Developing a managerial framework to manage the production implications of grain shortages in central South Africa

DD Kloppers

orcid.org/0000-0003-0941-2960

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Supervisor: Mr JC Coetzee

ABSTRACT

This mini dissertation addresses the critical challenge of grain shortages in central South Africa and aims to develop a managerial framework to effectively manage farmers' production implications. The study delves into the complex environment and multiple factors contributing to grain shortages, such as ineffective fertilizer application, inadequate farmer education, and the impacts of climate change, including the looming threat of El Nino in 2024. By synthesizing insights from various sources, including research studies and articles, the dissertation proposes a strategic approach that combines precision agriculture, sustainable farming practices, and governmental interventions.

The focus methods answering farmers through education programs, promoting organic farming methods, and incorporating drought-resistant maize varieties. Additionally, the research explores the economic aspects, considering factors such as input costs, government subsidies, and the potential for market expansion in the cultivation of drought-resistant crops. The objective is to contribute to the resilience of the agricultural sector in central South Africa by providing a practical and sustainable managerial framework for addressing grain shortages and ensuring long-term food security.

KEY TERMS

Agricultural Economics, Agricultural Sector, Comprehensive framework, Drought Resistant, El-Nino Impact, Food security, Government subsidies, Managerial framework, Organic Farming, Practices, Precision agriculture, Strategic management, Sustainability, Sustainable Agriculture, and Water Scarcity

Farmer Education Programs: Initiatives that provide knowledge and skills to farmers, covering various aspects like crop management, financial literacy, and sustainable practices.

Organic Farming Practices: Agricultural methods that avoid synthetic pesticides and fertilisers, emphasising natural processes to enhance soil health and crop growth.

Water Scarcity: A condition where the water demand exceeds its availability, posing challenges to agriculture and other water-dependent activities.

Sustainable Agriculture: Farming practices that balance economic profitability with environmental conservation and social equity for long-term viability.

Early Warning Systems: Systems that use advanced meteorological research to provide timely alerts about changing weather patterns, aiding farmers in decision-making.

Crop Diversification: The practice of cultivating a variety of crops in a specific area to enhance soil health, reduce pests, and improve overall resilience.

Input Costs: The expenses associated with inputs like seeds, fertilizers, and pesticides in agricultural production.

Market Expansion: Increasing the reach and scope of agricultural products in the market to stimulate economic growth.

Diversifying Income Sources: Broadening the avenues from which farmers earn income, reducing dependency on a single source.

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CHAPTER 1 NATURE AND SCOPE OF THE STUDY

1. INTRODUCTION

The food security and livelihoods of South Africa's population are threatened by frequent grain shortages, as in many other African nations (Clapp & Moseley, 2020:1393). Maize and wheat are the two most important grain crops in South Africa, and their production is crucial to the country's economy and to the survival of both smallholder and large-holder producers (Grote *et al*., 2021:2). However, disruptions in grain production have resulted in an increase in food insecurity and the risk of starvation for many people in the nation (Clapp & Moseley, 2020:1394).

The Food and Agricultural Organisation (FAO) indicates that in 2015, an estimated 800 million people were chronically malnourished. In addition, stunting among children ages 0-5 is prevalent, influencing approximately 161 million children globally, while 2 billion people suffer from micronutrient deficiencies. Population growth and dietary changes are expected to increase global food demand by 60% by 2050 (FAO, 2021). In South Africa, the prevalence of undernourishment in the entire population is 3.4%, while the prevalence of food insecurity is 6% (FAO, 2022a). South Africa is experiencing several food security challenges. Following the disturbing floods in the Province of KwaZulu Natal, the national administration confirmed a “state of disaster” in April 2022. Therefore, South Africa would need to produce 50% more food by 2050 to feed an anticipated 73 million people (Alfreds, 2019).

According to the 2022 Synthesis Report on food security by the Southern African Development Community (SADC), South Africa is grappling with surging fuel prices, inflation, and escalating costs of food and agricultural inputs, primarily attributed to the Russia-Ukraine war. Food insecurity is a result of several shocks, unemployment, and the socio-economic impact (SADC, 2022:33). Integrated Food Security Phase Classification (IPC) indicates that, at the national level, South Africa meets its food requirements out of imports and local food production (IPC, 2022). Grote *et al*. (2021:3) contend that while imports account for a substantial portion of grain supply, the quality of imported grains may not always satisfy the required standards, and it is frequently less expensive to import than to produce locally. In addition, concerns about genetically modified (GM) cereals influence the decision-making process regarding grain imports.

While the literature has extensively discussed climate change, global political instability, and policy inadequacies, this study directs its attention to the specific factors within South Africa that hold significance. Adopting a strategic management framework, it is feasible to analyse the implications of these factors on grain production and explore potential solutions. Given the private sector's role in job creation and corporate social responsibility, it is crucial to include them in this strategic approach. Even though the government cannot be directed, the utilisation of constructive criticism and cooperation with private sector entities can facilitate the formulation of helpful strategies. Through this approach, the fiscal responsibility of taxpayers can be mitigated, while

also facilitating the exploration of novel strategies to address the challenges presented by the scarcity of grain.

Overall, this research study seeks to address some of the structural causes underlying the production bottleneck in South Africa's grain sector. The purpose of this research is to establish a managerial framework that considers the unique context of South Africa's grain production and its implications for food security. Examining the underlying factors will also involve the private sector in strategic decision-making; this research seeks to provide insights and recommendations that can aid in effectively managing grain shortages in South Africa.

1.1 BACKGROUND TO THE STUDY

According to the Food and Agriculture Organisation (FAO), there will be approximately 670 million undernourished persons in the world by 2030 (FAO, 2022). This comprises residents from developed market economies, economies in transition, and developing economies. Moreover, 25% of the world's undernourished population resides in sub-Saharan Africa (SSA), while 60% reside in Asia and the Pacific (FAO, 2021), leaving South Africa with no less than 7.4 million individuals as victims. As indicated by the World Bank in 2019, a significant worry is food insecurity, which encompasses the inability to consistently acquire an adequate amount of food to meet nutritional requirements (World Bank, 2019). The World Bank’s widely accepted definition of food security emphasises access to sufficient sustenance for an active and healthy life. The four key food security dimensions include physical

obtainability of food, physical and financial access to food, stability, and food utilization (World Bank, 2023).

According to the World Food Summit, achieving food security requires a balance between food supply and demand, assuring access to food, and addressing the affordability and availability of food (World Food Summit, 2016). Four essential factors contribute to food security: food availability, cost, convenience of transportation, and body absorption efficiency (World Food Summit, 2016). Access to nutritious food is contingent upon its availability, as well as its affordability and accessibility. It is important to note that there is a connection between economic development and food security, with destitution frequently impeding an individual's ability to acquire sufficient food (Woetzel *et al*., 2020:3)

Oluwajuyitan *et al*. (2021:8) define cereal grains as products of grass varieties. They provide more nourishment to humans than any other dietary category and half the total caloric requirement. In South Africa, maize and wheat are the most essential grain commodities, playing a crucial role in the country's food production (Statistics South Africa, 2021). Grain production is moderately successful within central South Africa. The Free State is the central province of South Africa, which, when coupled together with the southern parts of the North West province, make up the area referred to as central South Africa. Understanding local production, import patterns, and potential substitutes for these cereals, is necessary for effectively addressing grain

shortages, and managing their production implications (Wegerif, 2020:797).

1.2. SIGNIFICANCE OF THE STUDY

1.2.1. Development of comprehensive managerial framework

The motivation behind initiating this research was prompted by the need for a comprehensive managerial framework to prevent grain shortages in the South African agricultural industry. Despite the critical importance of this issue, there is less current literature or frameworks to address the difficulties posed by South Africa's grain shortages. Unpredictable and frequently unfavourable weather conditions in South Africa, such as droughts and erratic precipitation patterns, are one of the primary reasons for the necessity of this study.

Unpredictable and frequently unfavourable weather conditions have a significant effect on the production of maize and wheat, which are highly dependent on a sufficient water supply. The country has experienced severe droughts and inundation in recent years, resulting in a decline in crop yields and an increase in food prices. Another factor contributing to the necessity of this study is the lack of a comprehensive strategy to address grain shortages in South Africa. While numerous policies and initiatives promote food security and agricultural productivity, there is no clear framework or strategy to address the challenges posed by grain shortages in the nation.

Due to the absence of a comprehensive plan, it has been difficult to coordinate efforts and resources to resolve the issue adequately. The other causal factors include climate change, limited access to credit and finance for farmers, inadequate infrastructure, and the limited adoption of technology and modern agricultural techniques. A comprehensive and

integrated approach involving all stakeholders in the grain value chain, including producers, policymakers, researchers, and the private sector, is required to address these challenges.

The proposed study on devising a managerial framework to manage the production implications of grain shortages in South Africa is crucial for several important reasons. This subsection focuses on the factors that contribute to the importance and relevance of this research:

In terms of South Africa's food security and nutrition, grain shortages directly impact food security and nutrition. Maize and wheat are essential staple grains, and their availability and affordability are essential for assuring a sufficient food supply and the nutritional health of the population. This study seeks to improve food security and nutrition by addressing the production implications of grain shortages.

1.2.2. Contribution to policy enhancement and development

The agricultural sector, including cereal grain production, is an essential element of South Africa's economy. Grain shortages can disrupt agricultural production, raise food prices, and hurt the nation's overall economic stability. Developing a framework for managing grain shortages will help stabilize the agricultural sector, promote economic growth, and contribute to sustainable development. Existing government policies are in place to address and alleviate grain shortages; however, the efficacy of these policies needs to be evaluated.

There is a need to assess the impact of current policies, identify potential voids or limitations, as well as the involvement of the private sector in

addressing grain shortages. Engaging the private sector, which encompasses agribusinesses and corporations, is crucial for fostering collaborative efforts and pioneering solutions. The study examines the potential for private sector involvement, utilizing concepts such as corporate social responsibility to contribute to cereal production and alleviate shortages.

By taking these factors into account, this study reinforces the rationale for establishing a management framework aimed at effectively handling grain shortage in South Africa. It highlights the significance of food security, its economic ramifications, the evaluation of current policies, and the potential role of the private sector. Through these lenses, the study aims to provide actionable recommendations and contribute to the nation's sustainable cereal production and increased food security.

Evidence that the South African government is struggling to provide for its people's food needs, inspired this investigation. Because of the country's extreme poverty, many people still do not have enough to eat despite the government's best attempts. Some policy interventions have been tried to control the problem. However, Boatemaa *et al.* (2018:1) note that these efforts have been hampered by gaps in policies, conflicts within policies, and a lack of coordination in policy creation and execution across all sectors. Food insecurity has been linked to many different issues. Ruszczyk *et al*. (2020:239) find that some families, particularly those living in informal settlements, experienced shame when they were forced to accept food aid for the first time in their lives.

Many households' incomes and hence their purchasing power were significantly reduced leading to the crisis. Persistent socioeconomic problems in the country have also made it harder for families to afford food (Pendleton, Crush, & Nicanor, 2016:127). People experiencing poverty, who are concentrated in rural and slum regions of cities, are the ones who suffer the most. There have been talks about how agriculture in rural areas has been ignored even though it fails to meet basic food needs. This is due to soil degradation, which has been linked to unsustainable agricultural practices (Onyango *et al*., 2021:92). Empowering farmers and women, as outlined by the United Nations Development Programme is one way in which governments may invest in agriculture.

Others disagree with this viewpoint, arguing that it oversimplifies the connection between migration and food security by assuming that increasing investment in agriculture will automatically lower the number of people forced to relocate to urban areas (Knoll *et al*., 2017:331). Instead, it is urged that a new narrative be crafted with an emphasis on identifying and addressing the fundamental issues that prompt people to migrate. This will help shape a "Knowledge Agenda" demonstrating migration's positive effects and interconnectedness (Laurini *et al*., 2023:225).

This research will add to the existing body of knowledge by examining food. Despite the government's efforts to make food more readily available, a sizable section of South Africa's population still faces food

insecurity, which is why this study was deemed necessary (Fanzo *et al*., 2020:243). According to Ruszczyk *et al*. (2020:236), the connection between food systems, food security, and food sustainability has received insufficient attention. Researchers argue that there is a close connection between urban poverty and urban food insecurity and that this connection is so important that it warrants increased attention from policymakers and additional studies.

3. PROBLEM STATEMENT

Grain shortages in South Africa have significant production implications for various industries, including agriculture and food processing (Statistics South Africa, 2021). The absence of a well-defined managerial framework to manage these implications hinders the ability of managers to effectively address and mitigate the impact of grain shortages on production. Consequently, there is a pressing need to develop a comprehensive managerial framework tailored to the South African context to guide managers in effectively managing the production implications of grain shortages.

The current lack of a structured framework leaves managers without a clear roadmap to navigate the challenges posed by grain shortages in South Africa. This absence of guidance increases the vulnerability of industries reliant on maize and wheat as principal grain produce (Department of Agriculture, Land Reform and Rural Development, 2019:6). Without a proactive approach to manage grain shortages, businesses face risks such as disruptions in production, increased costs,

and potential revenue losses. Consequently, there is a critical need to address this gap and develop a managerial framework that provides a structured approach for managing the production implications of grain shortages in South Africa.

By implementing the proposed managerial framework, tailored to the South African context, managers should be able to monitor grain supplies better, assess production requirements, and develop contingency plans for future grain shortages (Development Bank of Southern Africa, 2018:7). Additionally, communication with stakeholders, such as suppliers, customers, and employees, is crucial to ensure a coordinated response and minimize disruptions throughout the supply chain (National Planning Commission, 2012:79).

Moreover, by focusing on long-term strategies, such as increasing local grain production and exploring alternative sources, the framework will help foster resilience and sustainability in the face of future grain shortages (Woetzel *et al*., 2020:6). The inclusion of cost-saving measures will further enable businesses to navigate the economic challenges associated with grain shortages, thereby safeguarding their competitiveness and viability. This study will demonstrate that creating a comprehensive and context-specific framework empowers managers to adeptly tackle the challenges arising from grain shortages. This, in turn, helps in reducing disruptions to production and ensuring the long-term sustainability of industries that heavily rely on maize and wheat as the primary grains produced in South Africa.

1.3 LITERATURE REVIEW

1.3.1Global food prices and food insecurity

The price of all foodstuffs worldwide rose dramatically in 2017, as was the case in 20072008 and 2010-2011 (FAO, 2017) as well. Input prices went up so fast that it was similar to the historic food price crisis of 1974. Global food price indices hit record highs in the second quarter of 2018, tripling from their levels at the turn of the millennium. Consistent forecasts predict that agricultural prices will continue to increase in the coming months. Actual cereal prices were projected to rise by 20% by 2020 compared to the previous decade, and actual meat prices were projected to rise by 50%. (FAO, 2019). However, with inflation remaining consistent as it was in 2022, it is likely that the food prices will only rise marginally in 2023.

Figure 1.1 Monthly international food price indices, 2016–18 (2000 = 100)

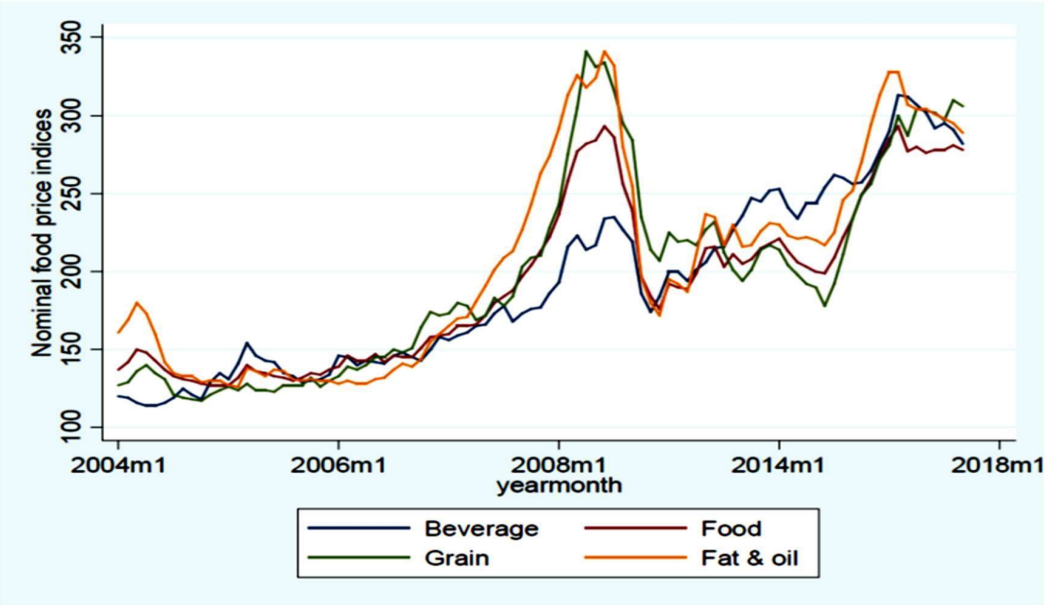
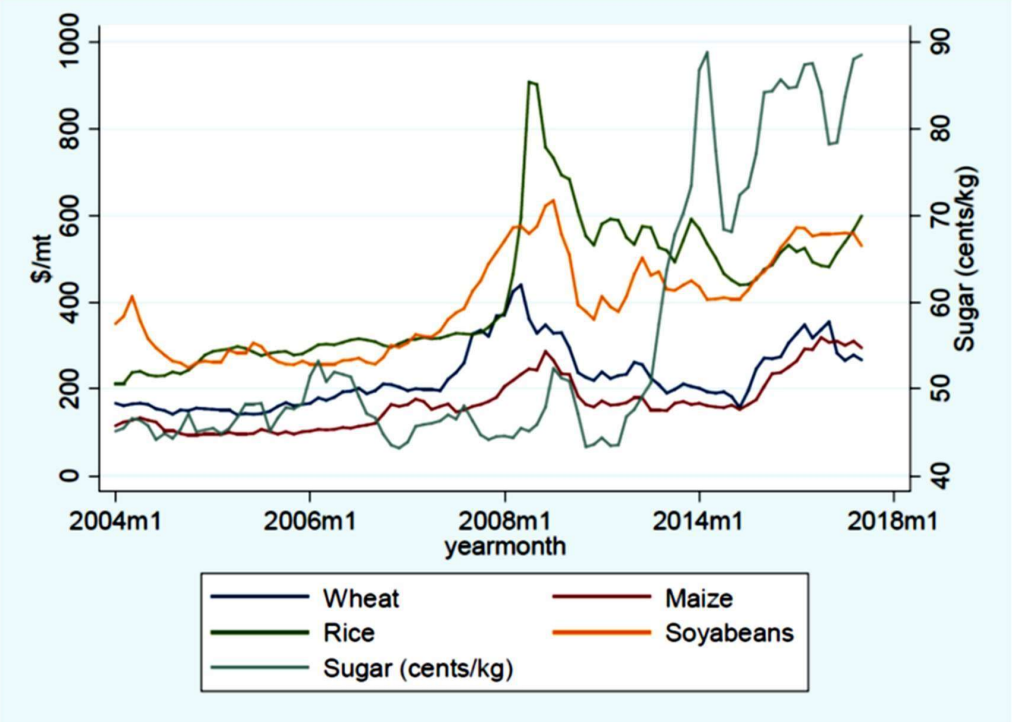


Figure 1.2: International nominal food commodity prices, 2016–18



Figures 1 and 2 above indicate that there are high food prices in South Africa from 2006 to 2014 and worldwide, regardless of the decrease five

years ago, i.e., in 2013. The increase in South Africa is a result of a decreased affordability for consumers, particularly for low-income households in areas like Free State. This is because a combination of favourable weather conditions and slowing food demand due to the global financial crisis and recession have contributed to the price decline. From 2010, there was yet another increase in the cost of food. The FAO (2021) food price index has remained elevated ever since, recently passing its all-time high in June 2008. Furthermore, because the FAO index is trade-weighted, the actual burden of price increases on poor people is not captured because it is determined by the domestic prices that they pay i.e., the prices of the food commodities are weighed by their relative shares in trade (World Bank, 2019).

