Analysing South Africa's food security environment based on the 2022 Global Food Security Index score and rank

by

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ABSTRACT

A report issued by the FAO has warned that, on a global scale, most nations are not progressing towards the achievement of the goal to eliminate hunger before the end of the year 2030, as outlined in the Sustainable Development Goals (SDGs) (United Nations, 2019). Consistent with global patterns, the general state of food security in South Africa has experienced a decline over the preceding five years. The study aimed to analyse South Africa's food security environment by utilising the Global Food Security Index (GFSI) score and rank, focusing on identifying areas for improvement and prioritising actions for stakeholders. Furthermore, it proposed to evaluate the trend in South Africa's GFSI rank and score from 2012 to 2022, reviewed performance in the four GFSI dimensions (affordability, availability, quality & safety, sustainability & adaptability), based on the 2022 report, and to suggest actionable steps for various stakeholders to enhance food security. The research adopted a comprehensive approach, blending primary and secondary data sources. Secondary data analysis traced the trajectory of South Africa's GFSI score and rank over the 2012–2022 period, while primary data collection involved semi-structured interviews with nine recognised experts in relevant fields respective to the indicators. Key findings indicated an initial increase in South Africa's food security from 2012 to 2016, followed by a moderate decline leading up to 2022. Thirteen out of 68 indicators including, change in the average food cost, food security and access to policy commitments, and water, significantly contributed to the deterioration of the 2022 score and rank. Despite having strong policies and strategies in place to protect and enhance South Africa's food security, implementation failures were identified in South Africa's food security environment, these included, lack of collaboration, water system failures and a lack of know-how and support. The GFSI should be understood as an evaluation tool for assessing the food security environment. This study suggests actionable steps that should be implemented and monitored by a food security agency in South Africa. Recommendations included the establishment of a dedicated food security task force or coordinating body to supervise implementation, fostering sustained collaboration among stakeholders. Continuous monitoring of South Africa's GFSI score, and rank was advised to track progress and identify further areas for improvement.

Keywords: Global Food Security Indicator (GFSI), food security, food security environment

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LIST OF ACRONYMS

APAP	Agricultural Policy Action Plan
ARC	The Agricultural Research Council
AU	African Union
BFAB	Bureau for Food and Agricultural Policy
CSI	Coping Strategy Index
DAFF	The Department of Agriculture, Forestry and Fisheries
DALLRD	The Department of Agriculture, Land Reform and Rural Development
DBE	National Department of Basic Education
DOA	Department of Agriculture
DTIC	Department of Trade, Industry and Competition
DWS	The Department of Water and Sanitation
EIU	Economist Intelligence Unit
FAO	Food and Agriculture Organization
FPI	Food Price Inflation
GFSI	Global Food Security Index
GHI	Global Hunger Index
HAI	Human Asset Index
HRCI	Hunger Reduction Commitment Index
IFPRI	International Food Policy Research Institute
IGDP	Integrated Growth and Development Plan
NCD	Non-Communicable Disease
NSP	National Strategic Plan

OECD	Organisation for Economic Co-operation and Development
PPI	Producer Price Index
PPP	Purchasing Power Parity
SADC	Southern African Development Community
SAWS	The South African Weather Service
SDGs	Sustainable Development Goals
TFP	Total Factor Productivity
UN	United Nations
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
WFP	World Food Programme
WHO	World Health Organization

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CHAPTER 1: INTRODUCTION

1.1 Background of Study

Food security, a multifaceted and evolving challenge, has navigated a remarkable trajectory within the academic discourse and global policy arenas (EIU, 2022a). As the world grappled with the intricacies of nourishment, the idea of food security saw an unprecedented multiplication of definitions during the 1970–1990 period, surging across international boundaries and transcending cultural, economic, and geographic divides. According to Maxwell and Smith (1992), during this timeframe, almost 200 definitions of food security spread, globally. Six-years later, in 1996, the concept of food security was refined to encompass cultural and dietary considerations (FAO, 1996a). The term 'social' was included in the State of Food Insecurity report of the Food and Agricultural Organization (FAO, 2001), which solidified an updated definition as being the leading and commonly accepted interpretation of the idea, a designation it retains to this day. The 1996 definition, "When all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 1996b), evolved further in 2004, by acknowledging the four dimensions of food security that comprise access, availability, utilisation, and stability (FAO, 2004).

Historically, the focus in South Africa, as in many other countries, was primarily on increasing agricultural production to ensure food security. However, global trends and evolving definitions of food security have emphasised not just production but also access to food (FAO, 1996a). South Africa has shifted its approach, accordingly, recognising that ensuring access to food for all citizens is as important as increasing production (DAFF, 2014a). The concept of food security has expanded to include not only access to an adequate quantity of food but also access to nutritious and culturally appropriate food (FAO & FHI 360, 2016). South Africa has recognised the importance of nutritional security and has implemented programs to address malnutrition and promote dietary diversity, particularly among vulnerable populations such as children and pregnant women (DAFF, 2014a). Global trends have highlighted the importance of inclusive and sustainable development in achieving food security. This includes addressing issues of poverty, inequality, and environmental degradation that can undermine food security (FAO, 2022). South Africa's approach to addressing food insecurity has increasingly focused on promoting inclusive growth and sustainable agricultural practices to ensure long-term food security for all people (DALRRD, 2022). With a growing understanding of the multifaceted nature of food security, there has been a trend towards integrating food security concerns into broader policy frameworks related to agriculture, health, social welfare, and economic development (FAO, 2012).

South Africa has adopted a more integrated approach to addressing food insecurity, recognising that effective solutions require coordinated action across multiple sectors and levels of government (DALRRD, 2022).

There are numerous food security measurement tools available, and they vary in their focus, methodology and scope, and serve various purposes, including assessing food access, availability, utilisation, and stability. Some of these food security measurement tools that reflect the multidimensional nature of this critical global concern include The Food Insecurity Experience Scale (FIES), which assesses individuals' direct experiences of food insecurity, and captures aspects like insufficient food quantity and uncertain access (FAO, 2018). The Global Food Security Index (GFSI) provides a comprehensive evaluation of food security across countries, considering factors such as affordability, availability, and quality of food (EIU, 2022a). The Dietary Diversity Score is another example and categorises food items based on nutritional attributes, reflecting the range of foods consumed by individuals and populations within a specified period (Habte & Krawinkel, 2016). These tools serve to quantify, monitor, and analyse the complexities of food security, thereby assisting policymakers, researchers, and organisations in developing targeted interventions and policies to address the multifaceted challenges associated with ensuring access to sufficient, safe, and nutritious food for all (FAO, 2012).

The Global Food Security Index (GFSI) is a tool that assesses a country's food security environment in 113 countries worldwide. The GFSI was created and funded by the Economist Intelligence Unit (EIU) in 2012, and was developed to measure the food security environment of a country. This index furthermore offers a way to compare food security across different nations, encompassing both developing and developed countries, providing a comprehensive global perspective. In its 2022 edition, the GFSI employs 68 distinct indicators to evaluate various aspects of food security, assessing the conditions that support it. These indicators are divided into four dimensions, namely (1) "affordability", (2) "availability", (3) "quality & safety", and (4) "sustainability & adaptation" (EIU, 2022a). The GFSI utilises a mix of qualitative and quantitative data to evaluate these 113 countries, assigning each a unique score and rank. Additionally, the GFSI offers guidance on developing country-specific food security strategies and identifying vulnerabilities within each country's food security environment (EIU, 2022a).

Amid an ever-developing idea of food security and the creation of various measurement tools, set against the backdrop of deteriorating global and local food security, this study has set on an academic exploration of the aspects of the GFSI that are deteriorating in South Africa's food security environment. The purpose of this study is to use the GFSI as an instrument to (1) identify aspects of food security deterioration in South Africa, and (2) analyse and identify areas for improvement. By

doing so, this research endeavours to contribute insights that could inform policy decisions, encourage food security strategies, and ultimately work towards alleviating the challenges that South Africa faces in ensuring a stable and secure food supply for its population.

1.2 Statement of the Research Problem

A report issued by the FAO has warned that, on a global scale, most nations are not progressing towards the achievement of the goal to eliminate hunger before the end of the year 2030, as outlined in the Sustainable Development Goals (SDGs) (United Nations, 2019). Statistics South Africa (2017) shows that approximately 821 million people, globally, were malnourished in 2017. Idris et al. (2020) have supported this by further suggesting that 690 million individuals were suffering from hunger in 2019, while 135 million individuals in 55 countries were suffering from acute food insecurity, globally (Nwosu, et al., 2022).

Consistent with global patterns, the general state of food security in South Africa has experienced a decline over the preceding five years. According to Hendriks and Olivier (2020), in the year prior to the onset of the COVID-19 pandemic in 2020, 11%, nearly 14 million people, of the South African population encountered instances of hunger. In 2021, this number increased to 2,1 million people, totalling 11,6% of people experiencing hunger in the period following the COVID-19 pandemic (StatsSA, 2021). South Africa intends to reach key goals as set out by the SDGs, the African Union's Agenda 2063, and the AU Malabo Declaration, all of which speak to ensuring a food-secure country. South Africa has also agreed to reduce poverty by 50% and terminate hunger by 2030, which includes ending all child undernutrition (NEPAD, 2014). South Africa is not on a trajectory to reach these goals, as set out according to the 2019 Sustainable Development Report produced by Statistics South Africa (StatsSA, 2017). The roots to the food security challenges emanate from interlinked failures within economic, social, environmental, and political systems. Food insecurity arises from poverty, inequality, and unemployment, while also being a consequence of these economic challenges. Evidently, the concern is not the willingness of South Africa to partake in food security initiatives, but rather about ensuring that each individual possesses adequate income to cover essential living expenses and afford a well-balanced diet, which is imperative (UNICEF, 2016).

The Global Food Security Index (GFSI), created by Economist Impact and backed by Corteva Agriscience, assesses food affordability, availability, quality and safety, as well as sustainability and adaptation across 113 countries. Sub-Saharan Africa registers an average score of 47 points for its overall food security environment in the 2022 GFSI, positioning it as the least food-secure region worldwide. South Africa is ranked 59th out of 113 countries in the index and is among the 28 Sub-Saharan African countries, with an overall food security environment score of 61.7. However, the nation

faces challenges in preserving and adapting its natural resources, especially agricultural water sources, oceans, rivers, and lakes. It's crucial to intensify efforts to safeguard these resources to ensure sustainable food production in the long run (EIU, 2022a).

Additionally, South Africa grapples with inadequate food supply and production volatility, which affect its overall food security environment. There has been improvement in South Africa's overall Food Security Environment score from 2012 to 2022, with all pillars except Affordability showing improvement during this period. However, Affordability has experienced a decline of 7.1 points since the 2012 GFSI, with scores dropping across four of the five indicators in this pillar. This decline suggests a trend of diminishing quality in food safety-net programs provided for the significant portion of the population living below the global poverty line. Furthermore, South Africa lags in its capacity to set nutritional standards from a policy perspective, and widening inequality gaps undermine the country's efforts to ensure food affordability for all. Food supply issues pose a significant challenge, requiring immediate action to ensure the provision of sufficient dietary energy (EIU, 2022b).

This study seeks to investigate areas of concern and, in turn, areas for improvement in South Africa's 2022 GFSI score and rank, and to prioritise actions that various stakeholders could take to address the areas of poor performance of South Africa's overall 2022 GFSI score and rank. This study will first explore which of the four dimensions of the GFSI that the country is performing poorly in, as an entry point to identify areas for improvement.

1.3 Research Objectives

The study's primary objective is to analyse South Africa's food security environment, based on the Global Food Security Index score and rank, by identifying the areas for improvement and to prioritise actions that various stakeholders could take to address the areas of poor performance in the four separate dimensions based on the GFSI.

The sub-objectives formulated for the research study are to:

i. Evaluate the trend of South Africa's performance, based on the GFSI rank and score from 2012 to 2022;

ii. Review the performance in the four separate dimensions (affordability, availability, quality & safety, and sustainability & adaptability) based on the 2022 GFSI; and

iii. Identify what actions could be taken by various stakeholders in South Africa to enable a more food-secure environment.

1.4 Research Questions

This study will investigate the following research questions:

i. Why is South Africa's GFSI 2022 score and rank decreasing?

ii. What can different stakeholders do to improve the deterioration of the food security environment in South Africa, based on the 2022 GFSI score and rank?

1.5 Significance of this Research

The 2022 GFSI score, and rank, serve as indicators of a country's food security environment. Attributes of food security, such as hunger and malnutrition, exhibit a direct correlation with human performance in terms of economic contributions to a nation (FAO, 2022). Consequently, the inference drawn is that a country with better food security is more favourably positioned for economic growth. This study aims to discern areas for enhancement in South Africa's 2022 GFSI database. Given the broad-ranging impact of food security, it has become a salient and extensively researched field. Both private and public sector stakeholders utilise information gathered from the GFSI to inform policymaking processes and formulate strategic initiatives (EIU, 2021). The deterioration of South Africa's food security environment could impede South Africa's progress towards achieving its SDGs of becoming a food secure nation by 2030. Consequently, an evaluation is required to discern the reasons behind the deterioration in South Africa's food security environment over recent years.

1.6 Summary of the Study's Chapters

Chapter 1 introduces the dissertation by outlining the significance of the GFSI and contextualising it within the broader global food security environment. It establishes the research purpose, problem statement, objectives and methodology, emphasising ethical considerations. Chapter 2 conducts a thorough literature study on food security, encompassing its definition, historical evolution, measurement practices and methodologies, as well as discussing South Africa's situation in the global context. A conceptual framework is introduced to guide subsequent analyses. Chapter 3 details the research methods, integrating quantitative and qualitative approaches, including questionnaire development and interview execution. Chapter 4 presents comprehensive results and discussions on South Africa's food security, across GFSI dimensions. It serves as a pivotal point in uncovering insights into the nation's strengths and vulnerabilities. Finally, Chapter 5 concludes the study, highlighting implications of the research findings and offering recommendations for future investigations.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

2.1.1 Overview

This chapter aims to evaluate the evolution of food security development and examine the diverse methodologies employed for its assessment. Additionally, the chapter endeavours to examine the status of the food security environment in South Africa. An assessment of the policy landscape that influences and impact on food security is conducted. Finally, the chapter focuses on introducing the GFSI indicator for the optimal approach for evaluating the state of the food security environment in South Africa. The term 'food security' holds diverse interpretations, shaped by individual perspectives and intersecting disciplines such as agriculture, sociology, health and economics. The comprehension of food security and its significance derives from a historical backdrop wherein global challenges related to hunger and malnutrition, impacting on a substantial population group ranging between 800 million and 1,2 billion individuals, have endured for the last forty years (FAO, IFAD, UNICEF, WFP and WHO, 2023).

2.1.2 Definition of food security

Numerous definitions of food security are present in the pertinent literature, with the most widely embraced definition stemming from the policy paper on food security by the World Bank (WB) (1986), titled "Poverty and Hunger". According to the WB's definition, food security is described as "… access by all people at all times to enough food for an active and healthy life." This definition underscores two pivotal components: the availability of food, and the capability to obtain it. Conversely, food insecurity is characterised by inadequate access to enough food to sustain life. These definitions have gathered international acknowledgment, owing to their clarity and extensiveness. Food security is stated by the FAO (1996a) as "a state achieved when individuals possess continuous and unrestricted physical and economic access to an adequate, safe, and nutritionally balanced food supply that caters to their dietary requirements and preferences, thereby enabling them to lead an active and healthy life". This description aligns with the principle that food security encompasses the entitlement of all individuals to enough food, ensuring their well-being and productivity. The availability and accessibility of food are pivotal factors in determining food security and are closely associated with poverty levels and economic growth (Anderson & Martin, 2005), as cited in Lado (2001).

Traditionally, food security is conceptualised through three core dimensions: income, access, and utilisation (McCalla, 1999). A person is not deemed food secure if the financial means to procure food

or encounter physical, social, or legal obstacles exist, that hinder their access to it. Sufficient access to food entails entitlement, encompassing the resources required for its acquisition. Moreover, the essential use of food requires understanding the effective methods for storing and processing of foodstuffs, knowledge of nutritional principles, and appropriate practices for childcare and managing illnesses (ECI, 2002). It is vital to differentiate food security from concepts like 'food self-sufficiency', 'meeting dietary requirements', and 'agricultural development'. Food self-sufficiency denotes a nation's ability to fulfil its staple food demands entirely through domestic production, whereas agricultural development pertains to augmenting agricultural output per capita. Food security, distinct from these notions, emphasises the consistent availability of adequate food supplies, as noted by Rukuni and Eicher (1988) and Maxwell and Frankenberger (1995)).

Table 2–1 below shows the different variations and evolvement of the food security definition from 1975 to the current most recent definition. During this timeframe, the understanding of food security underwent notable changes, reflecting the evolving global discourse on the subject. Different perspectives and approaches emerged, leading to refined definitions and nuanced interpretations.

Table 2-1: Modifications to the definition of food security from 1975 to 2012

Year	Food Security Definitions	Source
1975	"Availability at all times of adequate world supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices" – As stated by the United Nations in 1975	(Maxwell, 1996)
1977	"The probability of food grain consumption in developing countries falling below a desired level due to a fixed upper limit on the food import bill they can afford and an unfavourable combination of poor harvest and world food grain prices" – As mentioned by Reutlinger in 1977	(Maxwell & Frankenberger, 1995)
1980	"A condition in which the probability of a country's citizens falling below a minimal level of food consumption is low" – As noted by Reutlinger & Knapp in 1980	(Maxwell, 1996)
1981	"Everyone has enough to eat at any time – enough for life, health and growth of the young, and for productive effort" – Stated by Kracht in 1981	(Maxwell, 1996)
1982	"Freedom from food deprivation for the entire world's people all of the time" – Stated by Reutlinger in 1982	(Maxwell, 1996)
1983	"Ensuring that all people at all times have both physical and economic access to the basic food they need" – Noted by the FAO in 1983	(Maxwell, 1996)

Year	Food Security Definitions	Source
1984	"The stabilisation of access, or of proportionate shortfalls in access, to calories by a population" – Stated by Heald & Lipton in 1984	(Maxwell, 1996)
1985	"A basket of food, nutritionally adequate, culturally acceptable, procured in keeping with human 187 dignity and enduring over time" – as compiled by Oshaug and noted by Eide et al. in 1985	(Maxwell, 1996)
1986	"Access by all people at all times to enough food for an active, healthy life. Two essential elements are 'the availability of food and the ability to acquire it'. Food insecurity, in turn, is the lack of access to enough food" – as stated by the WB	World Bank, (1986)
1987	"Food security means always having enough to eat. People reach food security by (1.) Having land and resources to grow food, or (2.) having employment which pays enough to buy food" – as stated by Zipperer in 1987	(Maxwell & Frankenberger, 1995)
1988	"A country and people are food secure when their food system operates efficiently in such a way as to remove the fear that there will not be enough to eat" – Mentioned by Maxwell in 1988	(Maxwell, 1996)
1989	"The ability to satisfy adequately food consumption needs for a normal and healthy life at all times" – Compiled by Sarris in1989	(Maxwell, 1996)
1990(1)	"The ability of a country or region to assure, on a long-term basis, that its food system provides the total population access to a timely, reliable and nutritionally adequate supply of food" – As noted by Van Zyl in 1990	(Van Zyl, 1990)
1990(2)	"Food insecurity exists when members of a household have an inadequate diet for part or all of the year or face the possibility of an inadequate diet in the future" – Stated by Phillips & Taylor in 1990	(Maxwell & Frankenberger, 1995)
1991	"Enough food available to ensure a minimum necessary intake by all members" – Mentioned by Alamgir & Arora in1991	(Maxwell, 1996)
1992	"Food security is when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life. It requires food 188 availability, food access and food utilization/consumption" – Stated by USAID in 1992	(Maxwell & Frankenberger, 1995)
1996	"Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" – FAO, 1996	(FAO, 1996a)
2001	"Food security (is) a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." – noted by the FAO in 2003	(FAO, 2003)

Year	Food Security Definitions	Source
2012	"Food and nutrition security exists when all people at all times have physical, social and economic access to food, which is safe and consumed in sufficient quantity and quality to meet their dietary needs and food preferences, and is supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life." – Stated by the FAO in 2012	(FAO, 2012)

Source: Adapted from (Abdalla, 2007)

In the span from 1975 to the latest acknowledged definition in 2012, the progression of food security definitions illustrates an expanded comprehension of the concept. It now encompasses not only the "availability" of food, but also considerations of access, utilisation, and nutrition. These advancements have played a crucial role in fostering a more holistic and comprehensive strategy for tackling the challenges associated with food security (Maxwell, 1996).

Recognised as a fundamental human right, food security holds paramount importance for the physical, social, and economic well-being of individuals, households, and communities (FAO, 1996a). As stated by Ligmann-Zielinska and Rivers (2018), a holistic theory of food security considers the four dimensions, namely "availability", "access", "utilisation", and "stability". The World Bank considers availability to be the primary dimension because it relates to the physical presence of food in specific regions, including factors such as food production levels, stock quantities, and net trade (World Bank, 1986). Access deals with the ability of individuals and households to obtain food, depending on variables such as income, expenditure, market dynamics and pricing. Utilisation emphasises the proficiency of individuals in effectively using food to meet nutritional requirements, considering factors such as food safety, hygiene and health. Finally, the stability dimension involves the capacity to maintain consistent access to food, over time, even in the face of disruptions such as economic or climatic disasters. While the four dimensions of food security continue to be fundamental to the concept, the High-Level Panel of Experts (HLPE, 2020), mentions that certain elements are overlooked that are now considered crucial for reshaping food systems to align with the Sustainable Development Goals (SDGs). The concepts "agency" and "sustainability" are essential dimensions of food security stemming directly from the principle of the right to food.

Although not novel concepts, they merit greater prominence within both conceptual frameworks and policy considerations. (HLPE, 2020). Agency, defined as the freedom for individuals to pursue their goals and values, encompasses empowerment and the ability to engage in society, influencing policies and decision-making (Sen, 1985). It is vital for development and ensuring food security, allowing individuals or groups to make decisions about food production, distribution, and policies. Historically

disadvantaged groups often lack agency in food systems, contributing to disproportionate levels of food insecurity. Governments play a crucial role in enabling agency by supporting democratic processes and reducing power differentials, strengthening individual and collective capacity for improved food security outcomes. Agency in food systems is closely tied to human rights, particularly the right to food, as outlined in the Right to Food Guidelines, which call for inclusive processes and uphold access to information and resources as essential for exercising agency (HLPE, 2020). Sustainability is integral to food security, recognised in academic literature and policy frameworks like the SDGs. It denotes the long-term capacity of food systems to provide nutrition without compromising environmental, economic, and social foundations for future generations (HLPE, 2020). Incorporating sustainability is vital amidst challenges like climate change and socioeconomic inequality, necessitating coordinated efforts across ecological, social, and economic realms to support diverse and healthy food production. Sustainability is crucial for upholding the right to food, as highlighted in the Right to Food Guidelines, advocating for policies ensuring ecological sustainability (FAO, 2006).

A holistic approach to food security recognises that there are exchanges and trade-offs between the different dimensions, and that addressing one dimension alone is not sufficient to achieve food security (World Bank, 2022). This approach recognises the significance of addressing food security across various levels, encompassing the individual, household, community, national and global levels. A comprehensive approach to food security necessitates a collaborative effort to be made among diverse stakeholders, such as various departments of local government bodies, the private sector and international organisations, to challenge the underlying causes of food insecurity and advance sustainable and reasonable food systems (Ligmann-Zielinska & Rivers, 2018).

2.2 Food Security in South Africa

South Africa is categorised as being an upper middle-income country. When examining its food security situation, key indicators reveal pertinent information. The prevalence of undernourishment in the country stands at 6.9% (EIU, 2022a), highlighting the fact that a portion of the population lacks access to sufficient dietary intake. Conversely, the prevalence of obesity is relatively high, at 27% (StatsSA, 2021), indicating that a significant proportion of the population is grappling with excessive weight gain and associated health risks (EIU, 2022a). In terms of human development, South Africa has a Human Development Index (HDI) of 0.71, indicating a moderate level of overall human development in areas such as education, income and life expectancy (World Bank, 2022). However, challenges persist in the realm of child nutrition, with 23.2% of the country's children experiencing stunted growth and with 5.5% classified as being underweight (EIU, 2022a). These statistics underscore the importance of addressing the multifaceted aspects of food security in South Africa, including both undernourishment and nutrition-related concerns.

