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Emmanuel Ndhlovu *Editor*

Agriculture and Sustainable Development in Sub-Saharan Africa: Resilience and Recovery Toward Sustainable Futures

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Emmanuel Ndhlovu
Editor

Agriculture
and Sustainable
Development
in Sub-Saharan Africa:
Resilience and Recovery
Toward Sustainable
Futures

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To Abishai and Bethel

Preface

Agrarian Africa's development landscape is complex and multifaceted. While some countries are experiencing substantial economic growth and making commendable progress in various sectors, most face persistent challenges, including poverty, inequality, worsening climate change-related natural hazards and political instability. The factors contributing to Africa's lack of or sluggish development are complex, with scholars attributing this to a combination of historical, political, economic, social and environmental factors. These factors are often interconnected, with one issue exacerbating another. The slave trade, colonialism and neo-colonialism are some of the most significant factors contributing to this dire situation.

The slave trade had a distressingly long-term impact on Africa's development. It resulted in the loss of millions of young, able-bodied individuals, which delayed population growth, disrupted social structures and led to a decline in agricultural and industrial productivity. It also nurtured political instability and ethnic fractionalisation, as kingdoms and groups turned on one another to acquire slaves for trade. On the other hand, with colonialism, European colonial powers exploited Africa's natural resources for their own benefit, establishing 'extractive institutions' that were not designed for the development of African nations. Colonial borders were drawn without regard for existing ethnic or cultural realities, which contributed to post-independence conflicts. The economies established during this period were often dependent on exporting raw materials, a legacy that continues to make many African countries vulnerable to global price shocks. In addition, even after independence, neo-colonialism persists. This involves the continued economic and political influence of former colonial powers and other developed nations through mechanisms like unfavourable trade agreements, foreign aid dependency and the actions of multinational corporations, which can hinder local development.

Nonetheless, agriculture has always been at the centre of African efforts towards development for many former settler colonies such as South Africa, Namibia, Kenya, Algeria and Zimbabwe; and even amongst those that did not experience settler colonialism such as Ghana. Economic development in Africa—particularly in the post-colonial era—has largely depended on agricultural activities. This assertion can be confirmed by the sustained interest in agricultural-based development economics—especially amongst development economists and certain non-governmental organisations on the continent

who would from time to time argue that agriculture received increased development attention at government and donor levels. At the height of the new political transformation period in the early 1960s, agricultural economists such as Johnston and Mellor brought the debate to academic attention and also ensured the progression of the subject. In the current economics of the continent, the postulations made by these economists and others continue to dominate development imperatives—especially as it concerns the rural poor. It is heart-warming to see young African scholars, as demonstrated in this book, sustaining the debate. Indeed, agriculture has the potential to serve as the engine of development in Africa.

It is now widely acknowledged amongst policy makers, development practitioners and researchers in most economic and development sciences that agriculture dominates the economic practices and activities of the majority of people in developing regions of the world, including the Sub-Saharan Africa (SSA) region. The majority of households in SSA depend on agriculture for domestic livelihood, food production, employment creation, generation of household income and reduction of poverty, for instance. Agriculture has, therefore, become a major human economic practice in terms of its contribution to the Gross Domestic Product (GDP) in most African economies. As a result of the great potential of agriculture as a livelihood tool in SSA, it is, therefore, argued that the majority of socio-economic development measures of the majority of post-liberation and post-colonial SSA economies would focus mainly on the sector to improve the lives of the majority of the populace in the region.

Agriculture received increased post-independence development ahead of the other economic sectors. One of the contributing factors promoting the focus of the post-independence government on agricultural development over the rest of the economic sectors had to do with affordability in terms of capital availability and sectoral expertise in agriculture. The majority of post-independence governments were resource-poor and, therefore, opted to begin their development agenda on agriculture mainly because the general populace in the region already had existing indigenous skills in agriculture and not in the other economic sectors. Although the SSA region is still experiencing low levels of agricultural productivity and mainstream market expertise and participation of farmers at large, the region is known globally to be advancing in crop farming, horticulture, fisheries and livestock production, albeit dominantly for subsistence reasons. African agriculture is characterised by intensive subsistence farming and surplus-based informal marketing.

However, African agriculture, which is the backbone of many of the continent's economies and livelihoods, faces many challenges. These issues are deeply interconnected, ranging from environmental and climate-related problems to economic, political and infrastructural hurdles. The challenges are disrupting not only agriculture but the entire food system. As shown in this book, the state of agriculture and food systems in Africa is a story of significant challenges, but also of immense potential and ongoing efforts towards transformation. While Africa holds a large portion of the world's arable land and its agriculture sector is a major employer, its productivity and food security remain significant concerns. Factors such as reliance on smallholder

farming, persistent food insecurity, vulnerability to climate change, high post-harvest losses, weak value chains and market systems, political instability and conflict, corruption and poor governance, weak state institutions and inadequate infrastructure continue to hurt agriculture and food systems.

Nonetheless, as shown by the different voices in this book, there are optimistic emerging trends and opportunities to revolutionise regional agriculture and food systems. There is a growing consensus amongst governments, international organisations and the private sector that a holistic ‘food systems transformation’ is needed. This approach transcends simply increasing production to address all aspects of the food chain, including processing, distribution, consumption and waste management, with a focus on creating more resilient, sustainable and equitable systems.

To combat climate change and soil degradation, there is an increasing push for the adoption of sustainable agricultural practices. These include conservation agriculture (minimal tillage, crop rotation and cover cropping), agroforestry and improved water management techniques. While adoption can be slow due to resource constraints and a lack of awareness, these practices have shown promise in improving soil health and increasing yields. In addition, the book shows that technology is playing a growing role in African agriculture and food systems. This includes the use of improved seed varieties that are more drought-tolerant and disease-resistant, as well as the potential for Artificial Intelligence (AI), remote sensing and data analytics to help with crop monitoring, yield forecasting, and resource optimisation across the food chain, from production to consumption via food processing, storage, distribution and retail.

There has also been a concerted effort by various stakeholders to increase investment in the agricultural and food system sector and implement supportive policies. This includes initiatives to improve access to finance for smallholder farmers and other enterprises across the food chain, strengthen land tenure systems and create more favourable trade environments. The private sector is increasingly seen as a key driver of change. Initiatives are focusing on creating public-private partnerships to boost fertiliser production, build infrastructure and develop more efficient supply chains.

The chapters in this book show that while the challenges facing African agriculture and food systems are immense and complex, there is a clear recognition of the need for a comprehensive and collaborative approach. Efforts are underway to leverage technology, promote sustainable practices and reform policies to build more resilient, productive and inclusive food systems that can meet the needs of a rapidly growing population.

Auckland Park, South Africa

Emmanuel Ndhlovu

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Many other colleagues, students and friends provided support, encouragement and reference materials; to them, I say thank you. Despite the assistance of so many people and my best efforts, there are still likely to be omissions and errors.

About This Book

This book, presented in parts, offers a comprehensive and coherent in-depth overview of the state and condition of African agriculture, focusing on Sub-Saharan Africa. Comprising a range of voices of African scholars and practitioners in different countries and academic disciplines, the book provides context and culturally specific insights into African agriculture's complex and multifaceted nature and the conditions of sub-regions and individual countries within sub-regions. Using case studies drawn from countries across the continent, the book provides foundational insights into the underpinnings of African agriculture, its challenges and its opportunities for development, resilience, recovery following shocks and prospects for sustainable transformation. The book also outlines the key features and issues which must be addressed effectively to develop effective and efficient policies and practices for the African agricultural sector to serve as the basis for regional development. Attention is also given to the various opportunities and challenges for resilience, innovation and sustainability. Written for academic and policy readers, as well as those interested in food security, the book is suitable for courses on food politics, food systems, agroecology and sustainable development.

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Introduction: Rethinking African Agriculture: Pathways to Resilience, Recovery, and Sustainable Transformation

1

Emmanuel Ndhlovu 

1.1 Introduction

This chapter introduces the book *Agriculture and Sustainable Development in Africa: Resilience and Recovery Toward Sustainable Futures*. It argues that African agriculture and food systems, particularly in Sub-Saharan Africa (SSA), face substantial challenges, including climate change impacts, rapid population growth and urbanisation, conflict, limited infrastructure, and insufficient investment. This situation warrants urgent attention and sustained intervention because in Africa, agriculture is of paramount importance, serving as the base of many economies and a critical driver of livelihoods, food security, and economic growth (World Bank (WB), 2025). Agriculture has historically been, and continues to be, the backbone of African economies. It contributes a substantial share to the Africa's Gross Domestic Product (GDP), averaging around 22–32% for the whole of the continent and up to 25% in SSA (Davidson et al., 2025). For instance, since 2016, various calculations show that the sector contributes 26% to the GDP of Mozambique, Malawi (30%), Zambia (20%), Kenya (21.4%), Tanzania (26%), the Central African Republic (28.61%), Chad (25%),

Nigeria (21.07%), Ghana (20%), Senegal (16%), and Mali (33%) (African Development Bank (AfDB), 2020; International Monetary Fund (IMF), 2020; United Nations Economic Commission for Africa (UNECA), 2020). The agricultural sector also creates vital backward and forward linkages with other industries. For example, farmers purchasing inputs, such as fertilisers, create demand for the manufacturing sector, while agricultural produce provides raw materials for food processing, textiles, and biofuels.

The agricultural sector is also the largest employer on the continent, engaging over 60% of Africa's labour force. In many countries, this figure can reach up to 85%. For instance, since 2016, various calculations show that the sectors employed 69.48% of the labour force in Mozambique, Malawi (62.1%), Zambia (71%), Kenya (32.6%), Tanzania (65.5%), the Central African Republic (70.5%), Chad (80%), Nigeria (37.99%), Ghana (39.7%), Senegal (21.64%), and Mali (68%) (International Labour Organization (ILO), 2020). The sector also provides direct livelihoods for over 70% of the population, especially in rural areas where substitute employment opportunities are scarce (Ndhlovu, 2025a). Smallholder farms, which constitute about 80% of all farms in SSA, directly employ around 175 million people (AfDB, 2025). In addition, the agricultural sector facilitates the empowerment of women and youth, who form a significant part of the agricultural workforce, through access to resources

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and training can unlock vast potential and ensure inclusive development (Ndhlovu, 2025b).

The agricultural sector is also at the centre of continent-wide efforts to ensure food security for the continent's rapidly growing population. Increasing agricultural productivity is crucial to feed the continent and reduce dependence on food imports, which are projected to increase significantly in the coming decades (African Export–Import Bank (AFREXIMBANK), 2024). The sector's growth directly impacts the availability of affordable and nutritious food, contributing to better health outcomes and reducing malnutrition. Growth in the agricultural sector has been shown to be about eleven times more effective as a poverty reduction pathway than growth in other sectors (World Bank (WB), 2015; Will, 2021). This is especially true given that over 70% of Africa's poor are located in rural areas where they depend on farming activities for survival. By fostering growth in smallholder farming and agribusiness, agriculture can significantly reduce poverty levels, particularly in regions where the sector dominates.

In addition, it facilitates export earnings and foreign exchange. Africa is a significant producer and exporter of various agricultural products, such as cocoa, coffee, tea, cotton, and horticultural products. These exports generate valuable foreign exchange reserves, which are used to fund other development initiatives and social protection interventions. Agricultural exports also facilitate strengthening trade ties with international partners and can attract foreign direct investment into agriculture-related industries. Agriculture is also considered to be the engine of rural development and stability in Africa (Ndhlovu, 2025c). The health and growth of the agricultural sector are vital for supporting small towns and keeping rural Africa vibrant. It helps to prevent rural–urban migration by creating opportunities in rural areas. By providing economic stability and employment, agriculture can also help address social issues and contribute to overall peace and stability. Therefore, agriculture is not just an economic sector in Africa; it is a foundation for sustainable development, poverty reduction, and improved livelihoods for the majority of its population. Investing

in and transforming the agricultural sector is crucial for the continent's future prosperity.

Despite its immense importance, African agriculture faces several challenges, including climate change, inadequate infrastructure, limited access to finance and modern inputs, and post-harvest losses. Studies documenting these challenges abound (Abdullahi et al., 2024; Abu et al., 2024; Bedasa & Deksis, 2024; FAO et al., 2023). However, the traditional recommendations have been for African countries to roll out infrastructural development and adopt digital technologies (InfraCo Africa, 2024; Louis & Chartier, 2017; Olawuyi et al., 2022). This inclination has crowded out the possibilities for the emergence of more detailed blended theorisations of approaches through which African agriculture and food systems can be made more resilient and sustainable. This is a knowledge and literature gap that has policy and practical implications. The chapters in this book seek to close this gap.

In providing the background to the chapters that comprise this book, this chapter (i) conceptualises food systems, (ii) examines the current state of African food systems, (iii) identifies the challenges of African food systems, and (iv) explores strategies towards resilience, recovery and sustainable transformation. This book holds much potential to provide valuable understandings of the complex challenges and opportunities within Africa's food landscape. It can provide a platform for understanding the unique context of African food systems, which are shaped by a confluence of factors, such as colonialism, climate change, political leadership crises, rapid population growth, rapid urbanisation, and low productivity. By exploring these systems through a multidisciplinary lens, such a book can contribute to developing contextually relevant approaches for sustainable transformation and resilience. Policymakers, researchers, students, practitioners, and non-governmental actors, as well as politicians interested in sustainable development, food security, and the complexities of food systems in Africa, can benefit from its insights. Specifically, the book can inform strategies for improving food security, promoting sustainable agriculture, and

addressing the unique challenges and opportunities of the continent's diverse food systems.

This chapter is structured as follows: The following two sections conceptualise food systems in the African context and justify the need for an Africa-specific food system definition, respectively. This is followed by an exploration of the current state of African food systems, challenges of African food systems, and a conceptualisation of potential strategies for resilience, recovery, and sustainable transformation. Thereafter, the research methodologies used by the chapters in this book are summarised, followed by an outline of the book structure. Lastly, conclusions are drawn from the discussion.

1.2 Food Systems: An Africa-Centric Conceptualisation

In Africa, multiple definitions of food systems exist. In a document specifically focused on Africa, the FAO defined a food system as a compound network of activities which involves production, processing, transportation and consumption, all of which connect people to their food (Dumont et al., 2022). It also takes into consideration the administration and economics of food production and all the activities undertaken to ensure food reaches people who need to utilise it (FAO, 2018). In a document titled: Regional Dialogue: African Food Systems, the Economic Commission for Africa (ECA) and other organisations conceptualised food systems as the total of numerous actors and exchanges within and along the food chain, from input supply and production to consumption, and disposal (ECA et al., 2021).

While there is no specific definition of African food systems, there are, however, common aspects in the majority of existing food system definitions, which include drivers of change, food systems components (that include actors and activities in food supply chains), and food systems outcomes. Therefore, it may not be entirely incorrect to assert that in Africa, food systems are generally conceptualised as complex, interconnected,

and interdependent networks that involve all the processes through which food passes through, from production to consumption, with a focus on both traditional and modern technologies. These systems are considered to be shaped by a range of factors, including bio-physical, socio-economic, territorial, demographic, infrastructural, technological, political, and governance aspects (May et al., 2025). Furthermore, there is a growing acknowledgement of the need to strike a balance among food security, economic development, and environmental sustainability within food systems (Riley & Crush, 2023).

The Food Systems Research Network for Africa (FSNet-Africa) has also developed a contextualised framework to guide its food systems research. The developed framework recognised the TRANSMANGO framework as a potential conceptualisation that can be modified and utilised in the African context. The FSNet-Africa thus adapted the components of the TRANSMANGO framework to develop a framework that aligns with the African context. The FSNet-Africa (2021) acknowledges that Africa does not consist of a single food system. It posits that the challenges faced by African countries in their food systems always differ. For instance, between 2020 and 2022, undernourishment hovered around 25% of the sub-regional population in Central and East Africa, separately, while it was below 14% in West Africa and 12% in Southern Africa (FAO et al., 2023). There are also intra-sub-regional differences. For instance, in East Africa, while Madagascar and Somalia were the most affected, Seychelles and Mauritius were minimally affected. In Southern Africa, Zimbabwe, Zambia, and Lesotho were the most affected (FAO, 2023). Therefore, a one-size-fits-all conceptualisation of food systems can be misleading.

Despite these differences, however, FSNet-Africa identified commonalities that justify the adoption of a general food system framework. It argues that, first, numerous African countries have a shared history of colonisation and underdevelopment. Second, under the guidance and common governance structures of the AU, African countries have shared investments, partnerships, and

commitments, including those that are directly linked to food systems. Some of these collective efforts include the Africa Common Position on Food Systems, the Comprehensive Africa Agriculture Development Programme, the African Continental Free Trade Agreement, the Africa Region Nutrition Strategy (2015–2025), and the African Union 2022 Year of Nutrition, as well as the Malabo and Maputo Declarations. Lastly, the continent also has a wide range of shared visions of continental challenges and opportunities in the African Agenda 2063.

The FSNet-Africa developed a framework that includes food system *drivers*, which range from political and administrative systems to socio-economic restraints that shape food system components (from production to consumption). The FSNet-Africa continues to develop its food system framework. The FSNet-Africa aligns with FAO's definition, which describes food systems as.

...the entire range of activities involved in the production, processing, marketing, consumption and disposal of goods that originate from agriculture, forestry or fisheries, including the inputs needed and the outputs generated at each of these steps [and also involving] the people and institutions that initiate or inhibit change in the system as well as the sociopolitical, economic and technological environment in which these activities take place (FAO, 2013).

The food systems conceptualisation by the FSNet-Africa is gaining academic attention, with many scholars directly referencing it or generally drawing without referencing (see May et al., 2025; Mkandawire et al., 2024; Ndhlovu, 2025d). The chapters in this study also draw extensively from the FSNet-Africa framework.

1.3 Importance of an Africa-Specific Food System Conceptualisation

The call for an Africa-specific definition of food systems is valid for numerous reasons, including that Africa's food landscape has unique characteristics, challenges, and opportunities that are often ignored or inadequately addressed by global,

generalised frameworks. An Africa-specific definition ensures contextual relevance and accuracy. African countries have diverse realities, and the food systems of countries vary significantly across regions, countries, and even within communities, influenced by diverse ecologies, cultures, socio-economic conditions, and political landscapes (May et al., 2025). Therefore, a global definition might generalise or misrepresent these nuances. In addition, African food systems often integrate traditional farming methods, indigenous crops, and local food processing techniques that are highly adapted to the local environment and cultural practices. A generalised definition might fail to acknowledge or value these critical elements (Badiane et al., 2023). Smallholder farmers and informal markets also play a far more significant role in Africa's food systems compared to many industrialised regions, and thus an Africa-specific definition can centre on their needs, contributions, and challenges. Furthermore, a substantial portion of African agriculture is rain-fed, making it highly vulnerable to climate change and extreme weather events (see Chaps. 11 and 19). This characteristic needs to be explicitly factored into any relevant food system definition.

An Africa-specific food systems definition can also facilitate effective policy and intervention design. A context-specific definition can allow for the development of policies, programmes, and investments that are justly tailored to the African reality. This includes addressing issues, such as limited infrastructure, access to finance, market inefficiencies, and post-harvest losses, which are prevalent in many African food systems (see Chaps. 12 and 15). In addition, Africa faces unique challenges such as high rates of hunger and malnutrition, climate vulnerability, rapid urbanisation, and persistent poverty (FAO et al., 2023; Ndhlovu, 2025e). An Africa-specific definition helps to focus efforts on these critical issues and design interventions that build resilience and ensure food security for all. In addition, an Africa-specific approach, as one proposed by the FSNet-Africa, can help empower African countries to define their food destinies, focusing on food sovereignty and reducing dependence on external models that may not align with their development goals.

This includes prioritising investment in African indigenous and resilient crops (see Chaps. 16 and 17). Furthermore, Africa's rising middle class, growing youth population, and improvements in digital technologies present opportunities for transforming food systems. A localised definition can help identify and harness these opportunities for sustainable and inclusive growth.

An Africa-specific definition of food systems is also important for research and data collection purposes. Global frameworks might use metrics or indicators that are not relevant or easily measurable in the African context. An Africa-specific definition can guide the development of appropriate research methodologies and data collection systems that capture the unique dynamics of the continent's food systems (Karan et al., 2023). A vigorous, contextually grounded evidence base is vital for identifying possible and resilient transformation pathways (Riley & Crush, 2023). A clear Africa-specific definition provides the foundation for generating such evidence.

In addition, an Africa-specific definition facilitates ownership and collaboration. An Africa-specific definition fosters a sense of ownership and encourages African-led institutions and researchers to drive the agenda for food system transformation. While diverse, African countries also share common challenges. An Africa-specific definition can facilitate regional cooperation and the development of harmonised strategies, such as those outlined in the Comprehensive African Agriculture Development Programme (CAADP).

In essence, an Africa-specific definition of food systems moves beyond a one-size-fits-all approach, recognising the continent's distinct features and fostering more effective, sustainable, and equitable solutions for food security and nutrition.

1.4 Current State of Food and Nutrition in Africa

Africa is experiencing a food crisis, with many people facing various forms of hunger due to a dirty mixture of complex factors, ranging from the ripple effects of wars and conflicts, which

are aggravating the impacts of conflicts, climate change effects, poor economic development, and the aftermath of the COVID-19 pandemic. Despite the efforts of countries (see Chap. 5), food insecurity remains a challenge. The continent has already failed to meet many of the hunger reduction targets, both locally and internationally. In addition to hunger, many Africans suffer from prevalent micronutrient insufficiencies (FAO, 2023). Overweight and obesity are already a major concern in public health across the continent (FAO et al., 2023).

Africa is experiencing widespread food insecurity. In 2022, about 282 million people on the continent were undernourished. This is over 38% of the estimated people who faced hunger worldwide during the same period (FAO, 2023). While the level of hunger and undernourishment differ across Africa's five sub-regions, the general picture is that Africa is currently in a crisis. In 2022, 61% of the African population was food-insecure. This is twice the prevalence of 29.6% at the global level. Central Africa was the most affected sub-region (78.4%), followed by Eastern Africa (69.2%) and Western Africa (66.4%). Since 2019, following the COVID-19 pandemic, the food insecurity situation has worsened (FAO et al., 2023).

The WB (2025) reports that in the first quarter of 2025, food and nutrition security were dire in East and Southern Africa, with about 61.6 million food-insecure people in East Africa. While climate change and poor economic development are the key reasons, the conflict in the Democratic Republic of Congo (DRC) could have significantly contributed to food security and humanitarian needs (Angélique et al., 2022). In South Sudan, war and conflict have worsened the food insecurity, driven by the displacement of people, economic collapse, and restricted humanitarian access (Kirui et al., 2024). It is estimated that about 24.6 million people (almost half of the population) experienced high levels of acute food insecurity (IPC 3+) between December 2024 and May 2025 (WB, 2025). In Ethiopia, armed conflicts disrupt food production, distribution, and access, leading to increased food insecurity, which in turn worsens conflict. Bezabih

et al. (2025) found the devastating impact of conflict on food security in Ethiopia, particularly in Tigray and the Somali regions. In West and Central Africa, high food prices, aggravated by the impacts of climate change and conflict, continue to worsen food insecurity in countries such as Mali and Chad (Mayoukou, 2025). It was estimated that nearly 50 million people were food-insecure (IPC Phase 3 +) between June and August 2025 (WB, 2025).

To sum up, Africa is facing a food insecurity challenge, with millions of people across all its sub-regions facing hunger and malnutrition. While some countries show progress in specific areas, as a whole, the continent is not on track to meet the Sustainable Development Goal of ending hunger and malnutrition by 2030. Therefore, urgent interventions are required. Transforming Africa's food systems requires a detailed understanding of its challenges to be able to recommend and implement context-specific interventions. Several chapters in this book provide comprehensive details regarding these challenges (see Part II). The following section only summarises some of the challenges.

1.5 African Food System Challenges

Africa's food systems face several challenges, including climate variability, poor infrastructure, limited access to markets and financing, and post-harvest losses (Abdullahi et al., 2024; Bedasa & Deksisa, 2024). These challenges are worsened by rapid population growth, political instability, and poverty, hindering efforts to achieve food security and sustainable food systems (InfraCo Africa, 2024; Kirui et al., 2024; Mayoukou, 2025). The chapters in this book agree that Africa's food systems face a compound network of interrelated challenges that hamper food security and sustainable development. These challenges often disproportionately affect vulnerable populations, exacerbating poverty and malnutrition.

Climate change and environmental degradation are among the main challenges to African agriculture and prospects for food insecurity. As

shown in Chaps. 11 and 19, Africa is highly susceptible to climate change and variability, experiencing increased incidences and intensity of droughts, floods, and heatwaves. These events devastate crops, livestock, and infrastructure, resulting in substantial production losses and food shortages. Extreme weather events continue to be starker in Africa. Climate change poses a significant threat to agriculture and food systems across Africa. The impacts are multifaceted and far-reaching, worsening food insecurity and undermining livelihoods for the majority of Africans who rely on agriculture.

Increased occurrence and intensity of extreme weather events significantly destroy and disrupt agriculture and the food chain. For instance, prolonged droughts are becoming more common and severe in Africa, leading to significant crop failures, livestock losses, and water scarcity (Abdullahi et al., 2024). This directly affects food availability and access, pushing communities into hunger and malnutrition (see FAO et al., 2023). In addition, floods and storms have been destroying crops, infrastructure, and homes. For example, in 2019, Cyclone Idai destroyed fields and crops in the Southern African countries of Mozambique, Malawi, Zimbabwe, and parts of north-eastern South Africa. The cyclone also destroyed infrastructure and other types of livelihoods, exposing many communities to poverty and food insecurity (Williamson et al., 2023). Floods and storms also contaminate water sources and grazing lands, exposing livestock and humans to harmful toxicants and increasing the risk of foodborne diseases. Furthermore, rising temperatures directly impact crop yields, with many staple crops, such as maize and wheat, projected to experience significant declines. Heat stress also affects livestock health and productivity.

Climate change also alters rainfall patterns and water availability, significantly affecting African agriculture and food systems operations. Erratic and unpredictable rainfall characterises many countries across Africa (Tefera et al., 2025). Even in areas where total rainfall might remain consistent, its erratic nature (such as shorter, more intense rainy seasons or unpredictable onset/cessation) disrupts traditional farming cycles and

makes planning difficult for farmers. Higher temperatures also lead to increased evaporation, intensifying existing water stress, especially in regions already grappling with water scarcity, such as West African countries. This causes immense pressure on agricultural systems, particularly rain-fed ones, which constitute the majority of African agriculture (Ndhlovu, 2025d). Furthermore, as rain-fed yields decline, the demand for irrigation is projected to increase, placing further strain on already limited water resources.

Changes in temperature and moisture conditions create favourable environments for the migration and proliferation of crop pests and diseases (Benjamin et al., 2024; Mokone & Ndhlovu, 2025). This includes aggressive species, such as the fall armyworm, which can decimate maize yields. Livestock are also increasingly exposed to diseases due to heat stress and altered environmental conditions.

The collective effect of these climate-related factors is an extensive reduction in crop yields and overall agricultural productivity across the continent. This is particularly worrisome given Africa's growing population and the increasing demand for food. Declining yields contribute to food shortages, price volatility, and increased food insecurity, excessively affecting exposed populations, especially smallholder farmers and rural communities who depend directly on agriculture for their livelihoods. Warmer temperatures and unpredictable weather can create optimal conditions for foodborne pathogens, increasing the prevalence of diseases like *Salmonella* and *E. coli*. Floods can contaminate food supplies. Challenges in harvesting crops at the optimal time due to erratic rains can lead to fungal contamination (e.g., *mycotoxins*).

Climate change impacts can also worsen land degradation. Soil fertility depletion can easily emerge due to poor farming practices (such as monoculture, lack of crop rotation), overgrazing, deforestation, and the expansion of agriculture into marginal lands reduces productivity.

The other challenge for African food systems is the underdevelopment of the agricultural sector. African agriculture is highly characterised by low productivity. African agriculture is dominated by

smallholder farmers (Ndhlovu, 2025a). Most of these farmers lack adequate resources to carry out their activities, and therefore, mainly operate at a subsistence level (Bjornlund et al., 2020). Many African farmers use outdated farming practices and have low adoption rates of improved agricultural technologies, leading to low yields (Mathinya et al., 2022). These farmers often lack access to vital inputs such as improved seeds, fertilisers, and modern equipment, which limits their ability to increase productivity. In addition, heavy dependence on rain-fed agriculture makes food production highly vulnerable to hostile weather conditions. Moreover, there is often limited processing and value addition to agricultural products, meaning lower incomes for farmers and less resilience in the food system.

The other challenge to agriculture and food systems in Africa is inadequate infrastructure. Bad roads and inefficient transport systems in many African countries make it difficult and costly to move food from farms to markets, leading to high post-harvest losses and increased food prices. There is also insufficient storage and processing facilities, with a significant amount of food being lost or wasted due to inadequate storage, processing, and preservation facilities, particularly for perishable goods like fruits and vegetables. Poor infrastructure and high trade costs limit farmers' access to lucrative markets, reducing their incentives to produce more (Ndhlovu & Majova, 2023).

Africa also experiences significant food losses in its food chain. Despite prevalent hunger, the continent loses and wastes a substantial portion of the food it produces, with some estimates reaching 40% (Cromwell et al., 2025). This happens at several stages, from harvesting to consumption, due to factors such as poor handling, storage, and transportation. Fruits, vegetables, roots, and tubers suffer the highest losses.

Many of Africa's smallholder farmers (who make up the majority) have limited access to finance (Rusenga & Ndhlovu, 2023). Smallholder farmers face a significant funding gap, making it difficult for them to invest in improved technologies, inputs, and infrastructure (Mhlanga & Ndhlovu, 2023). Many farmers and agribusinesses

struggle to access formal credit and financial services (Majova, 2023).

Political instability and conflict, both inside and outside the continent, are significantly affecting African agriculture and food systems. Conflicts and civil unrest displace populations, making them leave their fields and their food. Conflicts also destroy agricultural infrastructure and disrupt supply chains, making it dangerous for people to access food or engage in farming. The war in Ukraine is reported as having significantly compromised African food systems (Majova & Ndhlovu, 2025a, 2025b, 2025c, 2025d, 2025e). Political instability also leads to poorly implemented or neglected government policies aimed at supporting agriculture and food security. For instance, an intense political standoff between the ruling Zimbabwe African National Union—Patriotic Front (ZANU-PF) and the then Movement for Democratic Change (MDC) in Zimbabwe resulted in the implementation of a short-circuited land reform programme that significantly affected the country's agriculture sector. Today, Zimbabwe is among the highly food-insecure countries in Southern Africa. Political instability also generally discourages investment in the agricultural sector, limiting technological advancements and improvements.

There are also many socio-economic factors which are affecting African food systems. Poverty and inequality are some of the factors. Poverty in Africa is a significant issue, particularly in SSA, with high rates of extreme poverty and a large number of people living below the poverty line (FAO et al., 2023). High levels of poverty limit people's ability to afford food, even when available. Inequality, including gender inequality, further aggravates food insecurity.

While not intrinsically a challenge, rapid population growth in Africa is straining existing food systems as productivity and distribution fail to keep pace. This is leading to increased food insecurity and pressure on resources. The strain on food production systems, coupled with climate change and limited access to technology, is worsening challenges in ensuring sufficient and nutritious food for all. A growing population

directly translates to increased demand for food, exerting pressure on existing agricultural systems to produce more. High population density in some areas also leads to smaller farm sizes, reduced fallow periods, and increased competition for land, potentially leading to land degradation and reduced productivity. In addition, population growth also increases water demand, leading to potential water scarcity and stress on irrigation systems, especially in regions such as Central Africa, which are already facing water-related challenges. Poor human resource development, including inadequate education, training, and poor health outcomes, also affect agricultural labour productivity and overall food security in many African countries.

Addressing these multifaceted challenges necessitates a multifaceted approach, including investment in climate-resilient agriculture, improved infrastructure, access to finance for farmers, conflict resolution, and sound policy frameworks.

Africa is also struggling with the aftermath of the COVID-19 pandemic. The pandemic and associated interventions, such as lockdowns, curfews, and travel restrictions, hindered the movement of agricultural inputs (seeds, fertilisers), labour, and food products. This led to delays, increased transportation costs, and spoilage of perishable goods. Restrictions on movement and illness among workers affected agricultural production, especially for labour-intensive crops, such as cotton, particularly in Southern Africa. Many smallholder farmers, who rely on informal markets, also struggled to sell their produce due to market closures or reduced activity, leading to post-harvest losses. In Zimbabwe, where COVID-19 restrictions were politicised, agricultural produce for smallholder farmers was seized and destroyed by the police (Mhlanga & Ndhlovu, 2020). International trade disruptions also reduced demand for some African agricultural exports, impacting revenue and livelihoods. In short, COVID-19 significantly strained African food systems, primarily through supply chain disruptions and

income losses, leading to increased food insecurity. While the agricultural sector showed some resilience, the pandemic underscored the need for long-term strategies to build more robust and equitable food systems across the continent.

1.6 Strategies for Food System Resilience, Recovery and Sustainable Transformation

There are several strategies which are being used and which can be used by African countries, farmers, and other food system actors to recover from disruptions such as pandemics, build resilience against global challenges such as climate change, and ensure sustainable transformation.

1.6.1 Climate-Smart Agriculture and Agroecology

One of the recommended strategies to ensure resilience, recovery and transformation in African agriculture and food systems is farming diversification. Governments and their private partners need to encourage diverse crop varieties and livestock in farming to reduce vulnerability to single-crop failures and adapt to changing climates (Watts et al., 2024). This should include promoting indigenous and drought-tolerant crops. Indigenous and drought-tolerant crops offer a vital resilience strategy for African agriculture, particularly in the face of climate change and drought. These crops, including sorghum, millet, and various legumes, are well-adapted to arid and semi-arid environments, requiring less water and offering greater yields during dry spells compared to conventional crops. Msweli et al. (2025) found that indigenous crops, such as sorghum and cowpeas, have distinctive traits that allow them to flourish in situations where water resources are limited. Diversifying farming

systems with these crops can improve food security, improve livelihoods, and build more sustainable and resilient agricultural practices across the continent.

In addition, African countries need to consider implementing practices such as drip irrigation, rainwater harvesting, and water-efficient technologies to optimise water use in agriculture. This is particularly important for regions such as West, Southern, and Central African countries, such as Chad, where rainfall tends to be inadequate to support farming. Practices such as terracing, contour farming, and agroforestry must be supported because they help prevent soil erosion, improve soil health, and conserve water. In addition, it is important for governments and relevant stakeholders, including extension services providers and agricultural marketing agencies, to utilise climate information services to provide farmers with timely data on weather patterns, enabling them to make informed decisions about planting, harvesting, and other farming activities. Agroforestry, the practice of mixing trees with crops and/or livestock to improve biodiversity, improve soil fertility, regulate microclimates, and provide additional income streams, is also another strategy to transform African farming. In the northern parts of Tanzania, multi-storied agroforestry cropping systems, which mix various plants and trees with crops and livestock on Mount Kilimanjaro slopes, have been successfully implemented. It is reported that agroforestry systems, particularly the traditional Chagga home gardens, play a significant role in climate change adaptation and mitigation, while also providing various ecosystem services and contributing to livelihoods (Watts et al., 2024).

1.6.2 Empowering Local Farmers and Communities

Capacity building and training are some of the most recommended interventions for transforming agriculture and food systems in SSA (Davidson et al., 2025; FSNet Africa,

2021). This entails equipping farmers, especially smallholders, with knowledge and skills in sustainable agricultural practices, market insights, and modern technologies. The empowerment of smallholder farmers should also involve improving and sustaining their access to resources. Providing access to subsidised farm inputs, financial support (e.g., microfinance), and technical assistance can help to enhance productivity and improve income. It is also vital to strengthen market linkages through connecting smallholder farmers to national, regional, and global value chains. This can be achieved through improved infrastructure, digital platforms, and support for cooperatives and unions (Olawuyi et al., 2022). In addition, prioritising women and youth in agricultural development initiatives, recognising their crucial role in food systems, should be part of the empowerment campaign. Empowering women farmers can significantly reduce food insecurity (Ndhlovu & Majova, 2023).

1.6.3 Policy Reforms and Investment

African governments must adopt supportive policy frameworks to strengthen their agricultural sectors and food systems. Developing and implementing policies that promote sustainable agricultural practices, de-risk investments in agriculture, and ensure food sovereignty must be the starting point for agriculture and food systems transformation (Mhlanga & Ndhlovu, 2023). Examples include supporting national agricultural master plans. African governments increase their investment in the sector. Significant investment in agricultural infrastructure (irrigation, storage, roads, energy), research and development, and social protection measures for smallholder farmers can help boost production activities, prevent food loss and waste, and also ensure the profitability of farming as a business. In addition, African governments can optimise public budgets and use trade and fiscal policies to create jobs, reduce poverty and malnutrition, and increase agricultural productivity. Further, they must promote

responsible business practices within the food system to mitigate environmental degradation, uphold human rights, and strengthen agricultural value chains.

1.6.4 Technology and Innovation

Technology integration is one of the strategies being used in other economic sectors to improve productivity and efficiency. In Africa, large-scale farmers are rapidly integrating digital technologies into their activities to transform their operations (Mhlanga & Ndhlovu, 2023). However, their smallholder counterparts continue to lag in this regard. The main obstacles for smallholder farmers are the lack of adequate resources, limited knowledge and skills, and land degradation. Utilising digital technologies such as mobile applications for accessing market information, renting farm equipment, and facilitating financial transactions for farmers could help boost the productivity of smallholder farmers, who are the backbone of African agriculture. Employing technologies can also help optimise resource use (water, fertiliser) and increase productivity and sustainability. In addition, digital technologies can help harness data for valuable insights and adaptive strategies to strengthen food system resilience.

1.6.5 Systemic and Collaborative Approaches

African governments can also adopt integrated food systems approaches. This involves moving beyond a focus on farm-level production to address interventions across the entire value chain, including processing, distribution, and retail. Government may also support multi-stakeholder collaboration, which involves fostering partnerships between governments, the private sector, civil society, research institutions, and local communities to drive food system transformation. In addition, African governments and their private partners can develop knowledge-sharing platforms to create pathways for spreading best practices and facilitating collaboration among

stakeholders. Local governments can also help develop food systems on urban fringes using green infrastructure, including vertical farming, hydroponics, and community gardens, to increase local food production.

Despite these opportunities, the chapters in this book show that Africa continues to face challenges such as political instability, lack of access to land, acute poverty, and limited organisational support. Addressing these requires a multifaceted approach that considers the unique contextual factors of different African regions, including their diverse agricultural systems, informal value chains, and the legacy of colonialism.

1.7 Methods and Materials

This edited book comprises chapters from different countries in SSA. The authors use diverse research approaches and methodologies in their investigation of the current conditions of agriculture and food systems in different countries. The research approaches used ranged from agrarian political economy and decoloniality to empowerment and sociological approaches. The authors utilised quantitative, qualitative, and mixed methods research methodologies to provide empirical and non-empirical-based discussions on African food systems. The qualitative research methods used include content analyses, in-depth interviews, document analyses, focus groups, semi-systematic literature reviews, case studies, and descriptive analyses. The quantitative methods utilised included PRISMA, bibliometric, sentiment analysis, systematic literature reviews, and quantitative surveys. This assortment of methodologies generated significant insights into the state of SSA agriculture and food systems. These insights are fit for both practical and theoretical usage.

1.8 Book Structure

Besides this introduction chapter, this book comprises 23 chapters which are divided into five

parts: *State of agriculture and food system in sub-Saharan Africa*, *Challenges of food systems in sub-Saharan Africa*, *Agriculture and food systems innovation*, *Case studies*, and *Conclusions and policy recommendations*.

Part I comprises seven chapters that explore the state of agriculture and African food systems. Chapter 2 by Emmanuel Ndhlovu and Neo Mokone provides a comparative analysis of conditions, challenges, and opportunities in SSA's sub-regions, namely, West, Central, East, and Southern Africa. In Chap. 3, David Mugambe Mpiima, Denis Tushabomwe, and Winnie Ejang analyse the state of agriculture and food security in East Africa from a gender perspective. Chapter 4 by Clainos Chidoko, Pardon Chidoko, and Tendayi Maravanyika examines the condition of agriculture and food systems in Southern Africa. In Chap. 5, Emmanuel Ndhlovu explores the state of food systems in Central Africa. Joseph Ato Forson, in Chap. 6, provides an overview of financial development, urbanisation, and Food Production in West Africa, focusing on the ECOWAS countries. In Chap. 7, Tafadzwa Jimu, Clainos Chidoko, and Emmanuel Ndhlovu evaluate formal and informal agricultural markets in SSA, highlighting opportunities for smallholder agricultural growth. Lastly, Chap. 8 by Wesonga Justus Nyongesa explores the intricate relationship between political stability and food security, focusing on East Africa.

Part II comprises three chapters that summarise the key challenges for SSA agriculture and food systems. Chapter 9 by Ezechi Kingsley Chukwuka, Okonkwo Wilfred Onyekwelu, Onyishi Anthony Ugwu, and Mbaeze Netchy Christian examines the inefficiencies of technology, energy, and transport in West Africa's smallholder farms, with ramifications for socio-economic development and food security. Chapter 10 by Clainos Chidoko, Tafadzwa Jimu, and Emmanuel Ndhlovu examines the impact of food imports on Africa's food systems and explores the challenges associated with food imports. In Chap. 11, Gideon Walter Mutanda explores the impact of climate change on agricultural and food resources and also proposes effective strategies to enhance climate resilience.

Part III consists of eight chapters that examine prospects for innovation to boost, recover, transform, and increase chances for agricultural and food system development in Africa. Chapter 12 by Anthony Gikuri Nchagwa and Maria Seithati Motebang maps formal surplus food networks through the food banking mode and analyses the volumes of surplus food recovered and redistributed in selected countries. It posits that food banks are on an upbeat track to advancing food recovery and redistribution, but with notable variations. Toritseju Begho and Tare Philip Daubry, in Chap. 13, highlight the potential of leveraging on the rapidly growing African youth population to develop regional agriculture and food systems. In Chap. 14, Sophia Nasaka and Emmanuel Ndhlovu argue that Africa's food security is extremely weak, with many countries facing severe hunger and famine. The authors review the interventions in the agricultural and food systems deployed to deal with this challenge. In Chap. 15, Beauty Zindi explores strategies, challenges, and opportunities in advancing sustainable food processing to build resilient and inclusive food systems across the continent. Chapter 16 by Miriam Hofisi and MT Lukamba examines existing institutions for indigenous knowledge in Africa and how indigenous knowledge, coupled with modern technology, can be harnessed to improve African agriculture and food systems. In Chap. 17, Winnet Hokoza highlights the crucial role of women in enhancing food security and fostering resilient communities, focusing on Zimbabwe and Mozambique. Chapter 18 by Emmanuel Ndhlovu explores innovation pathways for food system transformation in Southern Africa, focusing on digital and institutional insights from countries at different development stages, namely, Botswana, Malawi, and South Africa. Chapter 19 by Cosmas Parwada, Albert Gumbo, and Tavagwisa Muziri explores the potential of small grains in addressing food security challenges in semi-arid regions under the influence of climate change.

Part IV comprises four chapters that provide case study discussions on the conditions of agriculture and food systems in African countries.

Chapter 20 by Aphios Nenduva and Allan Tapiwa Maganga interrogates the food systems of two Southern African countries, namely Zimbabwe and Zambia, to disentangle practices which demean, discriminate, and obliterate the innovative potential of local producers. In Chap. 21, Mhlonipheni Petros Magubane and Matome Moshobane Simeon Maake investigate the challenges of crop production in community gardens in the Jozini Local Municipality. In Chap. 22, Pardon Chidoko and colleagues examine sorghum farmers' production systems and trait preferences as coping strategies in four major producing districts of Zimbabwe. Chapter 23 by Liphalela Mathe shows how traditional feasts have become part of the food security intervention strategy in Lesotho.

Part V comprises a single chapter, which summarises the book. This chapter, authored by Emmanuel Ndhlovu, concludes the book by highlighting the central role of governments in agricultural and food systems resilience, recovery, and transformation in Africa.

1.9 Conclusion

This chapter introduced the book *Agriculture and Sustainable Development in Africa: Resilience and Recovery Toward Sustainable Futures*. This has been achieved first by theorising agriculture and food systems and by providing an overview of the state of agriculture and food systems, as well as their potential to meet food demands in the region. Drawing on the chapters comprising the book, this chapter showed that Africa's agriculture and food systems are facing a complex set of challenges, ranging from climate change impacts and low productivity to inadequate infrastructure, political instability, rapid population growth, land degradation, and political leadership crises. The result has been severe food insecurity, including malnutrition, obesity, and stunting. The chapter argues that addressing these multifaceted challenges necessitates a multifaceted approach,

including investment in climate-resilient agriculture, improved infrastructure, access to finance for farmers, conflict resolution, and sound policy frameworks. This should include the acknowledgement of the unique contextual factors of different African regions and countries, including their diverse agricultural systems, informal value chains, and the legacy of colonialism. This blended-intervention approach opens up opportunities to respond to a variety of challenges, old and emerging, ranging from climate change impacts to rapid population growth, limited resources, conflict and instability, and economic factors. The different chapters in this book expand on the issues that have been summarised in this chapter.

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Part I

**State of Agriculture and Food System
in Sub-Saharan Africa**

Africa's Food Systems: A Sub-regional Comparative Analysis of Conditions, Challenges, and Opportunities

2

Emmanuel Ndhlovu  and Daniel F. Meyer 

2.1 Introduction

Food systems in Sub-Saharan Africa (SSA) face a compound and worsening crisis, making the region the most food-insecure globally. Despite international and regional efforts, progress towards achieving Sustainable Development Goal 2 (Zero Hunger) by 2030 and the Malabo targets of ending hunger by 2025 remains slow. The region continues to face persistent food insecurity and malnutrition. Measured by the prevalence of undernourishment (PoU) indicator of the Food and Agriculture Organisation (FAO), the burden of hunger continues to worsen significantly across all the sub-regions of SSA. In 2022, undernourishment prevalence ranged from 11% in Southern Africa to 15% in Western Africa and about 29% in both Central and Eastern Africa (FAO et al., 2023). Central Africa has the highest prevalence of undernourishment, followed by Western Africa. In the same period, Africa was home to 282 million hungry people (including 19.5 million in North Africa) in 2022 (FAO et al., 2023), representing over 38% of the approximated 735 million people who faced hunger worldwide. In 2025, about

61.6 million people were food-insecure in East Africa and nearly 50 million people in Western and Central Africa were documented as food-insecure (World Bank (WB), 2025a). Conflicts and climate change are the primary causes of food insecurity. Agricultural and export price indices have been rising at an average of 3% and 6% higher, respectively (WB, 2025a). SSA's food systems are, therefore, at a crisis point (Ndhlovu, 2025a).

SSA's food systems range from climate change, land degradation, hyperinflation, economic recessions, and poor supply chains. However, in addition to these conventional challenges, SSA struggles with recurrent political stability, especially in East and Central Africa, as well as the Southern African countries line Mozambique and Zimbabwe where access to and utilisation of agricultural is highly politicised. SSA also faces general leadership crises, poverty, poor policies, low technology uptake, gender differences in access to agricultural resources, limited credit services, and poor infrastructure (Mhlanga & Ndhlovu, 2024a, b; Mphaga et al., 2024; Ndhlovu & Mhlanga, 2023). The factors cut across the sub-sectors of SSA agriculture and food systems, making them underperform.

Existing studies mainly focus on regionwide overviews, with little focus on sub-regional and national levels (see FAO et al., 2023; Ndhlovu, 2025a; WB, 2025a). While these overviews are vital, they are too broad and do not allow for

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context- and culturally specific interventions. This is because SSA is vast, with sub-regions having distinct landscapes as well as climatic and geological conditions. Treating SSA as a single entity, therefore, leads to a narrow theorisation of the complex agricultural and food systems challenges faced by specific sub-regions and countries. This chapter contributes to current deliberations on the future of agriculture and food systems in Africa. This achieved by providing a sub-regional comparative analysis of the state of agriculture and food systems in SSA. Underpinned by a sub-regional perspective, this chapter (i) explores the condition of SSA's agriculture and food systems, (ii) identifies challenges and opportunities of SSA's agriculture and food systems, and (iii) explores pathways to sustainable agriculture and food systems in SSA. The sub-regional approach adopted in this chapter makes it vital for policymakers, academics, and investors targeting SSA agriculture and the food system sector. Policymakers can gain insights on how to make context-specific interventions, based on climatic conditions, geographical landscapes, and the social and economic conditions of countries or regions. Academics may draw insights on the evolutionary nature of SSA agriculture and food systems. Lastly, investors may gain insights into the nature of challenges and opportunities that each SSA sub-region faces and where they can invest their funds for profitable and sustainable operations.

This chapter is organised as follows: After the introduction, the following section reviews the literature that is related to the study. This is followed by an outline of the research methodology for the study. After that the chapter makes an overview discussion of the conditions of agriculture and food systems in each of SSA's four sub-regions. The chapter then reviews available opportunities for SSA agriculture and food system development and discusses the role of policies in fast-tracking agricultural and food systems development. Lastly, conclusions are drawn from the discussion.

2.2 Literature Review: Debating the State of Sub-Saharan Africa's Food Systems

A review of the literature on SSA food systems reveals a complex landscape shaped by historical bequests, global challenges, and diverse actors. While there is a shared vision for transformation and development, the reviewed literature agrees that SSA food systems are complex and dynamic, facing significant challenges as detailed in the following sub-sections.

2.2.1 Research Gaps

A review of SSA food systems shows that more attention has been on agricultural production, with little focus on other components of the entire food system (FAO, 2020). According to May et al. (2025), inadequate resources continue to negatively impact the extent and depth of food systems research in SSA. Béné et al. (2019) posit that the insufficient data is making it difficult to build a vigorous and empirical-based understanding of African food systems. However, despite these issues, it is widely agreed that African food systems face the same basic challenges related to climate change and land degradation, low productivity and outdated operational models, infrastructural deficiencies, economic restraints, and political instability, as well as demographic and social challenges (Abdullahi et al., 2024; Akpensuen & Rivero, 2025; Mhlanga & Ndhlovu, 2023).

2.2.2 Climate Change and Land Degradation

Climate change and the accompanying natural hazards, including floods, droughts, and storms, as well as changes in rainfall and extreme temperatures, devastate crops, livestock, and infrastructure, leading to significant yield losses and

food system operational deficiencies. This unpredictability makes farming a high-risk venture. For instance, in East Africa, Weesie et al. (2025) report that in 2025, agricultural activities were disrupted heavily by floods in Kenya in areas that included Homa Bay, Marsabit, Turkana, Tana River, Isiolo, and West Pokot. In Tanzania, the most affected areas due to severe flooding in 2025 were the Kyela, Rungwe, and Ileje districts in the southern highlands (Ringo et al., 2025). These districts experienced extensive flooding from heavy rainfall, causing significant damage to infrastructure and displacing over 3,000 people (Ringo et al., 2025).

In Southern Africa, South Africa experienced significant agricultural losses due to recent floods since 2022. The Western Cape, particularly the southern Overberg region and areas around Bredasdorp, have seen substantial harm to farm infrastructure, electricity, and road networks, especially impacting winter crops, wine grapes, and horticulture (Nhamo et al., 2025). KwaZulu-Natal has also been severely affected, with districts like Uthukela and Umgungundlovu experiencing crop and livestock losses, and infrastructure damage in 2022 (Thinane et al., 2023). In Zimbabwe, Malawi, and Mozambique, floods such as Cyclone Idai in 2019 devastated infrastructure, farms, livestock, and crops, affecting the livelihoods of these predominantly agrarian countries (Tevera et al., 2021).

In Central Africa, flooding and storms in the Democratic Republic of Congo have been significantly disrupting agriculture, leading to crop damage, food insecurity, and economic hardship (Missanga & Mmbando, 2025). The recurrent floods displace populations, destroy farmland and harvests, and contribute to rising food prices (Azine et al., 2025). This is exacerbating existing humanitarian crises in the country. In Angola, Correia et al. (2025) report that flooding and storms worsened by climate change are significantly impacting agriculture, leading to reduced crop yields, livestock losses, and infrastructure damage. These events, particularly affecting rain-fed agriculture, disrupt food security and livelihoods, especially for smallholder farmers. The changing climate also brings about increased

variability in rainfall, with longer dry spells and more intense flooding events in the country.

In West Africa, floods destroyed harvests in Nigeria when they covered nearly 1 million hectares (2.47 million acres) of farmland under water (Mohammed & Favretto, 2025). Soil nutrients were washed away. According to Offiong et al. (2025), flooding in Nigeria has had a devastating impact on agriculture, leading to significant crop and livestock losses, reduced yields, and disruptions to farming activities. These impacts contribute to food insecurity, especially in already vulnerable communities, and are leading to economic hardship for farmers. In Ghana, the areas most affected by floods with significant impact on agriculture since 2022 include the Greater Accra Region, specifically the Weija, Accra Metropolitan, and Ashiaman districts (Balstrøm et al., 2024). Other regions affected include the Upper East, Upper West, and Northern Regions, among others, facing perennial flooding and its consequences.

Climate change has also been linked to land degradation across SSA. Several studies have reported soil fertility depletion due to limited fertiliser replenishment, poor soil and water conservation, overgrazing, and expansion into marginal lands reduces agricultural productivity (Byaro et al., 2023; Chinseu et al., 2021; Tefera et al., 2024). In Zimbabwe, Ndhlovu and Dube (2024) also found that increasing temperatures and declining precipitation amounts were leading to an increase in crop pests and animal diseases, further impacting food production. In addition, climate change also ignited droughts across SSA, with some regions now facing chronic water shortages, limiting irrigation potential and reliance on rain-fed agriculture (Ndhlovu, 2024a).

2.2.3 Low Productivity and Outdated Practices

SSA's agriculture and food systems also face a challenge of low productivity and the use of outdated practices. The region is dominated by smallholder and peasant farmers who rely on subsistence production (Mhlanga & Ndhlovu,

2023; Nébié et al., 2021; Nyoni et al., 2024). Over-reliance on traditional, primary agriculture with minimal use of external farm inputs (fertilisers, improved seeds, technology) results in low yields. In addition, due to a lack of adequate resources, there is limited adoption of technology in SSA smallholder farming (Szőke & Ködmön, 2025). Outdated farming practices, monocultures, and lack of crop rotation are still prevalent, undermining possibilities for food system transformation (Mokone & Ndhlovu, 2025). Furthermore, SSA tend to record high post-harvest losses (Thwala & Ndhlovu, 2025a, b). In SSA, significant food crop loss occurs both pre- and post-harvest due to inadequate storage, processing facilities, and inefficient supply chains (Qange et al., 2024; Stathers et al., 2024). A staggering 37% of locally produced food is lost or wasted due to inadequate storage alone (Stathers et al., 2024).

2.2.4 Infrastructural Deficiencies

The review also shows that agriculture and food systems in Africa face significant challenges due to inadequate and underdeveloped infrastructure, which severely impacts productivity, market access, and food security. These problems are multi-faceted and include poor transportation networks. Many rural areas across SSA's sub-regions lack paved roads (Mohamed & Aboul-Atta, 2025). This makes it difficult and expensive for farmers and other food system actors to transport their produce to markets. In South Africa, Ndhlovu and Majova (2023) report that this is leading to high transport costs, increased post-harvest losses due to spoilage, and reduced competitiveness. In some SSA countries, it can even be cheaper to import goods from other continents than to transport them within Africa. In addition, inadequate rail networks and inefficient port infrastructure further incur the movement of agricultural goods, both domestically and for export. Delays and congestion at ports increase costs and affect food security (Solomon, 2025).

SSA agriculture and food systems also face the challenges of insufficient storage and processing

facilities. The region experiences high post-harvest food losses (Rutta, 2024). A significant portion of agricultural produce in Africa is lost or wasted due to a lack of proper storage facilities, such as cold storage (Missanga & Mmbando, 2025). This is particularly challenging for perishable goods like fruits, vegetables, and dairy products (Marson, 2025). Estimates suggest that 20–50% of food produced in Africa is lost or wasted annually (Rutta, 2024). In addition, SSA's food system have limited value addition (Mavhunga, 2023). The lack of adequate processing facilities thwarts farmers from adding value to their products, limiting their income and employment opportunities in the agro-processing sector. This often forces farmers to sell raw produce, often at lower prices (Ndhlovu and Majova 2023).

Many SSA countries have also electricity challenges. Many rural areas lack reliable access to electricity. Countries such as South Africa, Zimbabwe, and Zambia are also experiencing electricity loadshedding that is lasting for up to 18 h, particularly in Zimbabwe (Mhlanga & Ndhlovu, 2021). This obstructs the establishment and operation of cold storage facilities, irrigation systems, and processing plants, all of which require consistent power. Where electricity is available, it can be expensive, further increasing the operational costs for farmers and agribusinesses. Reliance on diesel-powered pumps for irrigation, for instance, is costly and polluting.

SSA agriculture has limited irrigation systems. The majority of African farmers, being smallholders, rely on rain-fed farming, making it highly vulnerable to climate variability, droughts, and unpredictable weather patterns (Ndhlovu, 2025a). SSA lags significantly behind other global regions in irrigation coverage, with only a small percentage of cultivated land being irrigated. This limits crop yields and resilience to climate shocks.

In addition, SSA faces the challenge of inadequate market infrastructure. For instance, in South Africa, Ndhlovu and Majova (2023) found that farmers often struggle to access larger, more profitable markets due to poor infrastructure, limited market information, and inefficient supply chains. Basic agricultural infrastructure like fencing and modern farming equipment is

often lacking, impacting productivity and efficient farm management.

2.2.5 Economic Constraints

SSA has significant economic development challenges. Although the region's economic growth is projected to increase, it faces significant challenges. While SSA growth is expected to accelerate from 3.3% to 4.3% in 2026–27 (WB, 2025b), it remains inadequate to significantly reduce poverty or meet development aspirations. High poverty levels in SSA limit farmers' ability to invest in better-quality agricultural technologies (Mokone & Ndhlovu, 2025). Many farmers lack access to adequate farm facilities (Zindi & Ndhlovu, 2025a, b). In addition, economic instability, market inefficiencies in SSA, and global price fluctuations is leading to high and unstable food prices, making food inaccessible for vulnerable populations in the region (Majova & Ndhlovu, 2025a, b). Many SSA countries are also heavily dependent on grain imports, making them vulnerable to international price shocks (Ndhlovu & Mhlanga, 2024). Furthermore, poor infrastructure and market distortions (e.g., monopolies and cartels in fertiliser and feed) limit access to markets for farmers and increase costs for consumers (Ndhlovu, 2025b).

2.2.6 Political Instability and Conflict

SSA is described as facing significant political instability that impacts its economic development and overall stability (Bi & Zhang, 2024; Yeboah et al., 2025). This instability manifests in numerous forms, including coups, political violence, and conflicts, often stemming from weak institutions, governance failures, and social inequalities. Conflicts and civil wars displace populations, disrupt agricultural activities, and destroy infrastructure, leading to severe food shortages and humanitarian crises (Missanga & Mmbando, 2025). In addition, the absence of good governance, inadequate policies, and lack of

enforcement mechanisms contribute to systemic fragilities in food systems (May et al., 2025). Furthermore, regional trade barriers and bureaucratic delays also hinder the movement of goods and increase the cost of selling food across borders.

2.2.7 Demographic and Social Factors

SSA is also experiencing a rapid population increase (Ayeni et al., 2025; FAO et al., 2023). This growth is projected to continue, with the region's population potentially more than tripling by the end of the century (Global Citizen, 2025). A burgeoning population places immense pressure on existing food systems to meet demand. Women, who are often key players in SSA's agriculture, face several obstacles and economic constraints that limit their contributions. In addition, poor human resource bases, inadequate education, and poor health contribute to low productivity and vulnerability (Bi & Zhang, 2024; Majova & Ndhlovu, 2025a, b).

Addressing these agriculture and food system challenges requires a multi-faceted and integrated approach, focusing on sustainable agricultural practices, infrastructure development, economic empowerment, good governance, and conflict resolution.

2.3 Materials and Methods

This exploratory chapter draws from a document review of primary and secondary documents, both in gray and academic formats, on SSA agriculture, food systems, and food (in)security. Document review is a systematic process of collecting, analysing, and interpreting documents to gain insights and answer research questions. It entails examining both internal and external documents, such as reports, policy documents, records, and even social media posts. This method is vital for providing background information, identifying key issues, and validating findings in research. In this chapter, the document review involved going

through various documents that focused on the conditions of SSA regarding agriculture and food systems. Document review provided the authors an opportunity to compare various documents on food systems and agriculture, ultimately helping them to authenticate or verify information with multiple sources at the same time.

Using Africa ‘food systems’, ‘food (in)security’, ‘Africa’ as key search words, the authors gathered various documents which included academic publications, research and policy report by national governments, and documents by sub-regional and regional Africa blocs, including the Southern Africa Development Community (SADC), Common Market for East and Southern Africa (COMESA), Economic Community of West African States (ECOWAS), and the Economic Community of Central African States (ECCAS). Documents on agriculture and food systems produced or endorsed by the African Union (AU) were also reviewed. These included the Africa Common Position on Food Systems (African Union Development Agency (AUDA), Comprehensive Africa Agriculture Development Programme, Report of the first meeting of the African Task Force on Food and Nutrition Development, Food Security and Nutrition Series, African Union 2022 Year of nutrition: Strengthening resilience in nutrition and food security on the African continent, and Nutrition and Food Security Dialogue Series.

In addition, the chapter draws from documents produced by international research and policy institutions. These documents included documents produced by FAO, including the State of Food and Agriculture 2023 – Revealing the true cost of food to transform agri-food systems, the state of food security and nutrition in the world 2017: Building resilience for peace and food security, Real-time evaluation of FAO’s response to desert locust upsurge (2020–2021), Suite of Food Security Indicators, and the Africa – Regional Overview of Food Security and Nutrition 2023: Statistics and trends.

Thematic analysis, a qualitative method used to classify, scrutinise, and report designs (themes) within qualitative data, was used in the chapter. The aim was to develop a comprehensive

understanding of the data by identifying and interpreting these themes. Three key themes emerged from the data across all four sub-regions. These themes revolved around the characteristics of agriculture and food systems in sub-regions, challenges, and opportunities of agriculture and food systems.

The use of document analysis offered several advantages. Firstly, it was cost-effective and time-efficient, particularly since the authors used pre-existing data. It could also be used as a standalone study. In addition, it provided valuable context to African agriculture and food systems, helped identify research questions, and offered a historical perspective to African agriculture. However, although useful, document analysis has several potential disadvantages, including the possibility of incomplete or biased data. In addition, in this study, document analysis presented difficulties in accessing and interpreting documents, especially documents that were not written in the English language. However, the authors dealt with these challenges through prolonged engagement with available documents. The authors also gathered as many documents as possible to close any possible knowledge and information gaps. Moreover, both gray and academic documents were used to have a larger sample. It is, however, hoped that this chapter will serve as the basis upon which future studies will adopt more empirical approaches to theorise the conditions of SSA agriculture and food systems.

2.4 Findings and Discussion: State of Agriculture and Food Systems in SSA

The review showed that SSA’s food systems are incredibly varied, shaped by a multifaceted interplay of environmental, economic, social, and political factors. While there are common challenges such as climate change, rapid population growth, and persistent food insecurity, the review shows that each sub-region faces unique circumstances and opportunities. In presenting and discussing the agricultural and food system conditions of each SSA sub-region, the chapter

first focuses on the key characteristics of each sub-region and the impact of identified characteristics on agriculture and food systems. This is then followed by an exploration of the challenges of agriculture and food systems in each particular sub-region. Lastly, opportunities available for sub-regions are examined.

2.4.1 West Africa

The review showed that West Africa is experiencing rapid population growth, with its population increasing fivefold since 1950 (Walther, 2021). This growth is projected to continue, with the region's population expected to exceed 500 million between 2030 and 2035 (Pinchoff, 2023). This growth is accompanied by a shift towards urbanisation, with more than half of the regional population now found in towns and cities. A large share of the population is under the age of 25, which contributes to continued growth due to high birth rates (Organisation for Economic Co-operation and Development (OECD), 2025). The process of urbanisation is accelerating the social, economic, and political changes that drive the demographic transition (Walther, 2021). The review showed that agriculture and food systems in West Africa are at a critical stage, facing significant challenges but also holding considerable potential for transformation. A staggering number of people in the sub-region are experiencing severe food crises. Recent reports indicate that about 52 million people in the sub-region are affected by food insecurity (FAO et al., 2023).

Agriculture and food systems are under enormous pressure from a confluence of factors. Increasing conflicts and insecurity have displaced over 12 million people, straining emergency food systems and disrupting agricultural activities (Security Council Report (SCR), 2025). The review shows that the sub-region faces several conflicts and sources of insecurity, including political instability, terrorism, and resource-based conflicts (SCR, 2025). These issues are often entwined with historical factors such as colonial legacies, ethnic tensions, and weak

governance. Several countries in the sub-region are experiencing internal conflicts with various armed groups, and external actors are also involved in some of these conflicts (Pinchoff, 2023).

The review also shows that West Africa is experiencing economic disruptions. High inflation (up to 50% in some areas), trade barriers, and increasing costs of agricultural inputs are crippling livelihoods and making food less affordable (Duho et al., 2022). Monetary policy maladministration and currency instabilities and high import costs are worsening food insecurity (FAO, 2023). As import-dependent nations struggle to access agricultural inputs due to high prices, food insecurity ensues because of constrained farming, as has also been flagged by the Food Crisis Prevention Network (RPCA).

In addition, the review reveals that increasing agricultural input prices in West Africa worsen food insecurity, especially given the sub-region's dependence on imports for agricultural inputs (FAO, 2023). Furthermore, costly infrastructure and increasing fuel costs intensify food and nutrition insecurity (FAO et al., 2023). Farmers in the sub-region are often net consumers rather than producers, and also struggle with the problem of high food prices (Behnassi & El Haiba, 2022). Higher food prices in the sub-region affect calorie consumption, but also lead to less nutritious diets. The cost of a healthy diet was found to be higher in West Africa compared to the global average (FAO et al., 2023; World Food Programme (WFP), 2024). These problems are intensified by the institutional complexity of addressing the manifold drivers of food insecurity in the sub-region.

The review shows that West Africa is also very prone to climate change effects, particularly given its substantial reliance on rain-fed agriculture (Iheonu et al., 2022). The costs are far-reaching, affecting crop yields, livestock, food security, and the overall livelihoods of people. Increased mean temperatures are a primary driver of yield loss for staple crops like rice, groundnuts, millet, yams, sorghum, maize, and beans in the sub-region (Asante et al., 2025). Temperatures which exceed crop tolerance ranges negatively affect plant physiology and productivity. Projections indicate potential yield declines of up

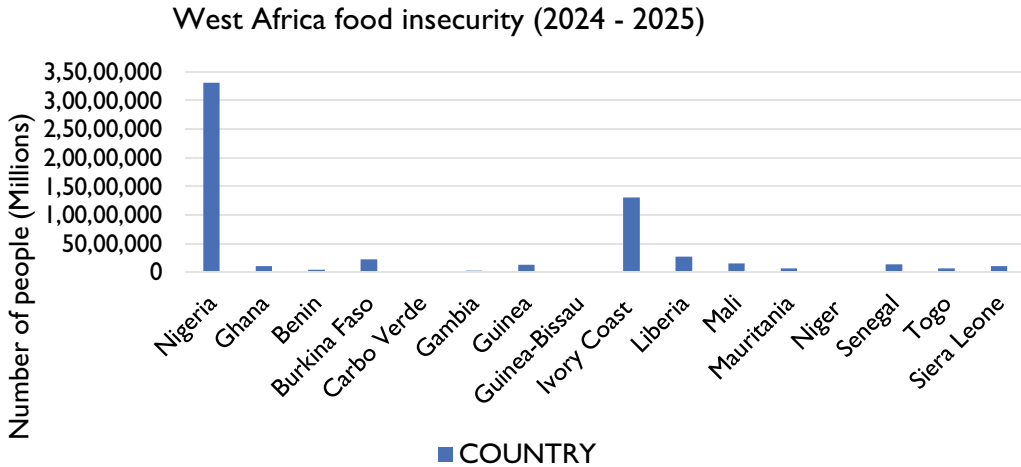


Fig. 2.1 Food insecurity in West Africa. *Source* Authors, Developed from various sources (2025 estimations)

to 20% under higher warming scenarios (Hultgren et al., 2025). West Africa is also experiencing significant inter-annual rainfall variations, increased incidence of extreme rainfall events, and prolonged droughts (Asante et al., 2025). This directly impacts rain-fed agriculture, leading to crop failures.

Figure 2.1 shows that Nigeria has the highest number of people who are food-insecure (33.1 million). This is followed by Ivory Coast with 13 million people, and Liberia (2.6 million). The rest of the countries have an average of 1 million food-insecure people.

Despite these agriculture and food systems challenges, there is a strong acknowledgement of West Africa's potential to sustainably transform its food systems. Various initiatives are underway. These include regional collaborations. Organisations, such as ECOWAS, are working with countries to strengthen food system resilience. The ECOWAS Agricultural Policy (ECOWAP) is developing a coordinated intervention framework to address common challenges faced by national agriculture systems in the ECOWAS region. Agricultural Productivity and Competitiveness is one of the critical sectors that the ECOWAS Agricultural Policy seeks to promote through several mechanisms (ECOWAS, 2020). Programmes such as the West Africa Food System Resilience Program (FSRP), supported by the

World Bank, aim to increase preparedness against food insecurity, improve resilience, and boost digital advisory services, adaptation capacity, and regional market integration (Aikins, 2025).

In addition, the sub-region is vigorously promoting climate-smart agriculture (CSA). Over 880,000 farmers in the sub-region have been supported to adopt CSA technologies, including drought-tolerant crop varieties, composting, and erosion-control techniques (Ma & Rahut, 2024). Digital innovations are also being leveraged to improve crop and livestock production, improve market access, drive financial inclusion, and address climate change (Tambol et al., 2025). Examples include mobile applications for pest control, hyper-local soil information, and weed control. Among the most impactful initiatives are Hello Tractor, Farmerline, and AgroCenta. These initiatives address different facets of the agricultural value chain while contributing to increased productivity, profitability, and sustainability (Miine et al., 2024). These platforms exemplify how technology is democratising access to resources, knowledge, and markets, empowering smallholder farmers to compete in both local and global economies in West Africa.

To boost agricultural productivity and improve food systems, regional trade and market integration are also underway. Efforts are being made to replace trade barriers with harmonised

sanitary and phytosanitary measures to facilitate food movement across borders and reduce food waste (ECOWAS Department of Agriculture, Environment and Water Resources (DAEWR), 2017). A Regional Rice Roadmap is also helping countries reduce import dependence. Over 100,000 hectares are under Sustainable Landscape Management in several West African countries. The aim is to balance human needs with environmental conservation to ensure lasting welfare and productivity of the region's landscapes (Atampugre et al., 2024). This entails integrating social, ecological, and economic considerations into land management practices to attain food security, social justice, and environmental protection.

The FAO is also playing a strategic role in strengthening early warning systems for food insecurity (FAO, 2019). This is being achieved by developing reports and tools to identify and address potential food security threats, focusing on defensive and proactive actions to mitigate the impact of disasters and crises on agricultural livelihoods. The review also reports that West Africa is investing in infrastructural development to improve food transportation and storage. In addition, West Africa is developing food systems on urban peripheries, restoring urban agroforestry policies, and encouraging agroecological practices like organic farming are being explored (Atampugre et al., 2024). Calls are also being made for increased and expanded resource mobilisation, including public–private partnerships, multi-donor approaches, and climate and green financing.

To sum up, West Africa's food systems are currently strained by a complex interplay of conflict, economic instability, and climate change, resulting in widespread food insecurity. However, transformative solutions are being actively pursued through technology, sustainable practices, improved infrastructure, and strengthened governance to build more resilient and equitable food systems for the future.

2.4.2 East Africa

The review shows that East Africa's agriculture and food systems face many challenges, ranging from climate change impacts and conflict to economic shocks, which have worsened food insecurity. While there are efforts to improve productivity and promote sustainable practices, significant gaps remain in areas like irrigation, access to technology, and addressing youth unemployment in the sector (Abdullahi et al., 2024; Bi & Zhang, 2024). The region heavily depends on rain-fed agriculture, making it very exposed to climate variability.