There has been little difference between the commodities hit by the two episodes of erratic food price increases in 2008 and 2011 (World Bank, 2019). Wheat, maize, and soybean prices were significantly higher in the early 2000's in both cases (Figure 2). Similar significant increases in cost were seen for foods like dairy, meat, palm oil, and cassava. Butter and milk prices, for example, tripled during that time, while beef and poultry prices increased by about 100% and 100%, respectively (Wegerif, 2020). While it was low in 2007 and 2008, the price of sugar in 2011 was three times what it was in 2002 to 2004. After increasing by a factor of five between 2007 and 2008, the price of rice has been stable since 2011 (World Bank, 2023).

Despite the general trend of declining prices, recent statistics show that rice and sugar prices have been on the rise since June 2011. Despite this, the prices of all major food commodities are still well above their long-term averages, l*et al*one the adverse impact of the new consumption taxes like sugar tax. Examining patterns over time reveals that fluctuating food prices are not a recent occurrence. The early 1970s was marked by several crises in the world's food markets. According to reports, agricultural commodity price peaks in the 1970s were much higher than in 2007 to 2008 (Piesse & Thirtle, 2009:119). In famine-prone regions of Africa during the 1980's and 1990's, cereal prices increased by a factor of two to five within a year, leading to devastating human suffering. However, the transmission rate and magnitude of the most recent price increases are not comparable to those of earlier epochs (von Braun *et al*., 1998:16).

The current price crisis affects all commodities equally, from metals and energy to minerals, and the rate of price transmission is high. For example, comparing 'real' values using US dollar deflators based on the middle class is misleading because they do not reflect the food basket of people experiencing poverty (FAO, 2014). Complex issues arise when attempting to deflate these nominal price changes. Food insecurity and scarcity are serious public health problems that have far-reaching consequences for college students' physical and mental well-being directly impacting their lives and productivity. According to the U.S. Department of Agriculture (2020), malnutrition occurs when access to

nutritious food is limited or uncertain, or when securing sufficient food does not feel feasible in a socially responsible manner.

Food insecurity is affected by many other variables. Inadequacy in managing one's resources (such as one's finances) and one's diet (such as one's ability to budget, pay one's bills, and stock up on canned food (Coleman-Jensen *et al*., 2016:7). Considering the preceding, the current study systematically reviewed previous research on food insecurity among university students in the United States, United Kingdom, Australia, and Malaysia (Coleman-Jensen *et al*., 2022:8).

It is worth noting that in recent years, the issue of food security has received much attention from academics and regular people (Akinola, 2020: 214)). Pawlak and Kołodziejczak (2020:13) urge increased agriculture production investment in countries (2020;48) prioritizing continued growth. Bjornlund, Bjornlund and Van Rooyen (2020:50) contend that the higher levels of unemployment and poverty in South Africa defeat the decades of efforts to end hunger and malnutrition and increased investment in South Africa's agriculture production and food insecurity. The presence of employment within a household is a crucial factor in guaranteeing its food security. Statistics South Africa (StatsSA, 2023) establishes the notable disparity between households without any employed members, where almost 19% experienced hunger, and those with at least one employed member, where only 7.9 % experienced hunger (StatsSA, 2023).

The political climate of the world is shifting and becoming more globalized. It is becoming increasingly clear that these developments are all interconnected with global warming (Jurabaevich & Bulturbayevich, 2021:9). Current worldwide patterns have resulted in an escalation of food costs, intensifying household food insecurity, destitution, and disparity (Phiri, 2017: 66). South Africa underwent a transition in 2008, from a state of being a net food exporter to a net food importer (Wudil, Usman, Rosak-Szyrocka, Pilař & Bo, 2022:22). That is why talks about and studies of food security have become increasingly popular in universities and policy circles (Mooney & Hunt, 2009:469).

1.3.2. Food security in South Africa

Although post-1994 land reform ideals prioritize the redistribution of land to low-income neighbourhoods and work to rectify the injustices wrought by pre-1994 policies, the small number of commercial farmers who produce most of the nation's food are rarely given the credit they deserve (Chakona & Shackleton, 2018:72). South African government needs to prioritize responses to resolving malnutrition beyond food insecurity and nutritional specific interventions, including nutrition-specific and sensitive programs and approaches; and building an enabling environment. Agriculture, land availability and wild food usage should be promoted. Besides the uncertainty created by the always imminent land reform programmes (Akinola, 2020:215).

Chakona and Shackleton (2018:73) indicated that there are three major threats to land security and food security in South Africa:

- Guaranteeing a stable supply of food for the present and the future

  Factors working against progress include the economy, rising demand, climate change, inadequate farming technology, ineffective crop yields, outdated regulations, and trade restrictions.

- Bringing food within reach of all by balancing prices with incomes

  Chronic poverty, fluctuating and falling real incomes, rising food prices, a lack of available jobs, and a dysfunctional food distribution system are all factors that limit progress.

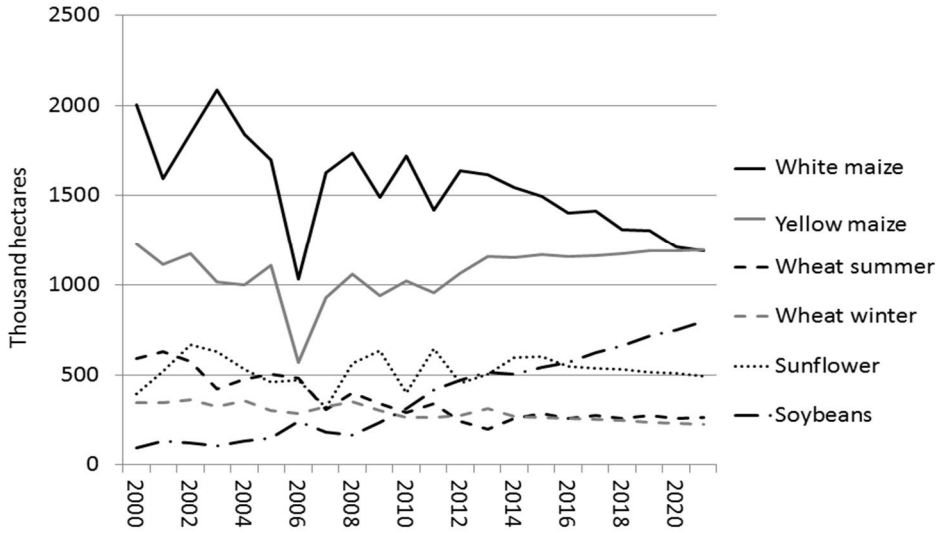
- Giving people the information, they need to make nutritious food choices.

  Social norms, cultural expectations, and insufficient information about food use and nutrition are all limitations.

In the quest for more of the significant causes of food insecurity in South Africa, the above elements are worth understanding and reflecting upon whenever there are issues with food security 80% of the food in the country comes from just 20% of the commercial farmers (Van der Merwe, 2011:1). Commercial output has dropped because of political stability and land reform. Most of the farms that the South African government bought in the years after 1994 to redistribute to Black farmers are abandoned and do not function (Akinola, 2020:218). Therefore, the efficacy of land reform as a solution is questionable, mainly due to the allocation of land to inexperienced farmers resulting in

a significant percentage (30%) of valuable land and resources being underutilised (Viljoen, 2020). While commercial maize farmers in South Africa averaged 4.4 t/ha in the 2015/2017 harvest, smallholder farmers averaged just 1.1 t/ha. The Department of Agriculture (DoA) indicates that constraints posed by small farm sizes are particularly severe for smallholders (DoA, 2018).

Figure 3.1 Land use of most important cereals



The cultivation area for maize and wheat, which are the primary constituents of cereal for households in South Africa, has witnessed a significant decline in the last decade (as illustrated in Figure 3). This trend raises concerns about the country's capacity to maintain food self-reliance (DoA, 2018). The demand for rice has been rising while the demand for maize for human consumption has been stable since 2018. During the same time frame, South Africa reversed its position from a

net exporter of food to an importer. The nation's ability to produce food in the future is threatened (Moseley & Battersby, 2020:449). The food supply chain is expected to experience increased strain due to the growing population and limited resources, l*et al*one other unexpected major challenges like infrastructure decay in some farming corridors.

According to Stats SA (2020), low levels of household and commercial involvement in agriculture have been increasingly concerning. The number of individuals employed in the commercial agriculture sector as of June 30th, 2018, was 757,628, indicating a decline from 769,594 on February 28th, 2007 (-1.6%). Even though more people garden in the more rural provinces (52.7% of households in Limpopo province), this is still less than half of all households. The number of farms in some provinces has continuously reduced. In 2017, Gauteng, Mpumalanga, and Limpopo provinces had the smallest number of farms, accounting for 5.7%, 7.0%, and 7.6% of the total number of farms, respectively (Stats SA, 2020).

Kirsten and Vink (1998:551) find that due to market deregulation, South African commercial and small-scale farmers receive less support than farmers in any other industrialized country except New Zealand. A combination of commercial, small-scale, and household farmers all believe that it is imperative to get more government support for agriculture to prosper in South Africa (Viljoen, 2020). There were both beneficiaries and losers of the deregulation policy. Building world-class sectors, including agriculture, requires more than the state being present

or absent in the market. Which interventions to make, how long, and why? In a contemporary economy, trading is regulated, giving up export markets and adding compliance under the pretext of removing red tape is the incorrect approach (Beattie, 2022).

The National Development Plan (NDP) has identified agriculture as a key area for future development. However, despite this focus, the sector has experienced a decline in employment opportunities, with the number of jobs decreasing from 1.09 million in 2006 to 661,000 in 2012. The NDP estimates that for every R1 million invested in agriculture, ten jobs will be created (NDP, 2019). Even though many programs are being implemented, this is not supported by evidence (Cheteni & Umejesi, 2022:70). Two initiatives for which estimates of the number of new jobs created have been provided are the Comprehensive Agriculture Support Programme (CASP) and the Ilima/Letsema Programme (Lukhalo & Zwane, 2022:1). Similar projects like the Letaba farm in Limpopo province have failed miserably. The level of conceit exhibited by the new inexperienced owners is surpassed only by their lack of knowledge and inadequacy, as observed in retrospect. The independent management of these farms without assistance from skilled stakeholders has led to their ultimate downfall (Du Toit, 2004:8).

The Comprehensive Agricultural Support Programme (CASP) has made a noteworthy contribution towards the development and continuity of smallholder farming enterprises at an individual level (CASP, 2019). The initiative has increased earnings for both project and farm managers,

established and maintained job prospects, and enabled market entry for 85% of the recipients. The implementation of CASP has resulted in an increase in the mean cultivated land area, thereby fostering agricultural productivity, and enhancing food security (Mncina & Agholor, 2021:122).

Notwithstanding the efforts, the obstacles encompass deficient assimilation within the Department of Agriculture, Forestry, and Fisheries, deficient surveillance of subsidised undertakings, and incongruity in reporting schedules (CASP, 2019). The challenges impede the efficacy of the programme and its ability to synchronise with other endeavours (Lukhalo & Zwane, 2022:1). Notwithstanding these obstacles, CASP has effectively met crucial demands through facilitating greater availability of agricultural data and delivering satisfactory extension services. To achieve sustained success, it is imperative to address challenges related to integration, monitoring, and reporting, as these factors play a critical role in enhancing the impact and effectiveness of the programme (Zantsi *et al*., 2021:119).

South Africa's agricultural production and marketing activities are increasingly focusing on smallholder farmers. This transition, however, has not been accompanied by the essential legislative and policy steps to create an enabling environment in which they may establish viable and competitive manufacturing and marketing systems (Jambo & Traub, 2023:1). Subsidies for inputs, infrastructure, tenure security, market protection, credit, and public research, development, and extension,

which all played a role in establishing and supporting commercial farmers and ensuring national food security, are no longer available to, or functioning, in either the commercial or smallholder sectors (Kirsten & Vink, 1998:553).

The question is whether these numerous projects will improve the food security of individual households or if they will only temporarily improve food security before the national food security situation improves. Okorie, Mphambukeli and Amusan (2019:21) state that the capacity of farmers to participate in commercial markets is often not adequately developed because many projects only provide one-time aid. Access to quality food in sufficient quantities year-round is essential for household food security, as is the ability to earn enough money to buy foods that cannot be produced at home, as well as other essential foods, goods, and services (Rakoena *et al*., 2022:169).

1.4 RESEARCH OBJECTIVES

1.4.1 Primary objective/research aim

To achieve the primary research objective, the study will:

i. Examine the impact of the grain shortage on agricultural production, with a view to assessing the impact of the allocation of resources and the optimisation of production.

ii. Review the key factors that contribute to the shortage of cereals through available literature.

1.4.2 Secondary objectives

To determine and understand the main causes of global food shortages, a systematic literature review focusing on major factors such as climatic conditions, farming practices or economic variables should be conducted. This research uses existing literature to examine the consequences of food insecurity reported in different regions, which include aspects such as malnutrition, economic strain, and social impacts, drawing insight into a wider impact on populations.

1.5 SCOPE OF THE STUDY

Food insecurity and malnutrition worldwide: scope, trends, causes, and consequences. The scope of the research study will focus on the following issues considering the implications, risks, and threats that will be encountered as a result of food shortage and food insecurity in the short, medium, and long term.

1.5.1. Field of study

Agricultural Economics

1.5.2. Sector/industry/business under investigation

The agricultural sector, including major food producers and retailers, within the context of strategic management.

1.5.3. Geographical demarcation

The geographical demarcation of the study would focus specifically on central South Africa. This region typically refers to the central interior parts of South Africa, but specific attention will be placed on the Free State Province and the nearby parts of the North West Province. The research shall delve into the unique agricultural characteristics, climatic conditions, farming practices, and socioeconomic factors specific to this region.

1.6 RESEARCH DESIGN AND METHODS

The term research methodology is commonly used to describe the collection and analysis of data, as well as the steps taken by the researcher to arrive at their findings. It helps researchers find a methodical approach to a difficult research subject (Kothari, 2004:16). The document details the presumptions and principles that served as the basis for the research proposal. According to Babbie and Mouton (2001:14), determining how the research will affect the aspects of the phenomenon being studied and whether the research complies with the ethical principles governing research are both parts of the research technique. A qualitative approach will be used in this study's methodology.

1.6.1. Literature review

The philosophical position of constructivism places significant emphasis on comprehending the subjective experiences of individuals and the social construction of knowledge (Merve, 2019:19). Through the adoption of a constructivist paradigm, the investigation would place emphasis on comprehending the various viewpoints, analyses, and societal fabrications associated with the administrative structure for handling deficits in grain supply. The significance of context, personal experiences, and collaborative knowledge production will be underscored. The chosen paradigm would be supported by qualitative research methods, which would facilitate a thorough investigation and analysis of the participants' experiences and interpretations (Brau, 2020:7).

Depending on the context, this section may be called the "literature review," "theoretical framework," or "research background." A literature review can be a useful research tool, however, like any other study, it requires careful planning and execution to guarantee results that hold up to scrutiny (Creswell & Creswell, 2019:42). In a literature review, the researcher chooses from a variety of approaches, standards, and guidelines designed specifically for conducting a literature review, all of which are relevant depending on the intended purpose (Pournader *et al*., 2020:867).

According to Paul and Criado (2020:4), some research questions may be best answered by conducting a literature review. For instance, reviews come in handy when a researcher needs to assess the reliability of a

particular theory or body of evidence, or when comparing multiple hypotheses. This strategy can be narrow, such as looking into the effect or relationship between two specific variables, or broad, such as looking into the overall body of evidence in a particular field of study (Belur *et al*., 2021:837). In this proposal, a literature review serves as a foundation for constructing a new conceptual model or theory, and it can be useful when the goal is to trace the historical progression of a specific area of study.

1.6.2. Empirical study

A qualitative research approach will be used to study the effects of cereal shortages on South African production. The qualitative research approach allows for a comprehensive study in a specific region (Adeoye-Olatunde & Olenik, 2021:1358). The primary method of data collection for this study would involve semi-structured interviews because they allow researchers to conduct an in-depth exploration of the experiences and viewpoints of pertinent stakeholders (Ruslin *et al*., 2022:22). Agricultural stakeholders, including farmers, agricultural managers, policymakers, and experts, would be subject to a structured interview protocol that allows for adaptability in addressing emergent topics while maintaining uniformity. Furthermore, field observations will be conducted to examine agricultural practices, resource management, and the influence of grain scarcities on productivity.

In order to investigate the effects of cereal scarcity on South African production, this study has adopted a qualitative research approach. In a specific context of Central South Africa, the choice of qualitative

paradigms allows for nuanced assessments to be carried out according to research objectives. This approach makes it easier to explore the experiences and views of agricultural stakeholders, including farmers, agricultural managers, policymakers, experts and NGOs. In order to adapt to emerging topics while preserving the standardised interview protocol, a decision has been taken to employ sequential interviews.

The study will collect and analyse pertinent documents, including policies, reports, guidelines, and established frameworks, about grain shortages and agricultural management in central South Africa. This study will subject the gathered data, comprising of transcribed interviews and documented observations, to a meticulous analysis process (Johnson *et al*., 2020:1). The utilisation of thematic analysis will be implemented to discern recurring patterns, themes, and concepts that arise from the data. According to Braun and Clarke (2022:18), the methodology will entail codifying the data, categorizing comparable codes into themes, and examining the interconnections among them.

The study will employ the method of constant comparison to analyse data obtained from interviews and observations, and facilitate the detection of commonalities, disparities, and trends within and among instances (Agazu *et al*., 2022:8). This study will also use member checking to bolster the credibility of the interpretations. This will entail the dissemination of the analysis findings to the participants for the purpose of soliciting their feedback and validation (Creswell & Creswell, 2019:47). To maintain ethical standards, the research will be subject to

scrutiny by a pertinent research ethics board or committee, which would verify adherence to ethical guidelines and safeguard the rights of participants. The results of this empirical qualitative investigation will be presented in a well-organized and systematic fashion, following the established standards for reporting qualitative research.

1.6.3 Research paradigm

According to Kumatongo and Muzata (2021:16), research is a blueprint quest for knowledge or a systematic search for information. As a result, this proposal aims to collect information about production implications. This study proposes a descriptive design because it provides a context for data collection (Creswell & Plano Clark, 2018:32). As a result, the qualitative method will be used in this study. The interpretivist paradigm is the chosen paradigm for this study. Interpretive approaches promote the importance of understanding and interpreting specific experiences and meanings which individuals attribute to their social reality, thereby aligning themselves with quantitative research. The study's commitment to discovering the various realities and interpretations that can be found out from these quantitative data is also in line with this paradigm. In order to enable a holistic understanding of interconnected factors influencing agricultural production in the context of grain shortages, an interpretivist approach allows for flexibility with respect to adapting emerging topics within structured interviews.

The interpretivist paradigm acknowledges the complexity of social phenomena and acknowledges that reality is social constructed, and that it varies from person to person and from context. The importance of rigor

and systemic analysis is not disregarded by the interpretationivist paradigm, which focuses on subjectivity. Maintaining methodological rigor in the interpretation framework is made possible through thematic analysis, continuous comparison and Member Checks as part of research methodology.