In accordance with the constitutional rights outlined in the Constitution of the Republic of South Africa, 1996, Sections 27(1)(b) (a broad right to 'sufficient food' pertaining to 'everyone'), 28(1)(c) (regarding the basic nutrition of children), and 35(2)(e) (regarding the adequate nutrition of detained persons) explicitly assert that every person is entitled to have access to access sufficient food and nutrition. Furthermore, the Constitution imposes an obligation on the State, within the constraints of available resources, to enact legislative and other measures to realise these rights. A National Development Plan (NDP) has been established to guide the nation's development (NPC, 2012). The NDP identifies links between poverty, inequality, food security and nutrition by acknowledging the interdependence of these factors and formulating comprehensive strategies to address them. Various approaches are employed and include the Comprehensive Development Framework, Inclusive Growth and Economic Transformation, Social Protection and Safety Nets, Health and Nutrition Programmes, and numerous other approaches (NPC, 2012). Furthermore, the NDP underscores the point that, despite the implementation of numerous programmes and substantial public investments, advances in the levels of food security are not guaranteed (UNICEF, 2016). However, such initiatives have the potential to add to a more food-secure environment in the country.

South Africa employs a diverse set of measures and indicators to comprehensively assess its food security. Measures, such as poverty and inequality indicators, agricultural production data, nutritional status indicators, social grants, and welfare programmes, as well as climate resilience and adaptation strategies, contribute to gaining a comprehensive understanding of South Africa's food security environment (EIU, 2022a). Unfortunately, recent developments, including challenges arising from factors such as high food price inflation, reduced incomes and the impact of the war in Ukraine, pose significant threats to South Africa's food security, potentially pushing its population into acute food insecurity (World Bank, 2022).

2.3 An Overview of the International Food Security Measurement Tools

Assessing food security poses a twofold challenge, encapsulated in two fundamental questions: what is being evaluated, and how is the evaluation being conducted. The first question, often referred to as the 'what' inquiry, revolves around choosing appropriate indicators to encompass diverse dimensions, as well as various components, including quantity, quality, safety and cultural acceptability or preference (Manikas, et al., 2023). These indicators serve as the building blocks of our understanding of food security, providing insight into its multifaceted nature (Cafiero, et al., 2014). Frequently used indicators include the Prevalence of Undernourishment (PoU) and Food Insecurity, which measure inadequate caloric intake and insufficient access to food, respectively. Other indicators include Dietary Diversity, Access to Food, Coping Strategies Index (CSI), Nutritional Status, and the Food Price Index, all of which contribute to a holistic understanding of food security (FAO, 2023a). The second inquiry, the

'how' question, pertains to the intricate methodology employed in the computation of these indicators. This encompasses the gathering and analysis of data, application of diverse methods, and utilisation of specialised models. In essence, it is the methodology that breathes life into these indicators, allowing us to transform raw information into actionable insights. Together, these two inquiries form the bedrock of food security measurement, engaging us in an essential exploration of both the substance and the process that underpin our understanding of this critical global challenge (Manikas, et al., 2023).

2.3.1 Different measurements of food security

Table 2-2 below shows several ways by which to measure food security on a global scale. The table outlines the various indicators and also describes each measurement used. The table includes a range of dietary diversity and food frequency measurements, as well as consumption behaviour measurements. "Dietary diversity", a qualitative metric of food intake, serves as a reflection of an individual's or household's access to varied selections of food items and concurrently functions as a representation for nutritional sufficiency. Typically, this metric involves summing the total unique foods or food groups eaten over a predefined timeframe, often spanning from 1 to 15 days (de Oliveira, et al., 2018). In contrast, food frequency embodies a quantitative measure of food consumption, quantifying the frequency of the consumption of specific food items or food groups over a specified duration (Ruel, 2003). These metrics collectively inform us about the dietary behaviours of individuals or populations, including aspects such as the quantity, frequency, and temporal patterns of food intake (Ruel, 2003). Consequently, such measurements offer valuable insights into dietary patterns, enabling the identification of areas where interventions may be warranted to enhance both diet quality and food security.

The GFSI undergoes continual adjustments, and new sub-measures have been incorporated over the last decade to mirror overarching trends that have influenced our current understanding of food security. This composite indicator is resilient in gauging food security and is built upon a blend of 68 quantitative and qualitative indicators. The GFSI demonstrates favourable statistical characteristics and encompasses a range of countries, both developed and developing. The GFSI has been recognised as a top-performing food security environment composite indicator, as noted by Izraelov and Silber (2019) and Maricic, et al. (2016).

Table 2-2: Different measurements of Food Security

Measurement Tool	Description	Limitations	Sources
1. Global Food Security Index (GFSI)	The GFSI annually evaluates the food security environment, considering four dimensions. These dimensions include	The GFSI's reliance on available data may be a constraint, especially in	(EIU, 2022a)

Measurement Tool	Description	Limitations	Sources
	various indicators, over a wide spectrum of factors. Additionally, the measurement tool enhances the accuracy by including a select panel of individuals, each an expert in the field in question. Finally, this tool ranks the various countries in question according to its unique score.	regions where data collection is limited or inconsistent. In such cases, the index may not accurately reflect the true extent of food security challenges, leading to potential inaccuracies in policy recommendations or interventions based on GFSI scores.	
2. Food Insecurity Experience Scale (FIES)	The FIES serves as an invaluable tool for gauging household or individual food security, rooted in direct experiential assessments. Within this framework, the FIES Survey Module (FIES-SM) emerges as a pivotal component, comprising a concise set of eight questions designed to elicit insights into "people's access to sufficient and nutritious food". Notably, the FIES-SM is highly adaptable, seamlessly integrable into a wide array of population surveys. These queries delve into the first-hand experiences of respondents, whether at the individual level or within their respective households, emphasising self-reported behaviours and encounters linked to the growing challenges of food access in the face of resource constraints. Through this nuanced approach, the FIES-SM stands as a potent instrument, bringing clarity to the intricate dynamics of food security and the real-world struggles that individuals and households encounter in their quest for sustenance.	The FIES relies on individuals' self-reported experiences and perceptions of food insecurity. As such, it may be influenced by subjective interpretations and cultural differences in the understanding of food security.	(FAO, 2018)
3. The Household Food Security Survey Module (HFSSM)	The HFSSM represents Canada's foremost validated tool for assessing food security. Comprising a comprehensive set of 18 meticulously crafted questions, this module is purpose-built to measure the extent of food insecurity stemming from financial constraints experienced over the course of the preceding 12 months. The HFSSM stands as an essential instrument, providing	Similar to other survey-based measurements, the HFSSM depends on self-reported information from household members. This reliance on self-reporting introduces the possibility of respondent bias	(Government of Canada, 1995)

Measurement Tool	Description	Limitations	Sources
	a detailed understanding of the multifaceted challenges individuals and households face in securing consistent access to nourishing meals within the Canadian context.		
4. Food Consumption Score (FCS)	The FCS, created by the WFP, is a food frequency indicator designed to encompass both the "quality" and "quantity" aspects of food consumption within households.	The FCS primarily focuses on the "quantity" and diversity of food consumed, providing insights into the range of food items but offering limited information on their nutritional quality. This limitation means that the FCS might not capture variations in the nutrient content of diets, potentially overlooking deficiencies in essential vitamins and minerals.	(WFP, 2006)
5. Current Population Survey Food Security Supplement (CPS-FSS)	Since 1995, the CPS-FSS have gathered data on "food security-related conditions", behaviours, and experiences in respondents' households over the preceding 12 months. Some questions also inquire if these conditions occurred within the preceding 30 days. The initial research, sponsored by the USDA and based on the 1995 CPS-FSS, resulted in scales being developed for measuring household food security for both 12-month and 30-day periods. The 12-month scale has primarily been used for monitoring and research on food security. However, ongoing efforts have focused on developing and refining the 30-day scale, which also holds significant potential for monitoring and research applications. This report outlines a slightly modified 30-day food security scale designed for use with CPS-FSS data, describing its characteristics and evaluating its effectiveness.	The CPS-FSS relies on information self-reported by individuals or households. This introduces the potential for social desirability bias, where respondents might offer responses that they perceive as being socially acceptable, rather than accurately reflecting their actual food security status.	(Hamilton, et al., 1997b)
6. Coping Strategies Index (CSI)	The CSI serves as a user-friendly and efficient household food security indicator, offering simplicity and quick applicability. It is readily comprehensible and exhibits strong correlations with more intricate food	The CSI primarily examines the "coping mechanisms" adopted by households in response to food shortages. While these strategies provide	(Maxwell, et al., 2003)

Measurement Tool	Description	Limitations	Sources
	security assessments. By posing questions about how households handle food shortages, the CSI generates a straightforward numeric score. In its basic form, tracking fluctuations in the CSI score effectively signals shifts in household food security status, whether it is deteriorating or improving.	valuable insights into adaptive behaviours, the index may not state the reasons of food (in)security, such as poverty, lack of access to resources, or systemic issues within the food supply chain. Therefore, the CSI may not completely capture the broader determinants of food security.	
7. Household Hunger Scale (HHS)	The HHS is a novel, cross-culturally validated indicator designed for measuring household hunger in regions that show signs of insecurity with regard to food. Distinguished from other food insecurity indicators, the HHS ensures the generation of valid and comparable results across diverse cultural contexts. This cross-cultural applicability facilitates meaningful and consistent descriptions of statuses in various groups in the population. As a result, it assists in evaluating how resources are allocated and interventions are implemented, facilitating the creation, monitoring, and evaluation of policies and initiatives aimed at addressing hunger and food insecurity.	The HHS depends on respondents' personal perceptions of hunger within their households. Relying on self-reported experiences introduces the prospect of social desirability bias, where respondents may offer answers that they consider to be socially acceptable, rather than providing an accurate reflection of their actual situation.	(Ballard, et al., 2011)
8. Dietary Diversity Score (DDS)	The DDS serves as a valuable indicator for evaluating nutritional adequacy by quantifying the range of food groups included in a diet over a defined period. DDS is classified into different dimensions, including the "Household Dietary Diversity Score (HDDS)", "Individual Dietary Diversity Score (IDDS)", which comprises the "Child Dietary Diversity Score (CDDS)", and the "Women Dietary Diversity Score (WDDS)" (USAID, 2006).	The DDS focuses on the diversity of food groups, but does not provide detailed statistics of the quantity or nutritional quality of foods consumed. Two diets with the same DDS may have different nutritional profiles, as the score does not differentiate between nutrient-dense and less nutritious foods. Therefore, the DDS alone may not fully capture the nutritional adequacy of a diet.	(Habte & Krawinkel, 2016)

Measurement Tool	Description	Limitations	Sources
9. Household Dietary Diversity Score (HHDS)	The term HHDS denotes the range of food clusters that a household consumes within a specified period. It holds considerable importance as an indicator of food security for several reasons. A greater diversity in a household's diet is linked to adequate intake of calories and protein, a higher proportion of protein obtained from animal sources, and an augmentation in household income.	The HDDS focuses on the diversity of food types, but does not provide statistics of the quantity of food used by each group or the nutritional quality of the foods within each group. Therefore, two households with the same HDDS may have different overall blends of food intake and nutritional adequacy. The score does not distinguish between consuming small or large amounts of food within a food group.	(Swindale & Bilinsky, 2006)
10. Minimum Dietary Diversity for Women (MDD-W)	The MDD-W serves as a food group diversity statistic that is known to capture a crucial facet of dietary quality: the sufficiency of micronutrients, including a spectrum of 11 essential micronutrients.	Like other dietary diversity scores, the MDD-W focuses on variety of food groups eaten, but does not provide statistics of the quantity of food eaten in each group or the nutritional quality of the foods within each group. Therefore, two individuals with the same MDD-W score may have different groupings of overall food intake and nutritional adequacy.	(FAO & FHI 360, 2016)
11. Global Hunger Index (GHI)	The GHI, initially presented in 2006 by IFPRI and Welthungerhilfe, is a multifaceted instrument to gauge hunger. This index encompasses three critical dimensions: (1) insufficient dietary energy supply, (2) child undernutrition, and (3) child mortality.	The GHI aggregates various values related to undernourishment, child stunting, wasting and child mortality in order to produce a composite index. While aggregation allows for a simplified and comprehensive measure, it may mask the nuances of individual indicators and their distinct underlying causes. Different countries may face diverse challenges contributing to hunger, and a composite	(Wiesmann, et al., 2015)

Measurement Tool	Description	Limitations	Sources
		index may oversimplify these complexities.	
12. **Reduced Coping Strategy Index (rCSI)**	The rCSI is a vital indicator employed to assess the adversity experienced by households as a result of food shortages. This index quantifies both the occurrence and seriousness of the food-related coping mechanisms that households had to resort to during the 7 days leading up to the survey, thereby providing valuable insights into their food security challenges.	The rCSI concentrates on households' coping strategies during food shortages, which provides insights into the adaptive mechanisms that they employ. However, it does not necessarily obtain all the foundational reasons for food insecurity, for example economic inequalities, access to resources, or systemic issues within the food supply chain. Therefore, the rCSI may not stipulate a holistic interpretation of the broader determinants of food security.	(Vhurumuku, 2014)
13. **Food Consumption Score Nutritional Quality Analysis (FCS-N)**	The FCS-N represents a derivative tool, rooted in the Food Consumption Score indicator, with a specialised focus placed on three key nutrients: "Vitamin A, Protein, and Hem Iron", found in the consumed food items. The data compiled through the FCS-N module serves as a crucial resource for gaining insights into the nutritionary health and well-being of households. The FCS is designed by assessing the regularity of food item consumption from various food groups over a "7-day reference period". Additionally, the FCS-N module gathers data concerning the sources from which households acquire the consumed foods, providing a comprehensive perspective on dietary patterns and nutritional intake.	The FCS Nutritional Quality Analysis primarily considers the quantity and diversity of food groups eaten, but may not explicitly assess the nutrient density of the diet. A diverse diet does not necessarily guarantee adequate consumption of essential nutrients, and certain food groups might contribute more or less to overall nutrient content.	(WFP, 2015)

Source: Compiled by the Author

2.4 Food Policy Context of South Africa

As stated by Shukla, et al. (2019), the food policy environment in South Africa is intricately interwoven with social, economic, and ecological elements that influence food security. Moreover, Kemoe, et al. (2022), explains that the South African food system faces challenges from non-climatic stressors,

including population and income-inequality growth, the increasing demand for animal-sourced foods, and the impacts of long-term alterations and shifts in regional weather patterns. In addition to these factors, climate change is exacerbating food insecurity in sub-Saharan Africa, with the war in Ukraine further contributing to food shortages and increased prices. The susceptibility of food supplies and prices to the changing environment is heightened by a lack of resilience shown by the market, dependence on food imports, and unwarranted government intervention (Kemoe, et al., 2022). This statement is strengthened by Wudil, et al. (2022), who point out that the food security status is worsening because of shifts in consumer behaviours, population expansion, and disruptions in the global economy.

In this context, governments frequently seek to provide support by involving themselves in agricultural production and the distribution of food. However, interventions that lack specificity can be ineffective, imposing burdens on governmental financial plans, inflating food prices, hindering competition, and diminishing crop yields (Kemoe, et al., 2022). Therefore, it is important to understand South Africa's food policy environment to identify the challenges and opportunities in order to address the situation in the country. Table 2–3 below depicts important policies that stipulate the framework in which South Africa's food security environment operates. Each policy's description and objectives are stated in the table to give an understanding of the food security policy environment.

Table 2-3: Policies and strategies influencing the food security environment of South Africa

Policy/Strategy	Description and Objectives/Pillars	Source
1. Strategic Plan for the Prevention and Control of Non-communicable Diseases (NSP), 2022-2027	**Description:** This comprehensive 5-year initiative is designed to propel South Africa toward achieving Sustainable Development Goal (SDG) 3.4 (UN, 2022a). **Objectives:** - "Give priority to preventing and managing non-communicable diseases (NCDs). - Encourage and facilitate health and well-being throughout all stages of life. - Ensure individuals with NCDs have access to comprehensive, person-cantered health services to prevent and manage these conditions. - Advocate for national capabilities in high-quality research and development for preventing and managing NCDs. - Monitor key patterns and factors influencing NCDs strategically to assess advancements in prevention and control efforts".	(Basu, 2022)
2. National Policy on Food and Nutrition Security, 2014	**Description:** The overarching objective is to "guarantee the presence, reach, and affordability of safe and nutritious food both at the national and household levels". **Objectives:**	(DAFF, 2014a)

Policy/Strategy	Description and Objectives/Pillars	Source
	- "Increased and targeted public investments in social programs affecting food security. - Initiatives to improve food production and distribution, including increased availability of production inputs for the agricultural sector. - Utilisation of government food purchasing to support community-based food production projects and small-scale farmers. - Strategic use of market interventions and trade measures".	
3. Agricultural Policy Action Plan (APAP), 2015–19	**Description:** The APAP represents the programmatic reaction to the revitalisation of agriculture and the agro-processing value chain. It delineates a value chain strategy that prioritises specific commodities, guided by their substantial growth potential and significant capacity for labour absorption, as identified in the NDP. **Objectives/Pillars:** - "Land capability; - Mechanisation support services; - Production inputs and infrastructure; - Agro-processing and market development; and - Capacity building".	(DAFF, 2014b)
4. White Paper on Agriculture, 1995	**Description:** The goal is to establish a policy framework that will guide the implementation of new policies and laws, aimed at bringing about transformation in the South African public service. **Objectives:** - "Establishing a new class of economically viable, market-oriented commercial farmers, emphasising the family farm as the foundation. - Improving access to agriculture through land reform, supported by effective agricultural policy tools and the provision of necessary services. - Directing financial systems towards resource-poor and novice farmers, facilitating their ability to acquire land and agricultural inputs. - Aligning trade and marketing of agricultural products with market trends. - Ensuring agricultural production is grounded in the sustainable utilisation of natural agricultural and water resources. - Enhancing the pivotal role of agriculture in the regional development of Southern Africa and other nations".	(DOA, 1995)
5. Comprehensive Agricultural Support Programme (CASP)	**Description:** The objective of the assistance initiative is to strengthen projects in land and agrarian reform, thereby fostering advancements in food security, job generation, and poverty reduction. **Objectives/Pillars:** - "Firstly, to information and contribute to knowledge management; - Providing technical advice, regulatory services, and advisory assistance; - Conducting training sessions and enhancing capacity; - Facilitating marketing and business development efforts;	(DALRRD, 2022)

Policy/Strategy	Description and Objectives/Pillars	Source
	- Developing on-farm and off-farm infrastructure and supplying production inputs".	
6. Comprehensive Africa Agriculture Development Programme (CAADP)	**Description:** The CAADP represents a continental initiative under Agenda 2063, with the overarching target of wiping out hunger and alleviating poverty in African nations by fostering economic growth through agriculture-driven development. Within the framework of the CAADP, African governments have made a collective commitment to contribute a percentage of their budgets to the development of the target nations. These financial commitments are underpinned by specific targets that encompass poverty and malnutrition reduction, enhanced productivity and agricultural incomes, and the sustainable management of agricultural production and natural resources. **Objectives:** - "To expand the coverage of sustainable land management practices and dependable water control systems; - Enhancing rural infrastructure and building capacities related to trade for improved market access; - Supplementing food supply, diminishing hunger, and enhancing responses to food emergency crises; and - Advancing agricultural research, technology dissemination, and adoption".	(AU, 2021)
7. National Development Plan (NDP)	**Description:** The policy provided for in the NDP aims to promote citizens' engagement in fostering their own development, enhancing democratic participation, and ensuring government accountability. Furthermore, the aim is to facilitate economic growth, reinforce export activities, and cultivate a labour-intensive economy. **Objectives:** - "Unifying South Africans across racial and class lines to eradicate poverty and decrease inequality. - Promoting citizen participation in self-development, strengthening democracy, and holding the government accountable. - Enhancing economic growth, supporting exports, and creating a more labour-intensive economy. - Concentrating on essential capabilities, encompassing skills, infrastructure, social security, strong institutions, and partnerships. - Establishing a competent and developmental state. - Fostering strong leadership across society to collaboratively address challenges".	(NPC, 2012)
8. Sustainable Development Goals (SDG)	**Description:** The global commitment to sustainable development finds its most comprehensive expression in the SDGs, which can be seen as the ultimate measure for determining progress, with a focus on	(StatsSA, 2017)

Policy/Strategy	Description and Objectives/Pillars	Source
	enhancing the well-being of both people and the planet. Comprising 17 "Global Goals", 169 specific targets, and 230 indicators, the SDGs serve as a universal benchmark for assessing global advancements in poverty reduction, the enhancement of value of life, and the realisation of the collective aspirations of people worldwide towards holistic development. **Objectives/Goals:** - Goals applicable to the four GFSI dimensions: "(2) Zero hunger, (5) Gender equality, (6) Clean water and sanitation, (7) Affordable and clean energy, (9) Industry, innovation, and infrastructure, (10) Reduced inequalities, (12) Responsible consumption and production, (13) Climate action, (14) Life below water, (15) Life on land, (16) Peace, justice, and strong institutions and (17) Partnerships for the goals".	
9. Zero Vat Rating of Basic Foodstuffs (ZVRBF)	**Description:** It allowed consumers to purchase 19 staple food items without the VAT levy. Nineteen staple foods are tax free because of this policy. **Objectives/Goals:** - To assist the vulnerable members of society by reducing the price of basic foodstuffs.	(Treasury, 1994)
10. Taxation of Sugar-sweetened Beverages (TSSB)	**Description:** A tax rate of 2.29 cents was imposed on sugar-sweetened beverages per gram of sugar. **Objectives/Goals:** - To help reduce the intake of excessive sugar.	(Treasury, 2015)
11. Integrated Nutrition Programme (INP), 2002-2007	**Description:** The Integrated Nutrition Programme (INP), implemented from 2002 to 2007, aimed to address malnutrition comprehensively by targeting various sectors and interventions to improve the nutritional status of vulnerable populations in South Africa. **Objectives/Goals:** - Improve the nutritional status of all South Africans.	(DOH, 2002)
12. Strategy for the Prevention and Control of Obesity in South Africa (SPCOSA)	**Description:** The Strategy for the Prevention and Control of Obesity in South Africa (SPCOSA) is a comprehensive plan developed to combat the rising prevalence of obesity through targeted interventions and policy initiatives aimed at promoting healthy lifestyles and reducing obesity-related risk factors across the population. **Objectives/Goals:** - To reduce the prevalence of obesity by 10% in 2020.	(DOH, 2015)
13. Regulations Relating to the Fortification of Certain Foodstuffs (RRFCF)	**Description:** The Regulations Relating to the Fortification of Certain Foodstuffs (RRFCF) are government mandates outlining specific requirements and standards for the fortification of essential nutrients in certain food products to address nutritional deficiencies and improve public health outcomes. **Objectives/Goals:** - Regulated the importation and production of fortification mix. - Required all food vehicles to be micronutrient fortified. - Regulated the labelling of fortified foods.	(DOH, 2003)
14. Roadmap for Nutrition in South Africa (RNSA)	**Description:** The Roadmap for Nutrition in South Africa (RNSA) is a strategic framework outlining comprehensive measures and objectives to	(DOH, 2013)

Policy/Strategy	Description and Objectives/Pillars	Source
	address malnutrition and improve nutritional outcomes across the country through targeted interventions and policy implementation. **Objectives/Goals:** - Optimal nutrition for all South Africans	
15. Integrated Food Security Strategy (IFSS)	**Description:** The Integrated Food Security Strategy (IFSS) is a holistic approach designed to address food insecurity by coordinating various interventions and policies to ensure sustainable access to nutritious food for all populations in South Africa. **Objectives/Goals:** - Attain universal food security and healthy life for all South Africans	(DAFF, 2002)

Source: Compiled by the Author

The ongoing population growth and shifts in agricultural systems have substantial implications for food policy, encompassing considerations related to consumption, production, and trade. The persisting population growth in South Africa is anticipated to exert continued burden on essential resources, such as food, land, and water. By 2030, it is expected that the geographical and demographic landscape of Africa will undergo considerable transformations (Hendriks, 2018). According to Thow, et al. (2018), enhancing the alignment of policies pertaining to the food supply, with the goal of improving food security and nutrition, presents promising avenues for promoting policy coherence. These opportunities include targeted modifications to economic policies associated with the food supply, which aim to concurrently achieve objectives of food security, nutrition, and economic prosperity. Moreover, the alignment of policies should prove beneficial in establishing networks between producers and consumers through the implementation of market mechanisms and fiscal incentives that enhance the affordability and accessibility of wholesome and fresh food items. Furthermore, facilitating the formal involvement of civil society in the formulation of nutrition and food security policies serves to encourage engagement (Thow, et al., 2018). These policies and strategies will supplement the analysis of South Africa's four dimensions based on the GFSI 2022, namely (1) "affordability", (2) "availability", (3) "quality & safety", and (4) "sustainability & adaptation".

