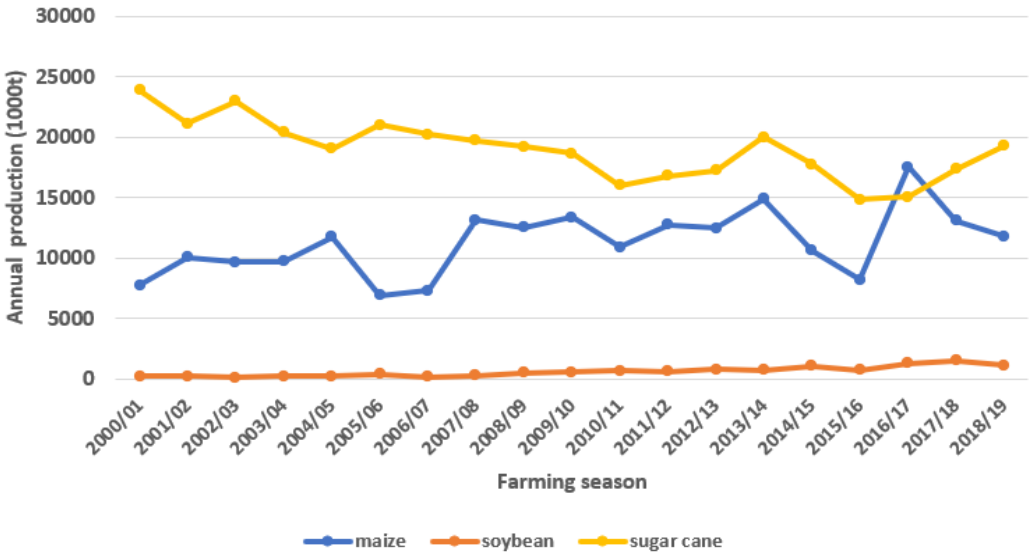

Figure 4.2: South African production of maize, soybean and sugarcane from 2001 to 2019

Source: Author's compilation with data from Abstract of SA Agricultural data (2020)

Because of its low quantities produced, compared with maize and sugarcane, soybean quantities are placed on the right axis so that the change in quantities can be easily seen.

South Africa is a significant producer of maize and sugarcane in the southern region of Africa. However, the production of maize and sugarcane is challenged by water shortages attributable to droughts in some areas. For example, the 2015/2016 farming season was challenged by droughts, leading to a drop in production of maize and sugarcane. Maize production reduced from 10 629 thousand metric tons in the 2014/2015 farming season to 8 214 thousand metric tons in the 2015/2016 farming season, representing a 22.7% decrease. Sugarcane production declined from 17 756 thousand metric tons in the 2014/2015 farming season to 14 861 thousand metric tons in the 2015/2016 farming season, representing a 16.3% decrease. Despite these challenges, South Africa still stands out as a large exporter of maize and sugar cane in the African region. It also imports maize and sugar cane and their residues from food processing industries in the region (mainly maize bran and molasses from sugar extraction or refining). The quantities imported vary annually, depending on local production.

South Africa is mainly constrained in the production of soybean. As seen in Figure 4.2 above, production of soybean was below 1600 thousand metric tons throughout the period under consideration. However, soybean production has, on average, increased since 2007. For example, in the 2006/2007 farming season, the total soybean production was 205 000 metric

tons, and in the 2018/2019 farming season, total soybean production was 1170.3 thousand metric tons. This represents a 470.9% increase. One of the contributing factors is the increase in the structural changes in the local soybean market that were announced by DTI and ITAC (DAFF, 2018b). These structural changes motivated the local production of soybean, as they provided a favourable environment for local farmers to increase their production. The availability of finance and a better soybean market and prices, among other factors, enhanced soybean production. The structural changes were associated with the expanded crushing capacity of soybean, which led to increased local soybean quantities being channelled for crushing (DAFF, 2018b). The increased soybean crushing capacity increased the demand for soybean, leading to increased production. Despite this increase in production, South Africa still does not produce enough soybean to meet the increasing demand for it for human and animal consumption. Most of South Africa's soybean imports are from overseas, as will be seen in the section below.

4.3.1 South Africa's soybean imports

The graph set out in Figure 4.3 below shows the imports of soybean by South Africa between 2001 and 2019.

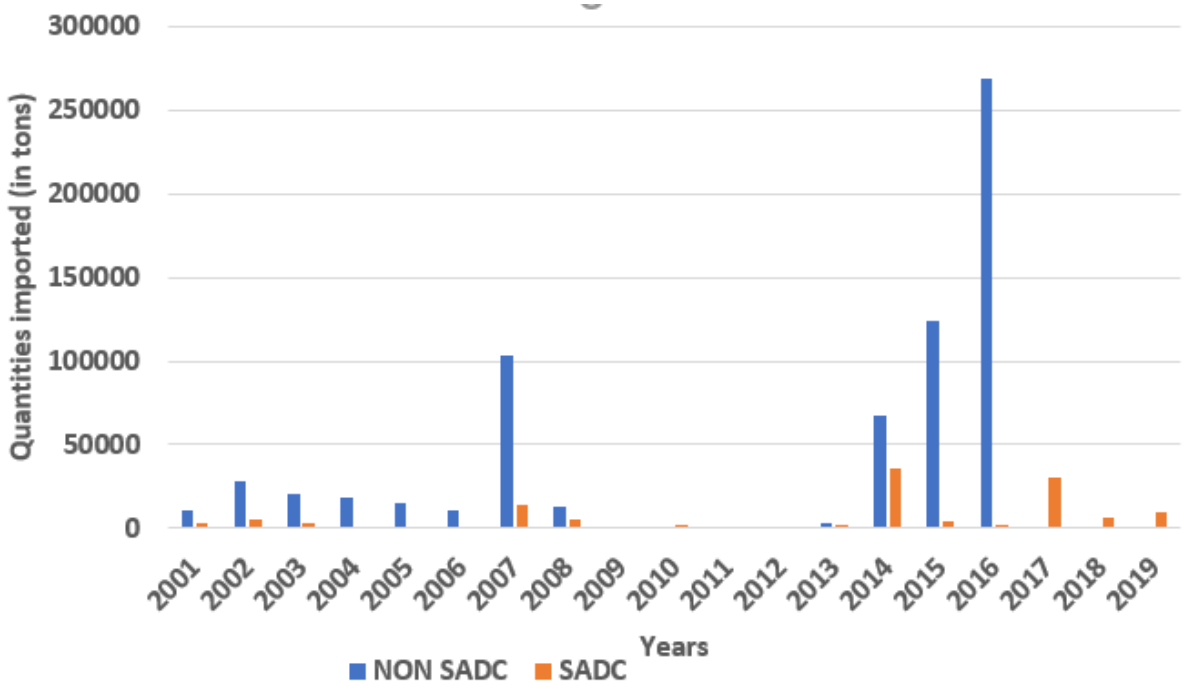

Figure 4.3: Soybean imports by South Africa

Source: Author's compilation with data from Trade Map statistics (2020)

Figure 4.3 above shows that South Africa's soybean imports fluctuate, depending on the quantities produced locally in a particular year. Compared with imports for other years, South Africa recorded the highest soybean imports in 2016, amounting to 270 850 tons. Compared with the 2015 soybean imports, the 2016 imports increased by 110.9%. This was mainly because severe droughts hit the North West and the Free States provinces of South Africa in the 2015/2016 farming season (Botai et al., 2016). The two provinces are critical to South Africa's soybean production. The effects of droughts have deleteriously affected soybean production, leading to high imports, mainly from Brazil and Argentina. Only 0.8% of the 2016 imports were from the southern Africa region, specifically from Zambia.

The 2016/2017 farming season had far better rainfall than the previous farming season did. Soybean production increased, leading to a sharp decrease in imports, from 270 850 tons in 2016 to 31 339 tons in 2017. This was an 88.4% decline in soybean imports. The soybean imports further declined by 75.5% in 2018, compared with 2017. However, in 2019, soybean imports increased by 23.3%. The increase was again due to the droughts that hit some parts of South Africa, constraining soybean production.

Over the past few years, the overseas imports of soybean by South Africa have slowly been replaced with regional imports. According to AFMA, there are minimal to no differences in the quality of feed ingredients from overseas and from southern Africa. This is because all products sold in South Africa must be registered under Act 36 of 1947 [9]before they enter the South African market. All products have to comply with the same quality standards as prescribed by the Act. This implies that there is no significant change in terms of quality when overseas imports are replaced by imports from southern Africa.

Between 2010 and 2019, South Africa's imports of soybean from the southern Africa region grew by 302%. The quantities imported have fluctuated highly from one year to another. For example, in 2013, the imported quantity was 4 456 tons, whereas in 2014 it was 103 638 tons. The quantities imported were determined by local production, as import demand arises mainly to fill in for any shortages in local production.

[9] The quality of products entering South African markets is certified according to Act 36 of 1947 before they can be sold. Act 36 of 1947 can be accessed at: https://www.gov.za/sites/default/files/gcis_document/201505/act-36-1947.pdf

Table 4.2 below shows the percentage growth of South Africa's soybean imports between 2010 and 2019. The table shows the main countries which were exporting to South Africa from the southern Africa region between 2010 and 2019. 'SADC total' refers to the total imports of soybean by South Africa from southern African countries, 'NON-SADC' refers to the total imports by South Africa from overseas countries, and 'World' represents the aggregate imports of South Africa from overseas countries and the SADC region.

Table 4.2: Percentage growth of South Africa's soybean imports between 2010 and 2019

Source	2010 imports (tons)	2019 imports (tons)	Import percentage growth between 2010 and 2019
Zambia	2195	3646	66%
Malawi	50	2938	5776%
SADC total	2262	9090	302%
NON-SADC	93	369	297%
World	2355	9459	302%

Source: Author's compilation with data from Trade Map statistics (2020)

Zambia has consistently remained the leading exporter in the southern region of Africa of soybean to South Africa. Among the southern African countries, Zambia is the leading exporter of soybean (whether broken or not) to South Africa, followed by Malawi. In 2014, Zambia and Malawi contributed about 36.6% of South Africa's soybean aggregate imports. In 2017, South Africa imported 31 339 tons of soybean, of which 95% of the soybean imports were from Zambia and Malawi (Zambia contributing up to 80% of the imports). In 2018 and 2019, 69.4% and 72% of South Africa's imports of soybean, respectively, were from Zambia and Malawi.

Some scholars have indicated that Zambia could not export soybean to South Africa due to competition from heavily subsidised imports of soybean from South American nations, mainly Argentina and Brazil (Business, 2015; Samboko et al., 2018). Nevertheless, the Trade Map statistics indicate that South Africa has been importing significant quantities of soybean from Zambia since 2013.

Zambia is becoming a key exporter of soybean in the region, mainly due to its increased

soybean production in the past few years. Between 2004 and 2014, the compound production growth rate of soybean in Zambia was 24.5% (Paremoer, 2018). In 2016/2017, Zambia produced about 351 416 metric tonnes (Paremoer, 2018). The increase in soybean production by Zambia has continued, leading to Zambia expanding its export quantities.

Zambia has low local demand for animal feed, as compared with South Africa, especially from the beef industry, as 85% of the cattle are kept under extensive production systems (Sinkala et al., 2014). This implies that soybean is less demanded by the cattle industry in Zambia. In Zambia, soybean is mainly demanded by the broiler industry, which has kept growing over the years, showing an annual growth of 20% (Munguzwe, 2014).

Zambia is self-sufficient in soybean production (Munguzwe, 2014) and can replace the overseas imports by South Africa of soybean and its by-products if its soybean production increases (Samboko et al., 2018). Currently, the production and exports of soybean for Zambia are still low for meeting South Africa's soybean deficit. Government subsidies and crop production in Zambia has been biased towards maize production over the years, thereby constraining the production of other crops such as soybean (Samboko et al., 2018).

4.3.2 South Africa's soybean oilcake imports

Soybean oilcake, a residue from soybean oil extraction, is another of the feed ingredients imported by South Africa for animal feed. Figure 4.4 shows the trend of soybean oilcake imports by South Africa, as well as local soybean production from 2001 to 2019.

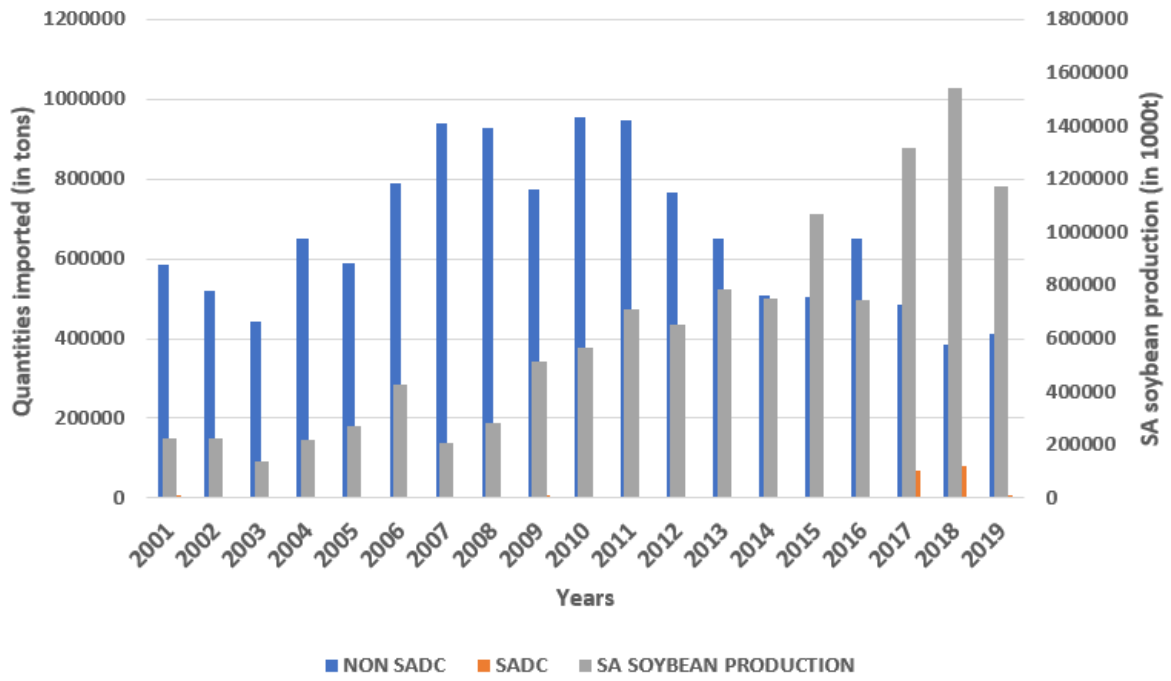

Figure 4.4: South African's soybean and production and soybean oilcake imports

Source: Author's compilation with data from Trade Map statistics (2020)

South Africa's total annual imports of oilcake have been decreasing since 2012. In 2012, the total oilcake quantity imported was 767 130 tons, whereas in 2019, it fell to 420 766 tons, representing a 45.2% decrease. This is mainly because South Africa's soybean production has been increasing, on average, since 2012. In 2012, South Africa produced 650 thousand metric tons, and in 2019, total production amounted to 1170.3 thousand metric tons. This represented an 80% increase in production between the two periods. However, scholars (Botai et al., 2017; Botai et al., 2016; Botai et al., 2019) have noted that South Africa would remain constrained in soybean production, as South Africa's weather outlook indicates that further droughts would challenge the country in the coming years. Therefore, South Africa's imports of soybean oilcake are likely to increase in the coming years.

Figure 4.4 above shows that South Africa has been covering its soybean oilcake deficits from nations outside the southern region of Africa. In the period between 2001 and 2016, South Africa annually imported more than 95% of its total imports of soybean oilcake from Argentina. From 2010 to 2019, South Africa's imports from Argentina, in most years, were close to 100%, mostly above 99.5%. However, in 2017, South Africa's soybean oilcake imports from Argentina decreased to about 90.2% in 2017, from about 99.9% in 2016. The percentage

of South Africa's soybean oilcake imports from Argentina further reduced to 86% in 2018. The decrease in South Africa's soybean oilcake imports from Argentina was attributable to increased imports from the SADC region.

South Africa's imports from the SADC region rose from 28 tons in 2016 to 67 191 tons in 2017, representing a 2398.7% increase. In 2018 and 2019, the imported quantities of soybean oilcake from the SADC region were 80 748 tons and 8495 tons, respectively. The 2019 imports decreased by 89.5%, when compared with the 2018 imports. The decrease in quantities imported from the SADC region in 2019 was mainly attributable to the Zambian government's export bans, which frustrated exports. Zambia is the primary source of oilcake in the SADC region, followed by Malawi. Malawi only started exporting to South Africa in 2014. The imports from Malawi are still lower than those from Zambia are. Mozambique also exports to South Africa, although its exports are still very low, compared with even those from Malawi.

Table 4.3 shows the percentage growth of South Africa's imports between 2010 and 2019. Only Zambia's exports are indicated, as it was the only southern African country exporting soybean oilcake to South Africa, starting in 2010.

Table 4.3: Percentage growth of South Africa's soybean oilcake imports between 2010 and 2019

Source	2010 imports	2019 imports	Import Percentage growth between 2010 and 2019
Zambia	1136	7414	553%
SADC total	1280	8495	564%
NON-SADC	956285	412271	-57%
World	957565	420766	-56%

Source: Author's compilation with data from Trade Map statistics (2020)

South Africa's total imports of soybean oilcake from the world declined between 2010 and 2019, as can be seen from Table 4.3 above. This could be due to the increase in soybean crushing capacity in South Africa, rendering the soybean import demand higher than the soybean oilcake import demand.

As South Africa's soybean oilcake imports from overseas declined, imports from the SADC region increased by 564% in 2019. The 2019 quantities were mainly sourced from Zambia and Malawi.

Compared with the import quantities of soybean oilcake from the world to South Africa, the SADC region quantities are still low for sufficiently covering the soybean oilcake deficit for South Africa. These results are similar to earlier findings by other scholars (Arndt and Roberts, 2018; Samboko et al., 2018), who indicated that there were very low imports of soybean oilcake from the SADC region, during the period understudy in that study. These researchers indicated that transport costs and low soybean production in the region were some of the factors contributing to the low supply to South Africa.

4.3.3 South Africa's maize grain imports

The following graph shows maize grain imports by South Africa from 2001 to 2019.