Climate change and variability are arguably the most significant challenges in the sub-region. East Africa experiences recurrent and extreme weather events, including prolonged droughts and catastrophic floods (Ackerl et al., 2023). These events disrupt agricultural cycles, reduce yields, and lead to prevalent food shortages (African Union Development Agency (AUDA), 2023). Rising temperatures also worsen water stress and increase the occurrence of pests and diseases (FAO, 2019). Climate change is leading to low crop yields, amplified food insecurity, and vulnerability to climate change impacts.

In addition, the review shows that reliance on rain-fed agriculture and lack of irrigation is another key challenge to East African agriculture and food systems. The majority of farmers in the region and across SSA in general, are smallholder and peasant farmers who depend on unpredictable rainfall, with inadequate and underdeveloped irrigation systems (African Union (AU), 2020). This makes them highly susceptible to climate shocks. Moreover, rapid rural–urban migration in countries such as Kenya, Rwanda, Uganda, and Tanzania, is reshaping both rural and urban food systems, often leading to a shift towards cash crop production and monoculture, compromising food availability. The food security and nutrition state remain alarming in the sub-region. In early 2025, an estimated 64 million people were food-insecure

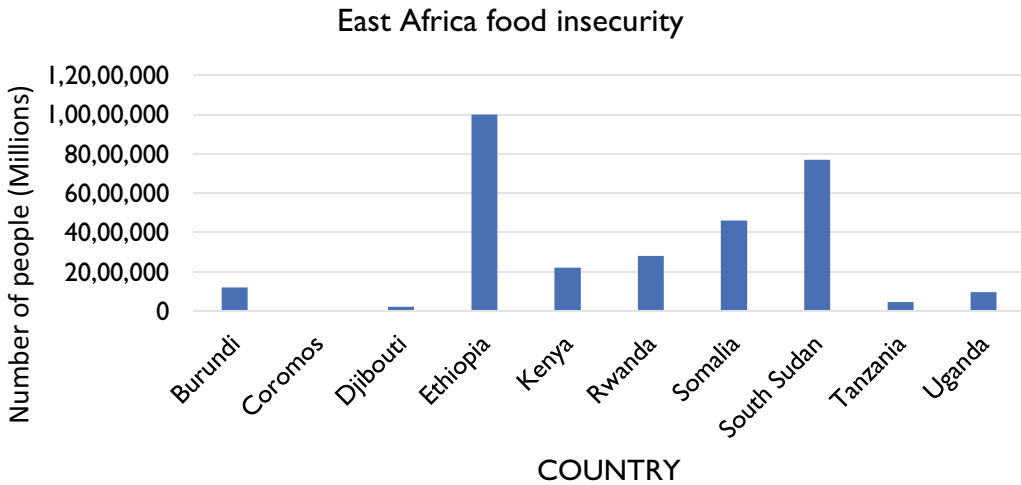


Fig. 2.2 Food insecurity in East Africa. *Source* Authors, Developed from various sources (2025 estimations)

in East Africa (ReliefWeb, 2025). This number represents a significant increase since the 2023 statistics (FAO et al., 2023). Conflict and displacement in countries such as Sudan and South Sudan have significantly worsened the situation.

East African food systems also struggle with issues of low productivity. Factors such as land degradation, limited access to modern agricultural inputs (such as quality seeds, fertilisers), poor management of markets, and inefficient land tenure systems contribute to low agricultural productivity, particularly for smallholders (Alliance for a Green Revolution in Africa (AGRA), 2022). Poor infrastructure (e.g., lack of all-weather feeder roads), inadequate storage facilities, poor post-harvest handling practices, and limited market information encumber farmers from accessing markets efficiently and getting fair prices for their produce (Lokuruka, 2020). Collusion among middlemen also impacts farmer earnings (AU, 2022).

Furthermore, inadequate financial support and limited access to agricultural credit are major barriers for farmers and other food system actors, to invest in improved practices and technologies that can contribute to food security in the region. The review also showed that conflict, supply chain disruptions, and currency depreciation are also contributing to elevated food prices and high food inflation across many East African

countries. Rapid population growth is also increasing demand for food, puts pressure on land resources, and can lead to smaller, less economically viable farm holdings, thus worsening food and nutrition insecurity in the sub-region (FAO et al., 2023). Figure 2.2 shows the number of people who are food insecure in selected East African countries where data is available.

To deal with the challenges of food and nutritional insecurity, East African countries, individually and collectively, are implementing various measures. For instance, there is a growing focus across the sub-region on promoting climate-smart agricultural practices, which include climate-resilient farming techniques, improved water management (e.g., precision irrigation), soil conservation, and the development of drought-resistant and high-yielding seed varieties.

Countries in the region are also investing in technological advancements. AI, drone technology, Internet, and satellite imagery are being explored to provide precise insights into field conditions (soil moisture, crop health), identify diseases and pests, optimise resource allocation (water, fertiliser), and improve overall farm management (AU, 2023a). Farmers and other food system actors are also working towards improving storage. Hermetic bags and improved silos are being introduced to preserve crops, reduce food wastage, and enhance food safety (East African

Community (EAC), 2019). In addition, mobile technology-supported early warning systems for extreme weather events are being introduced to empower farmers to adapt to climate challenges.

The review also shows that East African countries are engaging in regional trade and market integration. Efforts are underway to strengthen regional coordination, eliminate trade barriers, and boost intra-African agricultural trade (AU, 2023b). The African Continental Free Trade Area (AfCFTA) holds substantial potential in this regard. Although intra-regional trade is not a complete solution, it offers opportunities to enhance productivity and build more resilient food systems. East African countries are also investing in value chain development. Efforts are being made to encourage agricultural value chains in crops, livestock, and youth employment, enhancing safety considerations and market access for regional agricultural commodities (International Livestock Research Institute (ILRI), 2024). In addition, increased investment in agricultural research and development (R&D) is being promoted to improve productivity and reduce poverty in the sub-region. East African countries are also engaging the youth to participate in farming (AU, 2023a). Youth-targeted support is being rolled out by some countries to attract the youth into farming (Republic of Rwanda, 2024).

To sum up, East Africa's agriculture and food systems are at a critical juncture. While facing immense challenges from climate change, rapid growth in populations, and economic instability, there is also a concerted push towards sustainable, climate-resilient, and technologically advanced agricultural practices, alongside efforts to strengthen regional markets and address food insecurity.

2.4.3 Southern Africa

The review shows that Southern Africa's agriculture and food systems are complex, characterised by a mix of challenges and some areas of resilience, particularly in countries like South Africa, which often act as a sub-regional buffer.

In recent years, the sub-region has experienced devastating natural hazards, ranging from destructive cyclones, such as Cyclone Idai, which swept across Mozambique, Malawi, and Zimbabwe in 2019, to flash floods in Durban, South Africa. These events have had severe implications for human lives and socio-economic activities, including farming and food systems (Ndhlovu, 2024a). The arrival of COVID-19 worsened the situation. While agriculture is a cornerstone of Southern Africa's economies, providing livelihoods for a substantial share of the population, overall growth and productivity remain low, leading to persistent food and nutrition insecurity (Southern African Development Community (SADC), 2018). It contributes substantially to the region's Gross Domestic Product (GDP), often over 10% (Moyo, 2024). Crop production dominates, accounting for about 65% of total agricultural revenue, with South Africa being the top producer (Sihlobo, 2025). Livestock and fisheries also contribute.

Despite its importance, agricultural growth rates in Southern Africa have been low and inconsistent, averaging around 2.6% per annum in the last decade (Mabeta, 2025). Many countries struggle to meet the 6% agricultural GDP growth target (Sihlobo, 2025). Climate change and associated natural hazards are among the primary challenges. Southern Africa is highly susceptible to climate change, experiencing increased frequency and intensity of droughts, floods, and cyclones. This leads to erratic rainfall, higher temperatures, reduced crop and animal yields, and a decline in soil health. For instance, the 2023–2024 El Niño-induced drought has significantly exacerbated food insecurity in many countries, particularly Mozambique, Malawi, and Zimbabwe. In addition, the review shows that due to climate change, water resources are already unreliable in much of the sub-region. Most crop production is rain-fed, making it highly susceptible to unfavourable precipitation (Ndhlovu & Mhlanga, 2023). With rising temperatures and low precipitation amounts, outbreaks of pests (like the African Migratory Locust) and diseases cause considerable damage to crops and livestock (Ndhlovu & Dube, 2024). As a result,

agricultural labour productivity is significantly lower in Southern Africa (estimated at US\$851 per annum) compared to developed countries (US\$25,372 per annum) (Mabeta, 2025). This is often linked to limited access to modern farming techniques, inputs, and technology.

The review also showed that Southern Africa struggles with infrastructural deficiencies. Less than 10% of crop production is under irrigation, making the region heavily reliant on rainfall (Ndhlovu & Mhlanga, 2023). Poor rural infrastructure, limited access to markets, and inadequate storage and processing facilities hinder agricultural development (Ndhlovu and Majova (2023). While some countries have met the 10% agricultural spending target recommended by the African Union, public and private investments in the sector generally remain low. As a result, food and nutrition insecurity remain unacceptably high across Southern Africa. In 2024–2025, an estimated 67.7 million people (17% of the population) in 11 member states were reported as experiencing high levels of acute food insecurity (Intergovernmental Panel on Climate Change (IPCC), 2022).

Food insecurity in Southern Africa is, however, driven by a confluence of factors, including climate change, particularly El Niño-related droughts and cyclonic activity. Economic Shocks also contribute to food insecurity. Persistent high food prices, inflation, and weakened local currencies reduce household purchasing power, resulting in food insecurity. In addition, ongoing conflicts, especially in the Democratic Republic of Congo and Mozambique, disrupt food production and access. Pervasive poverty, low economic growth, high unemployment, and rising inequality reinforce food insecurity, especially in Zimbabwe, Malawi, and Mozambique. Insufficient safety nets exacerbate vulnerability (Ndhlovu, 2024b). Malnutrition, especially among young children, is at alarming levels, with stunting rates remaining high (averaging above 25% in most countries) (FAO et al., 2023). Supply chain disruptive events like COVID-19 lockdowns and the war in Ukraine, have further compounded food insecurity by affecting supply chains and disproportionately impacting smallholder producers (Majova & Ndhlovu, 2025). Table 2.1 summarises the state of

Table 2.1 State of food insecurity in Southern Africa

Country	Number of people
Angola	1,500,000
Botswana	58,000
Eswantini	304,000
Lesotho	335,000
Madagascar	1,940,000
Malawi	5,700,000
Mozambique	5,000,000
Namibia	1,260,000
Mauritius	300,000
South Africa	26,000,000
Zimbabwe	7,600,000

Source Authors, Developed from various sources (2025 estimations)

food insecurity in selected Southern African countries where data is available.

Southern African countries have introduced several policies and initiatives to deal with their agricultural and food system challenges. These include the SADC Regional Agricultural Policy. This policy guides sub-regional efforts to address agricultural challenges and promote food and nutrition security (AU, 2015). Southern African countries also commit to the African Union’s Comprehensive Africa Agricultural Development Programme (CAADP) goals, including increasing agricultural spending to at least 10% of national budgets and achieving 6% agricultural growth (AU, 2015). Initiatives such as the Regional Fertiliser and Soil Health Programme (RFSHP) are also being popularised in the sub-region. This programme aims to improve soil health and fertiliser availability. Several countries in the sub-region have also adopted the Guidelines for registration of biopesticides and the Strategy on the Management of Highly Hazardous Pesticides. These aim to promote safer pest and disease management.

The review also showed that Southern African countries are adopting novel methods to respond to climate change. Efforts are underway across the sub-region to improve early warning systems for floods, pests, and other disasters to enable proactive planning and response. Countries are

developing strategies to lessen the impacts of climate change on water resources and the agricultural sector through adaptive management practices. Initiatives to increase the production of drought-tolerant crops such as sorghum, millet, and cassava are being implemented (Ndhlovu & Dube, 2024). Policies that aim to create opportunities for smallholder farming enterprises, recognising their crucial role in food production, are also being vigorously pursued.

To sum up, while Southern African countries recognise the critical role of agriculture in their development and have put in place various policies and strategies, the sector continues to grapple with low productivity, significant vulnerability to climate change, persistent food insecurity, and malnutrition. Addressing these challenges requires sustained investment, improved climate resilience, enhanced infrastructure, and effective implementation of regional and national agricultural policies.

2.4.4 Central Africa

The review shows that Central Africa's agriculture and food systems, although characterised by a strong reliance on subsistence farming, face significant challenges, including widespread food insecurity, despite having substantial agricultural potential. Factors like conflict, climate change, and inadequate infrastructure contribute to these issues, leading to a reliance on food imports and hindering long-term economic development.

Agriculture is the largest sector in Central African economies, contributing significantly to GDP (e.g., 52% in the Central African Republic in 2023) and employing a large portion of the workforce (up to four-fifths in some areas) (African Development Bank (AfDB), 2025; Statista. (2025). Most people in the region depend on farming for their livelihoods, with women playing a crucial role in cultivation (Azine et al., 2025). The review reveals that staple crops grown in Central Africa include cassava, corn, millet, sorghum, rice, squashes, and peanuts. Cash crops like cotton and coffee are also produced. While efforts are being made to diversify and

Table 2.2 State of food insecurity in Central Africa

Country	Number of people
Cameroon	2,600,000
Central African Republic	2,200,000
Chad	4,300,000
DRC	28,000,000
Gabon	778,810

Source Authors, Developed from various sources (2025 estimations)

encourage commercial agriculture (e.g., sugarcane, oil palms, and vegetables for export), production largely remains at a small-scale, village level, supplying local markets (Ndeko et al., 2024).

The review shows, however, that Central Africa faces severe food insecurity challenges. A significant share of the population faces high levels of acute food insecurity. For instance, an estimated 2.6 million people were projected to face high levels of acute food insecurity in 2025 in Cameroon, while 26 million were projected in the Democratic Republic of Congo (DRC) (see Table 2.2). Food insecurity in the region is linked to several factors. Climate change and variability are reported as the main causes of food insecurity in the region (Ndeko et al., 2024). Central Africa is identified as a climate change hotspot and is highly vulnerable to its impacts (Azine et al., 2025). Rising temperatures, changes in rainfall patterns (including increased incidence of extreme rainfall), and extreme weather events (droughts, floods) negatively affect crop yields and livestock in the region (Farah et al., 2025). Climate change is estimated to reduce agricultural production, increasing the region's dependence on food imports (Farah et al., 2025). Higher temperatures and aridity threaten water storage capacities, putting pressure on already scarce water resources. In addition, pressures from pests, weeds, and diseases are expected to increase, further impacting crops and livestock. Most of the agricultural systems in the sub-region are rain-fed and underdeveloped, making smallholder and subsistence farmers particularly vulnerable due to limited financial resources and access to technology.

The ongoing conflicts and civil insecurity, particularly in the DRC, are also other drivers of food insecurity, displacing populations, limiting access to farmland, and disrupting agricultural activities (World Bank, 2025a). Over 10 million people have been forcibly displaced in the wider West and Central Africa region (United Nations High Commissioner for Refugees (UNHCR), 2025). Poor agricultural production is also implicated in food insecurity in the region. Irregular rainfall, seed shortages, crop pest infestations, and limited access to agricultural resources and tools constrain crop yields (Ndeko et al., 2024). In addition, economic instability, low purchasing power, and high food prices (especially for imported commodities) make it hard for many households to afford sufficient and nutritious food (Pomati et al., 2020). As a result, high rates of malnutrition, particularly among children, are prevalent (FAO et al., 2023).

Furthermore, the review shows that low agricultural productivity, weak local markets, and inadequate infrastructure hinder the efficient flow of food from farms to consumers (Szőke et al., 2025). Significant amounts of food are lost during production, post-harvest, storage, processing, and consumption (Farah et al., 2025). Table 2.2 summarises the state of food insecurity in selected Central African countries where data is available.

To deal with the challenges of food and nutritional insecurity, Central African countries, as well as Organizations international organisations such as the WFP and the West and Central African Council for Agricultural Research and Development (CORAF), The World Bank and regional organisations such as African Development Bank, are working to address these issues. The WFP focuses on improving food security and nutrition, supporting smallholder farmers, building resilience, and strengthening food systems through programs like home-grown school meals (WFP, 2024). CORAF supports agricultural research, promotes sustainable practices, facilitates market access for small farmers, and encourages agricultural innovation. There is an emphasis on improving water management systems and developing new seed varieties better suited to changing climatic conditions.

Focus has also been put on infrastructural development and technological adoption. Countries and various organisations are working on improving rural road networks to connect farmers to markets, reduce post-harvest losses, and facilitate the movement of inputs and produce. Irrigation projects are also being rolled out to reduce reliance on rainfed agriculture and mitigate the impact of climate-related shocks. In addition, processing and storage facilities are being developed to improve food storage and to add value to agricultural products, reduce waste, and extend shelf life (Abdullahi et al., 2024). Farmers are also being supported to adopt modern technologies to enhance productivity.

In the Central African Republic, efforts are being made to revitalise agriculture as a critical step towards economic growth and poverty reduction. Initiatives include providing seeds and tools, training farmers, strengthening agribusinesses, and investing in infrastructure like roads and drying areas (Ackerl et al, 2023). The WFP also works to improve food security and nutrition, integrating crisis response with early-recovery activities. Cameroon is also implementing a multi-dimensional approach with short-term farmer support and long-term investments in infrastructure, policy reforms, and research (Awazi, 2025). Emphasis placed on strengthening agricultural entrepreneurship, modernising value chains (e.g., cassava, maize, sorghum), and improving access to finance.

Countries such as Chad and DRC have adopted programmes aimed at building resilience for food security and nutrition in rural communities, with initiatives covering market garden production, farmland development, livestock management, and the establishment of cereal and agricultural input banks (WPF, 2024). The DRC is launching significant projects like the Agricultural Transformation Programme (ATP) with extensive investments to increase national productivity in various value chains (cassava, palm oil, maize, soya, fruits, and vegetables). The focus is on mechanisation, irrigation, post-harvest processing, and developing an inclusive and sustainable agricultural model. Equatorial Guinea, while heavily reliant on the petroleum

sector, is making efforts are ongoing to maintain staple food production (sweet potatoes, cassava, plantains) and reduce reliance on food imports. Gabon is also implementing an Economic Transformation Acceleration Plan that emphasises developing agriculture through High Agricultural Productivity Zones (ZAP). This includes efforts to boost the production of strategic crops like cassava and plantain, establish processing units, and attract foreign investors. Overall, Central African countries are increasingly moving from aid-dependent approaches to fostering investment, promoting trade, and strengthening the private sector to achieve sustainable agricultural growth and food security.

The review, however, shows that while agriculture is fundamental to the livelihoods of Central Africans, the region faces a complex interplay of conflict, climate change, and systemic vulnerabilities that severely challenge food security and the sustainability of its food systems. Addressing these issues requires comprehensive approaches that include peacebuilding, climate adaptation strategies, investment in agricultural infrastructure and technology, and support for vulnerable populations.

2.5 Conclusion and Recommendations

This chapter explored the condition of SSA's agriculture and food systems, identified challenges and opportunities of SSA's agriculture and food systems, and explored pathways to sustainable agriculture and food systems in SSA. The review showed that the agriculture and food systems of all the reviewed SSA sub-regions face significant challenges, including low productivity, climate change impacts, and dependence on imports. The study found that many countries rely on climate-sensitive, outdated agricultural systems, leading to food insecurity, low yields, and limited availability of food. Additionally, the sub-regions are heavily reliant on imported staple grains, making them vulnerable to global market fluctuations. The chapter argues that improving agriculture and food systems in all these sub-regions

is crucial for food security, economic development, and poverty reduction across the continent. Numerous interrelated strategies are needed to address the multifaceted challenges faced by the sector. These interventions include increasing productivity and production, strengthening infrastructure and value chains, embracing technology and innovation, sustainable and climate-resilient practices, and policy and governance. By focusing on these interconnected areas, SSA agriculture can unlock its vast potential, improve food security, and contribute significantly to sustainable development and poverty reduction across the continent.

Policy could play a pivotal role in shaping African food systems. This can include policies on investment in research and development. Significant increases in funding for agricultural R&D, alongside the creation of policy labs for innovation and learning, could help strengthen efforts towards transformation. Investments in agricultural infrastructure, particularly irrigation, are also crucial to enhance productivity and market access. In addition, policies that ensure fair terms of trade and improve access to markets are vital for African farmers. Furthermore, regulations on food composition, health claims, and marketing can promote healthier dietary patterns and combat the rise of non-communicable diseases. Policies supporting climate-resilient agriculture, early warning systems, and sustainable resource management are also critical for adapting to the impacts of climate change. Future research can the impact of governance on agriculture and food systems transformation prospects in SSA.

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Agriculture and Food (In)Security in East Africa: A Critical Gendered Analysis

3

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3.1 Introduction

Globally, 9.2% of the population—about 735 million people—faced chronic hunger in 2022, 122 million more than in 2019 (FAO, IFAD, UNICEF, WFP & WHO, 2023, 2024). Africa accounted for 282 million, representing over 38%, with 134.6 million in East Africa (FAO, AUC, ECA & WFP, 2023). This implies a worsening global food insecurity, affecting 735.1 million people, including 281.6 million in Africa (FAO, AUC, ECA & WFP, 2023). Women and children—especially in female-headed households—are the most affected; data shows that 27.8% of women face moderate to severe food insecurity, compared to 25.4% of men (FAO, 2025). Maternal malnutrition can trigger a cycle of deprivation, impacting child mortality, health, education, and productivity (FAO, IFAD, UNICEF, WFP & WHO, 2023). In Africa, over 59.9% of women, compared to 58.7% of men, face moderate or severe food insecurity (FAO, AUC, ECA & WFP, 2023). This persists despite agriculture employing 42% of Africa's workforce (Statista, 2024a, b), with

women contributing 40% of agricultural labour (Christiaensen & Demery, 2018).

The 1996 World Food Summit defined food insecurity as the uncertainty or inability to obtain adequate food for all household members, often due to insufficient resources to acquire food through socially acceptable means (FAO, 1996). In contrast, food security is when everyone, at all times, has physical, social, and economic access to sufficient, safe, and nutritious food to meet dietary needs and preferences for a healthy life (FAO, 2001). By 2050, global food demand is projected to rise by 70% (World Bank, 2022). Sustainable Development Goal (SDG) 2 aims to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture to meet this growing demand and stem food insecurity (United Nations, 2015; World Bank, 2025).

Food insecurity is a complex issue driven by interconnected factors such as gender discrimination, poverty, inequality, conflict, climate change, disasters, food loss, economic challenges, and weak governance and healthcare systems (Welt Hunger Hilfe, 2024). These climate change-related dynamics affect men and women differently, depending on their adaptive capacity influenced by income, resource power, access to extension services, and prevailing gender norms (Duff et al., 2017; FAO, IFAD, UNICEF, WFP & WHO, 2023). Climate change directly and indirectly disrupts food production through crop and livestock losses, reduced job opportunities, and climate-induced migration (IPCC, 2022). In 2024,

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72 million people in East Africa, Southern Africa, and the Caribbean faced climate change-induced food insecurity (Global Network Against Food Crises, 2024).

Conflict further worsens food insecurity, causing severe food shortages (Alnabih et al., 2024). Armed conflict has left 158 million people food-insecure, disproportionately affecting women's and children's nutrition (Action Against Hunger, 2025). Most are in countries like Palestine, Sudan, South Sudan, and Haiti (Global Network Against Food Crises, 2024). Conflicts damage food systems, displace farmers, destroy infrastructure, reduce resilience, disrupt markets, and raise food prices, leading to hunger and starvation (Weldegiargis et al., 2023). They also force households to rely on less preferred, less diverse foods and are sometimes used as deprivation tools to displace populations or provoke uprisings (Lin et al., 2022). This compounds conflict and food insecurity into the chicken-and-egg debate.

Location plays a key role in food security, with rural areas more affected than urban ones, and women more than men. In 2022, moderate or severe food insecurity affected 33.3% of rural adults, compared to 28.8% in peri-urban and 26% in urban areas (FAO, IFAD, UNICEF, WFP & WHO, 2023). Contributing factors in rural areas include limited job opportunities, low household income, climate change, food price instability, poor infrastructure, weak policies, and limited access to technology (Delgado, Tschunkert & Smith, 2023; Koroma et al., 2024).

Urbanisation is another food insecurity trigger, with 1.7 billion of 2.2 billion urban and peri-urban residents experiencing moderate to severe food insecurity (CFS & HLPE, 2024). While over half the global population already lives in urban areas, this is projected to grow by 70% over the next 30 years (CFS & HLPE, 2024). Studies show a positive link between rapid urban population growth and food insecurity (Kousar et al., 2021). Urbanisation reshapes food systems, making them unsustainable, nutritionally imbalanced, and highly vulnerable to shocks (CFS & HLPE, 2024). It has also shifted diets and food systems through rising incomes, changing lifestyles, employment patterns, and reduced time for food

preparation, increasing reliance on convenient, market-produced foods (de Bruin & Holleman, 2023; FAO, IFAD, UNICEF, WFP & WHO, 2023). While urban areas offer better transportation and dense populations that ease physical food access, many still face food insecurity due to unemployment or low incomes (Szabo, 2016). Urban food insecurity is further complicated by the interdependence of markets, logistics, transport, processing, settlements, and income, which influence food security and nutrition (CFS & HLPE, 2024). In developing countries, urban areas often lack disaster preparedness and social protection systems, contributing to food instability (Szabo, 2016). Urbanisation also drives up the cost of agricultural land by expanding into rural areas, while water becomes scarcer and more wasted due to industrial use, poor infrastructure, and inefficient food systems (Djan, 2023; Kousar et al., 2021; Szabo, 2016).

The rest of the chapter is structured as follows: Sect. 3.2 outlines the methodological approach adopted; Sect. 3.3 reviews regional and national-level policy and legal frameworks on gender and food security; Sect. 3.4 provides a comparative contextual overview of food (in)security in the East African region, highlighting the key drivers and the gender dynamics; 3.5 explores the region's potential to deal with food insecurity, while Sect. 3.6 concludes with recommended strategies and actions to address the crisis and persistent gender inequalities.

3.2 Research Method

While this chapter is grounded in the broader global discourse on food (in)security, it focuses on the East African sub-region by documenting the food security situation across different countries, and efforts aimed at improving food security and food nutrition, especially for women, whose gender and biological roles require robust and constant access to proper nutrition. Unlike previous studies that focused on country-specific food (in)security situations (Kibati, 2024; Lokuruka, 2020), this paper examines the drivers of food (in)security across multiple national

settings, with particular attention to gender. This comparative approach enables a broader understanding of how these drivers vary across different contexts. This comparative approach was chosen for its ability to illuminate both shared and context-specific challenges across the region. To bring out credible and up-to-date evidence on food (in)security and gender, a critical analysis of both electronic and print sources was conducted, including materials from the East African Community (EAC) and national websites, official reports from regional and international agencies, primarily the United Nations. Academic publications and relevant commentary on the six countries were also reviewed for a comprehensive and in-depth synthesis.

3.3 The East African Policies on Food Security and Gender

The East African Community (EAC) and member states have robust policy and legal frameworks centred on enhancing agricultural production, food security, household well-being and gender equality, as synthesised below.

The Treaty for the Establishment of the East African Community identifies cooperation in agriculture and food security as a key component of regional integration (East African Community, 2000). Article 110 outlines partner states' obligations, including harmonising food supply policies and strategies and maintaining strategic food reserves. This focus is reinforced in Article 45 of the Common Market Protocol, which emphasises cooperation in agriculture and rural development (East African Community, 2006). Similarly, the 2006 EAC Agricultural and Rural Development Policy (EAC-ARDP), under Article 45, promotes sustainable agricultural development and food security across the region (East African Community, 2006). The EAC Vision 2050 also underscores the importance of increased agricultural investment and improved productivity (East African Community, 2016). In line with the Maputo and Malabo Declarations, the EAC is committed to allocating at least 10% of national

budgets to agricultural development (East African Community, 2019). Gender equality is a central goal of the 2018 EAC Gender Policy, which emphasises equal rights and opportunities for women and men, boys and girls. The policy also acknowledges women's critical role in agriculture and food security in the region (East African Community, 2018).

EAC member states have embedded food security, nutrition, and gender considerations into national development frameworks. Across National Visions—including Burundi's Vision 2040, Rwanda's Vision 2050, Uganda's Vision 2040, Kenya's Vision 2030, South Sudan's Vision 2040, and Tanzania's Vision 2050—there is a shared commitment to improving agricultural productivity, boosting incomes, and ensuring food and nutrition security, particularly for vulnerable groups such as women and children (Republic of Burundi, 2023; Republic of Rwanda, 2015; Republic of Uganda, n.d.; Government of Kenya, 2007; Government of South Sudan, 2011; United Republic of Tanzania, 2024). Gender equality is a central focus in most countries, with Rwanda, Uganda, and South Sudan emphasising equal participation of women in agriculture and promoting gender-sensitive approaches (Government of South Sudan, 2021; Republic of Rwanda, 2015; Republic of Uganda, 2003).

National policies—such as Rwanda's *National Food and Nutrition Policy 2013–2018* (Republic of Rwanda, 2014a, b), Uganda's *Food and Nutrition Policy 2003* (Republic of Uganda, 2003), Kenya's *National Food and Nutrition Security Policy 2011* (Government of Kenya, 2011), and Burundi's *Stratégie Multisectoriel de Sécurité Alimentaire et de Nutrition (PSMSAN II 2021)* (Republic of Burundi, 2020)—focus on promoting access to nutritious food, establishment of food reserves, improved nutrition education, and inclusive value chains. Integrated strategies and sectoral frameworks—such as South Sudan's *Agricultural Sector Policy Framework* (Government of South Sudan, 2021), Tanzania's *Food and Nutrition Policy 1992* (United Republic of Tanzania, 1992) further support these efforts by aligning food, agriculture, and health priorities with long-term development goals, often through

a multi-sectoral lens that targets both household food access and national food systems.

Food and nutrition security and gender equality are emphasised in national legal frameworks, such as Uganda’s 1995 Constitution, which, under National Objectives and Directive Principles of State Policy, Objective XXII, mandates the state to promote food production, establish reserves, and support nutrition education (Republic of Uganda, n.d.). Kenya’s 2010 Constitution explicitly guarantees the right to adequate food and freedom from hunger as fundamental rights (Government of Kenya, 2010). While Rwanda, Burundi, South Sudan, and Tanzania lack explicit constitutional provisions on food security, they address these priorities through national development plans and sectoral policies that promote agricultural productivity, food access, nutrition, gender inclusion, and climate resilience (Government of South Sudan, 2011; Republic of Burundi, 2023; Republic of Rwanda, 2015; United Republic of Tanzania, 2024).

3.4 Drivers of Food (In)Security and the Gender Question in East Africa

As highlighted in the main introduction, food insecurity remains a pressing challenge in East Africa, shaped by a complex interplay of environmental, economic, political, and social factors. While much attention has been given to country-specific structural drivers of food availability, access, and stability, less explored is how these factors intersect with gender in different contexts to drive food (in)security, an issue explored under this section.

3.4.1 Armed Conflicts as Gendered Drivers of Food (In)Security and Malnutrition

The East African region continues to face persistent political instability and armed conflict, with severe gendered food (in)security consequences (Abdullar et al., 2024). In South Sudan, ongoing conflict has displaced millions—creating a large population of internally displaced persons (IDPs) and forcing many to seek refuge in neighbouring countries. According to UNHCR, over 1.8 million are internally displaced, about 3,500 have sought asylum, and more than 544,000 are registered as refugees (UNHCR, 2025). The prolonged conflict has disrupted food production by forcing people to abandon farmland, destroying infrastructure, and limiting access to agricultural resources. As a result, food security has deteriorated nationwide, with women—primary users of these resources—being the most affected (Kirui et al., 2024). This supports findings by Martin-Shields and Stojetz (2019), who note that conflict disrupts women’s livelihoods, increases caregiving responsibilities, limits food access, and raises malnutrition risks.

The UNHCR 2025 further indicates that each East African country hosts a substantial number of refugees and other forcibly displaced people (see Table 3.1), with Uganda and Kenya being the major hosts with 1,820,047 and 612,796 refugees, respectively. The refugee influx in the East African region has been compounded by ethno-political conflicts in other neighbouring countries, mainly Sudan, Ethiopia, Eritrea, Somalia, Rwanda, and the D.R. Congo. Oxfam (2023) states that East Africa hosts 10% of global refugees living in settlement camps or ‘self-settled’ in urban centres.

Table 3.1 Refugees and displaced persons in East African countries

Country	Uganda	South Sudan	Kenya	Tanzania	Rwanda	Burundi
Registered refugees	1,820,047	544,437	612,796	230,647	–	87,060
IDPs	–	1,844,914	–	–	–	79,917
Asylum seekers	38,013	3,599	224,109	–	–	2,093
Total population of concern	1,858,060	2,392,950	836,905	230,647	135,590	169,070

Source UNHCR (2025) <https://data.unhcr.org/en/>

Kampala and Nairobi host 136,887 and 96,348 refugees and asylum seekers, respectively, representing 8% and 15% of the total registered refugee population in the countries (UNHCR, 2025).

Refugees in settlement camps face numerous challenges, including limited access to healthcare, clean water, poverty, and food insecurity—exacerbated by a lack of land for food production and livelihoods (Abdullah et al., 2024). Land shortages often fuel tensions between displaced populations and host communities, with serious consequences for women, who are primary food providers (Nanfuka et al., 2025). Urban self-settled refugees also face food and nutrition insecurity due to high unemployment, poverty, discrimination, and limited access to humanitarian aid (Kotut et al., 2024). In both settings, food scarcity and rising urban prices often compel women to sacrifice their nutrition to feed their families, increasing health risks.

Refugees' food insecurity situation tends to be exacerbated by other factors, mainly climate shocks and economic hardships, increasing vulnerability levels (Food Security Monitor, 2025). Women and children are particularly vulnerable to these challenges due to their unique nutritional needs and the gender-based inequalities and power dynamics that restrict their access to household resources, especially land, and limit their involvement in income-generating activities and opportunities (Nanfuka et al., 2025). Conflict-induced displacement escalates these challenges for specific categories of women, primarily those with disabilities, exposing their families to famine and severe food insecurity risks. Moreover, evidence (UNHCR, 2025) indicates that females constitute most of the population in all refugee settlements in Uganda.

Despite East Africa's resource potential, internal displacement, conflict-driven migration, and other factors continue to drive food insecurity and widespread malnutrition (Lokuruka, 2020; Food Security Monitor, 2025). As of January 2025, over 61.6 million people in the region were food-insecure (WFP, 2025). The Food Security Monitor (2025) reports that more than 9.5 million people in Kenya, South Sudan, Tanzania, and Uganda face a Food Crisis (IPC Phase 3) or worse,

with South Sudan accounting for about 64% of these cases. Food insecurity and malnutrition are deeply gendered, with gender inequality intensifying their impact on women and girls. UNICEF (2025) highlights that over 4 million pregnant and breastfeeding women and girls, and more than 11 million children under five, are acutely malnourished—South Sudan showing some of the region's highest rates due to ongoing ethnic and political unrest.

3.4.2 Rapid Population Growth, Gender, and Food (In)Security

According to census reports from the East African community partner states, the population of the EAC is still growing at a fast rate for instance, Uganda at 2.9 percent its population as of May 2024 was 45,905,417 persons from 34,634,650 persons registered in 2014; Kenya, an increase from 38.6 million in 2009 to 47,564,296 persons in 2019; Burundi from 8,053,574 in 2008 to 12,332,788 in 2024; South Sudan from 8,260,490 in 2008 to 11,483,374 in 2023. Tanzania's population increased from 44,928,923 in 2012 to 61,741,120 in 2022, and Rwanda's population increased from 10,515,973 in 2012 to 13,246,394 as of August 2022 (Table 3.2).

Population growth rates in East Africa are among the highest in the world, creating increasing pressure for land cover conversion (Bullock et al., 2021). An increasing population heightens demand for fuel, building materials, land for crops and livestock, forcing people onto new land whose original vegetation cover is removed, hence leaving less fertile land for agricultural production (Kirui & Mirzabaev, 2014).

As the population in East Africa continues to increase, cropland also increases since people convert more land for agricultural purposes. Bullock et al. (2021) mention that the 18,154,000 ($\pm 1,580,000$) ha, or 34.8%, increase in the area of cropland in East Africa as land is converted from open grasslands, wooded grasslands, and open forests, to support the growing population, but in turn it affects some of the most environmentally

Table 3.2 Population changes in East Africa

Country	Census year	Average annual growth rate	Population (millions)		
			Male	Female	Total
Uganda	2014	3.0	17,060,832	17,573,818	34,634,650
	2024	2.9	22,314,289	23,591,128	45,905,417
Kenya	2009	2.9	19,192,458	19, 417,639	38,610,097
	2019	–	23,548,056	24,014,716	47,564,296
Tanzania	2012	2.7	21,869,990	23,058,933	44,928,923
	2022	–	30,053,130	31,687,990	61,741,120
Rwanda	2012	2.6	5,064,868	5,451,105	10,515,973
	2022	2.3	6,429,326	6,817,068	13,246,394
Burundi	2008	2.4	3,964,906	4,088,668	8,053,574
	2024	–	5,920,306	6,412,482	12,332,788
South Sudan	2008	–	4,287,300	3,973,335	8,260,490
	2023	4.2	5,648,789	5,834,585	11,483,374

Sources Authors, Developed from various sources

important and threatened ecosystems in the world. Altogether, the region had a decline of 18,940,000 ($\pm 1,600,000$) ha of naturally vegetated land uses (grasslands, forests, and vegetated wetlands). For example, in 2015, more than 56% of Rwanda’s land areas were converted to croplands to meet growing food demands, resulting in massive deforestation (NISR, 2021). Land cover changes as a proportion of land area was greatest in Uganda (5.29% $\pm$ 1.54) and lowest in Kenya (0.86% $\pm$ 0.47). Land cover conversion in Uganda was greatly accelerated after 2000, after which there was a notable increase in cropland and a reduction in open and wooded grasslands (Bullock et al., 2021).

One of the consequences of population growth, land fragmentation, is a common agricultural phenomenon in many countries, which is the division of one large agricultural holding into many separate small plots (Pius & Flavia, 2023). Population growth is considered one of the factors triggering land fragmentation in East Africa (Mayele et al., 2024) to create land for agriculture, industrialisation, or urbanisation, among others. Increased population pressures coupled with irregular rainfall, drought, floods, and the limited amount of land that is suitable for agriculture, alongside pests and diseases, continue to pose risks to food security, with over 38.2% of the population living

below the poverty line and almost one-fifth food insecure (Mwendwa et al., 2024).

Gender disparities exacerbate land reclamation from other uses for agriculture, land fragmentation, and food insecurity. Women who play a critical role in agriculture face great challenges in land ownership. Thirty-nine per cent of Ugandan women own or are rights holders of land (UBOS, 2020). In Kenya, women own 25% of agricultural land and 6.7% of non-agricultural land (KNBS, 2023). Similarly, in Burundi, women are the main rights holders to 25% of the land (IDLO, 2020). In Tanzania, 33% of women own land solely or jointly (KNBS, 2019). In Rwanda, 62% of the land is jointly owned by women and men, but women as sole land owners (24%) are more than the men (14%) (NISR, 2024a, b). Despite a dearth of statistics on land ownership in South Sudan, men dominate ownership (CONCERN Worldwide, 2022). Despite women owning land, in most cases, it is of poorer quality and in smaller plots (Bremner, 2012). Thus, women owning more land may not necessarily lead to more productivity and food security. More population pressure on land, therefore, complicates the role played by women as food providers within the households (Nyiranshimiyimana & Mupenzi, 2020). Yet in some situations, power relations between spouses and attitudes towards women make the situation

worse, as social norms and violence erode women's claims to agricultural land (United Nations, 2019; World Bank Group, 2021).

Poor farming methods compound these structural challenges. Most farmers in sub-Saharan Africa are small-scale entrepreneurs whose farm operations are performed with low-input agricultural technologies (Ibeawuchi et al., 2015). Low use of technology results in low yields and food losses. According to Kipkirui et al. (2023), food loss, specifically in Kenya, Tanzania, and Uganda, has significant resource implications, exacerbating food insecurity and water scarcity in a drought-prone region. They underline that in Kenya, 9% of food production is lost, in Tanzania, 13% is lost, while Uganda loses 6%. The food losses worsen the women's ability to secure food for their households.

3.4.3 Climate Change, Gender, and Food (In)Security

Climate change has become a critical driver of food insecurity in East Africa, exacerbating pre-existing socio-economic inequalities, particularly along gender lines (Palmer et al., 2023). The East African region has experienced a 1–1.5 °C temperature increase since the pre-industrial period, far above the global average (IPCC, 2022). This has led to severe droughts, mostly experienced in the arid and semi-arid areas of the region's northern part (IPCC, 2022). The rainfall cycle across the region has also varied between northern and southern parts (Richardson et al., 2022, p. 42; Palmer, 2023). In the northern part (north-eastern Kenya, northern Uganda, and South Sudan), there has been a decline in summer rainfall (June–September) since the 1960s, with one rainfall season realised. In contrast, the short rains (October–November–December) in the equatorial part (Uganda, Rwanda, Burundi, Kenya, and Tanzania) became wetter from the 1960s with heavy precipitation, leading to floods, while the long rainfall season (March–April–May) became drier, affecting crop growth and food production. Richardson et al. (2022) project that parts of equatorial East Africa will likely experience

annual average rainfall and precipitation increases by 2050. However, the climatic situation in East Africa remains 'increasingly unpredictable and extreme', implying far-reaching implications for food security.

Climate change hits women and girls in East Africa the hardest due to ingrained gender norms, unequal resource distribution, and their central role in household food security and care. Women constitute approximately 50% of the farm labour in the region but do not have secure land tenure, access to credit, and productive asset control, which limit their adaptive capacity to climate shocks (FAO, 2023). Women carry heavier loads during drought conditions because they walk longer distances to collect water and firewood, typically at the expense of their safety and health (UN Women, 2025). For instance, women in northern Kenya reported spending up to 8 h a day searching for water during the 2023–2024 drought, which exposed them to gender-based violence (GBV) and provided them with less time to earn money that they would exchange for food (Oxfam, 2020).

The East African Community Report to the Conference of the Parties of the UN Framework Convention on Climate Change (UNFCCC), COP 27 (EAC, 2019), indicates that over 70% of natural disasters in the East African region are climate-related and have produced varying impacts in different agro-climatic zones and countries. While some climatic zones have suffered chronic drought and desertification, others have been impacted by flooding and landslides. Across the countries in the region, more frequent and intense climate shocks, mainly droughts, floods, and cyclones, have heavily affected small-scale farmers and livestock herders, largely due to their dependence on rain-fed agricultural activity and natural resources (Richardson et al., 2022). Droughts, floods, and shifting weather patterns have not only driven crop failure and reduced agricultural productivity but also led to forced migrations, deepening the disparities in access to resources between men and women, often resulting in household food deficiencies and widespread famine (Abebe, 2014). Climatic shocks often intensify the burden of domestic

responsibilities on women and girls who have to find alternatives to ensure the nutrition and well-being of their households, mainly food, mostly in instances of crop failure, firewood, and water. However, women and girls are more vulnerable to malnutrition and exploitation due to weakened food systems and displacement (UN Women, 2025).

Climate-related hazards, mainly floods and landslides, affected 12,446 individuals (2,777 households) in the Ugandan districts of Kasese and Bundibugyo in the southwest, and Bulambuli and Bududa in the east, between June and July 2024, displacing 1,989 people from 540 households, over half (55%) of whom were women and girls (Uganda Multi-Hazard Report, 2024). In April 2025 alone, heavy rains flooded over 800 homes in Bulambuli District and destroyed significant hectares of crops. In Kenya, the National Disaster Operation Centre (NDOC, 2024) reports that 85% of the country (40 out of 47 counties) was affected by flooding in May 2024, displacing 293,200 individuals from their homes. In the northern and north-eastern parts of the country, floods affected over 640,600 hectares of land, of which around 18,300 hectares were cropland (World Meteorological Organisation, 2024). Prolonged flooding in South Sudan left 65,000 people displaced, damaged water facilities, and affected over 75,000 hectares of cropland and destroyed over 72,500 tons of crops, greatly exacerbating the subsisting humanitarian crises caused by internal conflicts and hostilities (Palmer et al., 2023; FAO, 2024). In Tanzania, since November 2023, more than 200,000 people have been displaced, and Cyclone Hidaya has destroyed at least 10,000 homes in the Pwani, Morogoro, Mbeya, Kilimanjaro, and Lindi regions (Tanzania Red Cross Society, 2024). In early May 2023, floods and landslides in Rwanda's northern and western parts destroyed over 4,000 hectares of soon-to-be-harvested crops. They caused the death of 4,000 livestock and damage to 6,138 homes and key infrastructure, including roads and bridges (FAO, 2024).

Flooding has further caused 'double displacement' of refugees, exacerbating their vulnerability to food insecurity and protection-related

challenges. In Kenya, nearly 20,000 people in Dadaa refugee camps, which host over 380,000 refugees, have been displaced due to the rising water levels (UNHCR, 2024). As of July 2024, Kenya faces a displaced population of more than 330,000 individuals due to the pre-flood drought and the recent floods (Kenya Disaster Response Plan, 2024). In Burundi, over 32,000 refugees, nearly 50% of the refugee population in the country, have been affected, while in Tanzania, floods have affected over 200,000 refugees, mainly from the DRC and Burundi, hosted in the Nyarugusu and Nduta camps (UNHCR, 2024). Social norms tend to prioritise men's access to food and resources in displacement environments, exposing girls and women to a higher risk of hunger and vulnerability to exploitation (FAO, 2023).

Apart from crop failure and effects on productivity, increasing temperatures have affected fragile pastoral livelihoods in arid and semi-arid areas of East Africa: Upper Nile region of Sudan, northern and eastern Kenya, north eastern Uganda, central and northern Tanzania, north eastern Burundi, and eastern Rwanda (Richardson et al., 2022). Higher temperatures have driven drought conditions, increasing water and pasture stress, leading to the death of livestock—the primary source of food and income—and lowering the productivity of pastoral livelihoods. Kenya's National Drought Management Authority (2024) indicates that over 2.61 million livestock died in 2024, while an estimated 300 cattle died in eastern Uganda. Prolonged droughts have often heightened conflicts over resources, mostly with neighbouring communities, while at the household level, they have perpetuated GBV and early marriages, disproportionately affecting women and girls (Abebe, 2014). Lastly, as men migrate for pasture or alternative work during droughts, women are left to manage increasingly strained resources. Women's limited mobility and traditional caregiving roles heighten their vulnerability to hunger and malnutrition. Women are further exposed to a greater risk of hunger and GBV due to their fixed location and caregiving status (UN Women, 2024). In South Sudan, for instance, drought-led resource conflicts have

led to an increase of 20% of reported GBV cases among displaced women (UN Women, 2025).

3.4.4 Urbanisation, Gender, and Food (In)Security

East African urban areas are undergoing rapid urbanisation, with an annual growth rate of approximately 4.5% (Friedrich-Ebert-Stiftung, 2022; Statista, 2020). This is driven by rural–urban migration, which is motivated by the need for better economic opportunities, quality services, and enhanced livelihoods. Adding to this are natural and man-made crises such as war, outbreaks of diseases, and severe weather patterns such as droughts, floods, and landslides (ibid). An increase in the internal population in the cities also drives this trend. Urbanisation rates for individual countries show the extent of this trend: Uganda leads at 6%, Burundi at 5.7%, South Sudan at 4.6%, Kenya at 4.4%, and Rwanda at 3.3% (Statista, 2020). Tanzania’s rate of urbanisation stands at 5.2% (REPOA, 2022). These figures confirm East Africa’s status as one of the world’s fastest-urbanising regions with significant land use and socio-economic consequences.

Urbanisation affects food security differently in rural, peri-urban, and urban areas, with increased gender inequities. Food insecurity decreases with increasing urbanisation in the world, with the prevalence rate at 31.9% in rural areas, 29.9% in peri-urban areas, and 25.5% in urban areas in 2023 (FAO et al., 2024). In East Africa, the trend is different, with food insecurity standing at 63.9% in rural regions, 68% in peri-urban regions, and 60.4% in urban regions (ibid). Women are also more likely to be food insecure compared to men in all regions, which shows deeply entrenched gender disparities (FAO et al., 2024). Malnutrition figures also indicate this difference: 9% of women aged 15–49 are underweight and 21% are anaemic in Uganda, with 25% of under-fives stunted (Republic of Uganda, 2020a, b; UNICEF, 2020). In Rwanda, 6% are underweight, with 33% of children stunted (National Institute of Statistics of Rwanda [NISR] & ICF, 2020). Kenya has

9% underweight women, 28.7% of women aged 15 to 49 years are anaemic, and 26% stunted children are stunted, whereas in Tanzania, it is 10% underweight women and 34% of stunted children (Global Nutrition Report, 2025; Tanzania DHS, 2016; UNICEF, 2020). In South Sudan, the figures are alarming, with over 20% of women underweight and 31% of children stunted (UNICEF, 2020). Urban poverty expands these challenges, with low-income households, particularly female-headed households, devoting a large proportion of their expenditure on food, leaving them vulnerable to impacts like loss of employment (FAO et al., 2023).

Urbanisation profoundly impacts nutrition by altering access to healthy, affordable diets. In urban areas, the inaccessibility or absence of nutritious foods usually forces poorer households to prioritise dietary energy over nutritional quality, or eat cheaper, poorer-quality food (FAO et al., 2023). This is evident in the widespread micronutrient deficiencies: 35% of women in Tanzania and over 50% in South Sudan suffer from them (Tanzania DHS, 2016; UNICEF, 2020). With their high concentration of supermarkets and fast-food chains, urban communities increase consumption of highly processed foods, energy-dense snacks, and sugar-sweetened beverages, all contributing to negative dietary consequences (FAO et al., 2023). In Kenya, for instance, urban women suffer from rising rates of obesity (12%) with persistent deficiencies (KNBS & ICF, 2015). Data from 11 sub-Saharan African countries show that the postulated “urban advantage” of accessing healthy diets overestimates it, and structural barriers within agri-food chains offer food deserts and swamps in cities (FAO et al., 2023).

Urbanisation brings profound changes in land use, reducing available land for agriculture and threatening food systems. In Uganda, Kampala’s urban area grew from 7.14% in 1989 to 55.10% in 2015, with agricultural land dropping from 48.02% to 16.69% (Muchelo et al., 2024). In Kenya, urban agricultural land has declined by 71.4% due to urban sprawl (Maina & Waiganjo, 2024). Dar es Salaam, in Tanzania, witnessed a 22.25% reduction in agricultural land due to urban growth between 1981 and 2016 (Malekela &

Nyomora, 2019). Rwanda's cropland loss between 2011 and 2020 due to urbanisation is 2.57% (Nshimiyimana & Nshimiyimana, 2023). Juba in South Sudan expansion affects arable land, though conflict hinders accurate measurement (FAO, 2020). In Burundi, the loss between 2000 and 2015 was 31.14% (Republic of Burundi, 2019). Regionally, urbanisation is projected to lead to a 3% loss of arable land in Africa by 2030, with production losses of 9% for Africa due to the reduced fertility of land converted (FAO et al., 2023). These conversions lead to lower agricultural productivity and increased food insecurity through diminished local food availability.

Urbanisation presents both opportunities and challenges for employment and livelihoods. Thus, high urban unemployment rates reflect economic strain: Uganda has 12.8% with more women (16.2%) compared to 9.9% unemployed men (UBOS, 2021); Rwanda urban areas record 15.7% (NISR, 2024a, b); Kenya's Nairobi County is at 13.96% (KNBS, 2019a, b); Tanzania urban unemployment is 25.4% with more women (30.2%) compared to 20.2% for men (National Bureau of Statistics [NBS] Tanzania, 2022). The report shows that in some areas, women are three times more unemployed than in some urban areas of Tanzania. In South Sudan, unemployment is estimated at 20–25%, though data is unreliable (ILO, 2019). On the other hand, Burundi, one of the least urbanised African countries, had an unemployment rate of 0.93% in 2023 (Statista, 2024a, b). High levels of unemployment, particularly among youth and women, are closely linked to food insecurity, as poor households often overconsume food, leaving themselves vulnerable to economic shocks (FAO et al., 2023). Formalisation activities in cities pose further risks to livelihoods by pushing informal operators out of businesses and limiting income sources (FAO et al., 2023). Social protection programs, for example, food assistance and communal cooking, usually do not extend to barriers like inadequate cooking facilities or substitute expenses; thus, urban households can still find it difficult to adjust (FAO et al., 2023).

3.4.5 USAID Funding Cuts for Agriculture, Gender, and Food (In)Security

Over the past five years, the United States Agency for International Development (USAID) has significantly contributed to agricultural development in East African countries, Uganda, Kenya, Rwanda, Tanzania, Burundi, and South Sudan (2020–2025). These efforts have often incorporated a gender lens, recognising women's critical role in agriculture and food security. The abrupt halt of USAID funding in January 2025, following an Executive Order to realign U.S. foreign aid, cancelled ongoing agricultural projects, threatening food security across these countries (Kilimo Kwanza, 2025). USAID's regional agricultural programs focused on enhancing productivity, resilience, and market access, particularly prioritising women as key stakeholders. Women constitute a significant portion of the agricultural workforce in these countries, up to 70% in some cases, but face systemic barriers, including limited access to land, credit, and training (Christiansen & Demery, 2018). Below is a comprehensive list of USAID-funded agricultural projects in Uganda, Kenya, Rwanda, Tanzania, Burundi, and South Sudan from 2020 to 2025, with funding amounts and gender-specific components.

USAID's agricultural funding in Uganda, Kenya, Rwanda, Tanzania, Burundi, and South Sudan from 2020 to 2025, totalling over USD 687.196 M (See Table 3.3), significantly bolstered food security, greatly contributing to the empowerment of rural-based farmers, mostly women. However, it remains that more agriculture-related aid could not be ascertained by the authors for this Chapter. What is clear, however, is that the funding was in some cases exclusively or mainly targeted at women farmers in the different East African countries. The sudden aid cuts, therefore, disproportionately affected women. An analysis of various reports shows that millions of women were directly affected (ISS Africa, 2025; Kilimo Kwanza, 2025; and Reliefweb, 2024).

Table 3.3 USAID funding cuts for agriculture in East Africa

Country	Project name	Duration	Funding (USD)
Uganda	Feed the future Uganda inclusive agricultural markets activity	2020–2025	\$35.8 M
	Uganda Strategic Investment Activity (SIA) support to agricultural cooperatives	2022–2027	\$105 M
	Resilience and food security activity	2021–2025	\$15.2 M
Kenya	Feed the future Kenya crops and dairy market systems	2020–2025	\$45.8 M
	Kenya feed the future local food systems	2025–2030	\$49 M
	Resilience and economic growth in arid lands	2020–2024	\$20.1 M
Rwanda	Feed the future Hinga Weze activity	2020–2025	\$32.6 M
	Feed the future Rwanda Hinga Wunguke activity	2023–2028	\$29.7 M
	USAID development innovation ventures program—village enterprise	2023–2027	\$6.5 M
	Rwanda dairy competitiveness program	2023–2024	\$12.4 M
Tanzania	Feed the future Tanzania Mboga na Matunda	2020–2025	\$28.9 M
	Feed the future Tanzania Tahifadhi Chakula (let's save food)	2023–2028	\$24 M
	USAID feed the future Tanzania agri-finance project	2024–2027	\$3 M
	USAID's Development Finance Corporation (DFC) for the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) and Zanzibar	2024	\$60 M
	USAID feed the future Kilimo Tija	2022–2027	\$38 M
	USAID Africa trade and investment activity partnership (under AGOA)	2024	\$8.3 M
	USAID-Building a Better Youth and Women Initiative for Agribusiness (BBT-YIA)	2023–2027	\$100 M
	“Accelerated Innovation Delivery Initiative-Livestock” (AID-L)	2024–2025	\$2 M
Burundi	Feed the future Burundi resilience activity	2021–2025	\$10.5 M
	Feed the future “Resilient food systems and improved local sourcing through private sector-led market access for job creation” activity	2025–2030	\$796,000
	Burundi better coffee initiative	2022–2027	\$1.7 M
	Agricultural productivity enhancement	2020–2024	\$8.3 M
South Sudan	Food security and resilience program	2020–2025	\$25.6 M
	Agricultural market development	2021–2025	\$24 M
Total			\$687.196 M

Source Authors, developed from various sources

The implication is that million more household members, whom these women support, were also affected. This has gravely affected incomes and nutrition, increasing the risk of food scarcity, famine, and thus food insecurity in the region. Countries like South Sudan and Burundi, already fragile, face the gravest risks, while Kenya and Tanzania may see broader economic ripple effects.

3.5 Prospects for Food Security and the Gender Question in East Africa

The drivers of food insecurity in East Africa are multiple and require urgent attention in a way that also addresses the gender issues therein. This section presents select efforts already underway to remedy the food security situation

in the EAC bloc. The efforts are interlinked, enhancing production, incomes, and controlling climate change for the most vulnerable, especially women, the youth, and refugees.

3.5.1 Environmental Protection

Different EAC countries are implementing programmes like Climate Smart Agriculture (CSA), carbon credits, reforestation, and conservation initiatives to reduce climate change, dependence on rain-fed agriculture, and boost agricultural production.

Climate Smart Agriculture Initiatives

CSA promotes various farming techniques tailored to withstand climate variability and extreme weather events. These techniques include crop diversification, drought and heat-resistant crop varieties, conservation agriculture methods, and agroforestry (Wanjohi, 2025). Thus, CSA sustainably increases agricultural production and incomes, builds resilience of agricultural systems, and minimises Greenhouse Gas (GHG) emissions (UNDP, 2017).

Countries like Tanzania and Kenya have CSA strategies to promote efficient agricultural practices. Tanzania has a *Tanzania Climate Smart Agriculture Programme 2015–2025* with gender considerations (United Republic of Tanzania, 2015). Kenya has the *Kenya Climate Smart Agriculture Strategy 2017–2026* (Republic of Kenya, 2017). However, it does not commit to gender in the objectives. Nevertheless, promoting drought-tolerant crops has led to a 20% increase in crop yields, a 15% reduction in greenhouse gas emissions, and training over 500,000 farmers in CSA techniques (Gatonye, Nzuki & Theuri, 2024). The strategy aims to reduce climate-induced economic losses to 3% to 5% of GDP by 2050.

Though Rwanda and Uganda have no CSA strategies, interventions are being made to institutionalise CSA. In Rwanda, for instance, CSA is part of the agricultural extension modules, with a strong gender mainstreaming component to climate change adaptation (Gfras, 2021; Republic of Rwanda, 2018a, b). Uganda is implementing a

6-year *Uganda Climate Smart Agricultural Transformation Project (UCSATP)*, which is expected to directly benefit 760,000 households (3,900,000 individuals) and indirectly benefit approximately 1,900,000 households (9,500,000 individuals) in 69 districts. Of these, 60,000 refugee households and 80,000 refugee-hosting households are planned to benefit (MAAIF, 2025). Some key project components include: strengthening climate-smart agricultural research, seed and agro-climatic information systems, a contingency emergency response component, and promoting adopting climate-smart agriculture technologies and practices. Burundi and South Sudan are not as organised as the other EAC countries but have CSA interventions.

Carbon credits

The EAC countries committed to reducing Greenhouse Gas (GHG) emissions by an average of 37% by 2030 (Eastern Africa Alliance on Carbon Markets and Climate Finance, 2023). The East African countries have generated significant results from a few projects. Kenya has generated the most GS credits, making up 46% of credits (over 12.7 million), followed by Uganda at 39% (10.6 million), Rwanda at 9% (2.4 million), Ethiopia at 3% (790,877), with Tanzania (383,467) and Sudan (368,399) at 1% respectively (ibid). Carbon markets can potentially drive gender equality and financial inclusion for women and girls by articulating women's needs, targeting women-led enterprises, and amplifying their voice since they play a leading role in agriculture (Africa Development Bank Group, 2023).

Afforestation, Reforestation, and Conservation Initiatives

Like other African countries, the East African bloc has several afforestation, reforestation, and conservation initiatives by governments, private investors, and non-governmental organisations. Women directly lead some efforts, contributing to controlling soil erosion and mitigating against flooding (International Tree Foundation, 2025; Kiiza, 2025). These include tree planting, converting previously empty land into forests, and conserving existing forests (DGB

Group, 2023). These efforts have led to planting tens of millions of trees and boosted incomes in East Africa.

3.5.2 Increasing Agricultural Productivity

Cooperation in agriculture and food security is one of the cornerstones of the EAC, and 70% of the industries in the EAC are agro-based, implying a high potential for value addition and food availability throughout the year (EAC, 2025a). However, poor farming methods, post-harvest handling, and negative gender relations in the food production systems negate the region's productivity. Women constitute over 40% of the women's farmer groups (EAC, 2025). In March 2025, EAC launched a \$12.5 million *Sustainable Regional Agricultural Extension (ENSURE) project* that targets 50% women and creates one million jobs, 500,000 of which will go to women (EAC, 2025b).

At the country level, Uganda has many agricultural programmes to boost production, food security, and commercialise the sector. The National Agriculture Advisory Services (NAADS) and subsequent interventions: Operation Wealth Creation (OWC), *Emyooga*, and the Parish Development Model (PDM) all aimed at supporting over 68% of smallholder farmers, with a focus on women and the youth (Presidential Initiatives, 2025). Centering smallholder farmers for these programmes provides women a unique opportunity to navigate food insecurity through government-supplied inputs, agricultural extension services, and improved incomes that can be used to buy other foods through the market. In Kenya, the government implemented the *National Agriculture Investment Plan (NAIP) 2019–2024* to boost agricultural productivity and incomes (Ministry of Agriculture, Livestock, Fisheries and Irrigation, 2019). In part, the NAIP targeted the 1.3 million chronically food-insecure Kenyans and the approximately 4 million Kenyans needing government support to be food-secure during emergencies. The NAIP

focused on women and the youth in the nine flagship programmes.

Tanzania's main agricultural transformation and food security programme is the *Agriculture Sector Development Programme (ASDP II)*. It is buttressed by the Pathways for Sustainable Food Systems 2030, Tanzania Agro-Industrialisation Development Flagship (TAIDF), and the Tanzania Livestock Master Plan (LMP), developed by the Ministry of Livestock and Fisheries as a pathway to achieving the Tanzania Development Vision (TDV) 2025 (African Union, 2023a, b). The aim is to improve food security and reduce undernourishment for millions of women and children in Tanzania.

The Government of South Sudan has made efforts to improve agriculture, food security and poverty through the Comprehensive Africa Agriculture Development Programme (CAADP), the 2015 Comprehensive Agricultural Master Plan (CAMP), and the Irrigation Development Master Plan (IDMP) running up to 2050. Furthermore, the Agricultural Markets, Value Addition and Trade Development Project (AMVAT). Central to these interventions is the inclusion of women and youth. There is also the South Sudan Emergency Food Production Programme (SSEFP) under the National Adaptation Programme of Action (NAPA), whose aim is to boost local food production and strengthen the resilience of food systems to mitigate short- and long-term risks due to the war (Republic of South Sudan, 2024).

In 2024, Rwanda launched the Fifth Strategic Plan for Agriculture Transformation, known as PSTA 5, to act as a tool for guiding efforts to address food systems challenges by building resilience, addressing climate change, enhancing food security, and economic growth (Ministry of Agriculture & Animal Resources, 2024). The sector has mechanised 47% of farm operations and adheres to gender equality in access to agricultural services like financing, training, and leadership. This integrated approach has ensured food security for 80% of Rwanda's households (Republic of Rwanda, 2024b).

3.5.3 Addressing Conflicts and the Refugee Influx

Each East African country, except Tanzania, has experienced direct or indirect conflict in the last two decades, posing various threats to citizens, agricultural production, and food security (Chikwanha, 2007). Although there are positive trends in Uganda, Rwanda, and Kenya, each of these countries shares borders with at least one other country experiencing intense conflict. This makes the refugee influx a real and continuing problem. The EAC has adopted a Ministerial Declaration on Durable Solutions for Refugees in the East and Horn of Africa as a targeting framework addressing the causes and drivers of displacement and the effects of conflicts (IGAD-EAC, 2023). Similarly, EAC member states, mainly Uganda and Kenya, have implemented Refugee Response Frameworks (RRF) and adopted legal provisions for refugee integration and protection. However, gender gaps remain in these policy sub-dimensions and their implementation, mostly regarding refugees' land rights, right to work, and general integration and social inclusion.

While there are promising prospects for improving food security and gender equality in East Africa, these are contingent on addressing intersections of conflict, displacement, and the gender issue through:

- (i) Promoting and further focusing on peace-building and regional stability, and creating an environment where agriculture and food systems can recover and thrive.
- (ii) A more coordinated response to refugee movements—focusing on integrating into host communities through access to land, employment, and food assistance.
- (iii) Working on a strategy for 'sharing the refugee burden' by moving refugees from countries with high influx, for instance, Uganda, to those with fewer numbers. This is critical in reducing pressure on local resources.
- (iv) Implement gender-responsive humanitarian action, mainly integrating gender into food aid, livelihood recovery, and peace-building efforts, and shift from the "women as vulnerable" mentality to women as agents to enhance their role in peace-building and humanitarian action.

3.5.4 Economic Growth

The average annual economic growth rate is projected to be 5.4% in 2025 for East Africa, from 1.1% in 2023 (Africa Development Bank, 2024). Particularly, Burundi from 2.8% to 3.5%, Kenya from 5.6% to 5.2%, Uganda from 4.9% to 6.5%, Tanzania from 5.1% to 6.2%, South Sudan from 2.5% to 27.2%, and Rwanda from 8.2% to 6.8%. The actual rates are from 2023 and projected to 2025, respectively. The combined GDP of the region is about USD163.4 billion (at purchasing power parity, about USD473 billion), and the average GDP per capita is about USD941 (at purchasing power parity, USD2,722) (EAC, 2025c). Agricultural commodities constitute about 65% of the volume of intra-regional trade. The EAC bloc has a common market arrangement, and most countries are also part of the Common Market for Eastern and Southern Africa (COMESA), with a GDP of USD 768 billion, except Tanzania, which withdrew at its inauguration in 2000 (ibid). These trading blocs promote the movement of agricultural products, ensuring incomes, food security, and nutrition for key populations like women and children at competitive prices, in a region that hosts almost a quarter of the world population in extreme poverty (Statista, 2025). Therefore, continued trade and free movement of agricultural products within East Africa, coupled with a reduction in disruptive war episodes in countries like South Sudan and Burundi, would guarantee sustained economic trade, increasing purchasing power for people residing in town and peri-urban areas to secure food through the market, as well as for the rural poor, especially women.

3.5.5 Post-USAID Funding Gaps

According to the Malabo Declaration of 2014, African countries should be spending 10% of their GDP on agriculture (African Union, 2014). Meeting the Malabo Declaration would ensure that the East African countries would make headway in ending hunger in Africa by 2025, halving poverty by 2025 through inclusive agricultural growth and transformation, boosting intra-African trade in agricultural commodities and services, and enhancing the resilience of livelihoods and production systems to climate variability. However, Burundi is the only East African country, and one of four other African countries, to meet this funding requirement, which also aligns with the 2019 EAC Food and Nutrition Security Strategy (Farming First, 2024; East African Community, 2019). With the withdrawal of the \$687 million USAID funding, meaningful participation of women and the youth is threatened, yet this is envisaged in Article IV (d) of the Malabo Declaration (African Union, 2014). The minimum for countries like Kenya, Tanzania, Rwanda, South Sudan, and Uganda is to allocate more funds to agriculture and meet the 10% funding gap. This will ensure more sustainability of agricultural projects that target climate change, gender inequalities, food insecurity, and low incomes.

3.6 Conclusion

Food insecurity in East Africa is a multidimensional challenge, driven by armed conflict, climate change, rapid population growth, urbanisation, and the recent USAID funding disruptions—all of which intersect with deeply entrenched gender inequalities, compounding the crisis. Women, who are central to food production and household nutrition, remain disproportionately affected due to limited access to land, resources, and decision-making power, with far-reaching consequences, particularly for children. While the region holds immense agricultural potential, systemic barriers undermine equitable food access. Coordinated action and gender-responsive strategies, beyond

short-term relief, alongside efforts to address the highlighted drivers of food insecurity, are required to break the vulnerability cycle, build more resilience, and achieve sustainable development across the region. Girl-child education, empowerment and enhancement of women's skills for value chain-based and 'off-farm' employment to reduce dependence on natural resources, and transformation from 'below' targeting change in social norms, values, and practices are underlined.

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Agriculture and Food Systems in Southern Africa: Experiences and Lessons

4

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4.1 Introduction and Background

The importance of the agricultural sector in Africa in contributing to food security is reflected in how it is prioritised in the development agenda. Agriculture contributes, on average, 15% of total GDP. In Malawi, 35.35%, in Mozambique, it contributes about 28%, in South Africa, 3% and in Zimbabwe 15% (World Bank, 2024). Agriculture employs more than half of the total labour force in Southern Africa (IMF, 2024) and, within the rural population, provides a livelihood for many smallholder farmers.

In Southern Africa, South Africa has the largest economy in terms of economic output, agricultural production, and trade. Despite being a giant economy, it is also susceptible to climate change hazards that the region has been experiencing lately due to low adaptive capacity (Nhamo et al., 2019). Southern Africa has been described as the

hotspot of climate change. As such, even the most resilient countries in the region, like South Africa, are bound to succumb to the effects of global climatic changes.

The issue of land tenure systems in Southern Africa continues to reflect the region's complicated history, which has affected agricultural production too. In Zimbabwe and South Africa, the governments continue to grapple with extremely inequitable land holdings (Lowder et al., 2016). Even in Zimbabwe, where land is vast, simply giving land to rural people does not ensure agricultural productivity, as rural people may use the land in various ways. While increasing smallholders' landholdings is needed to improve livelihoods, more land without increases in agricultural infrastructure investment will limit productivity.

The strategic role of agriculture formalisation of land tenure is not so straightforward within the diverse populations of Southern Africa (Basupi et al., 2017). Land tenure and gender inequality are intricately linked to agriculture in the region, especially in Mozambique, Malawi, and Zimbabwe. Legal frameworks have been amended to recognise women's rights to land in these countries. Despite this positive move, customary laws and traditions continue to challenge women in land ownership (USAID, 2019).

The next section outlines the theoretical framework for the study. This is followed by an outline of the research methodology and presentation of

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results, respectively. After that, the results are discussed, leading to the drawing of conclusions.

4.2 Theories Underpinning Agricultural Development in Southern Africa

In Southern Africa, agricultural development theories often focus on the Hayami-Ruttan induced development model, and the Integrated Agricultural Research for Development (IAR4D) concept that emphasizes innovation systems and stakeholder engagement. The Hayami-Ruttan model of induced innovation posits that technological and institutional changes in agriculture are endogenous to the economic system, driven by relative factor scarcities and changes in resource endowments, rather than exogenous scientific advancements (Hawkins et al., 2009). Hayami and Ruttan argued that changes in the relative availability of resources, like land and labour, are the primary drivers of technological and institutional innovations. The model suggests that when certain factors of production become relatively scarce (e.g., land becomes scarcer while labour is abundant), farmers and other interested parties respond by developing technologies and institutions that address those scarcities. This response leads to induced innovation, where new technologies and institutions emerge to facilitate substituting relatively abundant factors for scarce ones.

The Integrated Agricultural Research for Development (IAR4D) is a research approach that aims to address complex agricultural challenges by combining different disciplines and stakeholders to achieve sustainable and equitable development. IAR4D is a holistic approach to agricultural research, recognising that agricultural problems are often complex and require diverse solutions. The key features are interdisciplinary, multi-stakeholder, problem-oriented and sustainable.

In Southern Africa, agricultural development is intricately linked to various models, where the region heterogeneously presents opportunities for diverse approaches, including large-scale

commercial farming and smallholder systems, each having its challenges and potential.