2.5 The Global Food Security Indicator

The GFSI serves as a prominent and authoritative resource for gaining a comprehensive understanding of the factors relating to global food security. Formulated by *The Economist* publication, in collaboration with Corteva Agriscience, this index meticulously assesses the state of food security in 113 nations by evaluating their performance across four fundamental dimensions. To construct this index, a dynamic benchmarking model is employed, incorporating 68 distinct qualitative and quantitative indicators that significantly influence food security outcomes (EIU, 2022a). Based on the findings of the Economist Intelligence Unit (EIU), the GFSI demonstrated a declining trend in South

Africa. From its global rank of 42nd in 2018, it dropped to 44th in 2019. Furthermore, in 2020, South Africa's GFSI rank declined further to 48th out of 113 countries, with a score of 59.3 out of 100, indicating a moderate level of food security. The situation deteriorated even further in 2021, with South Africa's rank plummeting to 70th out of 113 countries (EIU, 2021). While a significant global focus is placed on making agriculture more resilient, productive and sustainable, according to the 2021 GFSI, the solutions for food insecurity go well beyond the farm (EIU, 2021). The devastating effects of the COVID-19 pandemic contributed to the deteriorating condition of the food security of many South Africans (Global Food Security Index, 2020).

According to the study by Thomas, et al. (2017), a critical examination of the conceptual framework of the GFSI reveals that it should be understood as being an evaluation of the food security environment. The GFSI primarily emphasises the determinants that contribute to food security, rather than directly measuring the outcomes. It integrates conventional factors influencing the food security environment, including aspects like food supply, overall spending allocated to food, poverty rates, and nutritional policies. Furthermore, it extends its perspective to encompass determinants, such as access to monetary assistance, political steadiness, and state of infrastructure. Consequently, the GFSI exhibits only partial overlap with existing food security indicators currently in use (Thomas, et al., 2017). However, the GFSI exhibits reliable statistical properties and includes both developing and developed countries. The GFSI has gained recognition as one of the leading composite indicators for assessing food security (Izraelov & Silber, 2019; Maricic, et al., 2016). Moreover, additional changes in the 2022 framework include the incorporation of data sources for indicators that are more recent, the implementation of more rigorous criteria for existing qualitative system of measurements, and the recalibration of weights following consultations with an expert panel. These modifications seek to bring the index in line with the current dynamics of the global food system, enhancing its strength and precision (EIU, 2022a). The concept of food security, along with its definition and measurement, has evolved in people's perceptions and understanding (Atieno, 2021).

According to Jones, et al. (2013), there is no consensus on how to assess the various dimensions of food security owing to its interdisciplinary nature. Hendriks and Olivier (2015), further elaborate this point by stating it touches different disciplines, such as economics, agriculture, and the environment. Utilising secondary data sources without thorough inspection might lead to inaccurate measurements being calculated, considering variations in format, units and quality of the measurements, as noted by Cafiero, et al. (2014) and Benin, et al. (2020). Ensuring the uniformity of survey instruments is essential for making international comparisons and conducting evidence-based monitoring, and for addressing global challenges in food security measurement (De Haen, et al., 2011; Cafiero, et al. 2014). Compound indicators were created to address limitations and to enhance the reliability of the outcomes.

The GFSI, a composite indicator, offers a comprehensive view of a country's food security, exemplified by South Africa. Composite indicators, as noted by Freudenberg (2003), combine extensive datasets into consolidated scores, aiding country ranking in benchmarking exercises and serving as valuable tools in policymaking and public communication (Nardo, et al., 2005). The GFSI stands out among food security indexes because of its reliable methodology, data sources, and statistical properties (Maricic, et al., 2016), drawing from reputable entities such as the FAO, WHO, World Bank, and WFP (EIU, 2021). However, it selectively focuses on specific dimensions chosen by its designers, emphasising economic indicators, governance, and policy aspects uncommon in comparable indexes such as Global Hunger Index (GHI) and the Food Access Index (FAI) (EIU, 2022a). Operating as a dynamic benchmarking model, the GFSI incorporates qualitative and quantitative data, with estimates or proxy data being used when values are unavailable. Notably, it has gained recognition as a top-performing food security composite indicator (Izraelov & Silber, 2019; Maricic, et al., 2016).

2.5.1 The Global Food Security Index (GFSI) methodology

The GFSI serves as a resource for comprehensive understandings into the factors of the global food security environment. This index is formulated by the EIU (2022a), a research and analysis firm that operates as a subsidiary of The Economist Group, in collaboration with Corteva Agriscience, a global agricultural company that focuses on providing solutions and products to enhance the productivity and sustainability of farming (Corteva Agricscience, 2023). The index assesses the state of food security in 113 nations by evaluating their performance across the four fundamental dimensions. To construct this index, a dynamic benchmarking model is employed, incorporating 68 distinct quantitative and qualitative indicators that significantly influence the food security environment outcomes (EIU, 2022a).

The GFSI was introduced in 2012 by the EIU as a comprehensive composite indicator. The GFSI methodology was formulated in collaboration with a board of expert peers. This process involved extensive consultation and deliberation to ensure the robustness and reliability of the index. It evaluates the state of the global food security environment on a national level, covering 113 countries annually. The inclusion of both developed and developing countries in the index allows for the identification of nations that are most susceptible or least susceptible to food insecurity (EIU, 2022a). The selection of countries for the GFSI takes into account regional diversity and economic significance (EIU, 2022a), aiming to represent a substantial portion of the world's population (Izraelov & Silber, 2019; Maricic, et al., 2016). To uphold its credibility and relevance, the methodology undergoes an annual review. This iterative assessment guarantees that the GFSI continues to serve as a reliable and widely utilised resource for stakeholders seeking comprehensive understandings of the international environment of food security (EIU, 2022a).

Policymakers operating in the field of food security find the GFSI a valuable diagnostic tool. It is employed by both public and private sectors as a strategic decision-making resource for analysing food consumption patterns and devising appropriate social support measures to address future food security concerns (Turan, et al., 2018). Comparisons between the GFSI and other established international food security composite indicators, such as the Global Hunger Index (GHI) and the Prevalence of Undernourishment (PoU), have demonstrated strong correlations, affirming the effectiveness of the GFSI in capturing essential dimensions of food security (Thomas, et al., 2017; Pangaribowo, et al., 2013). Furthermore, in contrast to the GHI that concentrates solely on emerging economies, the GFSI provides the benefit of encompassing assessments for both low- and high-income countries (Pangaribowo, et al., 2013).

The 2022 GFSI incorporates 14 new indicators, emphasising the importance of "first mile" and farm-level metrics in assessing food security globally. The focus on the "first mile", covering agricultural production and connections between farmers and markets, is crucial for improving food security throughout the value chain. New measures assess support for farmers, including access to extension services and empowerment of female farmers. The Availability pillar has been adjusted to better capture farmer-oriented factors, incorporating indicators related to agricultural inputs and relocating financial access measures (EIU, 2022a).

In response to global trends towards ensuring sustainable food systems and climate adaptation, the Sustainability and Adaptation pillar replaces the 'Natural Resources and Resilience' indicator. New indicators, including soil health, climate finance flows, and disaster risk management, have been introduced to reflect biodiversity and political commitment to adaptation. The 2022 framework also involves using updated data sources, stricter standards for qualitative metrics, and adjusted weights to enhance the alignment of the index with the current global food system's realities, ensuring robustness and accuracy (EIU, 2022a).

2.5.2 The GFSI's weighting method

The GFSI employs a methodology based on weighting and normalisation to aggregate and compare a wide range of indicators incorporated within the index. This methodology facilitates a comprehensive evaluation of food security across different countries and dimensions.

The weighting system implemented by the GFSI is structured as follows. Specific weights are allocated to distinctive indicators to reflect their relative importance in contributing to food security outcomes. These weights are determined through a consultative process involving an expert panel. The panel assesses the significance of each indicator, based on its relevance, impact, and evidential association

with food security. The objective is to capture the multidimensional nature of food security and ensure a balanced representation of various aspects within the food system (EIU, 2022a).

2.5.3 The GFSI's normalisation method

The normalisation method is employed to enable meaningful comparisons to be made among indicators that exhibit different measurement scales and units. This process transforms the indicator values into a standardised scale, often ranging from 0 to 100. The purpose of normalisation is to prevent indicators with larger numerical values from dominating the index and to ensure that each indicator contributes proportionately to the overall score. The specific approach to normalisation adopted by the GFSI may vary, depending on the characteristics of the indicator. Common normalisation techniques encompass min–max normalisation, z-score normalisation, or percentile ranking. These techniques adjust the values of indicators to conform to a standardised range or to reflect their relative position in comparison with other countries within the dataset (EIU, 2022a).

Through the application of weighting and normalisation techniques, the GFSI integrates diverse indicators into a unified composite index, providing a thorough and comparable assessment of food security across countries. This approach enables the identification of strengths, weaknesses, and areas for improvement in various dimensions of food security on a global scale.

2.6 Conceptual Framework

This mini-dissertation's conceptual framework serves as a visual representation of the study's logical progression. It begins by assessing South Africa's food security environment, subsequently delving into an in-depth examination of the four distinct dimensions. The framework then intricately traces the contributions of both the private and public sectors, clarifying their impacts on the 2022 GFSI rank and score. These insights, in turn, pave the way for the final stage of the study, where various stakeholders are engaged in creating actionable steps to address the identified challenges and improve the overall state of the food security environment in South Africa. The conceptual framework for achieving the study's objectives is presented in Figure 2-1 below.

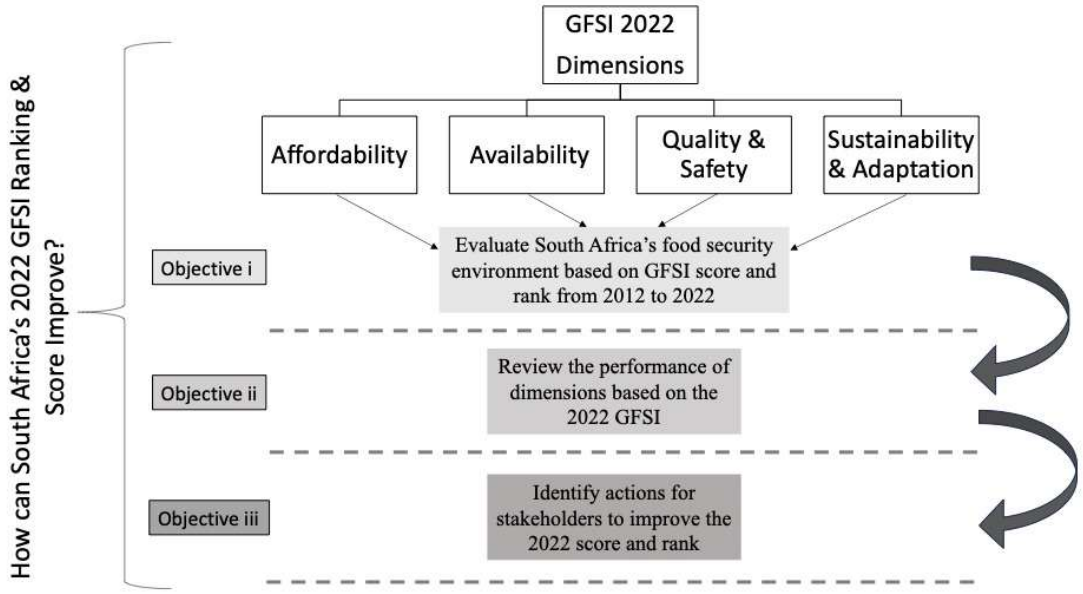


Figure 2-1: Conceptual framework for a systematic approach to improving South Africa's 2022 GFSI rank and score

Source: Author's compilation, 2023

Figure 2-1 above displays the four dimensions used by the 2022 GFSI score and ranks. The conceptual framework for this study outlines three key objectives. Firstly, objective (i) focuses on assessing South Africa's food security environment by analysing the GFSI score and rank data spanning from 2012 to 2022. Secondly, objective (ii) aims to delve deeper into the evaluation process by analysing the performance of the four pivotal dimensions based on the 2022 GFSI score and rank. Lastly, objective (iii) underscores the practical application of the study's findings, highlighting the identification of actionable strategies and recommendations for stakeholders to enhance the 2022 score and rank, ultimately contributing to the overall improvement of South Africa's food security environment (Hawkes, et al., 2020).

2.7 Chapter Summary

This literature review underscores the noticeable strain experienced in global food security in recent years, with South Africa's food security environment mirroring this deteriorating trend. The review also entails a comparative analysis of various methodologies for food security measurement, ultimately affirming the suitability of the GFSI for evaluating macro-level food security, particularly the broader food security environment. As a composite indicator, the GFSI offers a more comprehensive perspective, shedding light on the multifaceted factors contributing to the decline in South Africa's food security. Furthermore, despite the implementation of policies and strategies aimed at mitigating food

security challenges, the literature review identifies persistent gaps and continued deterioration in South Africa's food security environment. Consequently, the investigation into the decline in South Africa's food security score and rank, as assessed by the GFSI for the year 2022, is deemed to be necessary and justifiable. Hendriks and Olivier (2015) state that a blend of mitigation strategies in both public and private sector intervention, policy alignment and actions are essential for improving South Africa's overall food security environment score and rank.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter explains the methodologies used and procedures undertaken to fulfil the study's research objectives. The research approach encompasses both qualitative and quantitative data analysis techniques. Furthermore, this section outlines the methodological frameworks employed for the identification and evaluation of the food security environment, its dimensions, and indicators. It also expands upon the processes undertaken for questionnaire development and the conduct of interviews. Finally, it describes the methods used to analyse the qualitative data gathered.

3.2 Description of the Study's Scope

The research conducted to evaluate South Africa's food security environment focused on the indicators included in the GFSI 2022 report. The four dimensions are made up of 68 indicators, with nine for affordability, 25 indicators for accessibility, 14 for quality and safety, and 20 for sustainability and adaptation. Through the following criteria, the scope of indicators to be evaluated is narrowed down. Firstly, the indicators that decreased over the 2021 to 2022 period were considered. Secondly, indicators that decreased and were classified to be 'moderate', 'weak', and 'very weak' are included in the study's scope. Lastly, indicators that were "unchanged", but fall into the 'weak' or 'very weak' categories, are included in the scope. Indicators that fall within the 'good' and 'very good' ratings were excluded, along with indicators rated as 'moderate' and increased in score. The full list of 68 indicators used in the 2022 GFSI is listed in the Appendix A. The Table 3–1 below sets out a list of 13 indicators included in the study's scope, based on the criteria described.

Table 3-1: Indicators included in the study's scope

Food security Dimension	Indicator	Score classification	Movement from 2021 to 2022
1. Affordability	1.1. Change in the average food cost	Moderate	Decreased
	1.2. Inequality – adjusted income index	Very Weak	Unchanged
2. Availability	2.1. Access to agricultural inputs	Moderate	Decreased
	2.2. Agricultural research and development	Moderate	Decreased
	2.3. Volatility of agricultural production	Weak	Unchanged

Food security Dimension	Indicator	Score classification	Movement from 2021 to 2022
	2.4. Sufficiency of supply	Very Weak	Decreased
	2.5. Food security and access to policy commitments	Weak	Unchanged
3. Quality & Safety	3.1. Dietary diversity	Weak	Decreased
	3.2. Nutritional Standards	Very Weak	Decreased
	3.3. Protein quality	Moderate	Decreased
4. Sustainability & Adaptation	4.1. Water	Very Weak	Unchanged
	4.2. Oceans, rivers and lakes	Very Weak	Unchanged
	4.3. Political commitment to adaptation	Moderate	Decreased

Source: Compiled by the author

3.3 Research Strategy

This research study incorporated a blend of primary and secondary data sources to conduct a comprehensive evaluation of South Africa's food security environment, with a specific focus on the 2022 GFSI score and rank. Secondary data sources were leveraged to discern the trajectory of South Africa's GFSI score and rank from 2012 to 2022. Additionally, primary data collection involved the development of questionnaires and the execution of semi-structured interviews with recognised experts in the field of the specific indicators, outlined in Table 3-1 above, as well as with food security experts, who were selected purposefully based on their expertise in food security. The interviews conducted were aimed at gaining expert opinions and turning them into actionable steps to improve South Africa's food security environment. The actions recommended by primary and secondary research will be prioritised, based on the weights assigned to each indicator.

3.4 Research Design

According to Yin (2011) and Bryman (2012), a research design refers to a systematic and strategic framework outlining the intended methodology to use for conducting a study, encompassing procedures for data collection and analysis. In this research design, a mixed method, specifically a concurrent design approach, was employed. In concurrent designs, specifically, "concurrent triangulation designs", the purpose is to use both quantitative and qualitative data to define relationships more exactly among the indicators relevant to the research (Creswell, et al., 2003). This design approach served well to achieve the objectives set out by this study.

3.5 Research Approach

Amidst the framework of these design models, a persistent requirement arises for a methodological framework that permits a thorough and unified study of quantitative and qualitative data to be conducted, as explained by Schwandt (1994). Recognising the benefits and drawbacks of both quantitative and qualitative methodologies, it becomes apparent that the adoption of an integrative methodology holds the potential for achieving a more holistic outcome to the study, as Carey (1993) and Hanson, et al. (2005) have stated.

The specific methods used for each objective are stipulated below:

Objective i) followed both quantitative descriptive analysis and a qualitative literature review design to determine the trend South Africa followed from 2012 to 2022. The data from the GFSI database for the years 2012 to 2022 is included in this analysis. This was done by using a trendline graph and qualitative literature to support the increases and decreases witnessed in trend.

Objective ii) of the study set out to evaluate the performance of the affordability, availability, quality & safety, and sustainability & adaptation dimensions, based on the 2022 GFSI. Data collection encompasses the systematic process of gathering, quantifying, and analysing precise information for research purposes through the utilisation of established and validated methodologies (Bhat, 2019). For this research study's second objective, the four dimensions were evaluated based on secondary data available. The evaluation for this objective included delving deeper into the identified indicators, as well as conducting interviews with experts in the respective fields under question. Table 3-2 below serves as a guideline to gain an understanding of how the indicators are measured. Each indicator is also assigned a weight according to the EIU, which will be used to prioritise actions to be taken according to the third objective. The weighting system is designed by the EIU and is attached in Annexure B: GFSI dimensions and indicators weights

The higher the weight given to an indicator is, the more important the indicator is to determine the overall score of the country. The parameters, indicator, qualitative data score and weight of the four dimensions of food security at national level are summarised in Table 3–2 below.

Table 3-2: Food security dimension measuring techniques

Food Security Dimension	Parameters	Indicators	Quantitative data source	Weight given to indicator[1]
1. Affordability	1.1. Change in average food costs	Food CPI	FAO	23,85%
	1.2. Inequality – adjusted income index	GNI per capita	UN Development Programme (UNDP)	16,92%
2. Availability	2.1. Access to agricultural inputs	Composite indicator	FAO	11,71%
	2.2. Agricultural research & development	Composite indicator	UN/USDA	11,71%
	2.3. Volatility of agricultural production	Standard deviation of production growth rates	FAO	11,26%
	2.4. Sufficiency of supply	Composite indicator	FAO/OECD	11,71%
	2.5. Food security and access policy commitments	Composite indicator	Qualitative scoring (EIU)	12,61%
3. Quality & Safety	3.1. Dietary diversity	Composite indicator	FAO/OECD	19,50%
	3.2. Nutritional Standards	Composite indicator	Qualitative scoring (EIU)/WHO/FAO	20,33%
	3.3. Protein quality	PDCAAS	FAO/WHO/USDA	20,33%
4. Sustainability & Adaptation	4.1. Water	Composite indicator	World Resources Institute Aqueduct	16,50%
	4.2. Oceans, rivers, and lakes	Composite indicator	World Resources Institute/ Yale Environmental Performance Index	15,50%
	4.3. Political commitment to adaptation	Composite indicator	OECD/UN/CCAFS	19,00%

Sources: (Andeyhun, 2014), & (EIU, 2022a), as modified by the author

Objective iii) of the study is to identify actions that could be taken by various stakeholders within South Africa that could improve the country's GFSI score and rank. A qualitative approached is followed to analyse the third objective of the study. The method used for this objective is adapted from a study done by Hawkes, et al. (2020). The steps followed are listed and described below.

Step 1: Identify experts in the fields related to identified indicators

1 The complete table is set out in Annexure B: GFSI dimensions and indicators weights
.

The first step for analysing the third objective was to identify experts to identify solutions or make recommendations that could lead to actions being taken by various stakeholders in South Africa. The experts were chosen against the following criteria, before they were included in the study:

- They should hold a minimum of a master's degree;
- They should have five or more years' experience in the field of the relevant indicator interviewed for; and
- They should be willing to participate in the study.

Step 2: Semi-structured interviews

For the purposes of Step 2, nine experts were interviewed through semi-structured interviews, and actions that could lead to bettering the food security environment in South Africa were identified.

Step 3: Combine and consolidate similar actions

The recommendations provided by experts were transcribed verbatim into a spreadsheet and analysed using Atlas.Ti. Atlas Ti is qualitative data analysis and research software that was used during the third step for analysing the third objective. Similarities in the recommendations were identified and grouped into an action plan that was more comprehensive. This led to the fourth and last step of analysing the third objective.

Step 4: Further clarify and refine actions according to their pathway of impact

From the Atlas Ti output, several comprehensive actions were grouped into the applicable dimension. These comprehensive actions were then prioritised according to the findings in objective ii, as well as the weights stated in Table 3-2 above.

3.6 Sampling Strategy

3.6.1 Target audience

To proficiently pursue the objectives of this study, the targeted population would comprise experts within the field of food security, and other related subject matters. This selection is based on the distinctive characteristics exhibited by this population, which are anticipated to be advantageous in attaining the specified study objectives.

3.6.2 Sampling technique

Non-random sampling, commonly referred to as non-probability sampling, is an approach in which the selection of a sample is not contingent upon the probability of a unit being included, but rather relies on other factors, such as common sense, experiential knowledge, intentionality, and the expertise of the sampler (Rai & Thapa, 2015). Within the realm of non-random sampling, the purposive sampling technique (Tongco, 2007) is a specific technique employed, and in conjunction with snowball sampling (Rai & Thapa, 2015), it constitutes the methodological framework employed in this study. As stated in Step 1 of Section 3.5, the stakeholders purposefully chosen for the study should comply with the requirements set.

3.6.3 Sample size

Because of the inductive nature of qualitative inquiries, determining the exact sample size before the study posed challenges (Patten & Newhart, 2018). Interviews were carried out until data saturation was achieved, signifying the point at which no further new data emerged (Patten & Newhart, 2018). The sample selected for this study comprised a total of nine (9) experts. The experts interviewed met all the requirements as stated in Step 1 of Section 3.5. The details of the experts are set out in Table 3–3 below.

Table 3-3: Description of experts

Stakeholder number	Years of work experience	Date and time of interview	Credentials of interviewee	Area of work
1	12	31/10/2023 8:00-8:45	PhD	Research and development
2	20	31/10/2023 11:30-12:45	Master's degree	Agricultural economist
3	8	06/11/2023 12:00-13:00	Master's degree	Agricultural economist
4	9	13/11/2023 12:00-13:00	PhD	Research and development
5	25	11/11/2023 16:00-17:00	PhD	Water and environment
6	26	11/11/2023 15:00-16:00	PhD	Water, land, rivers and lakes
7	11	7/11/2023 11:00-11:30	PhD	Agricultural economist
8	10	14/11/2023 10:00-11:00	PhD	Research and climate
9	16	22/11/2023 7:30-8:30	PhD	Agricultural economist

3.7 Research Methods and Data Collection

This study's research methodology encompassed a spectrum of techniques, arranged for the purpose of data collection from the research sample. In the context of this comprehensive mixed-method approach, the researcher employed secondary data analysis in conjunction with semi-structured interviews, and subsequently engaged in qualitative coding and analysis.