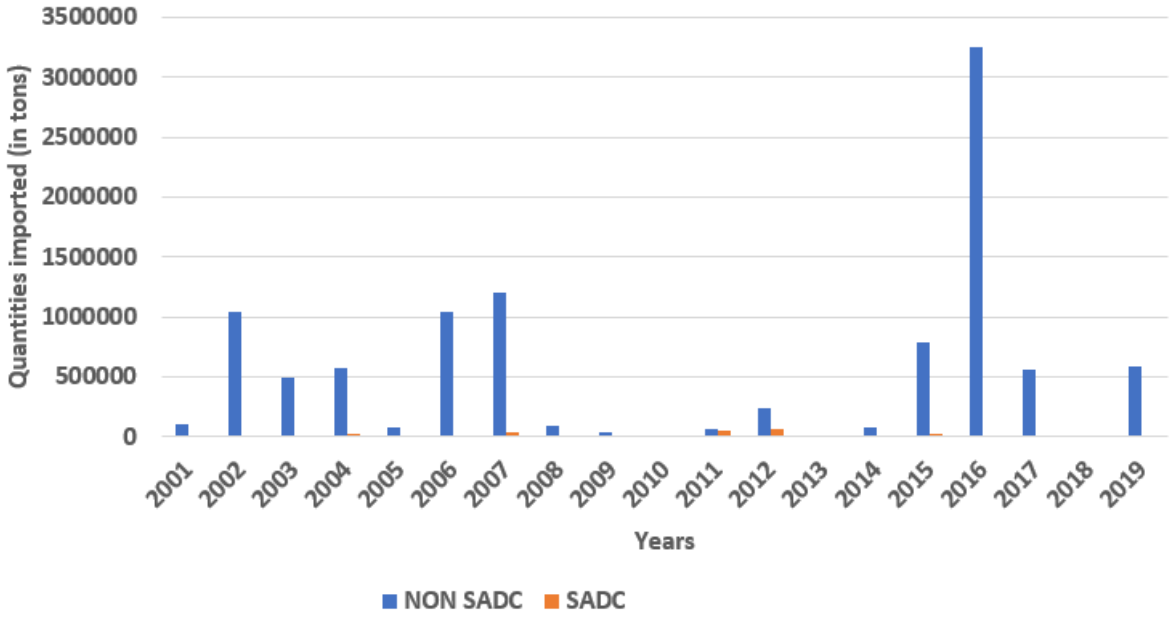

Figure 4.5: South Africa's maize grain imports

Source: Author's compilation with data from Trade Map statistics (2020)

From 2001 to 2010, South Africa's primary sources of maize grain were Argentina (71.3%), the USA (11.8%) and Brazil (5%). These mainly comprised yellow maize grains. From 2001 to 2010, at least 89% of South Africa's annual maize grain imports were from overseas.

In 2011 and 2012, the imports from overseas declined to 64% and 78%, respectively. In 2011, 33% of the maize grain imports were sourced from Zambia. In 2012, the percentage of imports from Zambia reduced to 21%, as the overseas imports increased again. Between 2013 and 2019, at least 90% of South Africa's imports were sourced from overseas. Similar to the soybean imports, South Africa experienced the highest imports of maize grain in 2016. The total maize grain imports in 2016 amounted to 3 262 937 tons, up from 809 400 tons imported in 2015, representing a 303.1% increase. About 99.8% of the total imports in 2016 were from overseas, mainly from Argentina, the USA, Brazil and Mexico. The high imports were attributed to constrained local production caused by droughts in the key production provinces.

The results indicate that South Africa's maize imports came mainly from overseas, and fewer from the SADC region. The main countries in the SADC region that export maize grain to South Africa include Zambia, Eswatini, Botswana, Lesotho, Malawi and Zimbabwe. Table 4.4 below shows the percentage growth of South Africa's maize grain imports between 2010 and 2019. The table shows the import growths per main exporting country between 2010 and 2019, and the aggregate imports by South Africa from the southern African region and the world.

Table 4.4: Percentage growth of South Africa's maize grain imports between 2010 and 2019

Source	2010 imports (tons)	2020 imports (tons)	Import percentage growth between 2010 and 2019
Zambia	44	720	1536%
Eswatini	120	383	219%
Lesotho	58	229	295%
Botswana	280	24	-91%
Other SADC countries	28	290	936%
SADC total	530	1646	211%
NON-SADC	3989	589900	14688%
World total	4519	591546	12990%

Source: Author's compilation with data from Trade Map statistics (2020)

As can be seen from Table 4.4, South Africa's maize imports increased greatly between the two periods. Maize is always in high demand for animal feed, as it makes up more than 50% of compound animal feed (Arndt and Roberts, 2018). Since 2001, South Africa has been importing maize grain from Zambia, Zimbabwe and Malawi. However, imports from these countries have been very low. South Africa began importing significant quantities from Zambia in 2007, and the imports increased from 98 tons in 2006 to 22 502 tons in 2007. On average, the imports from Malawi and Zimbabwe have been low throughout the estimated period. In 2010, South Africa began importing maize grain from Eswatini, Botswana and Lesotho. However, the imports from Eswatini, Lesotho and Botswana are still below 2000 tons, annually.

4.3.4 South Africa's maize bran imports

South Africa also imports maize bran, the residue from maize grain processing. Figure 4.6 below shows the maize bran imported by South Africa from 2001 to 2019.

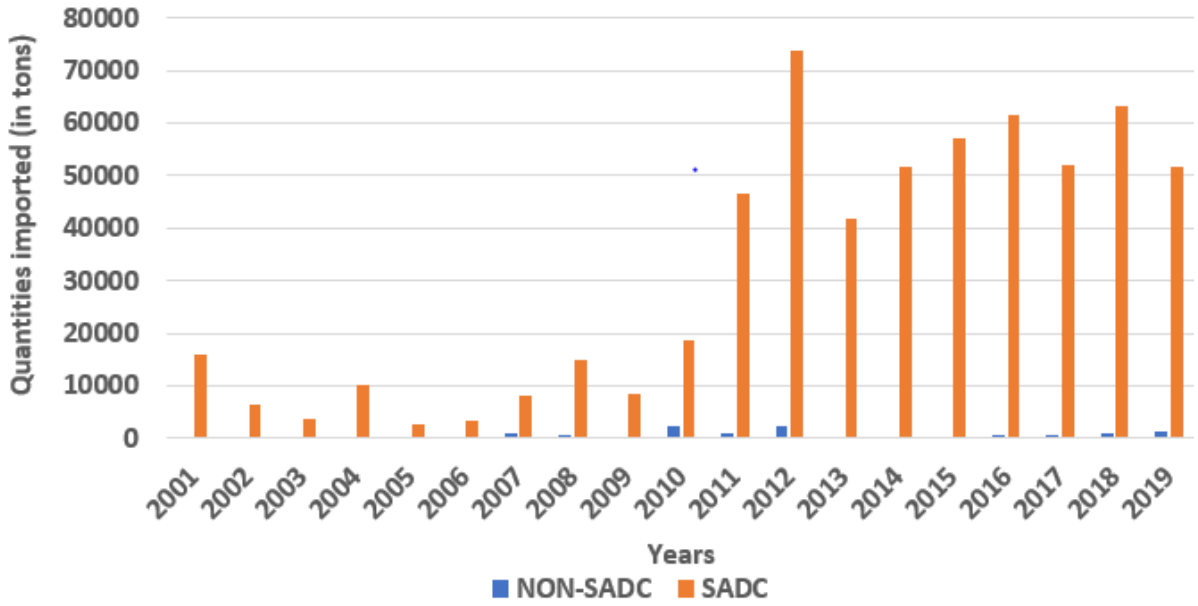

Figure 4.6: South Africa's maize bran imports

Source: Author's compilation with data from Trade Map statistics (2020)

Figure 4.6 above shows that the southern African region is the primary source of maize bran for South Africa. From 2010 to 2019, the imports of maize bran by South Africa from the SADC region grew by 179%. The five main countries supplying maize bran to South Africa are Lesotho, Zimbabwe, Mozambique, Botswana, and Zambia. Of these, Zambia and Lesotho are the two primary exporters of maize bran to South Africa. Zambia began exporting yearly from 2001 to 2019, while Lesotho started exporting in 2010. Since 2010, Lesotho has been one of the leading exporters of maize bran to South Africa, mainly due to its proximity to South Africa, as compared with Zambia. Furthermore, Lesotho is a small country with a lower demand for maize bran, as its animal feed industry is small.

Cattle production in Lesotho is mainly carried out under extensive production systems; therefore, there is very little demand for animal feed. In most countries, the poultry sector is the primary source of maize bran demand. However, the poultry sector is still small in Lesotho (Review, 2020). Lesotho's poultry sector is challenged by high costs of inputs, which are usually sourced from outside the country (Review, 2020). Therefore, Lesotho exports large quantities of maize bran to South Africa due to its lower local demand. In most years, Lesotho has supplied at least 50% of South Africa's total imports of maize bran from the region. In 2011, Lesotho contributed 71% of South Africa's total imports from the region. Imports from

Botswana, Mozambique, Zimbabwe and Malawi have been below 10%, on average, throughout the estimated period.

Between 2010 and 2019, South Africa's total imports of maize bran increased. The imports from overseas decreased, while imports from the region increased. Table 4.5 shows South Africa's percentage growth of imports of maize bran from each country and region between 2010 and 2019.

Table 4.5: Percentage growth of South Africa's maize bran imports between 2010 and 2019

Source	**2010 imports (tons)**	**2019 imports (tons)**	**Import percentage growth between 2010 and 2019**
Lesotho	12456	15960	28%
Zambia	1010	7043	597%
Zimbabwe	4500	17970	299%
Mozambique	3600	5836	62%
Botswana	43	3903	8977%
SADC total	18498	51679	179%
NON-SADC	2296	1241	-46%
World total	20794	52920	154%

Source: Author's compilation with data from Trade Map statistics (2020)

4.3.5 Cane molasses derived from sugar extraction or refining

Cane molasses is mainly used for cattle feeding, while sheep and goats are also a source of demand for molasses. Among the animal feed ingredients analysed, cane molasses is the only ingredient that is not used for broiler production, and therefore, it is the only ingredient that does not present demand from the broiler sector.

Figure 4.7 shows the yearly imports of cane molasses derived from sugar extraction or refining by South Africa.

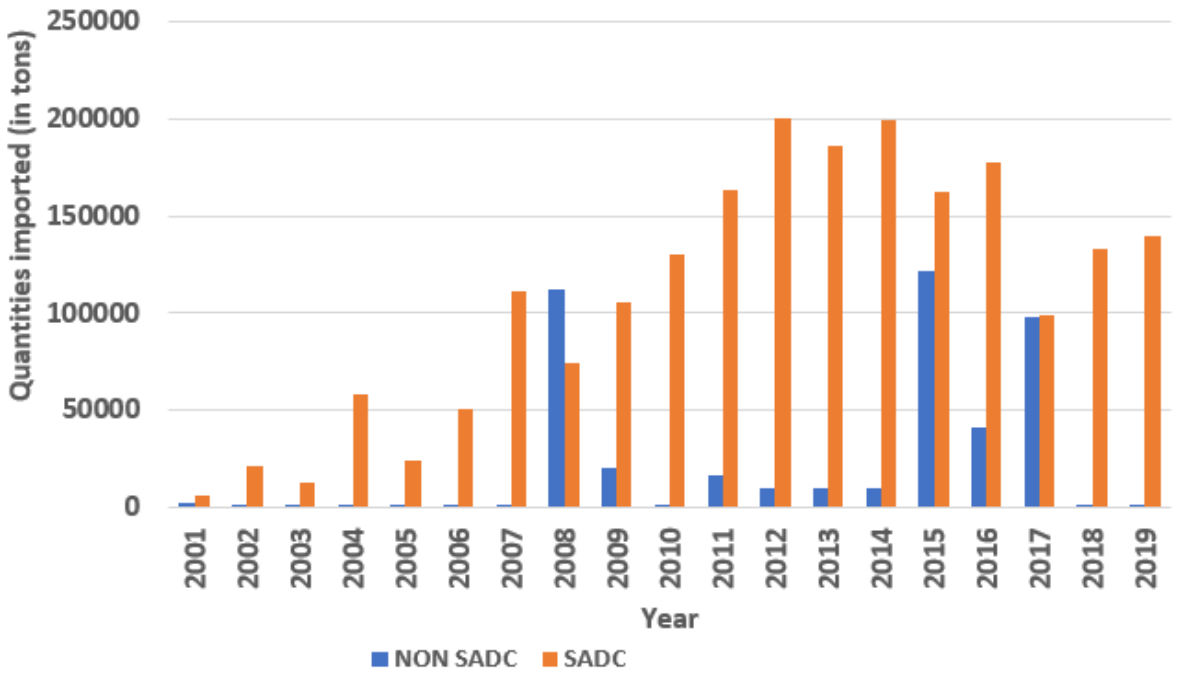

Figure 4.7: South Africa's cane molasses imports

Source: Author's compilation with data from Trade Map statistics (2020)

Southern African countries are the leading exporters of molasses to South Africa. From 2010 to 2019, South Africa's total imports of cane molasses from the SADC grew by 7%, on average, while the overseas imports decreased by 80%. From 2010 to 2014, the imports from the SADC region were above 90%. In 2018 and 2019, about 99.5% and 99.6% of the imports were from the SADC region, respectively. The leading exporters of molasses to South Africa are Mozambique, Zambia, Eswatini, and Zimbabwe. Mozambique and Zambia have the capacity to cover South Africa's cane molasses deficits, as both countries have good potential for increased sugar cane production (Paremoer, 2018).

Table 4.6 shows the percentage growth of South Africa's imports from the southern Africa region and the world.

Table 4.6: Percentage growth of South Africa's cane molasses imports between 2010 and 2019

Source	2010 imports	2020 imports	Import percentage growth between 2010 and 2019
Mozambique	65667	83663	27%
Zambia	24706	47881	94%
Eswatini	67	7004	10354%
Zimbabwe	26528	90	-100%
SADC total	130281	139236	7%
NON-SADC	101	20	-80%
World total	130382	139256	7%

Source: Author's compilation with data from Trade Map statistics (2020)

From the analysis of the five key animal feed ingredients set out above, it can be seen that the animal feed ingredient supply chain for South Africa has become restructured over the past ten years, mainly through geographical chain elongation, integration, and the concentration of actors and products. The elongation of the South African animal feed ingredient value chain has occurred more towards southern African countries. The reduction of overseas imports and the rise in southern African imports by South Africa shows that the animal feed ingredient supply chain for South Africa is becoming more regionalised. There appears to be a concentration of animal feed ingredients from southern Africa along the South African feed ingredient supply chain and a deconcentration of feed ingredients from the overseas supply chain. For example, according to the results above, while imports of maize bran by South Africa from the southern African region increased by 179% between 2010 and 2019, its imports of maize bran from overseas declined by 46% within the same period. This symbolises the development and strengthening of the southern African regional animal feed ingredient supply chain. This is important because regional trade can positively contribute to the economic development of the nations involved.

South Africa's imports from southern African countries such as Zambia, Mozambique, Malawi, Lesotho, Eswatini, and Botswana have increased over the past ten years. Although

there has been a decline in quantities of animal feed ingredients imported by South Africa from some countries such as Zimbabwe over the past decade, there has been an increase in the number of countries that have joined in supplying feed ingredients to South Africa. The decline in quantities imported from Zimbabwe could be attributed to the economic challenges that the country is facing, which have constrained agricultural crop production. The decline in imports from Zimbabwe was cushioned by the entrance of other countries in exporting feed ingredients to South Africa. Since 2010, Lesotho and Botswana have been significant suppliers of maize bran to South Africa. This has geographically elongated the animal feed ingredient supply chain, as these two countries had never supplied products under examination before 2010. South African also began sourcing maize grain from Eswatini and Lesotho in 2010. Furthermore, South Africa began importing soybean oilcake from Malawi in 2014. Similarly, South Africa commenced importing molasses from Eswatini in 2010.

As the supply chain is becoming elongated, integrated, and concentrated by actors and products, one area that requires understanding is the underlying drivers of the increased flow of feed ingredients from other southern African countries to the South African feed manufacturing sector. Understanding the drivers is important, as this will help to further establish the future elongation of the chain, as well as trade in general.

4.4 COMPETITIVENESS OF THE INDUSTRY

The competitiveness of the industry plays a key role as a driver of international trade. The competitiveness of a country's manufacturing sector is important for its growth and economic prosperity (Porter, 2011; Voulgaris et al., 2014). Serious competition in both local and international markets demands that firms in affected industries should advance their competitiveness (Voulgaris et al., 2014). Competitiveness can assist firms with conquering their local markets and extending their businesses abroad, thereby benefiting themselves and the nation at large (Voulgaris et al., 2014).

In this study, we argue that, among other factors, the competitiveness of the South African animal feed industry, compared with other southern African countries, is one of the drivers of the increased flow of feed ingredients to the South African feed manufacturing sector. Industry competitiveness is moreover contributing to the transformations of the supply chain of feed ingredients.

To analyse the competitiveness of the animal feed industry, the diamond framework model devised by Porter (1990) is used. The model is used to help to identify the determinants of competitiveness in the animal feed industry. The model has six main attributes, and these are analysed and discussed in this section. The attributes include factor condition variables, demand condition variables, supporting and related industries, firm strategy and structure and competitiveness, government support and policies, and chance factors. In addition to the attributes of Porter's model, the study included the socio-economic factors that are also driving the trade of animal feed ingredients in southern Africa. These factors were derived from the literature and key stakeholders' interviews.

The respondents were asked to state their perceptions on a range of stipulated statements by using the answer codes discussed in the methodology chapter[10]. Based on their perceptions of the statements, their responses are utilised to analyse their views on the conditions of the attributes of Porter's diamond framework. The competitiveness of the industry is discussed in this section, based on the stated perceptions of the firms in the animal feed industry. The attributes are analysed by using the mean values to determine whether the attributes are constraints or boosters of competitiveness, and this is discussed below.

4.4.1 Attributes of Porter's diamond framework

As discussed in the methodology chapter, factor condition variables speak to the position of the nation with regard to natural resource endowments, production factors, and production cost levels. The statistics shown in Figure 4.8 below indicate that, within the animal feed industry, the factor conditions are in a good state, with an average mean of 4.49. As noted earlier, the South African animal feed industry has expanded and is the largest in southern Africa. The industry is competitive and has made massive investments in infrastructure development. The firms in the industry have adequate and quality infrastructure (mean=5.68). This finding agrees with the literature (Arndt and Roberts, 2018; Samboko et al., 2018; Ncube et al., 2016), that South Africa's animal feed industry has the largest infrastructure development in the southern region. Furthermore, most of the factor condition attributes, including the availability of skilled labour, costs of skilled labour, quality of skilled labour, administration costs associated with labour, location of firms in relation to raw material suppliers, location of firms in relation to

[10] Less than 4 = Constraint; 4 = Neutral; over 4 = Booster

customers and firm access to natural resources, indicate that the factor conditions are in good state, thus rendering the industry competitive. However, the firms are constrained by the high costs of animal feed production (mean=3.60), the high costs of technology for animal feed production (mean=3.04), and high start-up capital (mean=2.17). The high start-up capital required for animal feed production has increased rivalry in some of the sectors within the animal feed industry, especially the feed manufacturing sector. Production costs are mainly attributable to the cost of feed ingredients, as some of the feed ingredients are imported from other countries. The machinery required to increase production is also acquired at a high cost, which also constrains firm growth in terms of production capacity.