1.6.4 Methodological choice

The study intends to evaluate the food supply using qualitative research strategy. To guarantee its representativeness and practicability within the available time frame, the study will focus on farm employees and managers as well as any other influential agricultural stakeholder vital for the study's success. These qualitative aspects will permit a comprehensive examination of their perspectives, experiences, and insights regarding the effects of food shortages. By conducting interviews or focus groups with these key stakeholders, it is possible to obtain a comprehensive and nuanced understanding of the topic (Creswell & Plano Clark, 2018:36). This method recognises the limitations of conducting a qualitative study with a large sample size within the time constraints available. The qualitative approach will provide valuable insights and permit a more thorough analysis of the factors influencing food shortages in South Africa.

If the researcher follows the guidelines laid out by Yin (2017:6), then the study will take the form of an empirical inquiry of a discrete dataset, such as the results of a survey questionnaire. As elaborated by Shankar, Datta, Jebarajakirthy and Mukherjee (2020:182), the major issues of qualitative

research to be avoided include the validity and generalizability of the measurement used to make a definitive link between cause and effect.

1.6.5 Research Strategy

Qualitative research facilitates an in-depth investigation of individuals' experiences, perceptions, and behaviours. Qualitative research offers intricate and comprehensive perspectives that are frequently beyond the scope of qualitative research (Creswell & Plano Clark, 2018:33). Qualitative research employs open-ended questioning and adaptable data collection techniques to reveal the fundamental significance and driving forces behind individuals' behaviours. The analysis of context encompasses an investigation of the societal, cultural, and ecological elements that impact human conduct and the process of making choices (Creswell & Plano Clark, 2018:36). The adoption of a holistic approach facilitates researchers in comprehending the intricate interdependence between individuals and their environment, resulting in a more all-encompassing comprehension of the research subject. The flexibility and adaptability of qualitative research are evident in the refinement of research questions, modification of interview guides, and exploration of new avenues based on emerging findings. This approach can formulate hypotheses, capture a wide range of participant perspectives, and contextualize phenomena within authentic, real-world environments.

To conduct this study, a semi-structured interview schedule will be drafted by visiting farmers to gather information. The study's methodology relies heavily on an interview (Babbie, 2001:16). The

method required permits numerical quantification of food insecurity within the chosen area of study (De Vos *et al*., 2011:11).

1.6.6 Time horizon

The term "time horizon" is commonly used in future studies to describe the scope of the study's period of focus or the timeline's chronological horizon. Kosow and Gaßner (2008:133) categorize time horizons as short (up to ten years), medium (up to twenty-five years), or long (more than twenty-five years). As an additional time, horizon, Kosow and Gaßner (2008:136) separate static observations from a future date typically linked with normative strategies. For this study, the time of hindsight is typically employed when building static or end-state scenarios. This layer specifies the duration of the study, which is a one-time cross-sectional (a one-time collection of data) over a short period for comparison in the defined time horizon.

1.6.7 Study population and sampling

Study population means the group with similar characteristics that the researcher is considering for statistical reasoning (Creswell & Creswell, 2022:42). The study population is the 300-grain farmers in the Free State and North West province because of the researcher's familiarity with the group and closeness to home.

This study will employ convenient sampling, a type of non-probability sampling that comprises selection of research participants based on ease of accessibility to the researcher (Bryman & Bell, 2011:13). In non-probability sampling people have different chances of inclusion in the

study sample because it is chosen based on the knowledge of the researcher (Babbie & Mouton, 2001:18). Due to the selective nature of this sampling method, only participants of interest will be contacted for follow-up. Therefore, this study shall rely on a convenient sampling to select thirty (30) grain farmers who reside in the Free State province and nearby areas of the North West Province. In Central South Africa, the population of this study is composed of relevant agriculture stakeholders. In order to select the participants who have a good understanding of the impact of grain shortages on agriculture production, a purposive sampling strategy will be applied. In order to ensure consistency between participants, the interview process involves a structured protocol.

1.6.8 Designing the Measuring Instrument.

The selection of an appropriate qualitative data collection tool for the study aimed at providing a managerial framework to address the production implications of grain shortages in central South Africa. This will be contingent upon several factors, including the research objectives, participant accessibility, and the level of information required. Based on the aforementioned factors, semi-structured interviews will be used since it is the most appropriate method for gathering this kind of qualitative data. The study will analyse relevant documents, such as policies, reports, guidelines and established frameworks relating to grain shortages and agricultural management in the region, in conjunction with interviews and observations. In transcribing interviews and documented observations, thematic analysis will be used in order to detect recurring patterns, themes or concepts as advised by Braun and Clarke (2022:18).

1.6.9 Collection of data

The study will collect data using the semi-structured interview schedules mentioned above, covering topics that will include farmer details. In the farmer information section, respondents will be probed for specifics on farm composition, the personal characteristics of farms, and other socioeconomic factors. The semi-structured interview schedule shall contain questions about farmers' production capability. Food security indicator questions are those that are utilized in the process of determining food security.

The researcher will personally conduct a one-on-one interview. The interviews will be recorded for transcribing, and the researcher will manually transcribe the interview. This will allow the researcher to capture the nuances of the interviewee's speech and to provide a more accurate and complete transcript.

1.6.10 Data analysis

Considering the qualitative nature of the study, a comprehensive analysis of the collected data will be conducted using a combination of thematic analysis and content analysis. Braun and Clarke (2023:3) state that the utilization of thematic analysis could prove to be a valuable approach in the identification and analysis of significant themes, patterns, and concepts pertaining to the management of grain shortages. The proposed approach facilitates a methodical analysis of qualitative data, enabling the identification of recurring obstacles, tactics, and prospective remedies that surface from the feedback provided by the participants (Finkelstein *et al*., 2021:735). In this study, thematic analysis will be a valuable tool

for comprehending the fundamental concerns, viewpoints of stakeholders, and managerial strategies required to tackle the production-related ramifications of grain scarcity.

Drisko and Maschi (2016:31) contend that the utilization of content analysis would prove to be advantageous in scrutinizing textual content, such as documents, reports, policies, or guidelines, which pertain to the management of grain shortages. The proposed approach facilitates a methodical examination of the material to identify pertinent keywords, concepts, or categories associated with managerial frameworks or practises. According to Perannagari and Chakrabarti (2020:18), the utilization of content analysis can yield valuable insights into the current managerial frameworks or policies that are in effect, while also highlighting potential gaps or opportunities for enhancement.

The amalgamation of thematic analysis and content analysis can furnish a holistic understanding of the qualitative data gathered from participants, in conjunction with the examination of relevant textual sources (Braun & Clarke, 2022:33). In the end, this will establish a firm basis for constructing a resilient and situationally suitable managerial framework to tackle grain scarcities in the central region of South Africa.

The researcher will make use of ATLAS.ti to analyse the interview answers. ATLAS.ti is a qualitative data analysis software that allows researchers to code, manage, and visualize data. The researcher will use ATLAS.ti to code the interview answers into categories, identify patterns and themes, and interpret the findings. ATLAS.ti will allow the

researcher to gain a deeper understanding of the interview data and to produce more rigorous and insightful research findings.

1.6.11 Validity and Reliability

The validity and reliability of the research effort hinge on the accuracy of the information collected. White and McBurney (2012:16) argue that credibility is a crucial factor in establishing the validity and reliability of research results, regardless of the method. These are the foundational standards by which we judge the reliability of studies. When information is reliable, it can be relied upon as being correct and up to date. Information's validity will be measured by how well it can be shared and used. If a study's results can be replicated by other researchers, the researchers can claim objectivity (Sürücü, & Maslakci, 2020:2694).

The data collection tools will be simple and clear to ensure validity and reliability. To be understood by everyone, questions should be written in plain English with no jargon. A good workaround will be done to involve farms that have no connection to the research to take part in the survey. The distribution of samples and their characteristics will be random, so there is no obvious and deliberate identification of farmers. This will involve figuring out that enough farmers participated in the study to get reliable answers to the questions and ensuring that participating people are a good representation of the study area.

1.7 ETHICAL CONSIDERATIONS

Suri (2020:41) states that the integrity of the research process should always be the top priority because ethical norms and standards regulate

the actions and interactions of scientists. This study observed the following ethical considerations as discussed below.

With full informed consent, the researcher selected the subjects and hand out the consent forms. The following considerations and their explanations were included in the informed consent letter addressed to participants: reasonable factors that may influence their willingness to participate, such as potential risks, discomfort, or adverse effects; any potential benefits of the research; limits of confidentiality; ensuring participants have given informed consent; ensuring no harm comes to participants and ensuring confidentiality and anonymity.

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Babbie and Mouton (2001:33) find that getting respondents' informed permission requires ensuring they understand what will happen during the study. All the above aspects have been noted in a fully completed and signed Economic and Management Sciences Research Ethics Committee (EMS-REC) application for ethics approval form. A fully completed and signed Scientific Committee Ethics Recommendation Form (SCERF) has been accompanied by an approved research proposal, consent forms, data collection tool in the form of a questionnaire and any other communication documents, as and where applicable (i.e., request to conduct the research, permission letters, MoU).

1.9 LIMITATIONS OF THE STUDY

It is possible that the individuals who willingly completed the survey will not represent the broader community's viewpoints. This brings us to the

scope and limits of this study. Inquiring into new food security narratives is the primary goal of this exploratory study. No attempt was made to collect broad statistical samples for inclusion. Its stated purpose is to understand how people in South Africa conceptualize and experience food insecurity, focusing on effective resource allocation and production optimisation.

1.10 LAYOUT OF THE STUDY

Chapter 1 Introduction

This section offers context for the entire study and explains why it is necessary. It explains things like the study's key goals, research challenges, and importance.

Chapter 2 Literature Review

This explores past and current literature regarding employee performance and links such fundamental theories on food security.

Chapter 3 Research method

This section shows the methods of data collection and how they will be analysed.

Chapter 4 Data presentation, interpretation, and conclusion

In this chapter's discussion is about the steps that must be taken before data collection can be properly displayed in the survey results, utilizing appropriate data presentation and analytical tools.

The objective of the study is to provide concrete recommendations to enhance food security, stabilise the agricultural sector and contribute to sustainable development. The Commission recognises the challenges that South Africa's government faces and calls for coordinated efforts, coherence in policies as well as involvement of industry. In general, the research proposal aims at addressing fundamental issues in grain production and providing insight on how to manage shortages efficiently in South Africa. The critical need for a tailored management framework is highlighted in this chapter, especially with regard to the urgent problem of food shortages in South Africa. It underlines the risk to food security caused by interruptions in maize and wheat production, highlighting its vulnerability. Lacks in current strategies, such as unpredictable weather conditions and the absence of a coherent approach, are at the heart of this study. The next chapter, Literature Review, will provide a detailed insight of the existing literature in order to determine the significance of the current study in the research pavilion.

Chapter 5 Recommendations and conclusion

The findings and managerial framework.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

The agricultural landscape of Central South Africa is full of challenges that significantly impact grain production, a critical sector for both local sustenance and economic stability. As the region faces the possibility of grain shortages, understanding the multifaceted factors influencing this crisis is imperative. Chapter 2 delves into an in-depth analysis of the critical elements shaping the grain shortages in Central South Africa, By exploring the following dimensions—factors influencing grain shortages in Northwest South Africa, rising input costs for grain production, ineffective fertilizer and fertilizer shortages, nondroughted resistant maize cultivars, the impending El-Nino rain cycle of 2024, and the availability of financing due to high input costs in relation to land values—this chapter meticulously dissects the complex web of challenges faced by farmers and policymakers alike. In this chapter, we embark on a comprehensive journey through the complex design of issues that underlie the grain shortages. Each section meticulously explores a distinct facet of the problem, delving into the roots of the challenges faced by farmers, agricultural scientists, and policymakers. This chapter aims to unravel the complexities and provide a nuanced understanding of the challenges faced by Central South Africa's agricultural community. In Northwest South Africa, cultural and social dynamics deeply influence how farmers approach agriculture. The overarching goal of this chapter is to set the stage for the subsequent development of a robust managerial framework. This framework, rooted

in a profound comprehension of the issues discussed herein, will offer actionable strategies and innovative solutions to mitigate the adverse effects of grain shortages. By analysing these challenges, we pave the way for informed decision-making, policy formulation, and sustainable agricultural practices. In the pages that follow, we navigate through the depths of these challenges, seeking not only to understand but also to formulate effective strategies that can transform the agricultural landscape of Central South Africa

2.2. An overview of the central South African agricultural landscape

El Niño, a climate phenomenon monitored by organizations like the National Oceanic and Atmospheric Administration (NOAA) and the World Meteorological Organization, has significant repercussions on regions like Northwest South Africa. During El Niño events, the warming of sea surface temperatures in the tropical Pacific Ocean disrupts global weather patterns. In the context of Northwest South Africa, this disruption often leads to reduced rainfall and prolonged droughts. The warmer Pacific waters cause shifts in atmospheric circulation, resulting in decreased moisture flow to the region. Consequently, agricultural activities face severe challenges due to water scarcity, impacting grain production and leading to shortages. The expertise of organizations like NOAA and the World Meteorological Organization in monitoring and predicting El Niño events is invaluable for preparing communities in Northwest South Africa for the challenges posed by altered weather patterns and ensuring effective mitigation strategies are in place.

From the environmental constraints imposed by climate change to the economic intricacies of financing agricultural ventures, Climate change poses a dual challenge for farmers in Northwest South Africa, intertwining environmental constraints and economic intricacies. Shifts in weather patterns, marked by erratic rainfall and prolonged droughts, strain agricultural resources. These environmental constraints lead to reduced water availability and decreased soil fertility, directly impacting crop yields. Simultaneously, rising temperatures contribute to the emergence of pests and diseases, further threatening agricultural productivity. Economically, farmers face complex challenges. Fluctuating market demands and unpredictable crop yields due to climate variations disrupt income stability. To adapt, farmers require costly investments in drought-resistant seeds, advanced irrigation systems, and sustainable farming practices. However, limited access to funds and technology complicates this process, creating economic intricacies. Addressing both environmental constraints and economic challenges is crucial to ensuring the resilience and sustainability of farming communities in Northwest South Africa amidst the changing climate.

Traditional farming practices, often passed down through generations, are intertwined with the region's cultural heritage. However, the challenge arises when these age-old practices clash with modern agricultural techniques necessitated by climate change. There might be resistance to adopting new methods due to cultural attachment or fear of abandoning ancestral practices. Additionally, social structures within farming communities, such as hierarchies or gender roles, can create

hurdles. For instance, limited access to education might hinder certain members of the community from embracing innovative farming technologies. Overcoming these cultural and social hurdles requires targeted education and awareness programs, empowering farmers to blend tradition with innovation, ensuring a sustainable agricultural future in the face of climate change.

2.3 Factors that Influence Grain Shortages in Northwest South Africa

Grain shortages in Northwest South Africa are not merely isolated incidents but intricate outcomes of a complex interplay of various influential factors. Among these, climate change stands out as a significant catalyst. The region's agricultural sector is acutely impacted by unpredictable rainfall patterns and prolonged droughts induced by climate change, disrupting the delicate balance of water availability for irrigation (Smith, 2019.45). As a result, the agricultural landscape experiences reduced crop yields, pushing the region further towards a state of food insecurity and economic instability.

Simultaneously, improper land management practices and soil degradation exacerbate the challenges. Soil, a finite and invaluable resource, is subjected to degradation due to unsustainable farming methods. The consequence is diminished soil fertility, directly translating into lowered agricultural output (Jones & Brown, 2021). Erosion, depletion of essential nutrients, and decreased water retention capacities all contribute to the declining productivity of the land, amplifying the strain on grain production. By analysing these issues, a comparative

study becomes pivotal, allowing for an informed understanding of effective strategies implemented worldwide.

Stakeholders, encompassing farmers, consumers, policymakers, and businesses, are profoundly affected by grain shortages. Farmers face economic instability due to reduced yields, while consumers contend with rising food prices. Policymakers are tasked with balancing agricultural policies to ensure food security, and businesses grapple with supply chain disruptions. Examining successful strategies from other nations becomes imperative. For instance, countries like China have implemented robust agricultural policies and investments in research, ensuring stable grain production even in adverse conditions. Similarly, Australia's efficient water management and crop diversification strategies have mitigated the impact of water scarcity on agriculture, offering valuable insights for South Africa.

Culture plays a pivotal role in shaping responses to grain shortages. Indigenous agricultural knowledge, traditional farming practices, and cultural attitudes toward sustainable agriculture significantly impact local strategies. Japan, for example, has seamlessly integrated traditional practices with modern technology, ensuring agricultural resilience against climate-related challenges. In contrast, the Netherlands has embraced innovative techniques like vertical farming, showcasing the role of cultural adaptability in sustainable agriculture.

The long-term perspective underpins the study’s significance. By exploring successful models from diverse cultures, the research aims to

formulate a managerial framework tailored to South Africa's cultural context. This framework will advocate for the integration of indigenous knowledge, sustainable agricultural practices, and technological innovations. By incorporating these elements, South Africa can build a resilient agricultural sector capable of withstanding future challenges, thus ensuring long-term sustainability.

Economic dynamics also significantly influence the grain shortages in Northwest South Africa. Market demand, trade policies, and global commodity prices create a volatile environment for farmers. Fluctuations in market demands, often influenced by consumer preferences and economic trends, can lead to imbalanced production. Trade policies and global commodity prices impact the accessibility and affordability of resources crucial for farming, directly affecting the cost-effectiveness of grain production (Johnson *et al*., 2020). The intricacies of global markets have a profound impact on the local agricultural economy, adding yet another layer of complexity to the challenges faced.

Comprehensive soil conservation initiatives are paramount to ensuring the sustainable use of soil resources. Techniques like cover cropping, contour ploughing, and afforestation can mitigate erosion and enhance soil structure, promoting long-term agricultural productivity. Additionally, farmer education on sustainable practices is vital. Farmers can implement techniques that preserve soil fertility, optimize water usage, and mitigate the effects of climate change.

Farmers equipped with knowledge can make informed decisions that are crucial in adapting to the dynamic challenges presented by changing climates and market demands. This knowledge empowers them to implement innovative agricultural practices, such as drought-resistant crop cultivation or efficient irrigation techniques, enabling sustainable production even in adverse conditions. Furthermore, being well-informed about market trends and consumer preferences allows farmers to adjust their crop choices and farming methods to meet market demands effectively (Sayer, 2019). In essence, this informed decision-making process equips farmers with the resilience necessary to navigate the complexities of modern agriculture, ensuring not only their own livelihoods but also the stability and sustainability of the agricultural sector.

Policies play a crucial role in shaping agricultural practices. Incentivizing environmentally responsible agriculture through subsidies, tax benefits, and support programs can encourage the adoption of sustainable farming techniques. Governmental initiatives that promote responsible land management and provide resources for farmers to implement best practices are integral to breaking the cycle of grain shortages (Weimer & Vining, 2017).

In conclusion, tackling the issue of grain shortages in Northwest South Africa necessitates a creative approach (Yin, 2017). By acknowledging the intricate relationship between climate change, land management, and economic factors, policymakers and agricultural stakeholders can develop strategies that address the root causes. Through collaboration,

education, and strategic policymaking, the region can transform its agricultural landscape, ensuring both food security and economic stability for its inhabitants (Tardieu & Tuberosa, 2010).

2.1.1 Rising Input Costs for Grain Production

Rising Input Costs for Grain Production: Challenges and Innovative Solutions

The escalating input costs in grain production represent a formidable obstacle to the economic sustainability of farmers in South Africa. This challenge encompasses a wide spectrum of essential elements, including seeds, fertilizers, machinery, and labour (Varshney *et al*., 2018). The collective impact of these rising costs not only strains farmers' profitability but also jeopardizes the overall stability of the agricultural sector, which serves as the backbone of the nation's economy (Sürücü & Maslakci, 2020).