3.7.1 Data collection instruments

3.7.1.1 Secondary data analysis

This research utilised the method of secondary analysis, which involves utilising existing qualitative and quantitative data to investigate new inquiries or verify previous studies. The advantage of using this approach, as described by Denzin and Lincoln (2005), is that it addresses the weaknesses inherent in each method and thereby increases the reliability of the research findings. For this purpose, diverse secondary data sources were compiled from the websites of national and international associations, and governmental departments, with a focus on food and environmental security.

The accumulated data, comprising both published and unpublished materials from various electronic sources such as journals, books, reports and interviews, served as both raw and processed data for this study. This quantitative analysis drew upon a diverse range of sources, including the GFSI by the EIU, Statistics South Africa (Stats SA), FAO's FAOSTAT database, the United Nations Children's Fund (UNICEF), the United Nations Development Programme (UNDP), the Global Hunger Index (GHI), and the World Bank's World Development Indicators, as well as other pertinent data sources. The integration of these multifaceted data sources was instrumental for conducting a wide-ranging assessment of South Africa's food security environment and offering potential explanations for the observed weaknesses in the identified indicators.

3.7.1.2 Semi-structured interviews

Data collection involved the utilisation of semi-structured interviews. The semi-structured interviews are a type of qualitative research method that allows for flexibility in the questions asked while still maintaining a level of structure (Kallio, et al., 2016). Semi-structured interviews are used to gather information from a variety of participants, such as policymakers, agricultural economists and researchers, to gain a broad understanding of the food security environment in South Africa. The goal of the interview is to acquire pertinent, high-quality, and detailed information regarding the topic being investigated (Tracy, 2010). Simultaneously, efforts are made to minimise the risk of data being "lost in translation" (Willig, 2008). Through analysing the data collected from the interviews, the researcher

identified the main factors contributing to the deteriorating food security environment in South Africa and developed actionable steps to address these issues. Overall, semi-structured interviews provided constructive insights into the complex and multifaceted nature of the food security environment in South Africa. The interview protocol used during the step can be found in Annexure D.

3.8 Data Analysis

Data analysis entails the systematic collection, refinement, transformation, and modelling of data, all aimed at uncovering valuable insights, shaping conclusions, and supporting the decision-making process (Pouyanfar, et al., 2018). Furthermore, the effective analysis of data entails following a methodical progression, involving data cleaning, analysis, modelling, and transformation through the application of statistical or analytical tools (Pouyanfar, et al., 2018).

3.8.1 Choice of analytical tools and variables used

3.8.1.1 Trend analysis

The pertinent data was collected during the designated time frame, as set out by objective (i) of the study, with a focus on maintaining uniformity in measurement units and ensuring precision. Statistical methods and visual tools, including graphs and charts, were employed to discern trends within the dataset by comparing the averages of the 113 countries, measured by the GFSI to South Africa's trend line. Furthermore, the trend lines of the top- and poorest-performing countries were also compared with South Africa's trend line. The identified trends were interpreted within the framework of the research objectives. The implications of these trends were comprehended, and due consideration was given to external factors that might have influenced the observed patterns.

3.8.1.2 Thematic analysis

The data collected from interview recordings and notes are carefully reviewed to identify, formulate, name, and define themes, aiming to determine actionable steps (Braun & Clarke, 2006). Within a thematic analysis framework, researchers identify, analyse, and report themes and patterns inherent in the collected data (Braun & Clarke, 2006). Additionally, thematic analysis serves as a method for interpreting findings pertinent to the research topic (Boyatzis, 1998). In this phase of the research study, the qualitative tool, Atlas Ti, will be employed. Following the thematic analysis, the next step involves integrating the insights derived from secondary research with the findings obtained from interviews to develop practical and actionable steps to take to address the shortcomings of the indicators included in the scope of the study. Table 3-4 below depicts a summary of the methods and procedures selected for this study to achieve the objectives set out.

Table 3-4: Summary of methods and procedures for achieving the study's objective

Sub-objective	Data Source	Analytical method approach	Specific Approach	Variables
i. Evaluate the trend of South Africa's performance based on its GFSI rank and score from 2012 to 2022	The 2012-2022 GFSI database	Quantitative approach & Qualitative approach	Trend analysis, statistics that describe, computations using Excel, and an examination of existing literature.	All indicators included in the 2022 GFSI list
ii. Evaluate the performance in the four separate dimensions based on the 2021 GFSI	The 2012 to 2022 GFSI database, FAOSTAT, GHI etc.	Quantitative & Qualitative approach	Trend analysis, statistics that describe, computations using Excel, and an examination of existing literature.	All indicators included in the 2022 GFSI list for the four separate dimensions
iii. Identify what actions can be taken by various stakeholders in South Africa to improve the country's GFSI score and rank	Interviews with key stakeholders. Literature and reports	Qualitative approach	Questionnaire development & interviews. Literature review, thematic analysis, qualitative coding, Atlas Ti	All indicators in the 2022 GFSI database that pertain to the dimensions in objectives i & ii

Source: Compiled by the author

3.9 Ethical Considerations

Ethical clearance was received from the University of Pretoria to conduct the study, under Ethics Approval number NAS175/2022. The ethics approval letter is set out in

Throughout the research, ethical considerations were taken into account, as outlined by Berg (1998), Wiles (2013), Qu and Dumay (2011), Willig (2013), and Wolgemuth, et al. (2015), which involved anticipating and planning for ethical aspects and addressing unforeseen dilemmas during interviews. The ethical dimensions encompassed a commitment to avoid harm, secure informed consent, safeguard privacy and confidentiality, and inform participants of their rights. A conscientious effort was made to prevent harm from arising by considering the emotional impact and prioritising confidentiality. While acknowledging potential harm, the researcher believes that participation in this study did not pose a threat, when aligning with research protocol and the study's purpose. Responsibilities included informing participants of their rights, recording interviews for restricted access, and conducting verbatim transcriptions. The interviews were recorded by using an audio device, with restricted access limited to the supervisor, researcher and the Natural and Agricultural Faculty (NAS) at the University of Pretoria. Verbatim transcriptions of the interviews were performed. The participatory nature of interviews highlighted participants' rights to withdraw without consequences, as recommended by Kvale (1996). Opportunities for questions or comments were facilitated before and after interviews, aligning with advice in Kvale (1996) and Qu and Dumay (2011).

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter provides a comprehensive exploration of South Africa's movement through the GFSI over the span of eleven years, from 2012 to 2022, based on score and rank. This evaluation is examined under various dimensions, and concludes with describing the interventions identified by stakeholders to improve the GFSI scores for the country. The chapter aims to provide a retrospective assessment of South Africa's performance and to describe insights into the challenges and opportunities that have shaped its food security trajectory. Through examination of data, trends, policy developments and expert insights, the chapter endeavours to shed light on the complex dynamics that underlie the nation's food security environment.

4.2 South Africa's Overall GFSI Score from 2012 to 2022

Figure 4-1 below displays South Africa's overall performance as compared with the top- and poorest-performing countries' scores, as well as the mean average for the world (113 countries) from the period 2012 to 2022, based on the GFSI report. In Figure 4–1, it is first seen that South Africa's trend line increased from 2012 to 2016, after which it showed a moderate decline. It is further observed that South Africa's trend line is in proximity to the world average, although during the first 10-year period, it was slightly above average. As seen from the year-2022 score, South Africa deteriorated to the point where it is trending below the world average. Compared with the top-performing country's 2022 score, South Africa's food security environment is scored 26% weaker. Looking at the difference between South Africa and the poorest-performing country, South Africa's food security environment is scored 41% higher than that of the poorest-performing country. This thus implies that South Africa is scored closer to the top-performing country.

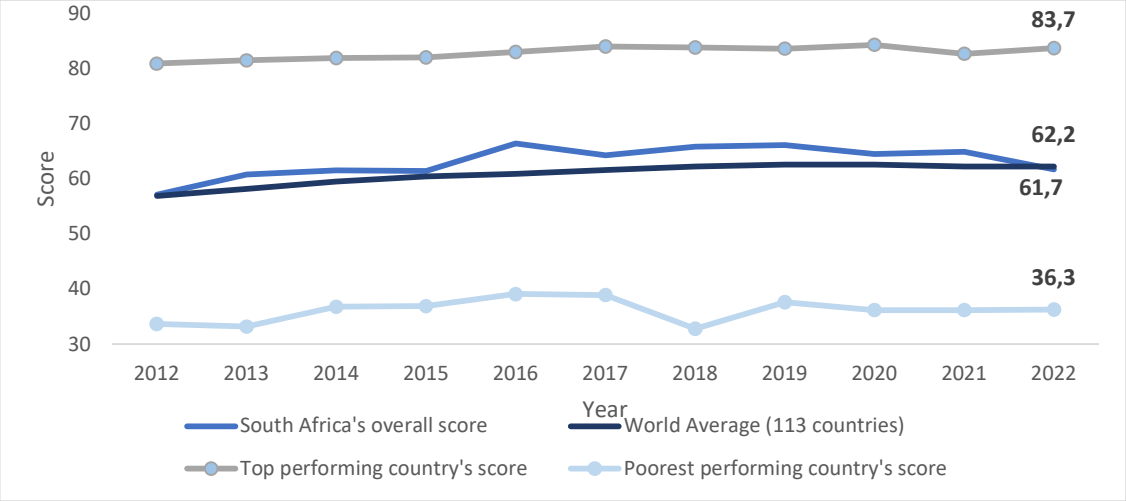


Figure 4-1: South Africa's overall GFSI score compared (2012 to 2022)
Source: Compiled by the author, based on EIU (2022a)

Figure 4-2 below depicts South Africa's trend analysis over the past 11-year period, from 2012 to 2022. As seen on Figure 4–2, South Africa's food security environment portrays a very volatile trend. Using 2012 as the base year, South Africa's overall score increased by 16% until 2019. This score decreased by 8% over the next three years to only an 8% improvement since 2012. Of this decline, 6% was accounted for from 2021 to 2022.

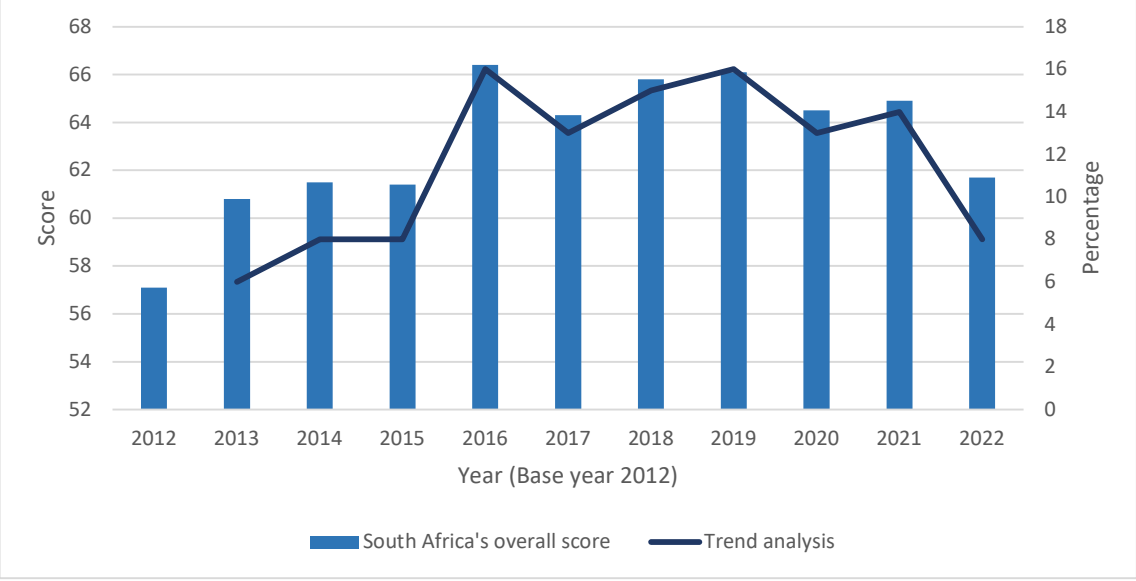


Figure 4-2: Trend analysis for South Africa's GFSI score from 2012 to 2022
Source: Compiled by the author, based on EIU (2022a)

As depicted in Figure 4-3 below, the score and rank consist of four dimensions, made up of 25 indicators that are all ranked according to a scale from 'very good' to 'very weak'. South Africa's top performing indicators over the past 11 years include micronutrient availability, food safety and disaster risk management, all with a score of 'very good'. At the lower end of the scale, the inequality-adjusted income index, sufficiency of supply, nutritional standards, water and oceans, rivers and lakes all score in the 'very weak' category. Among the four delineated dimensions, the dimension of quality and safety demonstrates the most favourable performance, while sustainability and adaptation exhibit the least promising outcomes.

South Africa has demonstrated an overall improvement in its Food Security Environment score, with an increase of 4.6 points between 2012 and 2022. However, it is important to note that, while all pillars have shown improvement during this period, the affordability dimension has undergone a downward trend in its score. Specifically, the dimension in South Africa has witnessed a decrease of 7.1 points since the 2012 GFSI report was first released. This decline is reflected in four out of the five indicators within the dimension. The downward trend indicates a deterioration in the food safety-net programmes provided for a significant percentage of the population falling beneath the international poverty threshold (EIU, 2022b).

Conversely, the most noteworthy improvement can be observed in the sustainability and adaptation dimension, where a remarkable increase of 21.9 points is seen. Notably, the score for disaster risk management has significantly risen by 99.1 points since 2012. This can be attributed to the acceptance of disaster risk reduction strategies by a substantial number of local governments in 2016, with continued progress being made in these efforts (EIU, 2022b). Despite an overall improvement of 3.7 points in the availability score throughout the 2012-2022 reporting period of the GFSI, South Africa has encountered significant declines in two specific indicators. The volatility of agricultural production (2.4) and the sufficiency of supply (2.7) have both experienced notable decreases. Of particular concern is the significant decline of 50.5 points in the sufficiency of supply indicator, largely attributable to a heavy reliance on chronic food aid over the past year (EIU, 2022b).

"The figure below shows country performance in 2022 (latest available data). Scores are normalised to 0-100, where 100 = best conditions. Δ = change in score, 2022 compared with 2021".

Food Security Environment 2022	61.7	△ -3.2

Indicator	Score	Change (2021 comparison year)
1. Affordability Dimension	63.4	△ -2.1
2. Availability Dimension	60.1	△ -3.9
3. Quality & Safety	66.1	△ -6.3
4. Sustainability & Adaptation	56.9	△ -0.6

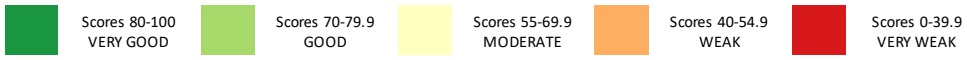


Figure 4-3: South Africa's Food Security Environment 2022
Source: Author's own compilation derived from EIU (2022a)

4.3 South Africa's Affordability Dimension

4.3.1 Analysis of the affordability dimension indicators based on the GFSI 2022 score and rank

Table 4-1 below shows South Africa's affordability dimension trend over the past eleven years. South Africa's overall score has deteriorated by 11,2% from 2012 to 2022. South Africa's overall trend as seen is volatile. During the past year, the score deteriorated from 65.5 to 63.4, decreasing by 3,3% from 2021 to 2022. The biggest change seen in Table 4–1 is in the "Inequality adjusted income index", which deteriorated by 37,5%, from a score of 42.9 in 2012 to 31.2 in 2022. Table 4–1 shows that the second largest change is in "Food safety net programmes", which decreased by 36,6%, from a score of 100 in 2012 to 73.2 in 2022. The only indicator portraying an upward trend is "Change in the average food costs". Over the past eleven years, this indicator has increased by 7,2%, from a score of 64.5 in 2012 to a score of 69.5 in 2022. This indicator has, however, decreased by 8,5% during the past year from 2021 to 2022.

Table 4-1: South Africa's GFSI affordability dimension trend from 2012 to 2022

Indicator	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Trend line	Change 2012 baseline
rall score	70,50	70,50	72,30	69,60	70,90	63,10	68,10	73,10	66,70	65,50	63,40		-11,2%
Change in the average food costs	64,50	64,00	71,50	60,00	75,00	42,00	65,50	84,50	82,00	78,00	69,50		7,2%
Proportion of the population under global poverty line	63,90	63,90	63,90	63,90	62,10	62,10	62,10	62,10	62,10	62,10	62,10		-2,9%
Inequality - adjusted income index	42,90	42,90	42,90	42,90	31,20	31,80	31,70	31,70	30,70	31,20	31,20		-37,5%
Agricultural trade	76,80	77,60	77,50	77,80	77,90	78,10	75,00	77,10	77,10	75,30	75,10		-2,3%
Food safety net programmes	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	73,20	73,20	73,20		-36,6%

Source: Author's compilation derived from EIU (2022a)

"The figure below shows country performance in 2022 (latest available data). Scores are normalised to 0-100, where 100=best conditions. Δ = change in score, 2022 compared with 2021".

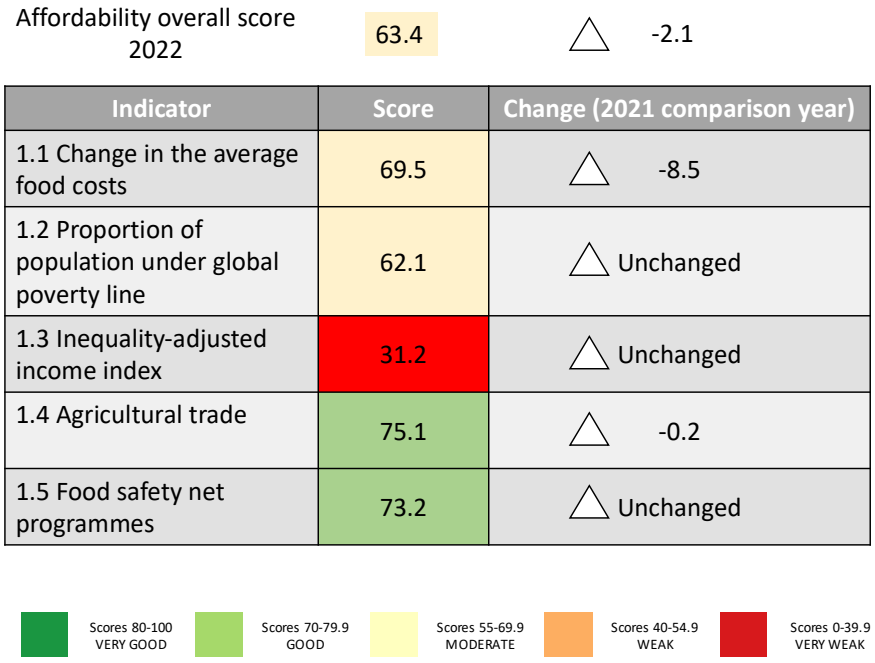


Figure 4-4: South Africa's affordability dimension 2022 score
Source: Author's own compilation, derived from EIU (2022a)

In the Affordability dimension, South Africa occupies the 70th position, worldwide, and secures the 2nd rank in its region, attaining a score of 63.4. The relatively elevated regional ranking is primarily attributed to a 'good' score (ranging from 70 to 79.9) in indicators (1.5) "food safety-net programs" and

(1.4) “agricultural trade”. However, the overall score in this dimension is weakened by a ‘very weak’ score in indicator (1.3) “inequality-adjusted income index”. This suggests the presence of broader challenges in ensuring that food remains affordable across all income levels within the country (EIU, 2022b).

Overall, food affordability experienced a decline, primarily attributable to food price inflation and income loss resulting from the influence of the COVID-19 pandemic. The prevailing global crisis exposed inherent weaknesses within the international food system, and is anticipated to worsen the difficulties associated with fulfilling nutritional demands (Mazuta, 2021). As seen in Figure 4-4 above, the biggest change y/o/y was seen in the “Change in the average food cost” indicator, decreasing by 12,2% from 78 to 69.5 in 2022.

Table 4-2 below depicts the affordability dimension measurement parameters. The parameters and indicators that support it will be examined further in the text below.[2]

Table 4-2: Affordability dimension measurement parameters

Food Security Dimension	Parameters	Indicators	Quantitative data source
1. Affordability	1.1. Change in average food costs	Food CPI	FAO
	Population under global poverty line	PPP	World Bank
	1.2. Inequality – adjusted income index	GNI per capita	UN Development Programme (UNDP)
	Agricultural Trade	Composite indicator	WTO
	Food safety net programmes	Composite indicator	Qualitative scoring (EIU)

Source: EIU (2022a)

Change in the average food costs is determined by considering the fluctuations in consumer prices and food indices (EIU, 2022a). The Consumer Price Index (CPI) is a contemporary socioeconomic metric designed for the purpose of measuring shifts in the overall price level of consumer goods and services that households regularly procure, utilise, and financially engage with over time. The CPI encompasses a basket of commodities and services, characterised by consistent, unvarying quantities and quality (FAO, 2023b). Looking at Figure 4-4 above, it is evident that the indicator decreased by 8.5 points since 2021 and holds a ‘moderate’ score.

2 Only indicators that meet the requirements stipulated in Section 3.5 will be further evaluated.

In recent months, South Africa has grappled with heightened food inflation, which is emblematic of a broader global challenge. Looking at the overall change from 2012, a 7.2% increase in score is observed. As stipulated by the Bureau for Food and Agricultural Policy (BFAB), indicators that affect food prices in South Africa include global food commodity prices, the exchange rate that saw a depreciation of 8% y-o-y, rising costs in the value chain, and infrastructure challenges (BFAB, 2023). Looking at data from the FAO, food price inflation (FPI) increased from 5,7% in March 2021 to 6,2% in March 2022. This increased significantly in March 2023 to an estimated value of 14.05% (FAO, 2023b). During the first half of 2023, there was a notable escalation in food inflation, followed by a subsequent moderation observed in the latter half of the year. Over the first eight months of 2023, the average food inflation rate in South Africa stood at 12.2% (Sihlobo, 2023).

The impact of these inflationary pressures was particularly pronounced in South Africa, given its elevated unemployment rates. Global factors contributing to escalating food prices encompassed a South American drought in the 2019/20 season, affecting maize and soybean production; increased demand from China during the reconstruction of its pork industry following an outbreak of African Swine Fever; and disruptions induced by trade policies and logistics originating from the onset of COVID-19. The Russia–Ukraine conflict exacerbated the situation because of the substantial roles these countries play in global grains and oilseeds markets (Sihlobo, 2023). Despite South Africa's relative resilience owing to its favourable weather conditions, global shocks prevailed, leading to a surge in food prices. The situation exhibited signs of improvement in late 2022 following the resumption of grain trade in the Black Sea region. As of September 2023, global agricultural prices, inclusive of those in South Africa, demonstrated a notable decrease from their peak in March 2022, with the FAO's Global Food Price Index registering an 11% year-on-year (y-o-y) decline and a 24% reduction from its record high (FAO, 2023b).

The **Inequality-adjusted income index** decreased by 37.5% since 2012. In 2022, the indicator was classified as 'very weak', and its score remained unchanged since 2021. This indicator is constructed on the United Nations Development Programme (UNDP) that uses an Index 0-1, where 1 = the highest inequality adjusted income rate, and is a measure of individual income. The rationale behind adding the indicator is that average levels of income can determine how affordable food is (EIU, 2022a). The extensive recognition of South Africa as a nation characterised by substantial socioeconomic disparities and inequality is widely acknowledged (Kerr, 2021). According to the UNDP, South Africa has shown that 57% of the population exhibits inequality in income (UNDP, 2022). Furthermore, according to the UNDP, the inequality-adjusted income index of South Africa portrayed a score of 0.316. A score of 0.316 on the Inequality-Adjusted Income Index suggests that a certain level of income inequality within the context of the country is being measured. The index used by the UNDP ranges from 0 to 1, with 1 indicating perfect equality (everyone has the same income) and 0 indicating complete inequality (one

person or group has all the income, and others have none). Therefore, a score of 0.316, according to the UNDP methodology, indicates that there is a significant degree of income inequality within the country, as it is closer to 0 than to 1 (UNDP, 2022). An alternative measurement used to measure income inequality is the Gini coefficient. According to Stats SA, South Africa's Gini coefficient improved from 0.65 in 2015, to 0.60 in November 2022, only to deteriorate to the current rate of 0.67 (StatsSA, 2022). Both these measurements indicate that a great concentration of inequality is present in South Africa.