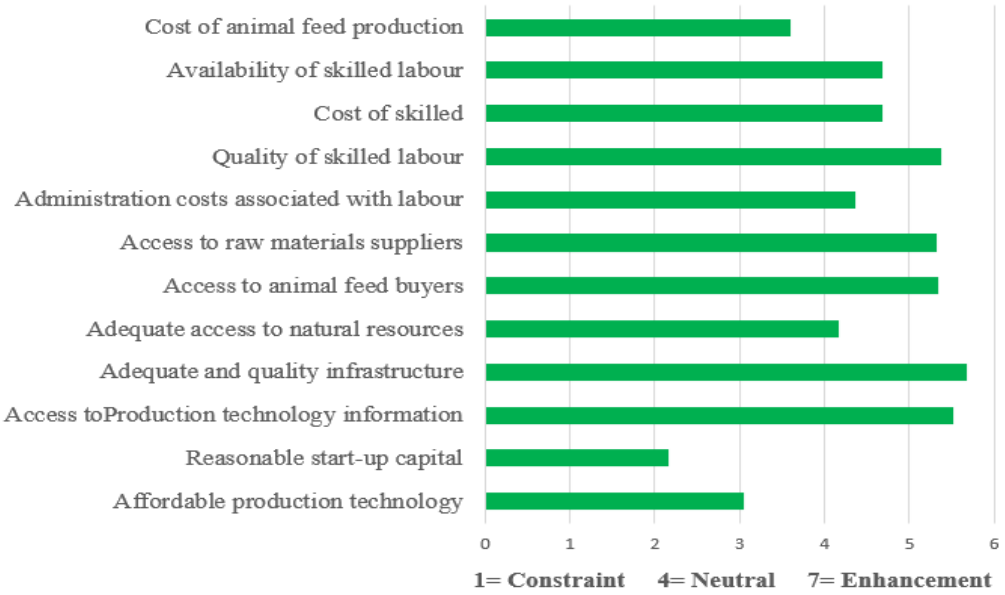

Figure 4.8: Firms' perceptions regarding the factor conditions of the animal feed industry

Source: Own survey illustration (2020)

The second attribute of Porter's diamond framework covers demand conditions. Product demand is very important as it keeps the industry afloat and competitive. The demand for agricultural commodities encourages producers to use more efficient ways of production to meet consumer needs. (Sands et al., 2014). In South Africa, demand for animal feed has led to the industry's expansion and commercialisation to meet the required demand. Figure 4.9 below indicates the nature of the demand in the South African animal feed industry. The variables measured here include the size of local market demand, the size of international market demand, the availability of market information, the quality of market information, and the quality of the product. The high average mean for demand conditions (mean= 5.51) indicates

the significance of the conditions that drive the industry's competitiveness. The South African animal feed industry has a high local demand for animal feed ingredients (mean= 6.32). This is also evident in the literature (Samboko et al., 2018; Arndt and Roberts, 2018), which has indicated that South Africa has the highest market demand for animal feed ingredients in the region. The high demand for feed ingredients means that South Africa is the largest importer of feed ingredients in the region. Droughts in some key crop-production provinces, such as the Free State and North West, exacerbate deficits in crop production (Botai et al., 2016). This leads to a high demand and the consequent importation of grain crops such as soybean, a key ingredient in compound animal feed. Similar to the global situation, meat demand by consumers in South Africa has led to the high demand for animal feed ingredients. To produce the quality of meat demanded in South Africa, cattle production systems have shifted over the years from extensive production systems to intensive production systems, with zero animal grazing (Hall et al., 2016a). Animal feed quality is important for feed manufacturing firms in meeting the exact consumer demands.

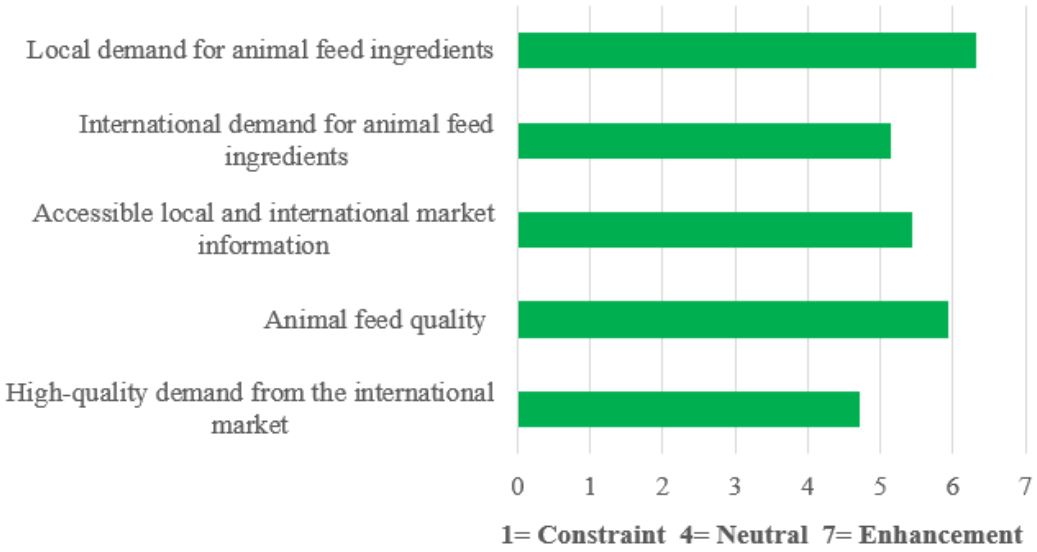

Figure 4.9: Firms' perceptions of the demand condition attributes

Source: Own survey illustration (2020)

In Figure 4.10 below, related and supporting industries are rated according to the perceptions of animal feed industry firms regarding their contributions to the industry's competitiveness[11].

[11] Supporting and related industries are those institutions/industries that help to boost the competiveness of the animal feed industry, but are not themselves part of the industry such as research institutions and financial institutions, and those offering necessary services to the industry such as electricity and transport.

Except for the electricity supply (mean=3.28), the supporting and related industries are regarded as enhancing the competitiveness of the animal feed industry (mean= 4.62). South Africa has high-ranked learning institutions that have increased international research collaborations with other well-established research institutions in the world (Bambo and Pouris, 2020). However, there appears to be increasing fragmentation between academic research and industrial research in South Africa (Bambo and Pouris, 2020). This implies that the industries in South Africa have access to credible research institutions to help boost industry competitiveness. As stated earlier, animal feed formulation is one of the areas that are currently undergoing ongoing research.

The South African government has also invested in road infrastructure development, thereby making it easier for the animal feed industry to transport feed from one place to another. This gives firms easy access to suppliers of feed ingredients required for making animal feed and to buyers of animal feed. The firms also have at their disposal well-coordinated transport and logistics services.

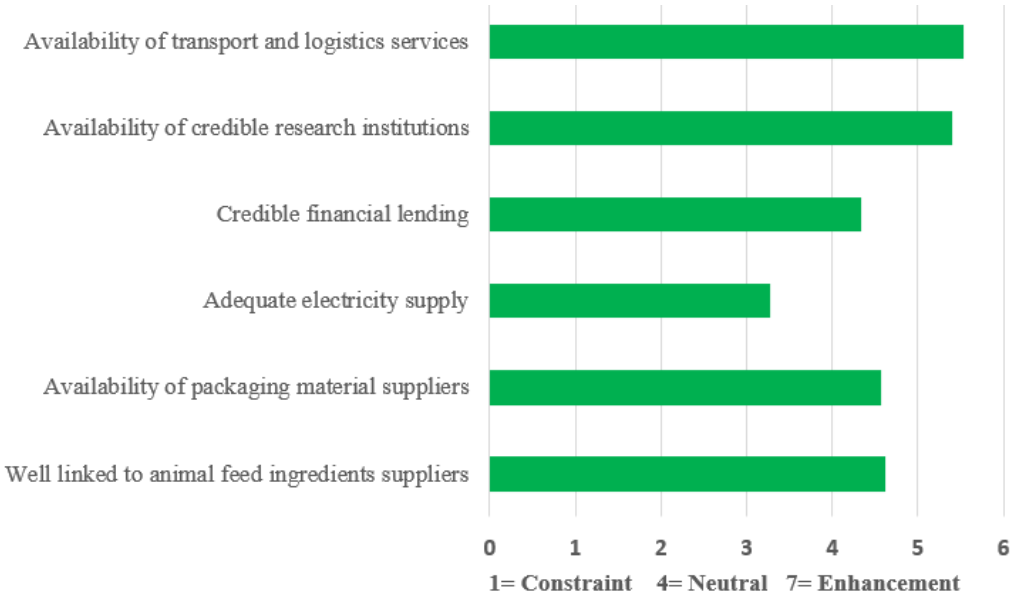

Figure 4.10: Supporting and related industries to the animal feed industry as drivers of competitiveness

Source: Own survey illustration (2020)

In Figure 4.11 below, the impacts of firm structure, strategy and rivalry as being determinants of South Africa's animal feed industry are shown. The average mean value of 4.68 indicates that firm structure, strategy and rivalry are rendering the industry competitive. Managerial

capabilities, strong relationships among industry firms, and the adaptability of agribusiness enhance the competitiveness of animal feed industry firms, especially feed manufacturers. However, both the market power of suppliers of feed ingredients (mean=3.19) and the market power of animal feed buyers (mean=3.04) constrain the competitiveness of the animal feed industry. Furthermore, hostility towards new entrants (mean=2.43), especially in the feed manufacturing sector, constrain the competitiveness of the animal feed industry.

Furthermore, the limitations of substitutes in terms of the main feed ingredients, mainly grain crops, constrain the competitiveness of the animal feed industry. Grain crops, especially maize, face competing and high demands for use in human consumption and in the production of biofuels, which limits the amounts available for animal feeding (Samboko et al., 2017). Maize and soybean are the two main ingredients in animal feeds and, at the same time, have limited substitutes. The production of other grain crops that could substitute for maize and soybean, for example, sorghum, sunflower, millet, Bambara nuts, to mention but a few, are still under-produced in South Africa and southern Africa at large.

Figure 4.11: Firm structure, strategy and rivalry as drivers of competitiveness in the animal feed industry

Source: Own survey illustration (2020)

Figure 4.12 below shows the perceptions of the animal feed firms regarding the contribution of government support and policies to the competitiveness of the animal feed industry. With an average mean score of 3.10, inadequate government support could be seen as constraining the competitiveness of the animal feed industry. The firms perceive that government fiscal

policies, labour policies, and direct and indirect government support are inadequate, thus constraining the competitiveness of the animal feed industry. These findings are similar to those of Esterhuizen et al. (2001), who analysed the determinants of the competitiveness of the South African agro-food and fibre industries. The firms in the present study indicated that the South African government has not supported the industry in negotiating trade agreements, especially with southern African countries. Trade policies are macroeconomic policies that have effects that change volumes, directions, and the composition of exports and imports. Since these policies are negotiated at the government level, firms in the industry have no control over the effects of the trade policies. The firms are challenged by unnecessary trade bans imposed by other countries when there is a need to import certain ingredients for animal feed. This, in turn, limits the availability of ingredients for animal feed when there is a high demand for animal feed in the country. The firms further perceive the land reform policy as being a constraint to the animal feed industry. The land reform policy in South Africa has been received with mixed feelings among landholders. Some perceive it as a way of promoting equal distribution of land, while others perceive it as destabilising the agricultural sector.

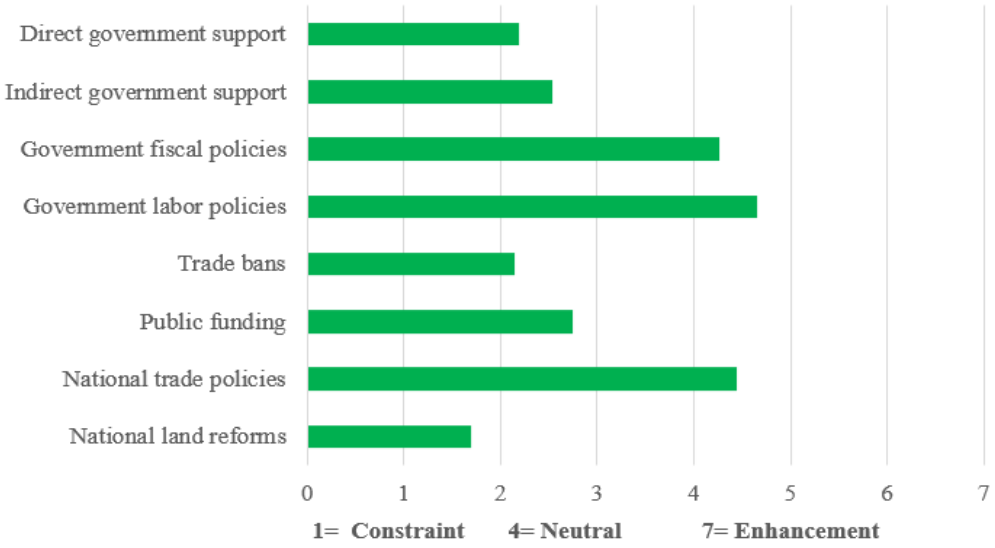

Figure 4.12: Government support and policies as drivers of competitiveness in the animal feed industry

Source: Own survey illustration (2020)

Figure 4.13 below shows the perceptions of the animal feed industry firms on chance factors. Chance factors are factors beyond the firms' control. These may be natural occurrences or may be a result of certain actions that are totally beyond an individual firm's control. The average mean score of 1.74 indicates that the noted chance factors constrain the competitiveness of the

animal feed industry.

South Africa is naturally prone to droughts. These droughts have negatively affected both the national economy and local communities (Baudoin et al., 2017). Climate change has impacted negatively upon the competitiveness of the industry. Most parts of South Africa, as indicated earlier, have been hit by droughts, thereby constraining crop production. The animal feed industry is directly dependent on crop production, as grain crops are the main ingredients in compound animal feed. Any shock to grain production greatly affects the performance of the animal feed industry.

Crime, corruption and border post bureaucracies are also negatively affecting the competitiveness of the industry. Furthermore, fluctuations in exchange rates lead to instability in the prices of imported animal feed ingredients.

Global pandemics, such as the current Covid-19 pandemic, have negatively affected the competitiveness of the industry. These have serious potentials to negatively impact upon the availability of labour in the industry, as the current Covid-19 pandemic has done. The Covid-19 variant of the coronavirus has directly affected the availability of animal feed ingredients due to the closure of border posts and travel bans. Although animal feed was seen as an essential good, the time taken to clear the goods at the border became longer due to coronavirus screenings.

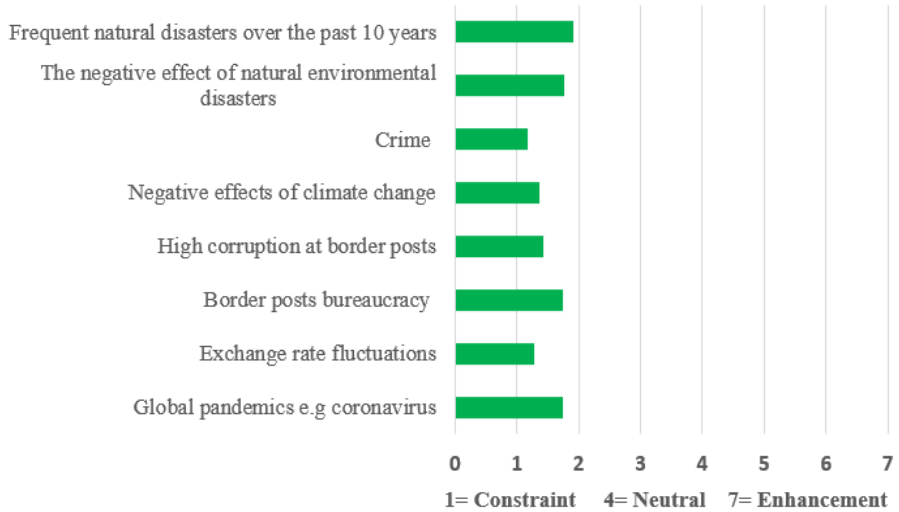

Figure 4.13: Chance factors

Source: Own survey illustration (2020)

Figure 4.14 below shows a summary of the average means for the six attributes of Porter's diamond framework. A mean below 4 implies that the attribute is a constraint. A mean equal to 4 implies that the attribute is neutral (it neither constrains nor boosts the competitiveness of the industry), and a mean above 4 implies that the attribute boosts the competitiveness of the industry. The higher the mean, the more enhancing to industry competitiveness that attribute is, and vice versa.