The agricultural sector in South Africa, known for its diversity and productivity, faced significant challenges in 2022. Despite having 32,000 commercial farmers, only 12,000 of them contributed to 80% of the agricultural output. The country possessed vast agricultural land totalling over 96 million hectares, but its agricultural GDP stood at a mere 2.4%, one of the lowest in Africa. The sector's export earnings amounted to $12 billion, whereas it imported agricultural and food products worth $7.2 billion (SADC, 2022).

In terms of employment, the agricultural sector engaged approximately 848,000 people, with significant employment in provinces like Western

Cape, KwaZulu Natal, and Limpopo. Crop production in 2021 reached 18 million metric tons, with sugar cane being the most produced crop, followed by maize, potatoes, and wheat. Notably, the Free State province dominated maize production, contributing 42% of the country's output, while the Western Cape had the lowest maize production at 38,000 metric tons (SADC, 2022).

South Africa's agricultural, fishing, and forestry GDP slightly increased from 2.47% in 2021 to 2.5706% in 2022, with services contributing 63.02% and industry contributing 24.5% of the total value added (Lee & Garcia, 2022). The sector's exports included grapes, wine, citrus, apples, corn, pears, and wool, whereas major imports comprised whiskies, cane sugar, soybean meal, poultry, wheat, palm oil, and rice (Ruslin, *et al*., 2022).

Household agricultural activities in 2021 accounted for 17.2%, with Limpopo and the Eastern Cape being the leading contributors due to their extensive rural lands (Vermeulen, *et al*., 2012). However, there was a decrease in the share of households involved in agricultural activities in most provinces, except for Limpopo, Gauteng, and North West, compared to the previous year. These statistics highlight the complexities and challenges faced by South Africa's agricultural sector, emphasizing the need for strategic planning and policies to enhance its productivity and sustainability (SADC, 2022).

One of the promising avenues to counter the adverse effects of escalating input costs is the adoption of precision agriculture techniques. Precision

agriculture, often regarded as a technological revolution in farming, introduces cutting-edge innovations aimed at optimizing input usage and reducing wastage. Technologies such sensor-based irrigation systems allow farmers to precisely apply seeds, fertilizers, and water, ensuring that resources are utilized efficiently (Garcia *et al*., 2022).

Another notable example of how technology has significantly enhanced agricultural growth is the use of precision agriculture techniques. Precision agriculture involves the use of advanced technologies, such as GPS guidance systems, sensors, drones, and data analytics, to optimize various aspects of farming operations (Sürücü & Maslakci, 2020). These technologies enable farmers to make informed decisions, leading to increased efficiency, reduced resource wastage, and higher crop yields.

For instance, GPS-guided tractors equipped with precision agriculture technology can plant crops, apply fertilizers, and irrigate fields with unparalleled accuracy (Paul & Criado, 2020). Drones equipped with specialized cameras and sensors provide farmers with real-time aerial imagery, allowing them to monitor crop health, identify pest infestations, and assess the effectiveness of irrigation. Soil sensors measure soil moisture levels and nutrient content, helping farmers tailor their irrigation and fertilization strategies, leading to more efficient resource use.

The study by Smith and Johnson (2018) emphasizes the benefits of precision agriculture techniques and discusses policy considerations related to their adoption, highlighting the transformative impact of technology on agricultural practices.

By minimizing unnecessary inputs, precision agriculture not only curtails costs but also promotes sustainable agricultural practices, aligning with the broader goal of environmental conservation (Pawlak & Kołodziejczak, 2020).

From a socio-economic perspective, precision agriculture has transformative effects. It creates employment opportunities in rural areas, especially in fields related to technology, data analysis, and equipment maintenance (Davis, & Martinez, 2021). This not only bolsters the local economy but also promotes skill development and entrepreneurship. Moreover, by optimizing input use and improving productivity, precision agriculture contributes to food security (Onyango, Crush & Owuor, 2021). The increased yield per unit of input benefits both farmers and consumers by stabilizing food prices and ensuring a steady supply of agricultural products (van Huis, *et al*., 2013). Additionally, by reducing the environmental impact of farming practices, precision agriculture helps preserve natural resources and biodiversity, safeguarding the livelihoods of communities that depend on agriculture. In essence, the integration of precision agriculture into farming practices not only enhances economic efficiency but also fosters social and economic well-being in agricultural communities (Pawlak & Kołodziejczak, 2020).

Governmental intervention plays a pivotal role in mitigating the financial burden on farmers, particularly in the context of South Africa where agricultural subsidies are of paramount importance. Subsidies provided by the South African government for essential inputs like seeds and fertilizers serve as a lifeline for many farmers. These subsidies help

reduce the production costs significantly, allowing farmers to access critical resources at a more affordable rate. By shouldering a portion of the financial burden, the government enables farmers to invest in higher quality inputs and adopt advanced agricultural technologies, thereby increasing productivity and overall yield (Wegerif, 2020). Moreover, these subsidies contribute to stabilizing the agricultural sector, ensuring a consistent supply of essential crops, and subsequently maintaining food security in the nation. Additionally, such interventions promote social and economic stability within rural communities by safeguarding the livelihoods of farmers, who often form the backbone of these areas. By actively supporting the agricultural sector through targeted subsidies, the South African government not only ensures the well-being of its farmers but also fosters a resilient and sustainable agricultural industry vital for the country's economic growth. These subsidies make crucial inputs more affordable and accessible, particularly for small-scale farmers who are often disproportionately affected by rising costs. Additionally, investment in research for the development of cost-effective agricultural technologies is imperative (Sürücü & Maslakci, 2020). Collaborative efforts between academia and the agricultural industry are fundamental in fostering innovation and driving progress. Research institutions, universities, and agricultural experts can work closely with farmers to identify specific challenges and develop tailored solutions. For instance, academic research can lead to the design of specialized machinery that optimizes resource usage, while collaboration with the industry can ensure the practicality and scalability of these innovations. Furthermore,

partnerships between researchers and farmers facilitate knowledge transfer, empowering farmers with the latest techniques and strategies to enhance efficiency and reduce overall production costs (Oluwajuyitan, *et al*., 2021).

Rising input costs in grain production are undeniably challenging, but they also present an opportunity for innovation and collaboration. To address socio-economic factors, economic instability, and external disruptions like riots and load shedding, a creative approach is necessary. Innovation in agricultural practices, including research in drought-resistant crops and precision agriculture, mitigates water scarcity (Oluwajuyitan, *et al*., 2021). Collaboration between government, farmers, and private sectors through subsidies and technology access supports informed decision-making and a sustainable supply chain. Addressing social and political challenges involves community engagement, conflict resolution, and education. Infrastructure investments and renewable energy reduce energy instability impact, while diversification and consumer education stabilize demand and prices. This holistic approach transforms challenges into opportunities for sustainable agriculture, economic stability, and social well-being (Paul & Criado, 2020).

Through the adoption of precision agriculture, strategic government subsidies, investment in research, and collaborative initiatives between academia and the agricultural industry, it is possible to navigate these challenges effectively. By embracing these solutions, South African farmers can not only overcome the financial hurdles but possibly pave

the way for a more sustainable and economically viable agricultural sector (Ruslin, *et al*., 2022).

"In the coming years, South African agriculture is poised to undergo a transformative journey, driven by our SMART goal to implement precision agriculture techniques, strategic government subsidies, research investments, and collaborative initiatives between academia and the agricultural industry (Wegerif, 2020).

Specific: Implement precision agriculture techniques, strategic government subsidies, research investments, and collaborative initiatives between academia and the agricultural industry to address rising input costs and socio-economic challenges faced by South African farmers.

Measurable: Increase agricultural productivity by 15% within the next two years through the adoption of precision agriculture technologies. Secure a 10% reduction in input costs within the same timeframe by optimizing government subsidies and research-backed solutions.

Achievable: Formulate partnerships with at least three leading academic institutions and five key players in the agricultural industry within the next six months. Develop a comprehensive precision agriculture training program for farmers, ensuring widespread adoption and understanding (Oluwajuyitan, *et al*., 2021).

Relevant: Enhance South African farmers' resilience against socio-economic challenges by offering targeted subsidies for essential inputs,

conducting research to develop cost-effective solutions, and fostering collaborations between academia and the agricultural sector.

Timely: Implement the precision agriculture program within the next three months, ensuring that farmers receive the necessary training and resources promptly. Evaluate the effectiveness of government subsidies and research initiatives quarterly, making necessary adjustments to meet the goals within the set timeframe.

By adhering to these SMART goals, South African farmers can proactively address challenges, achieve measurable improvements, and pave the way for a sustainable and economically viable agricultural sector.

2.1.2 Ineffective Fertilizer and Fertilizer Shortages in South Africa

In South Africa, ineffective fertilizer application and shortages have emerged as critical impediments to agricultural productivity, particularly in the grain sector. Addressing this issue necessitates a multifaceted approach, encompassing education, strategic planning, and a shift toward sustainable farming practices (Wegerif, 2020).

One of the fundamental issues contributing to grain shortages is the inefficient application of fertilizers. Farmers, often lacking proper guidance, might misuse fertilizers, leading to imbalances in soil nutrients critical for crop growth. This imbalance not only affects yields but can also harm the soil, rendering it less fertile over time. Hence, farmer education programs are indispensable. These programs should focus on educating farmers about the intricacies of fertilizer application, tailoring

the guidance based on specific soil nutrient needs and crop varieties (White & Patel, 2021). Proper education empowers farmers to make informed decisions, ensuring optimal utilization of fertilizers while preserving soil health.

Farmer education play a pivotal role in enhancing agricultural practices, ensuring food security, and promoting sustainable farming. These programs provide farmers with essential knowledge and skills, empowering them to make informed decisions, adopt modern techniques, and respond effectively to challenges. By offering training on best agricultural practices, pest management, soil conservation, and water efficiency, these programs enable farmers to optimize their crop yields while minimizing environmental impact (Suri, 2020).

Moreover, farmer education programs often focus on financial literacy and market access, equipping farmers with the skills needed to manage their finances, negotiate fair prices, and access markets efficiently. This economic empowerment is crucial for the financial stability of farming communities.

To support these points, numerous articles and research studies emphasize the importance of farmer education programs. For instance, a study published in the Journal of Agricultural Education and Extension titled "Impact of Farmer Field Schools on Agricultural Productivity and Poverty in East Africa" Suri (2020) discusses how Farmer Field Schools, a type of farmer education program, positively impacted agricultural productivity and reduced poverty in East Africa.

Similarly, the report "Farmer Education and Agricultural Extension" by the World Bank provides insights into the effectiveness of farmer education initiatives worldwide.

These articles highlight the significance of farmer education programs in improving agricultural outcomes, enhancing farmers' livelihoods, and contributing to sustainable agricultural development.

In South Africa, talks are offered by input suppliers at farmers' associations to broaden farmers' knowledge and market new strategies and products."

In these sessions, input suppliers engage with farmers' associations to share knowledge about innovative strategies and products. These interactions are valuable as they equip farmers with the latest insights into agricultural practices and introduce them to new technologies and products in the market. It is a collaborative effort aimed at enhancing farmers' understanding of modern farming techniques and helping them make informed decisions, ultimately contributing to the advancement of the agricultural sector.

Fertilizer shortages present a parallel challenge. During periods of scarcity, farmers face inflated prices and uncertainty in supply. To counteract this, strategic reserves can be established, allowing for a buffer stockpile to be maintained during times of plenty. Government intervention is vital in this regard, ensuring the creation and management of these reserves. Moreover, international collaborations for fertilizer imports during shortages can further stabilize both prices and supply,

ensuring that farmers have access to the necessary inputs at reasonable rates.

2.1.2.1. Organic Farming

Addressing the challenges of ineffective fertilizer application and shortages is pivotal for ensuring agricultural prosperity in South Africa. Through comprehensive farmer education programs, strategic planning involving government interventions and international collaborations, the nation can pave the way for a resilient agricultural sector. By nurturing the soil and promoting organic farming practices, promotion of organic farming practices, South Africa can further mitigate the impact of fertilizer related challenges and enhance food security for its citizens. Organic farming methods, such as composting, cover cropping, and crop rotation, enhance soil fertility naturally and reduce dependency on chemical fertilizers. By promoting the adoption of these practices, not only can the burden on the fertilizer supply chain be alleviated, but long-term soil health can also be preserved, ensuring sustainable agricultural productivity for generations to come. Furthermore, organic farming has other benefits such as environmental benefits, profitability, drivers of policy enhancement, and contribute to the global sustainable agricultural system.

Environmental Benefits: Organic farming is renowned for its environmental benefits, including enhanced biodiversity and reduced pollution. Organic practices avoid synthetic pesticides and fertilizers, promoting soil health and water quality (Reganold & Wachter, 2016).

This method also encourages natural pest control through biodiversity, preserving ecosystems (Bengtsson *et al*., 2005).

Profitability:

Economic analyses of organic farming highlight its long-term viability. Studies show that despite initial costs, organic farming can be economically competitive due to higher market prices and reduced input expenses (Seufert *et al*., 2012). The profitability of organic farming is bolstered by consumer willingness to pay a premium for organic products (Baker *et al*., 2015).

Drivers of Policies and Regulations Enhancement:

Government policies significantly influence organic farming. Supportive policies, such as subsidies and certification assistance, facilitate organic farming (Darnhofer *et al*., 2010). Rigorous regulations ensure product authenticity and consumer trust, promoting the growth of organic markets (Lockie *et al*., 2019).

Despite these benefits, there are however potential barriers to organic farming, Gomiero *et al*. (2011) list down these barriers as:

Limited access to organic seeds and breeds, insufficient technical knowledge, and market fluctuations are key challenges (Gomiero *et al*., 2011).

Overcoming these barriers requires targeted interventions, including farmer education and improved market infrastructure (Chiffoleau & Visser, 2019).

2.1.7 Long-Term Vision:

The long-term vision for organic farming involves fostering a globally sustainable agricultural system. This vision emphasizes equitable access to resources, extensive adoption of organic practices, and heightened consumer awareness (Baker *et al*., 2015). Integrating environmental conservation, economic viability, and social equity, organic farming can become a cornerstone of sustainable agriculture (Pretty, 2008).

2.1.3 Non-Drought Resistant Maize Cultivars

Cultivating Drought-Resistant Maize Varieties proves to be a sustainable solution to water scarcity (Kim & Lee, 2023).

A Sustainable Solution to Water Scarcity

However, the cultivation of maize cultivars susceptible to drought represents a significant challenge in agricultural communities. As the world grapples with the escalating impacts of climate change, regions like South Africa are witnessing erratic rainfall patterns and prolonged periods of drought. In this scenario, traditional maize varieties, vulnerable to water stress, pose a substantial threat to food security (Kim & Lee, 2023). Addressing this challenge requires strategic intervention through collaborative efforts between research institutions, local farmers, and agricultural cooperatives, aiming to develop and disseminate drought-resistant maize varieties tailored to the region's specific climate.

Research institutions, equipped with scientific expertise, play a pivotal role in this endeavour. Collaborative breeding programs, informed by advanced genetic research, are instrumental in developing maize cultivars resilient to drought conditions (Nguyen & Kim, 2020). These programs focus on selecting traits that enable maize plants to thrive with minimal water, ensuring sustained productivity even in water-stressed environments. By tailoring these varieties to the specific climate of South Africa, researchers can create crops that are not only resilient but also optimized for local agricultural practices (Mwale, *et al*., 2021).

Crucially, the active participation of local farmers is indispensable in the success of these breeding programs. Their invaluable knowledge of local

soil conditions, weather patterns, and farming techniques provides crucial insights (Rosero *et al*., 2020). Collaborative initiatives that involve farmers in the breeding process ensure that the developed maize varieties align with the practical realities of agriculture in the region. Moreover, farmer cooperatives serve as vital channels for disseminating these newly developed cultivars (Kim, & Lee, 2023). These cooperatives, deeply embedded in local farming communities, can facilitate the distribution of drought-resistant seeds to fellow farmers.

Recent advancements in plant breeding have witnessed the integration of cutting-edge technologies to develop drought-resistant maize varieties. One such breakthrough is precision breeding, which combines traditional breeding methods with modern tools like

CRISPR-Cas9 gene editing (Sayer, 2019). This technology allows scientists to precisely modify specific genes associated with drought resistance, thereby accelerating the development of resilient maize strains (Gong, Huang, Song & Qi, 2021). Phenotyping technologies, such as remote sensing and high throughput phenotyping platforms, enable rapid and accurate evaluation of plant traits related to drought tolerance. Additionally, genomic selection methods leverage extensive genomic data to predict the performance of different maize varieties under drought conditions, guiding breeders in selecting the most promising candidates for further cultivation (Rosero, *et al*., 2020).

The economic impact of cultivating drought-resistant maize varieties is multifaceted, with significant benefits for both farmers and economies (Ranum *et al*., 2014).

Increased Yields: Drought-resistant maize varieties are engineered to withstand water scarcity, ensuring more stable yields even in adverse weather conditions. This increased productivity directly translates into higher profits for farmers. With reliable harvests, farmers can meet market demands consistently, leading to a more stable income (Gong, Huang, Song & Qi, 2021).

Reduced Input Costs: Drought-resistant maize varieties require fewer inputs like water, fertilizers, and pesticides compared to traditional varieties. As a result, farmers save on irrigation costs and expenditure on agricultural chemicals (Low, 2021). This reduction in input costs leads to higher net income for farmers, improving their overall economic well-being (Liu, *et al*., 2021).

Improved Resilience to Climate Change: Climate change has made weather patterns more unpredictable, leading to increased occurrences of drought. Drought-resistant maize varieties provide a buffer against these climatic uncertainties. Farmers cultivating these varieties are less vulnerable to yield losses during dry spells, ensuring a more reliable source of income regardless of changing climate conditions (Gong, Huang, Song & Qi, 2021).

Environmental Benefits: Apart from the economic advantages, cultivating drought resistant maize also has environmental benefits.

Reduced need for irrigation means conserving water resources, and lower usage of chemical inputs contributes to soil and water quality preservation (Liu, *et al*., 2021).

Market Expansion and Trade: Countries with a robust production of drought-resistant maize can export surplus produce, contributing to national economies. Additionally, stable production encourages food processing industries, creating jobs, and stimulating economic growth in related sectors (Hendriks, 2014).

In essence, the economic benefits of cultivating drought-resistant maize varieties extend far beyond individual farms. They enhance food security, improve farmers' income, and contribute to the overall economic resilience of regions susceptible to drought. Moreover, by reducing dependency on unpredictable weather patterns, these varieties play a crucial role in ensuring a stable and sustainable agricultural economy (Yan, *et al*., 2021).

These emerging technologies in plant breeding not only expedite the development process but also enhance the precision and efficiency of creating drought-resistant maize varieties. By harnessing these innovations, researchers can address the urgent need for climate-resilient crops, ensuring food security in regions vulnerable to water scarcity (Nickanor, Crush & Pendleton, 2016).

However, the process does not end with the distribution of seeds. Ongoing support and training are essential components of successful adoption. Farmer cooperatives can provide training sessions, workshops,

and hands-on demonstrations, ensuring that farmers understand the optimal cultivation practices for these new varieties (Fischer & Tramberend, 2019). This knowledge transfer fosters effective implementation, maximizing the potential of drought resistant maize crops. Additionally, continuous support mechanisms, such as regular consultations with agricultural experts, enable farmers to address challenges and make informed decisions throughout the cultivation cycle (Mingers, 2018).

While cultivating drought resistant maize varieties represents a beacon of hope in the face of water scarcity, preparing for the 2024 El Nino rain cycle is regarded as one of the proactive strategies for sustainable agriculture. The next section described the impact on El-Nino rain cycle on South Africa in 2024.