4.3 Methodology

The study follows a descriptive qualitative methodology. The authors scanned the literature to identify factors that have enhanced the status of agriculture in selected Southern African countries (Malawi, Mozambique, South Africa and Zimbabwe). In analysing the status of agriculture in the four Southern African countries, the focus was mainly on key agricultural policies, the impact of the policies on agriculture and prospects for food security.

The study used primary and published international data to analyse Southern Africa's agricultural status. The study made use of online reports and articles, as well as similar documents. In other words, the study used online literature material and document analysis as shown in Fig. 4.1.

The study analysed literature and documentation that looked at agricultural production and, to some extent, international trade of agricultural commodities. The primary information was mainly sourced from Zimbabwean farmers and officials from the Ministry of Lands, Agriculture, Fisheries, Water and Rural Development. Online interviews were done with the Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA), where valuable information was provided on the general status of agriculture in Southern Africa. CCARDESA is a Southern African Development Community (SADC) subsidiary coordinating regional agricultural research and development cooperation.

4.4 Results Presentation and Analysis

This section presents the findings of a review conducted, focusing on the current state of agriculture in Malawi, Mozambique, South Africa and Zimbabwe.

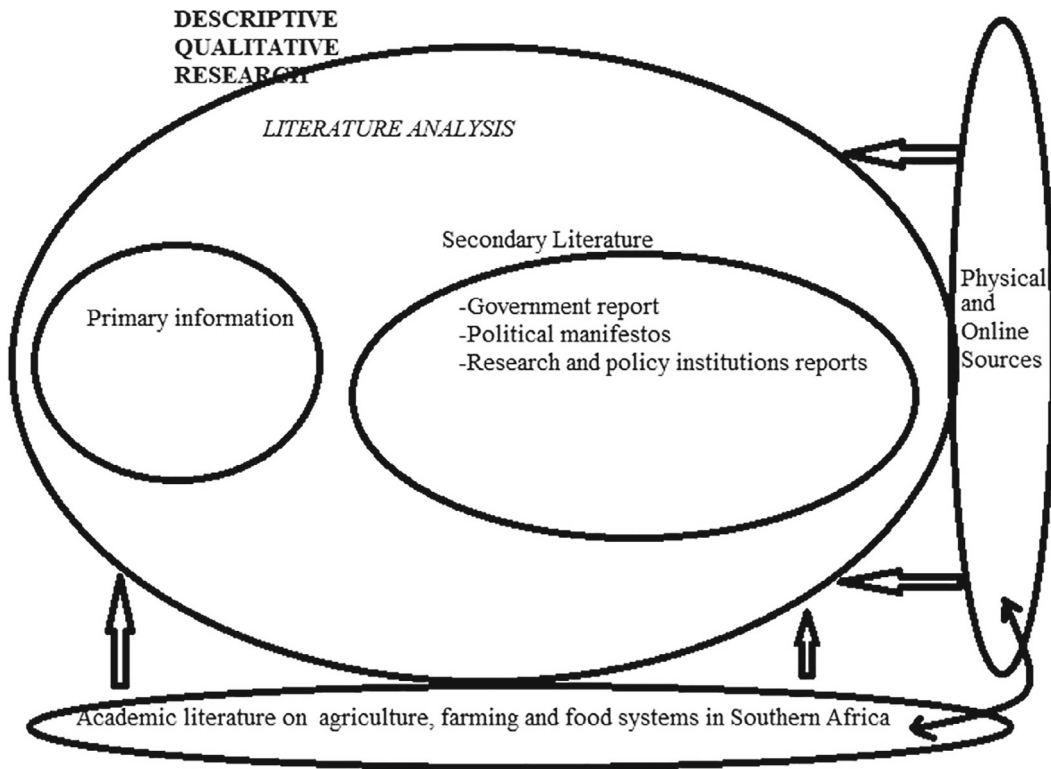


Fig. 4.1 Illustration of descriptive qualitative research. *Source* Adapted and modified from Chidoko (2024)

4.4.1 Malawi's Agriculture Sector

Agriculture remains the backbone of Malawi's economy, contributing approximately 30% to the national GDP and employing around 80% of the population, predominantly in rural areas (World Bank, 2023). Agricultural exports, particularly tobacco and tea, contribute significantly to foreign exchange, with tobacco alone accounting for 60% of Malawi's total agricultural exports (FAO, 2023). Several key crops dominate Malawi's agricultural sector. Maize is the most widely cultivated crop, covering around 50% of the total cultivated land and constituting about 70% of the country's total food crop production (FAO, 2023). Tobacco, a critical cash crop, also accounts for about 20% of total agricultural exports and contributes significantly to the country's foreign exchange earnings. The tea industry also generates approximately 5% of Malawi's agricultural export revenue. In addition, groundnuts (peanuts) are widely grown, particularly in the Central and

Northern regions, covering about 6% of total cultivated land. Groundnuts provide both local consumption and export value, contributing to the rural economy. Sugarcane covers roughly 4% of cultivated land, contributing to both domestic consumption and export markets. Rice also covers around 3% of the cultivated land, with rising local consumption and export demand. Cassava covers approximately 2% of agricultural land. It is an important food security crop, especially in areas with irregular rainfall. Furthermore, cotton contributes around 3% of agricultural output (FAO, 2023).

Additionally, fruits such as bananas, mangoes, citrus, and papayas make up about 2% of total agricultural output, contributing to local consumption and export. These crops form the backbone of Malawi's agricultural economy, supporting subsistence farming and generating income through exports.

Livestock is also another lucrative activity in the country. According to Chinsinga and Chasukwa (2018), the livestock sector in Malawi plays a crucial role in the country's agricultural economy. Cattle are the most significant livestock in Malawi, primarily raised for milk, meat, and as draught power. Poultry is another key component of the livestock sector, with an estimated 30 million birds raised annually. Poultry farming provides both meat and eggs, contributing to local consumption and serving as an important source of protein for households. Goats and sheep are mainly raised for meat, milk, and wool. The goat population is approximately 3.3 million, and the sheep population is around 1.6 million. The livestock sector contributes around 8–10% to Malawi's Gross Domestic Product (Chinsinga & Chasukwa, 2018).

Malawi also engages in fisheries. The fisheries sector in Malawi is vital to the economy, food security, and employment, with Lake Malawi being the primary source of fish. Around 80% of the total fish production comes from capture fisheries, with an annual harvest of 70,000–90,000 tons. The fisheries sector contributes approximately 4–6% to Malawi's GDP, with fish accounting for 20–30% of animal protein in the national diet. Fish are essential for nutrition, particularly in rural areas.

Malawi's agricultural sector, however, faces several challenges. The UNECA (2023) identified the following challenges for the Malawi agricultural sector: These challenges include: climate change and weather variability; soil degradation and low fertility; limited access to inputs; poor infrastructure; weak market linkages; land tenure insecurity; limited access to credit and financial services; low agricultural mechanisation; pests and diseases; weak agricultural extension services; post-harvest losses; and poor coordination between government and stakeholders.

Since attaining political independence from colonial rule in 1964, Malawi has adopted a series of policies, some of which directly impact the trading of cereals (Ndhlovu, 2025a). The country adopted several policies that enhance the production and trade of agricultural products, including cereals. See Table 4.1.

The Malawi agricultural policies in Table 4.1 sought to raise the profile of the agricultural sector. The performance of the agriculture sector in terms of output has not been consistent, though. Between independence and the late 1970s, the estate sector was the engine of economic growth. The smallholder sub-sector focused on food production, especially maize for national food self-sufficiency. However, the 1970s were characterised by substantial support from the government to the agricultural sector and consistency in policies (UNECA, 2023).

4.4.2 Mozambique Agriculture Sector

The agricultural sector in Mozambique currently represents almost a quarter of the total GDP. Mozambique remains predominantly rural, with about two-thirds of its estimated 34.5 million people residing and working in rural areas. Agriculture is an important source of job creation, increasing its relative participation in total job creation from 21.4% in 2018 to 29.5% in 2022 (World Bank, 2023).

Agriculture plays a significant role in Mozambique's economy, contributing approximately 26–30% to the national GDP and employing over 70% of the population, mainly in rural areas (World Bank, 2024). The sector is key for food security and income generation, with crops such as maize, cassava, tobacco, and cotton central to local consumption and export. Cashew nuts, sugar, and cotton are some of the primary export crops, with cashews being a notable contributor to foreign exchange earnings (World Bank, 2023).

The agriculture sector is a national priority in Mozambique and a source of income for more than 70% of the population in the country. Most of the agriculture in Mozambique is for subsistence. On that note, the country remains a net importer of food. The World Bank (2023) reports that services and agriculture composed 60% of total GDP growth in 2022. The sector is likely to continue to experience continuous growth in the coming years as the country is experiencing greater investments in rural infrastructure.

Table 4.1 Agriculture sector policies in Malawi

Policy	Description and purpose
Seed Policy (2018)	The policy targeted smallholder Farmers Crop diversification, Promotion of improved varieties that are demand-driven
Seed Act 2023	Regulates seed production, certification, and distribution to ensure farmers can access quality seeds
Fertiliser Policy (2020)	Guides fertiliser procurement, distribution, and subsidy to improve soil fertility and crop yields
Agriculture Sector Wide Approach (ASWAp) 2010–2014	– A comprehensive strategy to coordinate investments and programs in the agricultural sector to enhance food security and economic growth
	– Increase food security through increased maize productivity, crop loss reduction and diversification
	– Sustainable management of natural resources
	– Improvement of research that is market-oriented
	– To increase agricultural productivity in all agricultural Commodities
Malawi Poverty Reduction Strategy Programme (MPRSP) 2012	This has been facilitated by increasing farmers' access to credit, even non-creditworthy ones. Strengthening extension delivery services
	Strengthening access to agricultural inputs
	Implementation of the new extension policy
The National Agricultural Policy (NAP) 2016	– This has been facilitated by the Farm Input Subsidy Program (FISP), which the government is promoting among smallholder farmers
	– Facilitate investments in rainwater harvesting and water management;
	– Replacement of low-yielding varieties with high-yielding ones
	– Promoting agricultural productivity for national food security, economic growth, and development through value chain development
	– Provides a framework for agricultural transformation by improving productivity, commercialisation, resilience, and sustainable land management
National Irrigation Policy (2016)	– Aims to increase irrigation development and reduce dependence on rain-fed agriculture to enhance productivity and climate resilience
Land Act (2016) and Customary Land Act (2016)	– Establishes legal frameworks for land ownership, use, and security to support agricultural investments
Food Security sub-policy	Food production and distribution methods should be environmentally friendly and sustainable Crop Production sub policy
	Technology transfer. Crop diversification
	Processing and Preservation of food crops
National Extension Policy (2020)	Focuses on strengthening agricultural extension services to ensure farmers receive technical knowledge and skills for improved productivity
Green Belt Initiative (GBI)	Aims to expand irrigation farming along lakes and rivers to increase agricultural production and food security
National Export Strategy (NES) (2013–2018)	Promotes diversification and competitiveness in agricultural exports by improving value chains and market access
Contract Farming Strategy (2016)	Encourages contract farming to link smallholder farmers with commercial buyers and processors
Agricultural Development and Marketing Corporation (ADMARC) Policy	Oversees the marketing of agricultural produce and input distribution to support smallholder farmers

(continued)

Table 4.1 (continued)

Policy	Description and purpose
Control of Goods Act (Amendment) (2018)	Regulates agricultural commodity trade and price stabilisation to protect both farmers and consumers
Malawi Growth and Development Strategy (MGDS III) (2017–2022)	This includes agriculture as a priority sector that drives economic development and poverty reduction

Source Compiled from information sourced from the Ministry of Agriculture and Food Security (Malawi) (2025)

Mozambique’s agricultural output is diverse, and several key crops dominate production across the regions. Maize is the main staple food crop, making up about 40–50% of total crop production. Maize plays a crucial role in food security and as a source of income (FAO, 2023). Cassava covers around 20% of the total agricultural land. Cassava is essential for local food security, especially in regions vulnerable to irregular rainfall patterns. Sugarcane contributes to both domestic sugar production and exports, with Mozambique being a major exporter of sugar in the Southern African region. Tobacco is a key export crop, making up around 10% of agricultural exports. It is critical for foreign exchange earnings. Cashew nuts have grown in importance as a cash crop, with Mozambique being one of the leading global exporters. The crop contributes around 5–7% of the total agricultural export value. Cotton is another important cash crop, cultivated in the central and southern regions, contributing around 5% to total agricultural output (FAO, 2023). Rice is an increasingly important crop in the country. The rise in local consumption has led to increased production, now covering about 3–4% of total land under cultivation.

Mozambique also engages in livestock production. Livestock farming in Mozambique is a crucial part of the agricultural economy, contributing to 7–9% of the GDP (Silici et al., 2024). The sector is vital for rural livelihoods, with significant populations of cattle, goats, sheep, and poultry. Cattle are raised mainly for meat, milk and as draught power. Mozambique has an estimated 6 million cattle, and livestock contributes around 4–5% of the country’s agricultural output (FAO, 2023). Poultry farming is widespread, with an estimated 40 million birds. Poultry contributes significantly to the domestic protein supply, and

demand has been rising steadily. Goats and sheep are raised primarily for meat and milk, and these animals are crucial in regions where crop production is limited due to climate challenges.

The country also engages in fisheries. The fisheries sector is a significant contributor to Mozambique’s economy, contributing approximately 4–6% to the national GDP (Silici et al., 2024), with fish production exceeding 150,000 tons annually.

Popat et al. (2021) summarised that the key challenges to Mozambique’s agricultural sector include climate change. Mozambique is highly vulnerable to cyclones, droughts, and floods, frequently damaging crops, livestock, and infrastructure, threatening food security. Another challenge is low agricultural productivity (Mokone & Ndhlovu, 2025). There is also weak market access and infrastructure in the country. Poor road networks, limited storage facilities, and weak transport systems make it difficult for farmers to access markets and sell their produce at competitive prices. In addition, land tenure insecurity undermines the country’s agricultural sector. Furthermore, limited access to finance is another challenge. Smallholder farmers and agribusinesses struggle to obtain credit due to high interest rates, lack of collateral, and underdeveloped rural financial systems (Ndhlovu, 2025b).

Mozambique’s agricultural sector also faces challenges of pests and diseases. Crop pests like fall armyworm and livestock diseases such as foot-and-mouth disease and Newcastle disease threaten agricultural production and food security. Mozambique also lacks sufficient irrigation infrastructure, making agriculture highly dependent on unreliable rainfall. In addition, inadequate storage, poor processing facilities, and weak value chains lead to high post-harvest losses, reducing farmers’ incomes and food availability. Table 4.2

Table 4.2 Agriculture and food security policies in Mozambique

Policy	Description
Agrarian Programme ¹ Food security and agricultural development	To develop agrarian activity seeking to achieve food security, through the diversification of production for consumption, supply to the national industry, and for export, based on the sustainable use of natural resources and ensuring social equity
National Agriculture Policy (NAP) (2020)	Aims to modernise the agricultural sector by promoting sustainable production, climate resilience, and improved market access
Strategic Plan for Agricultural Development (PEDSA) (2011–2020)	Focuses on increasing agricultural productivity, strengthening value chains, and promoting food security
National Irrigation Policy and Implementation Strategy (2010)	Seeks to expand irrigation infrastructure to reduce dependence on rain-fed agriculture
National Seed Policy (1999, revised 2011)	Regulates seed production, distribution, and certification to improve seed quality and availability
Food and Nutrition Security Strategy (ESAN III) (2018–2025)	Aims to combat food insecurity and malnutrition through improved agricultural practices and food distribution
Agricultural Marketing Strategy (2012)	Focuses on improving access to markets, storage facilities, and transportation for farmers
Fertiliser and Input Subsidy Program	Encourages the use of fertilisers and other agricultural inputs to enhance productivity
Agro-Processing and Value Chain Development Strategy	Promotes agro-industrial investment to enhance value addition and competitiveness in domestic and export markets
Climate Resilience and Adaptation Strategy for Agriculture:	Encourages climate-smart agriculture and conservation practices to mitigate climate change impacts
Contract Farming and Agribusiness Promotion Policy	Aims to strengthen linkages between smallholder farmers and agribusiness companies to ensure market stability
Land Law (1997); Seed Act (2001)	Establishes land tenure rights, ensuring that land remains state-owned while allowing long-term use rights to individuals and businesses.; Governs seed certification
Plant Protection Act (2005)	Regulates pest control measures, quarantine requirements, and the use of pesticides
Fertiliser Regulation Act (2013)	Establishes rules for fertiliser import, production, distribution, and usage
Animal Health Act (2009)	Provides regulations on disease control, veterinary services, and livestock health management
Agricultural Extension Services Act	Defines the framework for extension services to support farmers with modern agricultural techniques and technologies
Water Resource Management Act (1991)	Regulates the use of water resources for irrigation and other agricultural activities

(continued)

¹The SUSTENTA programme, approved in 2017 and extended to the national level in 2020, was initially intended to be transformed into the National Family Farming Policy. However, in the end, it remained a programme. The overall objective of this programme was “improving the quality of life of the rural families by promoting sustainable agriculture (social, economic and environmental)” (Ministry of Land, Environment and Rural Development, 2020).

Table 4.2 (continued)

Policy	Description
National Biosafety Law (2005)	Regulates the use of genetically modified organisms (GMOs) in agriculture
Fisheries and Aquaculture Act (2013)	Governs the sustainable management and development of fisheries and aquaculture
Forestry and Wildlife Act (1999)	Regulates the use and conservation of forest and wildlife resources, affecting agroforestry and rural livelihoods

Source Compiled from information sourced from Aiuba (2022)

shows the agricultural policies that Mozambique has implemented.

Mozambique does not have an agricultural policy per se although it has an agrarian policy since 1995 (Aiuba, 2022). Upon the approval of this policy, regarding the agricultural sector, general and specific plans, strategies, programmes, and projects were designed, approved, and implemented. These are:

- National Programme for Agricultural Development phase I 1998–2004 and phase III (PROAGRI I and II, 1998, 2005),
- Food Security and Nutrition Plan phase I and phase II (ESAN I and II, 1998, 2007),
- Agriculture’s Extension Master Plan 1999–2004 (s/d), Agenda 2025 (2003),
- Green Revolution (2007), Rural Development Strategy (EDR, 2007),
- Agriculture’s Extension Master Plan (PDEA, acronym in Portuguese, 2007),
- Programme for Intensifying and Diversifying Agriculture and Livestock in Mozambique (2008),
- Action Plan for Food Production (PAPA, 2008), Strategic Plan for Agricultural Development 2011–2020 (PEDSA, 2011),
- National Strategic Fertiliser Programme (2012), National Agrarian Extension Program (PRONEA, 2012),
- National Irrigation Programme (2013),
- Operational Plan for Agricultural Development 2015–2019 (PODA, 2017),
- National Water Resources Management Plan (2019),
- National Investment Plan for the Agrarian Sector 2013–2017/19 (PNISA, s/d) and

- SUSTENTA (2016, 2020) (Beula, 2020; Mosca, 2011).

These documents had as the main goal the rise of the agricultural sector’s productivity, production, competitiveness, income and rentability, to fuel the domestic and international markets (Aiuba, 2022).

One of the key agrarian policies in Mozambique is the Strategic Plan for Agricultural Development (PEDSA), which was introduced to guide the sector from 2011 to 2020. PEDSA aimed to transform agriculture from a subsistence-based system into a competitive and sustainable sector by promoting commercial farming, improving value chains, and enhancing market access. It focused on increasing productivity through improved technology adoption, irrigation expansion, and extension services. While PEDSA set ambitious goals, its impact was constrained by insufficient funding, weak coordination among stakeholders, and difficulties in reaching smallholder farmers who constitute the majority of producers (Aiuba, 2022).

The National Agricultural Investment Plan (PNISA), which was aligned with PEDSA, sought to operationalise the strategic objectives by attracting investments and fostering public–private partnerships. It emphasised the need for infrastructure development, particularly in rural areas, to improve transport and storage facilities. PNISA led to some improvements, such as increased investments in irrigation and mechanisation, but its implementation was hindered by inconsistent funding and bureaucratic inefficiencies. Additionally, smallholder farmers still faced challenges in accessing credit and input subsidies, limiting their capacity to adopt

improved agricultural practices (Suit & Choudhary, 2015).

Mozambique has also implemented policies to enhance climate resilience and sustainability in agriculture, recognising the sector's vulnerability to extreme weather events such as cyclones, droughts, and floods (Silici et al., 2024). The National Adaptation Plan for Climate Change (NAPA) and the Sustainable Land Management (SLM) programme aimed to promote climate-smart agriculture, reforestation, and sustainable land use practices. Some progress has been made in integrating climate adaptation strategies, particularly in promoting drought-resistant crops and agroforestry. However, the lack of technical expertise, financial constraints, and limited farmer awareness have slowed down the widespread adoption of these practices (Matavel et al., 2022).

Land tenure remains a critical issue in Mozambique's agricultural policy landscape. The 1997 Land Law grants land ownership rights to the state while recognising customary land rights. This policy aimed to protect smallholder farmers from displacement while enabling investors to access land through long-term leases (Silici et al., 2024). However, conflicts over land use and allocation have persisted, particularly in areas targeted for large-scale commercial agriculture and foreign investments (Aiuba, 2022).

Agricultural trade and market access policies have also played a role in shaping Mozambique's agricultural sector. The government has sought to promote exports of key cash crops such as cashew nuts, sugar, and tobacco while ensuring food security through import regulations. However, logistical challenges, such as poor transportation networks and high post-harvest losses, have limited the competitiveness of Mozambican agricultural products in regional and global markets (Matavel et al., 2022).

Despite these challenges, Mozambique has made some strides in enhancing food security, increasing agricultural productivity, and fostering economic growth. The government has committed to addressing structural barriers by prioritising

infrastructure, research, and technology investments. However, achieving long-term agricultural transformation requires stronger institutional capacity, increased financial resources, and enhanced collaboration between the government, private sector, and development partners (Aiuba, 2022).

4.4.3 South Africa's Agriculture Sector

South African agriculture is highly diversified with both crop and livestock production. Major grains include oilseed, fruits, sugar, citrus, wine and most vegetables, whilst livestock includes cattle, dairy, pigs, sheep, and poultry (FAO, 2023).

South Africa is a major producer and net importer of wheat and wheat products for the crop sector. South Africa produces 60% of the domestic supply of wheat consumed as food. About 80% of the domestic supply of maize and maize products is produced locally, 20% of which is exported. Whilst half of maize consumption is used for food, the other half is used as feed for domestic livestock herds (Benjamin et al., 2024).

South Africa is also a major producer and net exporter of fruits and wine. More than half of the fruits are produced for export markets—grapes are processed into higher-value products such as wine. Almost half of the wine produced in the country is for export markets. In addition, South Africa is also a major producer of sugar, which is made from domestic sugar cane production. Rice is, however, solely imported as the country does not produce it locally (Benjamin et al., 2024).

South Africa is a major producer for the livestock sector and is self-sufficient in meat, milk and eggs. However, the country imports almost one-fifth of its poultry meat. The country produces thousands of tons of the following by-products from the livestock sector—hides, skins and wool and half of the produced by-products are exported (FAO, 2023).

For the fisheries sector, in 2011–13, the total production was 620 thousand tons (404 pelagic

and 170 demersal) fish catches—the products are consumed locally, and some are exported.

South Africa's economy is primarily driven by the tertiary sector, which accounts for an estimated 69% of GDP (value for 2016 according to World Bank Development Indicators). The combined contribution of primary agriculture, forestry and fisheries sectors to the total value added was only 2–2.7% between 2005 and 2016 (Fischer & Timberland, 2019). Agriculture contributes significantly to employment creation in primarily rural areas, accounting for 5.4% of the total labour force (Ministry of Agriculture, Land Reform and Rural Development, 2023).

The agriculture sector in South Africa faces many challenges, including biosecurity challenges. The livestock and poultry subsector forms nearly half of the South African agricultural economy, and therefore, biosecurity poses serious challenges, yet the country's food security and export potential depend on it. It also faces agricultural export challenges. The export-oriented agricultural sector relies heavily on specific services by the government, e.g., favourable trade agreements and other market access requirements initiated. Infrastructure challenges (water, roads, energy, ports) also exist. Adequate ports and rail are critical to agricultural exports and domestic product distribution.

cd several policy documents to transform agricultural commodities' production and trade locally, regionally and internationally. (Mudavanhu, 2015). Table 4.3 lists the policies that have governed the country's production and trade of agricultural products.

The policies given in Table 4.3 show that agriculture in South Africa is addressed within a range of national policies. The sector is highly deregulated. At first, this created some uncertainty. However, it opened opportunities for entrepreneurial farmers and led to a more efficient allocation of resources in agriculture. Thus, according to Pereira and Ruysenaar (2012), the South African agricultural industry has become less dependent on state support and internationally more competitive.

The South African economy, including agriculture, is increasingly integrated into world markets,

with about one-third of agricultural production exported. It is among the world's leading exporters of agro-food products. The agricultural sector is highly dualistic, with a small number of commercial operations run predominantly by white farmers and large numbers of subsistence farms run by black farmers (Cousins, 2013).

In the 1990s, a wide range of reforms liberalising domestic and foreign trade and lowering support to agriculture were implemented. The commercial agricultural sector adapted well to the policy reforms and liberalisation efforts. The overall results of the agricultural policies have been very positive, with a stronger and stable macro economy and better integration into the global trading system (Cousins, 2013). The policies have managed to enhance production in the country. The production has been rising over the past years. Thus, it exported a significant amount of cereals, especially maize.

4.4.4 Zimbabwe's Agriculture Sector

Zimbabwe has diverse agro-climatic conditions that makes it possible for a large variety of crops (over 23 types of food and cash crops) and livestock species to be produced (Chidoko & Gwatidzo, 2025). Main livestock produced include beef, dairy, small ruminants, pigs, poultry, apiculture, aquaculture and other small and emerging stock. The sub-sector contributes about 19% to the agricultural GDP. Main food and cash crops in Zimbabwe include maize, wheat, small grains (millet and sorghum), legumes, soya beans, sunflower seed, tobacco, cotton, sugarcane, horticulture (food and non-food) and groundnuts. According to the Ministry of Agriculture, Land Reform and Rural Development (2023), tobacco, cotton, sugar, beef, horticultural produce, coffee, and tea are the key agricultural exports from Zimbabwe.

There has been a major transformation in the agricultural sector in the last two decades, and this has transformed the structure of land ownership and access to and use of rural agricultural land, through the fast-track national land reform

Table 4.3 Agriculture and food security policies in South Africa

Policy	Description
Animals Protection Act No. 71 of 1962	To consolidate and amend the laws relating to the prevention of cruelty to animals
Plant Breeders' Rights Act, 1976 (Act No. 15 of 1976)	Establishes a system for granting and registering plant breeders' rights, protecting those rights, and providing for the granting of licenses
Plant Improvement Act, 1976 (Act No. 53 of 1976)	To provide for the registration of establishments from which the sale of certain plants or the cleansing, packing and sale of certain propagating material may be undertaken
Agricultural Research Act 86 1990	To establish a juristic person to deal with agricultural research
Livestock Improvement Amendment Act 85 1990	To provide for the breeding, identification and utilisation of genetically superior animals to improve the production and performance of animals in the interest of the Republic; and to provide for matters connected therewith
Agricultural Product Standards Act 119 1990	To provide for control over the sale and export of certain agricultural products and other related products; and, for matters connected therewith
Roodepoort and Weltevreden Agricultural Settlement Adjustment Amendment Act 38 1990 + Roodepoort and Weltevreden Agricultural Settlement Adjustment Act 19 1991	To amend the Roodepoort and Weltevreden Agricultural Settlements Adjustment Act, 1966 [repealed in 1999], to regulate the ownership of those portions of the common grazing ground of the Roodepoort Agricultural Settlement which were not divided into lots
Exemption from certain payments at the transfer of the Sorghum Beer Industry Act 72 of 1991	The "Exemption from Certain Payments at the Transfer of the Sorghum Beer Industry Act, 1991," exempts certain payments related to the transfer of immovable property used in connection with the sorghum beer industry from the Industrial Development Corporation of South Africa, Limited
Protection of animals (Amendment Act 132, 1991)	The "Protection of Animals Amendment Act 132 of 1991" is a South African law that amends the Animals Protection Act 71 of 1962, focusing on definitions, penalties, and other provisions related to animal welfare and cruelty prevention
Animal Diseases Amendment Act 18, 1991	The Animal Diseases Amendment Act 18 of 1991 likely refers to a South African law, and it amends the Animal Diseases Act, 1993, to provide for the control of animal diseases and parasites, including the performance of controlled veterinary acts at quarantine stations
Livestock Brands Amendment Act 10 1992	The Livestock Brands Amendment Act 10 of 1992, which is now repealed, dealt with the registration and application of livestock brands and honorary brands, including the size and location of livestock brands
Agricultural Development Fund Act 175 1993	The "Agricultural Development Fund Act 175 of 1993" (RSA) established the Agricultural Development Fund (ADF) to provide financial assistance to farmers, aiming to promote agricultural development and economic growth in South Africa
Animal Matters Amendment Act 42 1993	Amends the Animals Protection Act, 1962, to further regulate the prohibition of animal fights and to provide for matters connected therewith, including penalties for negligence in respect of an animal
Agricultural Labour Act 147 1993	Established an Agricultural Labour Court to address disputes between employers and employees in farming activities concerning alleged unfair labour practices
Agricultural Research Second Amendment Act 174 1993	Established a juristic person to focus on agricultural research, development, and technology transfer to promote agriculture and industry, and contribute to improving the quality of life

(continued)

Table 4.3 (continued)

Policy	Description
Societies for the Prevention of Cruelty to Animals Act 169 1993	Establishes the National Council of Societies for the Prevention of Cruelty to Animals (NSPCA) to control and coordinate SPCA societies, promoting uniformity in policies and standards, and preventing animal cruelty
Agricultural Credit Amendment Act (House of Assembly) Act 53 1993	Provided for assistance to farmers and the exercise of control over that assistance
Land reform (1994) Agricultural Labour Amendment Act 50 1994	The South African Land Reform Programme is implemented through three main programmes: • Land restitution: targeting people who lost their land in the past due to racially discriminatory legislation • Land redistribution: providing the poor and disadvantaged with land to improve their livelihoods, resettle or establish farming enterprises • Land tenure reform: ensuring tenure security by strengthening residents' rights on privately owned farms and state land and enabling individuals to benefit from their property
Agricultural Credit Amendment Act 65 1995	To amend the Agricultural Credit Act, 1966 [repealed in 2003], to make it applicable throughout the Republic; and to replace or delete specific definitions and expressions
Plant Breeders' Rights Amendment Act 15 1996 Agricultural Research Amendment Act 16 1996	Amends the Plant Breeders' Rights Act 15 of 1976, providing a system where plant breeders' rights relating to certain plant varieties can be granted To re-regulate the constitution of the Council managing the affairs of the Agricultural Research Council
Plant Improvement Amendment Act 25, 1996	Amends the Plant Improvement Act 53 of 1976, specifically by substituting the long title of the original act and providing for incidental matters related to plant propagating material
Marketing of Agricultural Products Act 47 of 1996	To authorise establishing and enforcing regulatory measures to intervene in the marketing of agricultural products, including introducing levies on agricultural products; to establish a National Agricultural Marketing Council
Agriculture Laws Extension Act 87 1996	Extended several South African agriculture laws to territories formerly part of the Republic of South Africa, including the former Transkei, Bophuthatswana, Venda, and Ciskei, as well as the former self-governing territories
Livestock Improvement Amendment Act 60 1997	Amended by the Livestock Improvement Amendment Act, 1993 (No. 25 of 1993). This amendment focused on the Livestock Improvement Board, its functions, and powers, among other things
Marketing of Agricultural Products Amendment Act 59 1997	To amend the Marketing of Agricultural Products Act, 1996, to amend, delete and insert specific definitions; and to emphasise the legal personality of the Council
Animal Improvement Act 62 1998	To provide for the breeding, identification and utilisation of genetically superior animals to improve the production and performance of animals in the interest of the Republic
Agricultural Product Standards Amendment Act 63 1998	Provides for control over the sale and export of certain agricultural products, control over the sale of certain imported agricultural products, control over other related products, and for matters connected therewith
Agricultural Laws Rationalisation Act 72 1998	To provide for the rationalisation of certain laws relating to agricultural affairs that remained in force in various areas of the national territory of the Republic prior to the commencement of the Constitution of the Republic of South Africa
Onderstepoort Biological Products Incorporation Act no. 19 1999	To provide for the establishment of a company to manage the institution known as Onderstepoort Biological Products, the appointment of directors, the holding and disposal of shares in the company, the transfer of personnel to the company and the transfer of funds and assets to the company

(continued)

Table 4.3 (continued)

Policy	Description
Meat Safety Act No. 40 of 2000	To provide for measures to promote meat safety and the safety of animal products
Agricultural Research Amendment Act 27 2001	To amend the Agricultural Research Act, 1990, so as to make further provision for the procedure to be followed in the appointment of members of the Council
Agricultural Debt Management Amendment Act 49 2002	Amends the Agricultural Debt Management Act, 2001, to address the preparation, execution, and attestation of documents for registration or filing at a deeds registry by an officer of the department, and to provide for related matters
Agricultural Debt Management Act 45 2001	To establish the Agricultural Debt Account, manage agricultural debt repayment, and administer related matters, including debt agreements, interest rates, debt collection, and property registration
Animal identification Act 6 of 2002	To consolidate laws related to animal identification and provides for incidental matters, including the registration of identification marks
Animal health Act 7 of 2002	To provide for measures to promote <i>animal health</i> and to control <i>animal</i> diseases
Land and Agricultural Development Bank Act 15 2002	To provide for a juristic person known as the Land and Agricultural Development Bank
Agricultural produce Agents amendment act 2003	Amended by Act No. 47 of 2003, which includes changes to definitions like “fund” and “livestock agent”
Agricultural Produce Agents Amendment Act 47 2003	Amends the Agricultural Produce Agents Act (Act No. 12 of 1992) and repeals the Acts listed in the Schedule
The National Development Plan (NDP) of 2012	Has become the overarching government development agenda (NPC 2012) although not all sectors of government necessarily adhere to its vision. The NDP identifies agriculture as primarily an economic activity in rural areas, potentially creating one million new jobs by 2030 Promote a sustainable increase in crop productivity, increasing agricultural exports Improve access to productive resources and services Strengthen public and private sector institutional capabilities
The Integrated Growth and Development Policy for Agriculture, Forestry and Fisheries (IGDP) (2012)	Increase in agricultural production and investment
The Agricultural Policy Action Plan (APAP) (2013)	The role of smallholder farmers in realising food trade surplus, with potentially one third produced by smallholders
The New Growth Path (NGP) (EDD, 2013)	South Africa’s vision is to place jobs and decent work at the centre of economic policy The NGP set targets to increase the smallholder sector by 300,000 households, ensure 145,000 additional jobs in agro-processing, and improve working conditions for 660,000 farm workers

Source Compiled from information sourced from the Department of Agriculture (2025)

and resettlement programme. The land redistribution exercise increased the participation of more than 300,000 newly resettled farmers (SADC, 2019).

The major challenges of the sector include low productivity (low yields) and low production, poor funding and the absence of

adequate agricultural lending institutions, gaps in production against national requirements for various crops and livestock production, inadequate resources and poor technologies, low institutional and human capacity, lack of a stable and enabling legal, policy and

institutional framework, leading to diminished investor confidence in the agricultural sector, environmental challenges and climate change (Chidoko, 2022). Table 4.4 lists the various policies which have been adopted by the Government of Zimbabwe for the overall agricultural sector since the 1980s.

The policies given in Table 4.4 had the mandate of increasing production to meet local consumption. If there were a surplus, this would be exported.² After independence, the Government of Zimbabwe sought mainly to maintain the dual agriculture system it inherited. However, it emphasised its efforts more on assisting black small-scale and communal farmers. It subsidised inputs, promoted conservation farming techniques, among many initiatives (Ministry of Agriculture, Land Reform and Rural Development, 2023).

The Economic Structural Adjustment Programme (ESAP) led the government to abandon its involvement in agriculture, as it adopted a liberal, market-oriented macroeconomic policy. This promoted trade liberalisation, specifically lifting government controls and removing subsidies. According to Anseeuw et al (2012), the government had to devise a new and relevant policy in line with the ESAP.

4.5 Discussion

Agriculture remains the backbone of Malawi's economy. Agricultural exports, particularly tobacco and tea, contribute significantly to foreign exchange, with tobacco alone accounting for 60% of Malawi's total agricultural exports. Malawi is a significant agricultural producer as well as a trading country with some dominance in maize and rice exports, among its cereal trade.

It boasts of a large resource endowment in the name of Lake Malawi (FAO, 2023).

The agricultural sector in Mozambique currently represents almost a quarter of the total GDP. Agriculture plays a significant role in Mozambique's economy, contributing approximately 26–30% to the national GDP and employing over 70% of the population, mainly in rural areas. The sector is key for both food security and income generation, with crops such as maize, cassava, tobacco, and cotton being central to both local consumption and export (Daum & Birner, 2020).

South African agriculture is highly diversified with both crop and livestock production. Major grains produced include oilseed, fruits, sugar, citrus, wine and most vegetables, whilst livestock produced include cattle, dairy, pigs, sheep, and poultry. South Africa is also a major producer and net exporter of fruits and wine. More than half of the fruits are produced for export markets. The agriculture sector has a dualistic nature with a developed commercial sector and a subsistence, communal sector (World Bank, 2024).

As alluded to earlier in Zimbabwe has abundant land, a large amount of underground and surface water resources. The country has diverse agro-climatic conditions that make it possible for a large variety of crops and livestock species to be produced. There has been a major transformation in the agricultural sector in the last two decades in Zimbabwe. The land redistribution exercise increased the participation of more than 300,000 newly resettled farmers. It is one of the major producers of cereal crops in Southern Africa, with substantial cereal volumes traded across the region (Ministry of Agriculture, 2023).

Malawi, Mozambique, South Africa and Zimbabwe have developed several policies that have been driving their agricultural sectors to increase production for local consumption and foreign trade. Production and trade policies go hand in hand. While a government enhances production, it is also concerned with exports and imports of the same commodity. Agricultural products are well protected so that they cannot be exported or imported at will (Daum & Birner, 2020).

² GMB has the mandate to maintain minimum strategic reserves of 500,000 tonnes of grain crops in physical stock. In this case exports would be considered after meeting this requirement. However, low productivity and production in the past few years has made it difficult to maintain strategic grain reserves at that level.

Table 4.4 Land, agriculture and food security policies in Zimbabwe

Policy	Description
Willing buyer, willing seller resettlement programme (1980)	The government distributed 2.46 million ha in the first five years to model 12-acre schemes, which became successful
High regulation and control policies ³ (restricted the trading of cereal grains to be centrally carried out by the Grain Marketing Board)	Maintaining the dual agricultural system. Continuation of the pre-independence government controls, with a bias towards black small-scale and communal farmers (these received subsidised inputs and protected marketing). National food security was a priority
Liberalised policies (1991)	This was meant to receive donor support, but the support was not forthcoming. The resettlement programme was very slow and far off target
	Trade liberalisation begins, founded in the macroeconomic reforms' proposed market-based economy. Abandonment of controls and subsidies, although the grain sector remained partially controlled. The start of efforts to write national agricultural policies
	The government prioritises food security by controlling trade in grains and funding relief aid (with help of NGOs) in years of drought
Compulsory land acquisition and Fast Track Land Reform Programme (FTLRP)-2000 Return of regularisation	Politically motivated land invasions. Land taken by blacks in two years alone
	Production falls drastically after the FTLRP. All efforts to craft national policy fail and the government becomes highly involved in trade regulation again. The central bank bankrolls national agricultural projects, and marketing of most produce (cereals are tightly controlled)
	Severely reduced agricultural production and lack of funds dampen national food security programmes. Government relies on the World Food Programme (WFP)
Mixed approach	Government partly liberalises agricultural trade again. Grain trade uncontrolled for the first time. Government and funds input projects to communal and resettled farmers. Non-governmental organisations also assist
Mixed approach (under Zimasset Food Security and Nutrition Cluster (2013) and Comprehensive Agricultural Policy (2012) focusing on increasing crop productivity and production, and increasing crop diversification	The government introduces the Maguta programme. This was also coupled by the Presidential Input scheme during the period (2015) that benefitted 300,000 small-scale farmers from \$28 million facility. This was followed by Command Agriculture. There is support for farmers through availing inputs
	Setting up an agriculture fund to subsidise inputs
	Promotion of sustainable agricultural production, including conservation agriculture techniques
	Diversify cropping patterns at the national level through supporting the production of small grains, especially in the drought-prone areas
National Agriculture Policy Framework 2019–2030	To create a stable enabling environment and flow of investment that sustainably enhances the capacity of the agricultural sector to anchor national economic growth to upper-middle income status by 2030
ZAIP 2017–2021	To facilitate a sustainable increase in production, productivity and competitiveness of Zimbabwean agriculture
National Climate Policy	Aims to empower the nation to become more climate resilient, addressing challenges related to climate variability and change, and guiding the National Climate Response Strategy

(continued)

³This was before Economic Structural Adjustment Programme (ESAP) (1991–5). The current situation is a partial liberalised scenario where private players have significant role in the trade of cereal crops in the country, although the government still controls the movement of these commodities.

Table 4.4 (continued)

Policy	Description
Zimbabwe Agricultural Growth Programme-2016–2023	To contribute to the development of a diversified and efficient agriculture sector that promotes inclusive green economic growth
Gender Policy	To promote gender equality and empower women in the agricultural sector by ensuring equal access to resources, opportunities, and decision-making, ultimately improving food security and rural development

Source Compiled from information sourced from the Ministry of Agriculture, Land Reform and Rural Development, (2023)

4.6 Conclusion

At the heart of the Southern African countries are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action to all countries. These goals recognise that ending poverty must go hand-in-hand with strategies that spur economic growth. Agriculture plays a crucial role in achieving several SDGs and would improve the region’s economies. The 2030 UN Sustainability Goals provide a roadmap to agriculture in Southern Africa. By aligning their practices with these goals, they can contribute to a sustainable future while improving their livelihoods.

It is prudent to point out that Southern Africa’s agricultural sector also faces significant challenges that hinder its growth and development, such as the lack of access to finance for small-scale farmers. This limits their ability to invest in technology, inputs, and infrastructure, hindering their productivity and competitiveness. Despite the challenges, Southern Africa’s agricultural sector has achieved notable successes. It has managed to sustain the economies of Southern African countries. It is recommended that in their policy formulation and implementation, the selected Southern African countries prioritise food security, promote local production, strengthen food systems, address climate change impacts, improve market access, support research and development, and infrastructure development. In addition, the countries in Southern Africa should support and capacitate the CCARDESA to coordinate agricultural research and development in the SADC region.

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Agriculture and Food Systems in Central Africa: Condition and Prospects for Transformation

5

Emmanuel Ndhlovu  and Neo Mokone 

5.1 Introduction

Agriculture plays a critical role in Central Africa, serving as the basis of the economies of countries in the sub-region and the primary source of livelihood for the majority of its population (Chavula & Kayusi, 2025; Ndhlovu, 2025a). A large share of the sub-regional population, particularly in rural areas, relies on agriculture for income and sustenance. In some countries, such as the Central African Republic (CAR), it provides livelihoods for a significant portion of the workforce (Ozigis et al., 2025). Agriculture is also the largest sector in Central African economies, often contributing a substantial portion (around half or more) of the Gross Domestic Product (GDP) (African Development Bank (AfDB), 2024) and is seen as a pathway to economic growth and poverty reduction (Angélique et al., 2022). For instance, in the CAR, agriculture accounts for over 55% of the national GDP (AfDB, 2024). It is also the largest employer, with figures often reaching 75–80% of the total population (AfDB, 2024). Cash crops

such as coffee, palm oil, rubber, cotton, sugar, tea, cocoa, and timber contribute crucial foreign exchange through exports. However, dependence on international commodity markets exposes these economies to price fluctuations. Food crops also include cassava, plantains, maize, groundnuts, and rice. Despite its importance, agriculture in Central Africa faces various challenges in its agricultural sector. These challenges require urgent interventions, particularly since the majority of rural households in the sub-region rely on the sector for livelihoods and income. The challenges faced in Central African agriculture and the entire food system chain.

Research, particularly academic, on Central African agriculture and food systems published in English is generally limited. The primary language used for academic communication in the sub-region is French. Translations of these texts also tend to be limited. This compromises the possibility of an in-depth understanding of the state of agriculture, challenges, and opportunities for sub-regional development, especially by non-French-speaking researchers. In addition, the research that is accessible and that deals with the agricultural and food system challenges tends to confine itself to traditional recommendations of infrastructural development and technology adoption (Kingueleoua & Canyurt, 2014; Mayoukou, 2025; Ouedraogo et al., 2023). Such research tends to disregard policy and leadership issues as well as the potential of other interventions, such as nature-based solutions and traditional

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knowledge, thus creating a knowledge gap. For instance, in a study that focused on South Kivu, DR Congo, Angélique et al. (2022) merely implicated the lack of sufficient infrastructure and technological innovation for low productivity and the underperformance of farmers. Furthermore, research on Central African agriculture and food systems tends to be mostly available in grey format, thus creating a gap in academic literature. This chapter seeks to contribute towards narrowing these gaps.

This chapter (i) explores the state of agriculture and food systems in Central Africa, (ii) identifies the challenges of Central African agriculture and food systems, and (iii) examines the actions being taken to address agricultural and food system challenges in the sub-region. The countries mainly covered are the Democratic Republic of Congo (DRC), Congo Brazzaville, the CAR, Chad, São Tomé and Príncipe, Angola, and Cameroon. In addition to flagging the importance of infrastructural development and technology adoption, the chapter highlights the importance of comprehensive approaches that include peacebuilding, land rights, climate adaptation strategies, and support for vulnerable populations. In addition, the chapter emphasises the importance of implementing an effective and equitable antipoverty policy in rural areas. Therefore, this study holds much potential to attract the interest of policymakers, politicians, non-governmental actors working on food security, and land activists. Academics and students could also find the chapter interesting to read.

This chapter proceeds as follows: The following section outlines the research methodology for the study. This is followed by a discussion of the state of agriculture, food systems in Central Africa, and research gaps in the literature. Thereafter, the challenges and opportunities of Central African agriculture and food systems are discussed in separate sections. The chapter then outlines country-specific interventions to deal with the identified challenges. Lastly,

the chapter makes recommendations and draws conclusions from the discussion.

5.2 Methods and Materials

The chapter draws from a review of primary and secondary documents, both in grey and academic formats, on agriculture and food systems in Central Africa. Reports by policy, research, and government institutions served as the primary source of data. At the international level, the dominant policy and research institutions mainly included the United Nations and its associated subsidiaries, including the FAO, WB, Organisation for Economic Cooperation and Development (OECD), and the United Nations' Children Fund (UNICEF). At the regional level, documents for review were developed mainly by the African Union, African Development Bank, and African Technology Policy Studies Network (ATPS). The dominance of grey literature in this chapter is necessitated by the lack of adequate academic literature available in English to be reviewed by the authors. The inclusion criterion includes the document being written in English for accessibility. Most of the documents by these policy and research institutions have translations. On the contrary, translations for academic texts, especially journal articles, are limited. A few identified academic texts were, however, integrated into the study to generate a balanced discussion.

While reliance on grey documents as sources of information is problematic due to the lack of peer review, it was the authors' considered view that these documents were produced by organisations whose reputations and credibility have lasted for many decades, and therefore, could be trusted as credible sources of information. It is hoped that colleagues in Central Africa, who are knowledgeable of the other languages in which research could have been published, will carry out more empirical studies to respond to the conclusions made in this chapter. Such investigations will

also need to utilise systematic literature reviews to verify the extent of research on agriculture and food systems in the region.

5.3 Agriculture and Food Systems in Central Africa

This section explores the condition of agriculture and food systems in Central Africa under two separate sub-sections. It also outlines the gaps within existing literature.

5.3.1 Condition of Agriculture in Central Africa

The literature on agriculture and food systems in Central African countries tells of a complex and often challenging landscape, characterised by substantial potential alongside persistent obstacles. The literature steadily highlights the immense arable land, favourable agro-ecological conditions, and diverse natural resources in Central African countries, such as the CAR, Cameroon, and the DRC (Chavula & Kayusi, 2025; Nchanji et al., 2024). The CAR has 1,800,000 ha of arable land (World Bank (WB), 2021). The DRC has about 80 million hectares of arable land, although only a small fraction (<10%) of it is currently under cultivation (International Trade Administration (ITA), 2024). According to the World Bank (2021), arable land was estimated to be around 6,200,000 ha in Cameroon, 1,270,000 ha in Burundi, 50,338,000 ha in Chad, 280,000 ha in Equatorial Guinea, 325,000 ha in Gabon, and 8,700 ha in São Tomé and Príncipe.

The literature review also shows that the diversity of climates in Central Africa, supported by a significant hydrographic network, enables the practice of a varied range of agricultural speculations. In DRC, for instance, the grasslands and savannahs can support a livestock population of about 40 million head of cattle (Azine et al., 2025; ITA, 2024). Tropical forests, which occupy 135 million hectares of the country, constitute a vital reserve of biodiversity and potential for forest-friendly products (Ozigis et al., 2025).

Although the potential for irrigation is projected at 4 million hectares, it remains modest (African Development Bank (AfDB), 2016). In Cameroon, the review shows that a favourable climate, characterised by sufficient and reliable rainfall and suitable temperatures, positively impacts agriculture (ATPS, 2013). This results in increased crop yields, improved food security, and enhanced livelihoods for farmers. In Burundi, a country deeply reliant on rain-fed agriculture, favourable climate conditions, such as consistent rainfall and moderate temperatures, significantly boost agricultural production and contribute to food security (Ouedraogo et al., 2023; Soulé-Baoro et al., 2018). Equatorial Guinea's climate, characterised by high temperatures and substantial precipitation, mostly supports a wide range of agricultural activities, mostly in its forested southern regions (ATPS, 2013). This favourable climate allows for the production of diverse crops such as taro, yams, cassava, rice, banana, plantain, maize, potatoes, roots and tubers, avocado, beans, and okra (AfDB, 2016). Chad is among the only few countries in the sub-region where the climate is highly variable, with recurrent droughts and floods impacting crop yields and livelihoods (Abdallah et al., 2025). While a favourable climate would improve food security and economic stability, Chad's agricultural sector presently faces challenges due to climate change and unsustainable land management practices. Notwithstanding this, the sub-region often struggles with food insecurity and relies on imports (Ngaressem, 2022). This points to a disconnect between potential and actual output.

The literature shows that Central African agriculture is dominated by smallholder farming and traditional practices, often rudimentary farming methods (Kapari et al., 2023). Smallholder farmers in the sub-region operate on small farms, typically family-run but critical for food production and employment, although they face challenges such as limited access to markets and resources (Abdallah et al., 2025; Angélique et al., 2022).

The agricultural sector has the potential for poverty alleviation in the sub-region. Over 70% of the sub-regional population engages in

agriculture for livelihoods and income (Ndhlovu, 2025b). Smallholder farmers in the sub-region continue to operate at subsistence levels, with limited possibility of developing into entrepreneurs. This impedes the possibility of the sector serving as the basis for a developmental revolution. Even small increases in agricultural productivity can directly lead to increased income for smallholder farmers, who constitute the majority of the rural poor (WB, 2025). This also creates on-farm employment and higher farm wages. The literature shows that agriculture could directly improve food security in the sub-region by providing a stable food supply for families, reducing food prices, and diversifying diets (Mayoukou, 2025).

The literature on agriculture in Central African countries paints a picture of a sub-region grappling with substantial structural challenges, but also possessing immense untapped potential. The focus is increasingly on actionable interventions to improve productivity, improve food security, and build resilience in the face of persistent obstacles. In essence, revitalising agriculture is seen as the most direct and effective way to reduce widespread extreme poverty in Central African countries.

5.3.2 Condition of African Food Systems

The challenges facing agriculture in Central African countries are also significantly affecting food system operations, from production to consumption. This is because the less food is produced, the less food is available to move through the food chain. As a result, the reviewed literature reveals that food systems in Central African countries face severe challenges, with high levels of food insecurity and malnutrition (Reardon et al., 2021). These challenges are worsened by conflict, displacement, and climate-related issues, hindering agricultural production and access to food (FAO et al., 2020). A significant portion of the population in the sub-region struggles with food insecurity, with a large number of children facing severe acute malnutrition at the end of 2022 (FAO et al., 2023) (see Table 5.1).

Table 5.1 Prevalence of moderate or severe food insecurity in Central Africa

Country	Percentage
Angola	79
Cameroon	59
CAR	81
Congo	88
DRC	77
São Tomé and Príncipe	53

Source Adapted from FAO et al. (2023)

Current conflicts and instability, especially in the CAR and DRC, disrupt agricultural activities, displace populations, and limit access to food markets (Reliefweb, 2024). Extreme weather events, such as droughts and floods, negatively impact crop yields and livestock production, further straining food systems (Ndhlovu, 2024). Chad is the country most affected by climate change (Abdallah et al., 2025). Long and ineffective food supply chains, particularly for perishable goods, lead to significant food losses and increased costs (WB, 2025). Inadequate infrastructure, including roads and electricity, hinders the delivery of food and other essential services (FAO et al., 2020). The absence of strong social protection systems leaves susceptible populations exposed to food crises. The food processing industry is largely informal and fragmented, hindering the development of efficient and sustainable food systems. Therefore, the reviewed literature shows that Central Africa’s agriculture and food systems are going through a crisis that requires an urgent intervention.

The food systems in Central African countries are in a precarious state, characterised by widespread food insecurity, high rates of malnutrition at the end of 2022 (see Fig. 5.1), and significant vulnerability to various shocks. A substantial portion of the population in the sub-region faces acute food insecurity. For instance, in the CAR, 57% of people are food insecure, with 41% experiencing severe food insecurity (FAO et al., 2023).

Child malnutrition is also alarmingly high (see Table 5.2). Combined with West Africa, an estimated 16.3 million children were expected to

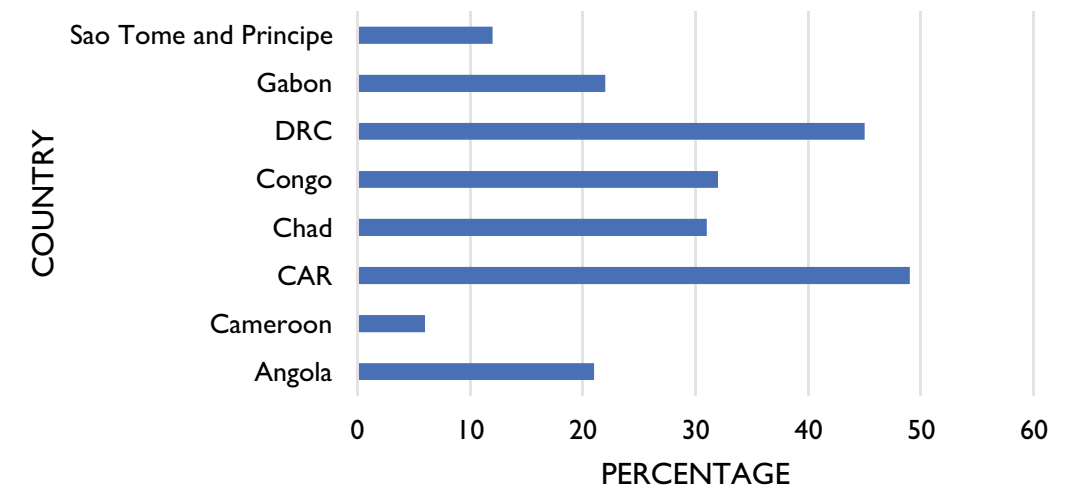


Fig. 5.1 Prevalence of undernourishment in Central Africa. *Source* Adapted from FAO et al. (2023)

Table 5.2 Prevalence of child malnutrition in Central Africa

Country	Percentage
Angola	23
Cameroon	22
CAR	27
Chad	41
DRC	31
Gabon	18
São Tomé and Príncipe	21

Source Adapted from FAO et al. (2023)

suffer from acute malnutrition in 2024, including 5 million in its severe form (UNICEF et al., 2023). In Chad, 388,000 children under five years suffer from severe acute malnutrition (WB, 2025). Many households in the region also struggle to afford nutritious food, leading to inadequate diets (FAO, 2023). More than 2 out of 3 households cannot afford healthy diets, and 8 out of 10 children aged 6–23 months do not consume the minimum number of foods required for optimal growth and development (UNICEF et al., 2023).

The situation is, however, not homogeneous. Each country in the sub-region faces country-specific experiences. For instance, despite agricultural potential and mineral wealth, CAR has severe food security issues, local inflation, and

global crises (Chavula & Kayusi, 2025). Displacements worsen food needs, especially during the rainy season (Abdallah et al., 2025). The WFP is working to integrate crisis response with early-recovery activities and bolster food systems through various programmes. In the DRC, agriculture is dominated by subsistence farming. The country has vast arable land and water resources but faces challenges from political instability, infrastructure deficits, and a lack of investment (WB, 2021). Although cassava and maize are key staples, the country imports significant amounts of rice and edible oils (ITA, 2024). Conflict deeply influences food availability and access, especially in the eastern provinces. In Cameroon, acute food insecurity affects a significant portion of the population, driven by ongoing conflict in the Northwest, Southwest, and Far North regions, as well as natural disasters like floods (Yene & Eke-Balla, 2025). Food prices are significantly higher than the five-year average. In Chad, an alarming level of hunger continues to worsen food insecurity, inter-community violence, climate shocks (early dry season, severe floods), and a massive influx of Sudanese refugees. Over 4.3 million people were projected to suffer crisis and emergency levels of food insecurity during the 2025 lean season.

In summary, the food systems in Central African countries are under immense strain, primarily due to a complex interplay of conflict,

climate change, and economic hardship. While there are ongoing efforts to mitigate the crisis and build resilience, the scale of the challenge necessitates sustained and coordinated humanitarian and developmental interventions. However, the existing literature seems to be inadequate in informing policy and practical action, and thus, there is a need for more conceptualisation and theorisation of Central African agriculture and food systems.

5.3.3 Knowledge Gaps in Literature

However, the existing body of literature itself has several knowledge gaps that make it insufficient to inform the theorisation of interventions. For instance, while general trends for Sub-Saharan Africa (SSA) are discussed, in-depth, country-specific research for all Central African countries is lacking in the literature. There is also limited literature that is focused on translating research findings and best practices into actionable knowledge that reaches food system actors, particularly smallholder farmers, effectively. Agricultural extension services are reported as often weak in the sub-region (Soulé-Baoro et al., 2018). In addition, the literature that integrates and documents indigenous farming knowledge and practices, which can offer valuable sustainable solutions, is also lacking in the sub-region. Furthermore, more rigorous evaluations of the long-term impact of specific agricultural policies and development projects to inform future interventions are also lacking. While climate change is acknowledged, more specific research on context-appropriate climate-smart agricultural practices and their adoption rates in different Central African agro-ecological zones is needed. Lastly, the literature highlights market access as a challenge; therefore, more detailed research on strengthening specific agricultural value chains, including processing and post-harvest management, is crucial.

5.4 Agricultural and Food System Challenges in Central Africa

The agricultural and food systems sectors of Central African countries face a confluence of challenges that make them unable to effectively and sufficiently meet the food needs of the people in the sub-region. These challenges are summarised in the following sub-sections.

5.4.1 Climate Shocks

Climate change poses severe and multifaceted threats to agriculture and food systems in Central African countries, worsening existing vulnerabilities and undermining food security for millions. These impacts are caused by rising temperatures, altered rainfall patterns, and an increase in extreme weather events. Central African countries are experiencing substantial warming trends, with temperatures likely to rise further (World Meteorological Organisation (WMO), 2024). This leads to heat stress for crops and livestock, reducing productivity and yields. Some studies predict substantial production losses for key crops (Ayanlade et al., 2022). Regarding rainfall, while some areas may experience increased rainfall, it is often characterised by more intense and erratic events, leading to floods, gushing storms, and prolonged droughts. Recurrent and severe droughts decrease water availability for rain-fed agriculture, which is dominant in the sub-region, leading to crop failures and livestock losses. Floods and storms, on the other hand, can cause widespread flooding, damaging crops, infrastructure, and agricultural land, and increasing soil erosion.

Rising temperatures and altered precipitation patterns also create more favourable conditions for agricultural pests, weeds, and diseases, further impacting crop and livestock health. Central African countries are experiencing significant challenges from crop and livestock pests and diseases, impacting food security and agricultural

economics (Neuenschwander et al., 2023). These include the spread of invasive pests like the fall armyworm and whiteflies, as well as various fungal and viral diseases affecting staple crops such as maize and cassava. These threats are worsened by limited access to sustainable pest management options.

Climate change also contributes to land degradation, including soil erosion and nutrient loss, which diminishes the productivity of agricultural land. Land degradation is a serious issue in the sub-region, with substantial consequences for livelihoods and ecosystems. It is driven by a combination of climate change, unsustainable agricultural practices, deforestation, and other human activities (United Nations Network on Migration (UNNM), 2025). The resulting loss of fertile land and ecosystem services contributes to poverty, food insecurity, and displacement.

Climate change impacts lower crop yields and causes livestock losses. This will directly translate to a decrease in the overall food supply, leading to food shortages. Food shortages and disruptions to supply chains caused by climate events lead to increased food prices, making food less affordable for vulnerable populations. Climate change impacts in Central Africa interact with existing challenges such as poverty, political instability, and conflict, further worsening food insecurity and malnutrition. For instance, the sub-region faces severe food insecurity partly due to a combination of armed conflict, displacement, rising food prices, low agricultural productivity, and climate-related disasters (AU, 2020; WB, 2025). The majority of farmers in the sub-region are small-scale, rain-fed, and have limited access to resources, technology, and infrastructure (Ndhlovu, 2025b), making them highly vulnerable to climate shocks.

Extreme weather events also damage transportation infrastructure, hindering the movement of food from production areas to markets. The deterioration in agricultural output and income directly impacts the livelihoods of farming families, pushing them deeper into poverty. Increasing temperatures intensify existing water stress, putting more pressure on agricultural systems (AU, 2020). Climate change affects the nutritional quality of staple foods and can lead to increased

food and waterborne diseases due to contaminated water sources during floods.

Overall, Central Africa is identified as a climate change hotspot due to its high reliance on rain-fed agriculture, limited adaptive capacities, and socio-economic challenges. The agricultural systems are largely traditional, with few technological inputs, making them particularly susceptible to the changing climate. Addressing these impacts requires a multi-pronged approach, including investing in climate-resilient agricultural practices, improving water management systems, developing new crop varieties suited to harsher conditions, strengthening early warning systems, and fostering economic diversification to reduce reliance on agriculture.

5.4.2 Conflict and Insecurity

Conflict is identified as a primary driver of food insecurity across the sub-region (ITA, 2024; WB, 2025). Ongoing conflicts and insurgencies, particularly in CAR, DRC, Cameroon (Northwest, Southwest regions, and Far North), and Chad (Lake region), lead to mass displacement, disruption of agricultural activities, limited access to markets, and hinder humanitarian aid delivery. Conflict forces large-scale displacement of populations, leading to the abandonment of farms and cultivated land. Farmers flee their homes for safety, leaving behind their livelihoods. Even for those who remain, conflict often restricts access to fields due to insecurity, checkpoints, or the presence of armed groups. This prevents crop planting, tending, and harvesting. Crops, livestock, and agricultural equipment are frequently looted or destroyed during conflict, leaving farmers with no means to restart production. This significantly impacts cattle populations and fish supplies. Conflict also leads to the loss of experienced farmers and agricultural workers, either through death, injury, or forced migration, further hampering production capacity. In addition, access to essential agricultural inputs like seeds, fertilisers, and tools is severely limited due to insecurity, damaged infrastructure, and disrupted supply chains. Furthermore, farmers

may switch from cash crops to staple foods for immediate survival or adopt less productive farming methods due to fear and uncertainty.

Conflict severely disrupts local and regional markets. Roads become unsafe, making it difficult and dangerous to transport agricultural products from rural areas to urban centres. This causes shortages in some areas and an inability for farmers to sell their produce in others. Reduced production and disrupted supply chains lead to sharp increases in food prices (Kemmerling et al., 2022), making staple foods unaffordable for many households, especially the most vulnerable. Interruption of trade routes and general insecurity hinder both internal and external trade, further limiting food availability. Recurring raids and insecurity lead to a significant exhaustion of food reserves in rural areas, leaving communities with little buffer against lean seasons or further shocks. Conflict not only affects agricultural output but also destroys other sources of income, forcing households to adopt negative coping strategies like selling assets or reducing food consumption, which have long-term consequences for nutrition and human capital. Decades of conflict and instability in the sub-region are damaging the institutional framework that should be supporting agriculture, including extension services, credit systems, and land rights management.

The direct consequence of these disruptions is a drastic increase in acute food insecurity, with millions facing emergency or catastrophic levels of hunger. Children are particularly vulnerable to malnutrition due to limited access to diverse and nutritious food, as well as disrupted health services (see Table 5.2). This can lead to lifelong physical and mental handicaps. The combined effect of agricultural collapse and food system breakdown often results in widespread humanitarian crises, requiring large-scale food assistance.

5.4.3 Economic Instability

Economic instability has a profound and devastating impact on food systems in Central African countries, worsening existing vulnerabilities and pushing millions into acute food insecurity.

Economic instability manifests as high inflation and currency depreciation in countries such as the DRC, CAR, Angola, and Chad. This has drastically reduced the purchasing power of households, making essential food items unaffordable (AfDB, 2024). In countries heavily reliant on food imports, such as the DRC, currency devaluation makes these imports even more expensive. Beyond food, rising costs of fuel and transport directly impact food prices, as transportation is a significant component of bringing food from farms to markets (Angélique et al., 2022). Central African countries already have high poverty rates (WB, 2021). Economic instability deepens this poverty, leaving a large portion of the population unable to afford sufficient or nutritious food. Many households spend a large percentage (over 60%) of their earnings on food, making them extremely vulnerable to price fluctuations (FAO et al., 2023).

Economic instability often means a lack of investment in the agricultural sector. This can lead to stagnation or even declining food production within countries. Most farmers in the sub-region often lack access to improved seeds, fertilisers, and modern techniques due to financial constraints (Kemmerling et al., 2022). Conflict and political instability, often intertwined with economic woes, damage agricultural infrastructure, including roads, irrigation systems, and storage facilities, further hampering production and distribution. In short, economic instability in Central African countries creates a devastating cycle of poverty, food scarcity, malnutrition, and social unrest. Addressing this requires a multi-pronged approach that includes fostering political stability.

5.4.4 Limited Agricultural Productivity

While agriculture is the backbone of the economy for most Central African countries (e.g. contributing half of CAR's GDP and employing nearly four-fifths of its workforce), productivity is often low. Poor agricultural productivity in the sub-region has severe and far-reaching impacts on their food systems, worsening food insecurity and impeding overall development. Low

agricultural productivity significantly weakens food systems, leading to food insecurity, poverty, and malnutrition. This is worsened by factors such as inadequate policies, limited access to modern technologies, and a reliance on outdated farming practices. The resulting low food production necessitates increased reliance on imports, further straining economies and potentially leading to food shortages. Productivity is caused by several factors, including reliance on subsistence farming; inadequate investment, pest and disease outbreaks, and political instability. Poor agricultural productivity in Central African countries creates a vicious cycle of food insecurity, poverty, and instability. Addressing this challenge requires a multifaceted approach that tackles underlying issues such as conflict, climate change, lack of investment, and inadequate infrastructure, while also empowering local farmers and building resilient food systems.

5.4.5 Infrastructural Deficiencies

Infrastructural deficiencies intensely impact food systems in Central African countries, leading to widespread food insecurity, economic stagnation, and worsened vulnerability for already struggling populations (Reliefweb, 2024; Soulé-Baoro et al., 2018). The challenges span across the entire food value chain, from production to consumption. Poor road networks and limited access to markets hinder the distribution of food, especially in remote areas, and can lead to significant post-harvest losses.

Many rural areas in Central African countries lack well-maintained roads, or even any roads at all (OECD/SWAC, 2025). This makes it incredibly difficult and expensive for farmers to transport their produce to markets. The result is higher transportation costs, delivery delays, and significant spoilage of perishable goods (African Union Development Agency (NEPAD), 2021). Food supply chains have become four times longer than in Europe, driving up the final price of basic commodities. Bureaucratic delays, inefficient customs, and non-tariff barriers at critical ports and border crossings inflate regional

trade costs by up to 25%, further increasing food prices (WB, 2021). Farmers are often forced to sell their produce directly from the field at depressed prices during harvest seasons due to limited access to markets and insufficient information. This reduces their income and disincentivises increased production.

The sub-region also experiences significant post-harvest losses. Due to inadequate storage facilities, a staggering 37% of locally produced food in the sub-region is lost or wasted due to insufficient storage facilities, especially for perishable items like fruits and vegetables (Cromwell et al., 2025). This includes a lack of proper cold storage, leading to spoilage and reduced quality. Poor infrastructure hampers the growth of agro-processing industries. Without adequate processing facilities, value addition to agricultural products is limited, and opportunities for employment and economic growth are missed.

Poor infrastructure limits farmers' access to essential agricultural inputs such as fertilisers, improved seeds, and modern farming equipment. This contributes to low yields and primitive farming practices. Inadequate infrastructure, including a lack of reliable electricity and digital technology services, hampers the flow of information between farmers, suppliers, and buyers. This limits innovation and the adoption of new farming techniques. Without robust infrastructure like irrigation systems and early warning systems, agricultural production remains highly vulnerable to adverse weather conditions and climate change.

5.4.6 Dependency on Imports

Many countries in Central Africa are structurally deficient in staple food production and rely on regional and international imports (Ndhlovu & Mhlanga, 2024), making them vulnerable to global price fluctuations and supply chain disruptions. The DRC, for instance, runs a substantial deficit on its agri-food commodity trade balance (African Export–Import Bank (AFREX-IMBANK), 2024). Food import dependency significantly impacts food systems in the sub-region, leading to a range of vulnerabilities

and aggravating prevailing challenges. Despite possessing vast arable land, most countries in the sub-region rely heavily on imported food, making their food systems fragile and susceptible to external shocks. Heavy reliance on food imports exposes these countries to fluctuations in global commodity prices. Events like the Russia-Ukraine war, supply chain disruptions (e.g. during COVID-19), and speculative market activities easily lead to soaring food prices, making essential foodstuffs unaffordable for many households (Ndhlovu & Majova, 2025). Global crises or disruptions in major exporting countries can severely impact the availability of imported food, leading to shortages and worsening food insecurity. Dependence on foreign sources for food also erodes food sovereignty, giving external actors significant influence over national food security (Ndhlovu, 2022).

Food imports undermine local agricultural production in Central Africa. Cheap or subsidised imported food makes local produce less competitive, discouraging domestic farmers and impeding the development of local agricultural sectors (WB, 2025). This leads to a vicious cycle where local production declines, further increasing import dependency. Increased imports easily displace smallholder farmers who struggle to compete with larger, often more efficient, international producers (Khadjavi et al., 2024), worsening their livelihoods and contributing to hunger. In addition, focusing on importing staple crops can lead to a neglect of diverse, locally adapted food systems and traditional agricultural practices, which are often more resilient and sustainable.

Food imports also bring enormous economic strain. Committing a substantial portion of import expenditure to food places a strain on sub-regional national economies, diverting resources that could be invested in other critical sectors like infrastructure, education, or healthcare. In addition, large food import bills are contributing to trade deficits and balance of payments issues in the sub-region, further destabilising already fragile economies (AfDB, 2016). Furthermore, over-reliance on agricultural imports stifles the development of diverse economies, keeping countries

dependent on a narrow range of economic activities.

While food imports may ensure calorie availability, they do not always guarantee access to diverse, nutritious diets in the region, as demonstrated by high malnutrition rates (FAO et al., 2023). The focus on staple imports can contribute to micronutrient deficiencies and other forms of malnutrition. In addition, when global prices rise or supplies are disrupted, the poorest households, who spend a large share of their income on food, are particularly exposed to increased hunger and severe food insecurity. The CAR, for example, has one of the highest prevalences of food insecurity in the world (WB, 2021). In summation, food import dependency in Central African countries is creating an unwarranted situation, exposing countries to global vulnerabilities, undermining their domestic agricultural potential, straining their economies, and eventually aggravating food insecurity and malnutrition. Addressing this requires a multifaceted approach, including strengthening governance and implementing social protection programmes.