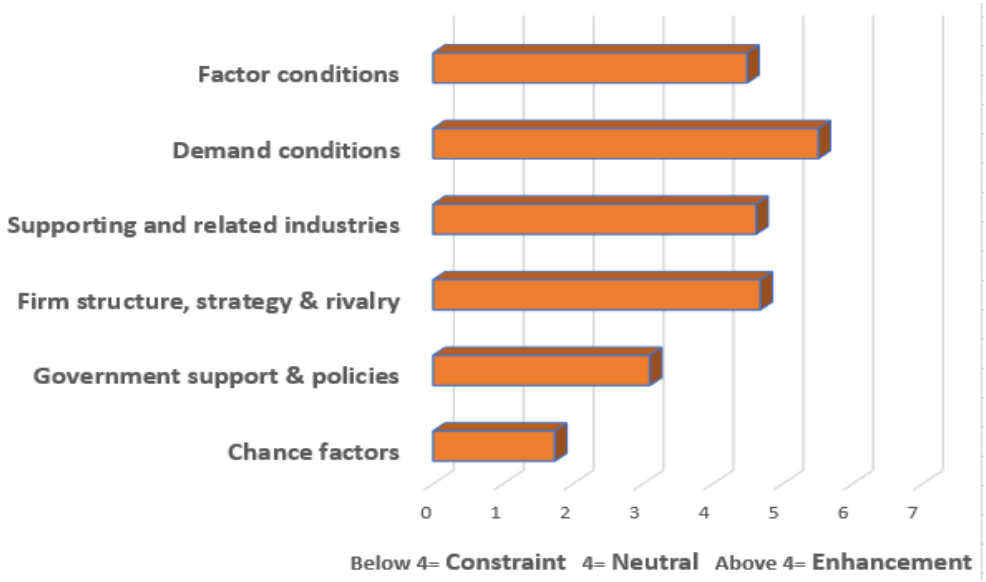

Figure 4.14: Average means of the six attributes

Source: Own survey illustration (2020)

On average, factor conditions, demand conditions, firm structure, strategy and rivalry, and supporting and related industries are contributing to the competitiveness of the industry. The industry is only constrained by government support and policies and by chance factors. These factors are mainly beyond the firms' control. Despite these constraints, the firms have skilled human capital, access to credible research institutions, good managerial capabilities, good linkages among firms, and good infrastructure. These have led to the increased competitiveness of the industry. According to the literature (Ncube et al., 2017; Samboko et al., 2018; Arndt and Roberts, 2018), South Africa's animal feed industry has been identified as the largest and most competitive, when compared with other animal feed industries in southern Africa. The industry has a production capacity of 3.5 metric tons per annum (DAFF, 2018b). The large size and capacity of the industry, compared with other southern African animal feed industries,

endows the South African animal feed industry with the largest market demand for animal feed ingredients.

According to Porter (1999), an industry needs to be competitive if it is to engage in international trade profitably. From the analysis of the southern African trade of animal feed ingredients, we noted that the South African animal feed ingredient supply chain is becoming elongated. Firms in the South African animal feed industry are competitively accessing the feed ingredients from different parts of the southern African region. Therefore, it is argued that the industry's competitiveness is one of the drivers of the increased flow of feed ingredients to the South African feed manufacturing sector. The firms in the industry have invested in themselves and are therefore able to access international markets for feed ingredients. Industry investments in terms of infrastructure and technology have made the South African firms competitive. Through their international competition, the South African firms have achieved international leadership in southern African region markets. This assertion is in line with Porter (2011), who indicates that a firm's competitiveness is key to achieving international leadership in markets. Apart from the competitiveness of the industry, socio-economic factors are also driving the increased flow of feed ingredients to the South African feed manufacturing sector.

4.4.2 Socio-economic factors as drivers of the animal feed trade

In this study, the firms were also asked to give their perceptions of the other proposed drivers of increased animal feed trade by the South African feed manufacturing sector. These are socio-economic drivers identified from literature (Drewnowski and Poulain, 2018; Green et al., 2019). These include population growth, increased middle-class income, a shift in consumption patterns, and increased demand for quality meat. Figure 4.15 below reflects the perceptions of the firms regarding the above as being drivers of the increased flow of feed ingredients to the South African feed manufacturing sector.

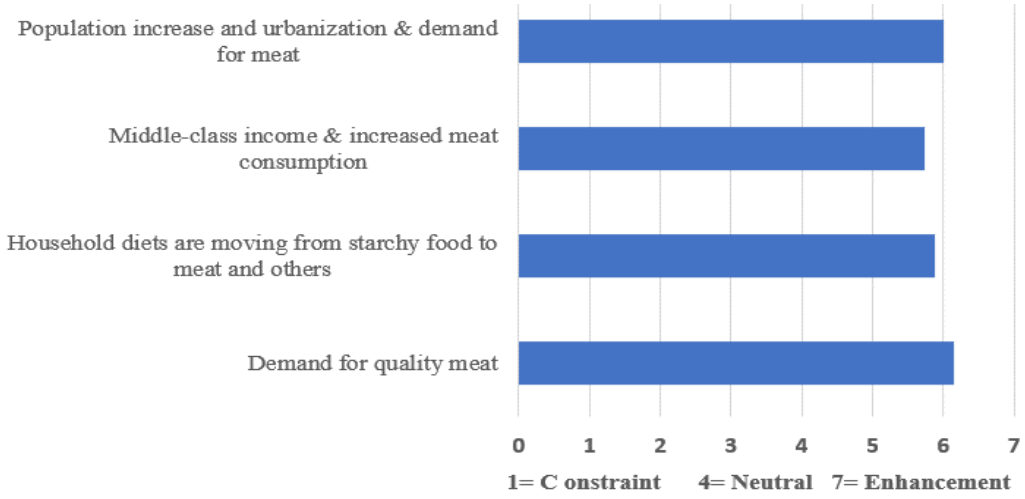

Figure 4.15: Firms' perceptions of other factors as drivers of trade

Source: Own survey illustration (2020)

The mean value of 5.95 indicates that the firms agree that these factors are also drivers of the flow of animal feed ingredients to the South African animal feed manufacturing sector.

South Africa's population has been growing annually by about one million people since 2011. In 2011, South Africa's population was 51.77 million people, and in 2020 the total population was estimated at 59.62 million people (Stats_SA, 2020). Similar to the global situation, urbanisation is on the rise in South Africa. The urbanisation in South Africa increased from 61.69% in 2009 to 66.86% in 2019 (Statista, 2021). Population increase and urbanisation (mean = 6) indicate that the firms agree that the rise in population, as well as increased urbanisation, comprise a contributing factor to the increased flow of animal feed ingredients to the South African feed manufacturing sector. As the urban population increases, the demand for meat increases, thereby exerting pressure on livestock production. Literature indicates that, as people move to cities, they abandon calorie-dense diets, which they perceive as a poor person's diet, and move to meat and other fast foods (Puoane et al., 2006). Since livestock production is mainly carried out under intensive farming systems (75%), the demand for animal feed increases, leading to increased imports of feed ingredients by South Africa (SAFA, 2019).

The rise in average incomes among households in South Africa is associated with the increase in population and urbanisation. The number of individuals classified as having a middle-class income increased from 3.6 million people in 1993 to 7.2 million people in 2012, representing a 100% increase (Burger et al., 2015; Khunou, 2017). The rise in income makes it possible for households to afford a variety of foodstuffs, including meat. Thus, rises in income are driving

changes in consumption patterns, as people can then afford to purchase meat and other meat products.

The worldwide dietary consumption patterns are changing due to population growth, socio-economic developments, rapid urbanisation, increased disposable income among households, and better nourishment distribution (Drewnowski and Poulain, 2018). South African diets are also experiencing this shift (Hall et al., 2015). Between 2010 and 2017, the per capita consumption of beef in South Africa increased from 17.8 kgs to 21.3 kgs. The mean value (5.89) noted in Figure 4.15 indicates that the animal feed industry firms agree that the South African diets are shifting to more meaty diets.

Regarding the demand for quality meat, the mean value (6.16) indicates that the animal feed industry firms agree that the demand for quality meat in South Africa has increased. The increased demand for quality meat is one of the main drivers of the increased research conducted on the animal feed formulations needed to produce the required quality of meat, while increasing productivity and profitability. Usually, animals between the ages of 12 and 22 months have less fat. In South Africa, carcasses with between 1 mm and 3 mm of fat obtain optimum prices on the market (Hall et al., 2016a). Irrespective of the production method used, producers in South Africa aim to reach this fat cover. As a result, breeds and feeding strategies have been highly adapted, over time, in South Africa (Hall et al., 2016a).

4.5 SUMMARY

The findings indicate that South Africa imports significant quantities of feed ingredients, both from overseas and from southern African countries. Between 2010 and 2019, imports of soybean, soybean oilcake, maize grain, maize bran and sugarcane molasses by South Africa from southern Africa increased by 302%, 564%, 211%, 179% and 7%, respectively. This implies that the animal feed trade in southern Africa is becoming regionalised, with nations supplying the animal feed ingredients that they have a comparative advantage in producing.

While more quantities of maize grain (mainly yellow maize), soybean and soybean oilcake are still coming from overseas (mostly South America), especially in years of droughts in South Africa, sugarcane molasses and maize bran imports by South Africa are mainly sourced from the southern Africa region. More than 80% of these ingredients are exported from southern Africa. Mozambique, Zambia and Eswatini are the three main suppliers of cane molasses. In

2019, 60%, 34% and 5% of South Africa's total imports of cane molasses were from Mozambique, Zambia and Eswatini, respectively. Lesotho, Zambia, Zimbabwe, Mozambique and Botswana are suppliers of maize bran to South Africa. Since 2010, Lesotho and Zambia have been jointly supplying at least 60% of South Africa's total imports of maize bran. Zambia remains the main exporter in the region of all the five analysed feed ingredients to South Africa.

South Africa's feed ingredient supply chain has become more elongated towards the southern Africa region, starting in 2010, as more countries began to supply some of these feed ingredients to South Africa. Since 2010, Lesotho and Botswana have become significant suppliers of maize bran to South Africa. This has operated to elongate the animal feed ingredient supply chain, as these two countries had never supplied maize bran to South Africa before 2010. South Africa also began sourcing maize grain from Eswatini and Lesotho in 2010. Similarly, South Africa started importing molasses from Eswatini in 2010.

In terms of trade and the changes in trade, the results indicate that the increased demand for animal feed ingredients in South Africa is being driven by socio-economic factors and competitiveness of the industry. The socio-economic factors include population increase, urbanisation, rise in middle-class income, shifts in diets, and demand for leaner meat. The South African animal feed industry is competitive. The industry firms have qualified personnel, good infrastructure, easy access to information, and access to production technology. Credible research institutions are available to the firms. These research institutions are making a great contribution to the knowledge that keeps improving the quality of animal feed produced.

Through its competitiveness, the South African animal feed industry can compete in international markets. Since South Africa is constrained in grain crop production in most years due to droughts, the competitiveness of the South African animal feed industry enables firms in the industry to competitively source the feed ingredients from other southern African countries. South Africa sources feed ingredients from countries that are, at times, more competitive at grain crop production than South Africa is. The competitiveness of the industry also points to increased demand for animal feed. The socio-economic factors and industry competitiveness points to South Africa's large market demand for animal feed. In this case, all these drivers can be aggregated into demand size as being the main driver of the flow of animal feed ingredients to the South African feed manufacturing sector.

CHAPTER 5: STRUCTURE AND CONDUCT TRANSFORMATIONS IN THE SOUTH AFRICAN ANIMAL FEED SECTOR VALUE CHAIN

5.1 INTRODUCTION

In Chapter 4, we saw that the South African animal feed industry is competitive, and therefore is able to gain access to international markets. For an industry to become competitive, several transformations need to occur within that industry at the firm level. This was evident in the research conducted by Hernandez et al. (2018) on the Bangladesh aquaculture value chain. As the aquaculture sector expanded, there was a proliferation of actors within the value chain and actor concentration in some sectors, together with the rapid diversification and commercialisation[12] of species (Hernandez et al., 2018). The research carried out by Reardon et al. (2019) also indicated that rapid transformations are occurring in the food systems of developing regions. These transformations vary per sector and are occurring at different intensities and times (Reardon et al., 2019).

In this regard, this study postulates that the animal feed sector in South Africa is also experiencing these transformations in most segments, and these are at the centre of the increased competitiveness of the industry in accessing international markets. These transformations in the segments will be explored and explained in this chapter. The chapter is organised into three main sections. The first main section focuses on the restructuring of the animal feed segments in terms of growth and concentration. The second main section focuses on firm expansion and commercialisation. The third main section focuses on technological changes in the industry. The last section summarises the findings. The findings from the survey conducted in this study will be used to explore these transformations.

5.2 VALUE CHAIN TRANSFORMATIONS

The South African animal feed industry has experienced rapid development and proliferation in most segments of the animal feed value chain over the past two decades, as will be seen in

[12] Commercialisation occurs after a small business has grown and scales up its operations and reaches levels that allow it to successfully reach a larger market.
Actor concentration is the change in the number of actors in a value chain, from a small number to a large number.
Diversification, on the other hand, is the process where a business enlarges or varies its categories of products or its area of operation.

this chapter. The numbers and concentration of actors have changed in some segments of the value chain, and these are also discussed in the next subsections. These segments include feed manufacturing, the feed ingredients segment, feed trading, premix and feed additives, laboratory and other services, and the transport segment. The segments are occupied by large firms, operating on a large scale. The structural changes per segment are discussed below. The segments analysed here are those as classified by the South African feed industry. Therefore, the firms analysed here are those registered as either full members or associate members of the South African animal feed industry.

5.2.1 Feed manufacturing segment restructuring

Over the past ten years, the number of individual feed manufacturing firms in South Africa (registered in the animal feed industry) has only increased by 6%, from around 32 in 2010 to about 34 in 2019. These are very large firms [13]operating at a large scale and with feed plants spread across the country. The feed manufacturing sector in South Africa is controlled by large firms which operate on a large scale. Due to their large scale of operation, the sector is rivalry in nature as small firms find it difficult to join the sector. The large firms are therefore spreading across the country as they are opening new branches. These branches in most cases report to their head quarter offices. The branches[14] (plants) for the feed manufacturing firms, however, increased by 25% from about 52 branches in 2010 to about 65 branches in 2019.

Some of these firms are vertically integrated, as they are also involved in livestock production and meat processing. In 2010, these firms concentrated their operations in Gauteng, and about 44% of the plants were in Gauteng. However, in 2019, the number of feed manufacturing plants in Gauteng decreased by 50%, as the firms started spreading their operations throughout the country, as can be seen in Figure 5.1 below. According to the key stakeholders, the following could be the possible reasons for the deconcentration of the firms in Gauteng province. Some feed manufacturing firms appear to have decentralised, as the firms have been seen to spread their branches throughout the country, with most of the activities of feed production, especially those regarding decision making and planning, being delegated to authorities at the local branch. Furthermore, some firms might have been consolidated during the period. It also could

[13] The large firms in this study are defined in terms of individual animal feed firms such as AFGRI which may have other branches across the South Africa or across Southern Africa.
[14] The branches (establishments) include all sites of animal feed production for the firms.

be that some firms moved to other provinces that have more market demand for animal feed and less competition from other suppliers.

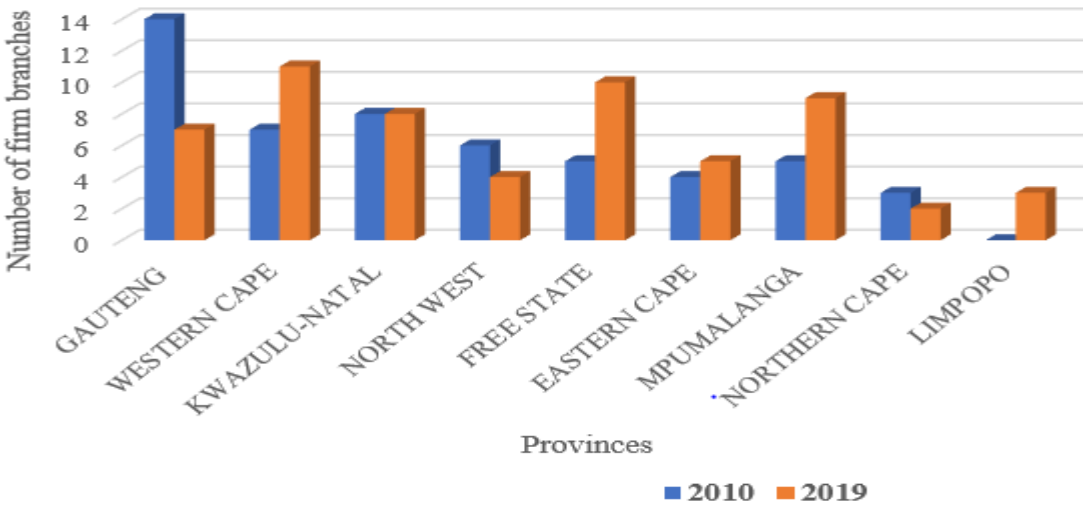

Figure 5.1: Animal feed manufacturing plants per province between 2010 and 2019

Source: Author's compilation with data from AFMA (2020)

It can be seen from Figure 5.1 above that the feed manufacturing firms are taking their services closer to the consumers in areas with high demands for animal feed. This can be seen from the increase of feed manufacturing plants being established in provinces such as Western Cape, Free State and Mpumalanga, which undertake high livestock production. In South Africa, animal feed is sold over provincial and national borders. Therefore, feed sales points represent production points, and not the movement of feed after production. Accordingly, Table 5.1 sets out a true reflection of feed demand per province. The Northern Cape has very low sales of feed due to fewer agricultural activities being conducted in the province. Its sales are therefore still below 1% of the total sales.

Table 5.1: Animal feed sales in tons per province from 1st April 2019 to 31st March 2020

Province	Total sales	Percentage of sales
Eastern Cape	501 130	7.5%
Free State	857 636	12.9%
Gauteng	1 005 749	15.1%
KwaZulu-Natal	837 603	12.6%
Limpopo	65 666	1.0%
Mpumalanga	1 136 879	17.1%
North West	610 552	9.2%
Western cape	1 357 127	20.4%
SADC	272 305	4.2%
Total	**6 644 647**	**100**

Source: Author's compilation with data from AFMA Chairman's Report(2020)

5.2.2 Processed feed ingredients sector restructuring

The producers and suppliers of processed animal feed ingredients have experienced a 75% increase, from 8 firms in 2010 to 14 firms in 2019. These firms are highly concentrated in the Gauteng province, mainly because of the Gauteng province's central location for onward distribution. The suppliers and producers of processed feed ingredients are processors of feed ingredients for animal feed. Feed millers also fall under this category. Feed millers mainly process maize into maize meal for human consumption, and the residue maize bran is supplied to animal feed manufacturers. Some of the producers and suppliers of animal feed ingredients include soybean crushers that process soybean for animal feed purposes. The soybean crushers are mostly located in regions of high soybean production in South Africa. The firms under this category also process feed ingredients, such as cottonseed and sunflower, the residues of which, sunflower oilcake and cottonseed oilcake, respectively, are used for animal feed.