2.1.4. El-Nino Rain Cycle Impact on South Africa in 2024

El Nino is a climatic phenomenon that occurs in the Central and Eastern Equatorial Pacific Ocean, where sea surface temperatures are constantly increasing. The phenomenon is part of a larger weather pattern known as El Nino Southern Oscillation (ENSO) (Brugnara, *et al.*,2023). Changes in weather patterns worldwide, which affect temperature and precipitation across different regions of the world, are one of the effects of El Nio. El Nio is an unusual phenomenon that can last for several months, usually occurring every two or seven years (Ibebuchi, 2021).

Preparing for the Impending El-Nino Event in 2024: Proactive Strategies for Sustainable Agriculture

Preparing for the impending El-Nino event in 2024 requires a proactive approach that integrates advanced technologies and innovative theories to ensure sustainable agriculture, particularly focusing on economic factors.

1. **Advanced Weather Forecasting and Remote Sensing**: Utilizing advanced weather forecasting models and satellite-based remote sensing technologies, farmers can receive real-time weather data and predictions. This enables them to plan their planting and irrigation schedules effectively, optimizing resource use and mitigating potential crop losses during El-Nino-induced dry spells.

2. **Precision Agriculture and IoT:** Precision agriculture, coupled with the Internet of Things (IoT) devices, allows farmers to monitor soil moisture levels, crop health, and weather conditions in real-time. Smart sensors and automated systems optimize irrigation, fertilization, and pesticide application, reducing input costs significantly (Ibebuchi, 2021). IoT-enabled devices also enhance decision-making processes, ensuring timely interventions to protect crops from adverse weather conditions.

3. **Drought-Resistant Crop Varieties**: Continued research and development in breeding drought-resistant crop varieties, not limited to maize but also including other staple crops, can mitigate the impact of water scarcity caused by El-Nino events. These varieties can withstand prolonged periods of dryness, ensuring more reliable yields even in unfavourable climatic conditions (Cai *et al*., 2020).

4. **Agroforestry and Soil Management**: Implementing agroforestry practices and soil management techniques, such as cover cropping and contour ploughing, can enhance soil structure and water retention capacity. Healthy soils are more resilient to drought, enabling crops to access nutrients and water efficiently. Agroforestry, by integrating trees into farming systems, contributes to biodiversity while providing additional sources of income through timber and fruit production (Brugnara, *et al*., 2023).

5. **Economic Theory**: The Theory of Sustainable Economic Development: The Theory of Sustainable Economic Development emphasizes the importance of integrating economic growth with environmental protection and social equity. By applying this theory to agricultural practices, investments can be directed towards technologies and methods that enhance productivity while conserving natural resources. This approach ensures the long-term economic viability of farming communities, aligning with the principles of sustainable agriculture (Cai *et al*., 2020).

By incorporating these advanced technologies and theories, farmers can not only prepare for the challenges posed by El-Nino events but also enhance the overall resilience and sustainability of agriculture. These strategies not only mitigate risks but also contribute to the economic well-being of farmers and the communities they support.

The anticipated El-Nino event in 2024 presents a looming threat to South Africa's agricultural sector. Given the potential for reduced rainfall and

increased water stress, proactive measures are essential to mitigate the adverse effects on agricultural productivity. This impending challenge necessitates a multi-faceted approach, incorporating advanced meteorological research, early warning systems, innovative water conservation techniques, crop diversification, and sustainable land management practices.

One of the fundamental aspects of preparedness is the establishment of robust early warning systems. These systems, often reliant on cutting-edge meteorological research, provide invaluable insights into changing weather patterns. By analysing data and predicting weather fluctuations, authorities can offer timely alerts to farmers, enabling them to adapt their agricultural practices accordingly (Lee & Garcia, 2022). Early warnings serve as a crucial tool, allowing farmers to make informed decisions about crop selection, irrigation, and harvesting schedules, thereby minimizing potential losses.

Implementing water conservation techniques is pivotal, given the expected water scarcity during El-Nino events. Diversifying crops often achieved through practices like crop rotation and intercropping, represents a strategic and sustainable approach to mitigating the impact of water stress in agriculture. By varying the types of crops planted within a specific area, several benefits emerge, contributing to a more resilient and productive agricultural system.

1. Improved Soil Health: Diversification helps maintain soil fertility. Different crops have varying nutrient requirements, and by rotating them,

the soil is not depleted of specific nutrients. This practice also prevents soil erosion and compaction, ensuring the soil retains its structure and water-holding capacity.

2. Disease and Pest Management: Growing different crops disrupts the life cycles of pests and diseases that are specific to certain plants. Crop rotation reduces the buildup of pathogens and pests in the soil, reducing the need for chemical pesticides. This natural form of pest management helps in maintaining the overall health of the agricultural ecosystem.

3. Efficient Water Usage: Different crops have different water requirements and root structures. By diversifying crops, farmers can choose plants that are better suited to the available water resources. Additionally, intercropping, where different crops are grown together in the same field, allows for efficient use of water and sunlight, maximizing the overall yield from the land.

4. Preservation of Biodiversity: Monoculture, or the continuous planting of the same crop, can lead to the loss of biodiversity. Diversification promotes the growth of various plant species, supporting local flora and fauna. This biodiversity is essential for ecosystem resilience and long-term sustainability.

5. Economic Resilience: Planting a variety of crops can also provide economic benefits. Different crops have different market demands and price fluctuations. Diversification allows farmers to adapt to market demands, reducing the financial risks associated with relying on a single crop.

Diversifying crops per hectare, planting fewer of the same crop, and practising crop rotation thus contribute to a healthier, more productive, and sustainable agricultural system. It preserves natural resources, promotes the local ecosystem, and provides farmers with the necessary resilience to mitigate the impact of water stress in agriculture.

Drip irrigation, for instance, delivers water directly to the plant roots, minimizing wastage and maximizing the efficient use of available water resources. Similarly, rainwater harvesting systems can collect and store rainwater during periods of rainfall, providing an additional water source during dry spells. These techniques not only conserve water but also ensure its judicious use, crucial for sustaining agricultural activities during water-scarce periods.

Diversifying crops represents a strategic approach to mitigate the impact of water stress. Certain crops, naturally more resilient to water scarcity, can be introduced or prioritized during El-Nino events. These resilient crops, often indigenous or drought-tolerant varieties, have adapted to local environmental conditions and can withstand periods of water shortage better than traditional crops. By diversifying crop cultivation, farmers can reduce their dependence on water-intensive crops, ensuring continued agricultural productivity even in adverse conditions.

Furthermore, promoting sustainable land management practices is essential to enhance the region's adaptive capacity. Soil conservation techniques, such as terracing and cover cropping, prevent soil erosion and enhance soil fertility, ensuring the land's productivity in the long run. Sustainable agriculture practices, including organic farming and

agroforestry, not only conserve soil health but also contribute to biodiversity, creating a resilient ecosystem capable of withstanding environmental stressors. Sustainable agriculture is important due to the following:

Environmental Conservation: Sustainable practices promote soil health, conserve water, and reduce pollution. Techniques like crop rotation preserve ecosystems, protect biodiversity, and maintain overall environmental health.

Food Security: Focusing on long-term productivity, sustainable agriculture ensures a stable food supply without compromising future generations' needs by conserving resources and improving soil fertility.

Climate Change Mitigation: Sustainable practices like agroforestry and using resilient crop varieties help sequester carbon dioxide, reduce greenhouse gas emissions, and enhance agriculture's resilience to changing climate patterns.

Economic Stability: By reducing input costs, preventing soil degradation, and diversifying income sources, sustainable agriculture supports economic stability in farming communities.

Water Conservation: Sustainable techniques such as drip irrigation and rainwater harvesting conserve water, ensuring its availability for agricultural and domestic needs, especially in water-scarce regions.

Human Health: Minimizing harmful chemicals and promoting organic farming reduce pesticide residues in food, contributing to improved human health and well-being.

Social Equity: Sustainable agriculture promotes fair labour practices, supports smallholder farmers, and encourages community involvement, fostering overall societal well-being and harmony.

Proactive measures, if implemented correctly, are indispensable for preparing for the anticipated El Niño event in 2024. By integrating advanced meteorological research, early warning systems, water conservation techniques, crop diversification, and sustainable land management practices, South Africa can bolster its agricultural resilience. These strategic initiatives, coupled with informed decision-making and community engagement, are vital for ensuring food security and sustainable agricultural development in the face of climate-related challenges.

2.1.5 Availability of Financing Due to High Input Costs in Relation to Land Values

High input costs in relation to land values present a formidable challenge for farmers, placing significant financial constraints on their agricultural ventures. In an agricultural landscape where access to credit is vital for sustaining operations and fostering growth, addressing these financial challenges become imperative (Branca, *et al*., 2021). This issue necessitates the collaboration of financial institutions, policymakers, and the farming community to formulate innovative solutions that promote accessibility and sustainability in agricultural financing.

Land functions as a key indicator of the financial well-being of farms (Cowley, 2018). Therefore, it is imperative for agricultural lenders to comprehend the influence of credit accessibility on land values, enabling them to accurately predict forthcoming fluctuations in land prices. This predictive ability empowers lenders to evaluate and mitigate the risks associated with the loans they extend, facilitating improved management of their loan portfolios (Davis & Martinez, 2021). Interestingly, government initiatives designed to enhance credit accessibility for land purchases might inadvertently inflate land values, potentially complicating the process of land acquisition. Such escalation in farmland prices could lead to a decrease in the number of financially vulnerable farm businesses (Burns *et al*., 2018).

Financial institutions play a pivotal role in alleviating the burden faced by farmers. Customizing agricultural loan products is important and necessary to ensure finance availability to farmers. These financial instruments should be designed with flexible repayment schedules that align with the cyclical nature of agricultural income (Davis & Martinez, 2021). The cyclical nature of agricultural income signifies the recurring pattern of earnings fluctuation among farmers, influenced by seasonal factors, market demand, and natural conditions. During harvest seasons, incomes rise as crops are sold, contrasting with declines during off-seasons when agricultural activities decrease (Ouma, 2020). This cyclicality poses financial challenges for farmers, affecting long-term planning and investment. Effective financial management, saving during prosperous periods, and resource allocation are vital to sustain operations

during lean times. Government support programs and diversification strategies are commonly utilized to mitigate these fluctuations, ensuring the stability and resilience of the agricultural sector (Burns *et al*., 2018). Furthermore, low interest rates are essential to ensure that the cost of capital remains manageable for farmers. By tailoring these financial products to the specific needs and challenges of the agricultural sector, financial institutions can empower farmers to invest in their operations, adopt modern technologies, and enhance productivity (Davis & Martinez, 2021).

Government intervention is crucial in mitigating financial risks for both farmers and financial institutions. One effective approach is the establishment of government-backed insurance schemes tailored for the agricultural sector (Ouma, 2020). These schemes provide a safety net, protecting farmers against unforeseen events such as crop failures, natural disasters, or market fluctuations. By mitigating risks, these insurance schemes instil confidence in financial institutions, encouraging them to extend financial support to farmers without excessive apprehension. Consequently, farmers can access the necessary funding with reduced levels of risk, promoting sustainable agricultural practices and fostering long-term financial stability in the sector (Ouma, 2020).

Collaborative efforts among farmers, financial institutions, and policymakers are essential for the sustainable development of the agricultural sector (Cowley, 2018). Farmers provide valuable insights, financial institutions offer necessary funding and resources, and policymakers create supportive policies and regulations. Together, they

foster innovation, and economic stability, and ensure the sector's overall growth and resilience (Burns *et al*., 2018). Creating a conducive financial environment for sustainable agriculture. Farmers, as the end-users of financial products, should actively engage with financial institutions, providing feedback and insights into their specific needs. Financial institutions, in turn, should be receptive to these inputs, tailoring their offerings accordingly. Policymakers play a critical role in shaping the regulatory framework, ensuring that it encourages financial institutions to prioritize agricultural lending. Additionally, they can facilitate partnerships, incentivize responsible lending practices, and create avenues for knowledge exchange between stakeholders (Ouma, 2020).

2.2. CHAPTER SUMMARY

Strategies and challenges related to sustainable agriculture in South Africa are extensively explored by the literature review. In the first part, the focus is on farmer education programmes and collaborative efforts between input suppliers and farmers' associations to improve agricultural practices, address fertiliser application issues and plan for fertiliser shortages in a strategic way. The second part stresses the benefits of organic farming in terms of environment, profitability and policy improvements. In addition, it looks at possible obstacles, long term visions and the role of targeted interventions. The third part focuses on the cultivation of drought resistant maize varieties, emphasising cooperation efforts, technological advances and economic benefits from increased yields, reduced input costs as well as improved climate resilience. The last part of the literature review envisages a

cycle of El Nino rain in 2024 and lays down proactive strategies for sustainable agricultural production. Advanced weather forecasting, precision agriculture, drought-tolerant varieties of crops, agroforestry and Sustainable Development economic theory are core components. Addressing financial constraints in agriculture, highlighting the importance of customized loan products, low interest rates, government backed insurance, and cooperation between farmers, financial institutions, and policymakers to achieve sustainable development in the agricultural sector, concludes the document. In order to reduce water stress, it stresses the need for a timely warning system, conservation of water and diversification of crops.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides a detailed account of the research methodology employed to address the primary and secondary objectives of this study. To develop a strategic managerial framework for managing the production implications of grain shortages in Central South Africa, it was essential to gather insights directly from experienced farmers. The chapter outlines the research plan, including the methodology, study participants, procedures, analysis methods, and ethical considerations. Additionally, it highlights the feedback obtained through semi-structured interviews. The careful selection of participants and the systematic approach to data collection and analysis lay the foundation for the subsequent chapter's presentation of findings and the ultimate development of a comprehensive managerial framework.

3.2 Methodology

In this section, we outline the research design employed to achieve the objectives of the study. The research design is crucial in guiding the collection and analysis of data to develop a comprehensive managerial framework for addressing production implications caused by grain shortages.

3.3 Participants

In this study, thirty experienced farmers from the North-West area of Central South Africa were interviewed. Chosen for their expertise and willingness to share insights, these farmers provide firsthand knowledge and experiences regarding the challenges posed by grain shortages

(Wardropper, *et al.*, 2021). The selection process emphasized expertise and openness, laying the foundation for a focused exploration of the implications of grain shortages on production (Shearer, 2021).

3.4 Data Collection

3.4.1 Interviews

The primary method of data collection was through semi-structured interviews with the participating farmers. The interviews were designed to gather detailed information on various aspects related to grain shortages, including their impact on production, strategies employed by farmers, and the effectiveness of existing programs (Wardropper, *et al.*, 2021).

A questionnaire was distributed to the participating farmers prior to the interviews, allowing them adequate time to prepare thoughtful responses. This sequential approach aimed to enhance the depth and quality of insights gathered during the interviews.

Subsequent to scheduling interviews, our team conducted on-site visits to engage with farmers and record their insights. The gathered information was then meticulously translated and transcribed for comprehensive analysis and documentation.

3.5 Data Analysis

3.5.1 Data Analysis with Atlas.ti

Atlas.ti was employed as the primary tool for refining the raw qualitative data gathered from the interviews. Utilizing Atlas.ti facilitated the identification, analysis, and reporting of patterns within the data,

allowing for a systematic exploration of recurring ideas and emerging patterns in participants' responses. The software played a pivotal role in transforming raw information into organized and usable data for in-depth analysis.

3.5.2 Qualitative Analysis

A qualitative approach was employed to analyse the data collected through the questionnaire, focusing on gaining in-depth insights into participants' opinions on various aspects related to grain shortages and production implications. Thematic patterns and rich narratives were extracted to offer a comprehensive understanding of the qualitative dimensions within the dataset.

3.6 Ethical Considerations

3.6.1 Informed Consent

Prior to the interviews and questionnaire distribution, participants were provided with detailed information about the study's purpose, procedures, and their rights. Informed consent was obtained, ensuring voluntary and informed participation.

3.6.2 Anonymity and Confidentiality

Participants were assured of the confidentiality of their responses, and steps were taken to anonymize the data to protect the identity of the participants.

3.6.3 Transparency

The research process was conducted transparently, with open communication about the study's objectives, methods, and potential implications.

3.7 Limitations

Despite the careful planning and execution of the research methodology, it is important to acknowledge certain limitations that may have impacted the study's outcomes and generalizability.

3.7.1 Sample Size and Regional Specificity:

The study focused on a specific region, Central South Africa, and the findings may not be fully applicable to other regions with distinct agricultural practices and challenges.

The sample size, though sufficient for in-depth qualitative analysis, might limit the generalizability of the results to a broader population.

3.7.2 Participant Bias:

The participants were selected based on their availability and willingness to share their experiences. This self-selection process could introduce bias, as those who chose to participate may have unique perspectives that differ from non-participants.

3.7.3 Single Timepoint Data Collection:

The data collection occurred at a specific point in time, capturing the participants' perspectives during that period. Agricultural challenges, including grain shortages, are dynamic, and the study may not reflect changes in the farmers' situations over time.

3.7.4 Dependence on Self-Reported Data:

The study relies on self-reported information from the participants. While efforts were made to encourage openness and honesty, there may be instances of underreporting or overemphasizing certain aspects.

3.7.5 Generalization to Other Crops:

The study predominantly focused on grain shortages, primarily affecting maize production. The findings may not be directly transferable to other crops with different cultivation practices and market dynamics.

3.7.6 External Factors:

External factors such as government policies, climate change, and global economic conditions were not directly addressed in the study. These factors can significantly influence farmers' experiences and were not within the scope of this research.

Acknowledging these limitations is crucial for interpreting the findings accurately and for considering avenues for future research. The upcoming chapter will delve into the findings, providing an understanding of the production implications of grain shortages in Central South Africa based on the perspectives of experienced farmers.

3.8 Chapter Summary

Chapter 3 outlined the research methodology employed to investigate the production implications of grain shortages in Central South Africa. The engagement with eight experienced farmers in the North-West area, coupled with a sequential approach using pre-interview questionnaires, ensured an exploration of their insights. The use of Atlas.ti for thematic

analysis and the qualitative approach to questionnaire data analysis set the stage for a comprehensive understanding of the challenges faced by farmers. With these methodological foundations laid, the subsequent chapters will unravel the findings and contribute to the development of a strategic managerial framework to address the complexities of grain shortages in the region. The next chapter will reveal the empirical findings with the validation of results with existing literature. The chapter begins with an introduction, which stresses the importance of a quantitative dimension for providing information on future management frameworks. The insights of farmers revealed in Atlas. The analysis has laid the foundations for the decision making and practical solutions for the management of the grain shortage in the region.

CHAPTER 4: EMPIRICAL FINDINGS AND DISCUSSIONS

4.1 Introduction

In the pursuit of developing a robust managerial framework to address the production implications of grain shortages in central South Africa, this chapter presents a comprehensive analysis of the qualitative data gathered from in-depth interviews with eight farmers in the region. Utilizing Atlas.ti as a powerful analytical tool, this study sought to uncover the perspectives, experiences, and insights of these farmers.

Chapter 4 serves as the core of the research, delving into the qualitative data obtained through a qualitative research design. The primary objective is to identify meaningful patterns, themes, and connections that emerge from the farmers' narratives. Through a systematic exploration of their responses, we aim to draw insightful conclusions and implications crucial for the development of an effective managerial framework.

The utilization of Atlas.ti allowed for a rigorous and structured analysis, enabling the identification of recurring themes and the extraction of valuable insights. As we navigate through the findings, we will gain a deeper understanding of the challenges faced by farmers in connection with grain shortages, as well as the innovative strategies they employ to navigate these challenges.