5.5 Agriculture and Food System Interventions in Central Africa

Central African countries are implementing a wide range of interventions in the agriculture and food systems. The interventions often focus on enhancing food security and building resilience against climate change and other shocks. These interventions include supporting smallholder farmers, improving access to markets, promoting climate-smart agriculture practices, and strengthening food systems through various initiatives. International, regional, sub-regional, and country-level actions are being taken in this regard. At the international level, countries in Central Africa subscribe to commitments such as the Sustainable Development Goals (SDGs). Countries also subscribe to the UN's Zero Hunger Challenge, an initiative that encourages countries to work towards a future where everyone has

access to adequate nutrition and resilient food systems. The countries also work together with the WFP, the world's largest humanitarian organisation, providing emergency relief, food assistance, and building sustainable solutions to improve food security and nutrition. They also work on issues like gender equality, nutrition, and climate action. The Global Alliance against hunger and poverty is also working with countries in the sub-region. The alliance works to mobilise resources and coordinate efforts to address hunger and poverty. Rise against hunger is another organisation present in Central Africa. This organisation focuses on providing meals and working with communities to address hunger through various programmes, including disaster relief and sustainable farming projects. Countries also subscribe to the Food Assistance Convention, an international treaty that aims to improve the effectiveness of food assistance in addressing food crises.

At the regional level, Central African countries are part of the AU efforts to revolutionise and transform African agriculture and food systems. These include the African Task Force on Food and Nutrition Development which sensitises African policymakers on the vital role of food and nutrition security as a basic input in the continent's socio-economic development, the Declaration on Agriculture and Food Security in Africa (Maputo Declaration), which stresses the importance of agricultural growth for economic prosperity, the African Regional Nutrition Strategy which seeks to address emerging nutrition issues, Malabo Declaration which provides the direction for agricultural growth and transformation in Africa, and the African Leaders for Nutrition Initiative which commits countries to overcoming malnutrition and using nutrition as a driver of overall economic growth and sustainable development. There is also the Africa Common Position on food systems, which summarises the views, priorities, and ambitions of Member States on the key challenges affecting African and global food systems, and the Declaration of 2022 as the Year of Nutrition for Africa, which seeks to increase political commitment and investment in nutrition. The African Continental Free Trade Area (AfCFTA) is seen as a vital instrument to boost intra-African

trade in agricultural commodities, reduce reliance on external imports, and enhance food security by increasing market access and diversifying produce. Efforts are underway to integrate family farming into national and regional agricultural policies and strategies, drawing on initiatives like the Regional Programme for Agricultural Investment and Food and Nutritional Security and the Common Agricultural Policy.

Countries in the sub-region, individually or collectively, have also adopted national policies, strategies, and plans dealing with food system challenges such as climate change. These include the National Programmes of Action, the National Communications to the United Nations Framework Convention on Climate Change, National Agricultural Investment Plans and Poverty Reduction Strategy Papers.

5.6 Examples of Country-Specific Interventions

There are also country-specific interventions being taken to deal with agricultural and food system challenges in the sub-region. For instance, in the CAR, the WFP and WB are supporting emergency food security, agricultural recovery, and agribusiness development, focusing on small-holder farmers and vulnerable populations. In the DRC, several projects are underway to decrease rural poverty through streamlined agricultural production systems, improved nutrition, and food security. FAO and the Central African Forest Initiative are supporting irrigation systems, national seed policy, and sustainable management of agriculture and livestock. In the Congo, Brazzaville, efforts are being made to intensify food production, although much agriculture remains subsistence. Initiatives like Eni's agri-hubs aim to boost vegetable oil production with potential local food security benefits.

In Cameroon, Peace Corps volunteers are supporting sustainable integrated farming, and projects like the Project for Investment and the Development of Agricultural Markets and the Agricultural Production Support Programme

focus on improving market access and providing agricultural inputs. In Chad, the WFP, WB, and other partners are implementing emergency response plans, providing food, seeds, and cash transfers, while also investing in long-term solutions for sustainable food security and resilience. Cereal banks and market gardening in river beds are practical solutions. In Equatorial Guinea, efforts are being made to boost the production of staple food crops such as cassava, sweet potatoes, and plantains, with the aim of reducing reliance on food imports. In Gabon, the government has launched agricultural programmes like the Grain Phase 1 Support Project to boost the production of crops like plantain and cassava, aiming for self-sufficiency and job creation. In São Tomé and Príncipe, infrastructural support is being provided to farmers to improve their cocoa agroforestry system.

Overall, interventions in Central African countries often involve a multi-pronged approach, combining humanitarian assistance with long-term development strategies to build resilient and sustainable food systems. Collaboration between national governments, international partners, and local communities is crucial for success.

5.7 Policy Recommendations

There are several potential policy areas that Central African countries can take to ensure the resilience, recovery, and transformation of their agricultural sectors and food systems to function efficiently and effectively.

5.7.1 Investment in Infrastructure and Market Access

Countries need to prioritise the development and rehabilitation of infrastructure such as roads and railway networks to connect farmers to markets, reduce post-harvest losses, and lower transportation costs for inputs and produce. They also need to invest in modern storage facilities (e.g. silos, cold chains) to reduce spoilage and extend the shelf life of agricultural products. Support

the establishment of small and medium-scale processing units to add value to raw agricultural goods, create jobs, and improve marketability. It is also vital to expand access to reliable and affordable energy in rural areas to power irrigation systems, processing facilities, and storage units. In addition, governments and their private partners need to develop and distribute real-time market information to farmers and other food system actors, enabling them to make informed decisions on what to grow, when to sell, and at what price.

5.7.2 Enhancing Agricultural Productivity and Sustainability

The region needs to improve and ensure access to modern inputs and technologies by farmers and food system actors. This includes improving access to high-yielding, climate-resilient, and disease-resistant seeds and improved livestock breeds for farmers. In addition, governments need to promote the judicious use of fertilisers and integrated pest management techniques to boost yields sustainably, potentially exploring ecological organic agriculture approaches. Furthermore, it is vital to support the introduction and adoption of appropriate agricultural machinery, from small-scale tools to tractors, through training, affordable financing, and maintenance support. Moreover, irrigation technologies are needed to mitigate the effects of erratic rainfall and droughts, particularly in Chad.

Regarding sustainability, climate-smart agriculture (CSA) need to be strengthened. Countries need to promote practices that increase productivity and resilience to climate change, such as agroforestry, conservation agriculture, and drought-resistant crops. They also need to implement policies that encourage practices, such as crop rotation, organic matter addition, and erosion control, to maintain and improve soil fertility. In addition, policies for efficient water use, including rainwater harvesting, drip irrigation, and management of shared water resources, must be developed and implemented. Moreover, governments must

strengthen agricultural research institutions to develop locally adapted technologies and disseminate this knowledge effectively to farmers through robust and participatory extension services.

5.7.3 Strengthening Access to Finance and Credit

The agriculture sector in Central Africa is dominated by smallholder farmers, most of whom lack the resources to effectively put the labour to productive use in farming. It is vital, therefore, that their access to financial resources be improved. Governments in the sub-region need to develop and promote financial products specifically designed for smallholder farmers, including low-interest loans, microfinance, and agricultural insurance schemes to mitigate risks. In addition, financial institutions also need to service smallholder farmers and expand access to mobile banking and other digital financial services to facilitate transactions and improve financial inclusion for rural populations. Furthermore, governments need to implement mechanisms that reduce the financial risk for farmers and investors in the agricultural sector, such as blended finance models.

5.7.4 Improving Land Tenure and Governance

Governments in the sub-region must establish clear, equitable, and legally recognised land tenure systems to provide farmers with tenure security and encourage long-term investments in land improvement. This should also consider the rights of women and marginalised groups. In addition, they must develop and implement legal frameworks that guide the efficient allocation and management of land for both crop farming and livestock grazing, reducing conflicts. Furthermore, effective and accessible mechanisms for resolving land-related disputes must be established.

5.7.5 Fostering Value Chains and Private Sector Engagement

Governments in Central Africa must support the development of local value chains that connect producers to consumers, promoting local sourcing and reducing reliance on imports as part of the broader strategy to support agriculture and local food systems. Policy makers must encourage collaboration between governments, the private sector, and civil society organisations to mobilise investment, expertise, and technology in the agricultural sector. In addition, it is vital to provide incentives and support for the growth of agribusinesses, including small and medium enterprises (SMEs), to create jobs, process agricultural products, and improve market linkages. Furthermore, policies that facilitate and promote intra-African trade in agricultural products and inputs, as outlined in the African Union's Comprehensive African Agricultural Development Programme (CAADP), must be implemented.

5.7.6 Human Capital Development and Social Protection

As part of the long-lasting strategy for agricultural and food systems development, Central African countries must engage in capacity building and training. They must implement comprehensive training and capacity-building programmes for farmers and other food system actors, especially women and youth, focusing on sustainable agricultural practices, financial literacy, and entrepreneurship. Through their education sectors and other platforms, governments must also promote nutritional awareness and education to improve dietary diversity and combat malnutrition, particularly among vulnerable populations. Furthermore, they must establish and strengthen social protection programmes, such as cash transfers or

food assistance, to support vulnerable households during periods of food insecurity or economic shocks.

5.7.7 Policy Coordination and Institutional Strengthening

The countries in Central Africa must adopt holistic policy approaches that consider all aspects of the food system, from production to consumption, and involve multiple stakeholders participating in the value chain. Governments must also invest in robust data collection and monitoring systems to inform policy development, track progress, and evaluate the effectiveness of interventions. In addition, it is vital to foster regional collaboration on agricultural policies, trade, and research to leverage collective strengths and address transboundary challenges.

The CAADP of the AU provides a basic framework for many of these policies, emphasising increased agricultural productivity, public investment in agriculture, and agriculture-led economic growth. Implementing these policies with strong political will, transparent governance, and active community participation is key to transforming agriculture and food systems in Central African countries.

5.8 Conclusion

This chapter explored the state of agriculture and food systems in Central Africa, identified the challenges of sub-regional agriculture and food systems, and examined actions being taken to address agricultural and food system challenges in the sub-region. The chapter showed that Central African countries face significant challenges in agriculture and food systems, including climate change impacts, conflict, limited infrastructure, and insufficient investment. The chapter also showed that although there is inadequate literature to inform policy and practical interventions, countries in the sub-region, together with their partners (locally and internationally),

are making efforts to deal with these challenges. In addition to sub-region-wide interventions, the chapter also outlines some country-specific interventions by individual countries. The chapter concludes that there is a strong recognition of the need for sub-regional actions and partnerships to unlock the agricultural potential and achieve food security in Central Africa. Countries are working towards these through multifaceted approaches that emphasise regional cooperation, policy harmonisation, investment in sustainable agriculture, infrastructure development, market access, and social inclusion to transform their agriculture and food systems and achieve lasting food security.

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Financial Development, Urbanisation, and Food Production in the Economic Community of West African States

6

Joseph Ato Forson 

6.1 Introduction

The Economic Community of West African States (ECOWAS) faces the dual challenge of leveraging financial systems to enhance agricultural productivity while managing rapid urbanisation and ensuring food security. With a population exceeding 400 million and an urban growth rate of nearly 4% (AfDB, 2022), financial development is crucial for modernising agriculture through investments in technology, irrigation, and value chain improvements (Abdulkareem et al., 2024). However, smallholder farmers face limited access to financial services, restricting their ability to expand food production (Jolloh et al., 2013; World Bank, 2024).

Urbanisation reshapes food demand patterns, with over 50% of the population expected to reside in urban areas by 2030 (UN-DESA, 2022). While it creates market opportunities, urban expansion reduces farmland and rural labour availability (FAO, 2024). Studies indicate that urban sprawl in cities like Accra and Lagos has resulted in a 20% decline in agricultural land (Abu Hatab et al., 2019; Frimpong et al., 2022), raising concerns about food affordability and sustainability (Palazzo et al., 2016).

Empirical evidence shows that financial development mitigates food security risks. ECOWAS Commission (2021) reports that stronger financial institutions reduce food price volatility by improving farmers' access to credit for inputs and infrastructure. However, increased energy demands from financial development may exacerbate environmental degradation and resource depletion (Forson et al., 2025; Kuranchie-Pong & Forson, 2025; Prempeh et al., 2024). Additionally, climate change poses a significant threat to food security, with projections indicating a 20% decline in African agricultural output by 2050 due to climate-related disruptions (Trisos et al., 2022). Without integrated policies that align financial development, urbanisation planning, and climate adaptation, food security challenges in ECOWAS could worsen.

This chapter examines the relationships among financial development, urbanisation, and food production in ECOWAS, synthesising literature on financial systems in agricultural resilience and the impact of urban expansion on food security (Palazzo et al., 2016; Prempeh et al., 2024). This approach is relatively novel and has important implications for the agricultural value chain. Although studies such as the ones by Forson et al. (2025) and Kamenya et al. (2022) have explored the dual role of financial innovation and agriculture investment on food security and sustainability in the region, there is still a knowledge gap on the interaction effects of financial development and other policy variables relevant in the region's food

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production discourse. The chapter makes modest contribution to the body of literature by examining the interactive effects of policy variables that includes (1) financial development and economic expansion, (2) financial development and urbanisation, (3) government effectiveness and regulatory quality, and (4) financial development and net migration, on the regional food production across different estimation techniques leveraging on the methodological strength for consistent and efficient outcomes. Therefore, the chapter aims to explore these dynamic relationships to propose an integrated framework that balances financial accessibility, urban planning, and sustainable agriculture, considering the economic strides made over the years.

The chapter is structured as follows: The next section presents the methodology, covering data sources, research design, and model specification. Section three reviews theoretical perspectives and empirical linkages, exploring urban food demand pressure theory, financialisation of agriculture, structural transformation, and rural–urban migration theory. This section also provides an overview of food production in ECOWAS, including value-added activities and the management of food waste. Section four presents empirical results, followed by Section five, which discusses key findings and challenges. The final section concludes by assessing policy implications and proposes evidence-based solutions to enhance food security in the ECOWAS region.

6.2 Methodology

6.2.1 Research Approach, Design, and Data

This chapter outlines the methodological approach for assessing the interconnections among financial development, urbanisation, and food production within ECOWAS. Key policy variables include financial development, economic growth, urbanisation, food wastage, migration, government effectiveness, and regulatory quality. A quantitative research approach

is adopted, utilising an ex-post facto research design. Panel data analysis is preferred for its robustness in controlling omitted variable bias and endogeneity (Baltagi, 2015; Imbens et al., 2009). Data is sourced from reputable databases, including the World Bank’s World Development Indicators (WDI), the United Nations Development Programme (UNDP), and the World Footprint Network. The dataset covers financial and economic indicators from 2012 to 2024.

The chapter employs a panel data structure, integrating cross-sectional data from 15 ECOWAS member states with annual time-series observations. This approach provides a comprehensive temporal analysis of food production trends, accounting for the financialisation of agriculture. The baseline panel model structure is presented in Eq. 6.1.

$$Y_{it} = \alpha_{it} + Y_{it} + \beta_{it} + \varepsilon_{it} \quad (6.1)$$

where Y is the dependent variable (food production) and its subscripts “ i ” and “ t ” meaning the dependent variable changes across countries and time, respectively, α_i and γ_t are countries and time are varying errors, “ ε ” is the idiosyncratic error term, and β represents the coefficient of the independent variables.

In terms of estimation technique, data structure, and econometric reasons, the chapter employs the generalised method of moments (GMM) dynamic model and the method of moments quantile regression (MMQR) as the preferred estimation models because (i) the number of entities (countries) is greater than the number of time series (years) (Tchamyou et al., 2017), and in this case, 15 countries is greater than 12 years (2012–2024), (ii) the persistence between the dependent variable and its lag crosses 0.8 correlational threshold (see Appendix), (iii) it controls for endogeneity which is prevalent in macroeconomic data such as the one used in this study (see Forson et al., 2017a, 2017b, 2023), and (iv) it can control for both autocorrelation and heteroskedasticity (Tchamyou et al., 2017). Owing to the econometric properties and data structure reasons, the dynamic GMM model is expressed mathematically in Eq. 6.2 as:

$$Y_{it} = \alpha Y_{it-1} + \gamma Z_{it} + \beta U_{it} + \phi H_{it} + \phi X_{it} + \varepsilon_{it} \quad (6.2)$$

where Y_{it} is the dependent variable (food production), Y_{it-1} represents the past values of food production, Z_{it} and U_{it} are the variables of interest (financial development and urbanisation), and H_{it} is the interactive term of financial development and migration. X represents a vector of control variables (GDP growth, Agric/forestry value addition, food waste, government effectiveness, and regulatory quality) established in prior literature (Olaniyan & Govender, 2023; Palazzo et al., 2016) to influence food production in the empirical literature (see FAO, 2024; Hussain et al., 2020; The High Level Panel of Experts—HLPE, 2017). Thus, following prior studies, the study contextualises the financial development/food production model in equations as follows:

$$FPI_{it} = \varphi_1 FPI_{it-1} + \varphi_2 FIN\_DEV_{it} + \varphi_3 URB_{it} + \varphi_4 NET\_MIG_{it} + \sum_{j=5}^n \varphi_j X_{it} + \varepsilon_{it} \quad (6.3)$$

$$FPI_{it} = \mu_1 FPI_{it-1} + \mu_2 FIN\_DEV_{it} + \mu_3 URB_{it} + \mu_4 [FIN\_DEV * URB]_{it} + \mu_5 NET\_MIG_{it} + \sum_{j=6}^n \mu_j X_{it} + \varepsilon_{it} \quad (6.4)$$

$$FPI_{it} = \alpha_1 FPI_{it-1} + \alpha_2 FIN\_DEV_{it} + \alpha_3 URB_{it} + \alpha_4 NET\_MIG_{it} + \alpha_5 [FIN\_DEV * NET\_MIG]_{it} + \sum_{j=6}^n \alpha_j X_{it} + \vartheta_{it} \quad (6.5)$$

$$FPI_{it} = \lambda_1 FPI_{it-1} + \lambda_2 FIN\_DEV_{it} + \lambda_3 GRW\_GDP_{it} + \lambda_4 [FIN\_DEV * GRW\_GDP]_{it} + \lambda_5 GOV\_EFF_{it} + \lambda_6 REG\_QUA_{it} + \sum_{j=7}^n \lambda_j X_{it} + \varepsilon_{it} \quad (6.6)$$

$$FPI_{it} = \varnothing_1 FPI_{it-1} + \varnothing_2 FIN\_DEV_{it} + \varnothing_3 GRW\_GDP_{it} + \varnothing_4 GOV\_EFF_{it} + \varnothing_5 REG\_QUA_{it} + \varnothing_6 [GOV\_EFF * REG\_QUA]_{it} + \sum_{j=7}^n \varnothing_j X_{it} + \varepsilon_{it} \quad (6.7)$$

Similar to Tchamyou et al. (2019) and Tchamyou and Asongu (2017), net effect in Eqs. 6.4–6.7 is computed as the marginal effect by the mean of the moderator plus the unconditional effect of financial development. In Eq. 6.3, the chapter examines the impact of financial development and urbanisation on food production. It employs Eqs. 6.4–6.7 to investigate the interaction effects of policy variables on regional food production.

Following the models, the food production index (FPI) is the dependent variable. It represents the changes in the production of edible food crops at the country level over time. FIN_DEV , NET_MIG , and URB are independent variables of interest. Regarding the control variables, Gross Domestic Product (GDP) growth is calculated as year-on-year changes in GDP, reflecting improvements in national income. Hence, improvements in national income indicate increased government revenues, which, in turn, enhance the government's efforts to improve infrastructure for financial development. Good governance, which is underpinned by the quality of policy regulation and government effectiveness, will safeguard the actualisation of a well-developed financial system that ensures investment in the agriculture value chain for food security. Table 6.1 summarises the study's variables, operationalisation, and corresponding data sources.

Table 6.6 in the appendix and Table 6.2 provide valuable insights into various economic, financial, and governance indicators across multiple ECOWAS countries, highlighting significant disparities in development and institutional strength.

The correlation matrix in Table 6.6 highlights the key relationships that influence food production in the ECOWAS region. Food production has a positive correlation with financial development, urbanisation, GDP, and agricultural productivity, suggesting its role in enhancing food output. However, weak correlations with governance effectiveness and regulatory quality indicate limited direct institutional influence. Financial development supports migration and governance but negatively correlates with urbanisation,

Table 6.1 Variable definitions and operationalisation

Variables	Variable definition and operationalisation	Source
FPI	Measures changes in the production of edible food crops over a period of time	FAO
FIN_DEV	Relative ranking of countries on the depth, access, and efficiency of their financial institutions and financial markets. It is an aggregate of the Financial Institutions Index and the Financial Markets Index	World Bank WDI
AFW	Estimated household food waste per household. The precise methodology used to determine estimates may vary from country to country	World Population Review
NET_MIG	Net migration is the difference between the number of immigrants and the number of emigrants, including citizens and non-citizens	UNPD
AFF_VALU	The net output of agriculture, forestry, and fisheries, after subtracting intermediate inputs	World Bank WDI
GRW	Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2015 prices, expressed in U.S. dollars	World Bank WDI
UBN	The urban population refers to people living in urban areas, as defined by national statistical offices	World Bank WDI
REG_QUA	Regulatory quality captures perceptions of the government's ability to formulate and implement sound policies and regulations that permit and promote private sector development. The estimate provides the country's score on the aggregate indicator, expressed in standard normal distribution units ranging from approximately -2.5 to 2.5	World Bank WDI
GOV_EFF	The perceptions of the quality of public services, the quality of the civil service and its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies are crucial. The estimate provides the country's score on the aggregate indicator, expressed in standard normal distribution units ranging from approximately -2.5 to 2.5	World Bank WDI

Source Author's construct

Note WDI = World Development Indicators (World Bank); FPI = Food production index; FIN_DEV = Financial development; UBN = Urban population growth; NET_MIG = net migration; REG_QUA = Regulatory quality; GOV_EFF = Government effectiveness; AFW = Annual food waste per capita; GDP_GRW = GDP growth rate; AFFR_VALU = Agriculture, Forestry, Fishing value addition to GDP

Table 6.2 Summary statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
Food production index	195	88.99	42.85	0.00	183.45
Financial development	195	0.10	0.07	0.00	0.29
Urbanisation	180	3.59	0.92	0.78	5.26
Net migration	180	-9928.59	35,646.28	-250,964.00	78,685.00
Government effectiveness	195	-0.78	0.46	-1.81	0.34
Regulatory quality	195	-0.62	0.36	-1.32	0.27
Agric, forestry, and fishing (value added)	195	3.75	5.53	-13.31	35.18
GDP growth	195	4.17	4.13	-20.81	21.08
Food waste per capita	30	3,310,750	7,862,084	52,600	3.79e+07

Source Author's construct

while migration is linked to food waste, highlighting distribution inefficiencies. Strong correlations between governance and regulatory quality suggest institutional interdependence, although concerns about multicollinearity persist. Strengthening financial access, managing urban expansion, and enhancing institutional capacity are crucial for achieving food security and economic stability.

Table 6.2 reveals significant variation in food production, with an average index of 88.99 and a standard deviation of 42.85, indicating disparities across countries. Financial development remains low (mean: 0.10), which could hinder agricultural investment. Urban population growth is moderate at 3.59%, but net migration fluctuates widely, ranging from a loss of 250,964 to a gain of 78,685, reflecting differences in the labour market and economy.

Governance indicators show variability, with mean regulatory quality and government effectiveness scores of 29.63 and 24.63, respectively, suggesting institutional weaknesses. Agriculture's contribution to GDP varies significantly, averaging 3.75%, with some nations heavily reliant on it while others shift towards industry or services. GDP growth is also volatile, ranging from -20.81% to 21.08%.

Food waste per capita is notably high, with an average of 33.1 million and a standard deviation of 7.86 million, indicating inefficiencies in food systems. Countries with weak financial sectors and governance may struggle to maintain economic stability and secure food supplies. Strengthening financial systems, governance frameworks, and economic diversification are crucial for enhancing resilience and long-term food security in ECOWAS.

production, and (3) an overview of food production in ECOWAS.

6.3.1 Theoretical Underpinnings

The interconnectedness of financial development, urbanisation, and food production is best explained through the urban food demand pressure theory, the financialisation of agriculture and rural–urban migration theory, and the theory of structural transformation. The urban food demand pressure theory posits that rapid urbanisation increases food demand, which can lead to either agricultural expansion or food insecurity if supply cannot keep up (Ericksen et al., 2009; Satterthwaite, 2017; Timmer, 2002). Growing urban populations drive the consumption of processed and perishable foods, prompting farmers to shift towards commercial agriculture. However, inadequate production leads to higher food imports, trade deficits, and inflation. Climate change, land degradation, and poor infrastructure exacerbate supply chain inefficiencies.

The financialisation of agriculture and rural–urban migration theory suggests that financial development promotes investment in large-scale agribusiness but may also accelerate rural–urban migration, causing labour shortages in food production (Burch & Lawrence, 2009; Clapp, 2014; de Haas, 2010; Isakson, 2014). Expanding financial services favour large-scale commercial farming, shifting production to industrialised models. However, urban job opportunities draw young people away from farming, potentially reducing food production and increasing reliance on imports. Over-financialisation risks marginalising smallholder farmers who lack collateral for loans.

Structural transformation refers to the long-term shift from agriculture to higher-productivity sectors, such as manufacturing and services (Lewis, 1955). In the ECOWAS region, urbanisation, industrialisation, and labour market shifts drive this transformation, though its pace varies by country (FAO, 2024). The Lewis Dual-Sector Model suggests that excess rural labour moves into urban industries as wages and job

6.3 Theoretical and Empirical Framework

This section explores: (1) theoretical frameworks linking financial development, urbanisation, and food production, (2) empirical connections across financial development, trade, growth, and food

opportunities grow (Harris & Todaro, 1970). Rapid urbanisation in ECOWAS has spurred demand for processed foods, but it has also led to land-use conflicts, a decline in rural labour supply, and increased food imports, threatening agricultural sustainability (Staatz & Hollinger, 2016).

6.3.2 Empirical Underpinnings

6.3.2.1 Financial Development, Trade, and Economic Growth

Empirical studies on financial depth and economic growth have yielded mixed results regarding causality, although most cross-sectional and panel studies confirm a positive impact (Adu et al., 2013; Ahmed et al., 2021; Forson, 2025; Hassan et al., 2011; Majeed & Mazhar, 2019). Levine et al. (2000) examined financial indicators in 71 countries from 1960 to 1995 and found a positive relationship. In Sierra Leone, Kargbo and Adamu (2009) supported the finance-led growth hypothesis, identifying investment as a key channel for growth. In Ghana, Quartey and Prah (2008) found limited evidence for the demand-following hypothesis, but none for the supply-leading or Patrick's (1966) development stages hypothesis (Achiyaale et al., 2022). Odhiambo (2009) found a demand-following pattern in South Africa, where economic growth drives financial development.

A key issue in the finance-growth literature is the direction of causality (Chee-Keong & Chan, 2011). Al-Yousif (2002) warns that correlation does not imply causation, while Wang and Yao (2003) critiques model misspecification and endogeneity biases in finance-growth studies. Demetriades and Hussein (1996) found bidirectional or reverse causality in 16 developing countries, challenging finance-led growth theories. Adu et al. (2013) argued that the growth effect of financial development is sensitive to the choice of proxy (Nsor-Ambala & Amewu, 2023).

The relationship between trade openness and growth remains a topic of debate, with no

consensus emerging from theoretical or empirical studies. Trade liberalisation follows a J-curve, initially causing adverse effects before yielding long-term gains (Falvy et al., 2012; Greenaway et al., 2002; Guru & Yadav, 2019). Sustainable growth benefits stem from productivity improvements via technology diffusion (Forson et al., 2017a, 2017b, 2021), though adoption depends on human capital, R&D (Forson et al., 2021), financial development (Aghion et al., 2016), and institutional quality (Forson et al., 2021; Forson, 2024a, 2024b). Developing countries often struggle to maximise technology transfer due to weaknesses in these areas.

Empirical evidence is mixed. Excessive regulations restrict resource mobility, hindering growth (Freund & Bolaky, 2008), while institutions explain trade-growth heterogeneity (Bhasin & Obeng, 2007). Falvey et al. (2012) found that trade liberalisation boosts post-crisis growth in external crises but lowers it in internal crises. Fosu (2002) linked exports to growth in Africa, while Ulaşan (2012) argued that trade openness alone does not ensure growth. Trejos and Barboza (2015) found that trade was not the primary driver of Asia's growth. Trade liberalisation's benefits require complementary policies for macroeconomic stability and investment. Kim and Lin (2009) found that its long-term impact varies by development level, while Forslid et al. (2018) noted benefits for developed economies but harm for developing ones. The effects of trade openness depend on income thresholds, with positive effects above and adverse impacts below (Forson et al., 2021).

6.3.2.2 Urbanisation, Migration, and Food Production

Urbanisation, migration, and food production are interlinked and significantly impact the economic development and food security of frontier markets. As urban centres expand, rural-to-urban migration reshapes agricultural practices and food systems. Urbanisation is occurring at an unprecedented rate, with urban populations projected to reach 60% by 2050 (UN, 2022). This expansion increases food demand, particularly for processed and imported goods, while also

contributing to farmland conversion, resulting in a 15% reduction in agricultural land in cities such as Lagos, Abidjan, and Dakar (FAO, IFAD, IOM, 2018). Labour shortages in rural agricultural sectors further exacerbate food insecurity (Alarima, 2018; de Haas, 2010).

While urbanisation fosters market expansion and supply chain improvements, it also disrupts traditional farming, increasing reliance on imports (Abu Hatab et al., 2019; Zhuo & Salleh, 2021). Food consumption patterns shift towards convenience foods, necessitating higher agricultural output (Palazzo et al., 2016). However, local production often fails to meet demand, making countries like Nigeria and Ghana reliant on imports (Abu Hatab et al., 2019; Frimpong et al., 2022). Unregulated urbanisation exacerbates land-use conflicts and environmental degradation (AfDB, 2022), reducing food production capacity. Effective urban planning, incorporating agricultural land preservation, is essential to mitigate these impacts (Acquah et al., 2020).

Internal and external migration affects agricultural labour dynamics. Rural-urban migration leads to labour shortages, as younger generations leave for better opportunities, leaving older individuals to manage farms (Alarima, 2018). However, remittances from migrants can offset these losses by enabling investments in agricultural inputs and technologies, improving productivity (Ubaid et al., 2023). While migration may initially reduce agricultural output, financial support through remittances can enhance production capacity (Ali et al., 2021; de Haas, 2010).

Urban agriculture is emerging as a viable solution to food security challenges in rapidly urbanising frontier markets. Innovative techniques, such as vertical farming and rooftop gardening, optimise space and boost local food production (FAO, 2024; Forson et al., 2025). These initiatives enhance food availability and generate urban employment opportunities. However, challenges such as land tenure insecurity, limited financial access, and poor infrastructure must be addressed for urban agriculture to reach its full potential (Acquah et al., 2020).

6.3.2.3 Financial Development and Food Production

Financial development enhances food production and ensures food security in frontier markets. Access to agricultural financing, microloans, and insurance mechanisms enables farmers to invest in high-yield seeds, irrigation systems, and mechanisation, boosting productivity (Dercon & Christiaensen, 2011). In Nigeria and Ghana, financial inclusion policies have resulted in a 25% increase in food production over the past decade (Adabor & Essah, 2024). However, financial constraints remain, with only 30% of smallholder farmers accessing formal credit (ECOWAS Commission, 2021). Climate change-induced shocks, such as droughts and floods, further challenge food security, underscoring the need for robust financial instruments like index-based insurance and adaptive credit schemes (Trisos et al., 2022). Digital banking solutions and cooperative lending models could enhance agricultural resilience in ECOWAS (Forson et al., 2022; Klapper et al., 2016; Kusi et al., 2023; Yap et al., 2023). Financial access enables farmers to adopt modern agricultural techniques, purchase high-quality seeds, and utilise irrigation systems, thereby contributing to increased productivity (Yu et al., 2024a, 2024b). Studies link agricultural credit access to higher crop yields, as farmers with better financial support can afford fertilisers and pest control measures (Crush & Caesar, 2017). In ECOWAS, credit availability facilitates investment in agricultural inputs and riskier, yet productive, farming practices. Financial markets also play a key role in risk management for farmers facing climate variability. Crop insurance and weather derivatives serve as safety nets, encouraging investment in improved agricultural practices. Research suggests that financial services related to risk management enhance agricultural resilience and increase food production (Yap et al., 2023).

Remittances from migrants are a vital source of funding for the agricultural sector. They help rural households purchase inputs, invest in land improvements, and diversify agricultural activities (Ofori & Grechyna, 2021). They also reduce

rural poverty and enhance food security (Ubaid et al., 2023). However, their impact varies across regions, requiring targeted financial policies to optimise their potential (Crush & Caesar, 2017). Challenges persist, including high interest rates, collateral requirements, and low financial literacy. Over 70% of West African smallholder farmers lack access to formal financial services, which limits their investment in agriculture (World Bank, 2024). Informal lending often imposes high interest rates, hindering sustainable agricultural growth (Klapper et al., 2016).

A multifaceted approach is needed to strengthen financial support for food production. Policymakers should promote agricultural cooperatives, expand financial literacy programmes, and develop agricultural insurance products. Enhancing financial accessibility can drive agricultural investment and food security in ECOWAS.

6.3.3 Overview of Food Production in the ECOWAS Region

Food production in the Economic Community of West African States (ECOWAS) is influenced by climatic conditions, economic constraints, shifting consumer preferences, and regional trade policies. Agriculture remains vital, contributing significantly to the region's GDP and employment, although productivity constraints persist (Abokyi et al., 2020). Agricultural productivity has improved due to rising global commodity prices and capital intensity, with an annual growth rate of 4.5%, surpassing GDP growth (Osabohien et al., 2022). ECOWAS comprises diverse agro ecological zones that shape crop production. Staple crops such as cassava, maize, yams, and millet dominate food production, but changing consumer preferences have led to diversification into high-value crops like soybeans and legumes (Staatz & Hollinger, 2016). However, limited access to quality inputs remains a significant challenge.

Despite productivity gains, growth is uneven across the region. Coastal nations, such as

Table 6.3 Overview of average food production, value addition, and wastage in selected ECOWAS member states (1980–2023)

	Food production index	Agriculture, forestry and fishing, value added (% Growth)	Annual food waste (Tonnes)
Ghana	62.43	4.3	2,700,000.00
Nigeria	67.65	5.4	31,350,000.00
Côte d'Ivoire	70.54	3.7	2,550,000.00
Burkina Faso	58.12	3.62	2,100,000.00
Gambia	82.1	2.21	245,200.00
Guinea-Bissau	68.32	3.12	195,700.00
Guinea	63.3	5.27	1,250,000.00
Liberia	70.67	4.7	497,300.00
Mali	61.63	3.9	2,050,000.00
Senegal	76.15	2.97	1,450,000.00

Source Author's construct with data from various sources

Ghana, Côte d'Ivoire, and Senegal, benefit from cash crops, while landlocked countries, like Mali and Burkina Faso, face market access barriers (Sanga & Sebege, 2020). Smallholder farmers dominate the sector, relying on traditional methods with limited mechanisation, leading to low yields per hectare (Arowolo & Ekum, 2016). Food wastage is a significant constraint, exacerbated by inadequate storage and transport infrastructure (Kamenya et al., 2022). Table 6.3 illustrates disparities in food production, value addition, and wastage, with Nigeria experiencing the highest food waste (31.35 million tonnes annually).

Urbanisation and income growth are transforming food demand, increasing the consumption of processed and convenience foods, particularly rice and livestock products (Staatz & Hollinger, 2016). This shift has driven food imports as local production struggles with structural bottlenecks (Osabohien & Al-Faryan, 2025; Osabohien et al., 2022). Intra-regional trade remains weak due to tariffs, inconsistent regulations, and inadequate infrastructure, which reduces efficiency and increases reliance on imports (Arawomo & Badejo, 2015).

Public agricultural investment significantly influences food production, yet it remains

relatively low. Countries with higher government expenditure experience improved food availability (Kamenya et al., 2022). However, limited access to finance, high interest rates, and financial exclusion hinder the adoption of modern farming techniques (Osabohien et al., 2022). Climate change exacerbates food insecurity, with rising temperatures and erratic rainfall affecting yields in Sahelian nations and excessive rainfall leading to post-harvest losses in coastal areas (FAO, 2024).

Inadequate infrastructure limits market access and contributes to food waste, with post-harvest losses estimated between 30 and 50% (Garcia-Herrero et al., 2018). Weak supply chains, poor roads, and a lack of cold storage facilities further exacerbate food insecurity (Malhotra et al., 2021). The absence of agro-processing industries hinders value addition and farmers' incomes (Fofana et al., 2015).

Despite these challenges, ECOWAS has significant potential to enhance food production through policy reforms. Climate-smart agricultural practices and regional trade liberalisation could reduce food deficits and enhance self-sufficiency (Osabohien et al., 2022; World Bank, 2024). Addressing structural inefficiencies through investment in innovation and regional cooperation is key to achieving long-term food security.

6.4 Results

Before presenting the regression results, a Pearson correlation analysis is performed (see Table 6.6) to assess potential multicollinearity. The Generalised Method of Moments (GMM) is first employed to present the regression results while controlling for the COVID-19 years. The chapter uses methods of moment quantile regression (MMQR) for a robust analysis to capture the heterogeneous relationship. Other checks, such as the cross-sectional dependence test for the models and individual variables, are presented in Tables 6.7 and 6.8, respectively. It is essential to emphasise that this test addresses the issue

of cross-sectional dependence when the n individuals in the sample are no longer independent observations but rather affect each other's outcomes. For example, this can result from examining a set of neighbouring countries in the ECOWAS, which are typically highly interconnected.

6.4.1 Effect of Financial Development and Urbanisation on Food Production

Table 6.4a presents the results of the Generalised Method of Moments (GMM) regression on the effect of financial development and urbanisation on food production. Column 1 in Table 6.4a presents the results without controlling for the COVID-19 period, while the regression results in Column 2 control for the COVID-19 years.

According to Table 6.4a, the previous year's food production has a significantly positive effect on current food production across all columns at a 1% significance level. This provides evidence of convergence. Financial development has a significant impact on food production across all columns at a 1% significance level. This implies that at a 1% significance level, a unit increase in financial development increases food production by 0.0454 and 0.0506 units in Columns 1 and 2, respectively. Without controlling for COVID years, urbanisation has an adverse effect on food production, but the relationship is insignificant (see column 1). In Column 2, urbanisation has a significant positive effect on food production at a 1% significance level.

For the controls, migration, GDP, and regulatory quality do not significantly impact food production in either column. Moreover, agriculture has a positive impact on food production, as shown in Columns 1 and 2. However, the relationship is only significant in Column 1. Food waste has a negative relationship with food production, but the effect is significant only in Column 1. Government effectiveness was found to have a significant negative relationship with food production.

Table 6.4a Effect of financial development and urbanisation on food production—GMM

Variables	(1)	(2)
L. Food production	0.7424*** (0.1281)	0.5775*** (0.0677)
Financial development	0.0454*** (0.0151)	0.0506*** (0.0073)
Urbanisation	−0.2773 (0.3673)	0.0819*** (0.0194)
Migration	0.0410 (0.0418)	−0.0095 (0.0249)
GDP GRW	0.0039 (0.0068)	0.0013 (0.0050)
Agriculture	0.0129** (0.0055)	0.0036 (0.0026)
Food waste	−0.3931*** (0.1328)	−0.3383 (0.2254)
Government effectiveness	−0.4133** (0.1706)	−0.3094** (0.1305)
Regulatory quality	0.2872 (0.2268)	0.1373 (0.1502)
2020		0.0661 (0.0425)
2021		0.0641 (0.0636)
2022		0.6831*** (0.1332)
Constant	2.0221 (1.3093)	0.9538 (1.0690)
Wald statistics	1763.35	11,838.61
P-value	0.0000	0.0000
AR (1)	0.54	−3.34
P-value	0.588	0.001
AR (2)	1.18	0.79
P-value	0.240	0.429
Hansen J	4.52	0.79
P-value	0.104	0.672
Instruments	12	15
Observations	179	179
Number of countries	15	15

Source Author construct

Note GDP stands for Gross Domestic Product. Robust Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

For a robust analysis, the chapter employs the method of moments quantile regression (MMQR) while controlling for COVID-19 years to examine the effect of financial development and urbanisation on food production. The chapter aims to understand the heterogeneity in the relationships presented in Table 6.4b. From Table 6.4b, consistent with the results in Table 6.4a, the lag of food production has a significant positive effect on food production at the higher quantiles (4th to the 9th quantiles). The magnitude of this effect increases as the quantile increases. Financial development has a significant positive effect on food production across all quantiles at a 1% significance level; however, the magnitude of the effect decreases as the quantile increases (see Table 6.4b). This finding is consistent with the results in Table 6.4a, which show the link between financial development and food production. Furthermore, urbanisation showed a significant positive effect on food production from the 10th to the 80th percentile (1st–8th quantile), but the effect is insignificant in the 90th percentile (9th quantile). This result is consistent with the results in Table 6.4a (see Column 2).

On the controls, migration has no significant effect on food production across all quantiles, consistent with the results in Table 6.4a. GDP has a positive effect on food production across all quantiles, but the relationship is only significant at the 10th percentile (1st quantile). Agriculture also showed a positive relationship with food production across all quantiles; however, the relationship is significant at higher quantiles (see 4th–9th quantiles). Food waste significantly negatively impacts food production, ranging from the 1st to the 4th quantiles. In addition, government effectiveness has a significant adverse effect on food production from the 1st to the 7th quantile. At a 10% significance level, regulatory quality has a significant effect on food production from the 1st to the 5th quantiles. Finally, the COVID-19 years also had a significantly positive impact on food production across all quantiles.

Table 6.4b Effect of financial development and urbanisation on food production—method of moments quantile regression (Robust Analysis)

Variables	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
L. Food production	Location	Scale	qtile_1	qtile_2	qtile_3	qtile_4	qtile_5	qtile_6	qtile_7	qtile_8	qtile_9
	0.3831*** (0.0935)	0.3182*** (0.0315)	-0.4166*** (0.1216)	-0.0283 (0.1455)	0.1761 (0.1411)	0.3262*** (0.1261)	0.4561*** (0.1035)	0.5519*** (0.0944)	0.6164*** (0.0878)	0.6946*** (0.0868)	0.7774*** (0.1033)
Financial development	0.0403*** (0.0054)	-0.0193*** (0.0024)	0.0889*** (0.0085)	0.0653*** (0.0094)	0.0529*** (0.0086)	0.0438*** (0.0074)	0.0359*** (0.0059)	0.0301*** (0.0053)	0.0262*** (0.0048)	0.0214*** (0.0048)	0.0164*** (0.0059)
Urbanisation	0.0737*** (0.0199)	-0.0403*** (0.0135)	0.1750*** (0.0438)	0.1258*** (0.0338)	0.0999*** (0.0264)	0.0809*** (0.0226)	0.0645*** (0.0198)	0.0523*** (0.0190)	0.0442*** (0.0190)	0.0343*** (0.0199)	0.0238 (0.0220)
Migration	-0.0026 (0.0169)	0.0158* (0.0083)	-0.0422 (0.0338)	-0.0229 (0.0258)	-0.0128 (0.0208)	-0.0054 (0.0181)	0.0011 (0.0160)	0.0058 (0.0148)	0.0090 (0.0143)	0.0129 (0.0141)	0.0170 (0.0146)
GDP GRW	0.0069 (0.0065)	-0.0058* (0.0031)	0.0216* (0.0128)	0.0144 (0.0096)	0.0107 (0.0080)	0.0079 (0.0070)	0.0055 (0.0062)	0.0038 (0.0058)	0.0026 (0.0056)	0.0012 (0.0054)	-0.0004 (0.0054)
Agriculture	0.0070** (0.0031)	0.0035* (0.0021)	-0.0017 (0.0070)	0.0025 (0.0049)	0.0048 (0.0039)	0.0064* (0.0033)	0.0078*** (0.0030)	0.0089*** (0.0029)	0.0096*** (0.0029)	0.0104*** (0.0030)	0.0113*** (0.0032)
Food waste	-0.1752* (0.0898)	0.2164*** (0.0603)	-0.7191*** (0.2264)	-0.4550*** (0.1619)	-0.3160*** (0.1276)	-0.2139*** (0.1062)	-0.1256 (0.0865)	-0.0604 (0.0773)	-0.0166 (0.0724)	0.0366 (0.0724)	0.0929 (0.0841)
Government effectiveness	-0.3232*** (0.1154)	0.1522*** (0.0508)	-0.7059*** (0.2082)	-0.5201*** (0.1464)	-0.4223*** (0.1404)	-0.3505*** (0.1268)	-0.2883*** (0.1147)	-0.2425*** (0.1096)	-0.2116*** (0.1068)	-0.1742 (0.1070)	-0.1346 (0.1123)
Regulatory quality	0.2511* (0.1414)	-0.1131 (0.0770)	0.5354* (0.2980)	0.3974* (0.2070)	0.3247* (0.1771)	0.2713* (0.1528)	0.2251* (0.1344)	0.1911 (0.1255)	0.1681 (0.1215)	0.1403 (0.1199)	0.1109 (0.1221)
2020	0.1974*** (0.0724)	-0.0178 (0.0349)	0.2422* (0.1267)	0.2205** (0.0943)	0.2090** (0.0818)	0.2006*** (0.0747)	0.1933*** (0.0710)	0.1880*** (0.0701)	0.1844*** (0.0704)	0.1800** (0.0715)	0.1753** (0.0735)
2021	0.1813** (0.0704)	0.0025 (0.0365)	0.1750 (0.1253)	0.1781* (0.0916)	0.1797** (0.0782)	0.1808** (0.0718)	0.1818*** (0.0694)	0.1826*** (0.0696)	0.1831*** (0.0708)	0.1837** (0.0731)	0.1844** (0.0766)

(continued)

Table 6.4b (continued)

	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
2022	0.6221*** (0.1187)	-0.2346*** (0.0601)	1.2118*** (0.2171)	0.9254*** (0.1850)	0.7747*** (0.1666)	0.6640*** (0.1421)	0.5682*** (0.1182)	0.4976*** (0.1058)	0.4500*** (0.0984)	0.3924*** (0.0956)	0.3313*** (0.1011)
Constant	0.4737 (0.4022)	-0.8597*** (0.2691)	2.6348*** (1.0335)	1.5855*** (0.7361)	1.0331* (0.5708)	0.6275 (0.4710)	0.2765 (0.3784)	0.0176 (0.3313)	-0.1567 (0.3055)	-0.3679 (0.3015)	-0.5916* (0.3540)
Observations	179	179	179	179	179	179	179	179	179	179	179

Source Author's construct

Note GDP stands for Gross Domestic Product. Robust Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

6.4.2 Financial Development, Urbanisation, Migration, Economic Growth, Institutions and Food Production

The GMM results for the relationship between financial development, urbanisation, migration, economic growth, institutions, and food production are shown in Table 6.5a, without controlling for COVID-19 time periods. Column 14 presents the GMM regression results for the interactive effect of financial development and urbanisation on food production. On the other hand, Column 15 presents the regression results for the interactive effect of financial development and migration on food production. While the GMM regression results for the interactive effect of financial development and GDP on food production are presented in Column 16, Column 17 presents the interactive effect of government effectiveness and regulatory quality on food production in Table 6.5a.

Controlling for COVID-19 years in Table 6.5b, Column 18 presents the GMM regression results for the interactive effect of financial development and urbanisation on food production. Column 19, on the other hand, presents the regression results for the interactive effect of financial development and migration on food production. While the GMM regression results for the interactive effect of financial development and GDP on food production are presented in Column 20, Column 21 presents the interactive effect of government effectiveness and regulatory quality on food production.

Similar to results in Tables 6.4a and 6.4b, the lag of food production has a significant positive effect on food production (see Tables 6.5a and 6.5b). Similarly, financial development has a significant positive effect on food production (see Table 6.5b). Table 6.5a shows a significant positive interactive effect of financial development and urbanisation on food production at a 5% significance level, with a net effect of 0.0108 (see Column 14). However, controlling for Covid-19 years, the interactive

effect is insignificant (see Table 6.5b, Column 18). The interactive effect of financial development and migration is negative and insignificant in Tables 6.5a and 6.5b (see Columns 15 and 19). In Tables 6.5a and 6.5b, the effect of financial development, conditioned on GDP, is significantly positive at a 5% significance level, with net effects of 0.0045 and 0.0081, respectively (see Columns 16 and 20). Finally, the effect of government effectiveness, conditioned on regulatory quality, is negative and significant at a 10% significance level, with a net effect of -0.3725 (see Table 6.5a, Column 17). However, the effect is insignificant in Table 6.5a (see Column 21). The findings suggest that food production in ECOWAS benefits from financial development, urbanisation, and economic growth, but is hindered by migration and weak governance. Financial development significantly enhances food production, emphasising the need for improved access to credit and investment in agriculture. The positive interaction between financial development and urbanisation highlights the role of infrastructure and market access in boosting agricultural productivity. However, the COVID-19 pandemic weakened this effect, underscoring the need for economic resilience. Migration negatively impacts food production, likely due to labour shortages in rural areas. Policy-makers should promote agribusiness opportunities to retain the workforce in farming communities. The more substantial effect of financial development during economic growth suggests that expanding economies should prioritise agricultural investments. Weak governance and regulatory inefficiencies negatively affect food production, highlighting the need for stronger institutions and effective policy implementation. Addressing corruption and inefficiencies is crucial for ensuring that agricultural policies translate into tangible productivity gains. To enhance food production, ECOWAS countries should focus on strengthening financial support for farmers, leveraging urbanisation, managing migration, and improving governance. These measures will help ensure sustainable agricultural growth and food security in the region.

Table 6.5a Financial development, urbanisation, migration, economic growth, institutions, and food production—GMM

Variables	(14)	(15)	(16)	(17)
L. Food production	1.8489*** (0.1167)	0.6962*** (0.0985)	2.2873*** (0.2623)	1.8438*** (0.1759)
Financial development	−0.0129 (0.0096)	0.0506** (0.0238)	−0.0184 (0.0119)	0.0051 (0.0081)
Urbanisation	0.0687 (0.2083)	0.1203 (0.2192)	0.1323 (0.2426)	0.1518 (0.1893)
Migration	0.1200*** (0.0368)	0.0877 (0.0648)	0.0921* (0.0515)	0.0945** (0.0392)
GDP GRW	−0.0232** (0.0102)	0.0026 (0.0305)	−0.1045** (0.0516)	−0.0245** (0.0106)
Financial development * urbanisation	0.0066** (0.0031)			
Financial development * migration		−0.0026 (0.0028)		
Financial development * GDP GRW			0.0055** (0.0025)	
Government effect * regulatory quality				−1.1135* (0.6089)
Agriculture	0.0060 (0.0058)	0.0477 (0.0380)	0.0179** (0.0074)	0.0050 (0.0056)
Food waste	−0.1240 (0.1836)	−0.2751 (0.2966)	−0.4300 (0.2664)	−0.2116 (0.3302)
Government effectiveness	−0.2748 (0.2629)	−0.2968 (0.3265)	−0.5118 (0.4187)	−1.0629* (0.5676)
Regulatory quality	0.5932* (0.3195)	0.9071** (0.4049)	1.1609** (0.5086)	−0.0046 (0.4267)
Constant	−1.4898** (0.7074)	0.2067 (1.8696)	0.1260 (1.1433)	−1.3784 (1.7397)
<i>Wald statistics</i>	5097.09	820.07	11,110.74	799.30
<i>P-value</i>	0.0000	0.0000	0.0000	0.0000
<i>AR (1)</i>	−3.36	−2.32	0.71	−3.10
<i>P-value</i>	0.001	0.020	0.478	0.002
<i>AR (2)</i>	0.96	1.13	1.55	0.69
<i>P-value</i>	0.336	0.258	0.122	0.493
<i>Hansen J</i>	1.03	7.76	3.82	0.25
<i>P-value</i>	0.795	0.101	0.282	0.883
<i>Net effect</i>	0.0108	N/A	0.0045	−0.3725
<i>Instruments</i>	14	15	14	13
<i>Observations</i>	179	179	179	179
<i>Number of Countries</i>	15	15	15	15

Source Author's construct

Note GDP stands for Gross Domestic Product. Robust Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6.5b Financial development, urbanisation, migration, economic growth, institutions and food production

	(GMM)	(GMM)	(GMM)	(GMM)
Variables	18	19	20	21
L. Food production	0.3916*** (0.1002)	0.4007*** (0.0673)	1.7626*** (0.2090)	0.4753** (0.2269)
Financial development	0.0436** (0.0183)	0.0832*** (0.0244)	−0.0027 (0.0060)	0.0747*** (0.0129)
Urbanisation	−0.0863 (0.0963)	0.0482 (0.1160)	−0.0622** (0.0298)	−0.1721 (0.3732)
Migration	0.0334 (0.0327)	0.0698** (0.0349)	−0.0027 (0.0181)	−0.0170 (0.0625)
GDP GRW	0.0056 (0.0132)	0.0010 (0.0091)	−0.0405** (0.0166)	0.0247 (0.0329)
Financial development * urbanisation	0.0064 (0.0054)			
Financial development * migration		−0.0026 (0.0021)		
Financial development * GDP GRW			0.0026** (0.0011)	
Government effect * regulatory quality				−1.5350 (1.2529)
Agriculture	−0.0272 (0.0292)	−0.0139 (0.0291)	0.0097*** (0.0037)	−0.1252* (0.0742)
Food waste	0.0065 (0.4016)	0.0793 (0.3507)	0.0586 (0.1242)	0.0301 (0.5077)
Government effectiveness	−0.2326 (0.1582)	−0.2121 (0.1898)	−0.3611** (0.1537)	−1.5063 (1.3365)
Regulatory quality	0.6141*** (0.2291)	0.7126*** (0.2164)	0.4523** (0.1945)	−0.3612 (0.8683)
2020	0.2019*** (0.0751)	0.2015*** (0.0632)	0.0527 (0.0587)	0.2944 (0.2673)
2021	0.1159 (0.0878)	0.1576* (0.0916)	−0.0327 (0.0798)	−0.0017 (0.2641)
2022	1.0260*** (0.1401)	0.9492*** (0.1687)	−0.0366 (0.1677)	1.3293*** (0.2892)
Constant	0.0919 (1.6595)	−0.9727 (1.5123)	−0.7858 (0.6584)	0.1493 (1.4019)
<i>Wald statistics</i>	2250.71	6125.67	7070.19	2190.76
<i>P-value</i>	0.0000	0.0000	0.0000	0.0000
<i>AR (1)</i>	−1.46	−1.64	−3.29	−1.80
<i>P-value</i>	0.144	0.101	0.001	0.071
<i>AR (2)</i>	0.65	0.69	0.82	0.98
<i>P-value</i>	0.513	0.491	0.414	0.327

(continued)

Table 6.5b (continued)

	(GMM)	(GMM)	(GMM)	(GMM)
Variables	18	19	20	21
<i>Hansen J</i>	1.84	2.08	2.55	0.28
<i>P-value</i>	0.175	0.149	0.110	0.600
<i>Net effect</i>	N/A	N/A	0.0081	N/A
<i>Instruments</i>	15	15	15	15
<i>Observations</i>	179	179	179	179
<i>Number of Countries</i>	15	15	15	15

Source Author's construct

Note GDP stands for Gross Domestic Product. Robust Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

For a robust analysis, Tables 6.5c, 6.5d, 6.5e, and 6.5f present the MMQR regression results on the interactive effect of financial development and urbanisation on food production; the interactive effect of financial development and migration on food production; the interactive effect of financial development and GDP on food production; and the interactive effect of government effectiveness and regulatory quality on food production respectively. COVID-19 years are controlled for.

Consistent with the results in Table 6.5a, financial development and urbanisation have a significant positive interactive effect on food production at higher quantiles in Table 6.5c (see from quantile 4 to quantile 9). Financial development and migration have no significant interactive effect on food production from quantile 1 to quantile 7. However, the relationship is negative and significant at the eighth and ninth quantiles (see Table 6.5d). Furthermore, when conditioned on GDP, financial development significantly affects food production at higher quantiles (see Table 6.5e, specifically the 4th to 9th quantiles). This is consistent with the results in Tables 6.5a and 6.5b. Finally, consistent with the results in Table 6.5b, the interactive effect of government effectiveness and regulatory quality has no significant effect on food production across all the quantiles.

6.5 Discussions

Financial development significantly impacts food production in low-, medium-, and high-food-producing countries in the ECOWAS region, enabling farmers to adopt innovative technologies, improve efficiency, and access advanced inputs such as high-quality seeds, chemicals, and fertilisers. Studies confirm this positive relationship (Appiah-Otoo et al., 2024; Zakaria et al., 2019).

Urbanisation also influences food production by increasing food demand, motivating farmers to enhance production, and improving food distribution infrastructure (Abdulai, 2022; de Bruin et al., 2021). However, some studies argue that urbanisation negatively affects food production (Abu Hatab et al., 2019; Acquah et al., 2020; Frimpong et al., 2022). Economic growth, measured by GDP, further enhances the relationship between financial development and food production by driving technological innovation, improving capital access, and strengthening agricultural markets. Financial development fosters economic growth by enabling efficient resource allocation, investment, and employment, thereby increasing food demand and supply.

Sustainable agricultural practices, including improved seeds, fertilisers, digital technologies, and soil conservation, enhance food productivity

Table 6.5c Interactive effect of financial development and urbanisation on food production—method of moments quantile regression (Robust Analysis)

Variables	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)
L. Food production	Location 0.3868*** (0.0906)	Scale 0.3098*** (0.0289)	qtile__1 -0.4365*** (0.1737)	qtile__2 -0.0368 (0.1185)	qtile__3 0.1390 (0.1474)	qtile__4 0.3156** (0.1260)	qtile__5 0.4803*** (0.1013)	qtile__6 0.5518*** (0.0828)	qtile__7 0.6002*** (0.0791)	qtile__8 0.6743*** (0.0824)	qtile__9 0.7607*** (0.0818)
Financial development	0.0255*** (0.0079)	-0.0174*** (0.0041)	0.0717*** (0.0172)	0.0493*** (0.0111)	0.0394*** (0.0109)	0.0295*** (0.0095)	0.0203** (0.0082)	0.0163** (0.0075)	0.0135* (0.0074)	0.0094 (0.0076)	0.0045 (0.0078)
Urbanisation	0.0006 (0.0408)	-0.0326 (0.0222)	0.0873 (0.0892)	0.0452 (0.0620)	0.0267 (0.0519)	0.0081 (0.0441)	-0.0092 (0.0384)	-0.0167 (0.0366)	-0.0219 (0.0360)	-0.0297 (0.0359)	-0.0388 (0.0364)
Financial development * urbanisation	0.0054** (0.0027)	-0.0003 (0.0015)	0.0062 (0.0061)	0.0058 (0.0043)	0.0056 (0.0036)	0.0054* (0.0029)	0.0053** (0.0025)	0.0052** (0.0023)	0.0052** (0.0022)	0.0051** (0.0022)	0.0050** (0.0022)
Migration	0.0015 (0.0165)	0.0117 (0.0081)	-0.0295 (0.0359)	-0.0145 (0.0252)	-0.0078 (0.0213)	-0.0011 (0.0179)	0.0051 (0.0153)	0.0078 (0.0144)	0.0096 (0.0139)	0.0124 (0.0136)	0.0157 (0.0136)
GDP	0.0044 (0.0065)	-0.0032 (0.0027)	0.0129 (0.0120)	0.0088 (0.0087)	0.0070 (0.0077)	0.0052 (0.0068)	0.0035 (0.0062)	0.0027 (0.0060)	0.0022 (0.0059)	0.0015 (0.0059)	0.0006 (0.0059)
Agriculture	0.0072** (0.0029)	0.0033 (0.0021)	-0.0016 (0.0074)	0.0027 (0.0050)	0.0045 (0.0041)	0.0064** (0.0033)	0.0082*** (0.0028)	0.0090*** (0.0026)	0.0095*** (0.0026)	0.0103*** (0.0027)	0.0112*** (0.0029)
Food waste	-0.2486** (0.1049)	0.2372*** (0.0619)	-0.8790*** (0.2813)	-0.5729*** (0.1816)	-0.4383*** (0.1575)	-0.3031*** (0.1274)	-0.1770* (0.0992)	-0.1223 (0.0851)	-0.0852 (0.0803)	-0.0284 (0.0792)	0.0377 (0.0816)
Government effectiveness	-0.2701** (0.1228)	0.1305** (0.0525)	-0.6169*** (0.2540)	-0.4485*** (0.1670)	-0.3745*** (0.1562)	-0.3001*** (0.1354)	-0.2308* (0.1184)	-0.2006* (0.1111)	-0.1802* (0.1084)	-0.1490 (0.1066)	-0.1126 (0.1055)
Regulatory quality	0.1822 (0.1511)	-0.0885 (0.0775)	0.4173 (0.3411)	0.3032 (0.2332)	0.2530 (0.1995)	0.2026 (0.1653)	0.1555 (0.1384)	0.1351 (0.1286)	0.1213 (0.1237)	0.1001 (0.1185)	0.0755 (0.1149)
2020	0.1703** (0.0743)	-0.0072 (0.0372)	0.1896 (0.1442)	0.1802* (0.1046)	0.1761* (0.0901)	0.1720** (0.0781)	0.1682** (0.0709)	0.1665** (0.0693)	0.1654** (0.0688)	0.1636** (0.0690)	0.1616** (0.0705)
2021	0.1520** (0.0721)	0.0005 (0.0390)	0.1507 (0.1404)	0.1513 (0.0999)	0.1516* (0.0854)	0.1519** (0.0748)	0.1521** (0.0700)	0.1522** (0.0698)	0.1523** (0.0703)	0.1524** (0.0720)	0.1526** (0.0755)
2022	0.6380*** (0.1193)	-0.2159*** (0.0621)	1.2117*** (0.2025)	0.9331*** (0.1828)	0.8106*** (0.1796)	0.6876*** (0.1454)	0.5728*** (0.1144)	0.5230*** (0.0983)	0.4893*** (0.0921)	0.4376*** (0.0890)	0.3774*** (0.0852)

(continued)

Table 6.5c (continued)

	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)
Variables	Location	Scale	qtile__1	qtile__2	qtile__3	qtile__4	qtile__5	qtile__6	qtile__7	qtile__8	qtile__9
Constant	1.0108* (0.5182)	-0.9597*** (0.3180)	3.5616*** (1.4087)	2.3232*** (0.9247)	1.7785*** (0.7793)	1.2314*** (0.6176)	0.7211 (0.4720)	0.4997 (0.4052)	0.3496 (0.3783)	0.1201 (0.3651)	-0.1477 (0.3749)
Net effect	0.0449	N/A	N/A	N/A	N/A	0.0489	0.0393	0.0350	0.0322	0.0277	0.0225
Observations	179	179	179	179	179	179	179	179	179	179	179

Source Author's construct

Note GiDP stands for Gross Domestic Product. Robust Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6.5d Interactive effect of financial development and migration on food production—method of moments quantile regression (Robust Analysis)

Variables	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)	(43)
L. Food production	Location	Scale	qtile__1	qtile__2	qtile__3	qtile__4	qtile__5	qtile__6	qtile__7	qtile__8	qtile__9
	0.3841*** (0.0936)	0.3184*** (0.0331)	-0.3198** (0.1339)	-0.0366 (0.1230)	0.1286 (0.1476)	0.3117** (0.1271)	0.4449*** (0.1042)	0.5449*** (0.0932)	0.6086*** (0.0869)	0.6929*** (0.0877)	0.7825*** (0.0879)
Financial development	0.0492** (0.0230)	0.0031 (0.0143)	0.0424 (0.0526)	0.0449 (0.0409)	0.0467 (0.0330)	0.0485* (0.0257)	0.0497** (0.0208)	0.0507*** (0.0175)	0.0513*** (0.0157)	0.0521*** (0.0140)	0.0530*** (0.0130)
Urbanisation	0.0744*** (0.0199)	-0.0367*** (0.0135)	0.1555*** (0.0412)	0.1252*** (0.0325)	0.1038*** (0.0277)	0.0828*** (0.0226)	0.0674*** (0.0197)	0.0559*** (0.0187)	0.0486*** (0.0187)	0.0389** (0.0195)	0.0286 (0.0216)
Migration	0.0056 (0.0330)	0.0339* (0.0192)	-0.0694 (0.0754)	-0.0414 (0.0578)	-0.0217 (0.0466)	-0.0021 (0.0370)	0.0120 (0.0304)	0.0227 (0.0263)	0.0295 (0.0241)	0.0385* (0.0222)	0.0480** (0.0210)
Financial development * migration	-0.0010 (0.0027)	-0.0026 (0.0017)	0.0047 (0.0065)	0.0025 (0.0049)	0.0010 (0.0039)	-0.0004 (0.0030)	-0.0015 (0.0024)	-0.0023 (0.0020)	-0.0029 (0.0018)	-0.0035** (0.0015)	-0.0043*** (0.0014)
GDP	0.0069 (0.0066)	-0.0060** (0.0030)	0.0203* (0.0121)	0.0153 (0.0097)	0.0118 (0.0084)	0.0083 (0.0071)	0.0058 (0.0063)	0.0039 (0.0058)	0.0027 (0.0056)	0.0011 (0.0053)	-0.0006 (0.0052)
Agriculture	0.0070** (0.0031)	0.0034* (0.0020)	-0.0005 (0.0064)	0.0023 (0.0050)	0.0043 (0.0041)	0.0063* (0.0034)	0.0077** (0.0030)	0.0088*** (0.0028)	0.0094*** (0.0028)	0.0103*** (0.0029)	0.0113*** (0.0031)
Food waste	-0.1507 (0.1168)	0.2732*** (0.0793)	-0.7546** (0.3207)	-0.5288** (0.2254)	-0.3699** (0.1843)	-0.2128 (0.1422)	-0.0986 (0.1090)	-0.0127 (0.0887)	0.0419 (0.0778)	0.1142 (0.0726)	0.1911*** (0.0736)
Government effectiveness	-0.3195*** (0.1173)	0.1585*** (0.0538)	-0.6698*** (0.2167)	-0.5388*** (0.1590)	-0.4466*** (0.1514)	-0.3555*** (0.1310)	-0.2892** (0.1165)	-0.2394*** (0.1095)	-0.2077* (0.1061)	-0.1658 (0.1063)	-0.1212 (0.1049)
Regulatory quality	0.2491* (0.1435)	-0.1130 (0.0782)	0.4988* (0.2894)	0.4054* (0.2206)	0.3397* (0.1900)	0.2747* (0.1576)	0.2275* (0.1373)	0.1920 (0.1266)	0.1694 (0.1219)	0.1396 (0.1196)	0.1078 (0.1184)
2020	0.1938*** (0.0734)	-0.0243 (0.0343)	0.2476** (0.1171)	0.2275** (0.0964)	0.2134** (0.0852)	0.1994*** (0.0762)	0.1892*** (0.0723)	0.1816** (0.0713)	0.1767** (0.0715)	0.1703** (0.0726)	0.1634** (0.0744)
2021	0.1824*** (0.0701)	0.0045 (0.0381)	0.1725 (0.1203)	0.1762* (0.0961)	0.1788** (0.0819)	0.1814** (0.0723)	0.1832*** (0.0689)	0.1846*** (0.0687)	0.1855*** (0.0697)	0.1867*** (0.0722)	0.1880** (0.0761)

(continued)

Table 6.5d (continued)

	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)	(43)
Variables	Location	Scale	qtile__1	qtile__2	qtile__3	qtile__4	qtile__5	qtile__6	qtile__7	qtile__8	qtile__9
2022	0.6218*** (0.1192)	-0.2273*** (0.0598)	1.1241*** (0.1823)	0.9363*** (0.1765)	0.8041*** (0.1730)	0.6734*** (0.1429)	0.5784*** (0.1194)	0.5069*** (0.1061)	0.4615*** (0.0989)	0.4014*** (0.0970)	0.3374*** (0.1011)
Constant	0.2909 (0.7145)	-1.2837*** (0.4693)	3.1283 (1.9042)	2.0673 (1.3782)	1.3206 (1.1019)	0.5825 (0.8473)	0.0459 (0.6509)	-0.3575 (0.5232)	-0.6142 (0.4504)	-0.9538*** (0.3969)	-1.3153*** (0.3630)
<i>Net effect</i>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0199	0.0116
Observations	179	179	179	179	179	179	179	179	179	179	179

Source Author's construct

Note GDP stands for Gross Domestic Product. Robust Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6.5e Interactive effect of financial development and economic growth on food production—method of moments quantile regression (Robust Analysis)

Variables	(44)	(45)	(46)	(47)	(48)	(49)	(50)	(51)	(52)	(53)	(54)
L. Food production	Location	Scale	qtile__1	qtile__2	qtile__3	qtile__4	qtile__5	qtile__6	qtile__7	qtile__8	qtile__9
	0.4122*** (0.0904)	0.2956*** (0.0307)	-0.2781** (0.1291)	0.0366 (0.1216)	0.1792 (0.1324)	0.3505*** (0.1176)	0.4864*** (0.1038)	0.5619*** (0.0901)	0.6153*** (0.0844)	0.6809*** (0.0863)	0.7707*** (0.0857)
Financial development	0.0352*** (0.0053)	-0.0191*** (0.0026)	0.0799*** (0.0100)	0.0595*** (0.0082)	0.0503*** (0.0082)	0.0392*** (0.0071)	0.0304*** (0.0061)	0.0256*** (0.0052)	0.0221*** (0.0049)	0.0179*** (0.0051)	0.0120*** (0.0053)
Urbanisation	0.0582*** (0.0193)	-0.0404*** (0.0132)	0.1526*** (0.0419)	0.1096*** (0.0314)	0.0901*** (0.0263)	0.0667*** (0.0218)	0.0481** (0.0195)	0.0378** (0.0184)	0.0305* (0.0184)	0.0215 (0.0192)	0.0092 (0.0203)
Migration	-0.0045 (0.0164)	0.0159* (0.0084)	-0.0416 (0.0329)	-0.0247 (0.0253)	-0.0170 (0.0215)	-0.0078 (0.0179)	-0.0005 (0.0154)	0.0035 (0.0141)	0.0064 (0.0135)	0.0099 (0.0131)	0.0147 (0.0129)
GDP	-0.0072 (0.0101)	-0.0019 (0.0039)	-0.0029 (0.0125)	-0.0049 (0.0104)	-0.0058 (0.0100)	-0.0069 (0.0099)	-0.0077 (0.0103)	-0.0082 (0.0106)	-0.0085 (0.0109)	-0.0089 (0.0113)	-0.0095 (0.0119)
Financial development*GDP	0.0013** (0.0006)	0.0003 (0.0004)	0.0006 (0.0011)	0.0009 (0.0008)	0.0010 (0.0007)	0.0012** (0.0006)	0.0013** (0.0005)	0.0014** (0.0006)	0.0015*** (0.0006)	0.0015*** (0.0006)	0.0016*** (0.0006)
Agriculture	0.0089*** (0.0030)	0.0020 (0.0018)	0.0042 (0.0057)	0.0064 (0.0042)	0.0073** (0.0036)	0.0085*** (0.0031)	0.0094*** (0.0029)	0.0100*** (0.0029)	0.0103*** (0.0029)	0.0108*** (0.0030)	0.0114*** (0.0032)
Food waste	-0.1311 (0.1002)	0.2110*** (0.0665)	-0.6239*** (0.2576)	-0.3992** (0.1759)	-0.2974** (0.1480)	-0.1752 (0.1167)	-0.0781 (0.0947)	-0.0242 (0.0815)	0.0139 (0.0751)	0.0607 (0.0735)	0.1248* (0.0737)
Government effectiveness	-0.3490*** (0.1115)	0.1457*** (0.0490)	-0.6893*** (0.2012)	-0.5342*** (0.1417)	-0.4639*** (0.1397)	-0.3795*** (0.1229)	-0.3125*** (0.1113)	-0.2753*** (0.1049)	-0.2489*** (0.1019)	-0.2166*** (0.1018)	-0.1724* (0.1029)
Regulatory quality	0.3051** (0.1350)	-0.1190 (0.0730)	0.5830** (0.2763)	0.4563** (0.1964)	0.3989** (0.1767)	0.3300** (0.1476)	0.2752** (0.1285)	0.2449** (0.1201)	0.2233* (0.1160)	0.1969* (0.1143)	0.1608 (0.1154)
2020	0.2337*** (0.0690)	-0.0049 (0.0391)	0.2451* (0.1311)	0.2399** (0.0974)	0.2376*** (0.0846)	0.2347*** (0.0723)	0.2325*** (0.0665)	0.2313*** (0.0652)	0.2304*** (0.0652)	0.2293*** (0.0663)	0.2278*** (0.0694)
2021	0.1847*** (0.0708)	0.0002 (0.0350)	0.1842 (0.1166)	0.1844** (0.0896)	0.1845** (0.0801)	0.1847** (0.0724)	0.1847*** (0.0699)	0.1848*** (0.0701)	0.1848*** (0.0709)	0.1849** (0.0727)	0.1849** (0.0763)
2022	0.6449*** (0.1211)	-0.2107*** (0.0615)	1.1369*** (0.2092)	0.9127*** (0.1808)	0.8110*** (0.1723)	0.6889*** (0.1423)	0.5920*** (0.1202)	0.5382*** (0.1062)	0.5001*** (0.0989)	0.4534*** (0.0966)	0.3893*** (0.0928)

(continued)

Table 6.5e (continued)

	(44)	(45)	(46)	(47)	(48)	(49)	(50)	(51)	(52)	(53)	(54)
Variables	Location	Scale	qtile__1	qtile__2	qtile__3	qtile__4	qtile__5	qtile__6	qtile__7	qtile__8	qtile__9
Constant	0.3731	-0.8492***	2.3565***	1.4524*	1.0425	0.5505	0.1599	-0.0568	-0.2105	-0.3988	-0.6569***
	(0.4414)	(0.2915)	(1.1379)	(0.7844)	(0.6536)	(0.5128)	(0.4116)	(0.3514)	(0.3208)	(0.3119)	(0.3097)
Net effect	0.0406	N/A	N/A	N/A	N/A	0.0442	0.0358	0.0314	0.0284	0.0242	0.0187
Observations	179	179	179	179	179	179	179	179	179	179	179

Source Author's construct

Note GiDP stands for Gross Domestic Product. Robust Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6.5f Interactive effect of government effectiveness and regulatory quality on food production—method of moments quantile regression (Robust Analysis)

Variables	(55)	(56)	(57)	(58)	(59)	(60)	(61)	(62)	(63)	(64)	(65)
L. Food production	Location	Scale	qtile_1	qtile_2	qtile_3	qtile_4	qtile_5	qtile_6	qtile_7	qtile_8	qtile_9
	0.3741*** (0.0923)	0.3189*** (0.0302)	-0.4124*** (0.1217)	-0.0213 (0.1340)	0.1679 (0.1423)	0.3309*** (0.1225)	0.4331*** (0.1056)	0.5440*** (0.0929)	0.6208*** (0.0873)	0.6787*** (0.0834)	0.7710*** (0.0894)
Financial development	0.0406*** (0.0054)	-0.0194*** (0.0024)	0.0884*** (0.0084)	0.0646*** (0.0086)	0.0531*** (0.0087)	0.0432*** (0.0073)	0.0370*** (0.0061)	0.0303*** (0.0053)	0.0256*** (0.0049)	0.0221*** (0.0048)	0.0165*** (0.0056)
Urbanisation	0.0962*** (0.0282)	-0.0419*** (0.0159)	0.1996*** (0.0520)	0.1482*** (0.0399)	0.1234*** (0.0341)	0.1019*** (0.0300)	0.0885*** (0.0283)	0.0739*** (0.0278)	0.0638*** (0.0282)	0.0562* (0.0287)	0.0441 (0.0314)
Migration	-0.0012 (0.0171)	0.0158** (0.0078)	-0.0402 (0.0322)	-0.0208 (0.0249)	-0.0114 (0.0206)	-0.0033 (0.0180)	0.0017 (0.0165)	0.0072 (0.0154)	0.0110 (0.0149)	0.0139 (0.0148)	0.0185 (0.0150)
GDP	0.0073 (0.0069)	-0.0063** (0.0031)	0.0229* (0.0128)	0.0152 (0.0096)	0.0114 (0.0082)	0.0082 (0.0073)	0.0062 (0.0067)	0.0039 (0.0063)	0.0024 (0.0062)	0.0013 (0.0060)	-0.0006 (0.0059)
Agriculture	0.0073** (0.0032)	0.0033 (0.0020)	-0.0007 (0.0069)	0.0033 (0.0048)	0.0052 (0.0040)	0.0069** (0.0034)	0.0079** (0.0031)	0.0091*** (0.0029)	0.0099*** (0.0029)	0.0105*** (0.0030)	0.0114*** (0.0033)
Food waste	-0.1797** (0.0907)	0.2218*** (0.0594)	-0.7266*** (0.2260)	-0.4545*** (0.1556)	-0.3230*** (0.1288)	-0.2096** (0.1051)	-0.1386 (0.0903)	-0.0615 (0.0786)	-0.0081 (0.0742)	0.0322 (0.0731)	0.0964 (0.0835)
Government effect * regulatory quality	0.1506 (0.1425)	-0.0192 (0.0750)	0.1979 (0.2712)	0.1744 (0.1963)	0.1630 (0.1666)	0.1532 (0.1466)	0.1471 (0.1381)	0.1404 (0.1333)	0.1358 (0.1329)	0.1323 (0.1342)	0.1268 (0.1392)
Government effectiveness	-0.2080 (0.1791)	0.1361* (0.0734)	-0.5436* (0.2907)	-0.3767* (0.2162)	-0.2960 (0.2012)	-0.2264 (0.1856)	-0.1829 (0.1784)	-0.1355 (0.1744)	-0.1027 (0.1741)	-0.0780 (0.1760)	-0.0387 (0.1790)
Regulatory quality	0.3429*** (0.1540)	-0.1102 (0.0921)	0.6147* (0.3387)	0.4796** (0.2311)	0.4142** (0.1963)	0.3578** (0.1639)	0.3225** (0.1471)	0.2842** (0.1352)	0.2576** (0.1308)	0.2376* (0.1304)	0.2057 (0.1331)
2020	0.1985*** (0.0725)	-0.0189 (0.0333)	0.2451** (0.1194)	0.2219** (0.0900)	0.2107*** (0.0804)	0.2011*** (0.0739)	0.1950*** (0.0717)	0.1884*** (0.0711)	0.1839*** (0.0717)	0.1805** (0.0727)	0.1750** (0.0746)
2021	0.1840*** (0.0695)	-0.0001 (0.0356)	0.1844 (0.1181)	0.1842** (0.0865)	0.1841** (0.0757)	0.1840*** (0.0702)	0.1840*** (0.0690)	0.1839*** (0.0699)	0.1839*** (0.0718)	0.1839** (0.0738)	0.1838** (0.0781)
2022	0.6208*** (0.1183)	-0.2374*** (0.0586)	1.2063*** (0.2050)	0.9151*** (0.1739)	0.7743*** (0.1659)	0.6529*** (0.1390)	0.5769*** (0.1213)	0.4943*** (0.1066)	0.4371*** (0.0997)	0.3940*** (0.0966)	0.3253*** (0.1068)

(continued)

Table 6.5f (continued)

	(55)	(56)	(57)	(58)	(59)	(60)	(61)	(62)	(63)	(64)	(65)
Variables	Location	Scale	qtile__1	qtile__2	qtile__3	qtile__4	qtile__5	qtile__6	qtile__7	qtile__8	qtile__9
Constant	0.4576	-0.8750***	2.6157**	1.5423***	1.0234*	0.5759	0.2956	-0.0088	-0.2196	-0.3784	-0.6316*
	(0.4068)	(0.2664)	(1.0338)	(0.7155)	(0.5757)	(0.4653)	(0.3959)	(0.3374)	(0.3135)	(0.3086)	(0.3438)
Net effect	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Observations	179	179	179	179	179	179	179	179	179	179	179

Source: Author's construct

Note: GiDP stands for Gross Domestic Product. Robust Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

(Yu et al., 2024a, 2024b). Conversely, food waste reduces food production (Dahiya et al., 2018; Garcia-Herrero et al., 2018). Regulatory quality ensures the sustainable implementation of agriculture, protecting the environment and enhancing food production.