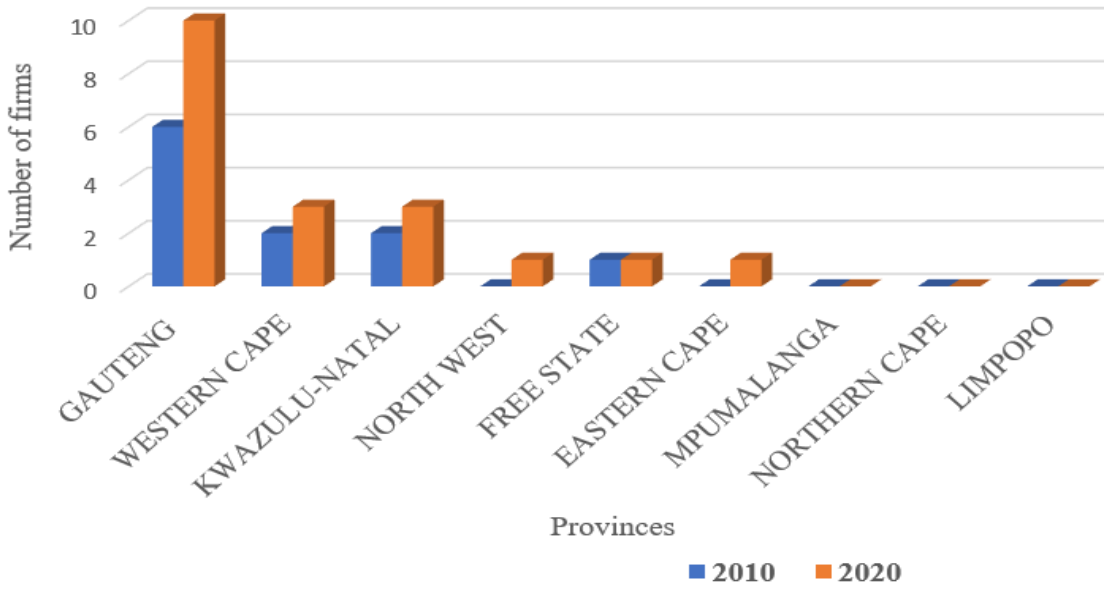

Figure 5.2: Producers and suppliers of feed ingredients between 2010 and 2019

Source: Author's compilation with data from AFMA (2020)

5.2.3 Premix and feed additives segment restructuring

In terms of numbers, the premix and feed additives segment in the South African animal feed industry is rapidly transforming. According to statistics provided by the South African animal feed industry, the firms increased by 89% between 2010 and 2019, from about 18 firms in 2010 to about 34 firms in 2019. The increase in the number of these firms is mainly attributable to the lower start-up capital required in this segment, as compared with the feed manufacturing sector. The other reason is the increased demand for feed premixes and feed additives to make different types and concentrations of animal feed to meet the specific demands for meat by consumers. Livestock producers choose the type of feed, with prior knowledge of the expected outcome from their production.

The vitamins and minerals premixes, feed additives, and oxidants are locally mixed or produced (DAFF, 2018b). Similar to the producers and suppliers of feed ingredients, the commercial suppliers of premix and feed additives are highly concentrated in Gauteng province, as can be seen from Figure 5.3 below. Over 50% of the suppliers of premix and feed additives are located in Gauteng. Generally, most of the goods that leave South Africa, destined for other parts of Africa, are exported through Johannesburg, the capital city. Therefore, the

locations of the suppliers of premix and feed additives might be selected for both local distribution and export purposes. South Africa is the leading manufacturer and exporter of premix and feeds additives to most southern African countries. Most of these countries, including Zambia, import the premix and feed additives required to make the compound animal feed from South Africa.

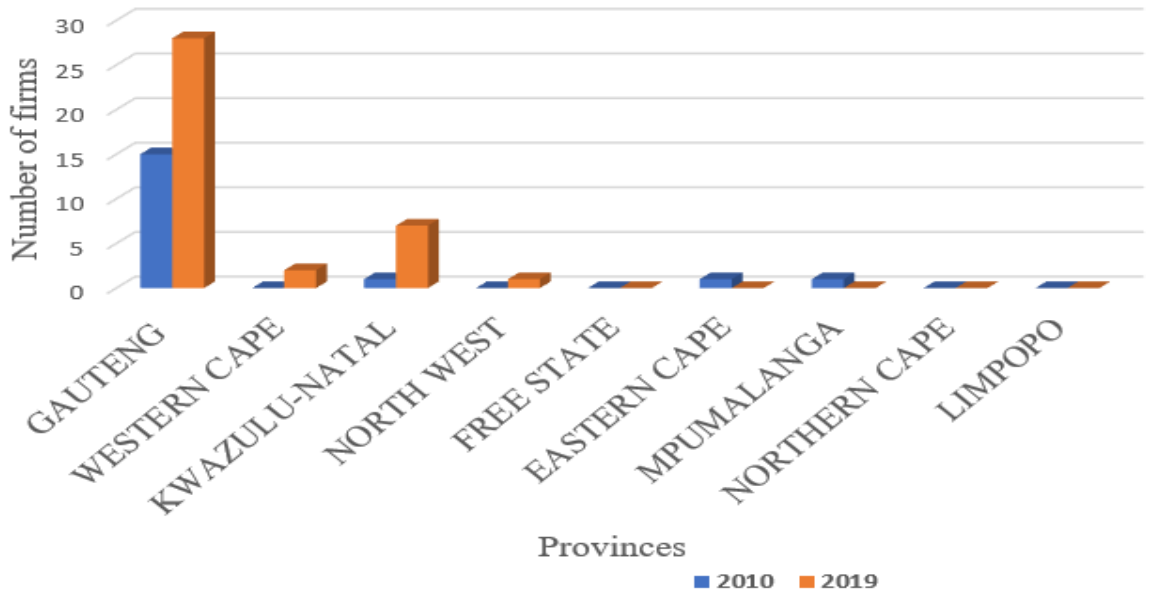

Figure 5.3: Distribution of producers of premixes and feed additive between 2010 and 2019

Source: Author's compilation with data from AFMA (2020)

5.2.4 Feed trading segment restructuring

These are large firms registered under the South African animal feed industry. They are involved in the procurement of bulk feed ingredients, both locally and internationally. The animal feed traders are also concentrated in Gauteng province, as can be seen from Figure 5.4 below. In 2010, 15 out of 18 animal feed trading firms were located in Gauteng province. In 2019, about 61% of these firms were in Gauteng province. As the number of firms slightly decreased in Gauteng between 2010 and 2019, we see a slight increase in the number of firms in provinces that are closer to harbours, such as KwaZulu-Natal. This could be a strategic firm positioning to more conveniently receive feed ingredients that are imported from overseas. Between 2010 and 2019, the number of firms remained almost the same, at around 18 firms.

Twenty years ago, most of these firms were locally oriented. However, over the years, the firms have become more internationally oriented, as they are sourcing most of their feed ingredients

from other countries, both from overseas and from the southern African region. This indicates that the feed ingredient supply chain for South Africa has become regionally elongated over the years.

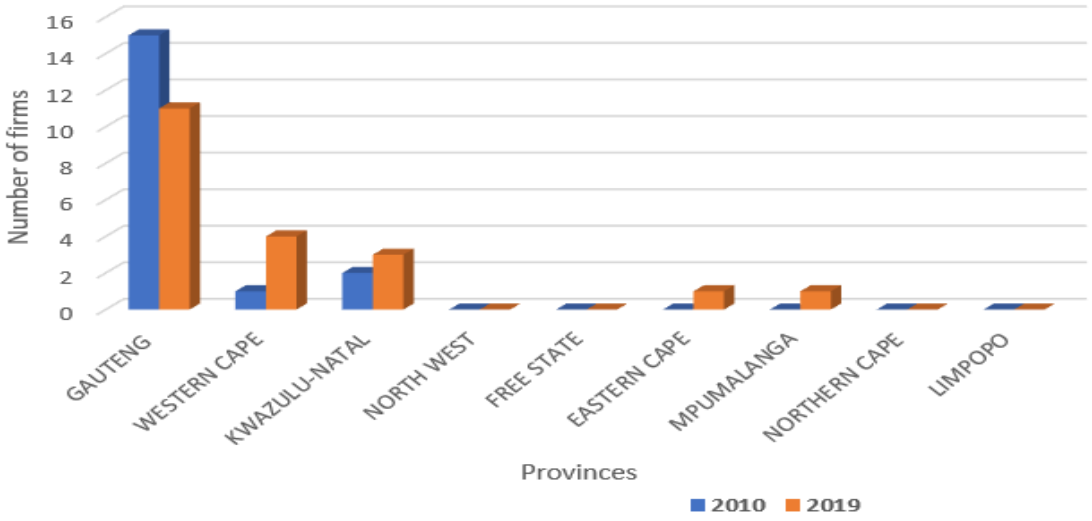

Figure 5.4: Distribution of trading firms between 2010 and 2019

Source: Author's compilation with data from AFMA (2020)

5.2.5 Laboratory and other services restructuring

The firms involved in laboratory and other services, such as grain testing, are still few in number. According to AFMA statistics, only one firm was registered under the South African animal feed manufacturing sector in 2010. In 2019, the number had increased to five. The four main laboratory firms are in the Gauteng province, with the other firm being in the Western Cape province, as can be seen in Figure 5.5 below.

These firms are playing a key role in testing the quality of feed ingredients in terms of nutrient content. With the existence of these laboratory firms in the animal feed industry, firms can reduce production costs by not including feed ingredients that are not digested by animals. The laboratory firms have increased research into nutrient content and nutrient digestibility by animals. The services offered by these firms include feed enzyme analysis, limestone analysis, maize grain analysis, and egg quality analysis. Ensuring that the correct level of enzyme is present at the correct stage during production is vital for ensuring that the producer will produce

according to the required goals. As mentioned earlier, maize is an important ingredient in compound animal feed. Maize differs in terms of hardness and energy content. Through maize analysis, these firms provide a great contribution to animal production, as gaining an understanding of the composition of the primary feed ingredient in production provides a competitive advantage. This is because feed formulations can be tailored more accurately to meet the nutritional need of the animals. This, in turn, means optimum utilisation of feed, reduced feed wastage and improved production performance.

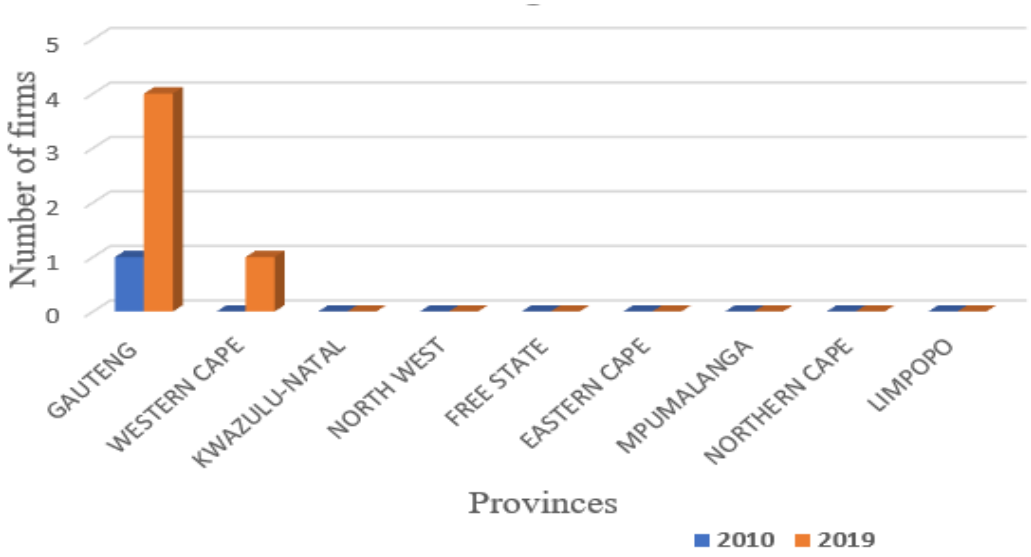

Figure 5.5: Distribution of firms involved in laboratory & other services

Source: Author's compilation with data from AFMA (2020)

5.2.6 Transport segment restructuring

The transport sector is vital to the distribution of animal feed throughout the country. According to the key stakeholders in the industry, the number of firms offering local transport services to the animal feed industry firms in South Africa has increased by over 50% over the past decade. The increase is required to improve the distribution of animal feed throughout the country in order to meet demand. Furthermore, individual firms in the animal feed industry have invested in transport services to improve their operations. The international transportation of animal feed ingredients from southern African countries to the South African feed manufacturing sector is also a key component within the restructured transport sector. The availability, as well as the cost of transport, is a key determinant of export quantities.

Previous scholars (Ncube, 2018; Samboko et al., 2018; Arndt and Roberts, 2018; Bagopi et al.,

2014; Paremoer, 2018) have indicated that the quantities of soybean, soybean oilcake and maize grain obtainable from the region are still too low to completely replace South Africa's overseas imports. The scholars indicated that higher transport costs, compared with those for overseas imports, are the main constraint to regional trade. While animal feed costs about US$400/ton, the transport costs, for example, from Zambia to Gauteng province of South Africa, have been about double the expected normal transport cost (Vilakazi and Paelo, 2017). In 2015, it cost US$100/ton to move animal feed from Zambia to Gauteng, whereas it only cost US$40/ton to move the same animal feed from South America to Gauteng (Vilakazi and Paelo, 2017).

However, the research conducted by Paremoer (2018), who explored the opportunities and linkages in agro-processing across the SADC region, indicated the possible solution to the transport cost challenge, especially between Zambia and South Africa. The author noted that South African companies, such as Pick n Pay and Shoprite, had established transport networks that deliver goods to Zambia. The transport vehicles, however, return to South Africa empty, in most cases. Therefore, the author indicated that the animal feed industry might be able to take advantage of this as a possible solution, as the transport owners might agree to this, as long as long-term agreements are concluded.

During the analysis of the transport sector, this study found that what Paremoer (2018) suggested has started happening. Some exporters, however, still deliver the feed ingredients to the buyers in South Africa through using their own transport. Some South African importers also transport the feed ingredients from Zambia to South Africa by using their own transport. This, however, rarely occurs due to the high transportation costs. This mostly occurs in times of a shortage of feed ingredients, and there is an immediate need for feed ingredients.

The findings from the study indicate that transport costs are no longer the main issue in the trade of animal feed from Zambia to South Africa.
The supermarkets transport goods to Zambia and not vice versa. This implies that the transport vehicles are usually empty when travelling back from Zambia to South Africa. The animal feed firms have taken advantage of the availability of these vehicles to transport animal feed ingredients from Zambia to South Africa at a lower cost. Where these supermarket chain transport vehicles are available, the animal feed firms pay only 25% to 30% of the total cost of transporting animal feed from Zambia to South Africa. Through the use of these supermarket

transport service providers, the transport cost has reduced from about US$100/ton to about US$30/ton, which is 10% lower than the cost of transporting animal feed from South America to South Africa. This implies that, by being able to use this supermarket transport system, and if regional grain production increases, it would be possible to replace South Africa's overseas imports with regional imports.

However, the main challenge indicated by the key stakeholders in the animal feed industry is the limited availability of animal feed ingredients. This renders it infeasible for animal feed firms to make long-term agreements with the animal feed transporters. The firms indicated the need for increased grain crop production in the southern African region to ensure the availability of feed ingredients to meet demand from the animal feed industry. This will, in turn, help to facilitate long-term transport agreements.

5.3 VALUE CHAIN COMMERCIALIZATION

Associated with the restructuring of the animal feed industry segments is the commercialisation of both the feedlot sector and the animal feed sector, which will be discussed in detail in this section. There is some level of consolidation also occurring in the animal feed industry. For example, between 2019 and 2020, TripleV and Nu-Pro animal feed manufacturing firms consolidated to form Qpro Feeds. This section begins by explaining the increase in beef production and consumption as being some of the contributing factors to the transformations in the animal feed industry. This will be followed by a discussion on the increase in cattle feedlotting in South Africa. The commercialisation of the feed sector is discussed in the last part of this section.

5.3.1 Increase in beef production and consumption in South Africa

Following after the broiler sector, the beef industry is the fastest-growing commodity component in the agricultural sector, being driven by structural changes in beef processing, technological changes and income growth (DAFF, 2018a). Beef production in South Africa contributes essentially to jobs , offering status to families, salary, and investment funds (Rasch et al., 2016). It is an important sector for fostering food security and development (Nyam et al., 2020). The growth of the beef industry is also driven by the increased consumption of beef in South Africa (DAFF, 2018a). Figure 5.6 below shows the trends of South Africa's total production, total consumption, and per capita consumption of beef and veal over the past two decades, measured in thousand tons (1000t). Veal is the flesh of young calves. In contrast to

the beef derived from older cattle, veal is meat derived from calves of any breed, but most often, the males of dairy herds, which are not used in the dairy enterprise or for further breeding.

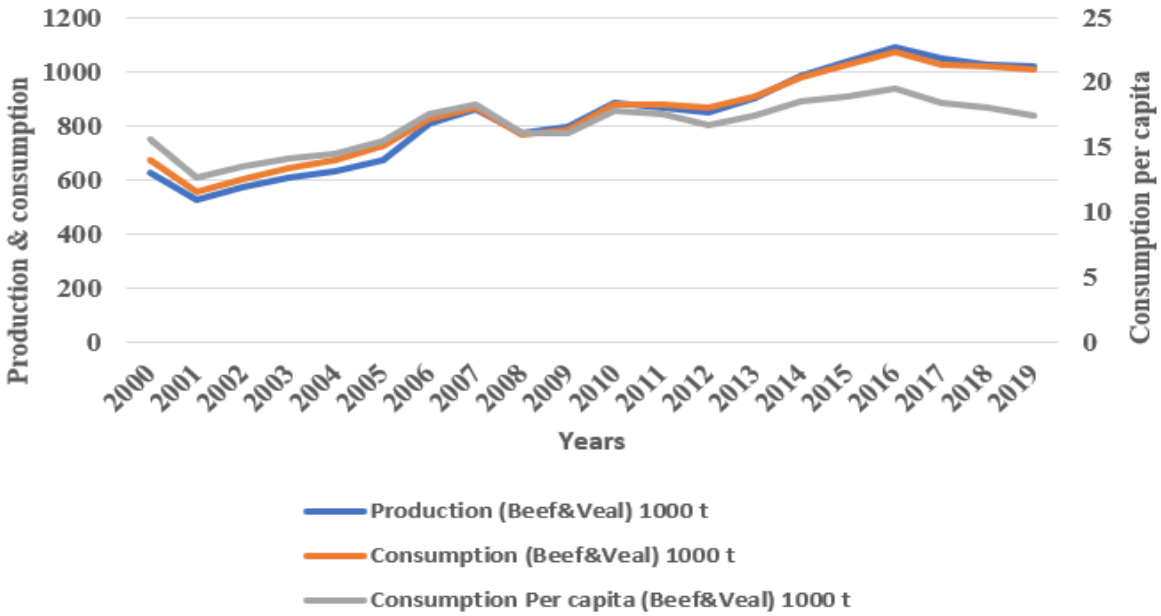

Figure 5.6: Production and consumption of beef and veal

Source: Author's compilation with data from Stats_SA (2020)

In Figure 5.6 above, we note that total beef and veal consumption, beef and veal consumption per capita, and total beef and veal production increased between 2001 and 2019 in South Africa. Total beef and veal consumption increased from 554 thousand tons in 2001 to 1006 thousand tons in 2019, representing an 82% growth in total consumption. Per capita consumption of beef in South Africa increased from 12.69 thousand tons in 2001 to 17.42 thousand tons in 2019, representing 37% growth between the two periods. The increases in beef and veal consumption led to the increase in total beef production from 524.3 thousand tons in 2001 to 1018.9 thousand tons in 2019, representing a 94% growth in production.