An interrelationship exists between income and employment status (Stronks, et al., 1997). Therefore, a decreasing unemployment rate would cause an increase in income levels as a result. The utilisation of variance decomposition methodology indicates that 85 percent of the total income inequality is attributable to disparities in earnings within the labour market. Within this context, it is discerned that one-third of this inequality originates from the substantial proportion of individuals not actively participating in the labour force, while the remaining two-thirds is ascribed to variations in earnings among those actively engaged in employment (Leibbrandt, et al., 2010). In the latest Quarterly Labour Force Survey (StatsSA, 2023), in contrast to the corresponding period one year prior, the aggregate employment figure exhibited a growth of 979,000 individuals, representing a percentage increase of 6.2%. Concurrently, the number of "unemployed" recorded an increase of 124,000 individuals, signifying a proportional rise of 1.6%. Conversely, there was a decrease of 539,000 individuals (or 3.2%) in the demographic categorised as "not economically active". Figure 4-5 below displays a summary of how the various provinces in South Africa performed during the third quarter labour survey of 2023.

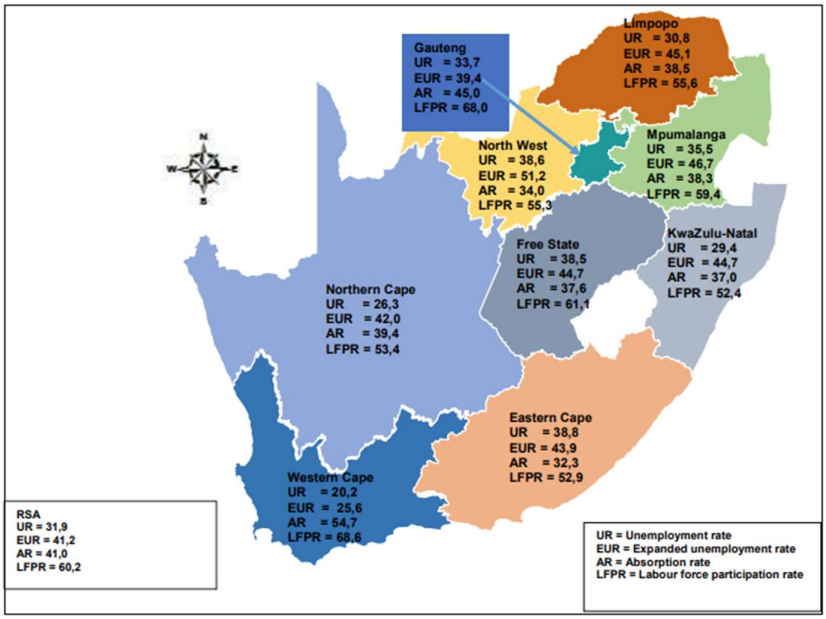


Figure 4-5: Summary of the labour market measures, Q3: 2023
Source: (StatsSA, 2023)

4.4 South Africa's Availability Dimension Analysis

4.4.1 Analysis of the availability dimension indicators based on the GFSI 2022 score and rank

Table 4-3 below shows the trend line of the availability dimension for the period from 2012 to 2022. The trend line showed improvement from 2012 to 2016, after which it deteriorated during the period from 2017 to 2019. Over the past decade, the availability dimension improved its overall score by 6,2%, with a score of 60.1 in 2022. This is, however, 6,5% less than the score recorded in the preceding year of 64.0. The indicator with the largest decline for the availability dimension is 'Sufficiency of supply'. It declined by a massive 185,7%, from a score of 77.7 in 2012 to 27.2 in 2022. Year-on-year, the score decreased by 48,1%. Looking at the indicators, it is seen that the second largest decline is in 'Volatility of agricultural production'. This indicator's score decreased by 42,9%, from 68 in 2012 to 47.6 in 2022.

Table 4-3: South Africa's GFSI availability dimension trend from 2012 to 2022

Indicator	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Trend Line	Change 2012 baseline
Overall Score	56.4	60.3	59.8	61.5	67.7	66.5	65	61.9	62.2	64	60.1		6.2%
Access to agricultural inputs	50.3	50.3	50.3	50.3	50.3	50.3	50.3	52	50.3	65.4	63.4		20.7%
Agricultural Research and development	56.5	72.5	66.2	67.4	72.4	70.4	59.8	62.5	69.8	70.8	63.8		11.4%
Farm Infrastructure	51.5	57.8	59.5	62.9	63.5	64.7	63.8	64.7	64.7	64.7	64.7		20.4%
Volatility of agricultural production	68	71.4	71.4	85	85	71.4	71.4	40.8	40.8	40.8	47.6		-42.9%
Food loss	79	79	79.4	78.6	78.9	80.8	79.8	80.8	77.8	77.4	79.7		0.9%
Supply chain infrastructure	59.5	61.3	61.3	59.3	59.3	62.2	62.2	58.8	58.8	58.8	67.3		11.6%
Suffieciency of supply	77.7	30.5	30.5	30.5	77.7	76.9	76.1	76.1	76.1	75.3	27.2		-185.7%
Polictical and social barriers to access	70.9	69.7	69.9	70.1	70.1	70.2	70.2	70.3	70.4	70.5	79.1		10.4%
Food security and access policy commitments	0.0	52.5	52.5	52.5	52.5	52.5	52.5	52.5	52.5	52.5	52.5		100.0%

Source: Author's compilation, derived from EIU (2022a)

"The figure below shows country performance in 2022 (latest available data). Scores are normalised to 0-100, where 100=best conditions. Δ = change in score, 2022 compared with 2021".

Availability overall score 2022	60.1	△ -3.9

Indicator	Score	Change (2021 comparison year)
2.1 Access to agricultural inputs	63.4	△ -2
2.2 Agricultural research and development	63.8	△ -7
2.3 Farm infrastructure	64.7	△ Unchanged
2.4 Volatility of agricultural production	47.6	△ 6.8
2.5 Food loss	79.7	△ 2.3
2.6 Supply chain infrastructure	67.3	△ 8.5
2.7 Sufficiency of supply	27.2	△ -48.1
2.8 Political and social barriers to access	79.1	△ 8.6
2.9 Food security and access policy commitments	52.5	△ Unchanged

Scores 80-100 VERY GOOD | Scores 70-79.9 GOOD | Scores 55-69.9 MODERATE | Scores 40-54.9 WEAK | Scores 0-39.9 VERY WEAK

Figure 4-6: South Africa's availability dimension 2022 score
Source: Author's own compilation, derived from EIU (2022a)

For the Availability pillar, South Africa achieved a score of 60.1, securing a joint 52nd position, globally, and ranked first in its region. The country demonstrates areas of strength, as it attains a 'good' score (ranging from 70 to 79.9) in indicators (2.5) 'food loss' and (2.8) 'political and social barriers to access'. These strengths contribute positively to the overall score in this dimension. South Africa's efforts in developing a food-secure supply chain are reflected in the 'moderate' scores (ranging from 55 to 69.9) obtained for indicators (2.1) 'access to agricultural inputs', (2.2) 'agricultural research and development', (2.3) 'farm infrastructure', and (2.6) 'supply chain infrastructure'. However, these scores also indicate areas where further improvement is needed (EIU, 2022b).

On the other hand, the country records 'weak' scores (ranging from 40 to 54.9) in indicators (2.4) 'volatility of agricultural production' and (2.9) 'food security and access policy commitments', and a 'very weak' score (ranging from 0 to 39.9) in indicator (2.7) 'sufficiency of supply'. These lower scores weaken the overall score in this dimension. The challenges, associated with agricultural production volatility and insufficient food supply, are revealed through these indicators. Furthermore, the absence of a dedicated food security agency hampers strategic long-term planning efforts, thereby detracting from the overall score (EIU, 2022b). Overall, while South Africa demonstrates strengths in certain aspects of food availability, there remain opportunities for improvement, particularly in addressing production-related challenges and enhancing strategic planning for long-term food security. Table 4-4

below depicts the availability dimension measurement parameters. The parameters and indicators that support it will be further examined below.[3]

Table 4-4: Availability dimension measurement parameters

Food Security Dimension	Parameters	Indicators	Quantitative data source
2. Availability	2.1. Access to agricultural inputs	Composite indicator	FAO
	2.2. Agricultural research & development	Composite indicator	UN/USDA
	Farm infrastructure	Composite indicator	FAO/ITU
	2.3. Volatility of agricultural production	Standard deviation of production growth rates	FAO
	Food loss	Total waste as percentage of total domestic supply	FAO
	Supply chain infrastructure	Composite indicator	EIU risk briefing/World Bank
	2.4. Sufficiency of supply	Composite indicator	FAO/OECD
	Political and social barriers	Composite indicator	EIU risk briefing/UNDP
	2.5. Food security and access policy commitments	Composite indicator	Qualitative scoring (EIU)

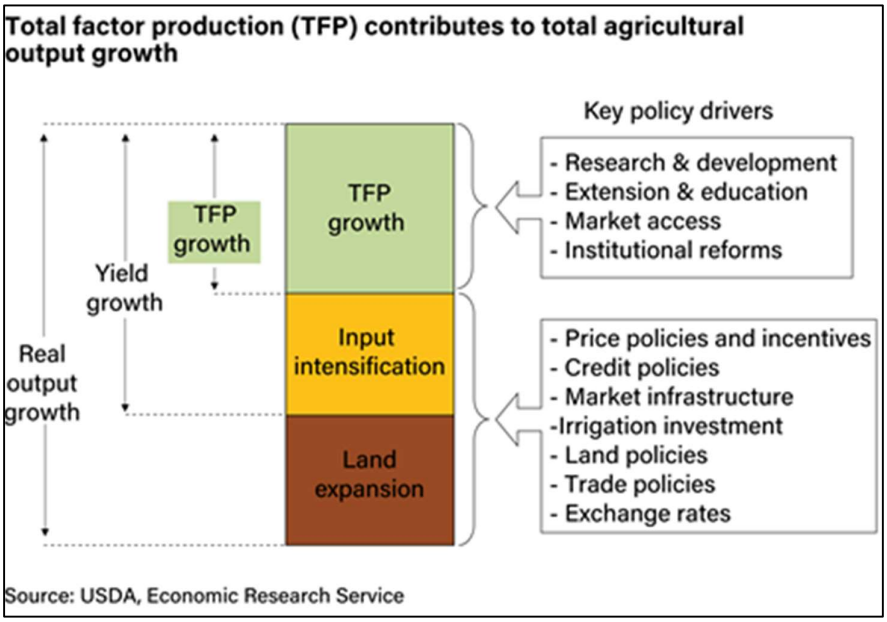
Source: EIU (2022a)

Access to agricultural inputs is classified as 'moderate' and decreased by 2 points in comparison with 2021. However, the overall score increased by 20.7% since 2012. The 2022 indicator consists of six sub-indicators. Of the six sub-indicators only one, namely agricultural producer prices, increased in score (EIU, 2022a). The purpose of including the previously mentioned sub-indicator is to determine whether producers are earning more money for their produce. This is measured through the Producer Price Index (PPI), which pertains to the mean annual variation, over time, in the selling prices garnered by farmers (EIU, 2022a). According to the FAO's PPI calculation, South Africa's farmers received 2,5% more for their maize, while total agricultural produce brought about 6,05% more to producers' pockets in 2022 y-o-y (FAO, 2023c). Among the existing sub-indicators, "access to finance and financial products for farmers, access to diversified financial products, access to extension services, and community organisations", remained unaltered. Furthermore, these sub-indicators scored 2 out of a possible 2 points in the 2022 GFSI score. The "Empowering women farmers" was allocated a score of 0 out of a possible 2 points for the entire period from 2012 to 2022. Therefore, the overall score of "access to agricultural inputs" decreased (EIU, 2022a).

3 Only indicators that meet the requirements stipulated in Section 3.5 will be further evaluated.

Agricultural research and development decreased by 7 points since 2021. As seen in Figure 4-6 above, it is classified as 'moderate', and as illustrated in Table 4-3 above, increased by 11.4% since 2012. This indicator is composed of three sub-indicators, namely "public expenditure on agricultural research and development, access to technology, education and resources, and commitment to innovative technology". Out of the three sub-indicators, access to agricultural technology, education and resources decreased from a score of 0,0481 to −0.0275 (EIU, 2022a). This is measured by the United States Department of Agriculture (USDA) by subtracting the annual growth in agricultural inputs (%) from the annual growth in agricultural outputs (%) (EIU, 2022a). This sub-indicator is measured by total factor productivity (TFP), a term employed to characterise a comprehensive measure of agricultural productivity, which involves comparing the aggregate output of crop and animal commodities with the complete ensemble of inputs, including land, labour, capital and material outputs employed in agricultural production. Total Factor Productivity (TFP) serves as a measurement assessing the overall efficiency in the consolidation of inputs to generate output. When the pace of increase in total output surpasses that of total inputs, TFP is deemed to be on the ascent (Fuglie, et al., 2021). Figure 4-7 below indicates key policy drivers that contribute to TFP growth. As seen in the figure, research and development, extension and education, market access and institutional reforms all play an intricate part in growing TFP. The sustained growth of Total Factor Productivity (TFP) arises from the adoption of improved technology and is influenced by policies that promote innovation and the integration of technology. This includes the allocation of funds to support agricultural research and extension initiatives (Fuglie, et al., 2021).

Figure 4-7: Total Factor Productivity (TFP)

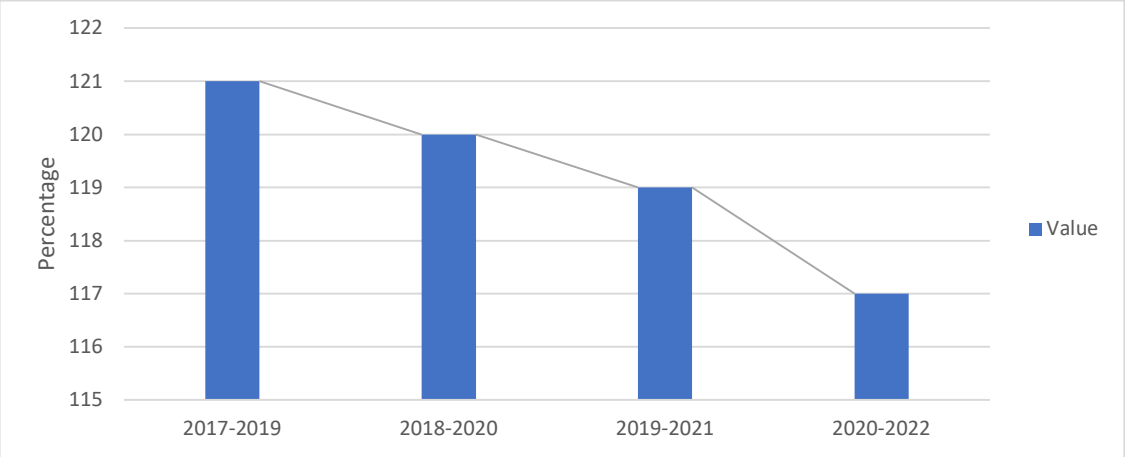


Source: Fuglie, et al. (2021)

Volatility of agricultural production increased by 6.8 points, but is still classified as 'weak'. It has decreased by 42.9% since 2012. According the findings of the EIU, this indicator is determined by assessing the fluctuations in agricultural output. This is determined through the standard deviation in the growth rates of both vegetable and cereal production over the most recent five-year period for which comprehensive data has been compiled (EIU, 2022a). This measurement is important because fluctuations in agricultural productivity can make it difficult to provide a stable food supply (EIU, 2022a). From 2021 to 2022, the standard deviation declined from 0.18 to 0.16. In the context of production growth rate analysis, a standard deviation of 0.16 serves as a quantifiable metric of data dispersion or variability. This indicator clarifies the extent to which individual data points, notably those pertaining to production growth rates, diverge from the central tendency, specifically the mean production growth rate. A standard deviation of 0.16, by quantitative standards, assumes a position on the lower extreme of the range, indicating a notable degree of homogeneity in production growth rates, with their values near the mean (Livingston, 2004). Essentially, this observation signifies a limited degree of departure from this statistical average. The relatively low standard deviation imparts heightened precision to predictions and forecasts regarding forthcoming production growth rates. In such an environment, the incidence of extreme fluctuations in growth rates is significantly mitigated, reinforcing the conception of a controlled and stabilised production environment.

Sufficiency of supply decreased by 48.1 points and is classified as 'very weak'. Moreover, the indicator decreased by 185.7% since 2012, as seen in Table 4-3 above. This indicator is compiled by two sub-indicators, "food supply adequacy" from FAO data, and "dependency on chronic food" aid based on OECD calculations (EIU, 2022a). The first sub-indicator is measured by looking at the quantity food accessible for human utilisation as a percentage of the average dietary energy necessity (EIU, 2022a). Figure 4-8 below displays three-year averages over the past five years for South Africa's average dietary energy supply adequacy, as measured by the FAO. From the figure, it is evident that South Africa's value have decreased over the period evaluated. According to Figure 4-8, the average dietary intake for the 2020-2022 period decreased by 2%, compared with the previous three-year average.

Figure 4-8: Average dietary energy intake adequacy of South Africa (3-year average) from 2017 to 2022



Source: FAO (2023c)

Food security and access policy commitments is classified as 'weak' and unchanged for the period from 2021 to 2022. This indicator exhibited a notable increment of 100% since the year 2012, when it had the value of zero. After 2013, the score associated with this indicator has remained consistent. It is important to note that this indicator comprises two constituent sub-indicators, specifically denoted as "food security strategy" and "food security agency." The former, "food security strategy," is characterised as an evaluative measure of the presence or absence of a national food security strategy within a given country (EIU, 2022a). This indicator is significant because of its ability to measure whether the government has accorded food security a position of emphasis and prioritisation within its policy framework (EIU, 2022a). The food security strategy stayed unchanged at a score of 100 from 2012. The second sub-indicator, "food security agency", denotes an evaluative criterion assessing the extent to which a government assumes responsibility and accountability for food security (EIU, 2022a). This metric is of substantial significance, since the presence of a dedicated agency, department, or ministry tasked with this responsibility serves as an indicator of whether the government has committed resources, can be subjected to accountability mechanisms, and is adopting a systematic and coordinated strategy to attain food security goals (EIU, 2022a). It is noteworthy that the score for this indicator has remained at zero since the year 2012.

Strategies aimed at addressing food security in South Africa operate at both the national and broader regional points. Nationally, initiatives such as the NDP and the National Policy on Food and Nutrition Security have been implemented. Additionally, South Africa has committed to regional and global strategies, including the Southern African Development Community (SADC) Region strategy (2015 – 2025), the SDGs, the Malabo Declaration, and the Paris Climate Change Agreement.

Despite these commitments, Olivier and Hendriks (2015) highlight a critical aspect observed in nations deemed successful in achieving food security goals, as outlined in the report of the Malabo-Montpellier Panel. This crucial characteristic involves the establishment of accountability and coordination structures tasked with supervising the execution of food security policies and programmes. The article underscores that the point that the governing body has long acknowledged the necessity for coordinated efforts to be made in food security and nutrition, a recognition dating back to the 1997 Food Security Policy for South Africa and further emphasised by the 2002 Integrated Food Security Strategy. The latter proposed the formation of an inter-ministerial committee for leadership, reporting directly to the Ministers' Social Sector Cluster.

In 2014, the "National Policy on Food and Nutrition Security" designated specific governmental departments for overseeing implementation, with the Department of Agriculture, Forestry and Fisheries (DAFF) introducing the "National Food and Nutrition Advisory Council" in 2015 as a crucial step in finalising the implementation plan. By 2017, DAFF reported on the development and implementation status of the "National Food and Nutrition Security Plan (2017 – 2022)" to the Portfolio Committee on Agriculture, Land Reform and Rural Development. However, Olivier and Hendriks (2020) identify a current obstruction in the establishment of an interim "National Advisory Food and Nutrition Council", with no official communication on the matter being given as a component of their report.

4.5 South Africa's Quality and Safety Dimension Analysis

4.5.1 Analysis of the quality & safety dimension indicators based on the GFSI 2022 score and rank

Table 4–5 below demonstrates the trend line of the quality and safety dimension, together with the world average over the past ten years. From the upward trend line, it is observed that South Africa's quality and safety dimension increased by 5,9%, from its 2012 score of 62.2 to its score of 66.1 in 2022. However, the dimension's score decreased by a significant 9,5% year-on-year from 72.3 to the current score of 66.1.

Table 4-5: South Africa's GFSI quality & safety dimension trend from 2012 to 2022

Indicator	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Trend line	Change 2012 baseline
Overall score	62,2	65,8	67,2	68,1	74,2	74,1	72,2	71,3	72,3	72,4	66,1		5,90%
Dietary diversity	44,7	44,7	44,9	45,6	45,4	45,3	45,4	45,8	45,6	45,6	44,7		0,00%
Nutritional standards	22,6	50	50	50	79,8	79,8	68,5	68,5	68,5	68,5	38,7		41,60%
Micronutrient availibility	86,7	86,8	86,8	86,8	86,8	86,8	86,8	86,8	86,8	86,8	86,8		0,12%
Protein quality	66	66	66,8	65,2	65,2	65,2	66,8	66,8	66,8	66,8	66,6		0,90%
Food safety	91,5	81,5	87,3	92,7	93	93,1	92,9	88	93,4	93,7	93,7		2,35%

Source: Author's compilation derived from EIU (2022a)

"The figure below shows country performance in 2022 (latest available data). Scores are normalised to 0-100, where 100=best conditions. Δ = change in score, 2022 compared with 2021".

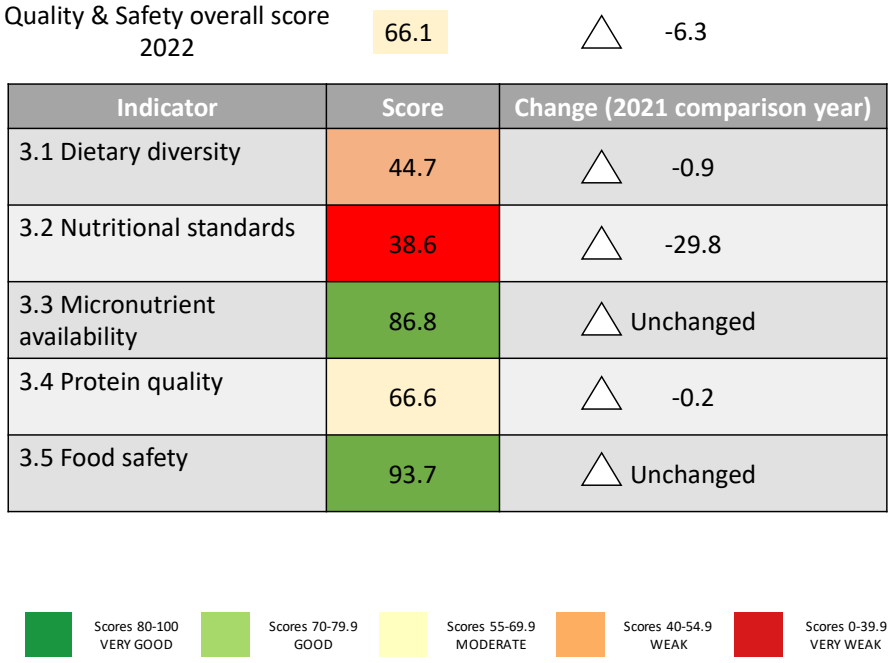


Figure 4-9: South Africa's quality & safety dimension 2022 score
Source: Author's own compilation derived from EIU (2022a)

For the Quality and Safety pillar, South Africa achieves a global ranking of 60th and secures the 2nd position in its region, obtaining a score of 66.1 (EIU, 2022b). The country's global standing is diminished by a 'very weak' score (ranging from 0 to 39.9) in indicator (3.2) Nutritional standards, and a 'weak, score (ranging from 40 to 54.9) in indicator (3.1) Dietary diversity (EIU, 2022b). However, South Africa demonstrates favourable performance in indicator (3.5) Food safety, being the only sub-

Saharan African country to achieve a 'very good' score (80+). Furthermore, the country attains a 'very good' score in indicator (3.3) Micronutrient availability.