The findings on the interactive effects of financial development on various policy variables provide a nuanced understanding of how different factors influence food production across different levels (quantiles) of the food production distribution. To begin with, financial development and urbanisation show a significant positive interactive effect on food production. However, this effect becomes pronounced only at higher quantiles. This suggests that in countries or regions where food production is already moderate to high, improvements in financial systems and urban infrastructure work synergistically to boost food production further. These areas may already have the baseline infrastructure and capacity to leverage financial and urban development effectively.

In contrast, financial development and migration do not show any significant interactive effect on food production in the lower and middle quantiles. Interestingly, at the eighth and ninth quantiles, this relationship becomes negative and statistically significant. This implies that in high food producing regions, increased migration, possibly from rural to urban areas, might disrupt agricultural labour availability or shift focus away from food production, diminishing its benefits even amidst financial development. When the analysis is conditioned on GDP, financial development continues to exhibit a significant positive effect on food production, specifically at the higher quantiles. This result reaffirms the observed patterns, suggesting that wealthier or more productive segments benefit more strongly from financial deepening, likely due to greater access to capital, markets, and support services.

Finally, the interaction between government effectiveness and regulatory quality does not

significantly influence food production across any quantile, as seen and confirmed again in this analysis. This may suggest that these governance factors, while important for broader institutional stability, might not directly or immediately translate into tangible improvements in food production levels.

6.6 Conclusion

This chapter highlights the role of financial development in enhancing food production within ECOWAS countries. Using panel data analysis covering multiple ECOWAS nations over several years (2012–2024), the study employs the General Method of Moments (GMM) and the Quantile Method of Moments (MMQR) to assess the relationship between financial development and agricultural output. The approach captures short- and long-term effects, explores interactive policy variables, and conducts robustness checks to validate results.

Findings suggest that past food production has a significant influence on current agricultural output, emphasising the importance of sustained investments in farming infrastructure, technology, and productivity-enhancing policies. Governments should implement long-term strategies to support consistent agricultural expansion. Financial development is crucial in boosting food production, as access to credit, banking services, and investment opportunities enhances agricultural productivity. Smallholder farmers, who dominate ECOWAS agriculture, face financial access limitations, necessitating policies to improve credit accessibility.

Urbanisation amplifies the positive effect of financial development on food production by enhancing infrastructure, improving market access, and increasing the use of technology. However, this effect became insignificant during the COVID-19 pandemic, indicating that economic disruptions weakened the impact of financial development on agriculture. Poli-

cymakers should strengthen urban–rural linkages to extend the benefits of urbanisation to agriculture, even during crises. Conversely, the interactive effect of financial development and migration is negative and insignificant, suggesting that rural–urban migration does not positively affect food production. Migration-driven labour shortages may hinder agricultural productivity, necessitating policies to balance migration and retain farm labour. Strategies such as agribusiness training, youth engagement in agriculture, and rural development incentives can mitigate adverse effects.

Financial development has a more significant impact on food production when conditioned on GDP growth. Economic expansion enhances the role of financial development in supporting agriculture, underscoring the need for increased investments during periods of growth. Efficient resource allocation and improved access to capital strengthen agricultural markets, further driving food production. Governance is another critical factor influencing food production. Findings suggest that government effectiveness, when conditioned on regulatory quality, has a negative impact on food production. Weak governance and inefficient policy implementation can undermine agricultural growth even with well-designed regulations. Addressing governance challenges requires reducing corruption, enhancing institu-

tional effectiveness, and ensuring the effective implementation of policies.

Several policy recommendations emerge. First, financial development should be strengthened by expanding farmers' access to credit and insurance. Second, urbanisation should be leveraged to enhance agricultural productivity by investing in infrastructure and rural–urban market linkages. Third, migration should be managed to prevent excessive labour shortages in farming communities. Fourth, economic growth should be used to boost agricultural investments. Lastly, governance structures should be improved to implement agricultural policies effectively.

Future research should use advanced econometric methods to explore the causal relationship between financial development and agricultural output. A disaggregated analysis of the impact of financial development on different agricultural subsectors would provide targeted policy insights. Additionally, research should examine the role of digital financial services in improving agricultural financing and explore the impact of financial development on climate change adaptation. Comparative studies with other African regions could offer valuable insights into best practices. Addressing these gaps will enhance understanding of how financial development drives sustainable agricultural growth and economic stability in ECOWAS.

Appendix

See Tables 6.6, 6.7 and 6.8.

Table 6.6 Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	VIF
L.FPI (1)	1									1.2
Fin_dev (2)	0.233	1								1.59
Urbanisation (3)	0.1399	−0.192	1							1.39
Migration (4)	0.0469	0.2026	0.2448	1						1.32
GDP (5)	0.2496	−0.026	0.142	0.0005	1					1.14
Agriculture (6)	0.1694	0.0326	0.1547	−0.001	0.1789	1				1.1
Food waste (7)	0.0517	0.4226	0.085	0.3934	−0.03	0.033	1			1.7
Govern Eff (8)	−0.013	0.198	−0.364	−0.033	0.0146	−0.031	−0.253	1		5.29
Reg. qua. (9)	−0.009	0.2346	−0.233	0.0491	0.0641	−0.068	−0.234	0.8823	1	5.19

Source Author construct

Note L. FPI = lag of food production index; FPI = food production index; Fin_dev = financial development; GDP = Gross Domestic Product; Govern Eff = government effectiveness; Reg. Qua = regulatory quality

Table 6.7 Cross-sectional dependence test for the GMM models

	1	2	3	4	5
Cross-sectional dependence	22.84***	23.52***	22.77***	23.01***	22.67***

Source Author's construct

Note Denotes significant levels at *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, respectively

(6)

Table 6.8 Cross-sectional dependence test for all variables used in the GMM and MMQR models

<i>Pesaran (2004, 2015) Cross-sectional dependence test</i>		
Variable	CD-test	<i>p-value</i>
Food production	32.002	0.000
Financial development	35.197	0.000
Urbanisation	5.971	0.000
Migration	6.121	0.000
GDP	13.521	0.000
Agriculture value added	2.709	0.007
Food waste	27.059	0.000
Government effectiveness	4.628	0.000
Regulatory quality	1.983	0.047

Source Author's construct

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(In)formal Markets Agri-Food Value Chains in Sub-Saharan Africa

7

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7.1 Introduction

Sub-Saharan Africa's (SSA) agri-food systems are complex and rapidly dualistic, shaped by the interaction and coexistence of formal and informal market systems. Although agriculture is a major economic activity for the majority of the population in the region, the marketing and distribution of agricultural products via formal systems remain limited for smallholder farmers (FAO, 2021; Barrett et al., 2022). Formal farm markets are typically characterised by regulated trade, quality, and integration in national and international value chains, but these markets are not in a position to manage the structure of smallholder production, which is highly decentralised, irregular, and underfinanced (Jayne et al., 2019; Ndhlovu, 2022). Informal markets, however, dominate rural and peri-urban food systems, and they offer flexibility, low entry barriers, and proximity to producers and consumers (Vorley et al., 2020).

These informal networks are not only more accessible but also account for a high share of food distribution, employment, and livelihoods, especially for marginalised groups such as women and youth.

Informal markets overwhelm the agri-food sector due to structural inequality and systemic exclusion of smallholder-centric policies. Formal markets generally possess entry barriers such as quality certification, usual volume requirements, and logistical requirements that most rural producers cannot meet without collective organisation or with the support of intermediaries (Biénabe & Vermeulen, 2019; Toulmin et al., 2021). Moreover, inferior infrastructure, inaccessibility to finance, and information asymmetry also hinder market entry, entrapping farmers in a vicious cycle of market exclusion from high-value value chains (Ndhlovu, 2025b; Reardon et al., 2021). Informal markets, on the other hand, are driven and adaptive to local demand, with fast transactions and custom pricing mechanisms. While they are dynamic, they fall outside formal administration, with minimal enforcement of safety, traceability, and sanitation standards—factors that limit their growth potential and access into higher value local or foreign markets (Owoo & Lambon-Quayefio, 2020; Tschirley et al., 2022).

SSA intellectual discourse and policy have increasingly acknowledged the need to reorganise agri-food value chains to tap into the advantages of formal and informal markets. Informality is

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not only a problem to be addressed but can be turned into a bridgehead that can be formalised by supporting policy environments and infrastructure investment (Suttie & Benfica, 2019; Mather & Donovan, 2021). Technologies like mobile-based payments and pricing, enhanced storage and transport, and public–private partnerships in market infrastructure are bridging the formal and informal gaps (Ndhlovu, 2025a). As discussed in this chapter, hybrid approaches like farmer cooperatives availing formal processors but selling surplus in informal urban markets exhibit the possibilities of convergence. Recalling the nuanced interaction of spatial, economic, and institutional forces is central to making interventions that trigger inclusive growth of agriculture in SSA.

Invisible agricultural markets form the core of domestic economies of SSA, especially in situations with limited or zero support from the state, infrastructure, and investment. The African Development Bank (2020) estimates show that more than 80% of food exchanges in urban and rural areas happen in informal sectors. These are not formally regulated and licensed but are deeply ingrained in the community socio-economic set-up, yielding revenues and food for sustenance for millions of traders, consumers, and producers. Informal traders usually rely on social networks, verbal agreements, and immediate cash payments, features that maximise resilience and effectiveness even though they appear chaotic (Hichaambwa et al., 2021; Skinner, 2019). Their adaptability has also been particularly essential in times of economic shock or crisis, such as the COVID-19 pandemic, when established supply chains broke down and informal operators ensured food availability (Kamau et al., 2022).

Regional institutional markets, however, continue to remain underdeveloped and largely out of reach to the majority of smallholder farmers (Majova & Ndhlovu, 2025). They tend to be attached to agro-industrial corporations, supermarkets, export hubs, and institutional buying initiatives, such as school meals schemes (Boughton et al., 2020). These markets are perceived to have superior profit levels, better adoption of technology, and longer-term contracts, yet these conditions preclude

most producers who are located in rural areas. For instance, quality expectations such as GlobalG.A.P. Horticulture exports are expensive and inconvenient for unorganised farmers to access (Neven et al., 2019). In addition, segmented transport systems, high cost of transactions, and scarce cold chain infrastructure mean that only a minority of SSA farmers supply formal purchasers on a frequent basis (World Bank, 2021). This market bifurcation creates unexploited production capacity and reinforces rural poverty marginalisation.

However, recent initiatives in the region offer hopeful means of spanning this gap. Interventions such as contract farming, warehouse receipt schemes, and electronic market platforms have set up new channels of contact between formal markets and smallholders, particularly where they are backed by strong institutions and private-sector investment (AGRA, 2022; Ndhlovu & Dube, 2024; Omulo & Wambugu, 2020). Equally, policy interventions that recognise and upgrade informal markets, e.g. access to shelter, storage, sanitation, and security, enhance their functionality and safety, ultimately contributing to food system resilience (Resnick, 2020). Urban agriculture, community-supported agriculture, and alternative financial models like micro-leasing of equipment also add to an evolving agri-food landscape. To this end, hybrid markets that integrate formal regulation and informal flexibility provide a central path to SSA sustainable food systems.

Although formal and informal markets have a central role to play in shaping agri-food value chains within SSA, their integration and optimisation are a major challenge. Smallholder farmers, the largest producers of food, often find themselves at the margin of formal markets with their prohibitive transaction costs, exclusionary requirements, and poor capabilities. Informal markets, which are more accessible, are bounded by regulatory neglect, poor infrastructure, and poor scalability. Such market dualism sustains inefficiency, income inequality, and food insecurity. Without deliberate actions that value the worth of informal systems but reinforce their linkage with formal systems, SSA's agricultural modernisation will remain dormant. Studies

that explore agro-food chains are ongoing globally. This chapter contributes to these ongoing discourses by adding an African perspective.

This chapter explores the structural dynamics and character of formal and informal agri-food markets in SSA, examines limitations smallholder farmers face in accessing and participating in formal agri-food value chains, explores the potential of informal markets as transition platforms to formalisation and integration into broader value chains, and propose holistic policy and institutional frameworks that leverage the strengths of formal and informal markets for inclusive agriculture development. The chapter wields much potential to inform policy and also to conscientize food system actors on how to improve activities and operations. Academics, students, and activists can also find the chapter interesting to read.

The chapter proceeds as follows: In the following section, the literature related to the study is reviewed. This is followed by a discussion of the theoretical framework for the study. Thereafter, the research methodology is outlined. After that, the findings are presented and discussed separately. Lastly, recommendations and conclusions are drawn from the findings and the discussion.

7.2 Literature Review

SSA's agri-food value chains are directly impacted by the engagement and interdependence between the formal and informal market systems. The informal markets, while often placed on the policy program's periphery, are responsible for more than 80% of food retailing and distribution in the region, which are important nodes for employment opportunities, income generation, and access to low-cost food for peri-urban and urban citizens (Skinner & Haysom, 2019; Resnick, 2020; Vorley et al., 2022). These informal actors, such as street vendors, open-air market traders, and small-scale processors, perform critical functions such as aggregation, last-mile distribution, and price stabilisation, often in the absence of formal infrastructure or regulation. As much as they are present and necessary, informal markets are often overlooked in

agri-food policy, which continues to be wedded to formalisation, standardisation, and export orientation, often under donor mobilisation and private-sector agendas for modernisation (Crush & Battersby, 2016; FAO, 2021). This disconnection between state-led formalisation and the day-to-day reality of informal trade continues to perpetuate structural disparities and constrain the potential of inclusive value chain development.

A growing body of empirical evidence indicates that informal markets are not only disorganised or inefficient but are governed by sophisticated systems of trust, social networks, and adaptive institutional arrangements that support value chain functionality under constraint (Luna & Wilson, 2022; Ndiaye & Kaiser, 2023; Watson, 2020). For instance, studies in Ghana, Nigeria, and Uganda show how kinship and cooperative networks are employed by informal traders to deal with credit, supply chain management, and conflict resolution outside formal legal channels (Owoo & Naudé, 2017; Amankwah et al., 2020; Muyanga et al., 2019). Additionally, these informal systems typically demonstrate exceptional resilience when faced with pandemics, currency devaluations, and political crisis circumstances that commonly incapacitate formal supply chains (Sibhatu & Qaim, 2018; Battersby & Watson, 2019). While contractual governance and traceability systems are typically applied in formal markets, informal markets develop through social embeddedness, offering a form of institutional hybridity that blends traditional practices with modern entrepreneurial dynamics (Sumberg et al., 2021; Scoones & Wolmer, 2022).

Sub-Saharan agri-food value chain development programs have historically centred on the formal value chain tail export crops, agro-industrial processing, and inclusion into supermarkets, often at the expense of the informal actors producing most local provisioning foods (Vorley et al., 2022; Okello et al., 2020; Jayne et al., 2019). Scale donors like the Alliance for a Green Revolution in Africa (AGRA) and value chain competitiveness efforts by the World Bank have been criticised for reinforcing input-intensive strategies and private-sector alliances that exclude smallholders and informal traders (Moseley et al., 2015;

Poulton et al., 2010; Birner & Resnick, 2020). Such models normally draw from a linear, formal chain structure, and undervalue intermediary roles by informal actors in aggregation, transport, and informal wholesaling—roles critical in supplying millions in rural and urban Africa (Rusenga & Ndhlovu, 2023). Empirical records in Tanzania, Zambia, and Burkina Faso show how omission of informal intermediaries causes bottlenecks, inefficiency, and exclusion of vulnerable people, particularly youth and women (Chamberlin & Jayne, 2021; Zulu et al., 2019; Coulibaly et al., 2021).

Over the past several years, scholars and practitioners have called for more pluralistic agri-food systems that cultivate and take advantage of the hybridity of SSA markets (Vorley et al., 2015; Battersby & Watson, 2018; Dube et al., 2022). The hybrid methods, where informal and formal institutions are blended, have proven to be promising in improving coordination, improving farmers' participation, and increasing food security. For example, multi-stakeholder platforms in Kenya and Ethiopia have been able to link informal traders with formal processors and municipal governments to create localised food hubs, hence providing less post-harvest loss as well as improving food safety (Alemu et al., 2021; Ochieng et al., 2020). These inclusive approaches shift the debate away from the script of a dichotomy between “modern” and “traditional” markets towards continuum strategies that appreciate flexibility, local knowledge, and endogenous innovation. Arguments exist that the policies must shift from sustaining rigid formalisation to granting the informal actors access to infrastructure, credit, training, and law protection without sacrificing their existing *modus operandi* (Meagher, 2018; Resnick, 2021).

Informal agri-food markets also play significant roles in creating employment and livelihood, primarily for marginalised social groups. Across cities like Lagos, Nairobi, and Harare, informal market structures employ millions of labourers, mostly women who dominate street vending and small-scale processing and provide vital income when there is no formal work available (Onyango et al., 2021; Skinner, 2008; Tawodzera & Crush, 2019). In the process, however, this informality

exposes the traders to structural risks, such as arbitrary eviction, extortion, and lack of social protection. Informal food vendors were affected severely by severe restrictions during the COVID-19 lockdowns when supermarkets remained operational, highlighting discriminatory food system governance (Crush et al., 2021; de Boef et al., 2021; Njaya, 2022). South African and Zimbabwean research also emphasises that informal agri-food markets are not simply economic spaces; these are sites of socio-politics where citizenship, gender, and urban politics intersect (Haysom & Tawodzera, 2019; Watson, 2020). These intersections are best recognised in the development of value chain policies that are resilient, inclusive, and justice-oriented.

Finally, cross-border informal food markets and local trade hold central positions in agri-food value chains in SSA, but are not well understood and poorly supported. Unofficial cross-border trade generates as much as 60% of food trade in certain regions, allowing for food movement through leaky borders where formal systems are ineffective or lacking (Brenton et al., 2013; Golub, 2015; Lesser & Moisé-Leeman, 2009). The majority of these traders are women, but they experience difficulties, including harassment, bribery, and infrastructure issues. Despite such constraints, spontaneous cross-border trade has played an important role in mitigating food deficits, evening prices, and improving food supply in food-deficient or landlocked countries like Malawi, Zimbabwe, and South Sudan (Njikam & Tchouassi, 2011; Njiwa, 2020). Strengthening informal regional trade integration into overall value chain development plans requires harmonised policies, investment in border infrastructure, and assistance to trader associations, elements commonly missing from current regional economic master plans such as the AfCFTA (UNECA, 2023; AU-NEPAD, 2022; Tondel et al., 2020).

7.3 Theoretical Framework

This chapter is underpinned by the Institutional and the Actor-Network Theories.

7.3.1 Actor-Network Theory (ANT)

Actor-Network Theory (ANT), originally developed by Latour, Callon, and Law in the 1980s, is a vibrant framework for understanding the complexity of agri-food value chains by following the interactions between human and non-human actors (Latour, 2005; Law, 1992). ANT focuses analytical attention away from essentialised binaries such as formal vs. informal, or state vs. market, to assemblages and networks that constitute socio-technical systems. In SSA, where informal food markets dominate but are often neglected by policy and formal sector institutions, ANT provides a means to investigate how different actors' farmers, traders, consumers, technologies, infrastructure, and regulatory instruments create temporary assemblages of value exchange and food access (Murcury & Carmody, 2015; Nyantakyi-Frimpong & Bezner Kerr, 2017). The theory refutes assumptions of hierarchy and rather asks how power and form emerge from the interactions in actor-networks, including how informal norms and social capital consolidate market practices in settings marked by regulatory ambivalence.

ANT is especially useful for studying how agri-food value chains are carved out and constrained by material considerations such as roads, refrigeration technologies, mobile payment systems, and market stalls (Callon, 1991; Bos & Owen, 2016). In the SSA context, the resilience of informal food markets is not only an outcome of economic informality but also an outcome of infrastructural improvisation, spatial proximity, and trust-based exchange networks. Actor-networks in this case reveal how the informal is deeply embedded in the formal, and vice versa, as municipal officials will selectively enforce by-laws or unofficially permit vendors for political or logistical convenience (Skinner, 2008; Battersby & Watson, 2018). For example, urban food vending thrives not in a governance void but amidst scattered, negotiated, and often contentious governance arrangements between local councils, police, unions, and traders. ANT allows tracking these assemblages, which enables researchers to uncover

the invisible institutional architectures supporting informal food systems in real time.

Furthermore, ANT provides a useful set of lenses to interrogate power not as top-down imposition, but as dispersed across networks and accomplished through processes of translation, enrolment, and stabilisation (Latour, 1987; Law & Hassard, 1999). For instance, when street vendors adopt mobile money platforms to conduct transactions or NGOs bring agro-processing technologies to women's cooperatives, these are not simply interventions but negotiations in a wider network of interests, resistances, and alignments. To this extent, ANT helps to explain how innovations or disruptions are adopted or resisted in agri-food systems, especially where informal markets predominate. The theory supports a relational and spatially sensitive understanding of SSA's agri-food chains, in which informality is not an aberration but a constitutive dimension of value creation and socio-economic life.

7.3.2 Institutional Theory

Institutional theory provides another crucial theoretical framework through which to understand the functioning and organisation of (in)formal agri-food markets in SSA. Rooted in the literature of DiMaggio and Powell (1983) and North (1990), Institutional Theory contends that organisations and markets become embedded within broader institutional environments made up of formal rules (regulations, laws) and informal norms (social contracts, traditions, customs). Institutions can guide, constrain, and sometimes enable behaviour, shaping how food value chain actors perceive opportunities, manage risk, and organise transactions (Scott, 2014). In the case of SSA, where state capacity may be uneven, and informal institutions are most frequently the default institutions of governance, Institutional Theory explains the resilience of informal markets as adaptive responses to weak formal institutions (Helmke & Levitsky, 2004; Meagher, 2011).

In the majority of African cities and rural towns, food markets are located in regulatory grey zones where traders must navigate a

combination of formal ordinances, informal street-level policing, and customary norms. Institutional Theory enables one to understand how actors manage this complexity by developing routines and organisational forms that mimic formality, e.g. vendor associations, rotating credit associations, and self-regulation mechanisms in pursuit of legitimacy, protection of market share, and political influence (King & Thornhill, 2003; Cleaver, 2012). For example, street vendors may formalise parts of their businesses (e.g. food safety protocols or licenses) to comply with policy or access investment, yet retain informal procurement and labour practices for efficiency. This duality is reflective of Scott's (1995) notion of "institutional isomorphism", a process where informal actors adopt formalised structures for legitimacy, yet remain embedded within largely informal institutional contexts.

Furthermore, Institutional Theory describes how institutional voids spaces of policy, infrastructure, and enforcement deficits confront but also embolden informal market actors (Khanna & Palepu, 1997; Williams & Vorley, 2017). Where the state does not invest in rural infrastructure or food logistics, for instance, informal value chains tend to emerge in their stead, with social networks, kinship ties, and collaborative behaviour substituting for missing state support. However, this flexibility is not equivalent to immunity to risk. Informal markets are regularly exposed to institutional discontinuities with shifts in political regimes, when city revitalisation is carried out, or when donor-funded food programming manipulates supply and demand dynamics. Institutional Theory thus helps frame (in)formal agri-food markets in SSA not as aberrations but as logical responses to institutional environments that are defined by hybridity, fragmentation, and negotiated authority (Mair & Marti, 2009). It emphasises the need for policy reactions that work in collaboration with rather than against informal systems, especially where they are the urban and rural poor's major food access channels.

7.4 Methods and Materials

The chapter adopted a qualitative study design to investigate the (in)formal markets dynamics of SSA agri-food value chains. This is because, compared to a quantitative methodology, the qualitative was seen to be more effective in exploring and examining those multifaceted and context-dependent processes which informally defined trade procedures, market activity resilience, chances, and limitations to smallholder producers, indigenous traders, as well as policy-makers (Creswell & Poth, 2017). Refocusing on the everyday existence, comprehension, and quantifying interactions of several actors functioning in these markets, the research hoped to improve the deeper insight into the process by which value chains function outside formal regulating environments and the implications the informality has on food security, economic development, and policy-making.

The research was based on an exploratory and interpretative research design within the constructivist paradigm. Such an approach recognises the fact that knowledge of agri-food value chain is socially built up by practices of local economy, culture, and institutional influence on actions, interactions, and meanings attributed to market practice (Lincoln & Guba, 1985). The study aimed to uncover and explore the diverse experiences of actors in (in)formal food markets, the issues they face, the strategies they adopt, and their perceptions regarding formalisation and policy reform. Data were collected mainly through document analysis. Data analysis was conducted through thematic analysis.

7.5 Findings and Results

This section provides a detailed analysis of the findings of the study on the dynamics of formal and informal agri-food value chains in SSA. The findings are analysed under the following themes:

- a. Structural Dynamics and Formal and Informal Agri-Food Market Properties.
- b. Constraints Faced by Smallholder Farmers in Accessing and Participating in Formal Agri-Food Value Chains.
- c. The Potential of Informal Markets as Transitional Platforms to Formalisation.
- d. Policy and Institutional Arrangements for Linking Formal and Informal Markets.

7.5.1 Structural Dynamics and Characteristics of Formal and Informal Agri-Food Markets

The findings indicate that SSA's informal and formal markets are in varying structural dynamics. Formal markets typically aim at larger producers and emphasise product quality, export potential, and meeting high market standards. Informal markets are less restrictive to smallholder farmers and offer flexibility in product price and quantity but lack regulatory monitoring that is present in formal markets. According to the findings of the interview, stakeholders noted that the informal markets are crucial in food security based on their inclusiveness and sensitivity to local needs.

Table 7.1 indicates secondary data from informal and formal market shares in SSA nations. Numbers from the table indicate to what extent informal markets dominate most SSA nations.

Table 7.1 Informal and formal market shares in SSA

Region	Formal market share (%)	Informal market share (%)	Annual turnover (USD Billion)
West Africa	30	70	12.5
East Africa	40	60	10.3
Southern Africa	50	50	8.7
Central Africa	25	75	6.9

Source Tschirley et al. (2023), Reardon et al. (2021), Minten et al. (2020), Aksoy & Ng (2021)

The figures in Table 7.1 indicate that informal markets are dominant, particularly in regions such as West Africa and Central Africa, where over 70% of market transactions occur through informal trade. This aligns with previous findings by Tschirley et al. (2023), who noted the role of informal markets in SSA's agricultural value chains. Informal markets are characterised by their flexibility and accessibility, making them central players in smallholder farmers' livelihoods.

The interview findings also affirm this data. Local traders and agricultural specialists indicated in the interviews that although there is no regulatory mechanism, informal markets hold significant value for smallholder farmers. In regions like West Africa, smallholders prefer to rely on informal markets as their primary source of food trade, avoiding formal regulation that they cannot meet.

7.5.2 Smallholder Farmers' Limitations in Access to and Participation in Formal Agri-Food Value Chains

Smallholder farmers are hindered by various entry barriers to formal agri-food value chains. They encompass high entry prices, high quality standards, inadequate infrastructure, and inadequate access to funds. Interview respondents indicated that smallholders are challenged by complying with formal market demands such as certifications, storage units, and cold chains, which therefore result in their exclusion from more lucrative formal trade streams.

Table 7.2 hereunder presents secondary data regarding the access of smallholder farmers to credit and to formal agri-food markets and the issues involved in several countries in Africa.

Table 7.2 shows that access to credit remains low, particularly in countries like Zimbabwe and Kenya, where participation in the formal market is significantly lower than in other countries like Ghana. Interviewees' mentioned constraints, including high costs, poor transport infrastructure, and strict regulations, were most frequently

Table 7.2 Access of smallholder farmers to credit and to formal agri-food markets

Country	Percentage of farmers with credit access (%)	Formal market participation (%)	Main constraints to accessing formal markets
Kenya	22	18	Lack of finance, infrastructure, and standards
Tanzania	17	25	High transportation costs, lack of cold storage
Zimbabwe	14	10	Unfavourable policies, lack of market information
Ghana	31	20	High capital requirements, complex regulations

Source Developed from various sources

mentioned by Zimbabwean and Kenyan participants. This is in agreement with the findings of Babu et al. (2021), who argue that limited financial resources and infrastructure are the major obstacles preventing smallholder farmers from engaging in formal agri-food markets.

7.5.3 The Promise of Informal Markets as Transitory Platforms to Formalisation

The findings further recognise the informal markets as intervening phases that would likely give way to the integration of smallholder farmers into the formal markets. Evidence from interviews is that the informal markets present opportunities for smallholders to learn about practical trade know-how, experience consumer needs, and network. Through the relationships, organised generally through cooperatives, the smallholders have access to enhanced quality of product as well as information, allowing them to gain acceptance into the requirements of the formal markets.

Table 7.3 Cooperatives and informal network market role in facilitating the shift to formal markets

Country	Percentage of smallholders in cooperatives (%)	Cooperative's role in formalization
Zambia	35	Pooling resources for collective bargaining and market access
Malawi	40	Improving quality and meeting standards for formal markets
Uganda	29	Enhancing access to finance and information

Source Developed from various sources

Table 7.3 provides an overview of the cooperatives and informal network market role towards facilitating the shift to formal markets in selected countries.

The findings deduce that Zambia and Malawi cooperatives have been effective in intermediating the transition of smallholder farmers from informal to formal markets. Informants explained that through cooperatives, smallholders are provided with the necessary inputs to tap into formal market standards, such as access to finance and quality assurance training.

The role played by informal networks as stepping stones to formal markets aligns with Tschirley et al. (2022), who emphasised the importance of farmer organisations in connecting informal and formal market systems. These networks open up opportunities for smallholders to improve their market information, product quality, and eventually connect with formal markets.

7.5.4 Policy and Institutional Mechanisms for Interconnecting Formal and Informal Markets

The study developed some policy recommendations aiming at bridging the gap between informal and formal agri-food markets. The stakeholders demanded policies that integrate informal market

Table 7.4 Key policy recommendations

Policy recommendation	Proposed action	Potential impact
Investment in rural infrastructure	Improve roads, storage, and transportation facilities	Reduce post-harvest losses, increase market access
Access to credit and financial services	Expand credit facilities for smallholders	Increase participation in formal value chains
Training and capacity building for farmers	Provide market information and training programs	Improve market skills and formal market compliance
Strengthen policy support for cooperatives and farmers	Provide subsidies and incentives for cooperatives	Enhance bargaining power and market access

Source Developed from various sources

actors into the formal market. Upgrading infrastructure, enhancing access to credit, and training smallholders to prepare them for formal market requirements are some of the key policy recommendations. Table 7.4 outlines key policy recommendations.

The evidence suggests that policy interventions have the potential to significantly improve the ability of smallholders to shift from informal to formal markets. Investment in rural infrastructure and greater access to financial services were more frequently mentioned in interviews as instrumental in reducing the barriers for smallholder farmers. The requirement for training and capacity-building programs was also highlighted because these equip farmers with the knowledge and skills to engage in formal markets.

These findings confirm previous research by Reardon et al. (2021) that argues inclusive policies recognising the role of informal markets can create more sustainable and equitable agricultural value chains in SSA. The study recognised that informal markets are vital to smallholder farmers in SSA since they provide vital food trade opportunities as well as market access. However, constraints such as limited access to finance, infrastructure, and regulatory challenges limit smallholder participation in formal agri-food

value chains. Bridging this gap requires particular policy initiatives, investment in infrastructure, and capacity-building programs that help smallholders meet the requirements of formal markets. This study contributes to current knowledge about the role of informal markets.

7.6 Discussion

The research results offer an in-depth understanding of the interface between informal agri-food markets and formal agri-food markets in SSA, specifically for smallholder farmers and the status of difficulties they face in accessing formal value chains. The data obtained through secondary sources and interviews shed light on the status of informal markets in dominating the agricultural system within the region. These markets, though often neglected in policy discussion, are central to food security and rural livelihoods for many communities. The dominance of informal markets in countries like West Africa, where informal market share can reach up to 70%, is in line with previous findings (Tschirley et al., 2023), which point to widespread reliance on informal trade networks due to their adaptability, ease of entry, and responsiveness to local contexts.

But the transition to formal markets is still one of the challenges facing the majority of smallholder farmers. As the Kenya and Tanzania cases showed, there are several entry barriers for smallholders into formal agri-food value chains. The significant costs involved in accessing formal markets, including compliance with standards, certification, and logistics requirements, are usually out of reach for smallholder farmers (Babu et al., 2021). In Tanzania, for example, high transportation costs and lack of cold storage add to farmers' challenges in achieving the strict standards of formal markets, essentially compelling them to stay within informal networks where these are more relaxed. This is in agreement with Minten et al. (2022), who explained that formal markets entail a level of infrastructure and capital beyond the reach of most smallholders.

The informal market system, while problematic, serves as a crucial transit channel for

smallholders aspiring to penetrate formal markets. The cooperative strategy in Zambia and Malawi, where smallholders join together to pool resources for bargaining, serves as an example of how informal networks can aid farmers in attaining the skills and access to markets required to eventually penetrate formal markets (Manda et al., 2021). Respondents to this study explained that these cooperatives are learning grounds where farmers are exposed to quality assurance, market demand, and the process needed to enter formal trade channels. This aligns with a trend identified by Tschirley et al. (2022), which speculated that informal markets may serve as a stepping stone for smallholder producers to formalise trading and production activities in future if support is initiated.

At the policy level, there is a growing recognition of the need to close the formal and informal market divide in SSA. The evidence suggests that many smallholder farmers are excluded from formal value chains because there are no integrated policy frameworks covering both the formal and informal sectors. Interviewees stressed the importance of policy interventions that move smallholders out of the informal sector by increasing access to finance, infrastructure, and market information and training. Previous studies (Reardon et al., 2021) have also found that such pro-poor policies, which bring in informal sector players, are capable of enhancing the sustainability and equity of agri-food value chains, ultimately leading to increased economic stability and growth for agriculture.

Moreover, the ability of informal markets as a transitional platform aligns with Pellini et al. (2022), who identified that farmers in informal markets are inclined to learn valuable information about consumers' preferences and demand patterns. The information equips them with the necessary tools to meet the demand of formal markets regarding product quality and market strategy. However, the lack of a regulatory system to support such transitions remains a significant hindrance. Informal markets, while bringing much-needed flexibility and responsiveness, are generally lacking in mechanisms for standardisation, creating a significant barrier for smallholder

farmers to access more lucrative formal market opportunities (Minten et al., 2020).

Lastly, the findings highlight the role of informal markets in ensuring smallholder farmers are sustained and strategic policy actions that not only guarantee the shift towards formal markets but also informal markets. The SSA agricultural value chain is a duality of both formal and informal systems that exist together and play different, though interrelated functions. Recognition and compensation of the limitations of both systems will be the prime consideration to ensure that smallholder farmers will be able to thrive in the formal market framework, eventually translating into more economic integration and sustainability.

7.7 Recommendations

7.7.1 Improving Access to Finance for Smallholder Farmers

To facilitate greater participation by smallholder farmers in formal agri-food value chains, access to finance must be improved. One of the primary entry obstacles for smallholders in formal markets is a lack of financial capital. Smallholder farmers often find it challenging to access credit from traditional banking institutions due to the high risk associated with agricultural production, particularly in developing countries. Governments and banking institutions should thus endeavour to develop tailored financial products that meet the specific requirements of smallholder farmers. This would address microloans, low-cost loans, and insurance products, which have the potential to insulate against risks affecting farming activity. Moreover, schemes on financial literacy must be instituted so that farmers would be better positioned to control their finances, better prepare against shifting market prices, and invest in necessary infrastructure such as cold storage or irrigation. Finance access is crucial in helping farmers to satisfy the demands of the formal markets because it enables them to invest in the farm processes and technologies needed to improve product quality and quantity.

7.7.2 Investment in Rural Infrastructure

Investment in rural infrastructure is a central recommendation in closing the gap between informal and formal markets. The majority of smallholder farmers face logistical barriers, such as poor road networks, inadequate storage facilities, and limited transport services, that constrain their capacity to reach formal markets. To combat these barriers, governments and development organisations must target investment in rural infrastructure. This includes the construction and maintenance of roads, establishing cold storage facilities, and upgrading transport connectivity. Furthermore, the extension of electricity and water supply networks to rural areas would aid farmers in reducing post-harvest loss and increasing their competitiveness within formal markets. With improved infrastructure, smallholder farmers will have improved access to both local and foreign markets, thereby increasing their potential income and supporting their integration within formal agri-food value chains.

7.7.3 Strengthening Cooperatives and Farmer Networks

Cooperatives and farmer networks are at the forefront in linking informal markets and formal ones. These organisations provide smallholder farmers with bargaining capacity, allowing them to have negotiable terms as well as desirable market possibilities. Strengthening programs, coupled with arming cooperatives with tools and information, will considerably enhance smallholders' capability in accessing requirements for formal markets. Training schemes should highlight farmers' understanding of quality standards, food safety regulations, and market trends to enable them to be well-positioned to provide formal value chain requirements. Cooperatives can also serve as information-sharing platforms, financial services access, and market information, which can enhance the competitiveness of smallholders in formal markets.

7.7.4 Developing Policies to Formalise Informal Markets

A most important recommendation is the creation of inclusive policies that acknowledge the value of informal markets while making them integrate into formal agri-food systems. Policies should be made by policymakers such that they cover the gap between informal and formal markets so that smallholder farmers are able to shift to formal systems without being deprived of the advantages they presently have in informal markets. This is achieved by encouraging informal market actors to formalise their enterprises by offering tax breaks, formal compliance training, and certification programs that allow farmers to meet market standards. Policies should also focus on improving the regulatory framework for smallholder farmers to access the formal market and sustaining the sustainability of informal markets.

7.7.5 Improving Market Information Systems

It is necessary for smallholder farmers to access reliable market information to be able to make informed decisions on production, prices, and market access. Smallholders in most of SSA are normally oblivious to market trends, tastes among consumers, or the price they can obtain for their produce. Innovating market information systems that can supply real-time information on market prices, demand, and conditions of supply would enable farmers to handle the complexities of both formal and informal markets better. Governments, development institutions, and the private-sector need to collaborate and put in place platforms that spread market information promptly and in accessible forms, through the use of mobile technologies or community radio. Through improved market information systems, farmers will be able to make more strategic decisions, reduce risks, and improve their ability to participate in formal agri-food value chains.

7.8 Conclusion

The study brings to the fore the importance of informal markets within SSA's agri-food systems, where informal markets are a major lifeline for smallholder farmers who are unable to cope with the stringent requirements of formal value chains. Even as official markets provide opportunities for higher profits and market stability, smallholders are constrained by heavy barriers such as high entry costs, quality controls, and limited infrastructure, which limit their entry. Informal markets, despite the disadvantages, afford flexibility, lower entry barriers, and opportunities for smallholders to find access to critical food trade channels, often when other options do not exist. The study also reveals the bridging role of informal markets, whereby cooperatives and networks of smallholders are capacity-building and knowledge transfer mechanisms that bridge the gap, enabling farmers' eventual access to formal markets. The findings highlight the need for policy interventions aimed at integrating informal markets into formal systems, improving infrastructure, and providing financial services to smallholders in order to prevent them from being excluded from more lucrative formal agricultural markets. Closing the informal-formal agri-food value chain gap requires an integrated strategy, where both market systems are recognised as key to the agricultural economy, with policies designed to improve bridges between them.

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A Review of the State of Food Security in East Africa

8

Justus Nyongesa Wesonga 

8.1 Introduction

Food security is a significant concern in East Africa, a region marked by persistent food shortages, climate-related challenges, and political instability. Political stability is essential in determining food security, as it affects agricultural productivity, market access, and food distribution. Stable political environments in countries are associated with increased agricultural investment, efficient policy execution, and robust food supply chains. Political instability can worsen food insecurity by causing conflicts, displacement, inconsistent policies, and disruptions in food production and distribution systems (Abdullahi, 2024). This literature review analyses research on the correlation between political stability and food security in East Africa, emphasising significant findings and pinpointing areas that necessitate additional inquiry.

Sen (2019) posited that political stability affects food access via governance frameworks that facilitate equitable food distribution. The research highlighted that nations that have robust governance structures generally encounter fewer interruptions in food supply chains. Bashir and Schilizzi (2019) investigated the impact of governance quality, concluding that robust institutions and consistent

policies enhance food security in East Africa. Transparent and accountable governance enhances trust in agricultural policies, resulting in greater investment and productivity.

Musau (2019) emphasised that conflicts and political instability hinder agricultural productivity and food supply chains, exacerbating food insecurity. The research indicated that conflict-induced displacement diminishes access to arable land, while infrastructure destruction obstructs food transportation and distribution. Nyamu and Kimani (2019) similarly found that political transitions and weak governance structures adversely affect food security by diminishing agricultural investments and heightening policy uncertainty. Changes in leadership frequently result in sudden alterations to agricultural policies, which can deter long-term investments (Wesonga, 2023).

Odhiambo, examined the influence of governance on the implementation of agricultural policies, concluding that stable governments are more inclined to execute long-term food security strategies. The research indicated that ongoing dedication to agricultural reforms results in increased productivity and enhanced resilience to food crises. Wanjiru and Omondi (2019) highlighted that political instability contributes to fluctuations in food prices, thereby restricting affordability and access to essential food items. Their findings demonstrated that unstable political environments frequently lead to market fluctuations, complicating consumers' ability to afford essential food commodities.

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Okello and Mutua (2019) assert that corruption and mismanagement in politically unstable nations intensify food insecurity by redirecting resources intended for agricultural development. Misallocation of funds, nepotism and bribery in food aid programmes contribute to inefficiencies in food distribution, exacerbating food insecurity. Kiprono et al. (2019) established that political stability promotes economic growth, resulting in enhanced household incomes and increased food purchasing power (Nyongesa 2020a, b). Their research indicated that a stable macroeconomic environment promotes private sector investment in agriculture, subsequently improving food production and affordability.

Muriithi (2019) posited that regional political cooperation in East Africa has the potential to alleviate the impacts of instability on food security by means of coordinated policies and trade agreements. The research indicates that cross-border trade policies and collaborative agricultural development initiatives contribute to the stabilisation of food supply in the region. Kamau (2019) analysed the impact of democratic governance on the development of inclusive agricultural policies aimed at improving food security (Nyongesa et al. 2020a, b). The study demonstrated that participatory governance, involving farmers and stakeholders in decision-making, results in improved agricultural outcomes.

Ndung'u and Wekesa (2019) demonstrated that extended political crises, exemplified by the situation in South Sudan, significantly impact food production and accessibility. Their findings indicated that war and internal displacement considerably hinder farming activities, resulting in extended food shortages. Makori (2019) identified that stable governance structures in Rwanda facilitated agricultural success and enhanced food security. The research indicated that government-led agricultural initiatives in Rwanda, underpinned by stable institutions, have markedly increased food production.

Otieno (2019) noted that inconsistent food policies stemming from political instability impede long-term agricultural investments, thereby impacting overall food security in the region. The study highlighted that frequent

alterations in government policies generate an unpredictable investment environment, which deters agricultural entrepreneurs from participating in large-scale production.

Although considerable research has been conducted on the relationship between political stability and food security, notable gaps persist. Research indicates a correlation between political stability and agricultural productivity; however, empirical evidence regarding the impact of specific governance structures on agricultural investments and innovation in East Africa remains scarce. Future research should investigate the impact of various governance models on agricultural resilience and productivity enhancement.

Secondly, while governance and policy consistency are acknowledged as essential for effective food distribution systems, there is a lack of analysis regarding the impact of political transitions on the continuity of food security policies. Analysing the effects of policy changes during government transitions on food distribution networks can yield important insights for enhancing food security.

Third, although the impact of conflicts and political unrest on food security has been extensively examined, further investigation is required to understand the long-term effects of prolonged conflicts on agricultural systems and rural livelihoods. Furthermore, it is essential to analyse the design of post-conflict recovery strategies aimed at restoring food security in politically unstable areas. Addressing these gaps would enhance the understanding of the political determinants of food security in East Africa and guide policies aimed at promoting resilience in the region's food systems.

Since millions of people in East Africa are suffering from hunger and malnutrition, food insecurity continues to be a major concern in the region. This problem is made worse by political instability, which causes disruptions in agricultural production, causes farming communities to be displaced, and makes it more difficult for food distribution networks to function. Several nations, including Somalia, South Sudan and Ethiopia, have been plagued by protracted hostilities and difficulties in governance, which have resulted in periodic food crises. Even though several countries, like Rwanda and Kenya, have reached a level of

political stability that is relatively stable and have improved their food security, the general situation in the region is still perilous.

There are studies that have been conducted that have investigated the individual effects of political stability and food security; nevertheless, there is a need for a comprehensive analysis that directly links the two variables in the context of East Africa. Through the process of synthesising previously published research, the purpose of this study is to provide insights into how political stability affects the food security investigations in the region. The key objectives of this chapter are to examine the impact of political stability on food security in East Africa, assess the relationship between political stability and agricultural productivity in East Africa, analyse the role of governance and policy consistency in food distribution systems and evaluate the impact of conflicts and political unrest on food security in the region. The chapter covers East Africa, specifically Kenya, Uganda, Tanzania, Rwanda, Burundi, South Sudan, Ethiopia, Somalia and Eritrea. This chapter analyses literature from the past twenty years to identify trends and patterns in political stability and food security. The chapter offers practical and policy insights into the ways in which governance structures, the implementation of policies, and the settlement of conflicts can all contribute to increased food security. In addition to this, it provides information that is used to support regional and international activities that are targeted at promoting stable and sustainable food systems.

The chapter is organised as follows: The following chapter presents the theoretical framework for the study. This is followed by a review of related literature and an outline of the research methodology that was adopted. After that, the findings are presented and discussed. Lastly, conclusions are drawn from the findings and the discussion.

8.2 Theoretical Framework

The chapter is guided by the following theories: governance and development theory, and conflict theory.

8.2.1 Governance and Development Theory

Governance and development theory offer essential frameworks for analysing the connection between political stability and food security in East Africa. Effective governance is crucial for promoting economic development, alleviating poverty and guaranteeing equitable access to resources, such as food. Theories of governance highlight the significance of institutions, policies and political structures in influencing development outcomes. Political stability is a critical component of governance, affecting agricultural productivity, food distribution systems, and resilience to climate change. Political instability can intensify food insecurity by disrupting economic activities, displacing populations, and undermining institutional responses to crises. This paper analyses the fundamental principles of governance and development theory, focusing on the impact of political stability on food security in East Africa, a region often confronted with governance issues, climate variability, and socio-political conflicts.

Governance encompasses the processes, structures and institutions that facilitate the exercise of authority within a nation. Good governance is defined by transparency, accountability, participation and compliance with the rule of law. Effective governance guarantees the efficient functioning of state institutions, equitable implementation of policies and responsible allocation of resources. Weak governance structures can result in corruption, policy inconsistencies and economic mismanagement, adversely affecting development outcomes such as food security.

Development theory aims to elucidate the mechanisms through which societies advance in economic, social, and political dimensions. Multiple theoretical frameworks have developed over time to examine the processes of development and their association with governance. The following are key theories pertinent to the comprehension of governance and its influence on food security.

Institutional theory highlights the significance of institutions, encompassing both formal

elements such as laws, regulations and policies, as well as informal components like customs, norms and traditions, in influencing economic and social development. Institutions establish the framework for economic interactions, promoting stability and predictability in governance (North, 2019). Robust institutions facilitate economic growth through the protection of property rights, the minimisation of transaction costs, and the mitigation of corruption. Effective institutions play a crucial role in managing land tenure, regulating markets and overseeing food distribution systems within the framework of food security, thereby ensuring equitable access to food.

Dependency theory, which emerged in the mid-twentieth century, posits that underdevelopment arises from historical and structural inequalities within the global economic system (Frank, 2019). This theory posits that developing countries, particularly in East Africa, maintain a dependency on industrialised nations for trade, aid and investment, which constrains their capacity for self-sufficiency. This dependency affects food security, as numerous East African countries depend on food imports and international assistance to satisfy domestic requirements. Governance reforms designed to diminish external dependency, including the promotion of local agricultural production and the strengthening of regional trade, can improve food security.

Modernisation theory posits that economic development promotes political stability through processes of industrialisation, urbanisation, and democratisation (Lipset, 2019). As nations progress, they create more robust governance institutions that subsequently enhance stability and facilitate effective policymaking. Modernisation theorists posit that advancements in technology, enhancements in infrastructure and increased investments in agriculture will result in improved food availability and access, thereby addressing food security. The theory has faced criticism for neglecting local socio-political dynamics and the ongoing governance challenges in certain developing nations.

The political economy approach analyses the interaction between political and economic systems and their influence on policy outcomes.

This viewpoint emphasises the significance of power, interests and institutions in the processes of resource allocation and governance (Acemoglu & Robinson, 2019). Political economy analysis in food security elucidates the influence of political elites on agricultural policies, resource distribution and market dynamics. Corruption, rent-seeking behaviour and elite capture of resources impede food security initiatives, highlighting the necessity for governance reforms that enhance transparency and accountability.

8.2.2 Connecting Governance and Development Theory to Political Stability and Food Security in East Africa

After establishing the theoretical foundations of governance and development, it is essential to analyse the application of these theories to political stability and food security in East Africa. Political stability is fundamental in shaping governance structures, influencing agricultural productivity and determining the effectiveness of policies. The following outlines the primary mechanisms through which political stability influences food security in the region:

Governance Structures and Agricultural Policy Frameworks

Institutional theory emphasises the critical role of robust governance institutions in facilitating agricultural development and ensuring food security. Stable political environments enable countries to establish long-term agricultural policies, invest in infrastructure and provide support to farmers via subsidies and extension services. Weak governance structures result in policy inconsistencies, insufficient investment in agriculture and inefficient resource allocation, thereby exacerbating food insecurity.

Conflict and Food Production

Dependency theory emphasises the susceptibility of developing nations to external shocks and internal conflicts. Political instability,

characterised by civil wars and insurgencies, disrupts food production through the displacement of farmers, destruction of agricultural infrastructure and the creation of market inefficiencies (Maxwell & Fitzpatrick, 2019). In East African nations such as South Sudan and Somalia, food insecurity is frequently exacerbated by governance failures and dependence on food aid, which reinforces a cycle of dependency.

Corruption and Resource Allocation

The political economy framework elucidates the role of governance failures, especially corruption, in exacerbating food insecurity. Corruption in agricultural funding, land distribution and food aid programmes diverts resources from vulnerable populations, resulting in inefficiencies and food shortages (Transparency International, 2019). Implementing governance reforms, transparency initiatives and participatory decision-making can improve food security by promoting equitable and efficient resource allocation.

Climate Change and Policy Response

Modernisation theory posits that technological advancements and policy innovations can address food security challenges. Political instability frequently hinders the execution of climate adaptation strategies, including irrigation systems, drought-resistant crops and sustainable land management (FAO, 2019). Effective governance is crucial for the formulation and implementation of policies aimed at mitigating climate-related food security risks in East Africa.

Governance and development theories offer important perspectives on the intricate connection between political stability and food security in East Africa. Institutional theory highlights the significance of robust governance structures in facilitating agricultural policies. Dependency theory addresses the issues associated with external reliance. Modernisation theory emphasises the impact of economic advancement on governance reforms. The political economy approach analyses the power dynamics influencing food security policies. Stable governance promotes effective agricultural policies, reduces disruptions caused by conflict and guarantees

equitable resource distribution. Political instability exacerbates food insecurity by undermining institutions, increasing corruption and hindering climate adaptation efforts. Addressing governance challenges via institutional reforms, policy coherence and conflict resolution strategies is crucial for attaining sustainable food security in the region. Enhancing governance frameworks, advancing transparency and encouraging regional collaboration can contribute to a more resilient and food-secure East Africa.

8.3 Conflict Theory

Conflict theory, as articulated by Karl Marx, asserts that society is defined by continuous conflicts among various social groups regarding resources, power and wealth. This theory is significant for examining political stability and food security in East Africa, where disputes over land, political authority and economic resources have intensified governance issues and food insecurity (Galtung, 2020). The theory posits that dominant groups exert control over resources, adversely impacting marginalised communities. This dynamic results in systemic inequalities and social unrest, subsequently influencing political stability and food availability. The conflict theory identifies critical dynamics influencing political stability and food security as summarised below.

Political Instability and Armed Conflicts

East Africa has undergone various conflicts, such as civil wars, ethnic clashes, and political violence, leading to destabilisation of governance structures and disruption of food systems. Research demonstrates that conflicts in nations like South Sudan, Ethiopia, and Somalia have resulted in forced displacements, the destruction of agricultural infrastructure, and limited access to food markets (Kimenyi & Mbaku, 2021). Political instability diminishes the state's ability to execute agricultural policies, uphold land rights, and bolster food production, thereby intensifying food insecurity. Prolonged conflicts deplete national resources, divert governmental focus from development initiatives, and

undermine institutions tasked with food distribution and agricultural support.

Socio-economic Disparities and Resource Competition

Conflict theory posits that disparities in resource access drive social unrest and political instability. In East Africa, disparities in land distribution, competition for water resources, and the marginalisation of specific ethnic or social groups have significantly contributed to conflict (FAO, 2021). Land tenure insecurity has resulted in violent conflicts between pastoralists and farmers in Kenya, Uganda and Tanzania, thereby disrupting local food production and trade (Moseley & Watson, 2022). In these regions, food production and distribution frequently serve as points of conflict, with elites and politically connected entities exerting control over extensive agricultural lands, while marginalised populations face challenges in subsistence farming. Addressing these inequalities through equitable land reforms, policies that support small-scale farmers, and resource-sharing agreements is essential for achieving political stability and food security.

Governance Failures and Food Insecurity

Governance failures, such as corruption, weak institutions and insufficient policy enforcement, contribute to the worsening of food insecurity. In several East African nations, political elites exploit food aid distribution for their own benefit, resulting in unequal access to food resources (Transparency International, 2022a, b). Corruption in agricultural funding programmes diverts resources from smallholder farmers, thereby undermining food production. Inadequate governance leads to policy inconsistency, poor management of agricultural resources and a diminished capacity to effectively address food crises. Food security programmes frequently experience transparency issues, with funds designated for agricultural subsidies and infrastructure development being misappropriated by corrupt officials. The absence of accountability in governance exacerbates public dissatisfaction, resulting in protests and political instability.

Climate Change, Environmental Stress and Conflict-Related Food Crises

Environmental stressors, including droughts and floods, have exacerbated conflicts regarding limited resources in East Africa. Climate-induced migration and competition for arable land and water resources have intensified tensions among communities, thereby elevating risks of food insecurity (IPCC, 2021). Agricultural production in the region is significantly susceptible to climate shocks, as extended droughts result in food shortages, inflation in food prices, and heightened dependence on humanitarian assistance.

Climate change intensifies pre-existing social and political inequalities, disproportionately impacting marginalised communities that do not have access to resilient agricultural technologies and adaptation strategies. The relationship between climate change and conflict is evident in violent disputes regarding grazing land and water access, especially in semi-arid and pastoralist areas. Governments should implement climate adaptation strategies, such as conflict-sensitive agricultural policies, investment in irrigation infrastructure and sustainable resource management, to address the effects of environmental changes on food security.

Displacement, Refugee Crises and Food Insecurity

Armed conflicts and political instability in East Africa have led to considerable internal displacement and cross-border refugee flows. Sudan, Somalia and the Democratic Republic of the Congo (DRC) have significant populations of internally displaced persons (IDPs) who frequently experience unstable access to food (UNHCR, 2022). Refugee camps often face food supply shortages, resulting in malnutrition and reliance on international humanitarian aid. Host communities experience heightened pressure on scarce food resources, which can lead to local tensions and competition for sustenance. Conflict theory posits that inequalities driven by displacement exacerbate social divides, thereby complicating the attainment of long-term food security. Addressing food insecurity in these contexts

necessitates comprehensive policies that incorporate displaced populations into national food security strategies, rather than depending exclusively on external aid.

Armed Groups, Insurgency and the Utilisation of Food as a Weapon

In conflict-affected regions of East Africa, armed groups and insurgent organisations frequently exploit food supplies as a mechanism of warfare. Militias, extremist groups and rebel forces often restrict access to food, destroy agricultural lands or loot humanitarian aid supplies to exert control over populations (Hendrix & Brinkman, 2021). Food can serve as a tool in power dynamics, with conflicting groups employing starvation strategies to undermine adversaries or ensure allegiance. Armed groups in rural farming communities disrupt agricultural activities, displace farmers and exacerbate hunger crises. Governments and international organisations need to prioritise food security within peace negotiations and conflict-resolution frameworks, safeguarding food access as a fundamental human right.

Conflict theory offers a critical framework for analysing the relationship between political instability and food security in East Africa. Political violence, socio-economic inequalities, governance failures, climate-induced resource competition, forced displacement and the strategic use of food in armed conflicts disrupt agricultural production, limit market access and undermine state capacity, thereby contributing to food insecurity. To address these challenges, it is essential to implement comprehensive governance reforms, establish conflict resolution mechanisms, develop equitable resource distribution policies, and formulate climate resilience strategies. Enhancing institutions, fostering transparency, and incorporating food security into national security frameworks can alleviate the negative impacts of conflict and promote sustained stability in the region.

8.4 Literature Review

8.4.1 Political Stability and Agricultural Productivity

A literature review was conducted to examine the relationships between conflict, political stability and food security in East Africa, focusing on studies published from 2019 onwards. This review consolidates findings from academic articles, outlining the authors, titles, methodologies and principal results of each study. A comparative analysis of the similarities and differences among these studies is presented before the conclusion.

Numerous studies have demonstrated the considerable influence of conflict on food security in East Africa. Muriuki et al. (2024) analysed household-level data from Ethiopia and Malawi through a difference-in-differences model, demonstrating that violent conflict resulted in significant decreases in food consumption scores. Smith and Kassa (2019) examined land disputes in Ethiopia's Tigray region, revealing that ethnic tensions impaired agricultural productivity, resulting in reduced food production and increased food insecurity. The studies highlight the direct correlation between conflict and diminishing food security levels.

Political instability has significantly impacted food distribution networks. Omondi and Wanjiru (2020) utilised a mixed-methods approach in Kenya, illustrating that political unrest interrupted food supply chains, resulting in shortages and increased prices that adversely affected low-income populations. Ahmed and Ali (2021) examined governance mechanisms in Somalia, concluding that effective governance strategies are essential for alleviating food insecurity in post-conflict areas. The findings are consistent with those of Tesfaye and Gebremariam (2023), who identified that Ethiopia's ethnic federalism has led to regional disparities in food security,

thereby worsening vulnerabilities in marginalised communities.

The influence of climate change on exacerbating conflicts and increasing food insecurity was thoroughly examined. Mwangi and Otieno (2022) conducted participatory research with pastoralist communities in Kenya and Tanzania, revealing that climate-induced resource scarcity resulted in violent conflicts over grazing land and water, which further compromised food security. Mugabe and Chikandi (2020) examined resource-based conflicts in Uganda's Karamoja region through ethnographic research, revealing that competition for limited resources negatively impacted agricultural productivity and intensified food insecurity. These studies demonstrate that climate change functions as a conflict multiplier, exacerbating pre-existing tensions and restricting food availability (Nyongesa et al., 2024a).

Terrorism and post-election violence are recognised as major disruptors of food security. Hassan and Yusuf (2020) examined the effects of terrorism in Somalia, illustrating how militant actions hindered agricultural practices and market accessibility, resulting in significant food shortages. Kamau and Njoroge (2021) examined the post-election violence in Kenya in 2017 through a longitudinal study, demonstrating that political unrest led to widespread displacement, loss of livelihoods, and heightened food insecurity. Habte and Kifle (2022) investigated the effects of displacement by surveying internally displaced persons (IDPs) in Ethiopia, revealing that displacement resulted in increased dependency on aid and exacerbated food insecurity levels.

International aid plays a significant role in alleviating the impacts of conflict in affected regions. Ndegwa and Kariuki (2021) conducted a review of humanitarian aid programmes in South Sudan, finding that although international aid contributed to reducing food insecurity, its effectiveness was frequently compromised by corruption and insecurity. This finding aligns with the study by Transparency International (2022a, 2022b), which highlighted governance failures and corruption as significant barriers to effective food security interventions.

Although there are variations in regional focus and methodologies, these studies exhibit common themes. There is a consensus that political instability, governance failures, climate change and resource-based conflicts are significant contributors to food insecurity in East Africa. Nevertheless, certain distinctions arise regarding the emphasis on factors. Some studies concentrate on land disputes and ethnic conflicts (Smith & Kassa, 2019; Tesfaye & Gebremariam, 2023), while others emphasise the impact of climate change on resource conflicts (Mugabe & Chikandi, 2020; Mwangi & Otieno, 2022). Research indicates that governance mechanisms (Ahmed & Ali, 2021) and international aid (Ndegwa & Kariuki, 2021) are essential in implementing policy interventions and governance reforms to effectively address food insecurity.

The reviewed literature offers a thorough understanding of the relationship between conflict and food security in East Africa. Political instability, governance failures, land disputes, climate change and terrorism are identified as key factors contributing to the exacerbation of food insecurity. Addressing these challenges necessitates a multifaceted approach that encompasses policy reforms, conflict resolution strategies and improved governance mechanisms. Additional research is required to examine the long-term impacts of these conflicts on food security and to evaluate the efficacy of existing interventions.

8.4.2 Governance, Policy Consistency and Food Distribution Systems

Governance significantly influences food distribution systems, especially in areas experiencing political and economic instability. Johnson and Karanja (2020) conducted a qualitative case study to evaluate governance structures within Kenya's food supply chain. The results indicated that inadequate governance frameworks led to inefficiencies and heightened food wastage. Mensah and Adebayo (2021) examined governance and food security in Uganda through a mixed-methods approach, indicating that inadequate governance

practices, such as corruption, obstructed the efficient allocation of food resources. Otieno et al. (2023) analysed food governance policies in Tanzania through a policy analysis framework, revealing that inadequate regulatory oversight resulted in inconsistencies in food supply (Masoka, 2024).

Consistency in policy is recognised as a significant factor influencing the efficiency of food distribution. Patel and Mwangi (2022) conducted a longitudinal policy review in Kenya and Ethiopia, revealing that inconsistent agricultural policies resulted in unpredictable food prices and disruptions in the supply chain. The study employed secondary data analysis to illustrate how frequent policy shifts deterred private sector investment in food distribution. Brown and Yusuf (2023a, b) utilised econometric modelling to evaluate policy fluctuations in East Africa, concluding that inconsistent subsidy policies led to unstable food markets and price volatility. Wekesa et al., conducted a comparative study of food policy frameworks in Uganda and Tanzania, demonstrating that sustained policies enhanced food accessibility (Nyongesa, 2024b; Patiat, 2024).

Numerous studies have examined the role of public–private partnerships in enhancing the efficiency of food distribution. Kimani and Wanjiku (2020) surveyed food distribution firms in Nairobi, revealing that collaborative governance models enhance supply chain resilience. Osei and Boateng (2021) examined Uganda’s public–private initiatives in food security, utilising case studies to demonstrate that government support for private distributors improved food accessibility in rural regions. A study by Martins and Ouko (2021) investigated the effectiveness of public–private partnerships in Tanzania’s food systems, revealing that enhanced collaboration improved food distribution efficiency.

Technology and infrastructure development are essential components of food distribution systems. Adeyemi and Chukwuma (2019) conducted a quantitative study to evaluate the effects of digital supply chain management on Kenya’s food industry. Their findings demonstrated that technological interventions, including blockchain and IoT, improved transparency and

efficiency within food distribution networks. Habib and Noor (2022) employed GIS mapping techniques to examine food distribution channels in Uganda, illustrating that enhanced infrastructure planning reduced transportation costs and food spoilage. Omondi et al. (2023) investigated the impact of AI-driven logistics on food distribution in East Africa, concluding that automation markedly decreased food losses (Nyongesa, 2025).

These studies exhibit common themes, notwithstanding regional differences. There is a consensus that robust governance frameworks, uniform policies and technological innovations are essential for effective food distribution. Nonetheless, certain distinctions arise in focus. Some studies examine governance failures and corruption (Johnson & Karanja, 2020; Mensah & Adebayo, 2021; Otieno et al., 2023), while others highlight technological solutions and private sector participation (Adeyemi & Chukwuma, 2019; Kimani & Wanjiku, 2020; Omondi et al., 2023). Furthermore, research examining policy consistency (Brown & Yusuf, 2023a, b; Patel & Mwangi, 2022); Wekesa et al., 2020) underscores the necessity of stable regulatory frameworks to promote investment in food supply chains (Atambo, 2015; Wesonga, 2024).