Prompted by consumer diversification in meat consumption, beef demand in South Africa is expected to increase by 24% by 2027 (BFAP, 2018). This implies that cattle production will have to increase to meet beef demand. The increase in the production of beef is directly linked to the increase in cattle feedlotting in South Africa.

5.3.2 Increase in cattle feedlotting in South Africa

With increased beef demand and consumption, the number of feedlots has been on the rise in

South Africa over the past two decades. The South African beef sector has moved from extensive cattle production to intensive cattle production. Beef production through the grain-fed production system has increased in South Africa because it allows cattle farmers to produce the required meat in a shorter period than the grass-fed production system does (Hall et al., 2016a). By means of the feedlot production of cattle, the South African red meat industry became vertically integrated during the 1990s (Frylinck, 2013). The feedlots expanded and created their abattoirs for cattle slaughtering and processing.

According to the estimations made by the Feedlot Association of South Africa, the number of commercial feedlots has doubled over the two decades, from around 50 feedlots to around 100 feedlots currently. These estimates indicate that the number of feedlots increased by 33% between 2015 and 2020. Associated with the increase in the number of feedlots is the increase in toal one-point cattle standing capacity in feedlots. Table 5.3 below shows the changes in combined one-point cattle standing capacity in feedlots.

Table 5.2: Combined cattle standing capacity in South Africa's feedlots

Total cattle standing capacity (number of heads of cattle)		
2012	2016	2018
470 000	550 000	620 000

Source: Author's compilation with data from SA Feedlot Association estimates (2020)

Between 2012 and 2018, the total one-point standing capacity for cattle in South African feedlots increased by 32%. The South African feedlot industry is now flourishing, with a one-point holding of over 620 000 head, and in the region of about 1.8 million head per annum (IDC, 2018). Of the total cattle head per annum, the top 8 commercial feedlots produce one million, three hundred and ninety-five head of cattle per annum, representing 77.5% of the total feedlot cattle production. Table 5.4 below shows the top 8 cattle feedlots in South Africa.

Table 5.3: Top 8 cattle feedlots in South Africa

Feedlot	Location	Head number per year
Karan beef	Gauteng	500 000
Sparta	North West	300 000
SIS/Rockdale	Mpumalanga	135 000
Beef Master	North West	100 000
NJ Coetzee	North West	100 000
AAA	KwaZulu-Natal	100 000
Chalmar beef	Gauteng	85 000
EAC group	Free State	75 000

Source: Author's compilation with data from SA Feedlot Association estimates (2020)

The production and classification system for meat in South Africa gives rise to a unique situation that is different from other countries, such as the USA (Hall et al., 2016a). Contrary to the global situation, beef cuts from grain-fed animals have low total fat content, when compared with the grass- or forage-fed animals in South Africa (Hall et al., 2016a). The evidence of lower fat in grain-fed beef to grass-fed beef has led to the increased demand for animal feed to produce cattle in feedlots to meet the customer demands (Hall et al., 2016a).

We have seen that the commercialisation of the feed sector has been fuelled by the commercialisation of the beef sector. The increase in feedlot cattle production has led to an increase in demand for animal feed. The increase in feed demand has led to the commercialisation of animal feed production in South Africa.

5.3.3 Commercialisation of the feed sector

Over the past decades, animal feed production has become commercialised in South Africa. This can be traced back to the start of the animal feed industry in the country. The South African animal feed industry came into existence after the 1930s droughts that hit South Africa greatly affected both livestock and crop production (DAFF, 2018b). Since then, the industry has

expanded and currently can produce 3.5 million tons, annually (DAFF, 2018b). The feed production sector in South Africa has a few firms that are operating at a large scale. For example, the top five producers of animal feed in South Africa provide 50% of the total feed produced (Ncube et al., 2016). Animal feed specialisation has also progressed. The feed manufacturers produce specialised feed for different animal species, including dairy cattle, beef cattle, sheep, layers, broilers, horses, dogs, aquatic animals, goats, ostriches, and game animals.

The survey results show that some firms produce over 2000 tons of animal feed per day. Through the increased scale of production, the firms have become more vertically integrated over the past decade. Of the 47 firms surveyed, 23.4% have become backwards and vertically integrated through the acquisition of firms that supply raw or intermediate products for further processing. The other 36.17% of the firms indicate forward and vertical integration through direct interaction with consumers, without any intermediaries. Furthermore, 19.15% of the firms have achieved both backward and forward vertical integration through the acquisition of firms that supply feed ingredients/intermediate products and have direct linkages with animal feed customers. These levels of vertical integration are seen where some firms are consolidating, while expanding their businesses across the country and across the southern African region. However, vertical integration levels are still low among firms. Factors affecting the levels of vertical integration according to the firms include; lack of government support to the industry firms, political instability, the nature of competition in the linked industries, the unbalanced bargaining power of distributors or suppliers and consumers, requirements for corporate strategy and demand uncertainty.

The animal feed ingredient supply chain stretches over long distances. Deficits in animal feed ingredients are covered by imports from both overseas (Argentina, Brazil, and Mexico) and the southern African region (Zambia, Lesotho, Botswana, Mozambique, Malawi, Eswatini and Zimbabwe). Accordingly, 61.7% of the firms surveyed engage in international trade of animal feed, and 58.62% trade internationally almost daily, while 34.48% engage weekly, 3.45% engage once a month, and 3.45% engage once a year. This is a shift from the local orientation of the supply chain to international orientation, as few firms engaged in international trade of animal feed, especially with southern African firms before 2010.

5.4 TECHNOLOGICAL CHANGES AND PRODUCT CYCLE

Associated with the structural changes in the value chain discussed above, are changes in

technology and animal feed composition. These include product advancement, capital investments, and firm technological improvements such as in feed formulation, production technology and traceability of feed ingredients.

5.4.1 Animal feed composition changes in the beef sector

Animal feed in South Africa has undergone development in the product cycle over the years. According to Hernandez et al. (2018), the product cycle is a widely observed feature of product advancement in many sectors of the economy, and can be determined for various agricultural sectors for various countries. Product cycle stages include (Hernandez et al., 2018):

a) the local niche produce stage;

b) the product/commodity state, during which the exotic or local product is commoditised through large quantity production, thus reducing the costs associated with little variation in quality and product;

c) The product differentiation stage, where the product becomes differentiated through different attributes such as variety, quality, and low fat vs full fat;

d) the commoditisation stage, where the differentiated product is produced in large quantities; and

e) the initiation of a new product or differentiated product. The cycle can continue, depending on the available innovation.

This study posits that the animal feed manufacturing sector supplying the beef sector has followed a product development cycle. This development has been facilitated by technological improvements along the whole value chain for animal feed. Firstly, the South African feedlot sector was initiated by a few entrepreneur cattle farmers in grain-producing areas during the 1960s (SAFA, 2018). This mainly provided for the local feeding of animals, driven by the shortage of quality cattle grazing areas during dry winter periods (SAFA, 2018). Farmers fed their animals with by-products from potato and grain crops. Unreliable and primitive methods were used on feeding practices, procedures and facilities, with unsatisfactory production results (Kahl, 2018).

The second stage of cattle feed production was reached when South Africa began to engage the services of human resources, with knowledge of animal health and nutrition skills, from

foreign countries such as the USA in order to improve production (Kahl, 2018). Similarly, feeding technologies, as well as new types of milling equipment, were imported and thereafter adapted to suit the South African environment (Kahl, 2018). Quantities produced at this stage increased, with little variation in product and quality.

The third stage of product cycle development in the beef sector was facilitated by consumer demand for quality meat. Non-communicable diseases, not excluding diabetes, cancer, and cardiovascular diseases, have been associated with livestock meat consumption (Hall et al., 2015; Barendse, 2014). Although other scholars, such as Chowdhury et al. (2014), have criticised this perception against meat consumption, consumers have continued to demand low-fat meat, globally, including South African consumers (Hall et al., 2016a). As a result of the expanded demand for meat with low-fat, the lipid content in beef has diminished generously, over time, in South Africa because of feeding and breeding practices (Hall et al., 2016b). Consumer demands regarding meat quality led to increased intensive cattle production, which has led to increased animal feed production. Over the past two decades, feed quality and variety have also increased to meet consumer demand.

Currently, cattle feed commoditisation has increased. Differentiated cattle feed is being produced in large quantities. Between 1st April 2019 and 31st March 2020, the total sales for cattle and sheep feed by AFMA members stood at 845 843 tons. This is more than a 50% increase in cattle and sheep feed sales, as compared with the previous two decades.

The feed manufacturers produce a wide range of quality, home-mixing concentrates for cattle and sheep. Liquid feed is available for enriching grains or low-grade roughage, for limiting wastage of unpalatable fodder, and preserving grass and drought maize silage. These liquid feeds are used profitably in cattle and sheep feedlots, and also as liquid protein licks.

5.4.2 Capital investments

Product development regarding animal feed is associated with capital investments being made by firms in all sectors of the animal feed industry. The survey results indicate that the firms have, over the past ten years, made investments in most areas. The results show that 72.34% of firms have made capital investments in infrastructure development, as they expanded their operations. The responses indicate 76.6% of firms invested into operational capital, 31.9% of firms investing in transport and 19.2% of the firms invested in feeding mixing technology.

Further,46.8% of the firms invested in feed production and processing technology and 12.8% have invested in the purchase of oilseed crushing equipment. The main drivers of the increase in capital requirements include the increased demand for animal feed, the need to expand the business to explore available opportunities, the need to advance production technology, and the need to explore international markets.

Associated with capital investments is the change in labour demand. As firms are expanding, the demand for skilled labour is also increasing. The survey results indicate that, for the firms expanding their operations, the skilled labour demand has increased by 81.5%, on average, over the past ten years.

5.4.3 Key technological improvements

Figure 5.7 below shows the key technological improvements that have occurred in the animal feed industry over the past ten years.

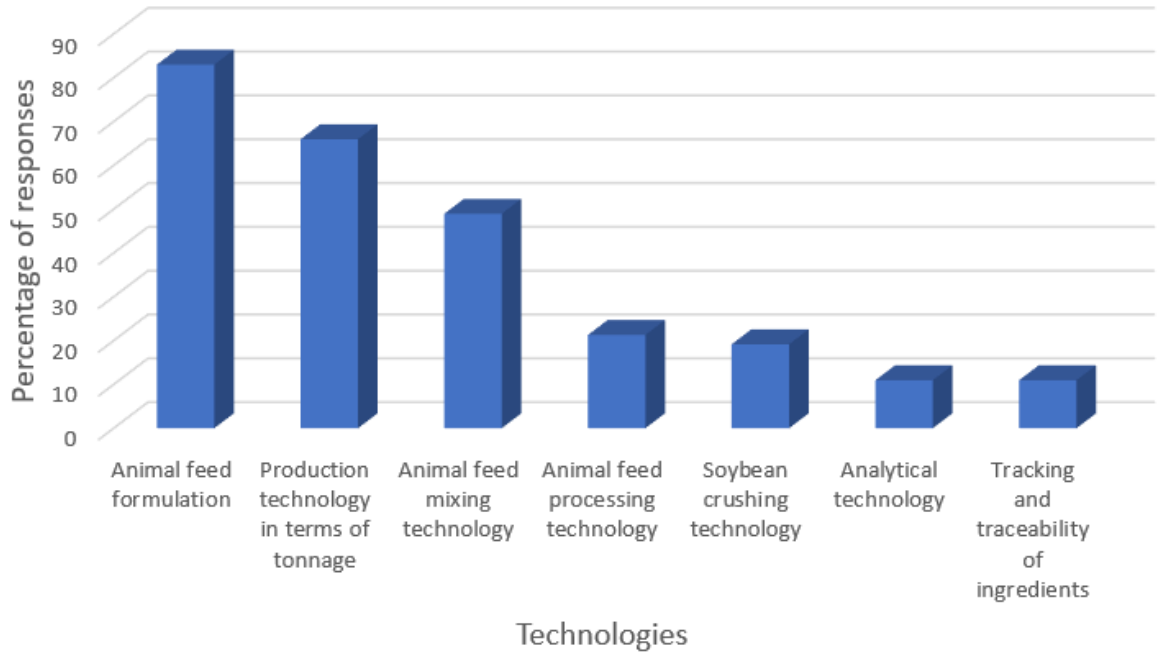

Figure 5.7: Technological changes

Source: Own survey illustration (2020)

The technology regarding animal feed formulation has advanced rapidly over the past ten years, as the demand for quality meat keeps rising. Animal feed formulation involves the manipulation of the concentrations of the ingredients in the compound animal feed, especially the protein and fat contents. To achieve the required results profitably, feed formulation includes identifying the appropriate volumes of animal feed ingredients that achieve the ideal minimum nutrient required at a minimal cost (Uyeh et al., 2019). This is important, as most animal producers aim to produce at optimal levels (Uyeh et al., 2019). Animal feed formulation is the key technological improvement because it enables firms to meet the exact demands of customers. Currently, there is a saying in the animal feed industry that "We feed people and not animals". This means that they keep the demands of the customer in mind when feeding animals.

Five years ago, the enhancement of soybean crushing capacity represented one of the main technological improvements in the animal feed industry. The structural changes in the local market for soybean of South Africa, announced by ITAC and DTI in 2013, led to an increase in the production of oilcake for animal feed, as witnessed by the increase in crushing capacity (DAFF, 2018b). As a result, huge quantities of oilcake imports were replaced, as this market mechanism permitted greater amounts of local soybean to be channelled for crushing (DAFF, 2018b).

Animal feed mixing technology and production technology in terms of tonnage have also experienced major improvements over the past ten years. Other technological improvements include animal feed tracking and traceability, feed analytical technology, and analysis of how the animals efficiently use the ingredients added in compound feed. The tracking and traceability of ingredients are important for maintaining constant access to feed ingredients. Analytical technology is mainly seen in terms of analysing the quality of the feed ingredients, especially grains. Analysing animal feed regarding each ingredient added helps to reduce the cost by using the ideal quantity of those ingredients that will be efficiently digested and absorbed by the animal body. In this way, feed wastage is reduced.

5.5 SUMMARY

The findings described in this Chapter have highlighted several changes that have occurred in the animal feed industry in terms of structure and conduct. Except for the number of traders, which seems to have remained the same, there have been changes in the number of actors in

all segments of the industry. Of all the segments, the premix and feed additive suppliers have experienced the highest increase in numbers. This is mainly attributable to the high demand for these feed ingredients in South Africa and other southern African countries. Furthermore, the start-up capital required for this business sector is far lower than that of the compound animal feed manufacturing business.

Individual firms in the industry have expanded their business operations over the past ten years. To be specific, the feed manufacturing firms have spread their operations throughout the country, as they are locating themselves closer to customers.

The results indicate that the firms in all sectors have intensified their capital investments, which has led to the expansion of the industry. The investments include those for infrastructure development, operational capital, production and processing capacity, and feed mixing capacity. Through these investments, technology use in all sectors has increased over the past years. Currently, feed formulation is the main focus of technological advancement in the industry.

These findings are similar to the findings of Reardon et al. (2014a), Reardon (2015), Liverpool-Tasie et al. (2017), Hernandez et al. (2018) and Reardon et al. (2019), where the number of firms in all parts of the value chain increased, being associated with the expansion of the sectors and business capacity. However, in some sectors, especially the feed manufacturing sector, the South African animal feed industry has a few large-scale players that are expanding the industry. In this sector, there are large barriers to entry and high capital investments are required to operate at a competitive level.

CHAPTER 6: CONCLUSION

6.1 INTRODUCTION

This dissertation used both quantitative and qualitative methods to analyse the changes in the animal feed ingredient sector in southern Africa, with a specific reference to the South African feed sector. The broad context of the dissertation was that global food systems are transforming rapidly, and their transformations hold future implications. Similar to other value chains, the agricultural value chains are restructuring rapidly, and their restructuring needs further analysis. This is extremely important because the value chain restructuring determines whether the chain flourishes or deteriorates in the future. Most importantly, the structural changes in the supply chain have a direct link to on-farm expansion, commercialisation, and technology change. Contemporary literature has focused on the upstream transformations of value chains. However, the literature has paid little attention to the midstream and downstream value chain transformations. Against this backdrop, this dissertation analysed the midstream and downstream transformations in the southern African animal feed value chain. This dissertation analysed the drivers of animal feed trade, the changes in volumes traded, the competitiveness of the South African animal feed industry, and the rapid transformations in the South African animal feed industry.

6.2 DISCUSSION OF THE RESEARCH PROPOSITIONS

The dissertation explored the changes that have occurred along the southern African animal feed value chain, specifically concerning the South African animal feed value chain. The premise was to identify and quantify the changes that have occurred along the animal feed value chain for southern Africa, with regard to South Africa as being the main driver of animal feed trade in southern Africa. To be specific, the purpose was to (1) map and quantify the chain of feed ingredients; (2) identify the actors along the animal feed value chain; (3) analyse the competitiveness of the South African animal feed industry; (4) characterise and quantify the changes in the trade of animal feed ingredients; and (5) quantify the transformations within the South African animal feed industry.

To address these objectives, three main propositions were examined in this dissertation. These are (1) The demand for a product plays a major role in influencing the flow of trade of a product, as well as the volumes involved during the trade; (2) As trade increases, a proliferation and

concentration of actors develops along the chain of trade; and (3) The competitiveness of the industry enables the firms within the industry to become competitive in international markets. These propositions were addressed in the two main results chapters (Chapter 4 and Chapter 5) through using both quantitative and qualitative methods of analysis.

6.2.1 Demand as a driver of the feed ingredients trade

The first proposition of the dissertation posits that the demand for a product plays a major role in influencing the flow of trade of a product, as well as the volumes involved during the trade. The proposition is investigated in Chapter 4 of this dissertation, which explores the trade of feed ingredients in southern Africa. Similar to the findings of other studies (Liverpool-Tasie et al., 2017; Hernandez et al., 2018; Belton et al., 2015), where volumes traded increased as the relevant sectors grew, the volumes of animal feed ingredients from southern African countries to the South African feed manufacturing sector increased over the past decade. The quantities of feed ingredients imported by South Africa from the region increased between 2010 and 2019 as follows: maize grain (211%), soybean (302%), maize bran (179%), soybean oilcake (564%), and sugarcane molasses (7%).