These positive scores in food safety and micronutrient availability contribute to South Africa's overall standing in the Quality and Safety pillar, while the weaker scores in nutritional standards and dietary diversity negatively impact on its global position. Table 4-6 below depicts the quality and safety dimension measurement parameters. The parameters and indicators that support it will be further examined below.[4]

Table 4-6: Quality and safety dimension measurement parameters

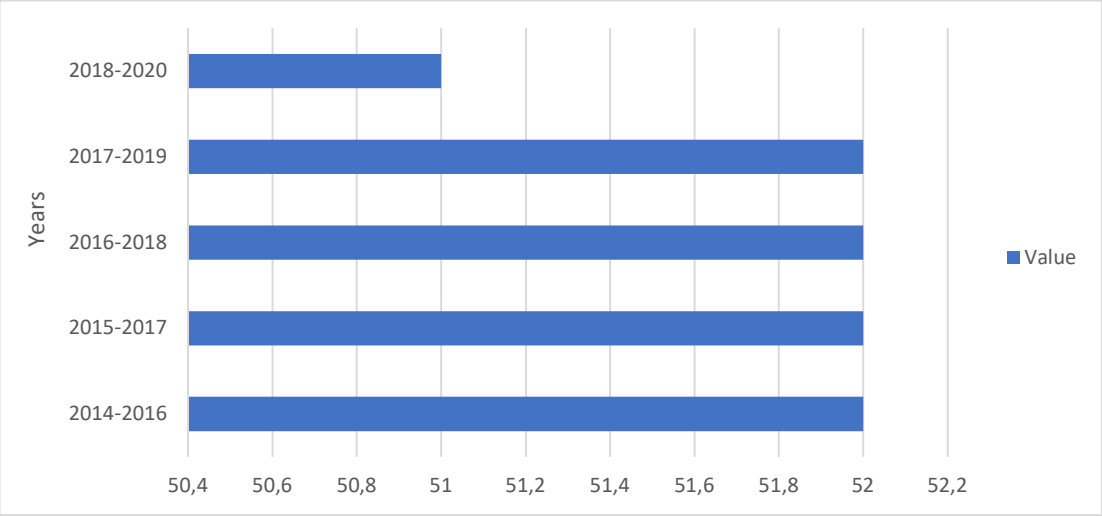
Food Security Dimension	Parameters	Indicators	Quantitative data source
3. Quality & Safety	3.1. Dietary diversity	Composite indicator	FAO/OECD
	3.2. Nutritional Standards	Composite indicator	Qualitative scoring (EIU)/WHO/FAO
	Micronutrient availability	Composite indicator	Global Nutrient Database
	3.3. Protein quality	PDCAAS	FAO/WHO/USDA
	Food safety	Composite indicator	Qualitative scoring (EIU)/WHO/World Bank/UN

Source: EIU (2022a)

Dietary diversity witnessed a decline of 0.9 points, categorising it as exhibiting a 'weak' status. The assessment for the year 2022 mirrors that of 2012, signifying a stasis in progress over an 11-year span, wherein any advancements achieved were subsequently reversed. This indicator is composed of two constituent sub-indicators. The first of these sub-indicators is "The Share of Non-Starchy Foods (FAO)", which is defined as a measure of the proportion of non-starchy foods within the total dietary energy consumption (EIU, 2022a). The significance of this sub-indicator lies in its capacity to denote a greater diversity of food groups within an individual's diet, where a larger proportion of non-starchy foods is consumed (EIU, 2022a). Referring to Figure 4–10 below, the most recent data available pertains to the period spanning from 2018 to 2020. According to this data, 51% of the dietary energy source is attributed to cereals, roots, and tubers. This proportion represents a decline from the 52% reported for the 2017–2019 period.

4 Only indicators that meet the requirements stipulated in Section 3.5 will be further evaluated.

Figure 4-10: South Africa's dietary supply derived from a 3-year average of cereals, roots and tubers



Source: FAO (2019)

The second sub-indicator used to assess dietary diversity pertains to the "Share of Sugar Consumption". This metric, developed by the Organisation for Economic Co-operation and Development (OECD), quantifies the proportion of sugars within the overall dietary energy intake (EIU, 2022a). This statistic carries significant relevance, as it serves as a measure of the prevalence of elevated sugar consumption within a population, potentially signifying greater ingestion of sugar-sweetened beverages (SSB) and non-essential energy-dense food items characterised by their limited nutritional value (EIU, 2022a). Such dietary habits are associated with an increased likelihood of negative health consequences. The OECD stated in its agricultural outlook for the 2023–2032 period that South Africa's sugar consumption, by kilogram per capita, is projected to decrease by 1,6 kilograms, from the current quantity of 28,1 kg/cap/yr. to 26,5 kg/cap/yr. (OECD, 2023).

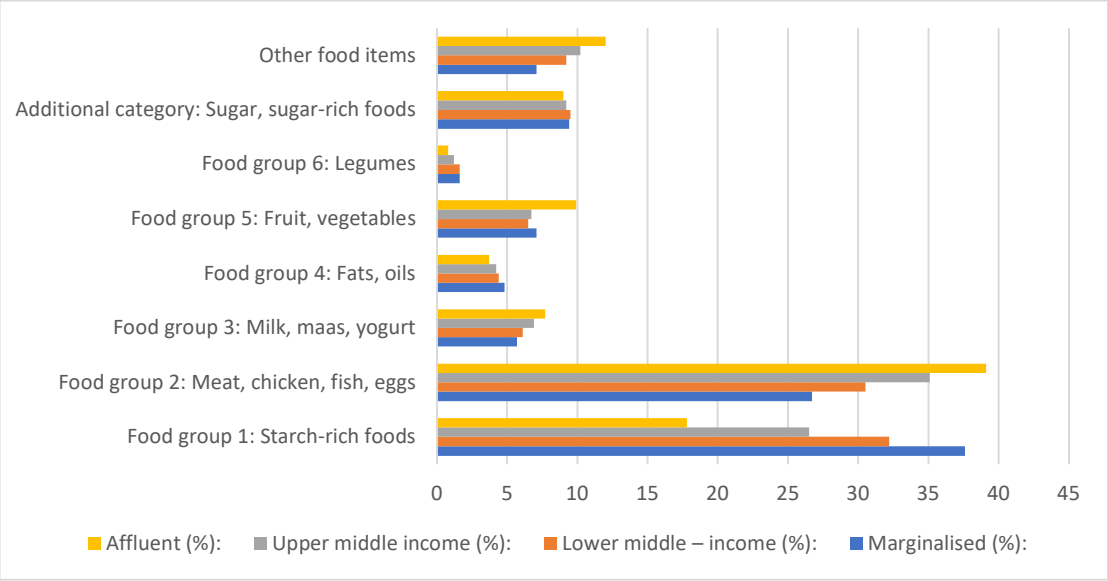
Nutritional standards decreased by 29.8 points and are classified as 'very weak'. Since 2012, it increased by 41.6%. According to the methodology used by the EIU (2022b), the assessment of national dietary guidelines involves determining whether the government has published and implemented such guidelines, and whether there are plans in place for their periodic reassessment. These guidelines play a crucial role in conveying messages regarding balanced and nutritious diets. The indicator shifted from 100 points to 50 points in 2018, and remained constant until 2022. The most recent data on nutritional guidelines, available as of the date of this study, was last updated and published in 2013 (DOH, 2013).

The nutritional standards indicator comprises three sub-indicators. The first sub-indicator evaluates the existence of a presently published national strategy aimed at improved nourishment for all the demographical groups, considering the differing nutritional needs of these populations, according to

(WHO, FAO). This sub-indicator has consistently scored 100 out of a possible 100 points over the past 11 years, as reported by EIU data. The second sub-indicator evaluates whether the government mandates nutrition labelling on packaged foods, aligning with Codex recommendations for nutrient declarations (calories, protein, carbohydrates, fats, sodium, and sugar). Nutrition labelling, in conjunction with educational policies, enhances consumer understanding of the caloric and nutritional content of purchased foods (EIU, 2022a). However, this sub-indicator has maintained a score of zero out of 100 since 2012 (EIU, 2022a). In the South African context, there are indications that the private sector wields influence in legal disputes or trade-related grievances associated with policies governing nutrition and alcohol regulation (Milsom, et al., 2021). In 2023, the Department of Health released the latest Government Notices of Regulations relating to the labelling and advertising of foodstuffs (DOH, 2023). The final sub-indicator, Nutrition Monitoring and Surveillance, estimates whether the government systematically monitors the nutritional status of the overall public, encompassing the collection of data on undernourishment and deficiencies related to nutrition (EIU, 2022a). This allows the government to detect prevailing deficiencies and to allocate reserves accordingly. Notably, the score for this sub-indicator declined from 100 to 0 between 2021 and 2022 (EIU, 2022a).

Protein quality, also classified as 'moderate', changed by 0.2 points since 2021. It increased, however, by a mere 0.9% since 2012. This indicator measures the quantity of high-quality protein in the diet, employing the "Protein Digestibility Corrected Amino Acid Score" (PDCAAS) methodology. PDCAAS evaluates the presence of nine essential amino acids in the typical national diet (EIU, 2022a). The calculation incorporates factors, such as the amino acid profile, protein digestibility value, and the average quantity (in grams) of each food item contributing at least 2% to total protein consumption (EIU, 2022a). As demonstrated in
Figure 4-10 above, the majority of South Africans consume 51% of the dietary energy required from a food group that is high energy, low protein, which consists of cereals, roots and tubers. Figure 4-11 below depicts the percentages of money allocated to the different food groups by various social groups.

Figure 4-11: Percentage contributions of food groups to total percentage spending of the social group segments



Source: Statistics South Africa (2017)

As illustrated above, there is a discernible disparity in the allocation of funds to food groups among the socio-economic categories presented in the table. A closer examination of food group 2 reveals that the marginalised and lower-middle-income groups spend approximately 26,7% to 30,5% on this protein-rich category. Contrastingly, the upper-middle-income and affluent groups exhibit an increased expenditure on food group 2, ranging from 35.1% to 39.1%. According to the OECD (2023), South Africa's protein meal projections, with specific reference to the consumption thereof, is set to increase by 2,9 kg rwe/cap from the current 39,6 kg rwe/cap to 41,5 kg rwe/cap in 2032. Examining various meat categories, the OECD report anticipates a marginal increase in beef and veal consumption, by 0.3 kg rwe/cap, transitioning from the current average (2020–2022) of 11 kg rwe/cap to 11.3 kg rwe/cap by the year 2032. Concurrently, pig meat consumption is set to rise by 0.5 kg rwe/cap, progressing from the 2020–2022 average of 3.9 kg rwe/cap to 4.1 kg rwe/cap in 2032. Poultry meat, constituting the predominant meat source for South African consumers, is expected to undergo the most substantial growth, projecting an augmentation of 1.3 kg rwe/cap from the current 22.8 kg rwe/cap (2020–2022) to 24.1 kg rwe/cap in 2032. The fish and seafood projections are also set to increase. The consumption of this protein type is set to rise by 8 kg/cap, from the current average of 6,5 kg/cap for the period 2013–2022, to the projected 7,3 kg/cap for the 2023–2032 period. Conversely, sheep meat, the sole category forecasted to decline, is expected to diminish by 0.2 kg rwe/cap, transitioning from the average of the period 2013–2022 to 1,7 kg rwe/cap for the duration spanning 2023–2032 (OECD, 2023).

4.6 South Africa's Sustainability and Adaptation Dimension Analysis

4.6.1 Analysis of sustainability & adaptation dimension indicators based on the GFSI 2022 score and rank

Table 4-7: South Africa's sustainability & adaptation dimension trend analysis from 2012 to 2022

Indicator	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Trend line	Change 2012 baseline
Overall score	35	43,3	43,5	43,6	51,3	53,7	57,2	56,3	56,2	57,5	56,9		38,49%
Exposure	78,9	78,9	78,9	78,9	78,9	78,9	78,9	78,9	78,9	78,9	78,9		0,00%
Water	36,2	36,2	36,2	36,2	36,2	36,2	36,2	36,2	36,2	36,2	36,2		0,00%
Land	40,7	40,7	40,7	40,7	40,7	40,7	40,7	40,7	40,7	40,7	40,7		0,00%
Oceans, rivers and lakes	36,1	35,9	37,2	37,2	37,2	37,2	37,2	37,2	37,2	37,2	37,2		2,96%
Politucal commitment to adaptation	17,3	17,9	18,1	18,8	23,8	36,3	54,8	50,1	49,7	54,3	50,9		66,01%
Disaster risk management	0	52,9	52,9	52,9	96,2	96,2	96,2	96,2	96,2	99,1	99,1		100,00%

Source: Author's compilation derived from EIU (2022a)

Table 4–7 above illustrates the trend for the sustainability and adaptation dimension, in comparison with the world average trend line. From the Table, it is seen that South Africa's score increased considerably over the past decade. The 2012 score of 35.0 increased by 38,5%, bringing the 2022 score to 56.9. Comparing the y-o-y change, however, it is observed that the score in 2021 of 57.5, decreased by 1,05% to the current score of 56.9.

"The figure below shows country performance in 2022 (latest available data). Scores are normalised to 0-100, where 100=best conditions. Δ = change in score, 2022 compared with 2021".

Sustainability & Adaptation overall score 2022	56.9	△ -0.6

Indicator	Score	Change (2021 comparison year)
4.1 Exposure	78.9	△ Unchanged
4.2 Water	36.2	△ Unchanged
4.3 Land	40.7	△ Unchanged
4.4 Oceans, rivers and lakes	37.2	△ Unchanged
4.5 Political commitment to adaptation	50.9	△ -3.4
4.6 Disaster risk management	99.1	△ Unchanged

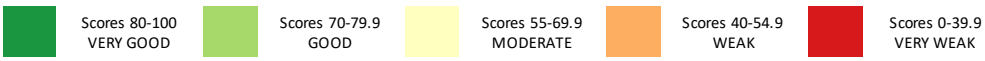


Figure 4-12: South Africa's sustainability & adaptation dimension 2022 score
Source: Author's own compilation, derived from EIU (2022a)

Sustainability and Adaptation represents South Africa's weakest pillar in the framework of food security. The country achieves a score of 56.9, securing a joint 44th position, globally, ranking fourth in its region (EIU, 2022b). South Africa demonstrates a 'very good' score (80+) in indicator (4.6) "disaster risk management". However, the country records 'weak' scores (ranging from 40 to 54.9) in indicators (4.3) "land" and (4.5) "political commitment to adaptation", and 'very weak' scores (ranging from 0 to 39.9) in indicators (4.2) "water" and (4.4) "oceans, rivers, and lakes". Consequently, South Africa obtained a 'moderate' overall score in this dimension, highlighting the need for improved management of its natural resources (EIU, 2022b).

These scores indicate the country's strengths in disaster risk management, but also reveal weaknesses in land management, political commitment to adaptation, and the sustainable utilisation of water bodies. To enhance its sustainability and adaptation efforts, South Africa must address these areas of concern to better manage its natural resources and ensure long-term food security. Table 4-8 below depicts the sustainability and adaptation dimension measurement parameters. The parameters and indicators that support it will be further examined below.[5]

5 Only indicators that meet the requirements stipulated in Section 3.5 will be further evaluated.

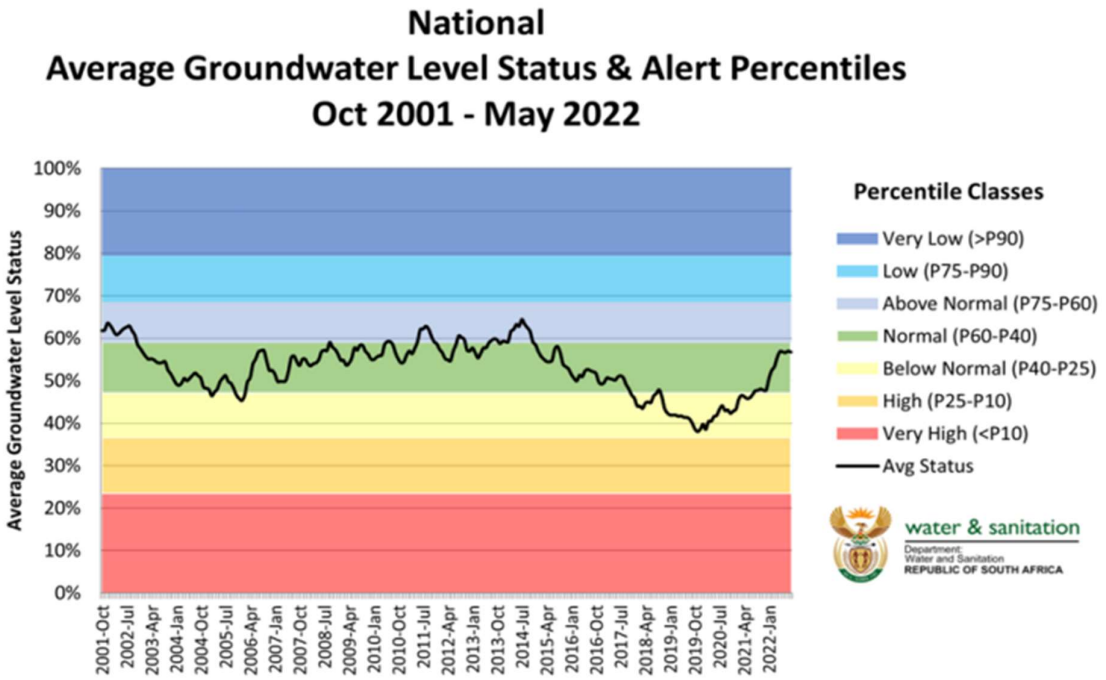
Table 4-8: Sustainability and adaptation dimension measurement parameters

Food Security Dimension	Parameters	Indicators	Quantitative data source
4. Sustainability & Adaptation	Exposure	Composite indicator	ND-GAIN/WRI
	4.1. Water	Composite indicator	World Resources Institute Aqueduct
	Land	Composite indicator	UN/FAO/World Bank
	4.2. Oceans, rivers, and lakes	Composite indicator	World Resources Institute/ Yale Environmental Performance Index
	4.3. Political commitment to adaptation	Composite indicator	OECD/UN/CCAFS
	Disaster risk management	Composite indicator	Qualitative scoring (EIU)/UN

Source: EIU (2022a)

Water is classified as 'very weak', as seen in Figure 4-12 above. The same trend is seen in the 11-year period since 2012, as water has shown a 0% change. The composite indicator comprises two sub-indicators, specifically agricultural water risk on the quantity available and the quality of the water available for agricultural use. Agricultural water risk – quantity quantifies the ratio of total annual water withdrawals to the available annual renewable supply. Conversely, agricultural water risk – quality measures the likelihood of water pollution (EIU, 2022a). As articulated in the "National State of Water Report" published by the Department of Water and Sanitation (DWS, 2022a), South Africa's water security confronts a difficult situation marked by a diminishing water supply. This decline is attributable to adverse effects on yields stemming from climate change, the deterioration of wetlands and water resources, siltation of dams, and a concurrent escalation in water losses and demand. Contributing factors to the escalating demand include population growth, economic expansion, urbanisation, inefficient water utilisation practices, and evolving lifestyles. Acquiring additional water resources to sustain the expanding economy is particularly important for South Africa as a developing nation (DWS, 2022a). The existing allocation of 98% of the country's available water resources leaves limited prospects for supplementing future water requirements (DWS, 2022a).

Water quantity in South Africa is anticipated to have a 17% deficit, by the year 2030, between the demand and supply of water according to the Sanitation Services report (DWS, 2022b). Figure 4–13 below shows the average groundwater level status and alert percentiles for South Africa. As seen in 4-13, the groundwater level stayed constant, until the five-year period between 2016 and 2021. As displayed in the figure, the groundwater levels drop to below normal levels, in the 25%–40% category. However, the groundwater levels have been rising since October 2019 and reached normal levels at the beginning of the year 2022. This can be ascribed to the above-normal rainfall, which has recharged aquifers (DWS, 2022b).



4-13: National average groundwater level status and alert percentiles
Source: DWS (2022c)

Climate emerges as a pivotal determinant influencing the hydrological response within a catchment. This encompasses various indicators, including but not limited to, rainfall, temperature, solar radiation, and evaporation. These indicators exhibit progressive and spatial variability, thereby exerting discernible effects on water availability and the supply of water for diverse applications such as drinking, rain-fed agriculture, groundwater, forestry and biodiversity (DWS, 2022d). The phenomenon of climate change further exacerbates the strain on South Africa's inherently stressed water resources (DWS, 2022d). When considering the production of maize and other crops in South Africa, it is seen that the average dryland production (tonnes) is about 80% of the total production, and that irrigation makes up 20% of the total maize production (tonnes). The total hectares under dryland cultivation, on the other hand, amount to approximately 90% and the total irrigated hectares planted form 10% of the hectares planted. In a relatively drier El Niño year, we might expect that maize and other crop production and our irrigation would have a greater impact on the country's production.

Figure 4-14 below depicts the water supply reliability for the nine provinces of South Africa. As shown below, Gauteng and the Western Cape are characterised by a 'favourable' status, signifying that they possess between 80% and 95% of the required water supply. The Northern Cape and Free State are rated as 'acceptable', indicating that the reliability of the water supply in these regions falls within the range of 65% to 80%. On the other hand, the North West, Kwa-Zulu Natal, and Mpumalanga are

designated as ‘areas of concern’, where the reliability of the water supply ranges from 50% to 65%. Limpopo and the Eastern Cape, however, are assigned a ‘crisis’ rating, denoting that less than 50% of the water supply in these areas is deemed reliable.

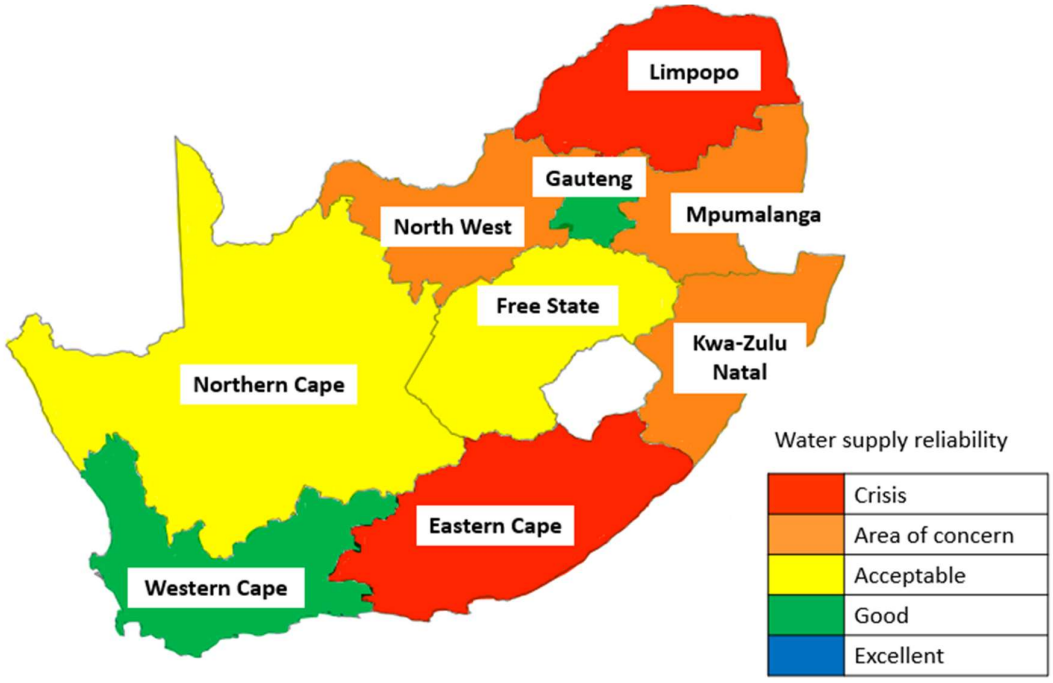


Figure 4-14: Water supply reliability as of November 2022
Source: Author’s own compilation, adapted from DWS (2022c)

Water quality, the second sub-indicator contributing to the score of water, depicts a deteriorating trend in South Africa by examining the latest Blue Drop Watch Report (DWS, 2023a). The report centres on the present state of drinking water infrastructure and treatment processes, examining them from a technical standpoint (DWS, 2023a). An analysis of drinking water quality reveals that 38% and 11% of systems attain excellent and good microbiological quality, respectively. Conversely, the remaining 51% exhibit poor to bad microbiological water quality status (DWS, 2023a). In terms of chemical compliance analyses, 16% and 14% meet the criteria for excellent and good water quality, respectively. However, most plants, constituting 71%, fall short of achieving chemical compliance (DWS, 2023a). Both **Figure 4-15** and **Figure 4-15** below portray high levels of poor and bad quality ratings for South Africa’s drinking water.