By exploring the qualitative dimensions of the research, this chapter lays the foundation for informed decision-making in the subsequent chapters. The farmers perspectives, coupled with the analytical capabilities of Atlas.ti, forms the backbone upon which our managerial framework will

be drafted. Through this exploration, we aim to contribute to the existing knowledge base and provide practical solutions for stakeholders involved in managing the production implications of grain shortages in central South Africa.

4.2 Gathering of data.

The primary objective of this qualitative study was to utilize a specific methodology to comprehensively capture the diverse viewpoints of farmers located in central South Africa. The focus of the study was to investigate the various implications that arise in the production process because of grain shortages. Acknowledging the importance of acquiring comprehensive and contextually relevant understandings, a qualitative methodology was adopted, incorporating the use of pre-constructed questionnaires and in-depth interviews.

The first stage of the study encompassed the creation of a systematic questionnaire consisting of ten questions that required open-ended responses. The inquiries attached in the annexure were carefully constructed with the intention of obtaining thorough answers, enabling farmers to express their experiences, difficulties, and approaches in effectively handling grain scarcities. The questionnaires have been distributed to a sample of eight farmers within the designated study area, affording them the chance to deliberate and formulate well-considered responses prior to submission.

In recognition of the diverse communication preferences exhibited by the participants, the study made provisions for the utilization of multiple

response formats. Certain farmers chose to offer feedback by means of vocal recordings, thereby introducing a more individualized and narrative-oriented aspect to their responses. Some individuals opted to express their perspectives through written means, presenting comprehensive explanations in the form of PDF documents. Furthermore, a subgroup of respondents indicated a preference for in-person interviews, facilitating a more comprehensive examination of their viewpoints.

After receiving diverse responses, the qualitative data was subjected to a translation process from Afrikaans to English to achieve consistency and facilitate analysis. The data's depth was further enhanced through the process of transcription, which encompassed not only the substance of the information but also the affective qualities conveyed through the participants' vocal expressions. The transcribed data were subsequently consolidated into a coherent document, which is appended as annexures, constituting a comprehensive dataset for analysis.

4.3 Results and Discussion

4.3.1. Farmers' Education Program

According to the study "The Impact of Field Schooles on Agricultural Productivity and Poverty in East Africa", it indicates that farmer education programmes have a positive impact on farm productivity and poverty reduction in Eastern Africa. Knowledge sharing and the adoption of innovative strategies and products contribute to this, in addition to strengthening farmers' understanding of today's farming methods by working with input suppliers and farmer associations in South Africa.

The environmental benefits of organic farming, including increased biodiversity and reduced pollution, are supported by empirical evidence (Reganold & Wachter, 2016). Economic analyses show the long-term viability of organic farming, with studies showing that higher market prices and lower input costs make organic farming economically competitive. The need for targeted interventions to promote widespread adoption is underlined by the identified potential obstacles, such as limited access to organic seed and breeding stock.

4.3.2. Cultivation of Drought Resistant Maize

According to the research findings, in areas of water scarcity it is possible to significantly improve sustainable agricultural production by growing drought resistance maize varieties. The adoption of drought resistant varieties is also supported by economic benefits such as increased yields, reduced input costs, and improved resilience to climate change. Alignment with regional farming practices is ensured by the cooperative involvement of farmers in breeding programmes. The development of resilient maize strains is accelerated by the integration of cutting-edge technologies such as precision breeding and advanced phenotyping.

4.3.4. Preparation of El-Nino

Advanced meteorological research, early warning systems and sustainable strategies are at the heart of the discussion on preparing for the El Nino event of 2024. A key element in reinforcing adaptation capacity is found to be the effective management of land, such as agroforestry and soil preservation. The impact of water scarcity during El Nino droughts can be mitigated by the adoption of advanced weather forecasting, precision agriculture and drought resistant crop varieties.

The findings of the survey confirm that farmers, especially in view of heavy input costs relative to land values, are confronted with an economic challenge. Key strategies for mitigating financial risks and encouraging financial institutions to support farmers are emerging as government subsidised insurance schemes and lower interest rates. It is considered necessary to adapt farm loan products with flexible repayment schedules in line with the seasonal nature of agriculture's income.

4.4. Chapter summary

Using Atlas.ti, Chapter 4 of the research project looks at empirical findings and discussions resulting from detailed interviews with thirty Central South African farmers in order to systematically analyse this data. Results and discussions are provided within the framework of agricultural training programmes such as Organic Farming, Drought Resistant Maize Preparations for El Nino in 2024 or Financial Challenges faced by farmers. Qualitative data collection to capture different farmer's views on the impact of grain shortage on agricultural production was carried out, including questionnaires, vocal recordings, writing responses and in-person interviews. The positive impact of education programmes and organic agriculture on productivity and environmental benefits is supported by empirical evidence. With the emergence of government-backed insurance schemes and lower interest rates as key financial risk mitigation strategies, financial challenges are recognised, in particular concerning input costs. The cultivation of drought-tolerant maize is a viable solution and effective practices are outlined for the preparation of

an El Nino event. Given the identified challenges, the next chapter presents a role model for stakeholders to move towards a more stable and resilient way of farming practice.

Chapter 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter goes beyond mere summary and examines the richness of research, analyses its nuanced impacts as well as moves to concrete recommendations. It will undertake a key task not only to summarise the study, but also to synthesize its essence in order to set up robust and pragmatic management frameworks. The culmination of an extensive research effort to synthesize and develop meaningful insights from the empirical findings is marked by this pivotal chapter, which will give rise to a comprehensive conclusion. This section includes not only key research results but also a strategic plan to address the challenges that have been identified during this investigation, as we move through the complexities of our study. In addition, the proposals for exploring avenues that would attract exploration and further research seek to establish a basis for future research efforts.

5.2. Conclusion

In order to effectively mitigate the impact of the grain shortage on agricultural production in Central South Africa, the comprehensive examination of the empirical findings illuminates the key role of proactive measures. The importance of a holistic approach to dealing with the complex landscape of agriculture is underlined by the wide range of strategies that were identified in this study. The adoption of organic farming practices emerged not only as a sustainable solution but also as a catalyst for environmental conservation and enhanced profitability. Stakeholders can increase their resilience to climate change uncertainties

through the integration of advanced meteorological research and sustainability practices in agriculture. The study underlines the need to develop active preparedness strategies in view of looming challenges associated with climate events like El Nino. In addition, the cultivation of drought resistance maize varieties has shown a pathway towards sustainable agriculture productivity that provides economic benefits and is environmentally resilient. These findings underline the necessity of a comprehensive and balanced approach to agriculture, one in which knowledge, sustainability as well as resilience are core values for long term success. The importance of support policies and interventions in order to guarantee economic viability for the agriculture sector is underlined by the difficulties faced by farmers, particularly with regard to their dependence on input costs.

5.3 Recommendations

It is envisaged that this framework will be a transformative guide for agricultural stakeholders, based on the insights gained from farmer education programs, organic farming practices and the cultivation of drought resistant maize. A robust set of recommendations, centred on the implementation of a dynamic and comprehensive management framework, has been developed in response to the study's findings. The proposed framework emphasises the key role of sustainable land management and calls for the integration of agroforestry and soil conservation practices. The use of advanced technology, such as precision breeding, can lead to a seamless alignment with regional agricultural practices that will promote resilience against climate change.

It is considered necessary to emphasise the use of advanced technologies, such as precision breeding, in agriculture so that these can be adapted according to regional features. The study recommends the establishment of government backed insurance schemes aimed at providing a safety net against unforeseen events in order to address these financial barriers. In addition, the management framework recognises that farmers are faced with financing problems and has to resort to strategy interventions. The key driver for reducing the cost of capital and enabling farmers to invest in their enterprises is identified as advocating a lower interest rate. In order to facilitate the effective implementation of the proposed management framework, to foster innovation, economic stability and overall growth in the agricultural sector, synergies between such partnerships are envisaged. Cooperation between farmers, financial institutions and policy makers is considered essential in implementing these recommendations. In addition, the need for long term sustainability is underlined by adapting farm loans with flexible repayment schedules in line with the seasonal nature of agriculture's revenue.

Table 1.1 Managerial Framework to manage production implications.

Theme	Key Points
Technological Advancements	- Technology plays a big role in food security. - Technologies such as precision farming enable farmers to optimize resource utilization, mitigate crop losses, and adapt to changing environmental conditions. - The pivotal role of technology, biotechnology, and remote sensing. - Using technology for precision farming, better tractors, and efficient implements. - Investment in agricultural research and development for crop varieties tailored to local conditions. - Policies incentivizing sustainable farming practices and land management.
Risk Management	- It prevents our expansion, maintenance, labour, and food production. Mitigating risks associated with price volatility by incorporating risk management measures like effective hedging strategies and maintaining diversified sourcing networks.
Planning	- Start on a small scale, not everything at once. - Planning for unpredictable years, like El Niño, by sticking to normal practices that work. - The importance of planning and commitment for better assurance and risk reduction.
Market Analysis	- The market needs to be watched, and the opportunities. - Price volatility in grain prices should be managed through effective hedging strategies and diversified sourcing networks. - Keeping an eye on market conditions and utilizing opportunities for exports.

	Food Security	- Technologies such as precision farming enable farmers to optimize resource utilization, mitigate crop losses, and adapt to changing environmental conditions. - Investment in agricultural research and development for enhancing crop varieties and farming techniques. -
	Theme	Key Points
		Promoting sustainable irrigation and water management practices to mitigate the impact of drought and water scarcity. - Implementing policies that incentivize sustainable farming practices and land management for environmentally friendly and resilient agricultural systems.
	Financial Pressure	- It prevents our expansion, maintenance, labour, and food production. Managing financial pressure by adapting strategies such as reducing costs, mechanizing more, and researching for larger, more efficient implements. - Addressing challenges like high input costs affecting expansion and maintenance.
	Dynamic Pricing	- Mitigating risks associated with price volatility through effective hedging strategies.
	Efficiency	- Mechanizing more to cut costs and increase efficiency. - Facilitating access to affordable and efficient agricultural machinery and technologies to improve productivity. - Supporting small-scale farmers through training, access to credit, and market linkages to boost productivity.

Environmental Sustainability	- Government assistance and subsidies for sustainable practices. Implementing policies that incentivize sustainable farming practices and land management. - Integrating technology like precision farming for resource efficiency and sustainable practices. - Promoting sustainable irrigation and water management practices.

5.4 Achievement of Research Objectives

The primary objective was to unravel the intricate layers of problems associated with a lack of grain and, in turn, gain insight which would be crucial for developing an effective management framework. In order to achieve these research objectives, qualitative data from in depth interviews with eight Central South African farmers have been carefully and comprehensively analysed. The study explored the rich narrative provided by the participants through the adoption of a qualitative research design. A first research objective is to gain a deeper understanding of farmers' views on the problems caused by crop shortages. Qualitative data, carefully collected through open-ended questionnaires, vocal recordings, and in person interviews, allowed for a nuanced examination of farmers' experiences, difficulties, and coping mechanisms. A thorough analysis of the collected data using Atlas.ti, a robust analytical tool, has been carried out in subsequent steps. The findings of this exhaustive survey have set the basis for a management framework to be developed. In order to develop a comprehensive and appropriate guide on the production implications of grain scarcity in Central South Africa, identifying patterns and themes have been an

essential starting point. The use of multiple response formats, including oral recordings and written documents, added layers of detail to the data base which captured not only content but also emotional features expressed by respondents. To find meaningful patterns, themes and links embedded in farmers' stories was a key element of this analytical phase. Hence, the qualitative approach taken has been validated by the achievement of these research objectives, and its effectiveness as a source of useful information on decisions to be made in agriculture has been reinforced.

5.5. Recommendations for Future Research

A range of societal and geographical dimensions are covered in the Recommendation on Future Research. While the study currently being conducted in Central South Africa contains a detailed understanding of the problems associated with cereal shortages and proposes management frameworks, there are opportunities for further research that could help to refine strategies and broaden their applicability. Firstly, there is a need for a more detailed examination of specific components within the management framework. A focus could be on precision breeding and its applicability throughout various agricultural zones. To adapt the framework to the specific needs of different regions, research exploring how precision breeding technology can be adapted to a variety of agricultural landscapes would contribute.

Secondly, it would be important to carry out an in-depth investigation into the social and economic impact of implementing the proposed management framework. In this context, an assessment of the

effectiveness of the Framework to improve farmers' livelihoods, reduce poverty and strengthen overall economy stability could be undertaken. Critical insight for policymakers and stakeholders would be to understand how the strategies proposed can lead to tangible social outcomes for farmers and rural communities. In addition, the understanding of its long-term viability would be enhanced by an evaluation of the social and environmental impacts of precision breeding practices. In addition, the generalizability of these strategies would be enhanced by a comparison study between regions with different ecological and social economic contexts. Lastly, it would be useful to explore the feasibility of a management framework that could cover all levels of agricultural production from smallholder farms to large enterprises. Valuable information on possible adaptations needed in the context of a wide range of agriculture landscapes would be gained through an examination of how the framework works in areas with various levels of infrastructure development, access to resources and weather conditions. In the years ahead, research efforts should focus on improving the suggested management framework by examining its socioeconomic impact, identifying individual components in different contexts, carrying out comparative studies between regions and investigating how it scales up at various levels of agricultural production. Policy recommendations adapted to different segments of the agricultural sector could be informed by a knowledge of how these strategies are implemented at each scale of operation. In the face of a shortage of grain, these recommendations are aimed at contributing to

an ongoing debate on sustainability and resilience building in agriculture.

5.6 Conclusion

The essence of the study's main components, such as conclusions, recommendations and achievement of research objectives, is encompassed in Chapter 5. The chapter begins with the conclusions and is accompanied by a synthesis of preliminary findings, highlighting the necessity of proactive measures to address the consequences of grain shortages on crop production. The summary is intended to provide an overall overview of the research carried out in Central South Africa, increasing its importance and possible impact on agricultural land. The comprehensive approach required for sustainable agriculture in the region is underlined by the identified strategies, including farmer training programmes, organic farming, the cultivation of drought resistant maize and preparedness for climate events. The achievement of the research objectives is highlighted, demonstrating the rigorous analysis of qualitative data. The commitment of the study to addressing all research objectives with precision and objectivity is reaffirmed in this section. The chapter describes how the views of farmers were carefully examined in order to identify patterns and themes that are essential for developing an administrative framework. The section on recommendations for future research lays down the study in a wider context and envisages ways of exploring it further.

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ADDENDUM 1: LIST OF QUESTIONS

Researcher: Daniel D Kloppers

Student #: 27223140

Orcid.org/0000-0003-0941-2960

MASTER'S IN BUSINESS ADMINISTRATION

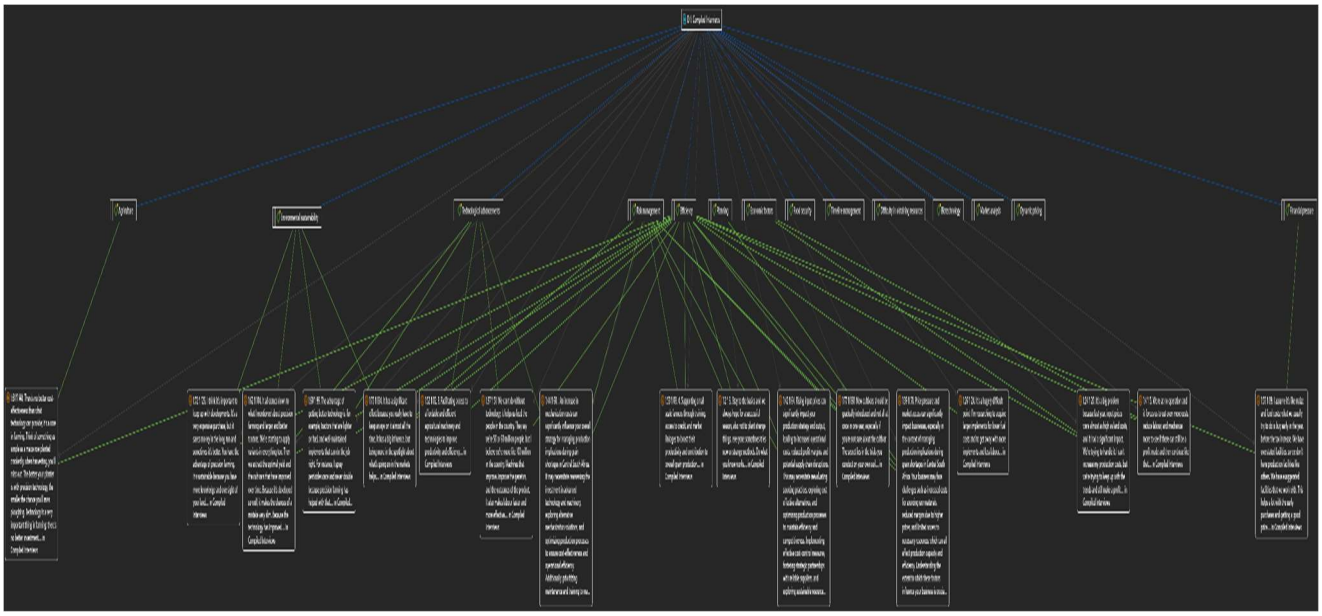
Title: Developing a managerial framework to manage the production implications of grain shortages in central South Africa

RESEARCH QUESTIONS

1. To what extent does price pressure and market access impact your business?
2. How do you plan to adjust your strategy during an El Nino cycle?
3. What is the typical timeframe for integrating new products into your business, such as new maize cultivars?
4. How are your production strategy and output affected by the rising input prices?
5. In what ways do the decreasing land prices impact your ability to acquire production facilities?
6. How does the increase in mechanization costs influence your overall strategy?
7. What measures do you take to mitigate the risks associated with price volatility in grain prices?
8. What are your thoughts on the role of technology in food security?
9. What are your experiences with government programs that support food security?