The results from the survey indicate that South Africa's population has been growing, with an average annual growth of around 1 million people. Population growth is associated with urbanisation and a rise in income among middle-income households. Furthermore, South African diets are shifting from starchy foods to meat and meat products, fatty foods and other vegetables. The shift in consumption patterns in South Africa is associated with the increase in meat consumption, including beef and veal. Total beef and veal consumption in South Africa increased between 2001 and 2019, from 554 thousand tons in 2001 to 1006 thousand tons in 2019, representing an 82% increase in consumption. To meet the increase in demand for beef and veal, beef production in South Africa increased by 94% within the same period. The increase in beef production was associated with the increase in demand for animal feed ingredients, since more than 75% of beef production in South Africa is conducted through cattle feedlotting. Since South Africa does not always produce enough grain crops to meet the demand for animal feed, the increased demand for animal feed ingredients in South Africa led to the increased trade of feed ingredients from other southern African countries. This served to meet the deficit in local grain production. Therefore, demand size is the main driver of the increased flow of animal feed ingredients to the South African feed manufacturing sector.

6.2.2 Proliferation and concentration of actors

The second proposition posits that the increase in trade is associated with the proliferation and concentration of actors along the supply chain. This proposition was interrogated in Chapters 4 and 5 of the dissertation. As the value chain restructures, many factors change, including the number and size of the actors involved (Hernandez et al., 2018). In Chapter 4, we saw an increase between 2010 and 2019 in the number of countries supplying animal feed ingredients to South Africa. The countries that began supplying feed ingredients to South Africa after 2010 include Lesotho (supplying maize grain and maize bran), Botswana (supplying maize bran), Eswatini (supplying maize grain) and Malawi (supplying soybean oilcake). In Chapter 5, we saw an increase in the number of firms within the South African animal feed industry, in most segments, between 2010 and 2019. The increase in number was comprised as follows: feed manufacturing firms (6%); suppliers of feed ingredients (73%); and suppliers of premix and feed additives (89%); while those offering laboratory services such as grain nutrient analysis increased by 400%. However, the number of firms in this segment is still below ten.

The results discussed in Chapter 5 further indicated that firms are making deep capital investments in infrastructure development, operational capital, feed mixing and processing, and transport. In terms of technological improvements, animal feed formulation is the major area that firms have concentrated on. This is because consumer demands and preferences have not remained constant. The firms have therefore invested in animal feed formulation to produce the type of meat that the consumers demand. Technology use among actors has rapidly increased over the past ten years. Production technology, together with feed mixing technology, comprises the main areas of technology advances in the industry. The advanced technology has enabled production capacity to increase in order to meet the high demand for animal feed in the country. These results are similar to the findings of other scholars (Hernandez et al., 2018; Liverpool-Tasie et al., 2017).

6.2.3 Industry competitiveness and access to international markets

The third proposition of the dissertation posits that the competitiveness of the industry enables the firms within the industry to become competitive in international markets. This proposition was investigated in Chapter 4, where the competitiveness of the South African animal feed industry was analysed by using Porter's diamond framework, linking it to the increased international trading of animal feed ingredients by the industry firms. On average, the findings

indicated that the South African animal feed industry is competitive, thus driving the demand for animal feed ingredients in the southern Africa region. The industry is only constrained by external factors such as inadequate government support. The findings on the competitiveness of the industry are similar to those of Esterhuizen et al. (2001), who found that the South African agrifood and fibre sector was competitive, but constrained by external factors, at the time surveyed.

Among others, factors such as managerial capabilities, technology availability, infrastructure developments, credible research institutions, and competitive demand drive the industry's competitiveness. Because of the competitiveness of the industry, the industry firms can access international markets to procure animal feed ingredients at an affordable price. The rationale behind the high importation of animal feed ingredients by South African firms is that South Africa is challenged by droughts in some years, which negatively affects the local production of feed ingredients. The firms, therefore, look for alternative and more cost-effective sources of feed ingredients from the southern region of Africa. Through the competitiveness of the industry, the firms can competitively source the feed ingredients from other countries in the southern region of Africa.

6.3 IMPLICATIONS OF THE RESEARCH

Value chain analysis has a long history in the research field. Although value chain analysis has been done in most countries, regional value chain analysis has received less attention in past decades. It is only recently that scholars have emphasised the analysis of regional value chains. In the past ten years, Reardon and many other scholars have done tremendous work on regional value chains, mainly in Asia.

In Africa, very little has been done on the analysis of regional value chains. One of the key challenges observed by Liverpool-Tasie et al. (2017) is the lack of relevant data required to conduct a complete analysis of specific regional value chains. However, there is a consensus in the literature that food systems are rapidly transforming and require attention for analysis.

The animal feed industry in southern Africa is one of the sectors that have experienced rapid transformations in all areas, including the trade of feed ingredients. However, current insights seem inadequate for giving a full explanation of what actual transformations have occurred. The importance of the specific regional value chain cannot be overemphasised, as we move

towards the estimated population increase by the year 2050. This dissertation identified opportunities for future research on regional value chain analysis and implications of value chain transformations. The dissertation identifies the limited body of knowledge on the trade of animal feed ingredients in southern Africa.

6.3.1 Implications for literature

There is limited available literature regarding regional value chain analysis in Africa. The animal feed industry in southern Africa is an interesting area for research. Some scholars in this field have explored the comparative advantages of nations in the region in terms of supply and demand conditions (Ncube et al., 2017; Ncube et al., 2016). These scholars have identified South Africa as being the main demand market for animal feed ingredients.

In this regard, this dissertation contributes to the literature, as it quantifies the main feed ingredients imported by South Africa from each country over the past decade. Specifically, the study identifies the individual sources of key animal feed ingredients and quantifies the percentage growths of imports from the main exporting countries between 2010 and 2019. The dissertation further contributes to the literature by mapping the chain of feed ingredients from southern Africa to the South African feed manufacturing sector. According to our knowledge, this could be one of the first mappings of the feed ingredient supply chain to South Africa. The dissertation analysed the changes in the number and size of actors along the chain. Through this analysis, the dissertation confirms the literature (Arndt and Roberts, 2018; Ncube et al., 2017; Samboko et al., 2018) to the effect that Zambia, in the southern African region, is the main supplier of most animal feed ingredients to the South African sector.

This study is also in agreement with Paremoer (2018), who stated that the existence of supermarket transport vehicle systems, such as those used by Shoprite and Pick n Pay, in most southern African countries could significantly reduce the costs of transporting animal feed within the southern African region. The investments by supermarkets in the southern African region have had positive, although collateral, impacts on the trade of animal feed ingredients within the region. With the utilisation of supermarket transport vehicles, the transport challenges identified by Samboko et al. (2018) seem to be being slowly addressed. Supermarkets are playing a key role in assisting with the transportation of animal feed ingredients from other southern African countries to the South African feed manufacturing sector. However, the firms and the supermarkets currently prefer to use short-term agreements,

and are not agreeable to operate on the basis of long-term agreements. The establishment of a long-term agreement is currently not feasible due to the lack of a constant supply of animal feed ingredients from the southern region. Entering into a long-term agreement might turn out to be costly for the firms, as supply is not always guaranteed. Therefore, the need to achieve increased grain crop production in the southern African region cannot be overemphasised.

It is worth noting that literature on regional value chain analysis is still limited. Liverpool-Tasie et al. (2017) have confirmed that there is limited information available, such as is required for conducting a detailed regional value chain analysis in many agricultural sectors in Africa. It is difficult to obtain full information about food industries, as most governments in Africa do not keep comprehensive records. Furthermore, there is much bureaucracy involved when trying to obtain information. This frustrates and lengthens the data collection process. In this regard, the need for African governments to maintain full information records of the investments and business operations cannot be overemphasised. This is because value chain analysis requires information from both the government and individual firms.

6.3.2 Implications to management and investments

The procurement of feed ingredients for animal feed, on time and at a lower price, is key to the development of the animal feed industry. This study has made a significant contribution by revealing the sources of the key animal feed ingredients. To be specific, the study has identified the main countries that supply the required animal feed ingredients to South Africa.

The results described in Chapter 4 show that more than 75% of the animal feed trade agreements are once-off agreements. This is mainly attributable to the lack of a consistent supply of animal feed ingredients. A sustainable supply chain, however, requires that long-term agreements be made between suppliers and buyers. The South African animal feed industry should take a similar approach to that taken by supermarkets in having a coordinated flow of products. Supermarkets have penetrated southern African markets by having direct interactions with customers. The South African firms in the animal feed industry should also increase their interactions with the suppliers of feed ingredients by taking their operations closer to the farmers. This would increase the production of feed ingredients because the farmers would have a sure market for their produce.

The firms can use the findings from this study to plan investments in other southern African

countries, with prior knowledge of the national conditions of that country in terms of grain crop production. One country that the firms could consider making off-farm investments in, in terms of animal feed production, is Zambia. The potential off-farm investments include animal feed manufacturing, animal feed milling and processing, and oilseed crushing. This is because the study has found that Zambia has the necessary crop production to potentially supply South Africa with most of the feed ingredients required to make compound animal feed.

6.3.3 Implications for policy

Trade policies play a key role in determining the sustainability of international value chains. The government is responsible for the formation of policies and reforms, as well as their amendments. The results in Chapter 4 indicate the limitations that trade policies have regarding the trade of feed ingredients between nations. Unexpected trade bans will limit the availability of feed ingredients when requested by the importing nation. This justifies the need for well-established agreements to be put in place between nations on the trade of animal feed ingredients in order to avoid random export or import bans. Furthermore, the results in Chapter 4 show that there is limited direct and indirect support from the government to the South African animal feed industry. For an industry to thrive, the government must, directly and indirectly, support the existing firms in that industry. Supporting the firms in the animal feed industry is also of economic importance. The animal feed industry has, over the years, become a key source of employment in the agricultural sector. As we move towards 2050, the animal feed industry will be vital for fostering increased livestock productivity, through increased animal feeding to meet the demands of the expected population. Government support for the animal feed industry is, therefore, key to foster the sustainability of the industry.

6.3.4 Implications for future research

Research on the industry must be continually undertaken, as it is fundamental to understanding the industry's prevailing circumstances and to fostering the development of new ideas for sustainability and progressive development. In Africa, further research on regional value chains is required to gain an understanding of how these food systems are restructuring over time. This is extremely important, as it determines the future supply and demand for agricultural products in the region.

This research study analysed the competitiveness of only the South African animal feed

industry. However, there is a need to analyse the competitiveness of the animal feed industries in other countries of the southern regions, such as Zambia, Malawi, Lesotho and Mozambique, who are key suppliers of animal feed ingredients to the South African feed manufacturing sector. Future research needs to be conducted to understand the capabilities of the firms in these industries to engage in the trade of animal feed ingredients at a large scale so as to supply the deficit in other countries in the southern African region, while becoming more vertically integrated to jointly benefit from trade.

The results discussed in Chapter 4 indicate that both backward integrations (23%) and forward integrations (36%) exist along the supply chain of feed ingredients from other southern African countries to South Africa. Backward integration is observed where some South African feed manufacturing firms access feed ingredients directly from suppliers within southern Africa. Other firms are becoming backwardly integrated through consolidation, as certain big firms are buying up firms/buying shares in firms that supply feed ingredients. Forward integration is seen where some firms, for example, supply feed ingredients directly to feedlot feed mills, without any intermediaries being involved. Some firms (19%) have achieved a combination of forward and backward integration, called balanced vertical integration, as they have direct access to both suppliers of animal feed ingredients and users of compound animal feed.

Future research should focus on analysing the possibility of South African feed manufacturers contracting with farmers from other southern African countries to produce grain crops required for animal feeding. This suggestion is in line with the idea by Arndt and Roberts (2018) concerning the poultry sector (which South African soybean groups then did not take an interest in) that areas for expanding production should be identified in nearby countries. Such a move would increase the availability of the product and help to boost regional trade through shared benefits.

There is also a need to conduct a micro-stacked survey of the southern African animal feed ingredients sector, similar to the survey done by Hernandez et al. (2018) on the Bangladesh aquaculture value chain. This would help interested stakeholders to obtain full information on the potential areas for investments related to animal feed, such as feed manufacturing and feed processing.

Since the last part of 2019, the emergence of Covid-19 has highlighted the need to understand food systems and the potential weaknesses so that we can build resilient chains. The resulting

Covid-19 pandemic has exposed some African countries, as their economies have been greatly shaken in all areas. This implies that in situations of pandemics, some countries may not have sufficient supplies to feed both their people and animals. Regional value chains need to be analysed to identify challenges along the chains and the investments required to render the value chains sustainable and resilient to shocks.

Lastly, there is a need for future research to conduct a detailed analysis of the capacity of the South African feed manufacturing sector to produce sufficient animal feed to supply the expected increased demand for animal feed in the future. This is important because the findings from this study indicate that the sector is competitive in nature, due to the high start-up capital required to produce animal feed at a large scale. Therefore, very few firms are likely to join this sector in the coming years.

6.4 SHORTCOMINGS OF THE RESEARCH

This research study has not been completed without limitations, and these are worth mentioning. Firstly, the survey relied on the participants' own understanding of the survey questions, as we could not explain the questions in the way we might have done, had it been possible to conduct the survey face-to-face. In this case, the dissertation relied on the respondents' own perceptions to understand the transformations that have occurred in the animal feed industry, as well as its competitiveness. While this was effective in gathering the information, some unclear items of information would have required conducting in-depth interviews to fully understand the transformations in the industry. With the above limitation, this study gives a basis for future research to build on by using a multi-layered methodology approach to conduct the research. This method of data collection can be done well, if face-to-face, in-depth interviews are conducted with key stakeholders in the industry.

Lastly, the regional value chain analysis was limited by the unavailability of data to fully estimate changes in terms of all the actors along the value chain over the past decade. Data limitation is a major challenge when analysing regional value chains in Africa (Liverpool-Tasie et al., 2017). This, therefore, makes the quantification of the changes that have occurred difficult to estimate, thereby making the analysis limited in certain aspects.

6.5 CLOSING REMARKS

Moving forward, regional trade will be of great significance as climate changes begin to constrain crop production in other countries. South Africa, for example, has been experiencing droughts for many years, and experts have indicated that the situation might get worse in the future, if these climatic patterns remain the way they are. In this regard, regional trade will play a key role to cushion deficits in other countries that will be facing challenges.

As populations are expected to increase, food systems are expected to be constrained. This is because there will be an increased demand for food and feed by both humans and the livestock sector. Similar to the findings of other researchers (Drewnowski and Poulain, 2018; Reardon et al., 2019), the results of this dissertation indicate that people's diets are indeed shifting from starchy foods to meat and meat products, vegetables, fatty foods and others. As diets are shifting, consumer preferences are in support of quality and tasty meat. Controlled animal breeding is crucial for meeting consumer preferences. In this regard, controlled animal feeding will be vital for meeting the demands of the rising population. With rising populations and changes in climatic conditions, very few undeveloped countries will be self-sufficient in both human food and animal feed.

So far, South Africa has been constrained in the production of soybean. Literature indicates that South Africa is likely to continue with the imports of soybean, and may even start importing more as demand increases due to constrained local production. One thing worth noting is that South Africa is the main driver of most investments made in the southern African region. In light of this, this dissertation analysed the competitiveness of South Africa's animal feed industry to find ways of promoting regional trade of animal feed and/or animal feed ingredients. The results indicate that South Africa's industry is well established and has a large demand for animal feed, with most soybean and maize imports coming from overseas. Southern African countries can boost their agricultural sectors through increased crop production to take advantage of the available market in South Africa through coordinated regional value chains. However, this can only be successful if there are proper long-term agreements among the nations involved in the trade.

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APPENDIX

Animal feed trade and competitiveness of the animal feed industry

1. Consent form

THE RAPID TRANSFORMATION OF THE FEED INGREDIENTS SECTOR IN SOUTHERN AFRICA. A CASE OF SOUTH AFRICA BEEF VALUE CHAIN.

Introduction

We thank you for sparing your time to participate in this research.

As a researcher, I am expectant to understand the rapid transformations that have occurred in the animal feed ingredients sector in Southern Africa. Over a few years, due to population increase, urbanization, and rising income among other factors, southern Africa has witnessed rapid transformations in the whole food system.

The increased demand for meat has led to an increased demand for animal feed especially animal feed ingredients, with South Africa standing as the main importer and Zambia as the main exporter. Understanding the rapid transformations that have occurred in the few years is important as the restructuring of the value chain determines the sustainability of the trade.

You are therefore requested to willingly participate in this survey and share your experience over the past few years. We have prepared a survey that will guide you in sharing the changes that your company has experienced in the past few years.

Study participation

All firms involved in the animal feed business at any stage are invited to participate. These may include; animal feed manufacturers, animal feed processors, traders, retailers, animal feed ingredients suppliers, and animal feed additives and supplements suppliers.

Associated risks

The study involves no risks. You are at liberty to express your discomfort at any time.
Confidentiality

The information you provide will be kept completely confidential and will be anonymously treated if

you decide to participate. At no point shall your name be mentioned in any writing. You are also at liberty to decline and/or withdraw from doing the questionnaire at any time without any penalty. You are at liberty to ask any questions concerning the research before you participate in the survey. You will also be allowed to access your information after participating in the survey if you need to do so. You are also free to contact us at any time. For any queries kindly contact us at kaangoeugine5@gmail.com or by phone at +27814535846/+260976127378.

Kindly note that there are two sections in this survey, that is section A and Section B. Section A focuses on the changes that have occurred in the animal feed industry over the past years. Section B focuses on the competitiveness of the animal feed industry. Answering the whole survey will take a maximum of 23 minutes.

Your participation in this survey will be highly appreciated. Thank you!

Do you agree to participate in this survey?

- ◯ Yes
- ◯ No

Animal feed trade and competitiveness of the animal feed industry

2. **SECTION A**

Firm information and changes that have occurred over time

Respondent name

1. Contact details

Company

City/Town

Country

Email Address

Phone Number

What are the three main capital investments currently? Please choose all that are applicable.

- ☐ Infrastructure investment
- ☐ Operating capital
- ☐ Transport
- ☐
- ☐

- [ ] Feed mixer
- [ ] Production/processing technology
- [ ] Seed crushing machinery
- [ ] Other (please specify)

What were the three main capital investments 5 years ago? Please choose all that is applicable.

- [ ] Infrastructure investment
- [ ] Operating capital
- [ ] Transport
- [ ] Feed mixer
- [ ] Production/processing technology
- [ ] Seed crushing machinery
- [ ] Other (please specify)

What were the three main capital investments 10 years ago?