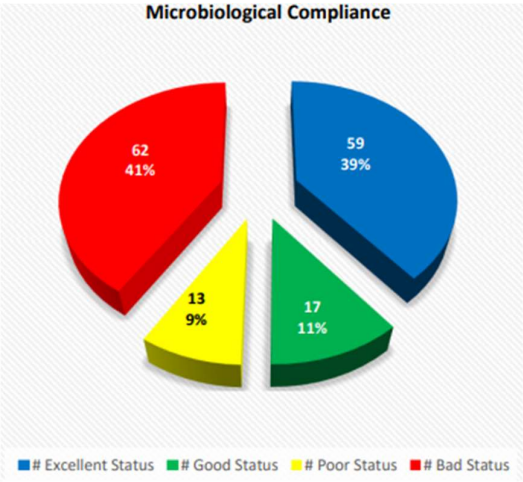


Figure 4-15: Microbiological compliance for South Africa in 2023
Source: (DWS, 2023b)

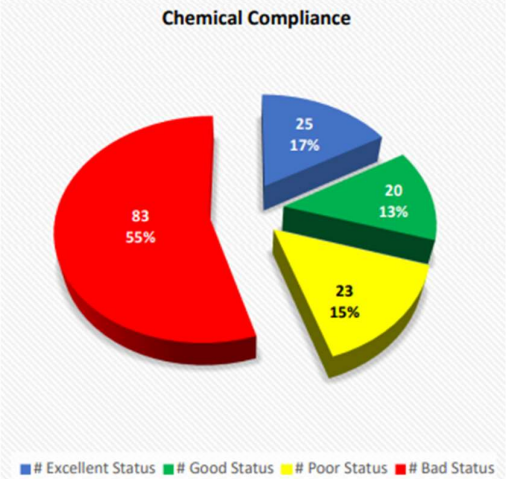


Figure 4-16: Chemical compliance for South Africa in 2023
Source: (DWS, 2023b)

The National Water Act (No. 36 of 1998) serves as the cornerstone legislation for implementing water quality management in South Africa (DWS, 2022e). Deteriorating water quality not only jeopardises ecosystem goods and services, including water quality enhancement, streamflow regulation and flood mitigation, but also impacts negatively on their economic value (DWS, 2022e). According to the report on the State of National Water Resource Infrastructure, 10% of South Africa's water infrastructure is rated to be in 'very good' condition, 30% is rated 'good', another 38% is rated as 'fair', and the remaining sections as in 'poor' and 'very poor' conditions (DWS, 2023b).

Oceans, rivers and lakes are classified as 'very weak' and also showed no change in score since 2021. This indicator showed a 2.96% increase since 2012. This indicator looks at both the eutrophication aspect and marine biodiversity (EIU, 2022b). South Africa established the National Eutrophication Monitoring Programme (NEMP) in 2002 (DWS, 2023b). The NEMP provides conceptual frameworks for addressing six specific objectives pertaining to impoundments (dams/lakes) and rivers. These objectives comprise the determination of the trophic status in dams/lakes; the establishment of an early warning system for water treatment; the implementation of an early warning system for blooms; the introduction of an early warning system for invasive macrophytes; the establishment of an early warning system for long-term impacts; and the management of nutrient balance (DWS, 2023b). According to the DWS (2023b), the NEMP sampled 119 out of the 289 registered sites during the 2021/2022 hydrological year, which constituted 52 sites more than the previous year. Over the last 40 years, eutrophication has emerged as a growing threat to the usability of South African freshwater resources. Despite regulations aimed at controlling phosphorus discharges from certain wastewater treatment facilities since the 1980s, freshwater eutrophication is currently prevalent. Two significant

outcomes are the obstruction of water-supply structures and a decline in the recreational value of aquatic resources (van Grinkel, 2011).

Marine biodiversity in South Africa is facing challenges in aligning to the UN Convention on Biological Diversity (CBD) 30x30 initiative (CBD, 2021). Peer, et al. (2022) state that an essential aspect of achieving this goal is the effective management of Marine Protected Areas (MPAs). Marine Protected Areas (MPAs) form part of a crucial instrument designed to conserve marine biodiversity and safeguard species by defining zones based on specific objectives (Day, et al., 2012). Various items of conservation legislation, such as the National Environmental Management Act ("NEMA", No. 107 of 1998), the Protected Areas Act ("NEM: PA", No. 57 of 2003), the World Heritage Convention Act ("WHCA", No. 49 of 1999), and the "Integrated Coastal Management Act ("NEM: ICMA", No. 24 of 2008), have been established.

Political commitment to adaptation has decreased by 3.4 points since 2021. The indicator showed a 66,01% increase since 2012. The sustainability and adaptation indicators consider several variables when determining the score and rank. The set of variables includes climate finance flows, implementation of environmental economic accounting, agriculture, the national agricultural adaptation policy, and sustainable agriculture (EIU, 2022a). Other measures used include the early-warning measures/climate-smart agriculture as described in the CGIAR research programme on climate change, and the commitment to managing exposure according to the same programme (EIU, 2022a).

According to the USAID (2023) report, the South African Cabinet has approved significant climate initiatives to address the nation's high greenhouse gas emissions, largely driven by coal-based electricity generation. The endorsed measures include the establishment of a Presidential Climate Commission, the formulation of a Low Emissions Development Strategy, a National Climate Change Adaptation Strategy, the implementation of a carbon tax, and the introduction of a Just Transition Framework. South Africa, among the top 15 global emitters, experienced a 14% increase in net emissions from 2000 to 2017, with the energy sector contributing about 80% to gross emissions, predominantly from energy industries (approximately 60%) and transport (around 12%). Climate change effects are evident in altered ecosystems, economies and livelihoods, with rising temperatures, increased extreme weather events, and impacts on water security leading to more frequent droughts and water shortages. South Africa's climate priorities involve adaptation and mitigation, emphasising initiatives to enhance institutional capacity, governance, legal frameworks, and funding for adaptation. The 2020 National Climate Change Adaptation Strategy focuses on building resilience, integrating adaptation into development objectives, and improving the understanding of climate impacts. For mitigation, South Africa has established fixed-level target ranges for 2025 and 2030, concentrating on critical sectors. The Just Energy Transition Partnership (JETP), formed at COP26, aims to support South

Africa's changeover from coal, setting a global precedent for just transition (PRSA, 2023). Furthermore, PRSA (2023), states that an equitable shift to a low-carbon economy in South Africa promises substantial benefits, including economic expansion, job creation and enhanced energy security, while addressing climate change threats. The Just Energy Transition Investment Plan (JET IP) for 2023–2027 outlines the necessary investments for achieving the decarbonisation goals outlined in the Nationally Determined Contribution (NDC). The NDC represents South Africa's dedication to reducing greenhouse gas emissions, in alignment with the objectives of the Paris Agreement.

4.7 Research Findings based on Interviews Conducted

This section discusses Table 4–9 below, which is organised according to the interview questions. The table corresponds to the indicators, which include themes and codes derived from the participants' responses, using Atlas Ti sample items, reflecting the original responses from the interviews, and which have been incorporated to support the codes. The various indicators are interconnected and pertain to the affordability (1), availability (2), quality and safety (3), and sustainability and adaptation dimensions(4).

Table 4-9: Interview responses according to themes

Theme	Codes	Sample item
Access	- Access to resources - Access to seeds - Reliable sources - Import dependency	"… so, they don't use new technology, new GMs, new chemistry, those types of things. So, the availability for those guys, and the access, to new inputs, then we have to coordinate that stuff from there, to get back to them, and if you just look at that process, and look at that logistics, it's one enormous logistics". "Living in remote rural areas where inputs are not readily available. There are no local Agribusinesses or input agents". "Another thing that will help keep the farmer on the farm in terms of plant health is export market now opening the other many other I mean soybean as grown soybean production has grown exponentially now over the last few years".
Affordability	- Availability - Cost of production - Price - Value chains - Investments	"Your analysis' hypothesis should be that if a free market is working properly, your consumer should win, it should be his cheapest source of food". "The access is not about being available, it is about the signalling of communal farming and the cost of production". "One of the biggest factors that negatively affects our score is the affordability of all agricultural elements which spill over into the affordability of food". "I see the concern more in terms of affordability. And the affordability is linked to many factors. And these are factors such as international

Theme	Codes	Sample item
		markets, the impact of international markets, these are factors such as the variability in production …".
Agriculture and Environmental agriculture	- Climate & resilience - Diseases - Technology & innovation - Water - Crop production cultivation, production, and protection	"a large amount of money is invested in temporary seasonal systems that artificially take water from the fields. The consequence of the systems is that our lands will not produce any harvest in the next drought season". "One of their biggest problems is that they struggle to keep the irrigation water clean. They are now taking the water issue to the Supreme Court because the water is being polluted. The water is polluted by sewage".
Barriers	- Access barriers - Geographic limitations - Government inefficiency - Lack of collaboration - Lack of know-how and support - Traditional barriers	"… the environment to municipalities, and even catchment management agencies. But the problem is that all these people, they work in silos, and you find that you're actually repeating a lot of work". "Things like compensation for land compensation for water getting subsidies. People actually need to own the projects themselves. I remember there was a project I worked on whereby the people would just not irrigate".
Business complexity	- Analysis - Coordination - Import regulation - Regulation - Resistance to change - Risk - Variability - Volatility - Weather conditions	"The farmers have water rights, but they do not have approved water licences. Most of the time the farmers do not have the rights in place to cultivate the fields or they are vegetable farmers who turn their fields into fruit orchards without the necessary approval. There is a big problem with law obedience and law enforcement". "… our weather components play a huge role like that. I mentioned that this Central West Free State always has a stable, erm, production. But we had weather conditions a few years back, which meant that the guys couldn't even plant. So, then you can have moisture in the soil, and you can have what you want, but if you can't plant, nothing helps you".
Capacity building & career development	- Collaboration - Funding - Information dissemination - Awareness	"In future, we are going to be looking at farmers now having the same amount of land but needing to produce more. So, this is a gap for many private companies where they need to find lines, they are not able to do that".
Economy and economics	- Bureaucracy - Economic development - Economic factors - Efficiency - Public-private partnerships	"Government initiatives mean well but are unfortunately, in most cases, ineffective due to bureaucracy and red tape". "Efforts have been made to involve commodity organisation in some initiatives, but the bureaucracy was still overwhelming and rendered the initiative ineffective".
Farmer Development	- Agricultural policy - Smallholder and subsistence farmers - Youth empowerment - Collaboration	"The gap lies in meaningful partnerships and holistic coordination of efforts. Efforts should be commodity based or at least informed by commodity organisations". "Okay, the top-down information is saved that we the researchers have workshop and can aid in we have all discussions and then we

Theme	Codes	Sample item
	- Self-sufficiency	come to the people and then we feed them all this information, but they don't understand". "We need to train farmers on crop production. That is actually led to climate smart agriculture".
Food quality and yield	- Yield optimisation - Food preparation - Quality control	"In terms of water quality, you put water that flows in from your big cities into the drain lines, it then feeds into your big rivers. The water comes from Gauteng and then goes to other areas, such as Brits where they use the water for irrigation, and it affects the vegetables and fruits to such a great extent that some of the supermarkets refuse to put the vegetables and fruits on their shelves". "… that we can get wheat cultivars that are higher yielding, that we can produce more of, more wheat in South Africa and become really self-sufficient".
Gender Issues	- Cultural practices - Gender disparity - Gender equality - Gender roles - Occupational segregation - Stereotypes	"In some areas there are still traditional barriers which does not allow a woman to own, lease or receive land from a chief. Their husbands generally receive land, but in many cases, it is the woman who works and manages the production with little assistance from their husbands. The support received is therefore minimal". "There is a very strong focus in all spheres of Government and private sector to promote black woman in Agriculture. Woman with potential is sought out and given opportunities that were not there before. Black women are prioritised when opportunities for funding, bursaries and other opportunities arise".
Geography	- Catchment areas - Geographical analysis - Soil classification - Natural resources	"If the state and or the private sector are not going to invest in agricultural training and research, then what will our future farmer rely on. This will lead to unsustainable development of certain catchment areas and water sources which will lead to a food security problem". "I have now looked at the aqueducts map and you can clearly see the line where the escarpments are. One will have to compare the map with a rainfall map as well as an altitude map to get a holistic picture. Region based data is also very important to consider".
Government and government expenditure	- Government support - Organisation - Policy formation - Government driven research - Public-private partnerships - Food security agency	"A challenge that is often experienced is that role-players mostly have a similar goal, but do not work together. There is plenty of funding available, but all tend to focus on their own outcomes and do not necessarily realise the magnitude of potential, should they work together". "A Ministerial directive to place trust in commodity organisations (that have a track record and the correct structures in place) to champion the implementation of development initiatives".
Market Analysis	- Free market - Competition - Dynamic market - Market distortions	"The consumer can either buy products locally or import the products for the best price. This is the advantage of a free market system. This protects the consumer in a free market system".

Theme	Codes	Sample item
	- Rural area hubs - Supply and demand	"The market is in place. As good as healthy competition in the market, this should result in the consumer being able to pay the best possible price for the products". "Because it is, it seems to me that supply and demand and the free market facilitate what is happening with food security".
Obstacles and challenges	- Logistics - Supply chain management - Illegal activities - Policy failure - Infrastructure failure - Lack of compliance - Unemployment - Youth unemployment	"You then get increased and rapid runoff that causes infrastructure damage such as dams, rivers and roads that wash away …". "A challenge that is often experienced is that role-players mostly have a similar goal, but do not work together. There is plenty of funding available, but all tend to focus on their own outcomes and do not necessarily realise the magnitude of potential, should they work together".
Research	- Lack of funding - Coordination - Private – public partnerships - Technology transfer	"Because private companies generally on their own are doing their own research, which is highly classified and but even within the research space of their own private research, I might be doing my own research, you might be doing your research, but there's that area of commonality that you might have as private company". "So, from our side it is really, we can see that there is enormous pressure on the funding sources". "And the universities will often decide, his is their niche field, because they do the research that is interesting to them, that gets published, and necessarily that always addresses the problems of the government".
Resource availability	- Inefficiency - Innovation - Dual nature - Geographical differences - Complexity - Uncertainty	"… climate change where we get more erratic rains, we lose waterpower in the area. Even the farmer who irrigates and those who make dry land are dependent on the catchment area on how the water moves through the landscape or sits in his fields or moves down to a stream. As a result of catchment areas being damaged by expansion, the catchment areas lose resilience".
Sustainability	- Climate smart technology - Government policies - Food security - Environmental standards - Water conservation and rights - International pressure	"The Minister of Water has publicly acknowledged that we are in a water crisis. It is good that the recognition was because, it means that the problem can be addressed. By addressing the water crisis, it contributes positively to the quality of water and not necessarily the quantity of water available to Agriculture". "Water quality has a great positive impact on our Agriculture sector and leads to better yields which has an impact on our country's food security. The farmers therefore also have a responsibility to act within the given legislation and sustainably take care of the natural resources they have at their disposal".

4.8 Insights and discoveries from quantitative and qualitative research

South Africa has multiple factors impacting its affordability dimension within the food security environment framework. Quantitative data signals a concerning trend, with a notable 11.2% decline in overall affordability scores from 2012 to 2022, reflecting volatility in the country's performance. The recent 3.3% decrease from 2021 to 2022 underscores immediate challenges, particularly evident in indicators such as the "inequality-adjusted income index" and the "Change in average food costs." These weaknesses contribute to South Africa's struggle with food inflation, compounded by high unemployment rates. Qualitative insights emphasise the importance of government support for smallholder farmers, agricultural policies, and gender equality initiatives in enhancing food quality and increasing yield. Moreover, market dynamics, including competition and rural hubs, play a significant role in shaping food security and pricing. Addressing these challenges requires concerted efforts to not only address income inequality and unemployment but also to create an enabling environment for smallholder farmers and promote inclusive agricultural policies that will enhance affordability.

The quantitative analysis highlights a concerning trend in the availability dimension, with a 3.9% decrease year-on-year, driven by indicators such as 'Sufficiency of supply', 'Volatility of agricultural production', and 'Food security and access policy commitments'. Despite challenges, the dimension maintains a joint 52nd position globally, indicating a level of resilience. However, 'Sufficiency of supply' has notably declined, marked as 'very weak', particularly concerning given its 48.1-point decrease. Qualitative research supports these findings, revealing challenges in accessing resources and affordability issues, exacerbated by logistic hurdles, supply chain complexities, and policy inefficiencies. Moreover, gender disparities persist in land ownership and agricultural opportunities, reflecting broader societal challenges. Addressing these multifaceted issues requires government support for policy formulation, public-private partnerships, and addressing market dynamics to enhance food security and accessibility amidst ongoing challenges in the agricultural sector.

South Africa's quality and safety dimension in the food security environment analysis reveals a positive trajectory with a 5.9% increase from 2012 to 2022, recent data indicates a concerning 9.5% decrease year-on-year, particularly evident in indicators such as dietary diversity and nutritional standards. The slight decline in dietary diversity, coupled with outdated nutritional standards, underscores challenges in ensuring a balanced and nutrient-rich diet for the population. Qualitative responses shed light on the underlying factors contributing to these trends, highlighting the correlation between high energy, low protein diets and income levels. While policies targeting the limitation of sugar-dense foods exist, there is a call for greater emphasis on promoting nutrient-dense alternatives such as millets like sorghum, which offer higher protein content. Bridging the gap between quantitative trends and qualitative insights

necessitates comprehensive policy interventions that address both affordability and accessibility of nutrient-rich foods, ultimately improving the overall quality and safety of the food supply.

South Africa's weakest dimension in the food security framework, Sustainability and Adaptation, faces multifaceted challenges according to both quantitative and qualitative insights. Despite ranking joint 44th globally and fourth in its region, indicators such as "water," "Oceans, rivers, and lakes," and "Political commitment to adaptation" exhibit weak or very weak performance. The water scarcity issue, projected to reach a 17% deficit in supply versus demand by 2030, underscores the urgency of addressing sustainability concerns. Efforts to regulate phosphorus discharges have been insufficient, leading to persistent freshwater eutrophication, as highlighted in research. Moreover, political commitment to adaptation has declined despite previous gains, necessitating a response to climate change. Interviews reveal that lack of funding and coordination hampers research efforts, hindering innovation and resource efficiency. Geographical disparities and climate change further add to challenges, emphasising the importance of climate-smart technology, government policies, and international pressure to drive sustainability initiatives. Water conservation and environmental standards are identified as critical for ensuring long-term food security, highlighting the interconnectedness of environmental and agricultural sustainability efforts amidst complex geographic and climatic factors.

4.9 Proposed Actionable Steps

4.9.1 Introduction

In this section, a comprehensive exploration of prioritised measures aimed at addressing key indicators influencing South Africa's food security environment is given. For compilation of the actionable steps, both primary and secondary data collected in Chapter 4 was considered. The proposed actions are systematically ranked, based on their respective weights, categorised into high, medium, and low priorities according to the significance of the indicators they address. This strategic classification provides an understanding of the relative importance of each actionable step in contributing to the overall advancement of the food security environment. Furthermore, the chapter introduces implementing agents for each actionable step. This structured approach not only guides the allocation of resources, but also facilitates a targeted and efficient execution of the identified measures, thereby contributing to the advancement of sustainable food security practices in South Africa. The action steps in the table below are intended to guide implementing agents in a direction towards comprehensive food security in the country. It is recommended that each implementing agency develop a strategic plan that outlines specific deliverables aimed at achieving food security.

Table 4-10: Proposed actions for addressing the identified indicators

Actionable steps	Specific dimension/s	Suggested implementing agent	Action priority according to weight
Access: - Establish local agribusinesses or input agents in remote rural areas. - Develop a coordinated logistics system to improve the availability and access to new agricultural inputs. - Encourage the establishment of communal farming signals to reduce the cost of production.	Availability and, affordability	DALLRD, provincial government, and agricultural co-operatives	Medium
Affordability: - Protect the free-market system to ensure consumer benefits and competition. - Address factors affecting affordability, such as international market impacts. - Investigate mechanisms to enhance the affordability of agricultural elements, through for example local production of agricultural inputs.	Affordability	Farmer representative organisations, agricultural input companies, and DALLRD	Low
Agriculture and Environmental agriculture: - Invest in sustainable and climate-smart technologies. - Address water pollution issues through legal interventions. - Promote environmentally friendly and sustainable agriculture practices.	Sustainability and adaptation.	ARC, DWS, and farmer representative organisations	Low
Barriers: - Facilitate collaboration between municipalities, catchment management agencies, and other stakeholders.	Availability, and	DALLRD, DWS, farmer representative organisations,	Medium

Actionable steps	Specific dimension/s	Suggested implementing agent	Action priority according to weight
- Provide incentives for efficient land and water use to encourage compliance. - Strengthen inter-agency coordination to avoid duplication of efforts.	sustainability and adaptation.	such as Agri SA, etc.	
Business complexity: - Streamline import regulations and facilitate coordination among various regulatory bodies. - Provide support for risk management and variability in weather conditions. - Encourage innovation through private-public partnerships.	Availability, and sustainability and adaptation	The DTIC, SAWS, and DALLRD	Medium
Capacity building & career development: - Allocate funding for training and research in climate-smart agriculture. - Increase awareness about career opportunities and advancements in agriculture.	Availability, and sustainability and adaptation	DALLRD, ARC, DBE, and South Africa's primary and tertiary educational institutions	Medium
Economy and economics: - Streamline government initiatives to reduce bureaucracy. - Foster effective public-private partnerships through streamlined initiatives. - Explore new economic models for agricultural development.	Affordability	Farmer representative organisations, DALLRD, National Treasury and other relevant private sector stakeholders	Low
Farmer Development: - Establish meaningful partnerships for holistic coordination. - Provide practical training for farmers in crop production and climate-smart agriculture. - Enhance support for smallholder and subsistence farmers through targeted policies.	Availability, and sustainability and adaptation,	Farmer representative organisations, ARC, and DALLRD	Medium
Food quality and yield: - Implement measures for water quality control in agricultural practices. - Invest in research for higher-yielding cultivars. - Collaborate with stakeholders to ensure food safety and quality standards.	Availability, and quality and safety	DOH, DAFF, ARC, DWS, and DALLRD	Medium
Gender Issues: - Address traditional barriers restricting women's access to land. - Promote gender equality through targeted policies. - Encourage support for black women in agriculture through targeted initiatives.	Availability, and affordability,	DALLRD, farmer representative organisations and the applicable private sector investors	Medium
Geography: - Invest in agricultural training and research for sustainable development. - Conduct holistic geographical analyses considering rainfall, altitude, and region-based data. - Encourage state and private sector investments in agricultural infrastructure.	Quality and safety, and sustainability and adaptation,	DAFF, ARC, SAWS, DWS, DALLRD, and farmer representative organisations	Medium

Actionable steps	Specific dimension/s	Suggested implementing agent	Action priority according to weight
Government and government expenditure: - Foster collaboration among role-players through effective communication channels. - Establish a food security agency for streamlined coordination. - Provide support to commodity organisations with proven track records.	Availability, and affordability	Farmer representative organisations, DALLRD, National Treasury and relevant private sector and industry role-players	Medium
Market Analysis: - Encourage healthy competition through market analysis. - Address market distortions through regulatory measures. - Establish rural area hubs for improved supply chain management.	Availability, and Affordability	DALLRD, provincial government, farmer representative organisations, and agricultural co-operatives	Medium
Obstacles and challenges: - Improve logistics and supply chain management systems. - Strengthen law enforcement to combat illegal activities. - Address policy and infrastructure failures through targeted interventions.	Availability, affordability, quality and safety, and sustainability and adaptation	DALLRD, National Treasury, Presidential Infrastructure Coordinating Committee (PICC), private sector investors, DWS and farmer representative organisations	High
Research: - Increase funding sources for agricultural research. - Enhance collaboration between private companies and research institutions. - Encourage technology transfer through public-private partnerships.	Availability	ARC, farmer representative organisations, private organisations and DALLRD	Low
Resource availability: - Invest in climate-smart technologies for efficient resource utilisation. - Promote innovation through research and development. - Address dual-nature challenges through targeted policies.	Availability, affordability, and sustainability and adaptation,	ARC, DALLRD, farmer representative organisations, private organisations, and DWS	High
Sustainability: - Advocate for the adoption of climate-smart technologies. - Develop and enforce environmental standards for sustainable agriculture. - Collaborate with international stakeholders to address global sustainability challenges.	Quality and safety, and sustainability and adaptation	DALLRD, farmer representative organisations, private organisations, and DWS and ARC	Medium

CHAPTER 5: CONCLUSION, SUMMARY AND RECOMMENDATIONS

5.1 Introduction

This concluding chapter describes a comprehensive exploration into South Africa's food security environment, as assessed through the GFSI score and rank. This chapter is structured to provide a summary of the research objectives and gives an overview of the key findings derived from the study. Furthermore, it delves into the critical domain of policy implications, based on the outcomes. The chapter revisits the primary research objectives, emphasising the original intent to investigate the weakest indicators within South Africa's food security context. The study navigates through the intricacies of identifying, prioritising, and validating actions relevant to addressing these vulnerabilities, engaging with diverse stakeholders to ensure a holistic and informed approach. Moreover, the chapter presents a set of recommendations derived from the study's insights. These recommendations are designed to offer guidance to policymakers, stakeholders, and practitioners involved in the domain of food security. The intention is to bridge the gap between theoretical exploration and actionable strategies, fostering a more resilient and sustainable food security framework in South Africa. The synthesis of key findings, policy insights, recommendations, and avenues for future research collectively positions this concluding chapter as an integral contribution to the multifaceted dynamics of South Africa's food security environment.