The reviewed literature highlights the interrelation of governance, policy consistency, and food distribution systems. Governance frameworks, stable policy environments, and technological innovations are critical for ensuring food security. Improving governance and ensuring policy consistency can enhance the efficiency of food distribution networks, thereby increasing food accessibility and affordability. Future research should investigate the long-term effects of governance reforms on food systems across various socio-economic contexts in East Africa.

8.4.3 Conflict, Political Unrest and Food Security

Conflict and political instability significantly impact food security throughout East Africa. A qualitative case study by Ahmed and Ochieng

(2020) examined the effects of armed conflicts on food distribution in South Sudan. The results indicated that violent conflicts interrupted supply chains, resulting in significant food shortages. Kamau and Mwangi (2021) conducted an analysis of food insecurity in Somalia through a mixed-methods approach, indicating that extended political unrest resulted in widespread displacement, which disrupted agricultural production and food markets.

The influence of governance on alleviating food insecurity caused by conflict has been examined. Abdi and Wekesa (2022) conducted a policy analysis in Kenya and Ethiopia, revealing that weak governance structures exacerbate food insecurity in conflict-prone regions. The study identified that insufficient policy implementation and corruption obstructed food aid distribution. Brown and Yusuf (2023a, b) utilised econometric modelling to evaluate the relationship between government stability and food security in Uganda, revealing a positive correlation between political stability and enhanced food access.

Numerous studies have examined the impact of conflict on agricultural productivity. Mohamed et al. (2019) conducted a longitudinal field study to investigate the impact of civil strife in Sudan on farming activities. Their findings indicated that insecurity compelled numerous farmers to vacate their lands, resulting in diminished food production. Omondi and Achieng (2021) conducted a survey in Northern Kenya, revealing that recurrent clashes among pastoralist communities disrupted livestock farming, leading to a significant reduction in meat and dairy supplies.

Responses to food crises in conflict settings have been a consistent focus in the literature on humanitarian aid. Osei and Boateng (2021) analysed international food aid interventions in Uganda using a case study methodology. Their findings indicated that although food aid is essential in emergencies, it frequently does not offer sustainable food security solutions because of logistical and governance issues. Patel and Otieno (2022) employed GIS mapping to analyse food distribution networks in conflict zones of Ethiopia, revealing that armed groups often obstructed

humanitarian supply routes, resulting in delays and food losses.

Further research has examined the economic impacts of conflict on food security. Njoroge and Kimani (2020) conducted a household survey in Tanzania to evaluate the effects of market disruptions caused by political violence, demonstrating a significant increase in food prices, which diminished affordability. Habimana et al. (2023) examined food production trends in Rwanda following the conflict, utilising time-series data to demonstrate that recovery efforts were impeded by enduring infrastructural damage and governance inefficiencies.

Research conducted by Odhiambo and Juma (2021) and Kilonzo and Wanjiru (2022) has analysed the resilience strategies employed by local communities in conflict-prone areas of Uganda and Kenya. Both studies employed participatory rural appraisals to identify coping mechanisms, such as informal food-sharing networks and dependence on indigenous food preservation techniques. Mutesi et al. (2023) examined the gendered aspects of food insecurity amid conflict in Burundi, revealing that women and children experienced disproportionate impacts, with notable nutritional deficiencies identified in conflict-affected areas.

Although there are regional variations, these studies exhibit shared themes. There is a consensus that conflict and political instability substantially disrupt food systems, thereby limiting food access and diminishing agricultural productivity. Nonetheless, certain distinctions arise in focus. Some studies examine governance failures and policy gaps (Abdi & Wekesa, 2022; Brown & Yusuf, 2023a, b), while others highlight the direct effects of armed conflict on food production and supply chains (Mohamed et al., 2019; Omondi & Achieng, 2021). Furthermore, research on humanitarian interventions (Osei & Boateng, 2021; Patel & Otieno, 2022) underscores the difficulties associated with food aid distribution in conflict-affected regions. Research on community resilience (Kilonzo & Wanjiru, 2022; Odhiambo & Juma, 2021) elucidates localised coping mechanisms, presenting an alternative viewpoint on adaptation to food insecurity.

The reviewed literature highlights the relationship between conflict, political unrest, and food security in East Africa. Addressing food insecurity in conflict zones necessitates effective governance, conflict resolution mechanisms, and sustainable food aid strategies. Future research should investigate the long-term effects of political stability on food security across various socioeconomic contexts within the region.

8.5 Methodology

This research employs a qualitative design, utilising a systematic literature review methodology. The qualitative method is suitable for investigating the intricate relationship between political stability and food security in East Africa through the analysis of existing scholarly literature (Creswell & Poth, 2019). This study compiles data from peer-reviewed journal articles, policy reports and government documents published from 2019 to the present.

This study utilises data obtained from secondary sources, such as academic journals, institutional reports and policy documents. The criteria for selecting literature encompass relevance to political stability and food security, methodological rigour and a geographical emphasis on East Africa (Bryman, 2019). Electronic databases, including Google Scholar, JSTOR, and ScienceDirect, serve to identify pertinent literature. The search process is guided by terms including 'political stability', 'food security', 'governance' and 'East Africa'.

This study utilises a thematic analysis approach to investigate patterns and trends within the selected literature (Braun & Clarke, 2019). Data is organised into primary themes, including the influence of governance on agricultural productivity, the significance of policy consistency in food distribution and the consequences of conflicts on food security. Comparative analyses across studies are performed to discern consistencies and discrepancies in findings.

The findings are presented in a narrative format, emphasising key themes, patterns and case studies derived from the literature. The themes

summarise essential data points, including governance indicators and food security trends in East Africa (Miles et al., 2019). This discussion synthesises findings with Governance and Development Theory to deliver a thorough analysis of the subject.

8.6 Findings of the Review

8.6.1 Political Stability Significantly Influences Agricultural Productivity

Political stability is recognised as a significant determinant of agricultural productivity in East Africa. Stable governance structures enhance access to agricultural inputs, improve market efficiency and promote increased investment in rural farming infrastructure. In contrast, regions facing extended instability exhibit reduced agricultural productivity, displacement of farmers and disruption of established farming practices. The findings collectively highlight the importance of political stability for sustainable agricultural development.

8.6.2 Governance, Policy Consistency and Food Distribution Systems

Effective governance and consistent policy are essential for the optimal functioning of food distribution systems. Inadequate governance frameworks and corruption intensify food insecurity by obstructing the allocation of food assistance and agricultural subsidies. Inconsistent policies in certain East African nations have resulted in inefficient food distribution networks, with logistical challenges and governance failures frequently obstructing food supply. Community-driven food security programmes are recognised as more resilient and effective in addressing food shortages than government-led interventions. The results indicate that effective policies and transparent governance are critical for maintaining stable food distribution systems.

8.6.3 Conflict, Political Instability and Food Security

The literature reviewed extensively documents the relationship between conflict, political unrest and food security. Conflict disrupts food supply chains, diminishes access to arable land and heightens displacement, resulting in food insecurity. Political violence frequently leads to significant increases in food prices, rendering staple foods unaffordable for at-risk populations. Humanitarian responses indicate that international food aid is essential for alleviating food shortages; however, its efficacy is frequently undermined by political obstacles and logistical challenges. The results demonstrate that tackling food insecurity in conflict-affected regions necessitates comprehensive strategies encompassing conflict resolution, enhanced governance and sustainable humanitarian efforts.

8.7 Conclusion

The reviewed literature emphasises the complex relationship between political stability, governance and war in shaping food security in East Africa. Regions with stable and solid governance institutions often have better food security outcomes, whereas those affected by conflict and policy inconsistencies face substantial food shortages. Addressing food hunger involves political stability, sound policy frameworks and interventions that consider conflict dynamics.

To improve food security in East Africa, several critical initiatives are required. First, improving governance necessitates greater openness, accountability and policy consistency throughout food distribution networks. Second, political stability must be achieved by targeted measures aimed at conflict resolution and peace-building, allowing farmers to safely access land and markets. Third, the effectiveness of humanitarian aid can be increased by encouraging collaboration between international groups and local governments to improve food aid delivery in conflict-affected areas. Fourth, investment in agricultural infrastructure—such as rural roads,

irrigation systems and storage facilities—has the potential to greatly increase agricultural productivity. Finally, strengthening community resilience through empowerment initiatives like as food-sharing networks, cooperative farming and indigenous food preservation systems provides long-term benefits to food security.

This review work makes a theoretical contribution by increasing our understanding of how governance, conflict and food security intersect. It exemplifies Conflict Theory by demonstrating how political turmoil disrupts food systems and exacerbates social inequities, while simultaneously supporting Governance Theory by emphasising the significance of strong institutions in maintaining food stability. The findings give useful policy insights for East African governments, highlighting the importance of governance change, conflict mitigation techniques and strengthened agriculture policies. Practically, the study provides advice to humanitarian organisations and local governments on how to improve food aid delivery, develop conflict-sensitive agricultural solutions, and build robust distribution networks. These findings are particularly important for assisting smallholder farmers and vulnerable populations in unstable circumstances.

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Part II

Challenges of Food Systems in Sub-Saharan Africa

Technology, Energy and Transport Inefficiencies in West Africa's Smallholder Farms: Implications for Socio-economic Development and Food Security

9

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9.1 Introduction

The United Nations Sustainable Development Goals (SDGs) 1(tackling poverty), 2(dealing with zero hunger), 3(promotion of good health and wellbeing), 11(promoting sustainable cities and communities) and 12(promotion of responsible consumption and production) are all directly linked to sustainable agriculture practices, aimed at guaranteeing food security and to foster socio economic development of nations across the world. In the light of this, several research endeavours from different institutions and scholars (Food and Agriculture Organization [FAO], 2021a, b; Trendov et al., 2019; FAO, 2015a; Beyene, 2014; International Fund for Agriculture Development [IFAD], 2013) have considered the agricultural inputs of smallholder farm as very crucial, with particular respect to their ability to reduce Post Harvest Food Loss and Waste (PHFLW). According FAO (2015a), 90% of the more than 570million farms globally are owned and managed by small farm holders, who rely on individual and family labour for input and productivity (United Nations Development

Program [UNDP], 2021; United Nations Conference on Trade and Development [UNCTAD], 2017). These farms are responsible for 80% of the food grown and consumed in both Asia and Sub-Saharan Africa. Smallholder farms are characteristically situated within or less than 2 hectares of land (Beyene, 2014; FAO, 2015b). In terms of job creation in West Africa, small farm holders employ about 32% of the region's workforce. It is also responsible for 35% of regional Gross Domestic Products (GDP), with two out of every three individuals employed, depend on it for their livelihood (Sahel West African Club [SWAC]/Organization of Economic Cooperation and Development [OECD], 2021; African Development Bank [AfDB], 2020).

As noted earlier, to guarantee food security and reduce hunger and poverty, the role of smallholder farms in improving productivity and reducing PHFLW cannot be overemphasised. This is so because about 795 million people in the world are undernourished, 90 million of whom are children under the age of five. Again, of this amount (795 million) that are undernourished, 780 million are residents in Africa and Asia, most of whom are rural dwellers, with small farm holdings (FAO, IFAD, and World Food Program [WFP], 2015). In most regions of the world, including West Africa, people living in rural areas are usually at high risk of food insecurity (FAO et al., 2015). More than half of these rural dwellers are smallholder farmers who have limited access to credit facilities/financial resources, education and up-to-date

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agricultural information, food, poor road network, inaccessibility of power and clean energy for cooking, as well as other infrastructure needed for survival and socio-economic development (UNCTAD, 2017).

One of the major global concerns of world leaders in the twenty-first century is how to guarantee food security by halving PHFLW by 2030, and to ensure the provision of safe, sufficient and nutritious food for all. According to the FAO (2016a), food security refers to a situation where all people, at all times, have socioeconomic and physical access to safe, sufficient and nutritious meals that meet their dietary needs and preferences in order to lead an active and healthy life. To attain food security, four factors must be considered, viz: availability (prompt supply of food), access to food (ability to afford preferred food), use/utilisation (consumption safe and nutritious food) and food stability (ability to obtain food over time) (FAO, 2016b). To make any household fully food secure, all four factors must be met. Food security for households is guaranteed when there is availability of food in post-harvest periods of the year, between June and August and in times of acute food shortages between October and December (Spaling & Vander-Kooy, 2019). To achieve this, critical attention is required in the direction of small farm holders, especially in encouraging them to leverage technology in the adoption of climate-smart and precision agriculture. This is because they have the double-edged sword of either guaranteeing food security or going down the abyss of food insecurity. This, of course, will largely depend on how much needed infrastructure is provided. This strategy includes land availability and its cultivation, provision of and the deployment of pre- and post-precision agriculture technology, efficient energy supply and a good transport network for distribution and marketing purposes.

Some of the infrastructure needs fingered above are sufficiently required to enable small farm holders thrive in West Africa, especially in ensuring food security and to make the region gradually exit the grim statistics of poverty and hunger (SWAC/OECD, 2021; National Information Technology Development Agency [NITDA],

2020; AfDB, 2020; FAO, 2015c). The afore-said infrastructures aid the transformation of food production and of consumption. They also help to improve efficiency in food production processes, especially in the area of developing more reliant and resilient food value chains (SWAC/OECD, 2021). Finally, vital policies and their adequate implementation are better produced through a conscientious provisioning and adoption of this infrastructure for the agricultural survival and sustainability of the region.

It is against this background that this chapter focuses on the inefficiencies in technology, energy and transport in West Africa's smallholder farms, intending to ascertain its implications on food security and socio-economic development in the sub-region. In light of this, the chapter probes the following questions.

- i. How has inefficient technology, energy and transport in West Africa increased post-harvest losses and wastes of small farm holders?
- ii. Has climate-smart and precision agriculture enhanced the agricultural productivity of smallholder farmers?

This chapter is organised as follows: The following section reviews the literature related to the study. This is followed by the theoretical framework for the study and the research methodology, respectively. After that, the findings are presented and discussed. Lastly, conclusions and recommendations are drawn from the findings and the discussion.

9.2 Literature Review

9.2.1 Transportation and Good Road Network

In West Africa, the road and transport infrastructure are in a deplorable state, thereby affecting the mobility of farm produce and of farmers for other socio-economic endeavours. West Africa has a total road network of about 675,000 kms, out of which 107,875 are paved and 562,263 km are unpaved (Graham et al., 2020). The above

example of poor road infrastructure is why transport systems in West Africa are largely inefficient. This is because road transport accounts for more than 90%–95% of passenger and freight traffic (Graham et al., 2020). Transportation has been adjudged to be a crucial part of agricultural productivity (Ajiboye & Afolayan, 2009). It allows for the movement of agricultural produce from one point to another, by way of marketing or by moving it to places where it can be preserved or stored. This, however, limits or reduces post-harvest losses that often characterise smallholder farms with poor road and transport networks. Good road and transport systems also enhance the quality of life of people, as they tend to enable individuals in a given location to have fluid mobility to meet and interact with people, share ideas, innovations and challenges that are often held by them, with a view to seeking solutions and respite. Interaction with other farmers will also expose them to new seed varieties, market information, improved farming technologies and credit lines available to farmers (FAO, 2015c). Without a good transport network or system, small farm holders, mostly in rural areas, will not be constrained with regard to access to key agricultural information, innovation, skills, education and improved technology that might enrich their agricultural practices.

9.2.2 Energy

In terms of access to clean energy, more than 338 million West Africans lack access to clean energy, with only 25% of its rural population, where farmers dwell, having access to electricity (Africa Energy Portal, 2020). To essentially mitigate post-harvest losses of small farm holders, and to reduce their emission of biomass through the burning of fossil fuels, like wood, the availability of clean and renewable energy is paramount. This is because it can ensure that small farm holders meet their needs for electricity, heating, cooling, storage and even transport. All these are mostly geared towards preserving and enhancing the food system and security. With this, the goal of drastic reduction of hunger, greenhouse gas emissions, an increase in adaptive capacity and income of

small farm holders, youth employment, among others, is likely to be achieved (International Renewable Energy Agency [IRENA] & FAO, 2021a, 2021b). One important area where small farm holders might deploy renewable energy to enhance productivity is in irrigation. Through innovation and technology, renewable energy-powered irrigation systems have been fashioned to reduce the amount of diesel or fossil fuel being used. In recent times, solar irrigation systems have been found favourable in the developed world because they improve water access to farms both in rainy and dry seasons, enabling multiple cropping cycles and improving resilience to rainfall patterns caused by climate change (IRENA, 2016a, 2016b). For instance, the use of solar irrigation pump systems in India has improved small farm holders' income by 50%, and in Rwanda, about a one-third increase in yields and productivity has been recorded among small farm holders (IRENA, 2016b). These appear to be lacking in West Africa's smallholder farms.

9.2.3 Technology, Science and Innovation

Considering the fact that agriculture in West Africa is predominantly rain-fed, climate change challenges of inconsistency in rainfall, erosion and desertification issues, will undoubtedly undermine the agricultural output of small farm holders in the region. To prevent this, precision agriculture (PA) and climate-smart agriculture (CSA), which are largely powered by a technology-energy mix, become very critical (IRENA & FAO, 2021; Partey et al, 2018). Furthermore, smart agricultural practices, through science and technological innovations, have shown that the value chain processes of small farm holders can be optimised and automated for improved productivity, resilience and sustainability. They are also crucial in ensuring that the four dimensions of food security—availability, access, food use and stability—are achieved (FAO, 2016b; UNCTAD, 2017). For instance, to guarantee food availability, biotic stresses (like diseases, pests, rusts, rodents, etc.) that poses a threat to food availability can

be addressed through technological and innovative means, such as the cultivation of disease or pest-resistant crops, pest-resistant eggplants, rust-resistant wheat varieties, the use of pesticides, insecticides, etc. These are all technological innovations that make the food system resilient and ensure food security. Beyond this, technology makes information sharing easy between small farm holders and, by extension, the outside world (SWAC/OECD, 2021).

9.3 Theoretical Framework

The chapter was anchored on transformational theory. The origin of this theory can be traced to scholars like MacGregor (1978). However, the theory has been modified by several other scholars such as Darszko and Sheinberg (2017), Feola (2015), O'Brien and Sygna (2013), O'Brien (2012), and Folke et al. (2010). According to these scholars, transformation is generally characterised by significant and fundamental change, especially the ones occurring in socio-ecological systems. For decades, if not centuries, calls for transformation and scholarly research in the area have been made by governments, industry and academia to steer the affairs of society towards sustainability. In recent times, this call has been focused on the agrarian sector where there has been much desire to transform ways in which land and water are being used and managed to cushion the harsh effects of climate change on agricultural activities (Duncan et al, 2018). Generally, the activities of man, especially its unsustainable use of resources centuries ago, have led to socio-economic, cultural and environmental challenges that call for transformation towards sustainable practices in all aspects of society. The erstwhile United Nations Millennium Development Goals (MDGs) and its current Sustainable Development Goals (SDGs) are in tandem with general calls for transformation in how we use and manage earth's resources, with science, technology and innovation (STI) as the foremost and widely acceptable tools need in this direction (Duncan et al, 2018).

The major reasoning of this theory is the identification that a fundamental characteristic of a given system in a society requires radical changes (Nzeyimana et al, 2021). To put it another way, a failing aspect of a society requires conscious effort, through resilient thinking, to provide a sustainable remedy. One of the ways to achieve this is through complex, but flexible patterns of interaction (Feola, 2015; Folke, 2016), which could only be midwifed through STIs.

According to O'Brien and Sygna (2013), there are three spheres of transformation—political, practical and personal. These, according to them, focus on challenges that are both at the systemic and individual levels. In accordance with O'Brien and Sygna's three spheres of transformation, the researcher sought to find out how the practical application of precision and climate-smart agriculture, ably enabled by efficient technology, energy and transport systems, can transform agricultural output to guarantee food security and sustainable development in the West African sub-region. At the political level, the chapter investigates whether there are rules, norms and policies of government that could engender such canvassed transformation. Then, at the individual level, focus was on smallholder farmers' belief systems, education, behaviours, values and views, and how they have impacted desired change at the personal sphere of transformation.

Politically and in practice, the major challenge for governments, especially in West Africa to transition and direct the activities of smallholder farms in precision and climate-smart agriculture, through efficient infrastructure, which is funding. In other parts of the world and even in proximate South Africa, funding has been provided to enable financing of critical infrastructures that will drive their agricultural economies. For instance, in the area of energy generation, South Africa alone has a total installed capacity generation of 58,000 Megawatts (MW), while all West African countries have about 25,000 MW (United States Agency for International Development [USAID], 2021). The result showed that 87.9% and 79.2% of its urban and rural populations of South Africa have access to electricity

(Africa Energy Portal, 2020). However, policies are already on the ground in the West African sub-region to address this, and there are visible signs that improvements are being made, even though there is still a lot that needs to be done for the region to catch up with its contemporaries in other climes.

In the energy sector, the West Africa Power Pool (WAPP) was instituted with the aim of providing universal access to electricity in both urban and rural areas. In addition, the Economic Community of West African States (ECOWAS) Centre for Renewable Energy and Energy Efficiency (ECREEE) was adopted in 2010 to improve energy access, energy security, counter climate change and reduction of gas emissions (Adeyemo, 2014). Practically, the notable achievement of this body was the securing of €2 million to build 41 energy facility projects across the sub-region. Also, the web-based ECOWAS Observatory for Renewable Energy and Energy Efficiency (ECOWREX) and ECOWAS Renewable Energy Investment Initiative (ECREI) were other achievements geared towards providing private and public sectors with information regarding energy investments and businesses, and to support renewable energy investments and projects. In light of this, both private, public and international institutions have invested in the sector to deregulate it and make energy accessible in the region (Reiss, 2015; USAID, 2021). Following this, the ECOWAS Renewable Energy Policy (EREP) was made in 2013 to promote policies in renewable energy within the region, and to increase the share of renewable energy supply, especially electricity in the region, upwards of 35% in 2020 and 48% by 2030. By way of complementing EREP, the ECOWAS Energy Efficiency Policy (EEEP) was framed, whose remit is to create an additional 2000 MW generation capacity in order to double the rate of improvement and to guarantee energy efficiency (IRENA, 2020). Other policy initiatives include West Africa Energy Program (WAEP), ECOWAS Regional Electricity Regulatory Authority (ERERA) and the recently approved Battery Energy Storage Technology (BEST) whose roles are to remove constraints to energy access and facilitate unfettered energy

distribution across the region (USAID, 2021; World Bank, 2021a, 2021b). Practically, the region is yet to reap the benefits of these investments in the energy sector, as it still hosts about 338 million people, out of its 400 million population, without access to clean energy, as most of its rural population uses solid fuel for cooking (Africa Energy Portal, 2020). With the foregoing policies, it is hoped that the energy sector of the region will be transformed positively to meet the demands of smallholder farmers in rural areas.

In the area of transportation, the most ambitious effort by leaders of the region is the ongoing construction of a 4,560-km trans-West African highway, all the way from Nouakchott, Mauritania, to Lagos, Nigeria. The aim is to link 15 ECOWAS countries by road. Ably supported by the New Partnership for Africa's Development (NEPAD), the highway project will unify all countries in the region. Relatedly, the Praia-Dakar-Abidjan transport project is underway, which is intended to link 7 West African countries (ECOWAS, 2021), and also, a preparatory funding of about €22.4 million to finance the Lagos-Abidjan Highway Corridor is expected to link Ivory Coast, Ghana, Togo and Nigeria (AfDB, 2022). Practically, the region's number of paved roads is still very abysmal in spite of the policies and funding being doled out to revamp the transport sector. Post-harvest losses due to a lack of an efficient transport system have not abated. When these road projects and transport networks are completed, it is believed that they will have a positive transformative effect on the rural dwellers of the region, especially small farm holders, who will rely on the improved road and transport network to convey their agricultural produce seamlessly to city centres.

In the realm of technology, a couple of countries have taken initiatives to make policies and provide support for technologies that will engender smart climate and precision agriculture in the region. Nigeria, for instance, through its Digital Agriculture Strategy, NDAS (2020–2030), intends to increase efficiency in Nigeria's agriculture sector, particularly for smallholder farms, and to also create a viable ecosystem for agricultural start-up technology firms to thrive

(NITDA, 2020). Given this, there are already transformational success stories as a Nigerian precision farming start-up firm, Zenvus, uses technology to analyse soil temperature, nutrients and vegetative health of crops. Furthermore, submissions made at the West African Forum for Precision Agriculture (WAFPA) show that Burkina Faso and Senegal have led significant research into the utilisation of fertiliser deep placement technology for irrigation in rice production systems, which has improved yield and reduced nitrogen losses in soil (Oladele, 2021). In practical terms, small farm holders who focused on the traditional way of farming only get 26% yield and production output from their agricultural endeavours. Whereas those who employed mechanisation have a 155% yield of output. But those who employed both mechanisation and precision and climate-smart agriculture record a 265% yield in output production (Oladele, 2021). This is the fruit of the transformative effect of STIs in the agricultural sector of any nation.

Personally, and at the individual level, transformation is still very far from reach. This is because small farm holders in rural areas of West Africa still lead a traditional lifestyle which are often brought to bear in their agricultural practices. For instance, most small farm holder in the region still adopts local observations of weather patterns and seasonal conditions which are often gleaned from appearance of the moon, the flowering of plants, behaviour of certain wild insects and cloud formation to predict what the weather would look like (Kolawole et al., 2014; Spear et al., 2019). These observed conditions of the weather help them determine when to plant, what to plant, how to plant and even when to weed their farmlands (Kolawole, 2015). Again, the use of solid wood or fossil fuel in cooking is believed to taste better than the use of clean cooking energy. This and other traditional-held beliefs have persisted due to a lack of education and proper enlightenment of smallholder farmers. Whilst laudable policies and programmes are well underway to transform West Africa's agriculture into precision and

climate-smart ones, the same energy and attention have not been channelled into education, sensitisation and awareness of smallholder farmers in rural areas of the region. This poses a serious threat to well-thought-out initiatives to transform agriculture in the region.

9.4 Methodology

The chapter adopted a qualitative case study research design, underpinned by a critical document analysis of secondary sources. The rationale for this was to enable the researchers to sieve rich, relevant data and documents (from irrelevant ones) that are trustworthy and germane to the case study, smallholder farms in West Africa. According to Coleman (2021) and Noble and Smith (2015), qualitative research designs are said to be valid and reliable if the data generated are from trustworthy, dependable, credible and confirmable sources. In light of this, data gathered for this study are mostly from confirmable sources such as United Nations Food and Agriculture Organisation (FAO), United Nations Conference for Trade and Development (UNCTAD), Organisation of Economic Cooperation and Development (OECD), African Development Bank (AfDB), United Nations Development Programme (UNDP), World Bank, National Information Technology Development Agency (NITDA), International Renewable Energy Agency (IRENA), African Energy Portal (AEP), World Food Programme (WFP), amongst others. Data gathered from these prominent institutions and used for analysis were triangulated (i.e. comparing two or more data sources in order to look for patterns of convergence or divergence) so as to help corroborate research findings of the study (Coleman, 2021; Fusch et al., 2018). Furthermore, a content analysis was done on the data obtained from documents in order to search for patterns, regularity and consistency, with a view to arriving at results that are verifiable, generalisable and also transferable.

9.5 Research Findings

9.5.1 Technology, Energy and Transport Inefficiencies in West Africa's Small Farms

West Africa's inefficiencies in the transport and technology-energy mix have been a bane for small farm holders. With its teeming population of about 400 million, which is projected to be about 540 million by 2030 (UNCTAD, 2017), the sub-region has a huge task to address the food needs

of its young population. Coupled with climate change stress, the challenge, however, is how to develop a smart, resilient and transformative agricultural food system, especially among small farm holders, that will cater for the needs of the present population without compromising the ability of future generations within the region to meet their own needs. Thus, inefficiencies within the above-identified infrastructure will run counterproductive, with dire consequences of acute food insecurity for the region.

Table 9.1 Energy access and distribution by African sub-regions as of 2021

African regions	Pop. (millions)	Installed capacity MW	% with access to electricity (national) (%)	% of urban with access (%)	% of rural with access (%)	Population without access to electricity (millions)	People without access to clean energy for cooking (millions)
Central Africa	219.5	5,994	30.1	58.1	4.8	105.1	134.61
West Africa	466.4	25,000	55.6	87.3	26.2	181.20	343.78
East Africa	513.4	17,527	50.9	81.7	38.2	207.21	363.1
North Africa	276.3	112,023	97.8	98.9	96.3	4.6	3.46
South Africa (as a country, not region)	61.4	58,000	85.0	87.9	79.2	8.71	8.13

Source Authors' compilation based on data from Africa Energy Portal (2020), Worldometer (2025)

Table 9.2 Number of undernourished populations in Africa sub regions, 2014–2022 (in millions)

Sub-region	2014	2019	2020	2021	2022
Southern Africa	5.1	5.5	6.4	6.8	7.2
West Africa	37.0	43.8	55.8	60.8	62.8
Central Africa	33.4	44.1	51.0	54.2	57.0
East Africa	91.4	116.9	126.4	131.2	134.6
North Africa	11.8	23.8	28.7	17.6	19.5

Source Authors' compilation and design based on data from FAO (2023)

Table 9.3 Population of food insecure regions in Africa, 2015–2022 (in millions)

Sub-region	2015	2017	2019	2020	2021	2022
North Africa	59.9	78.8	71.2	75.9	86.9	83.4
Southern Africa	13.8	14.3	14.7	16.6	16.8	17.8
West Africa	142.7	174.5	205.7	240.8	279.1	285.1
Central Africa	–	–	–	129.4	143.5	153.7
East Africa	223.5	267.9	277.9	298.8	308.2	327.4

Source Authors' compilation and design based on data from FAO (2021a, 2021b; 2023)

As documented earlier, road transport in West Africa is responsible for about 90–95% of passenger and freight traffic (Graham et al., 2020). The poor state of these roads is one of the major causes of trade barriers, both within and outside the region. It is the reason for the uncompetitive nature of the region's agricultural produce at international markets, because of the high cost of transporting the produce from rural areas to city centres (Ogunleye et al, 2018). According to Ogunleye et al. (2018), in the absence of a good transport system, smallholder farmers will also be unwilling to produce in large quantities, since it is unlikely that their produce will get to the market before it goes bad, especially perishable ones. Hence, they suffer PHFLW. Thus, for the region to be able to feed its teeming population, transportation of farm produce by small farm holders to the urban centres is paramount. In another light, it will provide an avenue through which resource persons in the city centres can commute easily to rural farmers, to share vital and recent innovative information, especially on climate-smart and precision agriculture methodologies for the benefit of small farm holders (Ogunleye et al., 2018).

Table 9.1 reveals the energy situation for West Africa. Although East and Central African regions have grimmer statistics, it also shows that West Africa has the second-highest population of people without access to clean energy. South Africa, as a single country, boasts more installed capacity of electricity compared to all 15 West African countries put together. Inefficiencies in the realm of technology and energy are another daunting challenge to productive agricultural enterprise in the region. Without the solutions provided by technology and renewable energy sources, it will be almost impossible to survive harsh climate conditions in the next decade. Future generations will be unable to meet their nutritional needs, even as the present generation is lacking basic nutrients in their meals as a result of inadequate food production in the region.

From Table 9.2, apart from East Africa, West Africa is the next region that is undernourished, with about 62.8million people in need of good nutrition in 2022. Relatedly, Table 9.3 shows that West Africa is the second most food insecure

regions on the continent with more than half of its population (285.1million) being food insecure in 2022. In terms of environmental uncertainty, West Africa is one of the most vulnerable regions to climate change conditions, as an increase in temperature and inconsistency in rain and weather patterns are already undermining food security, livelihoods, as well as governance and economic stability (USAID, 2018). Without climate-smart agriculture, warming above 2 degrees is likely to stress crops, leading to an 11% decrease in the yields of cereals. The most affected will be maize and rice throughout the inland forest regions (USAID, 2018). This challenge is not likely to be solved through traditional belief systems and patterns applied to agricultural practices by smallholder farmers in the region.

9.5.2 Inefficient Technology, Energy and Transport in West Africa and Post-Harvest Food Loss and Waste in Smallholder Farms

Post-Harvest Food Loss and Waste (PHFLW) are both quantitative and qualitative reductions in food production arising from poor management of agricultural harvest along the food value and supply chain (FAO, 2019). According to World Wildlife Fund-US (2021) and FAO (2011), 40% (more than one-third) of food produced for human consumption is wasted or lost, having undesirable environmental and socio-economic ramifications (Addai, 2021). A report by World Wildlife Fund-UK (2021) notes that global food waste on farms alone amounts to 1.2 billion tonnes annually, and represents 15.3% waste in food production. In Sub-Saharan Africa (SSA), there is an annual food loss of 36%; 12.5% of which occurs at harvest, 12.7% occurs during post-harvest, 4.5% during processing and packaging and 4.6% during distribution (Bamikole et al., 2022). Specifically, African food losses in quantity and caloric value are estimated at 15.9% and 17% respectively, with outright spoilage amounting to 50% of harvested foods (FAO, 2019). PHL can occur at

any stage between the farmer's field at harvest to the consumer's plate (Sheahan & Barrett, 2017). The causes vary, depending on the stage at which it occurs or the supply chain processes or the location and form of storage. Fundamentally, food losses occur when part of the crops are left behind unharvested, attacked by diseases and pests, split or damaged during transportation (Stathers et al., 2020). They could also be lost when there is an inefficient power supply, kept in poor storage facilities, absence of coolant and refrigerating technologies, poor road network and market access.

In West Africa's smallholder farms, food losses are a prevalent occurrence. Huge cereal production losses have been recorded in different West African smallholder farms. For instance, Niger recorded 38% loss in cereal production, Burkina Faso (18%), Ivory Coast (10%), Gambia (9%) respectively (WFP, 2022). In Ghana about 20% of cereals, 30% of legumes, 20% of fruits, 50% of vegetables are lost annually (Agyapong et al, 2022); meanwhile in Senegal, 30% of the total vegetables are lost before they leave the farm gate (Beye & Komarek, 2021). Nigeria loses and wastes about 40% of its total food production annually (World Bank, 2020). Instructively, it is projected that between June and August 2022, 38 million more West Africans will be food insecure, an increase of 22% in comparison to last year (WFP, 2022).

Figure 9.1 shows the various stages in which PHFLW occurs. The *primary stage* which are biological include infestations of pests, insects, diseases and animal attacks; and environmental to include to adverse/extreme weather conditions, like high temperature and humidity; poor/crude storage infrastructure like mud or clay silos, drums, cribs or barns to store agricultural produce like grains, fodder and seeds, instead of using hermetic grain storage bags (FAO, 2019). Although these storage bags are easy to construct and inexpensive to maintain, they are however, not resilient to physical, environmental and biological hazards for a long period (Troger et al., 2020); and processing which includes traditional/natural methodologies, like wind and sun, mashing with bare hands, etc.

The *secondary stage* concerns activities that happen with the movement of agricultural produce from smallholder farmers' gates to markets and consumers. This includes access to road networks, efficient transport systems, proper market information, availability of postharvest infrastructure and services, efficient and effective handling of agricultural produce, and consumer behaviour. The *tertiary stage* focuses on the external factors. This also includes poor/lack of transformative government policies towards agriculture, especially in rural areas where smallholder farmers reside, poor government investment in agricultural infrastructure in rural areas, poor private sector involvement/investments in the agricultural practices of smallholder farms, etc.

Taken together, the magnitude of the primary, secondary and tertiary stages of PHFLW determines the severity of their occurrences in smallholder farms. Some of the key identified causes of the various stages of PHFLW are inefficiencies in technology, energy and transport systems of small farm holders across West Africa. Upon maturity, the proper technology needed for harvesting crops is virtually non-existent in smallholder farms in West Africa. Traditional, crude and manual implements like sticks or bare hands are usually employed with all their attendant clumsiness to harvest agricultural produce. This has led to instant spillage and spoilage of food even before they leave the farm gate. Also, poor energy supply and lack of adequate storage and packaging lead to deterioration and spoilage of crops after harvest. Furthermore, after a clumsy harvest through the use of crude implements, Porter and Reay (2016) observe that smallholder farmers in the region package their produce poorly in sacks, woven baskets made from bamboo sticks, wooden crates and so on.

Armachius and Vumilia (2017) identify poor management and education of smallholder farmers in post-harvest handling of produce as one of the major causes of PHFLW. According to them lack of knowledge of/desire to use improved technologies for harvesting, packaging and storage of harvested produce leads to their loss in quantity and quality. In line with the foregoing, Kok and

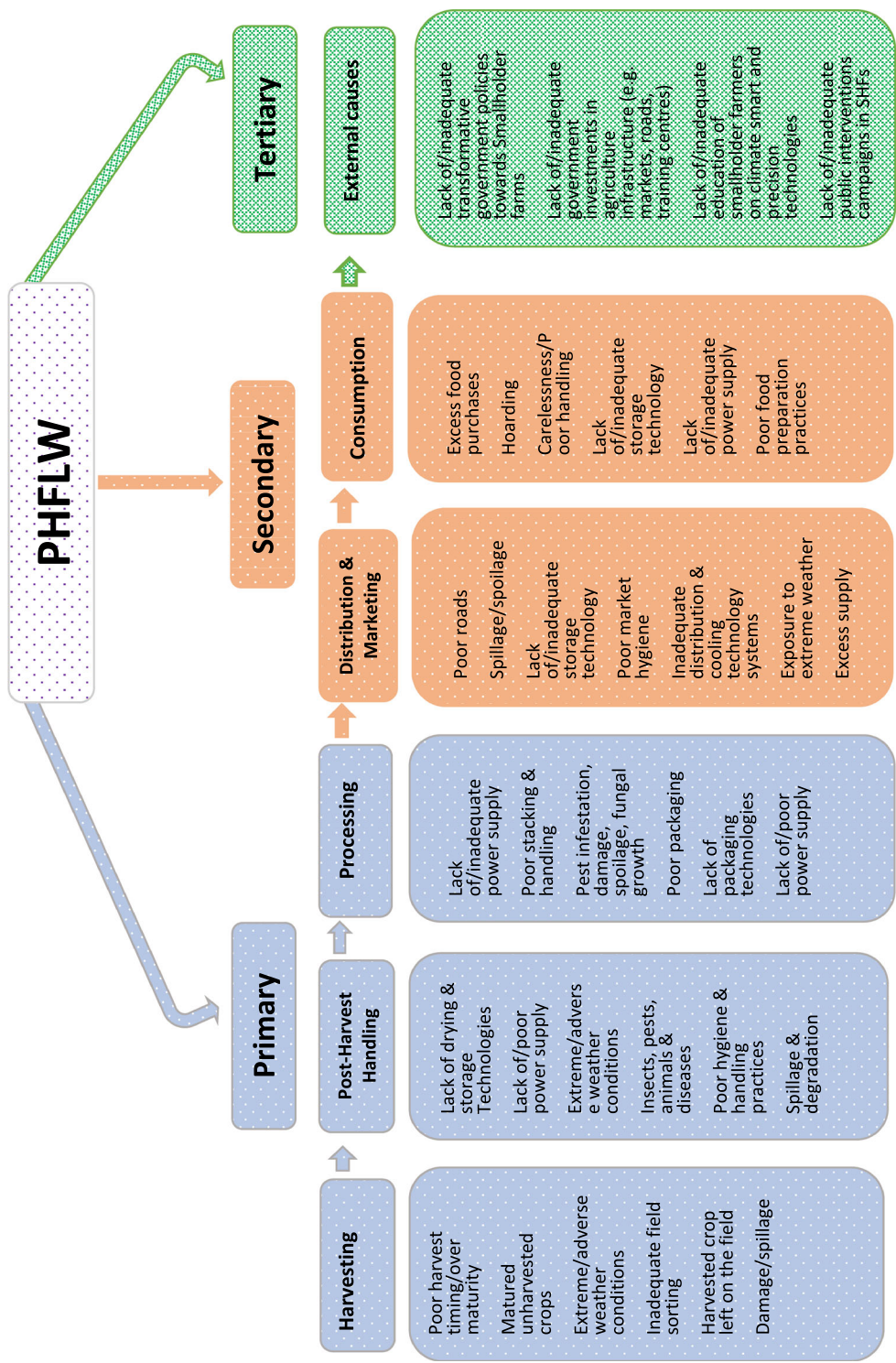


Fig. 9.1 Stages in post-harvest food loss and waste in West Africa's smallholder farms. *Source* Authors' design based on data gleaned from Stathers et al. (2020); Troger et al. (2020); Sheahan and Barrett (2017)

Snel (2019) observe that most food losses and wastages in developed countries usually occur at the secondary level of retailing and consumption (the household). But in developing and underdeveloped countries like West Africa, the major loss and wastage of food occurs at the primary stage due to limited resources and knowledge of smallholder farmers, particularly, their ‘knowledge of causality of problems and potential solutions’ (Castelein et al., 2021, p. 6). Hence, there is a need for transformative agricultural policies involving both government and private sector interventions in rural areas.

Apart from technology, energy and transport inefficiencies, conflicts and crises are also a major cause of PHFLW in West Africa. For instance, in Nigeria, the farmers-herders clashes led to tonnes of food wastes and losses especially in the Northern region of Benue, Adamawa and Kaduna States and some Southern region like in Ekiti, Enugu, Oyo, Ebonyi, Ondo, etc., leading to the passage of anti-grazing laws in most of the States in Nigeria.

9.5.2.1 Socio-economic Impacts of PHFLW

When there is massive food loss and waste, there is a corresponding increase in consumer prices, as fewer products make it to the market, leading to inflation. On the other hand, there will be less profit for smallholder farmers who would have made more in the absence of such losses and wastes. According to FAO (2021a, 2021b), consumers will save more if they employ judicious use of foods at home, as they channel their resources to other household needs. Also, consumers will save more if food loss reduction by suppliers makes food cheaper at both retail and wholesale levels. The current high prices for food in some West African countries can be largely attributed to the PHFLW discussed earlier. Food price increase in countries like Nigeria, Ghana, Benin, Togo, Burkina Faso, Niger and Mali have been attributed to food losses and wastes at various stages of the food supply chain (FAO, 2023). For Nigeria, it was attributed to the high cost of transportation due to a poor road network, which

contributes to the spillage and spoilage of crops in transit.

PHFLW has a heavy focus on the employment status of the sub-region. When there is a reduction in PHFLW, it creates high demand for labour in terms of harvesting, processing, distribution and marketing. Furthermore, its reduction will mean having enough food for the population and for export, which in turn brings in foreign exchange and revenue for the region. Such revenue can be used to finance other national projects or even reinvest in the agricultural sector to guarantee food security and help achieve several of the SDGs, particularly goals 1 (poverty reduction), 2 (fight hunger), 3 (favourable health and wellbeing) and 12(3) (halving PHFLW by 2030). Agriculture appears to be the lifeblood of the region as it employs almost 100 million of its population, as 2 or 3 persons in the region of West Africa are employed under the agriculture food production and supply chain (SWACO/OECD, 2021). This will be seriously hampered if food losses continue unabated. Also, PHFLW leads to increased importation of food by a nation to bridge the shortfall and deficit back home. For instance, between 2016 and 2019, Nigeria’s food importation stood at N3.5trillion, which is four times its food exports (N803billion) for the same period (FAO, 2021b).

Another impact is that it reduces an individual’s access to food whenever and wherever it is needed. This creates and exacerbates hunger, leading to undernourishment and food insecurity. According to FAO (2021a, 2021b), hunger is measured in terms of the prevalence of undernourishment. Table 9.4 reveals the level of undernourishment in various regions of Africa.

Table 9.4 % of severely food insecure regions and world average, 2014–2020

Regions	2014	2019	2020
World average	22.6	26.6	30.4
Africa	47.3	54.2	59.6
West Africa	39.2	54.2	68.3
East Africa	57.7	63.4	65.3
North Africa	29.7	28.9	30.2
Southern Africa	43.8	44.3	49.7

Source FAO (2021a, 2021b)

Specifically, in the absence of comprehensive data for Central Africa, West Africa is the region with the highest percentage of food-insecure population in the world. At 68.3%, West Africa's food insecurity level is more than twice that of the world average (30.4) and slightly higher than the African average (59.6%), respectively, in 2020.

Similarly, Fig. 9.2 shows that West Africa (115.7million) is poised to overtake East Africa (127.9million) as the region with the highest number of undernourished and food-insecure population. PHFLW seriously undermines food availability, accessibility, stability and utility. When this occurs, vast numbers of West Africa's population will continue to face undernourishment and food insecurity, with negative impacts on health and well-being. A well-balanced diet has the potential and capacity to reduce ill-health and diseases on one hand; and on the other, it helps aid recovery from ailments and diseases. The lack of it, therefore, is a negative double-edged sword. This also implies that the sub-region is not contributing meaningfully to helping the world fight hunger by 2030, as clearly stated in SDG 2. The data sets and figures revealed above and below also show that the subregion is not

making its contribution to assist the world and the African region to halve food loss and waste by 2030, as stated in SDG 12 (3), and by 2025, as stated in the Malabo Declaration.

In addition, a study carried out by Alliance for a Green Revolution in Africa (AGRA) identified four food insecurity hotspots out of seventeen countries studied. Three out of the four were found in West Africa: Burkina Faso, Niger and Mali. Some of the major reasons advanced for this were adverse climatic conditions/extreme weather patterns, especially low rainfalls in the region, as well as conflict, political instability and insurgent activities in the region (AGRA, 2021).

9.5.3 Climate-Smart Agriculture (CSA) and Precision Agriculture (PA) as Means of Enhancing Food Security in West Africa's Smallholder Farms

Africa is one of the world's most vulnerable regions to climate change challenges. The last two decades have been hotter than any of the previous

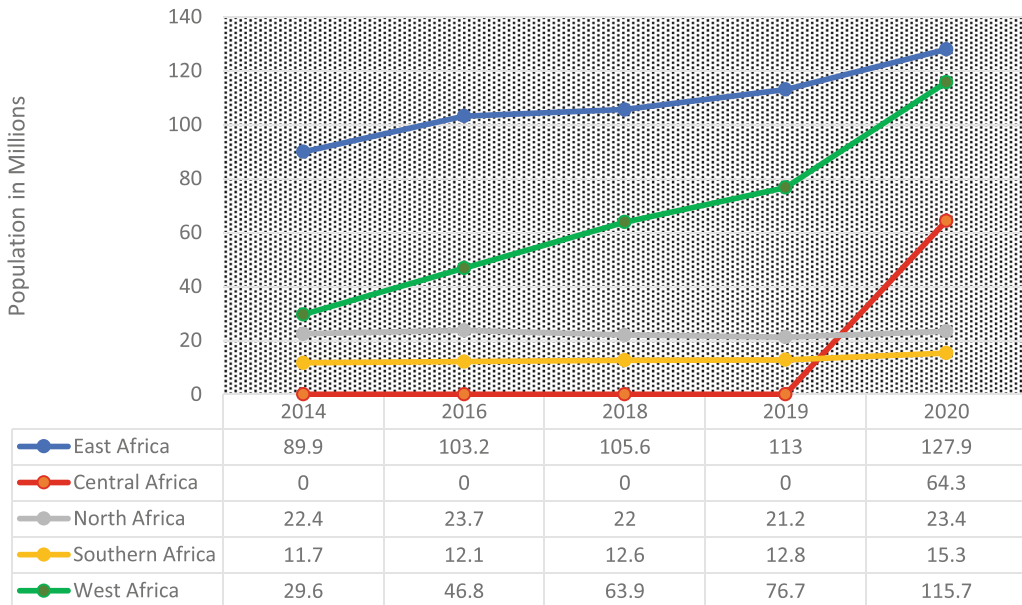


Fig. 9.2 Number of Undernourished People in various African Sub-Regions in Millions. *Source* Authors' design and compilation based on data from FAO, IFAD, UNICEF, WFP and WHO (2021)

years in its history (Fagbemi, 2021). Recently, heavy rainfall has led to flooding and rising sea levels in some West African countries, particularly Nigeria. In contrast, when there are limited rainfalls, it leads to desertification and prolonged dryness, which are not good for crop yields and agricultural productivity. All climatic conditions seriously affect the livelihoods of smallholder farmers who rely heavily on agriculture for sustenance (Ramires-Villegas & Thornton, 2015).

In light of the above, there is a need for adaptation and transformation in the agricultural activities of smallholder farmers to modify production methods in line with current technologies. This will enable them to build resilient and efficient sustainable agricultural practices. To this end, education and awareness creation among smallholder farmers on the adoption of precision and climate-smart agricultural technologies

is, at this point, crucial. The West African region is yet to grasp and understand the myriad of advantages that CSA and PA can provide the region (Oladele, 2021). Desertification, one of the consequences of climate change, has led to the constriction of arable lands used for farming in the region. This is especially the case with countries like Nigeria and Niger in the Lake Chad Basin Area. With this challenge, there is a need to deploy climate-smart techniques to ensure that food production through agriculture goes unhindered. In this regard, hydroponic and aeroponic farming can be adopted. This is a kind of farming by soilless means, with the former being fed more with water-rich nutrients, while the latter is fed with air and moist, rich nutrients. They are very climate-friendly, with healthy crops and robust yields (Bhatnagar, 2021). Below are a few ways

Table 9.5 Ways Climate Smart Agriculture (CSA) and Precision Agriculture (PA) can benefit smallholder farms

Area of need	What can be achieved	Expected results
Hydroponics farming	Small farm holders can conserve soil resources by growing plants through nutrients and water alone, while using available arable soil for other needed agricultural activities	- Faster growth, healthier plants and bigger yields of crops - Growing confidence of small farm holders in technologies offering climate-smart and precision agriculture - Farming without restrictions or borders
Aeroponics farming	Scarce water resources are conserved and used for other areas in the agricultural food system	A sustainable and efficient way of farming that produces incredible outputs
Farm operations	- Precision irrigation ensures efficient use of water and promotes unhindered farming activities all year round - There is also an efficient use of resources in the required quantity as may be needed by crops	- Profitable farming, which will lead to trust and buy-ins by small farm holders in precision agriculture, backed by technology - More investments will also be favoured
Resilience against climate change	- Precision and climate-smart agriculture can help protect crops from adverse climatic hazards caused by climate change. The planting of disease and pest-resistant crops will ensure that crops are protected from biotic stress - Also, the use of renewable energy from plant waste will help boost agricultural production activities at low costs	Through precision and climate-smart agriculture, there will be a drastic reduction of greenhouse gas emissions, while promoting agricultural productivity
The health of plants	Through technological applications used in precision agriculture, smallholder farms will be able to know the right quantity of Nitrogen, Potassium and Phosphorus (NPK) fertilisers needed for their soil and crops, respectively, without guessing, which often leads to waste or poor plant development output of plants	This can help to cut down the use of fertiliser by 30%, thus saving the rest for more productive agricultural endeavours

Source Authors' compilation based on data from Bhatnagar (2021), Olaleye (2021) and UNCTAD (2017)

CSA and PA can enhance food security for the region (Table 9.5).

PA is particularly important as it helps smallholder farmers harvest their crops at the right time to avoid PHFLW. Stathers et al. (2020), in their study of post-harvest loss reduction in Sub-Saharan Africa and South Asia, found that harvested maize cobs with tight husks reduced insect infestations from 20 to 1%, compared to those with open husks. Similarly, the World Food Program (2022) study on value chain processes in Burkina Faso and Uganda noted the importance of moisture at the harvesting stage of maize. According to the study, after maize reaches physiological maturity, it is vulnerable to attacks by pests (WFP, 2022). This implies that harvest must be done at the right time when the maturity moisture content is between 23 to 28%. This is clearly where the need for PA comes in. Technologies that ensure such certainty during the harvest of maize must be deployed to reduce infestation and to protect the harvest. This will reduce PHFLW, boost productivity and increase the income and profits of small farm holders.

No doubt, a growing world population, projected to reach 9 billion by 2050, and a rapidly changing diet are steadily driving up demand for food (World Bank, 2021a, 2021b). The world needs to produce 70% more to feed its teeming population (World Bank, 2020). And for West Africa, it is to plan for the feeding of about 540 million people by 2030. With the growing vulnerability of agriculture and farming to climatic conditions, the only viable answer to this existential challenge of the peoples of the region is the adoption of STIs that have provided CSA and PA technologies. Its adoption, as stated in Table 9.3, will lead to improved productivity to produce more nutritious foods, boost incomes and raise the living standards of small farm holders (World Bank, 2021a, 2021b). According to the President of AfDB, Akinwumi Adesina, the agricultural sector will become a \$1 trillion industry by 2030 (AfDB, 2016). Consequently, only farmers who have adopted various technological innovations in their farming practices will likely benefit in both the short and long terms. Again, the above shows that CSA and PA will enhance the resilience of

agricultural produce to climate-related shocks and risks, pests, and diseases; improved capacities for crops to grow in spite of erratic weather patterns and conditions. CSA will also help reduce emission of carbons for each kilo and calorie of food produced by identifying how to absorb carbon out of the atmosphere, and to avoid deforestation all together (World Bank, 2021a, 2021b). Beyond the above benefits of CSA and PA, they are also agents of transformative agricultural practices that are not only resilient, but sustainable.

9.6 Conclusion and Recommendations

The chapter focused on the inefficiencies of technology, energy and transport in West African smallholder farms, with implications for socioeconomic development and food security. The study advocated the use of a technology-energy mix to improve the agricultural production of farmers in rural areas in West Africa. More importantly, it stressed the need for a good road network and transport systems in the region, as it helps to aid unfettered distribution and marketing of agricultural produce of smallholder farmers in West Africa. In order to reduce PHFLW, the study noted that PA technologies can be a very innovative and invaluable aid to small farm holders, because they help them quantify and be precise with planting and harvesting, in ways that conserve resources and boost efficiency.

Given the foregoing, it is quite clear that for West Africa to surmount the grim statistics of food insecurity and not overtake or join East and Central Africa in their agricultural inefficiencies, the leaders of the region must improve budgetary allocation and spending to the agriculture sector, particularly to smallholder farms.

Although there are ongoing efforts by West African governments to scale up road, power and internet infrastructure in the region, as noted earlier in the study, they must, however, be conscientious and intentional in their policies in this regard, especially with implementation. They must also ensure that smallholder farmers see the need to use these infrastructures to their benefit

when completed. To this end, proper awareness campaigns must be carried out in rural areas to educate and sensitise them on how to benefit from these infrastructures, because, in the long run, the region will reap its fruits of having sustainable and resilient food production that will generate foreign exchange and revenues.

Notably, for the transformation of the current food production architecture in West Africa to be achieved, there should be a conscientization of smallholder farmers towards embracing climate-smart and precision agriculture. Most of them see the adoption of new technologies as too risky a venture, because they have not been tried and tested. Confidence-building measures must be promoted amongst them, so that they can believe and have faith in scientific technology, just like they have with local technology. This is so because, among the three spheres of transformation as espoused by O'Brien and Sygna (2013), the personal and individual level is where West Africa leaders need to do more, especially by consistent engagements with rural based smallholder farmers so they can understand and appreciate the wide range of benefits inherent in climate smart and precision agriculture. When they (smallholder farms) adapt, this will no doubt ensure food security and improve the socio-economic development and wellbeing of the people of West Africa. More importantly, there will be a drastic reduction in PHFLW that have characterised small farm holders of the regions for decades, which have ingloriously tarnished their agricultural practices with the infamous phrase- from harvest to dustbin.

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Food Imports and the Growing Debt Burden in Sub-Saharan Africa

10

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10.1 Introduction

Sub-Saharan Africa (SSA) is currently facing an increasing food import crisis that has become a serious concern for the economic sustainability of the region. Agriculture remains the backbone of the economies of the majority of African countries (Ndhlovu, 2025a). However, the increasing dependence on food imports is putting pressure not only on economic resources but also on food security (Grafton et al., 2022; Tafirei & Chitiga-Mabugu, 2021). In the last decades, food importation has rapidly risen in the region, contributing to an already poor economic base. The growing demand for food has been predominantly satisfied through such imports, which have inundated local production since local food supply cannot keep up with population growth and changes in consumption patterns (United Nations Economic Commission for Africa, 2023). Moreover, the

farm sector has faced various challenges like inferior infrastructure, antiquated farming methods and the adverse effects of climate change, all of which are to blame for the foreign food dependence in the region (Akinboade & Khamfula, 2020; Njeru, 2021). This chapter considers the relationship between food importation and rising debt burden in SSA, with a focus on the impact of these imports on the region's food system, its economic sustainability and the challenges arising from rising reliance on foreign food.

Concerning addressing the problem of food imports, it is evident that a convergence of domestic policy mishaps, global market determinants and absence of adopting right agricultural solutions has put countries into a spot where food safety is increasingly imperilled by reliance on imports (Chirwa & Kalula, 2020; Ochieng & Karingi, 2022). Misallocation of resources, for instance, paying more attention to export crops than food crops, has also hindered the growth of sustainable local food systems (Sulemana et al., 2022). At the same time, global food markets are becoming increasingly volatile, with staple food prices being pushed up and down by international trade relations and geopolitics (Juma et al., 2021). This increasing dependence on imports not only wiped out the domestic agricultural sector but also made many countries in SSA vulnerable to external shocks, further complicating their economic stability and contributing to the debt burden (Kombe et al., 2023). The deepening food trade deficit is a primary driver of a swelling

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fiscal imbalance, making it even more difficult for nations in the region to settle their financial obligations while food insecurity keeps rising.

Food import issues in SSA go beyond economic factors to affect social and political forces as well. Because agriculture is the principal source of livelihood for millions of people in the region, the reduction in domestic food production has had far-reaching effects on rural communities, labour and livelihoods in general (Osakwe, 2022). For this, the majority of the countries have turned towards food aid and emergency response channels, but these short-term solutions do not solve the root structural issues undermining food security in the region (Davis & Woodhouse, 2023; Haider & Raza, 2021). Long-term policy reforms are required to improve local agricultural productivity and reduce the rising reliance on food imports (Ndhlovu, 2025b). These policy reforms would have to be subjected to rigorous analysis of the key determinants of the region's food imports, including agricultural investments, trade policies, and the external pressures that affect the food systems in the region (Gauthier & Naidoo, 2022; Teshome et al., 2023). This chapter provides a detailed analysis of these issues and attempts to define the intricate relationship between food imports, debt burdens, and food insecurity in SSA.

The impact of food imports on SSA economies is inexorably connected to the overall economic challenges of the continent. The dependency on imported food has risen in step with the growing debt burden, which is an emerging problem for policymakers (Chikanda & Chisadza, 2021). SSA's food trade deficit has increased dramatically over the last few decades due primarily to lowered agricultural productivity, the effects of climate change, and unsustainable farming production (Hove et al., 2020). The subsequent imports of food have a tremendous impact on national resources, as several countries use most of their foreign exchange reserves to finance the demand for food products. This further aggravates the debt burden as governments need to borrow more to finance food imports, resulting in a vicious cycle of increasing debt and increasing dependence on

foreign food sources (Graham & Lee, 2022; Ojo et al., 2023).

SSA is also struggling with poor institutional frameworks, which further complicates the mitigation of food insecurity and increasing import dependence (Ndhlovu, 2025c). Poor farm policies that focus on food security and domestic production have resulted in poor farm planning, poor investment in rural areas and poor infrastructure, which in turn deters local production (Nabena & Ogbu, 2020). The nations in the region have, in some instances, embraced policies that prioritise cash crops and exports compared to food production, leaving the region vulnerable to food price fluctuations from the global market (Mavhura & Topp, 2021). With such policy failures being a causative factor of growing reliance on imported food, the effects are not only at an economic level but also social, as millions across the region are food insecure (Gyaase & Obeng, 2022; Sikiru et al., 2023).

The growing debt burden resulting from food imports presents an enormous challenge to SSA's long-term economic growth. With more reliance on food imports to maintain the needs of their populations, their external debt rises, subjecting them to higher risks of external financial shocks. This subsequently exacerbates food insecurity as governments are unable to finance both their external debt and the food needs of their populations (Nkosi et al., 2021; Sibanda et al., 2023). The indebtedness in most African nations has become unsustainable, with debt-to-GDP levels rising sharply over the past decade (Mwamba et al., 2020; Tella & Bankole, 2022). Considering that they have very limited budgetary space, the governments cannot spend enough on farm innovation, rural infrastructure and food systems, which are pivotal for reducing dependency on food imports and sustainably maintaining food security (Siringi & Kamau, 2022; Zinyemba et al., 2021). The problem has been exacerbated by the COVID-19 pandemic, which has disrupted global supply chains and aggravated the already precarious food security situation in the region (Juma et al., 2021; Lwenya et al., 2022).

The growing reliance on food imports and mounting debt burden in SSA have emerged as

major impediments to the economic and food security stability of the region. The persistent gap between local food availability and demand has resulted in a growing dependence on imported food, which, together with unsuitable farm policies, adverse infrastructure and failure to invest in the domestic food systems, explains the food insecurity in the area (Chikanda & Chisadza, 2021; Gyaase & Obeng, 2022). As the cost of imported food continues to rise, it has become challenging for governments to balance the books, and this leads to rising debt levels and limited capacity to invest in long-term food security solutions (Graham & Lee, 2022; Haider & Raza, 2021). This has contributed to underlying weaknesses in the economies of SSA countries, and this undermines the potential to achieve sustainable development and satisfy the basic needs of its citizens.

In contributing to ongoing theorisations on SSA food systems and agriculture, this chapter problematises regional food imports and the growing debt burden. The chapter (i) explore the key drivers of SSA's growing reliance on food imports and its impact on the food security and economic well-being of the region, (ii) identifies the link between food imports and the rising debt burden in SSA and (iii) provides policy interventions that can reduce food import dependence, enhance local food production and alleviate the debt burden in the region. The chapter departs from conventional tendencies of recommending infrastructural development and technology adoption in addressing SSA food system challenges, and focuses on policy and practical solutions. As a result, the chapter is useful for policy-makers, politicians and food system actors, particularly retailers.

The chapter is organised as follows: The following section provides a review of related literature. This is followed by an outline of the theoretical framework for the study and the methodology, respectively. Thereafter, the findings are presented, followed by their discussion. Lastly, policy recommendations and conclusions are drawn from the findings and discussion.

10.2 Literature Review

The increasing reliance on food imports in SSA has become a defining characteristic of the region's food systems, contributing significantly to fiscal pressures and exacerbating national debt burdens. Across the region, local agricultural production has not kept pace with population growth, urbanisation and shifting dietary patterns, resulting in a widening food trade deficit (Akinboade et al., 2020; Teshome et al., 2023). While global food systems have become more interconnected, SSA's heavy dependence on external food sources has made it highly vulnerable to global market shocks (Ndhlovu & Mhlanga, 2024). Between 2000 and 2020, food import bills for countries like Nigeria, Angola and Ghana increased more than fourfold, while local production remained stagnant or declined in some sectors (FAO, 2021; Grafton et al., 2022; UNECA, 2023). This imbalance has led to growing current account deficits, forcing governments to resort to borrowing, often in foreign currency, to finance basic consumption, including food imports.

The structural drivers of food import dependency are both internal and external (Mhlanga & Ndhlovu, 2024). Domestically, agricultural underinvestment, policy inconsistencies and land governance challenges have led to declining productivity and poor rural infrastructure (Njeru, 2021; Chirwa & Kalula, 2020). In many countries, agricultural policies have historically prioritised export crops such as tobacco, tea and cocoa, mainly to earn foreign exchange, at the expense of food crops needed for domestic consumption (Osakwe, 2022; Sulemana et al., 2022). At the same time, large-scale land acquisitions by foreign investors, often for speculative or non-food crop production, have reduced the area available for local food cultivation (Haider & Raza, 2021; Tafirei & Chitiga-Mabugu, 2021). Externally, global food price volatility and supply chain disruptions—particularly during the COVID-19 pandemic and recent geopolitical conflicts—have pushed up the cost of food imports and increased debt service obligations (Juma et al., 2021; Lwenya et al., 2022; Tella & Bankole, 2022). These dynamics have created a situation where

food insecurity and indebtedness are mutually reinforcing.

Debt sustainability has emerged as a central policy challenge in SSA, as the cost of servicing debt increasingly competes with expenditures on food security, social welfare and agricultural investment. The International Monetary Fund (2023) reports that over 22 countries in the region are either in or at high risk of debt distress, with food imports accounting for a growing share of external borrowing. This phenomenon is particularly pronounced in countries like Sudan, Zambia and Ethiopia, where climate-induced shocks, conflict and weak export performance have further eroded national resilience (Gauthier & Naidoo, 2022; Kombe et al., 2023). Food aid and short-term relief mechanisms have emerged as temporary buffers, but they are not sufficient to reverse the structural imbalances (Ndhlovu, 2024). Instead, scholars advocate for a shift towards long-term resilience strategies, including investment in agroecology, regional trade integration and food systems reform to reduce external dependency (Nkosi et al., 2021; Sibanda et al., 2023; Zinyemba et al., 2021).

Furthermore, the literature highlights significant intra-regional disparities in food import dependency and debt exposure. Countries with relatively diversified economies and stronger institutional frameworks, such as Kenya and Rwanda, have made more progress in promoting food self-sufficiency through domestic value chain development and regional trade (Gyaase & Obeng, 2022; Siringi & Kamau, 2022). Conversely, fragile states like the Central African Republic, South Sudan and Somalia remain heavily reliant on food imports and humanitarian assistance, with little fiscal space to invest in domestic agriculture (Ellis & Shaw, 2015; Hove et al., 2020). Regional efforts, including the African Continental Free Trade Area (AfCFTA) and the Comprehensive Africa Agriculture Development Programme (CAADP), have shown potential but require stronger political commitment, coordination, and resource mobilisation to make an impact (AU-NEPAD, 2022; UNECA, 2023). Collectively, the literature affirms that the challenge is not simply a supply

issue but one rooted in political economy, institutional capacity and historical policy choices that have side-lined the food sovereignty agenda.

10.3 Theoretical Framework

10.3.1 Food Regime Theory

Food Regime Theory, which is grounded in political economy and developed by Friedmann & McMichael (1989), provides a critical theory to study the structural and geopolitical dimensions of food import dependency and debt in SSA. The theory contends that regimes of global food are dominated by regimes of stable phases of food production and circulation headed by hegemonic states and multinational corporations that shape world trade, foreign investment flows, and agricultural policy in the periphery (Patel, 2013). In this context, SSA is viewed as belonging to a peripheral food regime, which is defined by its subordination to international food markets and its position as both a consumer of processed food and a producer of raw agricultural products for export.

Food Regime Theory describes how trade liberalisation policies, often triggered by international finance institutions such as the IMF and the World Bank during the 1980s and 1990s, undermined food sovereignty in many African countries (Davis & Woodhouse, 2023; Teshome et al., 2023). By encouraging the abolition of subsidies, reduction of tariffs on protection and privatisation of agricultural services, these reforms offered less room for domestic farmers to contend with subsidised imports from the Global North. The resulting flow of imported staples such as maize, wheat and rice has reordered the food diet, replaced domestic food production and created new dependence, which is financed through foreign loans (Kombe et al., 2023; Sulemana et al., 2022). This is not a natural process but is ordained within global food regimes, where making a profit and increasing markets are more important than local food security.

Additionally, the theory points out how large land transactions and agribusiness-driven development approaches have further commercialised African agriculture, diminishing its ability to feed the local population (Haider & Raza, 2021; Tafirei & Chitiga-Mabugu, 2021). Such developments have created what is referred to as ‘agrarian questions of food sovereignty’, where people are losing control over land, seeds, and production choices. In this instance, debt is not only an economic outcome but also a process through which authority over national food systems is outsourced and made subordinate to global capital (Patel, 2013; Gauthier & Naidoo, 2022). Food Regime Theory, therefore, provides a critical framework for analysing the systemic origins of Africa’s import dependence on food and its relation to fiscal and policy vulnerability.

10.3.2 Dependency Theory

Dependency Theory, originally held by analysts such as Andre Gunder Frank and Samir Amin, offers a different explanation of how SSA’s reliance on foreign food contributes to its structural economic subordination and risk of debt (Amin, 1976). Dependency theory argues that the global economic order is hierarchically structured, and ‘core’ (industrialised) countries capture resources and surplus from ‘peripheral’ (developing) countries. In terms of debt and food, this manifests as the continuous exportation of raw commodities by African countries, generally at reduced prices, against the importation of more costly food items, technology and services by industrialised nations (Ojo et al., 2023; Tella & Bankole, 2022).

Dependency Theory is used to explain how African economies, fuelled by colonial pasts and post-independence foreign aid relations, have failed to industrialise and diversify and thus are always reliant on foreign inputs to meet basic needs (Nabena & Ogbu, 2020; Zinyemba et al., 2021). Food importation is thus a physical indication of the same. With declining export revenues accompanied by volatility in commodity prices, countries are forced to borrow so that they can

pay for imports, generating balance of payment crises and incurring external debt (Gauthier & Naidoo, 2022; Mwamba et al., 2020). The cycle of dependence on borrowing to import and exporting to repay traps SSA economies in what Amin (1976) referred to as a ‘dependent development’, with externally determined progress and elusive sustainability.

Recent studies using Dependency Theory to understand the food and debt crisis in Africa attribute the role of donor-imposed policy conditionalities, bilateral trade agreements and agribusiness oligopolies in perpetuating the dynamic (Gyaase & Obeng, 2022; Lwenya et al., 2022). Even well-intentioned interventions such as food aid have perverse effects by deterring local production and fostering aid dependence (Chikanda & Chisadza, 2021; Siringi & Kamau, 2022). By its revelation of uneven power structures behind global food and financial relationships, Dependency Theory offers a mechanism for examining more deeply the ongoing food import dependency and how regional integration, agro-industrial policy and food sovereignty movements can counter it.

10.4 Materials and Methods

This study adopted a qualitative research design to explore the intricate relationship between food imports, food security and the debt burden in SSA. A qualitative approach was particularly appropriate for unpacking complex socio-economic phenomena such as trade dependency, policy gaps and structural debt vulnerabilities (Creswell & Poth, 2017). It enabled the authors to capture in-depth perceptions, lived experiences and expert opinions from stakeholders across the region’s agricultural, financial and policy landscapes.

The research design was exploratory and interpretive, rooted in the constructivist paradigm, which assumed that reality was socially constructed and that diverse perspectives shaped the understanding of food systems, import dependence and foreign debt (Lincoln & Guba, 1985). The aim was to interpret the subjective meanings and experiences surrounding the region’s growing

reliance on imported food, its consequences for economic well-being, and opportunities for sustainable policy reform.

To collect data, the study utilised document analysis. Data were analysed using thematic analysis.

10.5 Findings

This section summarises the findings of the study based on a systematic review of peer-reviewed literature, policy reports and institutional reports on food systems, agricultural investment, trade trends and debt management in SSA. The findings are grouped in relation to the objectives of the study and supported by descriptive interpretation. Since this study is qualitative in scope, significance is placed on emergent themes, interpretive accounts and policy discourses, rather than numerical analysis. Tables are used to condense insights, establish linkages and highlight policy contradictions identified throughout the literature.

10.5.1 External Control of Farm Land and Patterns of Export-Oriented Production

Literature firmly supports the argument that among the critical determinants of SSA’s food deficits and importation are rising foreign control over agro-lands (See Table 10.1). Foreign

investment in agriculture frequently has been towards export-oriented value-added crops, such as cut flowers, tobacco, cotton and export crops such as biofuels of jatropha, opening scant room for growing food crops at home. Countries such as Ethiopia, Mozambique, Tanzania and Sudan have seen massive land acquisitions where governments contracted out millions of hectares to China, India and Gulf States investors (Ndhlovu, 2024; Cotula, 2012; De Schutter, 2011).

These investments, though at times described as ‘developmental’, are most frequently speculative or for global market needs. Frequently, local farmers were displaced without appropriate compensation, jeopardising rural livelihoods and food sovereignty (Borras et al., 2011). State planning has also had a bias toward prioritising foreign exchange gains rather than nutritional needs, resulting in misplaced agricultural priorities. This has resulted in a paradox that exists where fertile regions of agriculture cannot sustain humans and instead rely on massive food imports (FAO, 2021; Moseley, 2017).