- [ ] Infrastructure Investment
- [ ] Operating capital
- [ ] Transport
- [ ] Feed mixers
- [ ] Production/processing technology
- [ ] Seed crushing machinery
- [ ] Other (please specify)

How did the overall capital needs change over time?

- Increased constantly
- Increased exponentially
- Remained the same
- Other (please specify)
- Decreased constantly
- Decreased exponentially

What were the three main drivers of this change?

- Increased demand for animal feed
- The need to expand the business
- The need to advance production technology
- The need for more storage facilities
- To reach out to international markets
- Other (please specify)

What are the main sources of working capital for the firm currently? Please choose all that is applicable.

- Own funding from business profits/sales
- Own funding from other businesses
- Investors
- Commercial banks
- Private finance institutions which are not commercial banks
- Grant
- Crowdfunding/cooperate funding
- Other (please specify)

What were the main sources of working capital for the firm 5 years ago? Please choose all that is applicable.

- [ ] Own funding from business profits/sales
- [ ] Own funding from other businesses
- [ ] Investors
- [ ] Commercial banks
- [ ] Private finance institutions which are not commercial banks
- [ ] Grant
- [ ] Crowdfunding/cooperate funding
- [ ] Other (please specify)

What were the main sources of working capital for the firm 10 years ago? Please choose all that is applicable.

- [ ] Own funding from business profits/sales
- [ ] Own funding from other businesses
- [ ] Investors
- [ ] Commercial banks
- [ ] Private finance institutions which are not commercial banks
- [ ] Grant
- [ ] Crowdfunding/cooperate funding
- [ ] Other (please specify

Animal feed trade and competitiveness of the animal feed industry

6. Firm workers

2. How many **permanent** labourers do you employ?

3. How many **non-permanent** labourers do you employ?

4. How many **permanent** labourers did you employ **5 years** ago?

5. How many **permanent** labourers did you employ **10 years** ago?

What is the role(s) of the firm in the animal feed industry?

- [ ] Animal feed manufacturer/processor
- [ ] Feed miller
- [ ] Animal feed wholesaler- May or may not process feed ingredients to compound animal feed
- [ ] transporter
- [ ] Animal feed trader
- [ ] Animal feed retailer
- [ ] Animal feed mixer(not fully established feed manufacturers)
- [ ] Suppliers of premix, feed additives & veterinary services
- [ ] Suppliers of other mixtures
- [ ] Lab & other services
- [ ] Suppliers of equipment
- [ ] Other (please specify)

From your answers to the previous question, which of the role(s) is the main role of the firm?

- ◯ Animal feed manufacturer/processor
- ◯ Feed miller
- ◯ Animal feed wholesaler- May or may not process feed
- ◯ Animal feed transporter
- ◯ Animal feed trader
- ◯ Animal feed retailer
- ◯ Animal feed mixer(not established feed manufacturer)
- ◯ Suppliers of premix, feed additives & veterinary products
- ◯ Suppliers of other mixtures
- ◯ Lab & other services
- ◯ Suppliers of equipment
- ◯ Other (please specify)

What is the current animal feed production/processing capacity of the firm(tonnage produced per day)?

6. How has the production/processing capacity changed per day compared to the **past 5 years**?

- ◯ Increased
- ◯ Remained the same
- ◯ Reduced

7. By what **percentage** has the production/processing capacity changed compared to the past 5 years?

Please indicate your answer in percentage.

How has the production/processing capacity changed compared to the past 10 years?

- ◯ Increased
- ◯ Remained the same
- ◯ Reduced

By what percentage has the production/processing capacity changed compared to the past 10 years?

Animal feed trade and competitiveness of the animal feed industry

9. Technological improvements

8. What are the key technological improvements in the animal feed industry **currently**? Please choose all that is applicable.

- ☐ Production technology in terms of tonnage
- ☐ Animal feed mixing technology
- ☐ Animal feed formulation
- ☐ Soybean crushing capacity
- ☐ Animal feed processing technology
- ☐ Other (please specify)

What were the key technological improvements in the feed industry that occurred 5 years ago?

- ☐ Production technology in terms of tonnage
- ☐
- ☐

Animal feed mixing technology

Animal feed formulation

☐ Soybean crushing capacity

☐ Animal feed processing technology

☐ Other (please specify)

What were the key technological improvements in the animal feed industry that occurred 10 years ago?

- [ ] Production technology in terms of tonnage
- [ ] Animal feed mixing technology
- [ ] Animal feed formulation
- [ ] Soybean crushing capacity
- [ ] Animal feed processing technology
- [ ] Other (please specify)

Which of the following describe how vertically integrated the firm has become over the past 10 years?

- ◯ Backward vertical integration where the firm acquires or owns a firm that supplies raw or intermediate products for further processing
- ◯ Forward vertical integration where the firm directly interacts with customers instead of having an intermediate
- ◯ Balanced vertical integration where the firm is both backwardly and forwardly vertically integrated through acquiring a firm that supplies raw material/intermediate for further processing as well as having direct contact with the customers
- ◯ None
- ◯ Other (please specify)

Does the firm engage in international trade of animal feed? That is either exporting or importing raw materials for animal feed or any animal feed type. Kindly note that this also includes importing or exporting or transporting on behalf of another firm.

- Yes
- No

Which feed ingredients does the firm trade in internationally? Please choose all that is applicable.

- [ ] Maize grain
- [ ] Soybean whether broken or not
- [ ] Maize bran
- [ ] Soybean oilcake/soybean meal
- [ ] Molasses from sugar cane processing
- [ ] Premix, feed additives & veterinary products
- [ ] Other mixtures
- [ ] Equipment
- [ ] Other (please specify)

How frequently does the firm engage in international trade of animal feed?

- ◯ Daily
- ◯ Weekly
- ◯ Every two weeks
- ◯ Other (please specify)
- ◯ Monthly
- ◯ Once every quarter of the year
- ◯ Once a year

How often did the firm engage in international trade of animal feed 5 years ago?

- ◯ Daily
- ◯ weekly
- ◯ Twice a month
- ◯ Once a month
- ◯ Other (please specify)

e every quarter of the year

O

Once a year

n

c

Never used to trade internationally

How often did the firm engage in international trade of animal feed 10 years ago?

Daily

Once every quarter of the year

Weekly

Once a year

Twice a month

Never used to trade internationally

Once a month

Other (please specify)

Does the international trade of feed ingredients follow a seasonal cycle?

- ◯ Yes
- ◯ No

9. Please elaborate on the seasonality. In which months do you engage in international trade of animal feed **more than average**?

- ☐ January
- ☐ February
- ☐ March
- ☐ April
- ☐ May
- ☐ June
- ☐ July
- ☐ August
- ☐ September
- ☐ October
- ☐ November
- ☐ December

Please indicate the reason why you engage in international trade more than average in the month(s) you selected in Q37?

10. Please elaborate on seasonality. In which months do you engage in international trade of animal feed less than average?

- ☐ January
- ☐ February
- ☐ March
- ☐ April
- ☐ May
- ☐ June
- ☐ July
- ☐ August
- ☐ September
- October
- November
- December

11. Please indicate the reason why you engage **less than the average** in these months you have selected in Q39.

Animal feed trade and competitiveness of the animal feed industry

14. Transporting animal feed

Who is responsible for transporting animal feed from one country to another?

- Importing firm
- Exporting firm
- Independent transporter paid for by the importing firm
- Other (please specify)
- Independent transporter paid for by the Exporting firm
- Independent transporter paid for by both the exporting and importing firms

Who was responsible for transporting animal feed from one country to another 5 years ago?

- Importing firm
- Exporting firm
- Independent transporter paid for by the importing firm
- Other (please specify)
- Independent Transporter paid for by the exporting firm
- Independent transporter paid for by both the exporting and importing firms

Who was responsible for transporting animal feed from one country to another 10 years ago?

- Importing firm
- Exporting firm
- Independent transporter paid for by the importing firm
- Other (please specify)
- Independent transporter paid for by the exporting firm
- independent transporter paid for by both the importing and exporting firms

Animal feed trade and competitiveness of the animal feed industry

15. Trade agreements

What type of agreement do you currently make with your trade partners from the other country during the trade? Please choose all that apply.

- [ ] Verbal agreement
- [ ] Written agreement each time a transaction occurs
- [ ] Vertical integration- The business is jointly run/owned by both firms involved in the trade.
- [ ] Long term agreement- Agreement for a certain period
- [ ] Other (please specify)

What were these arrangements like 5 years ago? Please choose all that apply.

- [ ] Verbal agreement
- [ ] Written agreement each time a transaction occurs
- [ ] Vertically integrated-The business is jointly run/owned by both firms involved in the trade.
- [ ] Long time agreement-Agreement for a certain period.
- [ ] Other (please specify)

What were these arrangements like 10 years ago? Please choose all that is applicable.

- [ ] Verbal agreement
- [ ] Written agreement each time a transaction occurs
- [ ] Vertically integrated-The business is jointly run/owned by both firms involved in the trade.
- [ ] Long time agreement- Agreement for a certain period
- [ ] Other (please specify)

What kind of international firms or partners do you transact with currently?

- [ ] Animal feed wholesaler/processor
- [ ] Animal feed trader
- [ ] Animal feed retailer
- [ ] Animal feed transporter
- [ ] Feedlots
- [ ] Farmers
- [ ] Other (please specify)

What kind of international firms or partners did you transact with 5 years ago?

- [ ] Animal feed wholesaler/processor
- [ ] Animal feed trader
- [ ] Animal feed retailer
- [ ] Animal feed transporter
- [ ] Feedlots
- [ ] Farmers
- [ ] Other (please specify)

What kind of international firms or partners did you transact with 10 years ago?

- [ ] Animal feed wholesaler/processor
- [ ] Animal feed trader
- [ ] Animal feed retailer
- [ ] Animal feed transporter
- [ ] Feedlots
- [ ] Farmers
- [ ] Other (please specify)

Do the international firms you trade with differ during the year?

- ◯ Yes
- ◯ No

If yes kindly explain why this is so

Why don't you engage in the international trade of animal feed? Please choose all that is applicable.

- [ ] Do not produce enough to trade internationally
- [ ] Costs associated with international trade are too high
- [ ] It does not make any economic sense
- [ ] Do not have access to international markets
- [ ] The local supply and demand for animal feed are enough for us.
- [ ] Other (please specify)

Whom do you transact with locally? Please choose all that apply.

- [ ] Animal feed manufacturers/processors
- [ ] Animal feed wholesalers
- [ ] Animal feed traders
- [ ] Animal feed transporters
- [ ] Animal feed retailers
- [ ] Other (please specify)

Animal feed trade and competitiveness of the animal feed industry

17. **SECTION B**

Competitiveness of the animal feed industry- **Production factor conditions**

I will now assess your perception of the following factor conditions as determinants of industry competitiveness and exports. Please note that animal feed ingredients denote the products such as maize bran, soybean oilcake, molasses, and others that are used to make compound animal feed.

Please further note that the term "animal feed" is used to denote compound feed produced by firms in the animal feed industry.

Please indicate your level of agreement or disagreement with the following statements.

	Strongly disagree	Disagree	Slightly disagree	Indifferent	Slightly agree	Agree	Strongly agree
The cost of producing animal feed is currently fair in the country.	○	○	○	○	○	○	○
There is enough skilled labour available in all segments of the animal feed industry.	○	○	○	○	○	○	○

	Strongly disagree	Disagree	Slightly disagree	Indifferent	Slightly agree	Agree	Strongly agree
The cost of skilled labor in the animal feed industry is fair.							
The skilled labour available in the animal feed industry is of good quality.							
The administration costs associated with labor in the feed industry are low or at least reasonable.							
The animal feed industry firms are well located and therefore can easily access animal feed ingredients suppliers e.g maize and soybean suppliers.							
The animal feed industry firms are well located and therefore can be easily accessed by animal feed buyers.							
The firms in the feed industry have adequate access to natural resources (e.g land and rainfall) for the production of feed ingredients.							
The firm has adequate and quality infrastructure for all business operations.							
Information on production and new technologies is available							

and easily accessible by the firm.							
The start-up capital required to commerce animal feed production is reasonable.							
The production technology in the animal feed industry is available at a reasonable cost.							

Animal feed trade and competitiveness of the animal feed industry

18. **Demand Conditions**

I will now assess your perception of the following demand conditions as determinants of industry competitiveness and exports.

Please indicate your level of agreement or disagreement with the following statements

	Strongly disagree	Disagree	Slightly disagree	Indifferent	Slightly agree	Agree	Strongly agree
There is a high demand	○	○	○	○	○	○	○
The international market demand for animal feed ingredients is higher than the local demand.							
Information on both local and international animal feed ingredients markets is available and easily accessible by the firm.	○	○	○	○	○	○	○
The quality of animal feed ingredients determines both price and demand.	○	○	○	○	○	○	○
The international buyers demand a high quality of animal feed ingredients compared to the local buyers.	○	○	○	○	○	○	○

19. Supporting and related industries

I will now assess your perception of the following statements about supporting and related industries as determinants of industry competitiveness and international trade.

Kindly indicate your level of agreement or disagreement with the following statements.

	Strongly disagree	Disagree	Slightly disagree	Indifferent	Slightly agree	Agree	Strongly agree
There are enough transport and logistics services providers (to move goods & services from one point to the other) for the industry.							
Creditable research institutions are available to carry out industry-related research.							
Competitive credit facilities are available to finance the industry.							
The electricity supply is adequate to meet the required daily animal feed production quantity.							
There are many suppliers of packaging materials in the animal feed industry.							
The industry has at its disposal competitive and linked animal feed ingredients suppliers e.g maize and soybean suppliers.							

Animal feed trade and competitiveness of the animal feed industry

20. **Firm strategy, structure & rivalry**

I will now assess your perception of the following statements about the firm strategy, structure & rivalry as determinants of industry competitiveness and exports.

Please indicate your level of agreement or disagreement with the following statements.

	Strongly disagree	Disagree	Slightly disagree	Indifferent	Slightly agree	Agree	Strongly agree
The culture in the area where the firm operates is not a barrier to the competitiveness of the firm.							
The firms easily adapt to the national regulations on firm creation and management.							
The firm has adequate managerial capabilities.							
The firm is flexible to national conditions on firm management and operations.							
The market power of suppliers does not constrain firm competitiveness.							
The market power of buyers does not constrain firm competitiveness.							
Firms within the industry have strong relationships and networks in and across the chain.							
There are few to no substitute goods to the animal feed ingredients.							
The entry of new entrants in the animal feed industry seldom occurs.							

Animal feed trade and competitiveness of the animal feed industry

21. **Government support and policies.**

I will now assess your perception of the following statements about government support and policies as determinants of industry competitiveness and exports.

Please indicate your level of agreement or disagreement with the following statements.

	Strongly disagree	Disagree	Slightly disagree	Indifferent	Slightly agree	Agree	Strongly agree
The industry receives adequate **direct support** from the government e.g government grants and subsidies to promote firm competitiveness.							
The industry receives adequate **Indirect support** from the government e.g deliberate lowering of export taxes by the government to promote competitiveness.							
Government spending and tax rates(fiscal policies) constrain the industry's competitiveness.							
The government labor policies constrain animal feed production.							
National trade policies constrain the competitiveness of the animal feed industry.							
Trade bans limit and frustrate international trade of animal feed.							
Public funding for the animal feed industry is adequate.							
The national land reform policies constrain local crop production thereby negatively affecting animal feed							

production/processing.

Animal feed trade and competitiveness of the animal feed industry

22. **Chance factors**

I will now assess your perception of the following statements about the factors that are mostly beyond the firm's control as determinants of industry competitiveness and exports.

Please indicate your level of agreement or disagreement with the following statements.

	Strongly disagree	Disagree	Slightly disagree	Indifferent	Slightly agree	Agree	Strongly agree
During the past 10years, natural disasters have frequently occurred.							
The natural environmental disasters have impacted heavily on the animal feed industry.							
Change in government (e.g coalition) works in the industry's favor.							
Changes in government policies regarding animal feed production/marketing have negatively affected the industry's performance.							
The rate of crime in the country is detrimental to the industry growth.							
Climate change has negatively impacted crop production thereby limiting the availability of animal feed ingredients for compound animal feed production.							
There is high level of corruption at border posts.							
The level of corruption within the animal feed industry is high.							

The bureaucracy at border posts negatively affects the frequency of trade.	○	○	○	○	○	○	○
Fluctuations in exchange rates negatively affect the industry role players' proceeds.							

	Strongly disagree	Disagree	Slightly disagree	Indifferent	Slightly agree	Agree	Strongly agree
Global pandemics e.g coronavirus have negatively impacted the international trade of animal feed.	○	○	○	○	○	○	○

Animal feed trade and competitiveness of the animal feed industry

23. Other factors

I will now ask for your level of agreement or disagreement on the following statements.

Kindly indicate your level of agreement or disagreement on the following statements.

	Strongly disagree	Disagree	Slightly disagree	Indifferent	Slightly agree	Agree	Strongly agree
Population increase and urbanization have raised the local demand for meat over the past 10 years.							
The middle-class household income has increased over the past 10 years, leading to increased consumption of meat.							
Over the past 10 years, household consumption patterns are moving from starchy foods e.g pap/nshima to meat and other meat products.							
Over the past 10 years, demand for quality meat(leaner meat) has increased.							
Over the past 10 years, the number of firms in the animal feed industry has increased at a faster rate.							
Over the past 10 years, the firms have highly expanded in size.							
Over the past 10 years, most firms have become more consolidated. That is, big firms are buying small firms in the industry.							
The time taken to clear the goods at the border posts is way too much.							

The cost of clearing the goods at the border is way too high.	○	○	○	○	○	○	○

What is your perception of the current working capital requirement(in ZMW or ZAR) per month?

- Very low
- Low
- Slightly low
- Indifferent
- slightly high
- High
- Very high
- Between 500000-1000000
- Above 5 million
- I decline to answer this particular question
- I don't know

Which year was the firm established?

12. What were the **sources** of your start-up capital? Choose all that are applicable.

- [ ] Own funding
- [ ] Investors
- [ ] Commercial banks
- [ ] Private financial institutions that are not commercial banks
- [ ] Grant from the government
- [ ] Donor funds
- [ ] Crowdingfunding/cooperate funding

Other (please specify)

What is your perception of the start-up capital required for operating in the industry?

- Very low
- Low
- Slightly low
- Indifferent
- Slightly high
- High
- Very high
- Above 10 million
- I do not want to answer this particular question
- I don't know