5.2 Recap of Research Objectives, Methodology and Summary of Key Results

The primary objective of this study was to conduct a comprehensive analysis of South Africa's food security environment, leveraging the 2022 GFSI score and rank. The primary focus was placed on identifying areas for improvement and strategically prioritising actions that various stakeholders could undertake to address the performance across the distinct dimensions delineated by the GFSI. The sub-objectives of the study included assessing South Africa's trajectory in terms of GFSI rank and score over the period spanning from 2012 to 2022. Furthermore, the objectives including critically evaluating South Africa's performance in each of the four discrete dimensions outlined by the GFSI. Lastly, the objectives included determining actionable steps to take regarding potential interventions and strategies. The overall goal is to foster a more food-secure environment in South Africa by addressing specific challenges highlighted by the GFSI. The methodology employed in the study to achieve its objectives proved effective because it combined both quantitative and qualitative methods. By integrating literature review, statistical analysis, and interviews, the study provided comprehensive insight into the current state of food security in South Africa. The diverse array of sources offered various perspectives and insights, enhancing the study's ability to deliver accurate findings and practical action steps.

The key findings of the study include the fact that South Africa's food security trend exhibited an initial increase from 2012 to 2016, followed by a moderate decline. Although proximity to the world average is noted, the 2022 score indicates a trend below the global average. In comparison with the top-performing country, South Africa's food security is 26% weaker, suggesting proximity to higher-performing nations. The trend analysis spanning 2012 to 2022 reveals volatility, with a 16% improvement until 2019, and an 8% decline in the subsequent three years, resulting in only an 8% net improvement since 2012. Furthermore, the findings include the fact that 13 out of 68 indicators are mainly responsible for the deterioration of South Africa's 2022 score and rank. It was found that South Africa has good policies and strategies in place, but failure comes about in the implementation thereof.

Moreover, this study found, based on interviews conducted with experts on the various indicators, that several gaps exist in resource allocation, communication and knowledge transfer, management of natural resources, among others. The study also suggests that actionable steps to take are in reach and would improve South Africa's 2022 food security score and rank. Furthermore, the successful execution of the proposed actionable steps requires a collaborative framework, engaging government agencies, private-sector entities, farmer representative organisations, and local communities. It is recommended that a dedicated food security task force or coordinating body should be established to efficiently oversee the implementation process, ensuring sustained collaboration among diverse stakeholders. A systematic approach, involving regular assessments and reassessments of the implemented measures, is crucial, allowing for data-driven adjustments and continuous improvements to be made. Furthermore, fostering a culture of knowledge-sharing and best practices among stakeholders is imperative for enhancing collective learning and contributing to the continuous improvement of South Africa's food security environment. In essence, if the study's recommendations are put into action, its findings have the potential to significantly enhance South Africa's food security environment.

5.3 Conclusions of the Study

The GFSI should be understood as an evaluation tool for assessing the food security environment. According to Thomas, et al. (2017), the GFSI places emphasis on food security environment factors, rather than on the actual results. It covers conventional determinants of food security, including factors such as food adequacy and supply, the proportion of total "expenditure" dedicated to food, and policies related to poverty and nutrition. Furthermore, it extends its scope to include less immediate determinants, such as access to financial services, corruption, and political stability. The latest data available from the GFSI gives a clear indication that more will need to be done to improve South Africa's food security environment. This study suggests actionable steps that should be implemented and monitored by a food security agency in South Africa. The establishment of an agency to monitor and regulate South Africa's food security environment is justified by the fact that food security

indicators included in the four dimensions of the GFSI are interlinked, as are the responsible parties. Therefore, if the actionable steps outlined by Section 4.8 were to be implemented, South Africa would be set to see an increase not only in its global score and rank, but also in the state of its food security environment.

5.4 Policy Implications based on the Findings

This study recommends a comprehensive set of policies that would enhance food security across the four dimensions. The key policies include supporting local agribusinesses and coordinated logistics for access; competition regulation for affordability; and environmental regulations for sustainable practices. Overcoming barriers involves the establishment of collaboration frameworks, incentive-based land-use policies, and inter-agency coordination. Business complexity could be addressed with trade and regulatory policies, financial support, and innovation frameworks. Policies for capacity building, public–private partnerships, and economic models are essential. Farmer development requires collaboration facilitation, training, and support for smallholders. Policies for food quality involve environmental and regulatory measures. Gender-specific policies address access barriers and promote equality. Geographic policies include providing for education, data collection, and infrastructure investments. The establishment of effective governance, a food security agency, and support for commodities are vital for government expenditure. Market analysis requires competition policies and support for rural areas to be put in place. Overcoming obstacles needs trade, law enforcement, and targeted interventions to be provided for. Research policies should allocate funding, encourage collaboration, and facilitate technology transfer. Resource availability requires policies for climate-smart technologies and sustainability. Global collaboration demands policies for foreign affairs and international cooperation. In summary, this study suggests a range of actionable steps for implementation that would require an integrated policy approach, involving various sectors and levels of government, to address the complex and interconnected issues related to South Africa's food security environment.

5.5 Recommendations for Improvement of the Study

The first limitation of this study lies in its exclusive focus on the national level for the analysis of food security, despite the inherent variations in food security dynamics from the national to the household levels. A further constraint is seen in relation to the GFSI indicator utilised in this research. The GFSI predominantly evaluates the broader, national-level food security environment, emphasising determinants rather than directly quantifying outcomes (EIU, 2022; Thomas, et al., 2017). Consequently, it is prudent to recognise the necessity for supplementing the GFSI with additional indicators that specifically capture the tangible outcomes of food security. It, therefore, serves as a

supplement to other food security measures, but does not serve as a replacement. By integrating these supplementary indicators, a more comprehensive evaluation of the actual food security and nutritional environment could be achieved, especially in regions facing food insecurity. This acknowledgement underscores the importance of considering multiple dimensions and indicators to enrich the understanding of food security beyond the GFSI's determinants-focused approach.

5.6 Recommendations for Future Research

In concluding this study, this section extends its view to future research undertakings. By highlighting potential areas for further investigation, it lays the groundwork for on-going scholarly exploration and refinement of strategies for enhancing South Africa's food security environment. The first recommendation is to narrow down future research efforts to a specific indicator that is identified by the study as either 'weak', 'very weak', or 'moderate and decreasing'. Furthermore, it is suggested that forthcoming research should conduct a thorough examination of the chosen indicator. This entails investigating the factors contributing to the 'very weak' rating, identifying the parties responsible for the indicator, determining who should be involved in its improvement, and pinpointing the starting point for implementing improvements. Furthermore, the execution of the proposed actionable measures requires the adoption of a collaborative model, involving government agencies, private-sector entities, farmer representative organisations, and local communities. It is recommended that a dedicated food security task force or coordinating body should be instituted to supervise the implementation process, ensuring sustained collaboration among diverse stakeholders. A systematic approach, incorporating regular assessments and reassessments of the efficacy of implemented measures, is imperative for facilitating adjustments and continual enhancements to South Africa's food security environment. Moreover, the cultivation of a culture conducive to knowledge sharing and the dissemination of best practices among stakeholders is fundamental for fostering collective learning and promoting a state of continuous improvement within South Africa's food security environment. It is, furthermore, suggested that the action steps proposed by the research be further investigated and championed by the applicable implanting agents. Lastly, as the GFSI is an annual publication, it is suggested that continuous monitoring of the score and rank of South Africa should be conducted to track progress and identify further areas for improvement in South Africa's food security environment and overall food security.

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Annexures

Annexure A: the GFSI dimensions and indicators' measurements

Series	Unit	Source
1) AFFORDABILITY	**Score 0-100**	**EIU calculation**
1.1) Change in average food costs	Annual change in Consumer Prices, Food Indices (2015 = 100)	FAO
1.2) Proportion of population under global poverty line	% of population living under $3.20/day 2011 PPP	World Bank, World Development Indicators
1.3) Inequality-adjusted income index	Index 0-1; 1=highest inequality adjusted income	United Nations Development Programme (UNDP)
1.4) Agricultural import tariffs	%	World Trade Organization (WTO)
ADDITION 2022 A) Trade Freedom		
1.5) Food safety net programmes	Score 0-100	EIU calculation
1.5.1) Presence of food safety net programmes	Qualitative rating 0-1	Qualitative scoring by EIU analysts
1.5.2) Funding for food safety net programmes	Qualitative rating 0-1	Qualitative scoring by EIU analysts
1.5.3) Coverage of food safety net programmes	Qualitative rating 0-1	Qualitative scoring by EIU analysts
1.5.4) Operation of food safety net program	Qualitative rating 0-1	Qualitative scoring by EIU analysts
1.6) Market access and agricultural financial services – Removed from 2022	Score 0-100	EIU calculation
1.6.1) Access to finance and financial products for farmers	Qualitative rating 0-2	Qualitative scoring by EIU analysts; FAO
1.6.2) Access to diversified financial products	Qualitative rating 0-2	Qualitative scoring by EIU analysts
1.6.3) Access to market data and mobile banking	Mobile subscribers per 100 inhabitants	ITU
2) AVAILABILITY	**Score 0-100**	**EIU calculation**
2.1) Sufficiency of supply	Score 0-100	EIU calculation
2.1.1) Food supply adequacy	Dietary Energy Supply (DES) as a percentage of the Average Dietary Energy Requirement (ADER)	FAO
2.1.2) Dependency on chronic food aid	US$ / capita / year emergency food aid received (5-year average)	OECD
2.2) Agricultural research and development	Score 0-100	EIU calculation

2.2.1) Public expenditure on agricultural research and development	Ratio: Agriculture share of government expenditure (%) / Agriculture value added share of GDP (%)	United Nations
2.2.2) Access to agricultural technology, education and resources	Annual growth in agricultural output (%) minus annual growth in agricultural inputs (%)	USDA
2.3) Agricultural infrastructure	Score 0-100	EIU calculation
2.3.1) Crop storage facilities	Qualitative rating 0-1	Qualitative scoring by EIU analysts
2.3.2) Road infrastructure	Qualitative rating 0-4	EIU Risk Briefing
2.3.3) Air, port and rail infrastructure	Qualitative rating 0-4	EIU Risk Briefing
2.3.4) Irrigation infrastructure	Land area equipped for irrigation, %	FAO
2.4) Volatility of agricultural production	Standard deviation of production growth rates	FAO
2.5) Political and social barriers to access	Score 0-100	EIU calculation
2.5.1) Armed conflict	Risk rating 0-4; 4=highest risk	EIU Risk Briefing
2.5.2) Political stability risk	Risk rating 0-100; 100=highest risk	EIU Risk Briefing
2.5.3) Corruption	Risk rating 0-4; 4=highest risk	EIU Risk Briefing
2.5.4) Gender inequality	Index score 0-1, where 0=most equal	UNDP
2.6) Food loss	Total waste as a percentage of total domestic supply	FAO
2.7) Food security and access policy commitments	Score 0-100	EIU calculation
2.7.1) Food security strategy	Qualitative rating 0-1	Qualitative scoring by EIU analysts
2.7.2) Food security agency	Qualitative rating 0-1	Qualitative scoring by EIU analysts
3) QUALITY AND SAFETY	**Score 0-100**	**EIU calculation**
3.1) Dietary diversity	% non-starchy foods in dietary consumption	FAO
3.2) Nutritional standards	Score 0-100	EIU calculation
3.2.1) National dietary guidelines	Qualitative rating 0-1	EIU scoring
3.2.2) National nutrition plan or strategy	Qualitative rating 0-1	Qualitative scoring by EIU analysts based on WHO, FAO and national health ministry documents

3.2.3) Nutrition labeling	Qualitative rating 0-1	Qualitative scoring by EIU analysts based on WHO, FAO and national health ministry documents
3.2.4) Nutrition monitoring and surveillance	Qualitative rating 0-1	Qualitative scoring by EIU analysts based on WHO, FAO and national health ministry documents
3.3) Micronutrient availability	Score 0-100	EIU calculation
3.3.1) Dietary availability of vitamin A	Qualitative rating 0-2	Global Nutrient Database
3.3.2) Dietary availability of iron	mg/person/day	Global Nutrient Database
3.3.3) Dietary availability of zinc	mg/person/day	Global Nutrient Database
3.4) Protein quality	grams of high-quality protein in diet	EIU calculation based on data from FAO, WHO and US Department of Agriculture (USDA) Nutrient Database
3.5) Food safety	Score 0-100	EIU calculation
3.5.1) Food safety mechanisms	Score 0-100, 100 = best	World Health Organization, Country-reported data
3.5.2) Access to drinking water	% of population with access to safely managed basic drinking water services	World Bank
3.5.3) Ability to store food safely	% of population with access to electricity in all areas	United Nations
4) NATURAL RESOURCES & RESILIENCE	**Score 0-100**	**EIU calculation**
4.1) Exposure	Score 0-100	EIU calculation
4.1.1) Temperature rise	Index score, 0=least vulnerable	Notre Dame Global Adaptation Initiative (ND-GAIN)
4.1.2) Drought	Risk rating 0-4, where 4=highest risk	World Resources Institute (WRI) Aqueduct
4.1.3) Flooding	% change in flood hazard	Notre Dame Global Adaptation Initiative (ND-GAIN)
4.1.4) Storm severity (annual average loss)	% of multi-hazard loss	Global Assessment Report on Disaster Risk Reduction
4.1.5) Sea level rise	Index score 0-1, where 0=least vulnerable	Notre Dame Global Adaptation Initiative (ND-GAIN)
4.2) Water	Score 0-100	EIU calculation
4.2.1) Agricultural water risk – quantity	Risk rating 0-4, where 4=highest risk	WRI Aqueduct
4.2.2) Agricultural water risk – quality	Risk rating 1-5, where 5=highest risk	WRI Aqueduct
4.3) Land	Score 0-100	EIU calculation

4.3.1) Land degradation	Proportion of land that is degraded over total land area (%)	United Nations
4.3.2) Grassland	Net emissions/removals (CO2), gigagrams	FAO
4.3.3) Forest change	Change in forest area as % of total land area	World Bank
4.4) Oceans, rivers and lakes	Score 0-100	EIU calculation
4.4.1) Eutrophication	Qualitative rating 0-2	WRI
4.4.2) Marine biodiversity	Index score 0-100, 100=most sustainable	Yale Environmental Performance Index
4.5) Sensitivity	Score 0-100	EIU calculation
4.5.1) Food import dependency	%, cereal imports as a share of total cereal production	FAO
4.5.2) Dependence on natural capital	Total natural resources rents as % of GDP	World Bank
4.6) Political commitment to adaptation	Score 0-100	EIU calculation
4.6.1) Early-warning measures / climate-smart Agriculture	Qualitative rating 0-2	CCAFS
4.6.2) Commitment to managing exposure	Qualitative rating 0-13, where 0 = No commitments to 13 = Full commitment	CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)
4.6.3) National agricultural adaptation policy	Qualitative rating 0-2	Qualitative scoring by EIU analysts based on WHO, FAO and national health ministry documents
4.6.4) Disaster risk management	% local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies	United Nations
4.7) Demographic stress	Score 0-100	EIU calculation
4.7.1) Projected population growth	% growth in population (5-year forecasted)	United Nations
4.7.2) Urban absorption capacity	%, forecasted 5-year growth in GDP per capita minus 5-year forecasted urban population growth	United Nations; EIU

(Source: Economist Intelligence Unit, 2022)

Annexure B: GFSI dimensions and indicators weights

Category weights

Category weights determine the relative contribution of each category to the overall score

	Weight, %
1) AFFORDABILITY	30,00%
2) AVAILABILITY	25,00%
3) QUALITY AND SAFETY	22,50%
4) SUSTAINABILITY AND ADAPTATION	22,50%

Indicator and sub-indicator weights

Indicator weights determine the relative contribution of each indicator its parent category. Sub-indicator weights determine the relative contribution of each sub-indicator to its parent indicator.

	Weight, %
1) AFFORDABILITY	
1.1) Change in average food costs	23,85%
1.2) Proportion of population under global poverty line	19,23%
1.3) Inequality-adjusted income index	16,92%
1.4) Agricultural trade	19,23%
1.4.1) Agricultural import tariffs	45,71%
1.4.2) Trade freedom	54,29%
1.5) Food safety net programmes	20,77%
1.5.1) Presence of food safety net programmes	26,83%
1.5.2) Funding for food safety net programmes	26,83%
1.5.3) Coverage of food safety net programmes	25,61%
1.5.4) Operation of food safety net program	20,73%
2) AVAILABILITY	
2.1) Access to agricultural inputs	11,71%
2.1.1) Access to finance and financial products for farmers	17,11%
2.1.2) Access to diversified financial products	16,45%
2.1.3) Agriculture producer prices	16,45%
2.1.4) Access to extension services	17,76%
2.1.5) Community organisations	15,79%
2.1.6) Empowering women farmers	16,45%
2.2) Agricultural research and development	11,71%

2.2.1) Public expenditure on agricultural research and development	29,49%
2.2.2) Access to agricultural technology, education and resources	37,18%
2.2.3) Commitment to innovative technologies	33,33%
2.3) Farm infrastructure	9,01%
2.3.1) Crop storage facilities	32,93%
2.3.2) Irrigation infrastructure	36,59%
2.3.3) Access to market data and mobile banking	30,49%
2.4) Volatility of agricultural production	11,26%
2.5) Food loss	11,26%
2.6) Supply chain infrastructure	9,91%
2.6.1) Planning and logistics	33,93%
2.6.2) Road infrastructure	33,93%
2.6.3) Air, port and rail infrastructure	32,14%
2.7) Sufficiency of supply	11,71%
2.7.1) Food supply adequacy	51,92%
2.7.2) Dependency on chronic food aid	48,08%
2.8) Political and social barriers to access	10,81%
2.8.1) Armed conflict	28,41%
2.8.2) Political stability risk	25,00%
2.8.3) Corruption	19,32%
2.8.4) Gender inequality	27,27%
2.9) Food security and access policy commitments	12,61%
2.9.1) Food security strategy	52,50%
2.9.2) Food security agency	47,50%
3) QUALITY AND SAFETY	
3.1) Dietary diversity	19,50%
3.1.1) Share of non-starchy foods	63,41%
3.1.2) Share of sugar consumption	36,59%
3.2) Nutritional standards	20,33%
3.2.1) National dietary guidelines	22,62%
3.2.2) National nutrition plan or strategy	27,38%
3.2.3) Nutrition labelling	20,24%

3.2.4) Nutrition monitoring and surveillance	29,76%
3.3) Micronutrient availability	19,51%
3.3.1) Dietary availability of vitamin A	35,48%
3.3.2) Dietary availability of iron	33,87%
3.3.3) Dietary availability of zinc	30,65%
3.4) Protein quality	20,33%
3.5) Food safety	20,33%
3.5.1) Relevant food safety legislation	23,46%
3.5.2) Food safety mechanisms	25,93%
3.5.3) Access to drinking water	28,40%
3.5.4) Ability to store food safely	22,22%
4) SUSTAINABILITY AND ADAPTATION	
4.1) Exposure	17,00%
4.1.1) Temperature rise	25,58%
4.1.2) Drought	26,74%
4.1.3) Flooding	25,58%
4.1.4) Sea level rise	22,09%
4.2) Water	16,50%
4.2.1) Agricultural water risk – quantity	55,10%
4.2.2) Agricultural water risk – quality	44,90%
4.3) Land	16,50%
4.3.1) Land degradation	26,25%
4.3.2) Grassland	21,25%
4.3.3) Forest change	23,75%
4.3.4) Soil organic content	28,75%
4.4) Oceans, rivers and lakes	15,50%
4.4.1) Eutrophication	46,51%
4.4.2) Marine biodiversity	53,49%
4.5) Political commitment to adaptation	19,00%
4.5.1) Climate finance flows	17,22%
4.5.2) Environmental- economic accounting implementation	14,57%
4.5.3) Early-warning measures / climate-smart Agriculture	17,88%

4.5.4) Commitment to managing exposure	15,89%
4.5.5) National agricultural adaptation policy	17,22%
4.5.6) Sustainable agriculture	17,22%
4.6) Disaster risk management	15,50%
4.6.1) Pest infestation and disease mitigation	52,94%
4.6.2) Risk management coordination	47,06%

(Source: Economist Intelligence Unit, 2022)

Annexure C: Ethics approval letter

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Faculty of Natural and Agricultural Sciences
Ethics Committee
E-mail: ethics.nas@up.ac.za

27 September 2023

ETHICS SUBMISSION: LETTER OF CONDITIONAL APPROVAL

Ms MJ Nel
Department of Agricultural Economics Extension and Rural Development
Faculty of Natural and Agricultural Science
University of Pretoria

Reference number: NAS175/2022
Project title: Analysing South Africa's food security state based on the 2022 Global Food Security Index score and rank

Dear Ms MJ Nel,

We are pleased to inform you that your submission conforms to the requirements of the Faculty of Natural and Agricultural Sciences Research Ethics Committee.

Conditions:

Please note the following about your ethics approval:

- Please use your reference number (NAS175/2022) on any documents or correspondence with the Research Ethics Committee regarding your research.
- Please note that the Research Ethics Committee may ask further questions, seek additional information, require further modification, monitor the conduct of your research, or suspend or withdraw ethics approval.
- Please note that ethical approval is granted for the duration of the research (e.g. Honours studies: 1 year, Masters studies: two years, and PhD studies: three years) and should be extended when the approval period lapses.
- The digital archiving of data is a requirement of the University of Pretoria. The data should be accessible in the event of an enquiry or further analysis of the data.

Ethics approval is subject to the following:

- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.
- **If Applications using GM permits:** If the GM permit expires before the end of the study, please make an amendment to the application with the new GM permit before the old one expires
- **If Applications using Animals:** NAS ethics recommendation does not imply that Animal Ethics Committee (AEC) approval is granted. The application has been pre-screened and recommended for review by the AEC. Research may not proceed until AEC approval is granted.

Post approval submissions including application for ethics extension and amendments to the approved application should be submitted online via the Ethics work centre.

We wish you the best with your research.

Yours sincerely,

Prof VJ Maharaj
Chairperson: NAS Ethics Committee

Annexure D: Interview protocol

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Interview protocol

The discoveries and results from the knowledge development phase laid the foundation for designing and developing the protocol. The design phase can be seen as problem-solving, aimed at finding effective tools to address the issue. The objective of this phase was to create the initial draft of the protocol.

The initial step of the protocol involved obtaining formal approval for the study from The Research Proposal and Ethics Committee (see Annexure C). Following this, the researcher assessed the outcomes of the quantitative research. Subsequently, the 13 indicators of the Global Food Security Index (GFSI) were pinpointed as the key areas exerting the most significant negative influence on South Africa's food security Environment.

These identified areas guided the researcher in determining the expertise required by potential interviewees. The researcher initiated the process by identifying experts in the field through email correspondence, phone calls, and referrals. Upon securing permission to conduct semi-structured interviews, appointments were scheduled with the identified experts.

Each interview session commenced with a semi-structured questionnaire, and the expert was queried on specific areas corresponding to the identified indicators. Questions revolved around current efforts, prominent gaps, and recommended actions to address the identified gaps. Occasionally, experts referred the researcher to additional specialists in the field willing to participate in the interviews. The duration of each interview ranged from 45 minutes to an hour.

Referrals for interviewees were received from organisations spanning the agricultural, research, non-profit, and public sectors. Interviews adhered to the established interview protocol tailored for this particular study. The majority of the interviewee's were able to comment on more than one indicator due to the overlapping nature of the indicators identified during the quantitative research section of the study.

Both in-person and online interviews were conducted, with the interviewee's consent obtained prior to recording. Subsequently, the interviews were transcribed, and Atlas Ti software was utilised to code the transcriptions. Atlas Ti generated codes and quotes that the researcher utilised to formulate the study's findings.