10.5.2 Link Between Food Import Dependency and Rising Public Debt

The study unveiled a strong story that links rising food import bills to rising debt burden in SSA. The majority of countries are stuck in a vicious trap where weak local production compels

Table 10.1 Summary of land deals and their impact on local food systems

Country	Land leased (Hectares)	Main crops	Investor origin	Effect on local food production
Ethiopia	3.6 million	Jatropha, Sugar	India, Saudi Arabia	Displacement of farmers, decline in maize/rice
Mozambique	2.1 million	Biofuels, Soybean	China, EU	Reduction in subsistence farming
Tanzania	1.7 million	Sugar, Biofuels	UK, Norway	Loss of community farmland
Sudan	3.0 million	Wheat (export)	UAE, Jordan	Export of food amidst local hunger

Source (Cotula, 2012; De Schutter, 2011)

Table 10.2 Selected countries with high food import bills and rising debt levels

Country	Food import bill (USD, 2022)	External debt (% of GDP)	Comments
Nigeria	\$10.3 billion	38%	Imports wheat and rice despite the vast land
Kenya	\$5.6 billion	70%	Borrowed to fund grain imports in 2022
Ghana	\$4.1 billion	84%	Heavily indebted, food prices rising
Zambia	\$2.8 billion	91%	IMF bailout amidst import dependency

Source (Gallagher & Kozul-Wright, 2021; Headey & Fan, 2010)

them to import food, and this is subsidised by borrowing, primarily foreign currency. Countries like Nigeria, Kenya, Ghana and Zambia spend billions of dollars annually importing staple grains like rice, wheat and maize (IMF, 2021). As these imports increase, so does the foreign exchange reserve pressure, leading to balance of payment deficits and ultimately external debt build-up. (See Table 10.2).

As Bhorat and Tyson (2020) and Tyson (2022) observe, countries that continuously import food due to inadequate supply at home are more likely to use short-term external debt in the form of Eurobonds, concessionary loans, or multilateral credit facilities. The literature warns that such borrowing is not sustainable, particularly when used for consumables like food over productive investment. In the long run, this debt increases fiscal risk and limits the capacity of the state to invest in agriculture, education or health-care.

These statistics highlight the fiscal vulnerability associated with external food dependency. The literature further emphasises that austerity conditions imposed by debt restructuring (e.g. via IMF conditionalities) often reduce

public spending on agriculture, creating a self-reinforcing trap (Gallagher & Kozul-Wright, 2021; Headey & Fan, 2010).

10.5.3 The Role of Food Aid and Emergency Relief in Reinforcing Dependency

The third fundamental finding is the increasing normalisation of emergency response and food assistance tools as policy interventions. While humanitarian food aid is inevitable in times of emergencies, such as drought or civil war, it has become a regular response instrument in the majority of countries rather than a last resort. Table 10.3 shows countries with chronic food aid dependence syndrome. Ndhlovu & Mhlanga (2024) argue that chronically relying on food aid misallocates resources from domestic markets, reduces prices for domestic producers and discourages investment in national food systems.

In South Sudan, Ethiopia and the majority of the Sahel, food aid has replaced state distribution or procurement mechanisms, and UN agencies and international NGOs now play a leadership

Table 10.3 Countries with chronic food aid dependence and policy consequences

Country	% Population receiving food aid	Policy consequences
South Sudan	62%	Collapse of local markets, aid dependency
Ethiopia	38%	Weak public procurement, loss of sovereignty
Somalia	44%	Emergency-focused planning dominates budgeting
Chad	35%	Donor-driven agriculture policy frameworks

Source Ndhlovu & Mhlanga (2024)

role. This has contributed to weakening local institutions, with countries not being able to respond autonomously to food shocks (Devereux, 2009; Patel, 2013).

Furthermore, the literature also points out donor pressure on agricultural policy, with aid being made conditional on market liberalisation and the elimination of agricultural subsidies (Mkandawire & Soludo, 1999; Moseley, 2017). This has further eroded local food production and neglected smallholder farmers.

10.5.4 Toward Sustainable and Sovereign Policy Interventions

The last of the above-mentioned subjects discussed in the studied literature is a call for structural, lasting changes that will reduce dependence on food imports and lower the debt burden simultaneously. The research and organisations such as the African Union (2021), emphasise agricultural revival, intraregional food exchange and agro-industrialisation as possibilities (see Table 10.4).

Investment in rural infrastructure, irrigation, research and development, and input subsidies for smallholders were found to be more effective than imports or aid in ensuring food security (Headey & Fan, 2010). In addition, enhancement of intra-African food trade under the AfCFTA umbrella could go a long way towards decoupling reliance on external markets while creating a regional buffer to cushion global price shocks (AU, 2022).

Table 10.4 Recommended interventions to break the import-debt cycle

Intervention	Expected impact
Local agro-processing	Reduce post-harvest losses, increase value addition
Smallholder support (inputs & credit)	Increase food production, rural income
Regional food trade (AfCFTA)	Stabilise supply chains, reduce import dependency
Debt restructuring tied to agriculture	Link relief to investment in local production

Source African Union (2021)

In summary, the study's findings demonstrate that SSA's food import dependency and debt challenges are intricately linked, rooted in structural inequalities in land ownership, weak agricultural systems, and international economic pressures. Emergency responses, although necessary, have become normalised at the expense of strategic, long-term planning. Addressing these problems requires not only national-level reforms but also coordinated regional and international policy shifts that prioritise food sovereignty and fiscal sustainability.

10.6 Discussion

The findings of this study illustrate a profoundly rooted structural issue facing SSA in terms of food security, trade deficits, and debt accumulation. Several researchers state that food import reliance of the region is a sign of historical under-attention to regional agroecological systems due to partially neoliberal economic policy and global investment flows directed towards export-led agriculture and away from food sovereignty (Patel, 2013; De Schutter, 2011; Borras et al., 2011). This orientation not only disenfranchised regional production but also increased Africa's vulnerability to international price shocks and climatically induced disruption (FAO, 2021). The continuous trend of renting large tracts of land to external actors for speculative and non-food crops is what different authors have described as a new colonial extraction phenomenon (Cotula, 2012).

The literature further indicates that the food import dependence of the region is directly related to the deteriorating debt profile in most Sub-Saharan nations. According to Tyson (2022), Bhorat et al. (2020) and the IMF (2021), food imports are usually funded by external borrowing because local production systems have been chronically underperforming, and export competitiveness has been eroding continuously. These borrowings, tententiously embraced with negative conditions, are exposing national budgets to exchange rate volatility and external shocks, and hence overloading fiscal space. Gallagher and Kozul-Wright (2021) strongly believe that

such borrowing, employed in the financing of consumption imports like food at the expense of investments, is fiscally unsustainable and might produce periodic debt crises. This is in line with the argument of Headey and Fan (2010), who argue that African public investment in agriculture continues to be inadequate relative to international standards, at times below 5% of national budgets, despite commitments under the Maputo and Malabo Declarations.

One of the most important observations from the literature considered is the past overreliance on emergency relief and food aid as normal policy tools rather than temporary humanitarian interventions. This observation is consistent with the cautions by Barrett and Maxwell (2005), and Devereux (2009) that long-term food aid can weaken local institutional capacities, distort markets and repress domestic production. In countries like Ethiopia and South Sudan, according to Patel (2013) and Moseley (2017), not only have aid interventions been the preponderance in food supply chains, but public sector actors have also been excluded, and local governments are now dependent on international NGOs and donor agendas. The shift from state-controlled procurement and storage policies has, in several nations, weakened institutions such as buffer stock schemes and food security planning, reinforcing reliance on unstable world markets.

Moreover, the failure to integrate food import reduction strategies into broader macroeconomic and industrial policies continues to erode regional resilience. According to some researchers, food security must be treated not only as an agricultural or humanitarian issue but also as a core economic development question (AU, 2021). Agro-industrialisation, food trade within and between regions in Africa, and investments in transport infrastructure are powerful levers capable of increasing competitiveness, reducing post-harvest loss and stabilising national food availability, as claimed by the OECD-FAO (2021). Mkandawire and Soludo (1999) and Moseley (2017) argue for rethinking African farm policy, transcending export-led expansion and towards resilience, equity-based, and smallholder-driven approaches that prioritise nutrition. This would

require deliberate protection of domestic markets, selective subsidies and the restoration of farm extension services.

Finally, the study confirms the multifaceted character of Africa's food import dilemma and its interconnectedness with land management, trade policy, institutional capability and fiscal management. It also substantiates the perception that until food systems are rendered structurally independent, Africa will continue to be a net food importer and a net creditor, trapped in dependency and vulnerability cycles. Therefore, solutions must be multifaceted and based on sovereignty, sustainability and structural change.

10.7 Policy Recommendations

10.7.1 Reclaim Agricultural Sovereignty Through Land Governance Reform

The most basic recommendation and the first is that governments in SSA must reclaim agricultural sovereignty by reforming land governance institutions. This involves revisiting the prevailing land tenure systems that have, over time, allowed the spread of large-scale land acquisition by foreign investors, popularly known as 'land grabs', that are most frequently driven by profit-making at the expense of local food security. Such land deals, which promote the cultivation of biofuels or export cash crops, marginalise domestic food production and jeopardise the continent's long-term food sovereignty. Governments must prioritise the safeguarding of communal and indigenous land rights, particularly in rural areas where traditional farming communities are most vulnerable to displacement. Land governance reform should also include stringent regulatory mechanisms for scrutinising the purpose and impact of land-based investments in an attempt to ensure that land leases and purchases serve the strategic interest of national food systems. Transparent mapping of land ownership, establishment of national land banks with priority for food production, and community-led participatory land use planning should be adopted as

inherent reforms to regain control over cultivable land and promote its productive use for food crops.

10.7.2 Reprioritise Public Investment in Food Systems

Reversing food import dependence also requires a major shift in the priorities of public investments. In the past, the farming sector in SSA has been chronically underinvested, despite being the cornerstone of livelihoods and national economies. This must be reversed by governments allocating a significant proportion of national budgets to transforming food systems in a way that works for smallholder farmers, who produce the majority of food across the region but are the most marginalised. Public investment must focus on building resilient agricultural infrastructure, including the establishment of irrigation facilities to reduce reliance on rain, mechanisation programmes to boost productivity and rural road construction to ease access to markets. No less important is assistance for robust seed systems, access to affordable inputs, and post-harvest facilities to limit losses and stabilise food availability. The investment by the public must also be inclusive and target youth and women who form a large percentage of the agricultural labour force. Programmes that increase access to land, finance, and extension services for these groups, based on their needs, can stimulate local food production and render agriculture a viable livelihood, thus rendering food importation unattractive.

10.7.3 Scale up Agro-Industrialisation and Value Addition

To reduce over-reliance on imported foods, SSA governments must go beyond raw production and speed up agro-industrialisation. Today, most governments export unprocessed agricultural products while, simultaneously, importing processed foods—a wasteful and unsustainable setup that loses foreign exchange and

undermines local food processing industries. Through the development of agro-industrial capacities, governments can reduce post-harvest losses, enhance the value addition of agriculture and create jobs, especially for the youth. Investments in food factory processing, cold chain logistics, rural agro-industrial parks and digital platforms for food traceability can be utilised to develop integrated food supply chains with a focus on domestic and regional markets. Food value chain prioritisation also improves food quality and safety, price stability, and reduces the importation of food products that are potentially locally produced and processed. Agro-industrialisation must be incorporated into national development strategies, with incentives for private sector investment, including tax rebates, concessional loans and public–private partnerships (PPPs). This change will foster food system resilience, diversify economies and enable countries to compete better in regional as well as international markets.

10.7.4 Strengthen Regional Food Trade Under AfCFTA

A strategic reduction in dependence on food imports also relies on increasing intra-African food trade through the African Continental Free Trade Area (AfCFTA). The region must shift from country-specific, fragmented food strategies to a single continental strategy that takes advantage of regional comparative advantages. For instance, countries with agricultural surpluses can supply those with deficits, rendering continental imports less needed. Making this vision a reality entails investing in cross-border infrastructure such as railways, warehouses, and trade corridors, and harmonising food safety standards and customs procedures. Digital platforms for food commodity exchange and early warning systems for food insecurity can also be leveraged to simplify regional food flows. Governments should enable AfCFTA to work by removing non-tariff barriers, harmonising cross-border regulations and establishing joint border committees to manage and facilitate food trade. In this way, Africa can create a robust internal food market that deepens regional

integration, stabilises food availability, and lowers dependence on volatile global markets, as well as increasing intra-African solidarity and economic resilience.

10.7.5 Restructure Public Debt with Conditionality for Agricultural Development

Finally, SSA governments need to include agricultural development goals in public debt rescheduling programmes. Most of the countries in the region are presently facing high debt distress levels, and the situation is worsened by continued borrowing to finance food imports. While negotiating new terms on debt with bilateral lenders or multilateral institutions, the governments should insist on debt-for-development swaps were cancelled debt is directly applied to fund transformative agricultural projects. These agreements can fund the scaling up of climate-resilient agricultural technologies, consolidate agricultural research institutions, improve food storage and distribution systems, and build early warning systems for food crises. Importantly, any conditionality for debt restructuring must be aligned with national food security objectives and promote inclusive growth. Transparency and accountability measures must be built into these agreements to ensure efficient use of funds and their access to targeted beneficiaries. By pairing debt relief with sustainable food system transformation, countries can simultaneously lighten their fiscal loads and lay the groundwork for long-term food sovereignty.

10.8 Conclusion

This study qualitatively investigated the intricate relationship between SSA's rising reliance on food imports and its expanding debt burden, documenting core drivers, structural constraints, and potential policy paths. The evidence from a broad sampling of literature implies that the region's food systems have been strongly

impacted by historical misalignments within agricultural planning, land use and external trade reliance. Misplaced priorities, such as leasing of cultivable land for export or non-food crops, have significantly undermined food sovereignty, leaving many countries vulnerable to climatic and economic shocks. Furthermore, the inability to produce enough food domestically has led to a recent food import explosion, which, when underpinned by external borrowing, results in unsustainable debt accumulation. The findings identify the urgency of sustained and rapid policy action targeting the local food production-based supply-side constraints and macroeconomic ramifications of the imbalance of international trade. Remediating SSA's food import dependence necessitates an aggregate strategy revitalising farm-level autonomy, reinforcing intraregional food security and integrating food systems with food systems-driven and inclusive economic growth ends.

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Impact of Climate Change on African Food Systems: A Systematic Review Incorporating Strategies for Enhancing Sustainable Wild Food Utilisation

11

Gideon Walter Mutanda

11.1 Introduction

It is anticipated that by 2050, there will be nine billion people on the planet, and by that time, the demand for food will have increased by 60% (Imathiu, 2020), driving up the need for macro and micronutrient sources and exacerbating food insecurity in developing nations (Kipkoech et al., 2023a). Humans will have nutritional difficulties as a result of the unavoidable downward trend in food and feed production, with new-borns and children being the most vulnerable (Nyangena et al., 2020). It will be difficult to feed this enormous population since resources, such as arable land, are becoming scarcer. Additionally, as the population continues to grow towards 2050, the existing agro-ecosystems will have to produce more food and feed, which will place greater strain on the environment (Raheem et al., 2019a). Finding sustainable and reasonably priced protein sources is necessary because the current sources of protein and other micronutrients are costly. Wild food is probably a good substitute (Kipkoech et al., 2023a). The practice of consuming wild edibles has persisted despite agricultural societies' major dependence on conventional crops and livestock.

According to the Food and Agriculture Organisation's State of Food Insecurity in the World report, roughly one billion individuals eat wild plants (Ojelel & Kakudidi, 2015). In addition to being consumed regularly or during periods of scarcity, wild food, including plant and animal products, also helps ensure food security when they are sold for money that may be used to buy more food (Wessels et al., 2021).

Firstly, a variety of wild delicacies, such as insects, have remarkable nutritional qualities from a nutritional standpoint (Guiné et al., 2021). It has been claimed that the gross content of these wild foods contains vitamins and nutrients needed for health (Salami et al., 2022). It has been demonstrated that these wild foods include more health-promoting components, including amino acids, vitamins, carbohydrates and dietary fibres, even though their nutritional contents vary significantly depending on the portion taken (Salami et al., 2022). WFPs usually have higher nutritional value than many crop plants, primarily micronutrients (da Silva et al., 2024). Lange and Nakamura (2021) states that edible insects seem to have nutritional value that is on par with, if not better than, diets made from birds and mammals. In addition to providing nourishment, they are typically considered a delicacy in traditional culture (Imathiu, 2020).

The rural poor, particularly in Africa and Asia, frequently eat natural edibles like insects, which are most used as food in developing nations with tropical and subtropical climates (Imathiu,

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2020). Indigenous peoples and local communities have relied heavily on wild edibles for their livelihoods because of their affordability, ease of harvesting, and renewable nature (Thapa et al., 2024). Accordingly, the first three SDGs, zero hunger, no poverty, good health and people's well-being, can be directly addressed by using wild foods (Imathiu, 2020). They can help accomplish SDGs, particularly SDGs 12 (to ensure sustainable patterns of consumption and production) and 2 (to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture). (Raheem et al., 2019b). In addition to providing tangible benefits, wild edible plants and mushrooms frequently support regional culinary traditions, cultural heritage preservation and biological data (Guzo et al., 2023). Collecting them can help maintain regional knowledge systems and customs, promote cultural identity, fortify social networks through the sharing of wild edibles, provide inspiration and leisure, and be linked to spiritual principles (Powell et al., 2023; Schunko et al., 2022).

In addition to their cultural and nutritional contribution, edible insects have the potential to mitigate climate change by lowering greenhouse gas emissions, which improves the environment because they are linked to organic waste consumption. They can help achieve the SDGs by 2030, particularly SDG 13, which urges swift action to lessen the effects of climate change (Raheem et al., 2019b). Succulent plants are becoming more widely acknowledged as a resource to lessen the negative consequences of climate change because of their increased efficiency in removing carbon dioxide from the environment (Sen et al., 2022). Edible insects use substantially less water and land, and produce comparatively less greenhouse gas emissions and ammonia than cattle (Lange & Nakamura, 2021). Guiné et al. (2021) supports this finding by stating that, in comparison to other animal protein sources, the production of insects has a far smaller environmental impact, including reduced greenhouse gas emissions. Their production and use contribute to the achievement of SDG 15, which seeks to prevent and reverse biodiversity loss and land degradation, manage forests sustainably, protect, restore and promote the sustainable

use of terrestrial ecosystems, as well as fight desertification (Raheem et al., 2019b). In contrast to alternative sources of animal protein, the ecological effect of producing insects is far lower. This is because it requires less land, energy and freshwater (Guiné et al., 2021).

Given that wild foods are often wild relatives of conventional crops, they offer a great source of favourable traits for climatic stressor adaptation and resilience (Powell et al., 2023). Wild food plants (WFPs) could be a useful tool for mitigation and adaptation to a changing climate (da Silva et al., 2024). Due to agricultural losses and a lack of other revenue streams, smallholder farmers frequently turn to resource extraction from the environment (da Silva et al., 2024). When severe drought, stress, and food scarcity occur, edible insects and wild plants might serve as a backup source of food or a substitute (Kipkoech et al., 2023b; Shadrack & Mwalilino, 2022). The Konso community in southern Ethiopia and the Berti people in Sudan, for instance, survived the drought-afflicted years of 1966–1969, 1973 and 1984–1985 by consuming wild food plants and seeds (Guzo et al., 2023). During periods of abundance, wild foods and long-horned grasshopper trading in Tanzania and Uganda can also generate revenue (Sen et al., 2022). For Indigenous peoples, the poor, and those living in regions with unpredictable growing seasons worldwide, wild edible plants (WEPs) are crucial food security buffers (Winstead & Jacobson, 2022). For rural populations, using wild-harvested food sources during “lean season”—the period between crop planting and harvest—can significantly enhance their quality of life (Shen et al., 2023). For instance, certain wild species eaten during such seasonal lean times are important sources of vitamin A, B2, and C, iron, zinc, calcium and essential fatty acids in the dry Ferlo area of Senegal, the Sahel, and Nigeria (Wessels et al., 2021). It has been discovered that these species have better energy and micronutrient content than wild edible foods used during the productive rain season (Wessels et al., 2021).

Using the International Union for Conservation of Nature's (IUCN) Red List, the State of the World's Biodiversity for Food and Agriculture

evaluated 1039 mushroom and wild food plants and found that 63% of these edible species are becoming less common, 18% are steady and 18% are increasing globally (Powell et al., 2023). Land-use change, unsustainable harvesting practices, habitat damage from deforestation, forest degradation, pollution and overexploitation were the most frequent underlying causes of the decline in edible wild plants and insects, though the reported drivers differed by continent and climatic region (Omuse et al., 2024). A study by Oluoch et al. (2023a), Thapa et al. (2024), Espinoza-Pérez et al. (2021), Villagrán-Vázquez et al. (2024) states both indirect and direct effects of climate change as one of the primary risks to wild foods and biodiversity. According to Powell et al. (2023), the problem of food security in developing nations is made worse by climate change, which exacerbates anthropogenic stress and reduces the availability of wild foods. It has become clear that human activity has been significantly altering the climate of our planet since the 1980s (Shadrack & Mwalilino, 2022). A further reduction in the future provision of essential ecological services, particularly food provisioning services, is anticipated as the consequences of climate change continue to become increasingly noticeable in most semiarid regions of many developing nations (Mugari et al., 2019). Therefore, this will exacerbate the current and anticipated occurrences of malnutrition and food insecurity, particularly in emerging nations (Nyangena et al., 2021).

Along with man-made factors, climate change is expected to affect the biological health of plants and other species, including edible wild plants, as well as the abundance and distribution of wild edible insects, the functioning of many ecosystems through changes in precipitation, climate variability and some related events like droughts (Mesa-Marín et al., 2023; Mugari et al., 2019; Omuse et al., 2024; Shen et al., 2023). The survival of all living things on Earth is in danger as a result of the climate change crisis, which has become a significant problem in recent decades (Suwardi et al., 2023). This also applies to the sources of wild foods. Although wild edible plants (WEPs) can offer a variety of nutrient-dense food sources that support human

health, wellbeing and climate change mitigation, these priceless food resources are in danger as a result of the increasing impacts of climate change, and their long-term viability is still uncertain (Oluoch et al., 2023a). The Himalayas are a prime example where the distribution, species richness, ecology, habitat and phenology of plant species are all affected by climate change (Thapa et al., 2024).

In the tropics, it is less clear how responsive edible wild plants are to change (Guzo et al., 2023). Omuse et al. (2024) explain further that it is anticipated that the range and quantity of edible insects will be impacted by climate change in ways that are currently mostly unknown. Even more concerning, there are currently limited studies evaluating the possible effect of climate change on WFP or WEF in a particular area, globally, or on the availability of these food supplies (Benítez et al., 2024; da Silva et al., 2024). Given the foregoing discourses and the visible gap, this study undertakes a systematic review of literature to synthesise and systematise previous study findings on the impacts of a changing climate on wild food. The following objectives guide the research: (i) to identify the impacts of a changing climate on wild food in the Global South; (ii) to evaluate efforts to promote resilient wild food systems in different areas of the world and (iii) to bring up future recommendations to promote resilient wild food systems.

11.2 Materials and Methods

11.2.1 Databases and Keywords

This study was done in accordance with the PRISMA 2020 framework. PRISMA guidelines ensure that the study follows a structured and standardised protocol for identifying, screening, assessing eligibility and extracting peer-reviewed articles from the chosen databases, which encourages transparency and reliability (Garg et al., 2024; Mutanda & Nhamo, 2024). For this research, the main source of publications was Scopus, complemented by publications from Google Scholar. With more than 27

million abstracts, the Scopus database is widely regarded as the most comprehensive collection of scientific literature and is highly respected in the scientific world for its multidisciplinary nature (Sahid et al., 2025). Other articles were obtained from the Google Scholar database. Gerasimov et al. (2024) state that Google Scholar is associated with over 90% of the citations listed in Scopus and Web of Science (WoS). Martín-Martín et al. (2018) state that Google Scholar has a lot more citations than both Scopus and the WoS Core Collection in all disciplines, while combining Google Scholar and WoS or Google Scholar and Scopus has a greater advantage, as this provides access to 94% of all citations (Gerasimov et al., 2024). However, Google Scholar has weaknesses, as some of its publications are not from academic journals but are dissertations/theses, unpublished materials (Gerasimov et al., 2024; Martín-Martín et al., 2018). These were part of the exclusion. Keywords such as ‘wild food’, ‘wild edibles’, ‘climate change’ and ‘climate variability’ were used to retrieve relevant published material in the Scopus and Google Scholar databases. Additional information on the search terms that were used to extract articles from the Scopus and Google Scholar databases is in the search string below.

11.2.2 Inclusion and Exclusion Criteria

On 06/03/2025, both generic and refined searches in the Scopus database produced 398 and 119 items, respectively. To prevent removing irrelevant items, the titles and abstracts of the papers were searched. A total of 84 articles were obtained from Google Scholar. The search terms that were used to extract articles from the Scopus and Google Scholar databases are as follows.

(i) Scopus generic search

TITLE-ABS (“climate change” OR “climate variability” OR “drought” OR “flood*” OR “heat stress” OR “heat wave*” OR “extreme weather” OR “extreme climat*” OR “temperature change*” OR “global warming” OR “changing climate”

AND “wild food*” OR “edible wild*” OR “wild fruit*” OR “wild edible*” OR “edible insect*” OR “edible plant*”).

(ii) Scopus refined search

TITLE-ABS (“climate change” OR “climate variability” OR “drought” OR “flood*” OR “heat stress” OR “heat wave*” OR “extreme weather” OR “extreme climat*” OR “temperature change*” OR “global warming” OR “changing climate” AND “wild food*” OR “edible wild*” OR “wild fruit*” OR “wild edible*” OR “edible insect*” OR “edible plant*”) AND (LIMIT-TO (DOCTYPE, “ar”)) AND (LIMIT-TO (PUBSTAGE, “final”)) AND (LIMIT-TO (LANGUAGE, “English”)) AND (LIMIT-TO (OA, “all”)) AND (LIMIT-TO (SRCTYPE, “j”)) AND (LIMIT-TO (SUBJAREA, “AGRI”) OR LIMIT-TO (SUBJAREA, “ENVI”) OR LIMIT-TO (SUBJAREA, “SOCI”) OR LIMIT-TO (SUBJAREA, “MULT”) OR LIMIT-TO (SUBJAREA, “EART”) OR LIMIT-TO (SUBJAREA, “ARTS”)).

(iii) Google Scholar search

“climate change” OR “climate variability” OR “drought” OR “flood*” OR “heat stress” OR “heat wave*” OR “extreme weather” OR “extreme climat*” OR “temperature change*” OR “global warming” OR “changing climate” AND “wild food*” OR “edible wild*” OR “wild fruit*” OR “wild edible*” OR “edible insect*” OR “edible plant*”).

Table 11.1 provides more details on the inclusion and exclusion criteria. Such information assists in giving clarity to the reader and for authenticity purposes.

11.2.3 Data Analysis

Data from the literature review were evaluated using ATLAS.ti 25 software. Quotations were created and each quote was given a theme or code based direct and indirect impacts of climate on wild foods. The quotations and codes were

Table 11.1 Inclusion and exclusion criteria

Inclusion	Exclusion
Articles available from Scopus and the Google Scholar databases	Articles outside the two databases
Downloadable full text	Not downloadable full-text
Articles written in English	Articles written in other languages
Only peer-reviewed articles from journals	Grey literature and non-peer-reviewed articles
Articles focusing on climate change, climate variability and wild foods	Articles focusing on wild foods but not relating to the changing climate

generated concurrently, and the codes were organised into code groups, which later served as the study’s themes. Network, code-document and co-occurrence analysis of the identified codes was performed to have a deeper understanding of how the identified themes are related to each other.

11.3 Results and Discussion

This section presents results obtained from the search for articles from the selected two databases and findings from the extracted articles.

11.3.1 Search and Screening Processes for Retrieved Journal Articles

Figure 11.1 shows the results from every stage of the search and screening of the article’s abstracts and full articles. Abstracts and full papers were screened by the author using the Covidence software. The RIS file was exported from the Scopus database, while articles from Google Scholar were imported into Mendeley reference manager and then exported as a RIS file. The two RIS files with 119 articles from Scopus and 84 from Google Scholar were then imported into Covidence software for full-text and abstract screening. A total of 36 articles remained after the automatic removal of duplicates by Covidence software and manual screening on the relevance of the articles. The authors considered empirical papers that focused

on the impact of a changing climate on wild food and sustainable pathways to enhance the sustainable utilisation of these food resources in the Global South.

11.3.2 Impact of Climate Change on Wild Food Species’ Geographic Range

The geographic ranges of wild food species are changing significantly due to a changing climate, which may have an effect on their availability. Foraging, conservation and the sustainable utilisation of edible species all depend on an understanding of the geographic ranges of wild foods. Figure 11.2 shows that four studies found that wild edible foods are expected to experience a decline, while three studies reported an expansion in the species’ geographical range. Benítez et al. (2024) report that the probable distribution area of the *P. guajava*, *M. sapota*, *P. dioica* and *P. sapota* species is predicted to decline by 50 to 82% under the RCP4.5 2050 scenario, and also RCP8.5 2070. The rise in temperature is associated with the shift in geographic distribution.

According to simulation results from Brazil, the geographical distribution zones of wild edible plants and fruits will see more losses than benefits. In future scenarios, over 70% of the species under analysis demonstrated a decrease in their geographical distribution region, with seven species (26%) exhibiting losses of more than 50% (da Silva et al., 2024). The relative increases of these species were less than 3% for the same species. Edifying these findings, de Oliveira et al. (2015) state that approximately nine of the sixteen wild edible plants and fruits in Brazil (56%) had decreased their range in pairwise comparisons between preindustrial and future time periods. Although the distribution range of wild food species is shrinking, some species are resilient to the scourge of climate change (de Oliveira et al., 2015). Figure 11.2 shows that four studies identified some species that expanded their range in the face of climate change.

According to modelling studies, the range extension of edible wild plants in Southern Africa

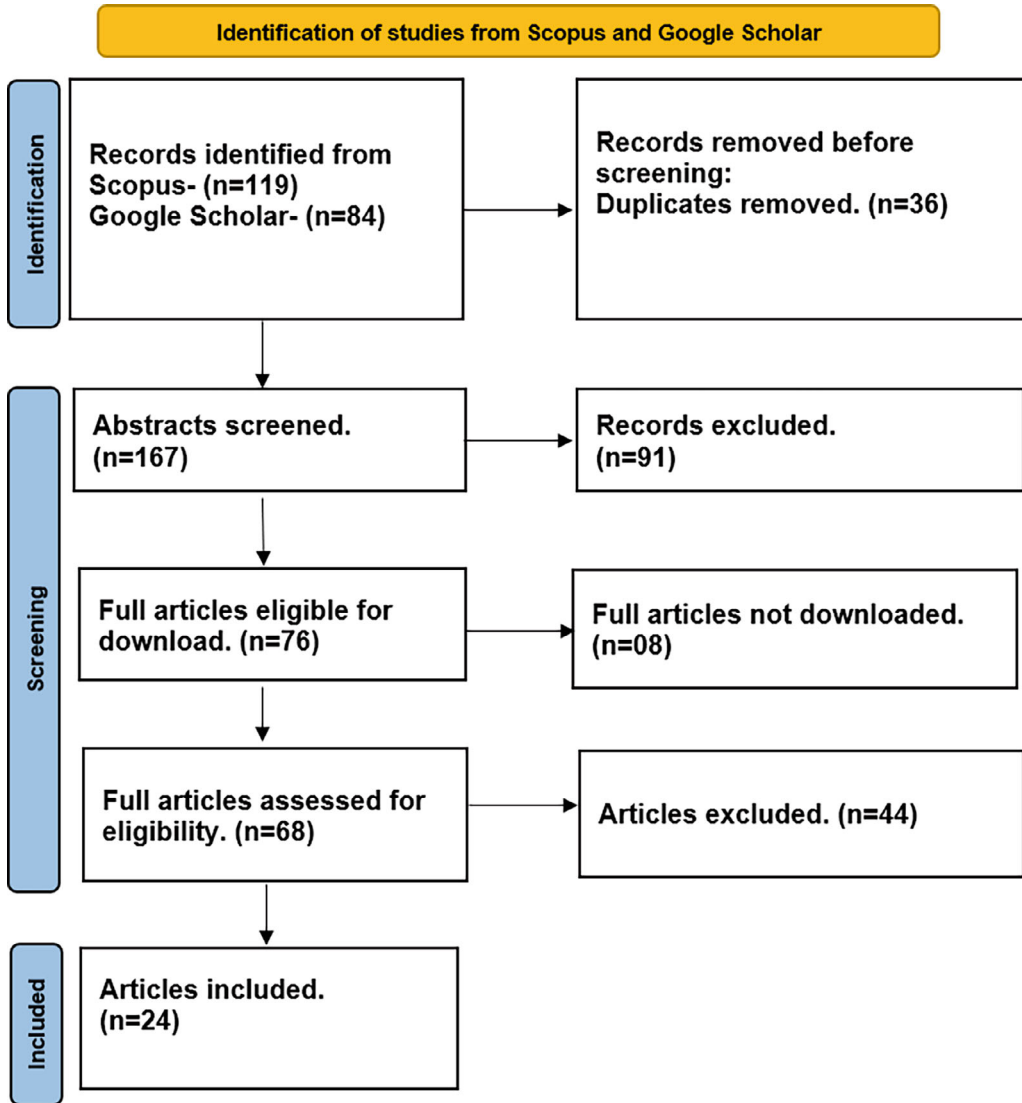


Fig. 11.1 The PRISMA flow diagram

is likely to be adversely affected. By 2060–2080, 60% of species will have their range extent reduced by 40% and 66%, respectively, under low warming and high warming scenarios, according to species distribution models on the dangers that climate change poses to 1190 WFP species that are utilised by 19 indigenous groups in southern Africa (Wessels et al., 2021). Although the majority of species are predicted to shrink their potential ranges of distribution, *Pithecellobium dulce* in Mexico may be able to find favourable

environmental conditions due to climate change, increasing its potential distribution by 35% given by the RCP4.5 2050 scenario and 11% in the RCP8.5 2070 future scenario (Benítez et al., 2024). As has already been noted in temperate latitudes, future climate change will benefit multi-voltine species like the Aphididae and some Lepidoptera, like *Pieris brassicae*, by causing them to develop more quickly and extending their distributional ranges to upper latitudes and altitudes (Bale et al., 2002). According to the RCP4.5

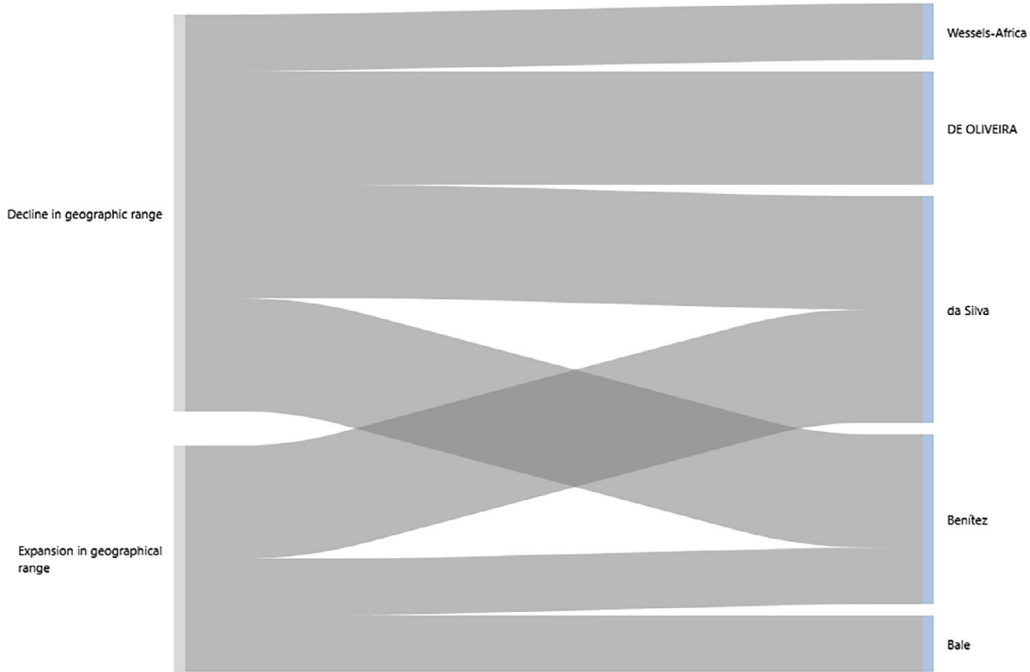


Fig. 11.2 Effect of a changing climate on the distributional range of edible wild species

2070 forcing scenario, *P. guajava* species in the same nation may have mixed outcomes, with possible distribution area decreases and a slight 0.3% gain. Future habitat degradation and eventual extinction will be faced by those species that are unable to expand their altitudinal distribution (Guo et al., 2024). In all future scenarios, the simulation results of nine wild edible plant species in Brazil were predicted to increase (gain more than loss) (da Silva et al., 2024). Other species (although few) will be able to develop more quickly and expand their geographic ranges to higher latitudes faster due to future climate changes (Bale et al., 2002; Benítez et al., 2024).

11.3.3 Impacts of Climate Change on Wild Food Species' Habitat Suitability

In order to conserve biodiversity, guarantee food security, preserve cultural legacy and uphold ecosystem services, it is essential to comprehend

how a changing climate affects the habitat appropriateness of edible wild species. Figure 11.3 shows that seven studies found that wild edible foods are expected to experience a climate change-induced decline in habitat suitability, while one study reported an expansion in the same.

Under most future climate scenarios, wild food species like *P. armeniaca* and *M. sieversii* are expected to see a 32.21 and 3.71% reduction in the overall area of habitat that is suitable in southern Russia, Romania and some isolated areas in Central Asia, respectively, to 885×106 ha and 1389×106 ha in the 2050s and 2090s (Guo et al., 2024). While there are some slight habitat expansions for the same edible wild plants, primarily in Central Asia, there are notable decreases under the 2090 scenario. In the 2050s scenario, the amount of suitable habitat area for another edible wild plant, *P. ledebouriana*, will decrease to 517.95 million ha, or 47.1%, while in the 2090s scenario, there will be significant reductions of 46.68% on the borders of Georgia, Russia, Kazakhstan, Mongolia and northwest China (Guo et al., 2024). Climate change is causing these three edible wild

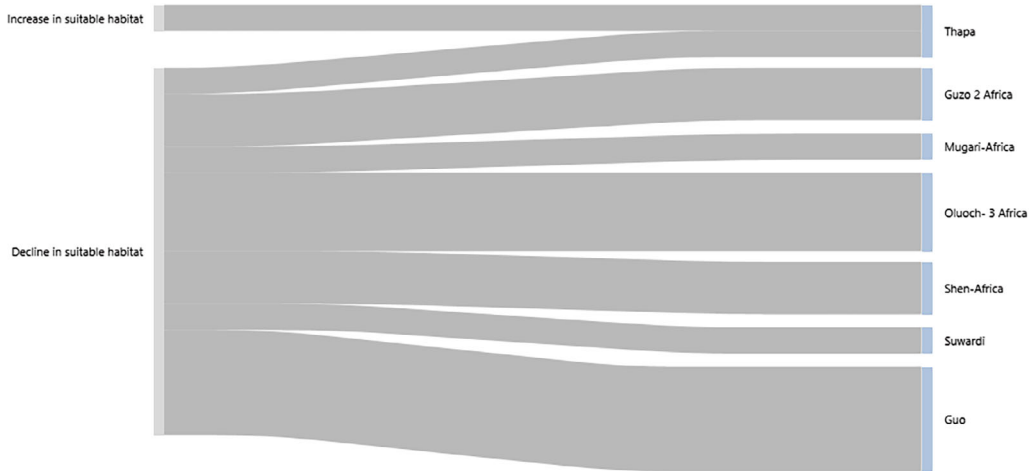


Fig. 11.3 Impact of a changing climate on edible wild species richness

plants' geographic ranges to shrink, with suitable species habitats shifting to upper latitudes. This increases the risk of species extinction due to the loss of suitable habitats. According to a study by Guzo et al. (2024) on how climate change is affecting the wild edible plant *S. afromontanum* in Ethiopia, between 94% and 94.5% of the species' distribution range and suitable habitat could be lost between 2050 and 2070 under RCP4.5 and RCP8.5. Further warming may cause its biological niche's habitat to shift towards higher elevations.

Kenya is another African country where climate models predict that climate change may alter potentially favourable habitats for particular wild food plants. Climate models in Turkana County, Kenya, indicated that between 2041 and 2070, 61% of the wild edible plants will preserve or increase their existing potentially appropriate habitats, while up to 39–48% would see a decrease in their current habitats (Oluoch et al., 2024). Those species which continue to survive in their habitats will be very tolerant of the upcoming climate change. For three WEPS, the situation is worse because it is anticipated that they will lose more than 40% of their current acceptable habitat in the same time frame. One of the three edible wild plants whose habitat will be impacted by climate change is *Balanites aegyptiaca*. According to Suwardi et al. (2023)'s research in Indonesia,

under the 3 climate change scenarios, the total areas of *D. oxleyanus*'s appropriate habitat would decrease by 7.35–12.39% in the future. *D. oxleyanus*'s survival will be influenced by its future surroundings, and its ideal range will likely move west-south of Sumatra, Indonesia. According to two Nepali climate scenarios, wild edible plant populations will gradually decline by 4.9–6.2% in highly appropriate habitats and 2.4–3.5% in moderately suitable habitats by 2050 and 2070, while low-compatible areas will slightly grow (Thapa et al., 2024).

Climate change is threatening edible insects, such as Botswana's Mope caterpillars, as well as edible wild flora. Locals reported that compared to ten years ago, the quality, quantity and breeding of mopane caterpillars are being negatively impacted by the recent, recurring extremes of rainfall (such as significant droughts and floods) that are extremely unpredictable and variable, resulting in shortening of the breeding season (Mugari et al., 2019). Recent seasons' flash floods have also been blamed for preventing Mopane caterpillars from reproducing, which has resulted in a decrease in their numbers (Dube & Sekhwela, 2007). According to another study conducted in Zimbabwe, Botswana, and South Africa, the spread of *G. belina* is expected to significantly drop because of a changing climate. Major losses are anticipated to persist as a few isolated pockets

and total loss in in appropriate habitat as defined by RCPs 4.5 and 8.5 in Southern Zimbabwe, whereas 99% and 100% of the simulated habitat, respectively, are forecast to disappear by 2080 (Shen et al., 2023).

11.3.4 Impact of Climate Change Effects on Species Richness

Species richness is an important aspect of biodiversity because it demonstrates how adaptable an ecosystem is to shocks like climate change and how well it can carry out different ecological functions like energy flow and nutrient cycling. Future projections for Brazil's species richness revealed that the semiarid northwest and midwest will see higher temperature and precipitation increases, resulting in a 50–80% rise in species richness (da Silva et al., 2024). Under future climatic circumstances, it is anticipated that species richness for the chosen WEPs will grow in central and centre-south Brazil (de Oliveira et al., 2015). However, under future climate circumstances of rising temperatures, species richness will be adversely affected in northern Brazil, western Paraguay, northwestern Peru and northern Argentina. Under a different model but for the same time period, it was projected that Turkana County, Kenya, which covers an area of roughly 27,900 km², will see a decrease in the richness of the examined WEPs by 2041–2070 and a minor increase in species richness (0.16%) (Oluoch et al., 2024). Two models for the 2071–2100 period once more forecasted an average species rise in WEPs' richness (0.79–3.47%) of the present WEP species. Brazil's outcomes will be uneven, with the southwest exhibiting the largest loss in species richness, ranging from 50 to 80%, as the region is linked to the biggest increases in temperature and decreases in rainfall in future scenarios (da Silva et al., 2024).

According to modelling results in South Africa, species are expected to shift their ranges southward into cooler montane regions and wetter conditions brought on by the Drakensberg Mountain range, increasing the WFP species richness

in the provinces of the Eastern Cape, KwaZulu-Natal and Mpumalanga (Wessels et al., 2021). It is projected that the rise in species richness will spread throughout western southern Africa, particularly to Namibia's coastline region and South Africa's Mediterranean/Cape climate region. Wessels et al. (2021) further add that between 2060 and 2080, it is anticipated that at least 200 species in northeastern southern Africa will see a decline in their geographic range and adequate climatic circumstances, which will result in a decline in WFP species richness. The changing climate is believed to have a compounding impact on invasive plants like *Prosopis juliflora*, which are outcompeting some native WEPs, leading to a decline in species richness and abundance (Oluoch et al., 2023b).

11.3.5 Climate Change and Species Abundance

Smilax aristolochiifolia is used as traditional medicine and as food by indigenous families in Poblano Totonacapan, Mexico. However, because of human activity and climate change, the villagers have observed a fall in the species' population over the past 50 years, making them feel as though their livelihoods are in jeopardy (Espinoza-Pérez et al., 2021). Nyangena et al. (2021) report that some Mexicans who depend on aquatic insects claimed that they are disappearing due to habitat loss caused by dried-up lake beds in Mexico brought on by climate change and other human activities. Mopane worms are an important protein source in Southern African nations like Botswana and Zimbabwe. Compared to ten years ago, Botswana is one of the first nations predicted to experience a 1.5 °C rise in temperatures above pre-industrial levels, along with more unpredictable and serious rainfall events (such as droughts and flash floods) that will negatively impact mopane caterpillar breeding, quality and quantity (Mugari et al., 2019). Even under the more moderate scenario, modelling results indicate that climate change is going to cause the habitat of the *G. belina* species to shrink in future,

which would reduce the amount of this delicious insect that can be harvested. According to additional data, the species’ decline in the Mangwe district of Zimbabwe between 2007 and 2016 was 98%. The pH and dissolved oxygen levels of India’s Loktak Lake are also changing due to greenhouse gas emissions and global warming. As a result of the continuous deterioration of the water quality of the lake, the aquatic insect population in India’s Loktak Lake is declining, which in turn results in a decline in the edible insect population of the gigantic water bug (Nyangena et al., 2021). Many mountain communities rely on wild foods for their food and nutrition security. Powell et al. (2023) explain how climate change has impacted the availability of certain edible wild plants, like *Asparagus racemosus* and *Urtica dioica*, in places like Nepal’s Himalayan region. Climate change affects the harvest season timing and the length of time that edible wild plants are available, in addition to reducing the supply of wild foods (Smith et al., 2019). The fruiting season for several wild fruits in Kenya has become highly unpredictable due to climate change and variability (Oluoch et al., 2023b).

Nonetheless, warm temperatures in some East African regions and Lake Victoria have an impact on the development and reproduction of insects, including termites and lake flies, by providing favourable breeding and reproduction conditions. As a result, their numbers have increased, and during the last ten years, swarms of these insects have been observed in the area (Nyangena et al., 2021). Ayieko and Tamale (2010) claim that the emergence of elate termites in new locations indicates increased reproduction brought on by rising temperatures, while dormant mounds and those producing only a few elates for years are returning to high production. Several termite mounds are achieving more than one or two outputs in a year. Elevated temperatures are anticipated to promote high fecundity in female insects and impact the physiological development of juveniles, causing them to develop more quickly than they typically would (Ayieko & Tamale, 2010).

11.3.6 Pathways of Enhancing Their Sustainable Use of Wild Foods

As global challenges of climate change and habitat loss intensify, it becomes increasingly important to develop effective strategies that promote the responsible harvesting and management of wild edible resources. Table 11.2 shows various

Table 11.2 Strategies to promote sustainable utilisation of edible wild species

Sustainable practices	References
Agroforestry	
Breeding, propagation and cultivation of edible wild plants	Oluoch et al. (2023a), Shan et al. (2021), Guo et al. (2024)
Community-based management of the important genetics of wild fruits and the use of bylaws	Ojelel and Kakudidi (2015), Guzo et al. (2023)
Customs against eating immature and pregnant animals, and reptiles	Shadrack and Mwalilino (2022)
Conservation of wild edible species in their natural areas	Oluoch et al. (2023a), Guo et al. (2024), Guzo et al. (2023), Ramos-Elorduy (2006)
Conservation of wild edible species in new areas (ex situ)	Guo et al. (2024), Ramos-Elorduy (2006), Oluoch et al. (2023a)
Controlled harvesting	Oluoch et al. (2023a)
Research and genetic profiling to inform conservation	Oluoch et al. (2023a); Guo et al. (2024)
Insect farming	Imathiu (2020)
Transplanting of wild edible plants	Powell et al. (2023)
Conserving wild plants around settlement areas	Ojelel and Kakudidi (2015)
Use of future climate scenarios data to inform conservation	Guzo et al. (2023)
Use of IKS for wild plant conservation	Guzo et al. (2023, 2024), Oluoch et al. (2023a), Guo et al. (2024)
Venturing into agriculture, especially for indigenous people reliant on wild foods	Shadrack and Mwalilino (2022)

pathways that can enhance the sustainable use of wild foods. Breeding, propagation, and cultivation of edible wild plants were identified as one approach to sustainable utilisation of these resources in the face of a changing climate and other threats. This approach is related to genetic profiling and research. Research on edible wild species contributes to conservation efforts and food security as genetic profiling seeks to find robust cultivars that are better suited to a changing climate. The study also notes the importance of the conservation of wild edible species in their natural and non-natural areas. Protecting wild edible species in their native habitats is essential for maintaining ecosystems, while conservation programmes in new areas (*ex situ*) ensure that species at risk of extinction are preserved. This approach can serve as a backup to *in-situ* conservation strategies, providing a reservoir of genetic material.

Insect farming and agroforestry can diversify food sources and reduce pressure on wild foods can be farmed with minimal environmental impact. Transplanting wild edible plants into cultivated areas can enhance local food systems, as it can also serve to reintroduce native edible species that have been wiped out due to habitat destruction. All these scientific approaches must be informed by data on future climate scenarios if proactive conservation planning is to be a success, as it helps in forecasting changes in climate and ecosystems and then adapting management strategies accordingly. Scientific approaches to the management of wild edible plants should be augmented by community-based management approaches and utilisation of local knowledge. Integrating IKS into scientific conservation practices enriches strategies with local wisdom. This collaborative approach ensures that conservation methods are culturally relevant and ecologically effective. Cultural practices are preserved, and conservation efforts are matched with local needs when local communities are involved in the management of wild fruit genetics. Through the implementation of regulations, communities can control harvesting methods in a sustainable manner. Some communities uphold traditional customs in conserving edible wild species. These

practices help maintain ecological balance and ensure the availability of wild foods for future generations. Some communities focus on conservation efforts near settlements to enhance community access to wild foods and the conservation of wild edible plants.

11.4 Discussion

The geographic ranges of wild food species are significantly affected by climate change, leading to alterations in their availability. Studies indicate a general trend of decline, with some species projected to lose up to 82% of their distribution area under future climate scenarios. Bale et al. (2002) argue that many of these species are more likely to suffer from climate change than the flexible polyphagous species because they lack the flexibility to inhabit a variety of habitat types in different latitudes and altitudes. The change in climate can make it harder for many species to adjust to their existing climate, increasing the danger of extinction (Muluneh, 2021). This shift poses a challenge for foraging and conservation efforts; therefore, it is essential to comprehend these shifts in order to manage wild food resources sustainably. However, the study noted that a few resilient species may expand their ranges, highlighting a complex interplay between climate factors and species adaptability. According to modelling results, the distribution range of certain mushrooms (*A. phalloides* and *Amanita muscaria*) in new hosts increased more along the western coast of the United States between 2000 and 2019 (Villagrán-Vázquez et al., 2024). However, the fact that populations frequently differ based on environment indicates that wild edible species are subject to significant selection pressure from climate change. Feyssa et al. (2011) claims that because these wild food species can withstand harsh conditions, they are crucial for both transhumance and settled farmers, since people cannot continue migrating to other places because of a shortage of land to access these important sources of food. It is essential to monitor these dynamics to ensure effective conservation strategies, and even the breeding of such wild edible

foods has the potential to increase and/or maintain the geographic ranges in the context of climate change. Their genes are also important for the infusion into food crops being affected by climate change.

The study findings show that the suitability of habitats for wild food species is increasingly threatened by climate change. Research shows that many edible plants will experience a decrease in suitable habitats up to 94%, which could lead to higher extinction risks. For instance, specific species in southern Russia and Central Asia are expected to see significant habitat loss, underscoring the need for proactive conservation measures. While some species may find new suitable habitats at higher altitudes and experience slight habitat expansions, this adaptation is not universal. Bale et al. (2002) assert that even though very few edible insects have evolved strains with physiological adaptations appropriate for the latitude at which they inhabit, many have tracked climate change rather than adjusting to it, which has an impact on their survival (Muluneh, 2021). Continuous monitoring and habitat restoration efforts are vital to preserve these species and maintain biodiversity.

The study's findings on species richness, an indicator of ecosystem health and resilience, project an uneven change across regions due to climate change. While some areas may experience an increase in species richness, others, particularly in the tropics, may see significant declines. The loss of native species to invasive species exacerbates this issue, complicating conservation efforts. According to Lynn et al. (2013) climate change may intensify current stressors and generate new ones, for instance, diseases and invasive species that restrict the survival of some wild edible species. Having an understanding of the patterns is important for developing targeted conservation practices that preserve biodiversity and ecosystem functions.

Findings from this study show that the abundance of edible species from the wild is closely tied to environmental conditions, which are shifting due to climate change. The abundance of numerous wild food species is being impacted by climate change. Changes in precipitation and

temperature patterns are altering the breeding, reproduction, and development of these edible wild species, leading to declines in their populations. Besides changes in temperature and precipitation patterns, higher CO₂ concentrations can cause lower foliar nitrogen levels, which hinders the growth of some edible wild plants since increased carbon emissions dilute nitrogen concentrations in the leaves (Hunter, 2001). In regions like Southern Africa, traditional food sources such as mopane worms are declining due to unpredictable weather patterns. These findings confirm Lynn et al. (2013) projections that revealed that when water temperatures rise, salmon populations in the Pacific Northwest's Puget Sound are predicted to drastically decrease. Additionally, the geographic range of disease organisms may expand due to climate change, posing a greater hazard to salmon and other species. This decline not only threatens the species, but also local diets and cultural practices tied to these species. Kipkoech et al (2023b) contends that insect farming to increase mass production is the best option because suitable sites for the natural breeding of edible insects are becoming fewer due to climate change, taking lessons from bee farming, which has been practised since ancient times. More importantly, insect farming will act as both a climate change mitigation and adaptation strategy. Researchers have found that the greenhouse gas emissions from raising edible insects, like crickets, locusts and mealworm larvae, are about 100 times lower than those from beef production (Lange & Nakamura, 2021).

Reviewed literature also showed that some species may benefit from warmer temperatures, leading to increases in their populations. The change in climate is linked to a rise in carbon emissions and, subsequently, warmer temperatures. For other plant species, a rise in atmospheric carbon emissions provides a significant supply of carbon for photosynthesis. Therefore, higher CO₂ levels typically lead to higher rates of photosynthesis and growth for some plant species (Hunter, 2001). Stange and Ayres (2010) explain further that in some areas, like temperate and boreal regions, higher summer temperatures tend

to speed up insect growth and can boost their capacity for reproduction, which can result in widespread insect outbreaks. In North America, for instance, edible painted turtles got larger and attained sexual maturity more quickly during warm years (Muluneh, 2021). This confirms findings by Powell et al. (2023), as stated in the State of the World's Biodiversity for Food and Agriculture report, which evaluated 1039 mushroom and wild food plants and found that 63% of these edible species are becoming less common, 18% are steady, and 18% are increasing globally. More edible species are at the losing end of the climate change crisis, although a few seem to be resilient for now. The question is, for how long will the steady species remain steady, and will those expanding continue to do so? This is in the context of numerous climate models' projections showing that global temperatures will continue to increase even beyond 2050, even if mitigation measures to curtail the emission of greenhouse gases are put in place.

11.5 Conclusion

The study's findings show that most edible plants found in the wild are negatively affected by climate change in terms of their distributional range, species richness, habitat suitability and species abundance, with a few experiencing positive trajectories. This highlights the urgent need for comprehensive approaches to address the impacts of climate change on wild food in different geographic regions. Players in the biodiversity sector should adopt multiple strategies that include the integration of scientific research with traditional knowledge and community-based management to enhance the resilience of these vital resources. The extinction of these wild species will not only affect conventional agriculture, as this is a reservoir of important genes, but also food security for some indigenous communities. Continued monitoring and adaptive management will be key to ensuring the sustainability of wild foods in a changing climate. Additionally, promoting sustainable harvesting practices

is crucial for maintaining long-term availability, especially during droughts when unsustainable harvesting can occur. Advocating for international and national legal frameworks that promote conservation, breeding, transhumance and sustainable utilisation of wild foods is vital to ensure that scientific research is effectively implemented. The extinction of wild edible species poses a significant threat not only to conventional agriculture, due to the loss of genetic diversity, but also to food security for many indigenous communities. Addressing these issues is essential for conserving biodiversity and making food systems remain resilient in the context of climate change.

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Part III
Agriculture and Food Systems
Innovation

The Role of Surplus Food Recovery in Tackling Food Loss and Waste and Hunger in Sub-Saharan Africa

12

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12.1 Introduction

In 2022, roughly a fifth of consumer-level food, spanning retail, food service and homes, was wasted. Households alone exceeded one billion meals per day in wasted edible food (UNEP, 2024a). Advocates for a sustainable food system argue that the recovery and redistribution of surplus food offer a win–win benefit: feeding the hungry and addressing food waste problems (Bierwagen & Dias, 2021; United States Environmental Protection Agency, 2018). To promote surplus food rescue operations, different measures, including tax deductions (Franco & Cicatiello, 2021; Pollans, 2022; Yao & Zhou, 2023), credit donation (Kinach et al., 2020), and public awareness and education programmes (Neff et al., 2015; Shen et al., 2023; Wang et al., 2022) have been emphasised. Consequently, there has been a global surge in the development of recovered food markets, primarily through the centralised food banking model (Moon, 2021; Riches, 2018). This model has helped increase the

recovery and redirection of food that would have been discarded (Moon, 2021; Rivera et al., 2023).

The surplus food recovery initiative aligns with the current socioeconomic and sustainability policy framework across Africa (Moono, 2021). This is particularly relevant given that many countries face alarming levels of hunger, with one-third of the population living below the poverty line (Global Hunger Index, 2024). Moreover, Africa's population growth is already higher than the global average and is expected to double, reaching up to 2 billion people by 2050 (Bremner et al., 2010). Such a population growth presents additional challenges to food accessibility, consequently putting more pressure on the already weak food system. Shockingly, the region also reports significant levels of food loss and waste, much of which is edible items (Gikuri, 2021; UNEP, 2024a). For instance, Nigeria, a country where over 80 million people live in poverty, experiences approximately 100 million tonnes of food loss and waste each year (Obi, 2024). This amount is sufficient to feed half of its poor population for an entire year (ibid). Similarly, South Africa records an annual food loss and waste of 10 million tonnes (Food Forward SA, 2024). At the same time, two to three million South African households experience some form of food insecurity (Statistics South Africa, 2023). In Tanzania, food and organic materials constitute one-third of municipal solid waste (MSW) (Ministry of Agriculture, 2019). Households alone discard an estimated 150 kg per capita per year (UNEP, 2024b).

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Investing in surplus food recovery and redistribution offers both a practical and strategic pathway to advancing circular economy goals and strengthening food security. Unfortunately, efforts within Africa's postharvest loss management frameworks have insufficiently prioritised the recovery of food surpluses (African Union Commission, 2018). This oversight may stem from the fragmented nature of many food recovery initiatives and food banks, which often lack systematic documentation and record-keeping. To address this gap, this chapter explores food recovery and redistribution initiatives from selected food banks in Africa. In particular, the chapter (i) assesses the volume of food donated, recovered and distributed, and (ii) examines the trend and characteristics of beneficiaries served.

The chapter is organised into different sections, including a brief literature review, food banking theoretical framework, methods, results and discussion and conclusion. It focuses on key surplus food recovery organisations in five selected countries.

12.2 Background on Global Food Recovery and Redistribution

Surplus food is edible food items produced or sold that go uneaten for various reasons (Garrone et al., 2014). Surpluses originate from multiple sources, including farms, private homes, businesses and institutional food outlets (Berri & Toma, 2023; ReFED, 2025). Unsold stock, unharvested crops, overproduction and consumer aesthetic considerations are among the factors that generate surplus food (University of Auckland, 2022). Efforts to recover such food and redirect it to food-insecure and hungry populations are increasingly prevalent in urban settings (Aloysius & Ananda, 2023).

In Western cities, surplus recovery is primarily motivated by strong consumer environmental consciousness (ReFED, 2025). There are two main approaches to surplus food recovery: one driven by commercial objectives and the other

by social purpose. Businesses that follow the economic-profit model generally offer unsold food items at reduced prices, making surplus products more accessible to consumers (Berri & Toma, 2023). Moreover, emerging mobile applications such as 'Too Good To Go' (Vo-Thanh et al., 2021) and Nigeria's Chowberry (Chowberry App, 2024) create avenues for businesses to earn profits while helping to prevent food waste. Another surplus-food channel involves non-profit organisations collecting edible surplus from donors and redistributing it, most often free of charge, to partner agencies and beneficiaries (Baglioni, Pieri, & Tallarico, 2017a, 2017b; Baglioni, Pieri, Lulkiewicz, et al., 2017a, 2017b; Moon, 2021). The social-impact model is the focus of the current chapter.

Surplus-recovery efforts have been advanced by food-banking networks united under a humanitarian cause (Fontefrancesco, 2019). For example, in 2019, food banks in over 70 countries recovered 3.8 million metric tonnes of food. With this, they fed 70 million people and prevented the emission of over 12 billion kilograms of greenhouse gases (Global Food Donation Policy Atlas, 2022). The primary beneficiaries of food donations have been vulnerable groups, including schoolchildren and women (FSIN&GNAFN, 2024).

In the UK, between 2015 and 2021, one billion meals, equivalent to £1.3 billion of surplus food, were collected and redistributed (Bowles & Devine, 2022). Between 2020 and 2021 alone, the UK rescued and redistributed more than 250 million meals, a sixteen per cent increase compared with the previous year (ibid.). In the United States, it is estimated that 15 per cent of food waste is rescued. This amount could feed more than 25 million people and save more than US\$160 billion (Musicus et al., 2022). Leib et al. (2022) further assert that more than half of the food recovered in the United States originates from farms, suggesting that rescue strategies are being implemented at the initial stages of food loss.

The growth of the surplus-food recovery sector is attributed to the expansion of activities by charities and social foundations dedicated to poverty- and hunger-relief missions. These organisations include Feeding America (USA), The Trussell Trust Food Bank (UK), the European Food Banks Federation (FEBA), the Global Food Banking Network (GFN) and the Harvard Law School Food Law and Policy Clinic (FLPC) (The Global Food Donation Policy Atlas, 2024). Together, these agencies facilitate the food-donation agenda by mapping and connecting stakeholders. Most importantly, they lobby for policy reforms that enhance the operational capacities of food-recovery systems.

12.2.1 Impact of Food Recovery on Environmental Management

Surplus food recovery provides sustainability benefits by reducing environmental, economic, and societal burdens. For instance, municipal solid waste is a serious global issue when dumped in landfills without pre-treatment (Okayama & Watanabe, 2024). Food and other organic matter constitute more than a quarter of landfill composition, especially in the United States, where regulations are less strict or absent at the national level (ReFED, 2024). Dumping food instead of recovering it for human consumption carries an environmental cost. In the United States, the 55 million metric tonnes of food waste decomposing in landfills account for 58% of the fugitive methane that escapes into the atmosphere (Krause et al., 2023). Diverting food from waste streams significantly lowers greenhouse gas emissions. For instance, studies indicate that the kilograms of CO₂ equivalent saved per kilogram of food rescued for human consumption range between 0.4 and 2.7 (UN, 2017).

Moreover, every ton of food sent to a landfill is associated with a cost of US\$5.10 per ton in landfill fees (ReFED, 2025). This demonstrates the dual benefits of food donation in addressing environmental and economic challenges (University of Auckland, 2022). Furthermore, improper

management of food waste in various forms has been a major contributor to outbreaks of water-borne and foodborne diseases, particularly in urban areas (Salemdeeb et al., 2017).

12.2.2 Food Banking Model and Food Redistribution System

The Food Banking Model (FBM) is a community-level solution that addresses both food waste and food insecurity. A food bank is a charitable or non-profit organisation dedicated to sourcing food and distributing it to individuals in need either directly or through partner organisations (Parker et al., 2020). Food sources are diverse but may include direct donations from corporations, individuals, surplus recovery, food grants and purchase.

In practice, food banks exhibit considerable differences in their structures and operations. These differences stem from variation in scope, objectives, resources and cultural contexts (Rivera et al., 2023; Warshawsky, 2025). Nevertheless, core values and principles remain sufficiently flexible, leading to new developments in Sub-Saharan Africa (Moon, 2021).

The FBM is embedded in a broader framework of food recovery known as the Hierarchy of Food Recovery (HFR). The United States Environmental Protection Agency established the HFR as a catalyst for addressing food waste through circularity (United States Environmental Protection Agency, 2018). In the HFR framework, food donation is highlighted as one of the most effective strategies, as it prevents food from being sent to landfills (Mourad, 2016; United States Environmental Protection Agency, 2018).

Some countries require businesses to prevent food waste by donating unsold food to charities (Mourad, 2022). For instance, in France, companies with premises larger than 400 m² are required by law to partner with charities to redirect unsold food to secondary markets as a strategy to mitigate food waste (Condamine, 2020). These partnerships are built on voluntary agreements (European Union, 2024; Fontefrancesco, 2019). A voluntary agreement denotes a non-binding

pact under which parties set shared targets to monitor, measure and implement interventions to reduce food waste in line with SDG 12.3. Examples include The Courtauld (UK) and the France National Pact Against Food Waste (European Union, 2024).

One key characteristic of food banks is their well-established infrastructure, facilities and trained staff to collect, handle and manage food (Food Banking Kenya, 2023; Food Forward SA, 2024). Many food charities in Europe and the United States, such as Feeding America (USA), The Trussell Trust (UK) and the European Food Banks Federation (FEBA), are already practising this model. Food banks rely on volunteers who are recruited periodically to support field and office operations (Woods, 2024). However, the effective execution of food-recovery activities requires adequate resources, facilities, and a conducive policy and legal environment (Rivera et al., 2023). As a result, many food banks operate within strong networks of reliable partners, including both local and international agencies, to secure funding (Kazibwe, 2024).

This is further enhanced through membership in global networks that bring together key stakeholders in the food-donation, recovery and redistribution sector (Moon, 2021). Most importantly, not all food distributed by food banks is surplus; they often purchase food using donated funds. Surplus supply is unpredictable, making it difficult for food banks to rely on it entirely.

12.3 Methods and Procedures

12.3.1 Study Setting

This chapter analyses food donation and recovery efforts of five food banks in Sub-Saharan Africa, mainly those registered with the Global Food Bank Network (GFBN). They are Lagos Food Bank Initiative (LFGI) from Nigeria, Food Banking Kenya (FBK), Food Bank Botswana (FBBT) and Forward Food South Africa (FFSA). Haba na Haba Food Bank (Uganda) is affiliated with the Regional Food Banking Network (RFBN) instead of GFBN. The FBRN primarily

collaborates with Arabic-speaking regions and northern African countries, including Egypt and Tunisia (Food Banking Regional Network, 2025). At the time of analysis, limited information was available regarding other food banks in the FBRN, a network that could be considered in future.

12.3.2 Study Design

This chapter used case study analysis to assess food redistribution by five food banks in Sub-Saharan Africa, as stated in Sect. 12.3.1. Case study analysis is particularly effective in exploratory research designs such as the current analysis and has proven to yield valuable results (University of Auckland, 2022). The analysis relied on organisational reports, mainly annual reports. It focused on the quantity of recovered food (that could have otherwise been wasted), and meals provided, and the beneficiaries served. Some media coverage of related food banking initiatives was also reviewed. Some media coverage of related food banking initiatives was also reviewed.

Food banks were initially identified and screened using the Global Food Banking Network (GFBN) directory. The network listed eight banks operating in Sub-Saharan Africa (SSA) (see Fig. 12.1 for shaded countries). After reviewing each bank, additional inclusion criteria were applied. First, only food banks in English-speaking countries were selected. Second, priority was given to East African food banks to reflect the researcher's context (Tanzania). On this basis, no food bank was listed for Tanzania. However, an emerging one in Kenya, Food Banking Kenya, was identified. A more targeted web search subsequently identified Haba na Haba Food Bank (H&H). Although outside the GFBN, H&H was included owing to its relevance.

Given the focus on obtaining reliable information on total food distributed, donated and food recovered, FoodForward South Africa (FFSA) and the Lagos Food Bank Initiative (LFBI) were prioritised. Yet their reporting standards were not fully comparable. Further searches were conducted via the respective food banks' websites

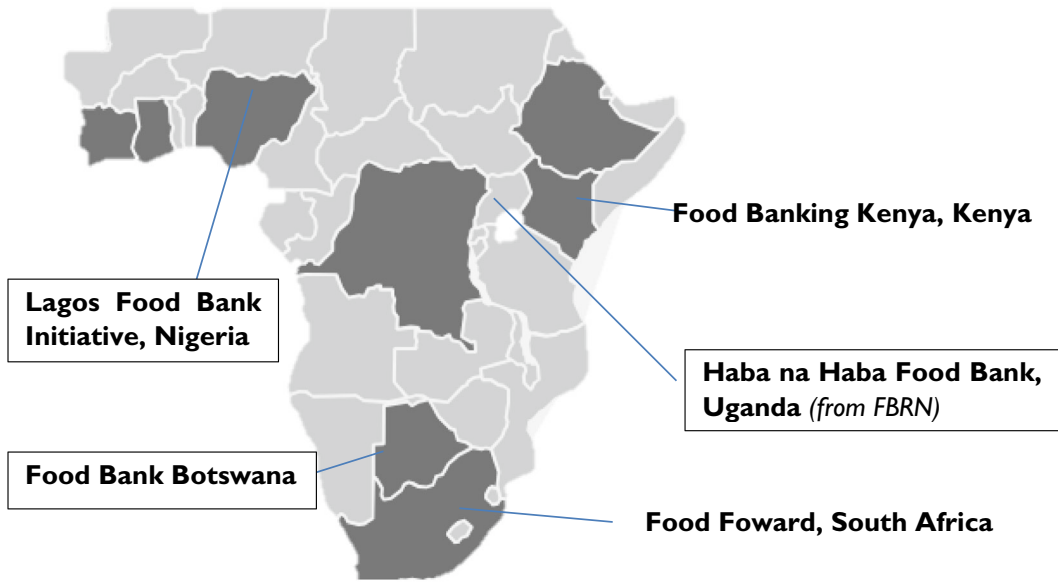


Fig. 12.1 Map of Africa to show selected food banks. *Source* Global FoodBanking Network (2025)

and other online sources. Particular attention was given to data from 2019 to 2024. This period, spanning the years immediately preceding, during, and following the COVID-19 pandemic, was regarded as pivotal for food banking operations.

Additional information, particularly regarding policies and regulations relating to these food banks and associated food-recovery initiatives in Sub-Saharan Africa, was obtained from the Global Food Donation Policy Atlas (GFDPA). The GFDPA focuses on advancing food-donation policies and legislative frameworks (Harvard Law School Food Law & Policy, 2025; Plekenpol et al., 2023). Although they operate independently, the GFBN and the GFDPA collaborate on a wide range of matters relating to food-donation operations and policies.

12.4 Findings

This section analyses food bank supply volumes, sources and beneficiary coverage and characteristics.

12.4.1 Food Bank Profile

Boxes 12.1–12.5 provide profiles of selected food banks: Food Banking Kenya, Lagos Food Bank Initiative, Food Forward South Africa, *Haba na Haba* Food Bank and Botswana Food Bank. The data has been gathered from several sources, including media reports, official websites and the respective food banks' own reports.

Box 12.1: Food Banking Kenya

Food Banking Kenya (FBK) began operations in 2017 and by 2020 had served 170,000 people, a substantial increase from the 26,000 served in 2019. Its agricultural recovery programme, involving more than 600 farmer groups, salvages surplus vegetables, such as kale, carrots, spinach and potatoes, that would otherwise be wasted. Through these efforts, over 55% of donated food is recovered from farms, helping to reduce food loss and waste. For example, in 2022, FBK recovered 296,000 kg from small-scale farmers, commercial farms and processors.