10. What are the possible solutions to improving grain production in SA?

ADDEMNDUM 2: ATLAS.Ti



Project: Interviews

Report created by Rodante du Plessis on 2023/11/18

Code Report

All (15) codes

○ Timeline management

1:41 ¶ 74

The timeframe for integrating new products, such as new maize cultivars, into your business can vary depending on several factors, including research and development timelines, regulatory approvals, and production scale-up processes. Typically, this process can take anywhere from se…. D 1: Interview 5_Participant 5

○ Technological advancements

12 Quotations:

1:27 ¶ 40

Technology plays a big role in food security, and you have to stay up to date and put effort into it. And at the end of the day, you can't farm, it's a core part of integration in farming. D 1: Interview 3_Participant 3

(6502:6690)

1:29 ¶ 44

Precision farming, and the technology for it, better planting methods, and better products can make a big difference. We can see it with seeds because it has improved a lot, and we find that changing small parts makes a real difference. D 1: Interview 3_Participant 3

(7217:7453)

1:37 ¶ 63

We can't do without technology; it helps us feed the people in the country. They say we're 50 or 60 million people, but I believe we're more like 100 million in the country. Machines that improve, improve the genetics, and the outcomes of the product. It also makes labour faster and more effective. D 1: Interview 4_Participant 4

1:44 ¶ 80

An increase in mechanization costs can significantly influence your overall strategy for managing production implications during grain shortages in Central South Africa. It may necessitate reassessing the investment in advanced technology and machinery, exploring alternative mech…D 1: Interview 5_Participant 5

1:46 ¶ 85

The role of technology in food security is pivotal, as it contributes to enhancing agricultural productivity, improving resource efficiency, and fostering sustainable D 1: Interview 5_Participant 5

1:47 ¶ 86

farming practices. Technologies such as precision farming, biotechnology, and remote sensing enable farmers to optimize resource utilization, mitigate crop losses, and adapt to changing environmental conditions. Moreover, digital platforms and data analytics facilitate better market…D 1: Interview 5_Participant 5

1:52 ¶ 94

Facilitating access to affordable and efficient agricultural machinery and technologies to improve productivity and efficiency. D 1: Interview 5_Participant 5

1:60 ¶ 111

The advantage of getting better technology is, for example, tractors that are lighter on fuel, and well-maintained implements that can do the job right. For instance, I spray pesticides once and never double because precision farming has helped with that. D 1: Interview 6_Participant 6

1:62 ¶ 116

It all comes down to what I mentioned about precision farming and larger and better tractors. We're starting to apply variants in everything too. Then we extract the optimal yield and the

cultivars that have improved over time. Because it's developed so well, it makes the chances of a mistake very slim. Because the technology has improved. D 1: Interview 6_Participant 6

1:70 ¶ 134

If the costs of mechanization keep rising, it becomes too expensive. But it can also cause trouble because the lifespan of the implements decreases as they stagnate due to the high cost of improvement. D 1: Interview 7_Participant 7

1:76 ¶ 148

The strategy would be not to pre-price in advance, if the markets perform well, it's a different story. The other thing is I never plant at full capacity because it can turn out badly. Technology is there to help. D 1: Interview 8_Participant 8

1:80 ¶ 156

Prices on mechanical goods have skyrocketed, I paid about R1.4 million just for maintenance last year alone. It's just expensive, and as the implements improve, labour costs are high too, and as you move from simpler to more technological implements, it's double. Having fewer but…D 1: Interview 8_Participant 8

○ Risk management 34

Quotations:

1:1 ¶ 2

It prevents our expansion, maintenance, labour, and food production because we can't expand. D 1: Interview 1_Participant 1

(23:115)

1:2 ¶ 3

Stay to the basics and we always hope for a successful season, also not to plant strange things, everyone sometimes tries new or strange methods. Do what you know works. D 1: Interview 1_Participant 1

(128: 297)

1:3 ¶ 4

Start on a small scale, not everything at once, maybe it can be done in a year. If El Niño is predicted, it's best to stick to normal things that work and not try something new because it's going to be an unpredictable year. D 1: Interview 1_Participant 1 (310:534)

1:5 ¶ 6

With high input costs, it means that the sum of your output costs is such that you can't expand. Without a backup, you won't be able to expand. D 1: Interview 1_Participant 1

(731:837)

1:8 ¶ 9

It's a big concern, labour is expensive, and we're trying to reduce it. Of course, the bigger your implements, the greater your productivity becomes. The larger you go, the more expensive it becomes, labour is currently a very high cost at hand. D 1: Interview 1_Participant 1

1:10 ¶ 11

I think it would be something we could do, government assistance, providing subsidies like they do in other countries. Most purchases we make are too expensive, for example, seeds, fuel, and fertilizer. There are too many laws, taxes, and interest. That's why other countries are successful. D 1: Interview 1_Participant 1

1:21 ¶ 26

Number one is the price pressure and market access because we are price-takers and not price-setters; it puts a lot of pressure on us, especially concerning maize, actually on all our products. Market access will help to improve prices on all our products. Market access is not such a big p... D 1: Interview 3_Participant 3

(4463:4844)

1:22 ¶ 28

The El Niño year is a difficult one; we are currently trying to limit unnecessary expenses. Prices can't be cut so much, so it all comes down to planning, like producing more feed and

everything in that regard. El Niño has given both good and bad years, so planning is really all we can do. It... D 1: Interview 3_Participant 3

(4859:5246)

1:25 ¶ 34

Production facilities are a problem to obtain, especially when trying to get hold of land, but it takes a big hit in cash flow, and it causes problems. D 1: Interview 3_Participant 3

(5920:6071)

1:32 ¶ 53

I integrate a portion every year. A new cultivar might come to me with data from surrounding farmers, but I only plant a 50x100-hectare block and then test it for a year or so before it enters my production cycle. I also plant a 50x100-hectare block of a new supplier's cultivar every year, and...D 1: Interview 4_Participant 4

(8103:8447)

1:33 ¶ 55

Higher input costs make us very price-sensitive; on our hectares, we've been price-sensitive from day one, and in the end, R5 or R10 can make a significant difference.

I'm price-sensitive when it comes to my supplier; I want to keep costs low as much as I can. D 1: Interview 4_Participant 4

(8461:8721)

1:34 ¶ 57

In this case, I'm in a privileged position. We don't plant anything beforehand and don't sign any maize contracts beforehand. The high land costs are a problem; currently, I'm in a cycle where I want to improve my land, and I'm currently taking one and two-hectare grids and mapping... D 1: Interview 4_Participant 4

1:35 ¶ 59

Mechanization costs are definitely expensive, but for example, on October 27, I didn't have one worker on my farm out of the 70, so I didn't have to struggle with that difficulty.

Mechanization costs are expensive, but you have to keep up with the times; in the end, you can only plan you…D 1: Interview 4_Participant 4

1:39 ¶ 70

Price pressure and market access can significantly impact businesses, especially in the context of managing production implications during grain shortages in Central South Africa. Your business may face challenges such as increased costs for sourcing raw materials, reduced margins…D 1: Interview 5_Participant 5

1:40 ¶ 72

During an El Niño cycle, it is crucial to adjust your strategy in response to the potential exacerbation of grain shortages in Central South Africa. This can involve implementing measures such as diversifying sourcing regions to mitigate the impact of localized crop failures, enhancing…D 1: Interview 5_Participant 5

1:42 ¶ 76

Rising input prices can significantly impact your production strategy and output, leading to increased operational costs, reduced profit margins, and potential supply chain disruptions. This may necessitate reevaluating sourcing practices, exploring cost-effective alternatives, and optional …D 1: Interview 5_Participant 5

1:44 ¶ 80

: An increase in mechanization costs can significantly influence your overall strategy for managing production implications during grain shortages in Central South Africa. It may necessitate reassessing the investment in advanced technology and machinery, exploring alternative …D 1: Interview 5_Participant 5

1:45 ¶ 83

To mitigate the risks associated with price volatility in grain prices, it's essential to incorporate various risk management measures into the managerial framework. This can include developing effective hedging strategies, maintaining diversified sourcing networks, and fostering long-term… D 1: Interview 5_Participant 5

1:47 ¶ 86

farming practices. Technologies such as precision farming, biotechnology, and remote sensing enable farmers to optimize resource utilization, mitigate crop losses, and adapt to changing environmental conditions. Moreover, digital platforms and data analytics facilitate better market a…D 1: Interview 5_Participant 5

1:49 ¶ 89

subsidies for farmers, infrastructure development, research and development funding, and policies promoting sustainable agricultural practices. Moreover, interventions like market stabilization measures, emergency food aid, and support for small-scale farmers can contribute to ensure... D 1: Interview 5_Participant 5

1:50 ¶ 92

Investing in agricultural research and development to enhance crop varieties and farming techniques tailored to local conditions. D 1: Interview 5 Participant 5

1:53 ¶ 95

Supporting small-scale farmers through training, access to credit, and market linkages to boost their productivity and contribution to overall grain production. D 1:
Interview 5_Participant 5

1:54 ¶ 96

Implementing policies that incentivize sustainable farming practices and land management, fostering environmentally friendly and resilient agricultural systems. D 1: Interview 5_Participant 5

1:59 ¶ 109

Luckily, we have the feeding supply that works together because we make money on it throughout the year and then use it. This allows us to do certain things that others can't do. Land doesn't increase much, the price goes for market value. The problem is nobody really wants to sell, a… D 1: Interview 6_Participant 6

1:61 ¶ 114

We have to sell a certain amount of maize, and we usually store some on the farm, which is cheaper because there are no transport or handling costs. I usually get a return on that maize,

which serves as my buffer against price volatility. What we do need to price and sell, which usually a…D 1: Interview 6_Participant 6

1:65 ¶ 123

Price pressure has a significant effect because it puts pressure on me—will there be enough to sell, will my prices be right for someone to buy from me? It's about what I have to pay and what I have to sell. Market access is basically whether I have access to a market where I want to sell. If…7_Participant 7

1:69 ¶ 131

As I mentioned, input prices and land prices are what ultimately put us in tight situations. It makes your chances of expanding and improving very slim. D 1: Interview 7_Participant 7

1:71 ¶ 136

Somewhere you have to commit, even if it's just a few tons. It's important to commit, for example, from December to the end of January. And to have certainty about a fixed product. It helps with assurance. It also helps to reduce risk because everything gets better as it develops and al... D 1: Interview 7_Participant 7

1:73 ¶ 140

I haven't personally experienced it, but from what I hear or see, there's never good feedback. D 1: Interview 7_Participant 7

1:75 ¶ 146

It has a significant effect because you really have to keep an eye on it almost all the time. It has a big influence, but being more in the spotlight about what's going on in the markets helps. D 1: Interview 8_Participant 8

1:76 ¶ 148

The strategy would be not to pre-price in advance, if the markets perform well, it's a different story. The other thing is I never plant at full capacity because it can turn out badly. Technology is there to help. D 1: Interview 8_Participant 8

1:77 ¶ 150

New cultivars should be gradually introduced and not all at once in one year, especially if you're not sure about the cultivar. The secret lies in the trials you conduct on your own soil. D 1: Interview 8_Participant 8

1:79 ¶ 154

Prices make it difficult to acquire extra land, it's tough to involve new farmers too because they also want to survive. The other problem is obtaining finances, sometimes a loan is unsuccessful. D 1: Interview 8_Participant 8

1:86 ¶ 16

Start on a small scale, not everything in one basket, maybe it can be done in one year. If they predict El Niño, it's best to stick to the normal things that work and not try something new because it's going to be an unpredictable year. D 1: Interview 2_Participant 2

○ Planning

13 Quotations:

1:3 ¶ 4

Start on a small scale, not everything at once, maybe it can be done in a year. If El Niño is predicted, it's best to stick to normal things that work and not try something new because it's going to be an unpredictable year. D 1: Interview 1_Participant 1 (310:534)

1:7 ¶ 8

The market needs to be watched, and the opportunities that the market offers need to be used. Consultants who watch the market are, of course, the best option. You won't make it with average prices. D 1: Interview 1_Participant 1

(1374:1619)

1:8 ¶ 9

It's a big concern, labour is expensive, and we're trying to reduce it. Of course, the bigger your implements, the greater your productivity becomes. The larger you go, the more expensive it becomes, labour is currently a very high cost at hand. D 1: Interview 1_Participant 1

1:31 ¶ 51

I don't change my strategy during El Niño or La Niña years at all; I'm more conservative than my fellow farmers. It doesn't affect me; in crop farming, it's the long-term average that keeps me going. The average is what I work on, so at the end of the day, it's the long-term average that keeps me going. D 1: Interview 4_Participant 4

(7783:8087)

1:39 ¶ 70

Price pressure and market access can significantly impact businesses, especially in the context of managing production implications during grain shortages in Central South Africa. Your business may face challenges such as increased costs for sourcing raw materials, reduced margins due… D 1: Interview 5_Participant 5

1:41 ¶ 74

The timeframe for integrating new products, such as new maize cultivars, into your business can vary depending on several factors, including research and development timelines, regulatory approvals, and production scale-up processes.
Typically, this process can take anywhere from se... D 1: Interview 5_Participant 5

1:57 ¶ 105

So, every year I conduct a few trials with Pioneer, so I will assess it every second year before I include it in the third year with my other plants. D 1: Interview 6_Participant 6

1:61 ¶ 114

We have to sell a certain amount of maize, and we usually store some on the farm, which is cheaper because there are no transport or handling costs. I usually get a return on that maize, which serves as my buffer against price volatility. What we do need to price and sell, which usually a… D1: Interview 6_Participant 6

1:64 ¶ 120

I think we're in a good environment that provides us access to everything, but if we could get more incentives to help improve precision farming, I think it could be really good D 1: Interview 6_Participant 6

1:66 ¶ 125

What you do, like planting soon, the best is to plan and trust because we don't control nature. Ensure your soil is properly analysed and treat your plants so they can survive those times. Stick to what you always do and don't experiment in your plantations because that could become a... D 1: Interview 7_Participant 7

1:88 ¶ 17

We are at no operation and force us to cut even more costs... D 1: Interview 2_Participant 2

1:94 ¶ 20

The market must keep an eye and use the opportunities that..D 1: Interview 2_Participant 2

1:97 ¶ 22

Currently, the programs are aimed at emerging farmers and very few aimed at your commercial farmers, and... D 1: Interview 2_Participant 2

○ Market analysis 6

Quotations:

1:7 ¶ 8

The market needs to be watched, and the opportunities that the market offers need to be used. Consultants who watch the market are, of course, the best option. You won't make it with average prices. D 1: Interview 1_Participant 1

(1374:161)

1:30 ¶ 49

Price pressure, as it is for me, would be when one has to sell maize; it's critical, and market access is obvious because we have an open market, which doesn't really affect us. My cash flow is what gets affected when the price is under pressure, forcing us to change the price to sell. D 1: Interview 4_Participant 4

(7482:7768)

1:43 ¶ 78

Decreasing land prices can present both challenges and opportunities for acquiring production facilities in the context of managing grain shortages in Central South Africa. While it may facilitate cost-effective acquisition and expansion of production facilities, it could also signify potential benefits... D 1: Interview 5_Participant 5

1:49 ¶ 89

subsidies for farmers, infrastructure development, research and development funding, and policies promoting sustainable agricultural practices. Moreover, interventions like market stabilization measures, emergency food aid, and support for small-scale farmers can contribute to ens... D 1: Interview 5_Participant 5

1:63 ¶ 118

I haven't really come across anything like that because I can't say that we get anything back from it, so right now, it feels like more of a marketing or a story because I have no experience with it. I think it's more about helping young farmers, but I think it should involve more mentorship. D 1: Interview 6_Participant 6

1:94 ¶ 20 The market must keep an eye and use the opportunities that the market offers. Consultants who keep an eye on the market are, of course, the best option. You won't make it with average prices D 1: Interview 2_Participant 2

○ Food security 3

Quotations:

1:47 ¶ 86 Farming practices. Technologies such as precision farming, biotechnology, and remote sensing enable farmers to optimize resource utilization, mitigate crop losses, and adapt to changing environmental conditions. Moreover, digital platforms and data analytics facilitate better market a…D 1: Interview 5_Participant 5

1:48 ¶ 88 While I don't have direct experience, government programs that support food security often play a crucial role in mitigating the impact of grain shortages in regions such as Central South Africa. These programs typically encompass initiatives such as D 1: Interview 5_Participant 5

1:82 ¶ 164 Start by giving uncultivated or workable land to farmers who can work and improve it, then train people to do the same. I believe if we could get more help, we would perform

much better than we currently do. It can improve food security, and if we could really get subsidies because we... D 1: Interview 8_Participant 8

○ Financial pressure

13 Quotations:

1:1 ¶ 2 It prevents our expansion, maintenance, labour, and food production because we can't expand. D 1: Interview 1_Participant 1

(23:115)

1:5 ¶ 6 With high input costs, it means that the sum of your output costs is such that you can't expand. Without a backup, you won't be able to expand. D 1: Interview 1_Participant 1

(731:873)

1:6 ¶ 7 With the increase, we can't afford to implement, everything becomes more expensive. Without an increase in outputs, you can't expand, or purchase implements or maintain them. Everything becomes more expensive, so everything also becomes more difficult to obtain. D 1: Interview 1_Participant 1

(887:1148)

1:22 ¶ 28 The El Niño year is a difficult one; we are currently trying to limit unnecessary expenses. Prices can't be cut so much, so it all comes down to planning, like producing more feed and everything in that regard. El Niño has given both good and bad years, so planning is really all we can do. It... D 1: Interview 3_Participant 3

(4859:5246)

1:25 ¶ 34 Production facilities are a problem to obtain, especially when trying to get hold of land, but it takes a big hit in cash flow, and it causes problems. D 1: Interview 3_Participant 3

(5920:6071)

1:55 ¶ 101 I assume it's like maize and feed costs; what we usually try to do is buy early in the year before the tax increase. We have overstated facilities, so we don't have production facilities like others. We have exaggerated facilities that we work with. This helps a lot with the early purchases…D 1: Interview 6_Participant 6

1:59 ¶ 109 Luckily, we have the feeding supply that works together because we make money on it throughout the year and then use it. This allows us to do certain things that others can't do. Land doesn't increase much; the price goes for market value.

The problem is nobody really wants to sell…D 1: Interview 6_Participant 6

1:65 ¶ 123 Price pressure has a significant effect because it puts pressure on me— will there be enough to sell, will my prices be right for someone to buy from me? It's about what I have to pay and what I have to sell. Market access is basically whether I have access to a market where I want to sell. I… D 1: Interview 7_Participant 7

1:68 ¶ 129 It has a significant impact, especially if you want to expand, like making your implements more efficient or increasing your land area. The rise in prices puts great pressure because you can't set too high a price just because you want to make a profit; it doesn't work. Currently, we... D 1: Interview 7_Participant 7

1:79 ¶ 154 Prices make it difficult to acquire extra land, it's tough to involve new farmers too because they also want to survive. The other problem is obtaining finances, sometimes a loan is unsuccessful. D 1: Interview 8_Participant 8

1:88 ¶ 17 We are at no operation and force us to cut even more costs... D 1: Interview 2_Participant 2

1:92 ¶ 19 With the rise, we cannot afford to implement, everything becomes more expensive…D 1: Interview 2_Participant 2

1:95 ¶ 21 It's a big affair, labour is expensive, and we try to make it less, of course, the bigger your implements, the bigger your productivity... D 1: Interview 2_Participant 2

○ Expansion limitations 4

Quotations:

1:83 ¶ 14 It prevents our expansion, maintenance, labour, and food production because we cannot expand. D 1: Interview 2_Participant 2

1:85 ¶ 15 Stay to the basics, and we always hope for a successful season, also not to plant strange things, everyone sometimes tries new or strange methods. Do what you know works. D 1: Interview 2_Participant 2

1:90 ¶ 18 With the high input costs, it means that your output costs' sum is not of such a nature that you can expand if you don't have a backup. D 1: Interview 2_Participant 2

1:92 ¶ 19 With the rise, we cannot afford to implement, everything becomes more expensive. Without an increase in outputs, you won't be able to expand, or purchase implements or maintain…D 1: Interview 2_Participant 2

○ Environmental sustainability

1:10 ¶ 11 I think it would be something we could do, government assistance, providing subsidies like they do in other countries. Most purchases we make are too expensive, for example, seeds, fuel, and fertilizer. There are too many laws, taxes, and interest. That's why other countries are successful. D 1: Interview 1_Participant 1

(1931:2222)

1:23 ¶ 30 It usually takes a year or two; we test it for a year in a small area, and if it performs well, we'll plant it on a larger area in the second year, and that's how it works. But it's important to test it over different years; we can't just test it in a good year alone. It takes about two years basically; quality and yield are very important because I focus on quality... D 1: Interview 3_Participant 3

(5260:5640)

1:32 ¶ 53 I integrate a portion every year. A new cultivar might come to me with data from surrounding farmers, but I only plant a 50x100-hectare block…D 1: Interview 4_Participant 4

(8103:8447)

1:36 ¶ 61 I'm not a commercial maize farmer, so for me, it's the first 25 to 30 tons of silage. I cut that off, and what remains, we sell immediately if the prices look good. Another thing we did this year is I bought seeds with futures; I sold my maize and bought a bunch of corn. It depends on the. D 1: Interview 4_Participant 4

1:40 ¶ 72 During an El Niño cycle, it is crucial to adjust your strategy in response to the potential exacerbation of grain shortages in Central South Africa. This can involve implementing measures such as diversifying sourcing regions to mitigate the impact of localized crop failures, enhancing…D 1: Interview 5_Participant 5

1:43 ¶ 78 Decreasing land prices can present both challenges and opportunities for acquiring production facilities in the context of managing grain shortages in Central South Africa. While it may facilitate cost-effective acquisition and expansion of production facilities, it could also signify... D 1: Interview 5_Participant 5

1:46 ¶ 85 The role of technology in food security is pivotal, as it contributes to enhancing agricultural productivity, improving resource efficiency, and fostering sustainable D 1: Interview 5_Participant 5

1:47 ¶ 86 Farming practices. Technologies such as precision farming, biotechnology, and remote sensing enable farmers to optimize resource utilization, mitigate crop losses, and adapt to changing environmental conditions. Moreover, digital platforms and data analytics facilitate better market…D 1: Interview 5_Participant 5

1:49 ¶ 89 Subsidies for farmers, infrastructure development, research and development funding, and policies promoting sustainable agricultural practices. Moreover, interventions like market stabilization measures, emergency food aid, and support for small-scale farmers can contribute to ensure production... D 1: Interview 5_Participant 5

1:50 ¶ 92 Investing in agricultural research and development to enhance crop varieties and farming techniques tailored to local conditions. D 1: Interview 5_Participant 5

1:51 ¶ 93 Promoting sustainable irrigation and water management practices to mitigate the impact of drought and water scarcity. D 1: Interview 5_Participant 5

1:54 ¶ 96 Implementing policies that incentivize sustainable farming practices and land management, fostering environmentally friendly and resilient agricultural systems. D 1: Interview 5_Participant 5

1:56 ¶ 103 I still want to put everything into achieving a top yield, so I still try to put everything in, but also protect my crops for good growth. We use the right pesticides or plant killers beforehand and soil enhancers to strengthen root growth. So, we make the water bank for the crops as large as possible to prevent that stress. D 1: Interview 6_Participant 6

1:58 ¶ 107 I recently lost a new cultivar that was half of my product, but because I conducted trials, I could prepare with the data I already had. We usually test it on a 200 or 300-hectare piece. I save about R500 to R1000 per hectare with early purchases. D 1: Interview 6_Participant 6

1:60 ¶ 111 The advantage of getting better technology is, for example, tractors that are lighter on fuel, and well-maintained implements that can do the job right. For instance, I spray pesticides once and never double because precision farming has helped with that. D 1: Interview 6_Participant 6

1:62 ¶ 116 It all comes down to what I mentioned about precision farming and larger and better tractors. We're starting to apply variants in everything too. Then we extract the optimal yield and the cultivars that have improved over time. Because it's developed so well, it makes the chances of a mistake very slim. Because the technology has improved. D 1: Interview 6_Participant 6

1:63 ¶ 118 I haven't really come across anything like that because I can't say that we get anything back from it, so right now, it feels like more of a marketing or a story because I have no experience with it. I think it's more about helping young farmers, but I think it should involve more mentorship. D 1: Interview 6_Participant 6

1:64 ¶ 120 I think we're in a good environment that provides us access to everything, but if we could get more incentives to help improve precision farming, I think it could be good. D 1: Interview 6_Participant 6

1:72 ¶ 138 I think it's important to keep up with developments. It's a very expensive purchase, but it saves money in the long run and sometimes it's better. You have the advantage of precision farming. It's sustainable because you have more knowledge and oversight of your land. D 1: Interview 7_Participant 7

1:74 ¶ 142 If farmers can do better in exports overall with support, it would be a great thing for us. I believe it should also help with exports and imports and how it can be beneficial for local farmers. D 1: Interview 7_Participant 7

1:75 ¶ 146 It has a significant effect because you really have to keep an eye on it almost all the time. It has a big influence, but being more in the spotlight about what's going on in the markets helps. D 1: Interview 8_Participant 8

○ Efficiency

21 Quotations:

1:2 ¶ 3 Stay to the basics and we always hope for a successful season, also not to plant strange things, everyone sometimes tries new or strange methods. Do what you know works. D 1: Interview 1_Participant 1

(128:297)

1:4 ¶ 5 We're at no operation and it forces us to cut even more costs, reduce labour, and mechanize more to see if there can still be a profit made and then continue like that. D 1: Interview 1_Participant 1

(584:717)

1:10 ¶ 11 I think it would be something we could do, government assistance, providing subsidies like they do in other countries. Most purchases we make are too expensive, for example, seeds, fuel, and fertilizer. There are too many laws, taxes, and interest. That's why other countries are successful. D 1: Interview 1_Participant 1

(1931:2222)

1:24 ¶ 32 It's a big problem because last year, input prices were almost as high as land costs, and it had a significant impact. We're trying to handle it; I can't increase my production costs, but we're trying to keep up with the trends and still make a profit. D 1: Interview 3_Participant 3

(5655:5906)

1:26 ¶ 36 It's a hugely difficult point; I'm researching to acquire larger implements for lower fuel costs and to get away with more implements and less labour. D 1: Interview 3_Participant 3

(6086:6235)

1:37 ¶ 63 We can't do without technology; it helps us feed the people in the country. They say we're 50 or 60 million people, but I believe we're more like 100 million in the country. Machines that improve, improve the genetics, and the outcomes of the product. It also makes labour faster and more effective. D 1: Interview 4_Participant 4

1:39 ¶ 70 Price pressure and market access can significantly impact businesses, especially in the context of managing production implications during grain shortages in Central South Africa. Your business may face challenges such as increased costs for sourcing raw materials, reduced margins due to higher prices, and limited... D 1: Interview 5_Participant 5

1:42 ¶ 76 Rising input prices can significantly impact your production strategy and output, leading to increased operational costs, reduced profit margins, and potential supply chain

disruptions. This may necessitate reevaluating sourcing practices, exploring cost-effective alternatives, and options... D 1: Interview 5_Participant 5

1:44 ¶ 80 An increase in mechanization costs can significantly influence your overall strategy for managing production implications during grain shortages in Central South Africa. It may necessitate reassessing the investment in advanced technology and machinery, exploring alternative... D 1: Interview 5_Participant 5

1:52 ¶ 94 Facilitating access to affordable and efficient agricultural machinery and technologies to improve productivity and efficiency. D 1: Interview 5_Participant 5

1:53 ¶ 95 Supporting small-scale farmers through training, access to credit, and market linkages to boost their productivity and contribution to overall grain production. D 1: Interview 5_Participant 5

1:55 ¶ 101 I assume it's like maize and feed costs; what we usually try to do is buy early in the year, before the tax increase. We have overstated facilities, so we don't have production facilities like others. We have exaggerated facilities that we work with. This helps a lot with the early purchases and getting a good price. D 1: Interview 6_Participant 6

1:60 ¶ 111 The advantage of getting better technology is, for example, tractors that are lighter on fuel, and well-maintained implements that can do the job right. For instance, I spray pesticides once and never double because precision farming has helped with that. D 1: Interview 6_Participant 6

1:62 ¶ 116 It all comes down to what I mentioned about precision farming and larger and better tractors. We're starting to apply variants in everything too. Then we extract the optimal yield and the cultivars that have improved over time. Because it's developed so well, it makes the chances of a... D 1: Interview 6_Participant 6

1:72 ¶ 138 I think it's important to keep up with developments. It's a very expensive purchase, but it saves money in the long run and sometimes it's better. You have the advantage of precision farming. It's sustainable because you have more knowledge and oversight of your land. D 1: Interview 7_Participant 7

1:75 ¶ 146 It has a significant effect because you really have to keep an eye on it almost all the time. It has a big influence, but being more in the spotlight about what's going on in the markets helps. D 1: Interview 8_Participant 8

1:77 ¶ 150 New cultivars should be gradually introduced and not all at once in one year, especially if you're not sure about the cultivar. The secret lies in the trials you conduct on your own soil. D 1: Interview 8_Participant 8

1:81 ¶ 160 There's no better cost-effectiveness than what technology can provide; it's a core in farming. Think of something as simple as a maize row planted crookedly, when harvesting, you'll miss out. The better your planter is with precision technology, the smaller the chance you'll miss plo... D 1: Interview 8_Participant 8

1:88 ¶ 17 We are at no operation and force us to cut even more costs... D 1: Interview 2_Participant 2

1:94 ¶ 20 The market must keep an eye and use the opportunities..D 1: Interview 2_Participant 2

1:97 ¶ 22 Currently, the programs are aimed at emerging farmers and very few aimed at your commercial farmers... D 1: Interview 2_Participant 2

○ Economic factors

1:4 ¶ 5 We're at no operation and it forces us to cut even more costs, reduce labour, and mechanize more to see if there can still be a profit made and then continue like that. D 1: Interview 1_Participant 1

(548:717)

1:8 ¶ 9 It's a big concern, labour is expensive, and we're trying to reduce it. Of course, the bigger your implements, the greater your productivity becomes. The larger you go, the more expensive it becomes, labour is currently a very high cost at hand. D 1: Interview 1_Participant 1

1:24 ¶ 32 It's a big problem because last year, input prices were almost as high as land costs, and it had a significant impact. We're trying to handle it; I can't increase my production costs, but we're trying to keep up with the trends and still make a profit. D 1: Interview 3_Participant 3

(5655:5906)

1:30 ¶ 49 Price pressure, as it is for me, would be when one has to sell maize; it's critical, and market access is obvious because we have an open market, which doesn't really affect us. My cash flow is what gets affected when the price is under pressure, forcing us to change the price to sell. D 1: Interview 4_Participant 4

(7482:7768)

1:34 ¶ 57 In this case, I'm in a privileged position. We don't plant anything beforehand and don't sign any maize contracts beforehand. The high land costs are a problem; currently, I'm in a cycle where I want to improve my land, and I'm currently taking one and two-hectare grids and mapping... D 1: Interview 4_Participant 4

1:43 ¶ 78 Decreasing land prices can present both challenges and opportunities for acquiring production facilities in the context of managing grain shortages in Central South Africa. While it may facilitate cost-effective acquisition and expansion of production facilities, it could also signify potent…D 1: Interview 5_Participant 5

1:49 ¶ 89 Subsidies for farmers, infrastructure development, research and development funding, and policies promoting sustainable agricultural practices.

Moreover, interventions like market stabilization measures, emergency food aid, and support for small-scale farmers can contribute to..D 1: Interview 5_Participant 5

1:58 ¶ 107 I recently lost a new cultivar that was half of my product, but because I conducted trials, I could prepare with the data I already had. We usually test it on a 200 or 300-hectare piece. I save about R500 to R1000 per hectare with early purchases. D 1: Interview 6_Participant 6

1:68 ¶ 129 It has a significant impact, especially if you want to expand, like making your implements more efficient or increasing your land area. The rise in prices puts great pressure because you can't set too high a price just because you want to make a profit; it doesn't work. Currently, we…D 1: Interview 7_Participant 7

1:69 ¶ 131 As I mentioned, input prices and land prices are what ultimately put us in tight situations. It makes your chances of expanding and improving very slim. D 1: Interview 7_Participant 7

1:70 ¶ 134 If the costs of mechanization keep rising, it becomes too expensive. But it can also cause trouble because the lifespan of the implements decreases as they stagnate due to the high cost of improvement. D 1: Interview 7_Participant 7

1:74 ¶ 142 If farmers can do better in exports overall with support, it would be a great thing for us. I believe it should also help with exports and imports and how it can be beneficial for local farmers. D 1: Interview 7_Participant 7

1:82 ¶ 164 Start by giving uncultivated or workable land to farmers who can work and improve it, then train people to do the same. I believe if we could get more help, we would perform much better than we currently do. It can improve food security, and if we could really get subsidies because we... D 1: Interview 8_Participant 8

1:95 ¶ 21 It's a big affair, labour is expensive, and we try to make it less, of course, the bigger your implements, the bigger your productivity. The bigger you go, the more expensive it gets, labour is currently a very high cost on hand. D 1: Interview 2_Participant 2

1:99 ¶ 23 I think that would be something we could do, government assistance, providing subsidies as they do in other countries. Most purchases we make are too expensive, for example, seeds, fuel, and fertilizer. There are too many laws, taxes, and interest. That's why other countries are successful. D 1: Interview 2_Participant 2

○ Dynamic pricing

1:45 ¶ 83 To mitigate the risks associated with price volatility in grain prices, it's essential to incorporate various risk management measures into the managerial framework. This can include developing effective hedging strategies, maintaining diversified sourcing networks, and fostering long-term... D 1: Interview 5_Participant 5

○ Difficulty in obtaining resources

1:6 ¶ 7 With the increase, we can't afford to implement, everything becomes more expensive. Without an increase in outputs, you can't expand, or purchase implements or maintain them. Everything becomes more expensive, so everything also becomes more difficult to obtain. D 1: Interview 1_Participant 1

(887:1148)

1:90 ¶ 18 With the high input costs, it means that your output costs' sum is not of such a nature that you can expand if you don't have a backup. D 1: Interview 2_Participant 2

○ Agriculture

1:10 ¶ 11 I think it would be something we could do, government assistance, providing subsidies like they do in other countries. Most purchases we make are too expensive, for example, seeds, fuel, and fertilizer. There are too many laws, taxes, and interest. That's why other countries are successful. D 1: Interview 1_Participant 1

(1931:2222)

1:22 ¶ 28 The El Niño year is a difficult one; we are currently trying to limit unnecessary expenses. Prices can't be cut so much, so it all comes down to planning, like producing more feed and everything in that regard. El Niño has given both good and bad years, so planning is really all we can do... D 1: Interview 2_Participant 2

1:35 ¶ 59 Mechanization costs are expensive, but for example, on October 27, I didn't have one worker on my farm out of the 70, so I didn't have to struggle with that difficulty. Mechanization costs are expensive, but you must keep up with the times; in the end, you can only plan …D 1: Interview 3_Participant 3

1:36 ¶ 61 I'm not a commercial maize farmer, so for me, it's the first 25 to 30 tons of silage. I cut that off, and what remains, we sell immediately if the prices look good. Another thing we did this year is I bought seeds with futures; I sold my maize and bought a bunch of corn. It depends on the... D 1: Interview 3_Participant 3

1:46 ¶ 85 The role of technology in food security is pivotal, as it contributes to enhancing agricultural productivity, improving resource efficiency, and fostering sustainability. D 1: Interview 5_Participant 5

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1:50 ¶ 92 Investing in agricultural research and development to enhance crop varieties and farming techniques tailored to local conditions. D 1: Interview 5_Participant 5

1:54 ¶ 96 Implementing policies that incentivize sustainable farming practices and land management, fostering environmentally friendly and resilient agricultural systems. D 1: Interview 5_Participant 5

1:56 ¶ 103 I still want to put everything into achieving a top yield, so I still try to put everything in, but also protect my crops for good growth. We use the right pesticides or plant killers

beforehand and soil enhancers to strengthen root growth. So, we make the water bank for the crops as large as... D 1: Interview 6_Participant 6

1:58 ¶ 107 I recently lost a new cultivar that was half of my product, but because I conducted trials, I could prepare with the data I already had. We usually test it on a 200 or 300-hectare piece. I save about R500 to R1000 per hectare with early purchases. D 1: Interview 6_Participant 6

1:63 ¶ 118 I haven't really come across anything like that because I can't say that we get anything back from it, so right now, it feels like more of a marketing or a story because I have no experience with it. I think it's more about helping young farmers, but I think it should involve more mentorship. D 1: Interview 6_Participant 6

1:66 ¶ 125 What you do, like planting soon, the best is to plan and trust because we don't control nature. Ensure your soil is properly analysed and treat your plants so they can survive those times. Stick to what you always do and don't experiment in your plantations because that could become a …D 1: Interview 7_Participant 7

1:67 ¶ 127 I don't believe there's a specific period; you just have to do what you think is right, like using a 30x40-hectare piece of land for new cultivars. Be patient with it before planting among the cultivars you already have. That's how the process works. D 1: Interview 7_Participant 7

1:68 ¶ 129 It has a significant impact, especially if you want to expand, like making your implements more efficient or increasing your land area. The rise in prices puts great pressure because you can't set too high a price just because you want to make a profit; it doesn't work. Currently, we're... D 1: Interview 7_Participant 7

1:71 ¶ 136 Somewhere you have to commit, even if it's just a few tons. It's important to commit, for example, from December to the end of January. And to have certainty about a fixed product. It helps with assurance. It also helps to reduce risk because everything gets better as it develops and... D 1: Interview 7_Participant 7

1:74 ¶ 142 If farmers can do better in exports overall with support, it would be a great thing for us. I believe it should also help with exports and imports and how it can be beneficial for local farmers. D 1: Interview 7_Participant 7

1:81 ¶ 160 There's no better cost-effectiveness than what technology can provide; it's a core in farming. Think of something as simple as a maize row planted crookedly, when harvesting,

you'll miss out. The better your planter is with precision technology, the smaller the chance you'll miss plough… D 1: Interview 8_Participant 8

1:82 ¶ 164 Start by giving uncultivated or workable land to farmers who can work and improve it, then train people to do the same. I believe if we could get more help, we would perform much better than we currently do. It can improve food security, and if we could really get subsidies because ..D 1: Interview 8_Participant 8

1:83 ¶ 14 It prevents our expansion, maintenance, labour, and food production because we cannot expand. D 1: Interview 1_ Participant 1

1:85 ¶ 15 Stay to the basics, and we always hope for a successful season, also not to plant strange things, everyone sometimes tries new or strange methods. Do what you know works. D 1: Interview 1_ Participant 1

1:86 ¶ 16 Start on a small scale, not everything in one basket, maybe it can be done in one year. If they predict El Niño, it's best to stick to the normal things that work and not try something new because it will be an unpredictable year. D 1: Interview 1_ Participant 1

1:95 ¶ 21 It's a big affair, labour is expensive, and we try to make it less, of course, the bigger your implements, the bigger your productivity. The bigger you go, the more expensive it gets, labour is currently a very high cost. D 1: Interview 1_ Participant 1

○ Biotechnology

1:43 ¶ 78

Decreasing land prices can present both challenges and opportunities for acquiring production facilities in the context of managing grain shortages in Central South Africa. While it may facilitate cost-effective acquisition and expansion of production facilities, it could also signify production... D 1: Interview 5_Participant 5

1:47 ¶ 86 farming practices. Technologies such as precision farming, biotechnology, and remote sensing enable farmers to optimize resource utilization, mitigate crop losses, and adapt to changing environmental conditions. Moreover, digital platforms and data analytics facilitate better market...D 1: Interview 5_Participant 5

1:95 ¶ 21

Question 8: It's a big affair, labour is expensive, and we try to make it less, of course, the bigger your implements, the bigger your productivity. The bigger you go, the more expensive it gets, labour is currently a very high cost on hand. D 1: Interview 5_Participant 5

ADDEMNDUM 3: LANGUAGE EDITING

Psychmetrica

CERTIFICATE: LANGUAGE EDITING

Herein, confirmation that the following document was edited:

MASTER'S DISSERTATION

Developing a managerial framework to manage the production implications of grain shortages in central South Africa

DD Kloppers

orcid.org/0000-0003-0941-2960

The following was edited according to the NWU requirements, subject to Harvard Guidelines:

Spelling; grammar, layout, alignment, flow, referencing, and similarity.

Additionally: AtlasTi Data Processing, Transcriptions, and Translations for provided interviews

Final changes and application of editing remain the responsibility of the student

W Smith

Registered Psychometrist
HPCSA: PMT0097012

R du Plessis

Ethical Editing Advisor

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www.psychmetrica.co.za; 083 390 4091 ; psychmetrica@gmail.com