In 2023, FBK distributed more than 1.2 million meals (approximately 628,000 kg of food) to 65,919 people, including more than 10,000 children each day across 11 schools in Nairobi. This was made possible by the efforts of 180 volunteers and the support of local and international partners. Nonetheless, challenges persist, including rural infrastructure constraints, storage and cold-room limitations, and gaps in donation policy Food Banking Kenya, (2023) and Moon (2021).

Box 12.2: Lagos Food Bank Initiative (LFBI), Nigeria

Between 2019 and 2024, LFBI distributed more than 1.5 million tonnes of food to nearly two million people. This food was obtained from multiple sources: corporate donations (31%); food grants; purchases; and recovered surplus (6%; approximately 94,000 tonnes).

The food recovery programme has been prioritised as part of LFBI's strategy to achieve SDG 12.3, which aims to reduce food waste. The principal beneficiaries have been children under 16 years, pregnant women, and older people; other groups include students in school feeding programmes. As a result, by 2024, LFBI's footprint had reached 13 states (36%) in Nigeria.

Source Lagos Food Bank Initiative (2024)

Box 12.3: Food Forward South Africa (FFSA)

Food Forward South Africa (FFSA) is a leading non-profit organisation that addresses hunger and food insecurity

in South Africa. FFSA supports children, women, senior citizens and destitute people with nutritious food. The food distributed is sourced from the FoodShare recovery programme (farms, restaurants and retailers) and is supplemented by donations and purchases.

Through a network of over 2,700 partners, FFSA supports nearly one million people each day, 30% of whom are children (Global Food Donation Policy Atlas, 2022; Woods, 2024). The number of meals provided has more than quadrupled, from 20 million in 2019 to 88 million in 2023. FFSA has expanded its operational footprint, increasing coverage from six provinces in 2019 to nine by 2024. This progress is reflected in an increase in the annual volume of food distributed, from 5,115 tonnes in 2019/20 to 21,760 tonnes in 2023, totalling 60,000 tonnes. In Cape Town alone, over 2,100 tonnes of food were rescued in 2020/21, valued at approximately US\$2.4 million (GreenCape, 2021).

The mobile food distribution system provides access to 29 rural communities and 200 towns each month. For example, greenhouse gas emissions avoided through food recovery increased from 20,000 tonnes to 113,000 tonnes over four years, with more than 8,500 tonnes averted in Cape Town alone. Each kilogram of recovered food yielded an economic value of US\$6.24, totalling US\$13.1 million. However, the lack of a national food-donation policy remains a barrier, underscoring the need for continued stakeholder advocacy for policy and legislative reform.

Source FFSA Annual Reports 2019–2024.

Box 12.4: Haba na Haba Food Bank, Uganda

Established in Uganda in 2015, Haba na Haba Food Bank distributes food to vulnerable populations, thereby contributing to food security and reducing food waste. The bank operates across six geographical regions in Uganda. In 2017, it collected 325 tonnes of otherwise unsold produce, valued at UGX 1 billion (US\$600,000) (Jhingi, 2021). At the peak of COVID-19, the bank distributed over 3.7 million meals (Kisakye, 2022). By March 2024, it had distributed 172,541 kg of food, equivalent to 345,000 meals. The monthly distribution stands at 60,000 meals, translating to approximately 1 million meals annually (Kazibwe, 2024).

Supported by 100 volunteers, the food bank assists around 1.2 million beneficiaries, including schoolchildren, marginalised groups, and families affected by the COVID-19 pandemic, and has distributed more than 1 million meals (Bukede, 2021). The organisation collaborates with more than 70 local and international partners and is part of the Regional Food Banking Network. While it primarily operates in Kampala, its outreach extends to the city's neighbourhoods through community-based organisations.

Source <https://hnhfoodbank.org>

provided significant relief to over 26,000 people, including 500 elderly individuals, 2,000 school children and various organised groups. Additionally, more than 10 local agencies, along with a growing list of support organisations, have joined the effort to combat food waste and reduce hunger.

Source <https://foodbank.org.bw/>

12.4.2 Trend of Food Distributed

Analysis of selected food banks (Boxes 12.1–12.5), together with other reports, indicates that, between 2019 and 2023, about 70,000 tonnes of food were distributed by four food banks. Collectively, this food amounted to more than 235 million meals. Within these efforts, FFSA accounted for more than 95 per cent of the total volume, followed at some distance by the Lagos Food Bank Initiative. Food banks such as FBK, Haba na Haba and Food Bank Botswana also continued to increase their distributed volumes each year. Overall, the majority of the food consisted of cereals and grains, predominantly in the form of low-moisture, dry foods. Fresh produce accounted for a small proportion of the total food distributed.

LFBI's distribution increased by 700 per cent over 2019–2021. Despite earlier growth, the volume of food distributed had fallen by more than 40% by 2023 relative to the pandemic period (2020–2021). FFSA increased its distributed volume from 5,115 tonnes in 2019 to 12,015 tonnes in 2021, an increase of 130% over two years. The bank continued to expand thereafter, albeit at a lower rate (80%) than during the COVID-19 pandemic period (2020–2021). The other banks also recorded varying rates of distribution by 2023, although these observations are based on limited data (Fig. 12.2).

Box 12.5: Foodbank Botswana

In Botswana, one in five people faces severe food shortages. Since 2017, Food Bank Botswana (FBBT) has taken steps to rescue and distribute food, targeting vulnerable groups at risk of hunger. While most efforts remain concentrated in the capital city Gaborone, initiatives to expand coverage are ongoing.

In 2022, FBBT distributed 38 tonnes of food, 10 tonnes of which were recovered from food supply chain players, ranging from farms to consumers. This food

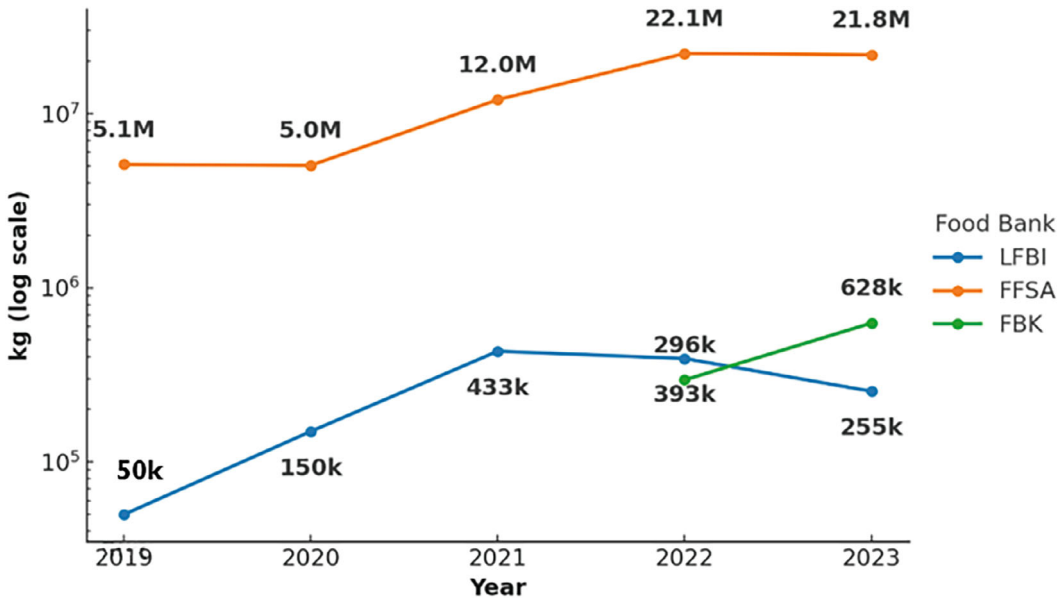


Fig. 12.2 Trends of food distribution (kg) between 2019 and 2023

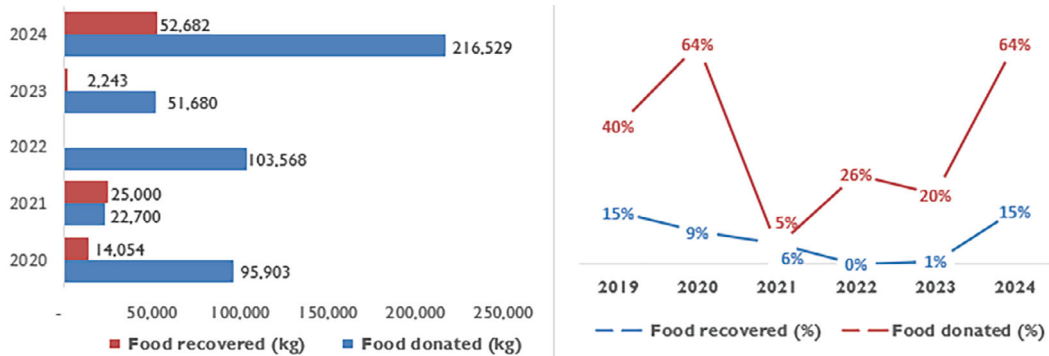


Fig. 12.3 LFBI food donated and recovered between 2020 and 2024 (kg/%)

12.4.3 Surplus Food as a Share of Total Food Distributed

Over the five-year period 2019–2024, the Lagos Food Bank Initiative (LFBI) recovered 94 tonnes (6 per cent) of the 1,572 tonnes distributed. In 2020, recovered food accounted for 9.4% (14 tonnes), falling to 5.8% (25 tonnes) in 2021 and then peaking at 15.4% (52 tonnes) in 2024.

Corporate donations totalled 490,380 kg in 2024, representing one-third of all food distributed. This level fell markedly between 2020 and 2021, but began to rise gradually from 2022, and ultimately peaked again in 2024 (for details, Fig. 12.3).

At Food Banking Kenya, the share of total food distributed that was recovered through agricultural efforts increased from 55% in 2021 to 90% in 2024, through its agricultural food recovery programme.

For FFSA, the organisation has collaborated with partners through its Second Harvest

Programme to recover food directly from farms. This collaboration, centred on Standard Bank (South Africa)’s OneFarm Share and HelloChoice, links commercial farmers with communities in need of food. More than 90% of donations consist of nutritious fresh produce. Similarly, some of Haba na Haba’s food stock in Uganda was reported to be sourced from farms and food-service providers, including restaurants and food stores. Likewise, Food Bank Botswana has more than a quarter of its food sourced from farms, manufacturers and food-service providers.

12.4.4 Beneficiaries Served and Trends (2019–2023)

Figure 12.4 shows that between 2019 and 2023, the food banks served more than five million beneficiaries in total. Annual totals rose by 122%, from 481,000 in 2019 to 1.07 million in 2020. Then beneficiaries served increased modestly to 1.17 million in 2021 and 1.29 million in 2022, before falling to 1.08 million in 2023, a decline of about 16.5% from the 2022 peak.

Growth trends varied across food banks, particularly between the two largest banks for which reliable data are available in this analysis. For instance, LFBI recorded a sharper surge at the onset of COVID-19. Beneficiaries increased by 110% in 2020, compared with 86 per cent for FFSA. Unlike FFSA, LFBI continued to contract

in the post-COVID-19 period (2021–2023). In both food banks, however, the exceptional growth trends observed during the pandemic was not fully sustained thereafter. Among the emerging food banks, FBK reported serving 174,000 people in 2020, up from 26,000 in 2019.

Food banks have extended their services to underserved beneficiaries in rural areas. For example, FFSA has used its mobile rural distribution programme to serve 400,000 people facing food shortages (Food Forward SA, 2024). Other delivery channels include school lunch programmes, such as the school breakfast programme, which serve students. In addition, Food Banking Kenya provided lunch to more than 10,000 students each day in 2023. Meanwhile, the Lagos Food Bank Initiative prioritises pregnant and lactating women, adults at risk of food insecurity, patients and young people.

12.5 Discussion and Future Research Directions

12.5.1 General Trends in Food Distribution

Profiled food banks delivered 70,000 tonnes of food between 2019 and 2023. FFSA accounted for 95% of the total, indicating its significant share within the continent. Its annual distribution jumped from less than 6,000 tonnes in 2019 to over 20,000 tonnes in 2023, indicating an upward

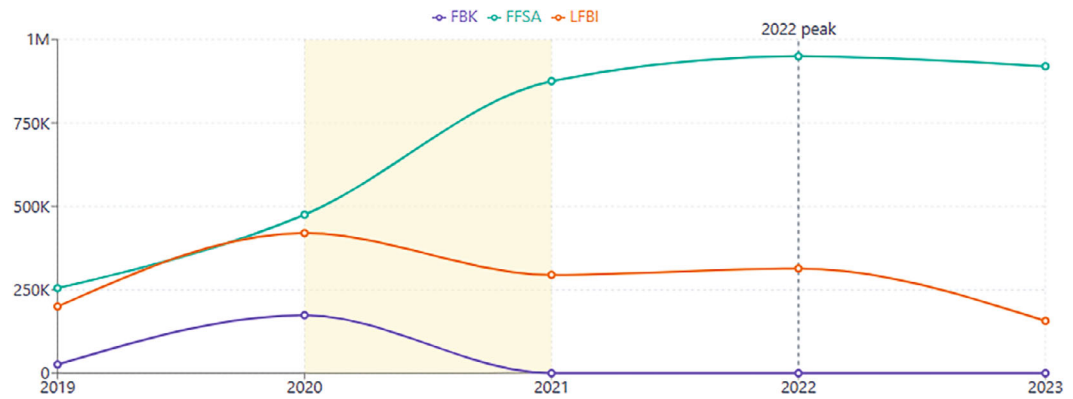


Fig. 12.4 Trends of beneficiaries served between 2019 and 2024

trajectory. The Nigerian food bank, LFBI, also saw an approximate 700% increase in distribution during 2019/2020, followed by a decline as the COVID-19 pandemic slowed. However, distribution reports from several other food banks were inconsistent owing to a lack of reliable data.

Food banks, particularly the larger ones, have extensive national coverage. For example, FFSA has already reached all nine provinces of South Africa, while LFBI currently provides services in 13 states, equivalent to 35% of Nigeria. As expected, emerging food banks, namely FBK, Haba na Haba and Food Bank Botswana, are continuing to expand their coverage from the capital cities. This is evidence of differences in resources, capacities and investment. Disproportionate coverage between rural and urban areas highlights the investment and logistical challenges. However, partnerships make these investments partly feasible, particularly when target groups are served collectively.

12.5.2 The Role of Food Recovery in Total Distribution

Food banks demonstrate mixed results in food recovery. For instance, Lagos Food Bank performed well initially. However, these efforts are hampered as the pandemic sets in, partly due to economic and production disruptions. This trend highlights how surplus supports self-reliance and steadies corporate donations during difficult periods.

Moreover, the acquisition of surplus food indicates that vulnerable communities, such as patients, are better protected during emergencies. Beyond improving access to nutritious food, it also advances broader objectives. For instance, it reduces food loss and waste, preventing greenhouse-gas emissions, lowering waste-management costs, and protecting animal and human health from contamination. The effectiveness of food recovery has been demonstrated through collaborative efforts between food banks and other stakeholders. Acting as a bridge,

food banks connect beneficiaries and donors, increasing the efficiency of recovery and reducing the likelihood that edible food becomes waste. Clear partnerships in Kenya, through farmer networks, and in South Africa, through the Second Harvest Program, provide models that other food banks or recovery organisations can adapt and scale.

Nevertheless, reporting on food recovery remains problematic. Although nearly every food bank targets food waste reduction, data are often incomplete. LFBI appears to perform particularly well, largely because it disaggregates data by food source. Large food banks can cover costs such as transport and redistribution, while smaller banks may focus on low-cost food recovery efforts. However, further analysis of the costs and logistics of food recovery is required if scaling such solutions is to be prioritised.

One limitation of surplus donations is their concentration at the production stage. While other actors, such as restaurants, are mentioned by studied food banks, there is insufficient evidence to substantiate their contribution to the food distributed. This may reflect an inherent lack of donor-liability protection, prompting activities to occur informally. Supportive food-donation policies could trigger systematic documentation of sources and enable tracking against broader sustainable-development goals, particularly Target 12.3.

12.5.3 Food Bank Usage Trends

Between 2019 and 2023, there was a dramatic surge in the number of people relying on food-bank provision. The increase of 122% at the outbreak of COVID-19 reflects weakening economic systems and contraction in employment. These efforts were part of the global food banks' response to the COVID-19 pandemic in 2020/2021 (Moon, 2021). Again, the thriving of food banks during the pandemic serves as a testament to their resilience, adaptivity, innovation potential and knowledge of regional needs and partnerships. For example, LFBI continued to

register new users; beyond systemic food insecurity, rising unemployment increased the number of dependents and those in need. Several countries, such as South Africa, Uganda and Kenya, enforced strict lockdowns, in some areas lasting more than a year.

Conversely, the continued dependence on food-bank support in urban areas in the post-pandemic period demonstrates unresolved poverty and persistent food insecurity. While food banks cannot on their own provide strategic solutions to these structural problems, the findings call on government and other stakeholders to address the root causes of poverty and food insecurity.

12.6 Conclusion

This chapter underscores food recovery and redistribution as among the most effective preventive strategies for reducing food loss and waste while simultaneously enhancing food security. However, evidence on surplus food recovery in sub-Saharan Africa (SSA) remains dispersed and often inconclusive. The chapter sought to identify and map food distribution efforts among five selected food banks and to examine how such humanitarian endeavours impact both community wellbeing and the broader food system.

The findings show that food banks successfully redistributed about 70,000 tonnes of food to more than 5 million vulnerable people between 2019 and 2023. During the COVID-19 pandemic, food banks served as critical safety nets in times of crisis. Beyond contributing to the fight against hunger, food banks have also helped to prevent significant amounts of greenhouse gas emissions. Food bank activities remain largely concentrated in urban areas. Nevertheless, expanding farmer partnerships and the adoption of new technologies indicate a positive trajectory towards extending their reach into rural communities. Food sources continue to be dominated by corporate donations, although increasing contributions from both smallholder and large-scale farmers are strengthening distribution streams. Nonetheless, reporting challenges, especially the lack of disaggregated

data on food sources, persist and undermine effective planning and decision-making.

The success of food recovery and redistribution efforts in SSA is closely tied to local partnerships, adaptability, and flexibility. Addressing post-harvest losses requires integrated prevention and recovery measures across all levels of the food chain, including retail and consumer sectors. Achieving this will depend on supportive food donation policies, the integration of digital technologies, sustained financial investment, and broad stakeholder engagement. Further research is urgently needed to examine management strategies for surplus food in downstream supply chains, as well as the associated costs and regulatory frameworks.

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Sub-Saharan Africa's Youths as Change Agents for Sustainable Food System Transformation: Evidence, Challenges, and Opportunities

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13.1 Introduction

Recent studies have advocated for a shift toward sustainable food systems as a response to global and regional challenges in Africa such as climate change, environmental pollution, ecosystem degradation, malnutrition, ongoing conflicts and instability, inefficient supply chains, population growth among others (Akinola et al., 2020; Rahmann et al., 2020; Ulimwengu, 2024). The sustainable transformation of Africa's food systems is crucial to ensure the system delivers nutritious diets, secures decent livelihoods for all actors along the food value chains, and does so in a manner that supports environmental sustainability. The urgency of transforming the food system is underscored by demographic trends (Klingholz, 2020; Thornton et al., 2011). By 2050, Africa's population will reach approximately 2.5 billion people (United Nations Economic Commission for Africa, 2024). A significant portion of this growth will be concentrated among the youth population projected to exceed 830 million (Bekele-Thomas & Westgaard, 2024).

The agricultural sector has been perceived as an unattractive sector for young people due to its association with subsistence farming, manual labor, and limited financial returns (Henning et al., 2022; Ude, 2020). This has led to youths seeking employment opportunities in urban centers, resulting in rural–urban migration and a decline in the agricultural workforce (Dokubo et al., 2023; Thibane et al., 2023). However, some youths are beginning to challenge these narratives by constructing and performing new identities as modern, entrepreneurial farmers and agripreneurs, thereby setting themselves apart from the traditionally stigmatized image of smallholder farming, and by doing so, redefining what it means to engage in agriculture (Mwaura, 2017). One key factor shaping youth engagement in agriculture is the shift from subsistence-based to market-oriented agricultural activities (Abubakari, 2016; Leavy & Hossain, 2014), which has broader implications in positioning youth as agents of change in reshaping food systems.

The need to accelerate food system transformation in Africa is well established. However, existing literature and policy discussions have not paid sufficient attention to the central role of youth in this process. While some studies (e.g., Gashu et al., 2019; Kalibata, 2022; Moseley & Battersby, 2020) have extensively documented the challenges facing African food systems, a limited synthesis remains on the agency of youth in addressing these challenges. In addition, when discussing youth, there has been more

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studies focused on barriers to their participation rather than on the strategies they use to overcome these obstacles and actively drive food system transformation. Given the current population demographics, understanding the contributions of youths to the transformation of sustainable food systems are critical for shaping policies and interventions that support their efforts (Barzola et al., 2019; Piselli et al., 2019). Further, the need for this chapter is justified by the increasing emphasis on sustainability in global food policies. Visions for the United Nations' Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger) and SDG 12 (Responsible Consumption and Production), need to be translated into impact through systemic changes in agriculture and food systems (Joint SDG Fund, 2023; United Nations, 2023). Given that African youth are at the forefront of adopting sustainable farming practices, utilizing technology to reduce inefficiencies, and building resilient agribusinesses (Lohento & Ajilore, 2015; Mureithi, 2023; Ulimwengu, 2024), understanding their contributions is key to achieving these goals.

This chapter's objective is to synthesize evidence on the role of youth in Sub-Saharan Africa in driving the transformation of food systems toward sustainability. Under the African Union (2006), youth are defined as individuals aged 18 to 35 and this categorisation is adopted in this chapter. However, it is acknowledged that the definition of youth differs depending on national and cultural contexts.

The rest of the chapter is structured to synthesize the role of youth in transforming Africa's food systems toward sustainability. Section 13.2 presents the methodology, Sect. 13.3 discusses seven key areas of youth-led innovation: youth-led efforts toward regenerative agriculture (Sect. 3.1), the adoption of technologies for efficiency and productivity (Sect. 3.2), the foundation of circular food economy solutions (Sect. 3.3), engagement in agro-processing and value addition (Sect. 3.4), the expansion of sustainable agribusiness to enhance rural resilience (Sect. 3.5), promotion of inclusivity and shared economic benefits in agricultural transformation (Sect. 3.6), and the selected impacts and outcomes of

youth-led agricultural transformation (Sect. 3.7). In Sect. 13.4, challenges faced by young farmers and agripreneurs are discussed, and opportunities and strategic directions for the future are outlined. Section 13.5 concludes the chapter. By providing evidence on how young people are transforming food systems, this chapter aims to inform policy and investment and capacity-building strategies that can enhance the impact and scalability of youth-led food-system transformation.

13.2 Research Methods

This chapter employs a non-systematic narrative synthesis approach to explore the role of Sub-Saharan Africa youths as agents of change in transforming sustainable food systems. The approach offers a broad and interpretive analysis of relevant literature, highlights the diverse factors that influence youth engagement in sustainable agriculture and food systems, as well as the challenges and opportunities they face in driving this transformation. Rather than attempting to comprehensively cover all existing publications, the literature selection process prioritized studies based on their relevance to the research questions and contributions to the understanding of youth-driven change within the context of sustainable food systems in Sub-Saharan Africa. Key resources were sourced from academic journals, policy documents, and reports from development agencies, with targeted searches conducted in databases such as PubMed, Web of Science, and Google Scholar. In addition, blogs, articles, and reports from international media outlets, research institutes and academic institutions focusing on youth and agricultural innovation in Africa were also included to capture emerging trends, on-the-ground case studies, and real-time reports on youth engagement in agriculture and food systems transformation. These sources provided wider perspective, insights and up-to-date information that may not yet be available in peer-reviewed academic literature. The search terms were carefully developed to align with the seven key areas of youth-led innovation explored in this review. Exclusion criteria eliminated studies outside the

Sub-Saharan African context, not addressing youth-specific roles or contributions, non-English sources, and opinion pieces or content lacking sufficient evidence or relevance to the themes of the review.

13.3 Results and Findings

The call for a transition to regenerative food system is not new, but it has recently gained increasing advocacy (Buckton et al., 2024; Dahlberg, 1994; Loring, 2022). A regenerative food system offers numerous interconnected benefits. It improves soil health and water retention, making land more productive over the long term; enhances biodiversity both above and below ground, significantly contributes to carbon sequestration while helping to mitigate climate change (The Nature Conservancy, n.d.; Kretschmer, 2024). By reducing dependence on synthetic inputs and promoting nature-based solutions, regenerative systems support climate-resilient livelihoods, particularly for smallholder farmers. Beyond these benefits, regenerative food system places dietary health, especially of young people, at their core, increase food security by creating more diverse and stable food sources, and at the same time strengthen communities through local and equitable food networks (Doherty et al., 2022; Duncan et al., 2020). This section illustrates how, through collective action, African youths are pushing the food system toward sustainability and highlights projects and initiatives of the youths, many of whom have been recognized as Youth Agri-Champions (BKMC, 2024).

13.3.1 Youth Are Leading Efforts Toward Regenerative Agriculture

Regenerative agriculture has emerged as one of the transformative approaches to regenerative food systems. The essential pillar is focused on improving soil health, enhancing biodiversity, and increasing resilience to climate change in food systems with a broader goal to improve the social

and economic aspects of food production alongside the environment (Ntawuhiganayo et al., 2023; Schreefel et al., 2020). Given the high rate of soil degradation across Sub-Saharan Africa, where nearly 65% of agricultural land is classified as degraded (Zingore et al., 2015), the role of youth in scaling up regenerative farming practices is crucial. Young farmers, with their openness to innovation, capacity for knowledge transfer and willingness to experiment with non-traditional approaches, are spearheading efforts to promote regenerative agriculture (Maina & Maina, 2012; Nkonki-Mandleni et al., 2022).

Youth across Africa are playing a pivotal role in advancing sustainable farming practices, mainly through agroecological transformation and capacity building for resilient agriculture. In countries such as Kenya, Rwanda, Zambia, and Nigeria, young agripreneurs are leading initiatives that integrate crop rotation, composting, agroforestry, biodiversity conservation, vertical gardening and organic pest control to enhance soil health and protect ecosystems (BKMC, 2024). Specifically, young farmers are heading initiatives that promote sustainable farming practices, such as Green Treasures Farms in Kenya and ProtectOzone in Nigeria, which are mobilizing youth to adopt agroecological methods that enhance soil health and improve agricultural productivity (Green Treasures Farms, n.d.; Sipasi, 2019). Similarly, innovative community-based approaches, such as Konservation engage other young professionals in environmental conservation activities (Konservation. (n.d.)).

Urban youth-led projects such as the Tukuze Shambani project are transforming dumpsites into productive farms in informal settlements, while coastal regions are witnessing youth-driven revitalisation of climate-adaptive value chains through conservation farming (BKMC, 2024). These efforts often combine technical training, farmer field schools, and equipment access to empower smallholder farmers, especially women and other marginalized groups, thereby anchoring sustainability in inclusive, grassroots innovation. Beyond farming, youth-led initiatives are driving innovative solutions that reduce agricultural waste. In Zimbabwe, maggot farming has

emerged as a circular agricultural practice in which organic waste is converted into nutrient-rich livestock feed by young people (Matiashe, 2021).

In parallel, youths are at the forefront of implementing climate-smart agriculture (CSA) technologies and approaches that drive adaptation and resilience. Across Ghana, Nigeria, Kenya, Zambia, Rwanda, and Tanzania, young innovators are promoting solar-powered irrigation systems, drought-resilient crop varieties, and bio-fertilizer production to mitigate the adverse effects of climate variability. As part of the AfriEvolve project, Nature Kenya has provided support to youth groups working on climate change adaptation (Mateche, 2023). Climate-smart demonstration farms managed by youth-led organizations, for example, Gracious Mission Community Based Organization in Kenya, provide training on climate adaptation. In contrast, other youth-led initiatives focus on CSA practices such as intercropping, water conservation, and energy-efficient farming tools (BKMC, 2024). These initiatives integrate traditional knowledge with emerging digital and ecological solutions, ensuring scalability and community relevance. By leading CSA interventions, young people are addressing environmental challenges and also transforming agriculture into a more inclusive and economically viable livelihood pathway for themselves and their communities.

13.3.2 Youth Are Pioneering and Adopting Technologies for Efficiency and Productivity

Despite the growing discourse around digital transformation in agriculture, many structural and systemic challenges limit the scalability, inclusivity and impact of digital innovations across Africa. Unequal access to digital infrastructure, limited digital literacy, gender and rural–urban divides, and affordability constraints remain key barriers preventing widespread adoption among smallholder farmers. To address these issues,

African youth are driving digital agriculture by enhancing efficiency, productivity, and sustainability through innovative agritech start-ups that offer digital solutions.

Specifically, the role of digital platforms in market access is one area where youth are driving change. Limited access to markets has long been a significant challenge for African farmers, leading to post-harvest losses and low farmgate prices. E-commerce and digital logistics platforms, including KivuGreen (Democratic Republic of Congo) and the Farmerline platform (Ghana), are either linking farmers and agro-processors or providing direct-to-consumer sales channels, eliminating middlemen, and reducing the dependency on informal markets. Platforms such as Soupah Farm-en-Market and Farmcrowdy (Nigeria), Agromyx (Ghana) and Kiasili Farm (Kenya) are addressing gaps in farm financing and trade by connecting smallholder farmers with investors, buyers, and providing financial literacy training, and other essential e-commerce opportunities to farmers (Restrepo et al., 2023; BKMC, 2024; Hillsdon, 2024). In Uganda, a youth-led initiative, AgroSupply, has developed a digital layaway platform that enables farmers to save and prepay for agricultural inputs such as seeds and fertilizers (Africa Eats, 2020). This model addresses financial barriers by providing an alternative to traditional credit systems, which often exclude smallholder farmers. Research on blockchain applications in agriculture suggests that these systems enhance transparency, reduce fraud, and increase trust among farmers, buyers and financial institutions (Adewusi et al., 2023).

Another example of African youths driving digital agriculture for efficiency is the development of precision farming tools. Precision agriculture involves using real-time data, sensors, and satellite imagery to optimize farm inputs such as water, fertilizers, and pesticides. Youth-led start-ups such as Lifeline Technologies, Grain-Mate, and Rural Farmers Hub have developed AI-based technologies that map fields, detect diseases and enhance farm productivity (el-Kurebe, 2025; Obonyo, 2023). The Africa drone

academy in Malawi has also been set up with similar objectives (Chagara, 2020). Another area where digital agriculture transforms food systems is mechanization and farm equipment access. Youth-led agritech ventures are addressing the problem of limited access to farm machinery, which has historically constrained productivity in rural areas. One of the successful initiatives is Hello Tractor, which utilizes a mobile app to connect smallholder farmers with tractor owners, providing them with affordable and timely access to mechanization services (Daum et al., 2021).

Web and mobile platforms are also important in supporting youth in agribusiness. In Uganda, the Farm Kiosk mobile application is helping address land access challenges faced by young agripreneurs. The platform identifies and profiles landowners open to leasing their land for agricultural use, making this information accessible nationwide (Do4Africa, 2021). Through connecting prospective agribusiness operators with available land, the app creates new pathways for youth participation in farming, facilitates inclusive access to productive resources and promotes agribusiness growth.

Youth-led technology-driven solutions also bridge information gaps, facilitating timely access to agricultural advice and enhancing decision-making among farmers. In Kenya, Plant Doctor provides farmers with advisory services, knowledge and resources for sustainable farming. In Ghana, the Farmerline platform provides voice-based extension services in local languages, which ensures accessibility for farmers with low literacy levels (Boothoo, 2024). Similarly, IPREN is providing farmers in Niger with digital climate adaptation solutions and best agronomic practices (Draganov, 2023). In addition, digital disease and pest monitoring tools, powered by digital or renewable energy, from Farmer Life-line Technologies, Kenya, AgriTech Analytics, Kenya, and AgriPredict Zambia offer early warning systems that help farmers mitigate risks and improve yields (African Development Bank Group, 2022; Torvaney, 2021). By capitalizing on technology, these initiatives are enhancing farm efficiency and strengthening Africa's food systems.

13.3.3 Youth Are Laying the Foundation for a Circular Food Economy

The traditional linear model of food production, characterized by excessive resource extraction, high levels of food waste and environmental degradation, is increasingly proving unsustainable. Sub-Saharan Africa loses an estimated 37% of food produced post-harvest (Kaminski & Christensen, 2014). This loss is attributed to inadequate storage, inefficient logistics, and market bottlenecks (Affognon et al., 2015). At the same time, the region faces mounting environmental challenges, including plastic pollution, soil degradation, and greenhouse gas emissions from organic waste (Adeniran et al., 2022; Tully et al., 2015). In response, emerging evidence highlights the potential of food waste valorisation to address both post-harvest losses and environmental concerns. By converting waste into valuable products, such as compost, bioenergy, or animal feed, these practices contribute to environmental sustainability and create new economic opportunities, particularly for youth-led enterprises. Notably, African youths, with their technological adaptability and entrepreneurial drive, are at the forefront of this transformation.

The growing demand for sustainable and nutritious food products among consumers has prompted youth-led agribusinesses to explore innovative methods for converting surplus or discarded food into value-added products. INNOV Tech in Benin produces innovative solutions and trains farmers on using these solutions to produce compost from organic and agricultural waste (Musmanni, 2023). Kisumu Innovative Youth Agripreneurs (KIYA) in Kenya source organic waste from local markets and convert it into high-quality compost. This approach supports sustainable agriculture in the region by decreasing dependence on synthetic fertilizers. Similarly, in Ghana, Green Africa Youth Organization promotes environmental sustainability and community well-being through one of its key initiatives (the Sustainable Community Project), which is a localized waste management program

that incorporates composting, recycling through art, and the production of charcoal briquettes from agricultural waste. The project is working toward establishing a zero-waste framework tailored to the needs of rural–urban communities (Sano, 2022).

Another rapidly growing sector within circular food economies is insect farming for the production of alternative proteins. By integrating insect farming into food production systems, young entrepreneurs are reducing organic waste and emissions, and creating affordable, nutrient-rich feed solutions for the aquaculture industry. In many African countries, Youth-led startups are pioneering the use of insects as sustainable alternatives to traditional protein sources for animal feed. Specifically, youth-founded agribusinesses in Ghana and Uganda, i.e., West African Feeds and Akatale on Cloud, respectively, use organic waste to feed black soldier fly larvae, which are then processed into high-protein animal feed and organic fertilizer (Global Center on Adaptation, 2022). Studies have shown that insect-based protein production requires significantly less land, water, and feed compared to soybean- and fishmeal-based animal feed sources (Quang et al., 2022; Adetunmbi, 2023).

Biogas and renewable energy production from agricultural waste are also emerging as crucial components of circular food economies, with young people playing a central role in scaling these technologies. In Uganda, Eco-Fuel Africa (EFA) employs user-friendly technology to convert locally sourced biomass waste into clean cooking fuel. Similarly, a youth-led collective in Cameroon transforms pig manure, cow dung, and household waste into biogas, which is one innovative approach to sustainable energy production (ELISA, n.d.; Climate Chance, n.d.). In Uganda, Bio-Green Technology is developing sustainable innovations for the energy sector. Its flagship product is a compact household biodigester that converts organic waste such as agricultural residues and kitchen scraps into biogas (Elkhoully, 2023).

These innovation addresses multiple challenges simultaneously, ranging from reducing deforestation caused by reliance on charcoal and firewood, lowering methane emissions from decomposing organic waste, to providing an alternative revenue stream through the sale of biogas and biofertilizers.

Sustainable packaging solutions are another avenue through which youth entrepreneurs contribute to reducing food waste. The overuse of plastic packaging, particularly in urban areas, has led to a growing environmental crisis across Africa, with plastic pollution contributing to soil and water contamination (Ugoeze et al., 2021). Youth-led NGOs and social enterprises are addressing this issue by either advocating for change, supporting policies that ban single plastic use or are developing biodegradable and compostable packaging alternatives (SustyVibes. n.d.; Wachaya, 2023). TileGreen, U-Recycle Initiative, and United Youth Initiative for Africa exemplify how youth-led organizations are deploying mobile platforms, incentive-based recycling systems and community engagement tools to promote plastic waste reduction (Wachaya, 2023). In Kenya, young entrepreneurs produce cassava starch-based bioplastics that are eco-friendly alternatives to plastic bags and containers (Jeet, 2025; Muiruri, 2020). In Côte d'Ivoire, AGRIBANANA repurposes waste from banana plants into environmentally friendly materials such as biodegradable packaging, paper-based products and natural fibers. Similarly, Kenya-based Rethread Africa works with small-holder farmers to upcycle agricultural residues into sustainable bioplastics, which offer green alternatives for industrial use (GoGettaz, 2024). Similar ventures across Africa use banana fibers and sugarcane bagasse to manufacture biodegradable food packaging to reduce environmental pollution and support circular economy goals. These initiatives offer sustainable alternatives to single-use plastics while also creating green jobs and adding value to agricultural by-products (PAFO-COLEAD, n.d.).

13.3.4 Youths Are Actively Involved in Agro-Processing and Value Addition

Agro-processing and value addition play a vital role in transforming food systems. It offers practical solutions for improving farmer incomes and contributing to food security. Young people increasingly engage in agro-processing and value addition as producers and innovators. Youth-led agribusinesses are exploring new ways to preserve food, develop nutrient-rich products and apply environmentally responsible processing methods. A primary drive behind the growth of youth-led agro-processing ventures in Africa is the persistent issue of post-harvest losses, which continue to undermine agricultural productivity and food security across the continent.

In response to these systemic challenges, young innovators are developing affordable, energy-efficient technologies that aim to preserve the quality and extend the shelf life of agricultural products. For example, in Tanzania, an enterprise known as SokoFresh has implemented solar-powered cold storage units that enable smallholder farmers to retain their produce for longer periods, allowing them to target higher-value urban markets and reduce income volatility (Nyaguse, 2022). Across Africa, numerous youth-run businesses are processing raw food for both domestic and international markets (Yami et al., 2019). These ventures create opportunities for farmers, processors, and distributors and contribute to industrialisation within the agricultural sector. Young entrepreneurs are also taking advantage of innovation and direct-to-consumer models to add value to local crops such as cassava and rice, while others process mangoes, bananas, or overripe fruits into healthy snack bars, effectively reducing post-harvest losses (Cross-Boundary Group, 2025; Top Africa News, 2022). By shifting focus beyond primary production, these young agripreneurs are helping to create new markets, generate employment and drive rural development. Their contributions point to

the broader potential of agro-processing as a pathway to more resilient and inclusive agricultural economies.

Another area led by youth is addressing malnutrition through biofortification, which enables the production of a wide range of nutrient-rich and functional foods (Okezie-Odoemene, 2018). In addition, young food entrepreneurs are processing indigenous and orphan crops such as millet, sorghum, and baobab into fortified flour, snacks and beverages (Okezie-Odoemene, 2018). These crops, which are often rich in essential nutrients, are naturally adapted to local environments, require fewer inputs, withstand harsh conditions and are ideal for sustainable agriculture. By commercializing these underutilized crops, youth create new income opportunities and value chains while also helping preserve agricultural biodiversity and cultural food heritage.

13.3.5 Youths Are Expanding Sustainable Agribusiness to Enhance Social and Economic Resilience of Rural Areas

Sustainable agribusiness models are critical in ensuring Africa's food systems become more resilient, equitable and economically viable. With agriculture being a large employer of labor in rural areas in Sub-Saharan Africa, reforming it to embrace sustainability is both an environmental necessity and a key economic opportunity (Christiaensen & Maertens, 2022). Young entrepreneurs in Africa are increasingly seeking avenues to unlock new sources of capital and expand sustainable agribusiness while contributing to the social and economic development of rural areas.

Crowd-farming, also known as agricultural crowdfunding, is an emerging financing model that takes advantage of digital technology to connect multiple investors with agricultural enterprises. This approach has gained increasing popularity due to the widespread availability of online platforms and mobile payment systems. It offers

a practical solution to one of the key challenges which young farmers face, i.e., limited access to capital, by enabling individuals or groups to co-invest in farms and receive a portion of the returns. In Nigeria, for example, Farmcrowdy has transformed agricultural investment by linking smallholder farmers with sponsors who fund essential inputs, mechanization and farm expansion (Amuzu & Sarpong, 2019). Studies suggest that such platforms broaden access to finance and enhance farm productivity and incomes for beneficiaries (Akinwale et al., 2023; Stamborowski, 2023; Sylla, 2023).

Another rapidly expanding model is the cooperative approach, where youth form collective enterprises that provide shared resources, training, and market access. Unlike traditional farming cooperatives, youth-led agribusiness cooperatives and organizations are integrating modern management practices and technologies to optimize operations. YESRUD Uganda, and Omia Agribusiness Development Group Ltd are examples that demonstrate how cooperative models can empower African farmers by providing high-quality agricultural inputs, expert guidance, and access to reliable markets to boost productivity and sustainable income (FAO, n.d.; Yakazi Network, 2024).

Beyond financing and market access, young entrepreneurs are also integrating regenerative agritourism and eco-farming enterprises into their business models. Regenerative agritourism, which combines sustainable farming with tourism, offers an alternative revenue stream while promoting awareness of sustainable agricultural practices. Examples include Mazizi agritourism farm in Malawi and Ndanifor permaculture ecovillage in Cameroon, which provides people from urban areas and international visitors with hands-on experiences in farming, creating an additional income source for local communities. Crucially, these models help bridge the rural–urban divide by connecting consumers directly to food producers and increasing demand for locally sourced agricultural products.

13.3.6 Youths Are Promoting Inclusivity and Shared Economic Benefits Along the Path to Agricultural Transformation

African youth-led farms, agribusinesses, and initiatives are critical in promoting inclusivity, ensuring just and equitable livelihoods and empowering women and vulnerable groups across the continent. Many youth-led agribusinesses are actively creating inclusive models that prioritize gender equity and the participation of marginalized groups (BKMC, 2024). For example, initiatives such as M-Omulimisa and AgroCenta have developed platforms and services that provide women farmers with digital financial literacy and access to digital tools and resources, including land that was traditionally denied to them due to structural inequalities (WSA, n.d.). Others, such as Guzakuza, deliver support and resources to women entrepreneurs to help them grow and succeed in agribusiness (Donkor, 2023). These initiatives empower women to become financially independent and recognized contributors to local economies.

Similarly, youth-led agro-processing ventures and value chain enterprises consciously employ women, persons with disabilities, and unemployed youth in production, packaging and distribution. This creates dignified work opportunities while promoting economic inclusion. In Ghana, for instance, the Agrocenta platform is helping to remove barriers smallholder female farmers face in accessing financial services, supporting thousands of women within cooperatives in the transition to well-established and structured enterprises, thereby enabling these farmers to sell directly to large buyers and bypassing middlemen (GSMA, 2019). Through youth-led projects such as Onion Doctor and Nabahya Food Institute, smallholder farmers, particularly women and youths, have gained access to improved seeds, along with training in climate-resilient farming practices (Global Center on Adaptation, 2025).

13.3.7 Selected Impact of Youth-Led Agricultural Transformation

Youth-led agricultural initiatives across Africa deliver transformative outcomes in productivity, sustainability, and resilience. These efforts have accelerated the adoption of CSA, promoting sustainable farming practices and enhancing decision-making through data-driven tools and training (Amuzu & Sarpong, 2019; Restrepo et al., 2023). Initiatives driven by youths have also supported the development of precision farming technologies, resulting in reductions in input costs and yield increases (BKMC, 2024). Mechanization, and improved access to farm equipment have helped reduce labor burdens, while renewable energy innovations such as biogas and solar-powered irrigation systems have improved environmental sustainability. These activities bridge the divide and support environmental goals and financial inclusion (Amuzu & Sarpong, 2019; Yakazi Network, 2024). Many youth-led ventures have pooled resources from multiple investors to finance agricultural growth, making capital more accessible for youth-led innovation (Africa Eats, 2020; Restrepo et al., 2023).

These efforts also generate strong social outcomes. Youth initiatives are transforming post-harvest management, reducing agricultural waste and reshaping food systems to be more efficient and inclusive (Adeniran et al., 2022; Matishe, 2021). Innovative approaches such as food waste upcycling, sustainable packaging, and using discarded or underutilized materials for farming infrastructure are promoting circular economy principles. Surplus and “ugly” produce are upcycled into value-added products, while agro-processing innovations open new income streams and enhance food security (BKMC, 2024). Supply chain solutions are being streamlined through digital traceability and logistics tools, expanding market access. These efforts also support inclusive growth by creating opportunities for women and marginalized groups through targeted training, access to climate-resilient technologies and leadership development (BKMC, 2024; Boodhoo, 2024). Beyond individual gains, these youth-led

innovations are catalyzing structural shifts in rural economies. Through new agri-based enterprises and value chains, youths generate employment, stimulate rural entrepreneurship, and reduce youth migration to urban centers. Collectively, these outcomes position African youth as beneficiaries and active instigators of sustainable food system transformation across the continent.

13.4 Challenges and Opportunities

13.4.1 Key Challenges and Strategic Recommendations

Although these small-scale successes demonstrate the transformative potential of young agripreneurs, a widespread impact may remain elusive due to structural, institutional and infrastructural challenges, such as limited access to land, financing, and markets, inadequate digital infrastructure, and weak policy support. Regulatory hurdles such as ambiguous food waste recycling laws and complex licensing processes further inhibit youth from formalizing or expanding their ventures. Capital-intensive technologies, such as biogas systems and agro-processing facilities, are often out of reach for many young entrepreneurs due to the lack of affordable, risk-tolerant financing. These constraints are especially acute for marginalized youths in rural areas. Overcoming these barriers will require comprehensive, youth-focused interventions that span policy reform, infrastructure development, tailored financing, and skills enhancement.

To address these challenges, governments should expand access to land for youth, including through lease arrangements and land tenure reform. Regenerative agriculture training and extension programs should be developed with a focus on the specific needs of youth. Dedicated financing instruments are needed to support youth-led start-ups and cooperatives. For example, youth-inclusive financing mechanisms, such as credit guarantees, start-up grants, and

blended finance models, can de-risk youth investments in value-added enterprises. Embedding regenerative practices into national agricultural strategies is necessary to help scale their adoption. Also, national digital literacy campaigns targeting youth should be put in place to build the capacity required to use digital technologies to their advantage. Strategic investment in rural digital infrastructure, including broadband and mobile connectivity, is also urgently needed.

Governments should develop clear and supportive regulatory frameworks that support recycling. At the same time, financial products tailored to circular economy ventures, such as green loans or impact investment funds, are necessary to scale capital-intensive innovations. Infrastructure for waste collection, processing, and distribution should be expanded, alongside public–private partnerships and innovation hubs that promote circular solutions, which youths can use to their advantage. Rural areas often lack the energy, storage, and transportation systems necessary to support agro-processing and value-added operations. Addressing these challenges requires investment in agro-processing infrastructure, particularly targeting youths in underserved regions. Enabling policies and targeted capacity-building programs for youths can strengthen cooperative models and drive innovation ecosystems in agro-processing.

Attracting more youth into agriculture is pivotal to the successful and sustainable transformation of the food system. Recognizing that the perception of agriculture by many young people needs to be changed through rebranding agriculture as a modern, innovative and opportunity-rich sector is an important first step. This can be achieved through early exposure to agribusiness education in schools, practical training and integration of agriculture into entrepreneurship curricula. Highlighting successful youth agripreneurs through media and peer-led mentorship programs can inspire new entrants. In addition, supporting youth-led agribusiness hubs and providing start-up incentives for first-time young farmers are critical steps.

13.4.2 Future Opportunities

Africa's large youth population offers a strategic demographic advantage that, if effectively harnessed, can serve as a driver of transforming food systems toward sustainability, resilience, and inclusivity. This demographic trend presents several interlinked opportunities. First, a large youth population represents a good source of labor and entrepreneurial energy in a sector often characterized by older farmers. Youth bring creativity, are less resistant to change, are more likely to adopt new technologies, experiment with novel production methods, and challenge outdated practices. Second, youth are highly engaged with digital technology. Many youths are already utilizing mobile phones, social media, and digital platforms in innovative ways. This presents an opportunity to scale up digital agriculture by utilizing tools such as mobile apps, remote sensors, or online marketplaces to enhance farm productivity, connect farmers to buyers, and provide access to vital information and financial services.

Third, the youth population provides a latent market for food system transformation. As producers and consumers, young people shape food preferences, value propositions and consumption patterns. Their growing demand for healthy, ethically sourced and climate-conscious food creates market incentives for sustainable production and value addition, and opens opportunities for ethical, sustainable agribusinesses. Fourth, Africa's youth are increasingly speaking up and organizing themselves to demand change. Their involvement in community projects, advocacy, and entrepreneurship shows their potential to help influence food policies and reshape food systems from the ground up. Lastly, Africa's youth offer a cultural and creative capital that can rebrand agriculture, making it aspirational, innovative and relevant to contemporary identities. This redefinition of agriculture will encourage more young people to view farming as a viable and reliable livelihood. It will also help to shift public perceptions and support broader efforts to transform Africa's food system.

13.5 Conclusion

The transformation of Africa's food systems is crucial. It fundamentally depends on its youth's engagement, innovation, and leadership. As this chapter demonstrates, young people across the continent are challenging traditional perceptions of agriculture through their efforts to provide solutions that integrate environmental stewardship, technological innovation and economic inclusion. This synthesis reveals that African youths are not passive participants but strategic actors who are reimagining how food is produced, processed, and consumed. Across Africa, youth-led initiatives are delivering tangible impacts across multiple dimensions, including enhancing productivity, improving environmental sustainability, reducing post-harvest losses, generating employment and building enterprises that respond to local and global sustainability needs. These transformations are strengthening local food systems, improving rural economies and catalyzing structural shifts toward a sustainable food system.

However, this momentum is still impeded by structural and institutional gaps. Limited access to essential resources, unclear regulatory pathways and inadequate support systems often undermines the scalability of youth-led innovations. Overcoming these challenges demands youth-centered interventions such as youth-responsive financing, supportive land policies, infrastructure development, and capacity-building tailored to modern agricultural realities. Also, reshaping how agriculture is perceived is crucial to drive broader youth engagement. Integrating agribusiness training into education systems and amplifying the success of young role models can accelerate this shift.

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An Overview of Agricultural and Food Systems Digital Initiatives in Sub-Saharan Africa

14

Sophia Nasaka  and Emmanuel Ndhlovu 

14.1 Introduction

African agriculture and food systems are at a crisis point and face significant challenges, including food insecurity, malnutrition, conflict, pandemics and the impacts of climate change. These challenges encumber productivity, aggravate food insecurity and impact the livelihoods of the African population, over 70% of whom depend on agriculture for livelihoods and income (African Development Bank, 2024; Ndhlovu, 2025a). African farmers, most of whom are smallholders, have demonstrated an incapacity to deal with the challenge. As a result, despite regional and country-level efforts, the African continent is unlikely to meet the 2030 food security and nutrition targets of Sustainable Development Goal 2 on Zero Hunger. The Malabo targets of ending hunger and all forms of malnutrition by 2025 have already been missed. About 20% of the regional population was undernourished in 2022. Approximately 868 million people were moderately or severely food-insecure in the same period (FAO et al.,

2023a). Millions of Africans are suffering from prevalent micronutrient deficiencies. Overweight and obesity are weighty public health concerns in many countries (World Health Organisation (WHO), 2020). In 2021, about 78% of the African population could not afford a healthy diet, compared with 42% at the global level (FAO et al., 2023b). In 2021, about 35.5% of the population lived in extreme poverty based on the \$1.90 per day poverty line (Institute for Security Studies (ISS), 2021). The percentage varies by region, with Central Africa having the highest rate of extreme poverty at 54.8% and Southern Africa at 45.1% (ISS, 2021).

African agriculture is also dominated by smallholder farmers of the peasant category. Many of these farmers depend on traditional methods, including monoculture, limited crop rotation and poor soil management, which reduce productivity (Delfani et al., 2024a, 2024b; Ndhlovu, 2025b). Low adoption rates of improved modern seeds and animal breeds, fertilisers, and irrigation systems hinder the development of more efficient and sustainable farming practices (Alaran et al., 2025a, 2025b; Butcher et al., 2021). The pursuit of traditional farming in Africa faces significant challenges that make it unable to meet the continent's food needs, particularly in light of the rapidly growing population expected to reach 10 billion by 2050. Traditional farming practices significantly contribute to environmental

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degradation due to soil depletion and deforestation. Furthermore, climate change and variability are challenging traditional farming practices, reducing their reliability and impacting yields. African traditional farming systems are contributing to poverty and inequality, particularly due to a lack of integration with modern agricultural practices and technologies.

Furthermore, traditional farming practices are prone to the ravages of climate change. Climate change significantly impacts African agriculture, leading to low crop yields, decreased livestock productivity and overall food insecurity (Ejeta & Bai, 2025a, 2025b). Erratic weather patterns, such as increased droughts, storms and floods, worsen these issues, particularly affecting smallholder farmers who rely on rain-fed agriculture. Rising temperatures also contribute to reduced soil fertility and increased water scarcity, further hindering agricultural production (Thomas et al., 2022). Changes in temperature, precipitation patterns and extreme weather events directly affect caloric production and cropping frequency in Sub-Saharan Africa (SSA) countries (Onyeaka et al., 2024a, 2024b). Projections of crop yield reduction and rising input costs lead to food scarcity and negative nutritional outcomes.

There have been many recommendations to improve African food systems. They include the need for joint ventures and contract farming. Joint ventures in farming involve partnerships between several parties, typically farmers, investors or other businesses, to share resources, expertise and risks in a farming enterprise. The aim is often to improve production, access new markets and improve the overall efficiency and profitability of the farming operation. Contract farming involves an agreement between a farmer (producer) and a buyer outlining the terms and conditions for producing and marketing agricultural products (Ndhlovu & Dube, 2024). However, in recent decades, the advent of digital tools accompanying the Fourth Industrial Revolution (4IR) has gained increased policy and academic attention as potential solutions to the challenges of African agriculture and food systems (Ndhlovu & Mhlanga, 2023; Ronquest-Ross & Sigge, 2024a,

2024b; Ulimwengu, 2024a, 2024b). Digital innovations are lauded as having the potential to transform African agriculture and food systems by leveraging technology to address challenges like food insecurity, climate resilience and sustainable practices. The main areas of focus include digital tools for precision crop and livestock farming, crop and animal disease/pest detection, supply chain optimisation and online marketplaces for agricultural inputs and products. These initiatives aim to increase productivity, reduce waste, improve livelihoods and improve the efficiency and sustainability of food production. This chapter contributes to ongoing debates about the diagnostic potential of digital innovation by providing an overview of agricultural and food systems digital initiatives in SSA.

Several studies have documented the challenges and opportunities for technology integration in SSA (Erlangga et al., 2023a, 2023b; Ronquest-Ross & Sigge, 2024a, 2024b; Ulimwengu, 2024a, 2024b). However, studies providing an overview of the current conditions of digital innovation are still limited. This chapter seeks to close the knowledge and literature gap that has practical and policy implications. The chapter (i) identifies digital initiatives in African agricultural and food systems and (ii) discusses the potential impact of digital initiatives on African agriculture and food systems. By providing an overview of the current conditions of digital innovation in the sector, this chapter holds much potential to inform policy and practical action on how to transform food system activities and operations, thus helping to deal with the current food insecurity challenges in the region. Policymakers, politicians, non-governmental actors, academics and other stakeholders can find the chapter interesting to read, particularly as it offers insights into how digital integration can be fast-tracked in the sector.

This chapter is organised as follows: After the introduction, the following section reviews the literature related to the study, followed by an outline of the research methodology. Thereafter, the findings are presented and discussed.

Lastly, conclusions are drawn from the findings and discussion.

14.2 Literature Review

This section provides a literature review on digital data and associated digital innovations in SSA, focusing on the agricultural sector.

14.2.1 Digital Infrastructure for Agricultural Transformation in Sub-Saharan Africa

The enhancement of digital infrastructure has emerged as a critical driver of agricultural transformation in SSA, offering innovative solutions to long-standing challenges such as low productivity, limited market access, climate vulnerability and food insecurity (Ulimwengu, 2024a, 2024b). Over the past decade, there has been a growing recognition of the transformative potential of digital technologies ranging from mobile applications and remote sensing tools to blockchain and artificial intelligence in improving agricultural outcomes across the region (Ndhlovu & Mhlanga, 2023; Ronquest-Ross & Sigge, 2024a, 2024b). According to Delfani et al., (2024a, 2024b), digital innovations are increasingly being integrated into smallholder farming systems, enabling precision agriculture through real-time weather data, soil health monitoring, and pest and disease forecasting. These tools not only enhance decision-making but also optimise resource use, particularly among farmers who have historically lacked access to timely agronomic information (Alaran et al., 2025a, 2025b).

The proliferation of mobile technologies has played a pivotal role in bridging the information gap in rural areas, where over 60% of the population resides (Butcher et al., 2021). Mobile-based platforms such as Esoko, Farmerline and iCow have demonstrated a significant impact by delivering extension services, market prices and financial services directly to farmers' phones, thereby increasing efficiency and reducing transaction costs (Erlangga et al., 2023a, 2023b). In

addition, satellite imagery and drone technology have enhanced land-use planning, crop monitoring and yield prediction, which are essential for adaptive management in the face of climate variability (Thomas et al., 2022). Ejeta and Bai (2025a, 2025b) further highlight how these technologies contribute to climate-smart agriculture by enabling early warning systems and facilitating targeted interventions to mitigate the impacts of droughts and floods on food production.

Moreover, digital infrastructure has catalysed the development of e-marketplaces and agri-financial services, allowing farmers to access credit, insurance and fair pricing for their produce (Dube & Ndhlovu, 2024). For instance, platforms like Twiga Foods and AgroCenta are streamlining supply chains by linking smallholders directly with urban retailers and processors, thus reducing post-harvest losses and enhancing value addition (Onyeaka et al., 2024a, 2024b). Despite these promising developments, scholars such as Ulimwengu (2024a, 2024b) caution that the uneven distribution of digital infrastructure, particularly internet penetration, electricity access and digital literacy, remains a significant barrier to inclusive agricultural transformation. Rural–urban disparities in connectivity hinder widespread adoption, especially among women and youth, who constitute a large proportion of the agricultural workforce (ISS, 2021).

14.2.2 Promotion of Inclusive Digital Financial Services for Farmers in Sub-Saharan Africa

The promotion of inclusive digital financial services (DFS) has become a cornerstone strategy for enhancing financial inclusion among smallholder farmers in SSA, where over 60% of the rural population lacks access to formal banking systems (Ndhlovu & Mhlanga, 2023; World Bank, 2022). Digital financial tools such as mobile money, digital credit platforms, insurance apps and blockchain-based lending systems are increasingly being integrated into agricultural value chains to address long-standing barriers

to finance faced by rural producers (Ronquest-Ross & Sigge, 2024a, 2024b; Ulimwengu, 2024a, 2024b). According to IFAD (2023), digital finance has enabled farmers to access timely and affordable credit, savings, and insurance products without requiring physical bank branches, which are often absent in remote areas. Studies by Asante et al. (2022) indicate that mobile money platforms like M-Pesa in Kenya and MTN Mobile Money in Uganda have significantly expanded financial access, particularly among women and youth engaged in agriculture. These platforms facilitate instant payments for inputs, reduce transaction costs and allow farmers to store value securely. Moreover, digital credit providers such as Tala, Branch and Jumo offer microloans based on alternative data analytics, enabling unbanked farmers to secure short-term financing for seeds, fertilisers and equipment (Alaran et al., 2023; Omondi et al., 2021).

The integration of DFS with Agritech platforms has further enhanced inclusivity services like FarmDrive in Kenya, which combines digital credit scoring with farm management advice, using mobile data to assess creditworthiness and provide tailored financial products (Delfani et al., 2024a, 2024b). In addition, digital insurance products, such as those offered by Pula Advisors, mitigate climate-related risks by providing index-based crop and livestock insurance via mobile phones, improving resilience among vulnerable farming communities (Ejeta & Bai, 2025a, 2025b; Thomas et al., 2022). Despite these advances, scholars caution that persistent challenges, including low digital literacy, gender disparities in mobile phone ownership and inadequate internet infrastructure, continue to limit DFS uptake among the most marginalised groups (Butcher et al., 2021; ISS, 2021). For example, women account for only 37% of mobile internet users in SSA, which hampers their ability to benefit fully from digital financial innovations (GSMA, 2023). To address these gaps, governments and development partners have launched initiatives such as the African Union's Digital Financial Inclusion Strategy and the World Bank's Universal Financial Access Program, aiming to scale DFS through regulatory reforms, digital

ID systems and capacity-building programmes (Dube & Ndhlovu, 2024; Ulimwengu, 2024a, 2024b). However, as Onyeaka et al., (2024a, 2024b) argue, sustainable DFS adoption requires context-sensitive design, stakeholder collaboration and farmer-centric digital literacy campaigns.

14.2.3 Strengthening Data-Driven Decision-Making in Agricultural Policy in Sub-Saharan Africa

The strengthening of data-driven decision-making in agricultural policy has gained increasing traction across SSA as governments and development partners seek to enhance food systems' efficiency, inclusivity and sustainability. Traditionally, agricultural policymaking in the region has been hampered by fragmented, outdated or inaccessible data, resulting in poorly targeted interventions and inefficient resource allocation (Thomas et al., 2022; Ulimwengu, 2024a, 2024b). However, recent advancements in digital infrastructure, remote sensing technologies and national agronomic databases have enabled more timely and accurate data collection and analysis, thereby improving evidence-based policy formulation (Ndhlovu & Mhlanga, 2023; Ronquest-Ross & Sigge, 2024a, 2024b). According to FAO (2023, 2023a, 2023b), adopting geospatial tools and satellite imagery has enhanced crop monitoring, yield forecasting, early warning systems for climate-induced shocks and critical inputs for adaptive policy responses.

Moreover, mobile data collection platforms such as CSPro, KoboToolbox and ODK have improved field-level data gathering, particularly in rural areas where traditional survey methods are costly and time-consuming (Delfani et al., 2024a, 2024b). Integrating artificial intelligence (AI) and machine learning into national agricultural information systems has further enabled predictive analytics that supports early intervention in pest outbreaks, droughts, and market disruptions (Ejeta & Bai, 2025a, 2025b). Institutions such as the African Union's Committee

on Agriculture and Rural Development and the Comprehensive Africa Agriculture Development Programme (CAADP) have catalysed regional efforts to harmonise data standards and promote open-access agricultural data portals (Ndhlovu & Dube, 2024). Despite these gains, scholars like Ulimwengu (2024a, 2024b) highlight persistent challenges, including weak institutional capacity, limited technical expertise and inadequate funding for continuous data generation and analysis.

In addition, data silos between ministries, research institutions and private sector actors hinder effective knowledge sharing and policy coordination (ISS, 2021; Onyeaka et al., 2024a, 2024b). Gender-disaggregated data gaps also persist, limiting the ability of policymakers to design inclusive programmes that address the specific needs of women farmers who contribute significantly to food production (Butcher et al., 2021). To bridge these divides, several countries, including Kenya, Ghana and South Africa, have launched national digital agriculture strategies aimed at strengthening data ecosystems through public–private partnerships, investment in data science training and legal frameworks that support open data principles (Alaran et al., 2023; World Bank, 2022). As Thomas et al. (2022) noted, building sustainable data-driven governance requires not only technological investments but also political will, stakeholder engagement and institutional reforms that embed data use into everyday policy processes. Thus, while SSA has made significant strides towards strengthening data utilisation in agricultural policy, achieving long-term impact depends on continued investment in data literacy, interoperability and inclusive data policies.

14.2.4 Scaling Digital Market Linkages for Agricultural Trade in Sub-Saharan Africa

The scaling of digital market linkages has emerged as a transformative force in agricultural trade across SSA, addressing long-standing

inefficiencies such as poor market access, fragmented supply chains and high transaction costs (Ndhlovu & Mhlanga, 2023; Ulimwengu, 2024a, 2024b). Traditional agricultural markets in SSA have been characterised by weak farmer-buyer linkages, limited price transparency and inadequate infrastructure factors that have constrained productivity and income growth for millions of smallholder farmers (Ronquest-Ross & Sigge, 2024a, 2024b; Thomas et al., 2022). However, the proliferation of digital technologies, particularly mobile-based agri-market platforms, e-commerce systems and blockchain-enabled traceability tools, has significantly improved the efficiency and inclusivity of agricultural trade (Delfani et al., 2024a, 2024b).

Platforms like Twiga Foods in Kenya, AgroCenta in Ghana and Hello Tractor in Nigeria are facilitating direct connections between farmers and buyers, reducing post-harvest losses and enabling fairer pricing through real-time market data (Omondi et al., 2021; Onyeaka et al., 2024a, 2024b). These innovations leverage mobile money integration, GPS tracking and AI-driven logistics to streamline transactions, enhance trust and improve delivery times (Alaran et al., 2023). According to FAO (2023, 2023a, 2023b), digital marketplaces not only reduce intermediation but also increase farmers' bargaining power, particularly when integrated with warehouse receipt systems and commodity exchanges that enable bulk trading and forward contracts. In addition, blockchain-based platforms such as FarmerConnect and AgUnity are being piloted in countries like Uganda and Malawi to ensure traceability, build buyer confidence and support certification schemes for export-oriented commodities (Ejeta & Bai, 2025a, 2025b). Despite these promising developments, challenges remain in scaling digital market linkages across the region. Butcher et al. (2021) note that infrastructural constraints, including unreliable internet connectivity, low smartphone penetration and poor rural road networks, continue to limit platform reach, especially among women and youth.

Moreover, institutional barriers such as weak regulatory frameworks for digital commerce, lack of standardisation in product quality and limited

farmer awareness hinder widespread adoption (Dube & Ndhlovu, 2024; ISS, 2021). To address these gaps, several governments and development agencies have launched initiatives aimed at strengthening the digital ecosystem for agricultural trade. The African Continental Free Trade Area (AfCFTA) recognises the role of digital agriculture in promoting regional integration, while the African Union's Digital Transformation Strategy (2020–2030) supports investments in digital infrastructure and agribusiness innovation hubs (Ulimwengu, 2024a, 2024b; World Bank, 2022). As highlighted by Thomas et al. (2022), successful scaling of digital market linkages requires multi-stakeholder collaboration, context-specific platform design and policies that promote inclusive access to digital tools.

14.3 Materials and Methods

This chapter adopts an exploratory qualitative approach, which is underpinned by a content analysis. The chapter draws from primary and secondary literature, mainly organisational websites, blogs and academic texts. The authors searched for organisations that are developing, implementing and providing digital solutions in the agricultural sector. A sub-regional approach was used to search for the sources of information. Words such as 'digital initiatives in agriculture', 'agricultural innovation' and 'food systems innovation', focusing on agriculture and food systems, were used as keywords. Some of the key stakeholders in digital innovation in African agriculture included Aerobotics PTY LTD, the ITIKI Project, the Khula Initiative, Agripredict, the Nuro Project, the Farmcrowdy, the Farmerline and AgroCenta. Information was obtained through reviewing the websites of these organisations. The review also reviewed academic documents that analyse the impact of these digital initiatives on agriculture and food systems. These articles were searched using the same key terms that were used to search for companies.

Data is then reported through summaries of the digital initiatives being adopted and implemented in each sub-region. The authors acknowledge that this loose approach may not be replicable since new organisations and initiatives are emerging. However, since the aim was to identify digital initiatives, the approach was believed to be effective enough. It is hoped that future researchers will use empirical approaches to validate the descriptions and conclusions reached in this chapter.

14.4 Findings and Discussion: Food Systems Digital Initiatives in Sub-Saharan Africa

The review showed that digital initiatives focusing on food systems are increasing in SSA. This section provides a sub-regional description of digital initiatives in different sub-regions in SSA.

14.4.1 Southern Africa

The review shows Southern Africa as the hub for digital agricultural innovation, leveraging cutting-edge technologies to address persistent challenges such as low productivity, climate variability and limited market access. Among the most notable innovations is Aerobotics PTY LTD, a South African agritech company that uses drones, satellite imagery and artificial intelligence (AI) to provide precision farming solutions (Aerobotics, 2025). Aerobotics focuses on crop monitoring, pest detection and yield optimisation, offering real-time data that empowers farmers to make informed decisions. According to PwC (2021), Aerobotics' tools have helped reduce input costs by up to 20% while increasing yields through efficient resource allocation. For example, small-holder citrus farmers in Limpopo, South Africa, used Aerobotics to detect early signs of citrus greening disease. This devastating condition can

wipe out entire orchards if left unchecked. By identifying affected trees early, these farmers were able to implement targeted interventions, reducing crop losses by 15% (Moyo et al., 2022). This case highlights how advanced technologies can mitigate risks and enhance resilience among small-scale producers. These digital initiatives are particularly critical in a sub-region where small-holder farmers dominate the agricultural landscape but often face barriers like inadequate infrastructure, poor access to inputs and limited technical knowledge (Ndhlovu, 2025b).

Another ground-breaking initiative is The ITIKI Project. This initiative was developed by researchers at the University of Pretoria. The ITIKI initiative integrates indigenous knowledge systems with modern weather forecasting techniques to provide localised agricultural advice via a mobile-based platform. Indigenous knowledge, which includes traditional methods of predicting rainfall patterns and pest outbreaks, has long been undervalued in favour of scientific approaches (Africa Alive, 2024). In Mozambique, maize farmers use ITIKI to adapt to erratic rainfall patterns caused by climate change (Africa Alive, 2024). By aligning planting schedules with accurate weather prediction, farmers achieved a 25% increase in yields during the 2018–2019 season (Thothela et al., 2023). This success underscores the importance of culturally sensitive technologies that respect and build upon local expertise (Kalawole, 2020).

The Khula Initiative represents another transformative effort in Southern Africa's digital agriculture space (Schulz, 2019). Khula is an e-commerce platform designed to connect small-holder farmers directly to markets, bypassing exploitative middlemen who often take a significant share of profits (Khula, 2025). Additionally, the Khula initiative offers supply chain management tools and financial services, addressing multiple pain points faced by farmers. Tambe et al. (2021) show that Khula has reduced post-harvest losses by 30%, a critical achievement given that spoilage due to poor storage and transportation remains a major issue in the region. Vegetable farmers in KwaZulu-Natal, for instance, reported

a 40% increase in sales after joining the platform. By streamlining logistics and integrating payment systems, Khula improves cash flow for farmers and enables them to compete in broader markets, fostering economic empowerment (Khula, 2025).

The AgriTech Analytics is another initiative in Southern Africa. This initiative leverages big data analytics to monitor soil health, water usage and crop performance (AgriTech Analytics Limited, 2025). Its focus extends beyond individual farms to include government partnerships aimed at supporting smallholder farmers. A report by FAO (2021) highlights that AgriTech's solutions have reduced water wastage by 25% in irrigated systems across Zambia and Zimbabwe. Large-scale maize producers in Zimbabwe adopted AgriTech's soil sensors, achieving a 10% reduction in fertiliser use without compromising yields (Hove et al., 2024). This demonstrates how data-driven insights can optimise resource use and promote sustainability in agriculture, especially in regions facing acute water scarcity.

Lastly, Agripredict, a Zambian start-up, is another digital initiative operating within the food system space in Southern Africa. This initiative uses AI and machine learning to predict pest infestations and crop diseases (Agripredict, 2025). Farmers upload images of affected crops to a mobile app, which then analyses the data and provides actionable recommendations. Tufa et al. (2023) found that Agripredict's predictive models have reduced pesticide expenditure by 15% while improving early detection rates of pests like fall armyworms. In Malawi, cassava farmers using Agripredict reported a 30% reduction in crop damage due to timely interventions (McCarthy et al., 2024). This initiative exemplifies how AI-powered diagnostics can help farmers mitigate risks and protect their livelihoods in an era of increasing climate uncertainty.

Taken together, these initiatives showcase the transformative potential of digital technologies in Southern Africa's food systems. From precision farming and market linkages to pest management and climate adaptation, these innovations are helping farmers overcome long-standing challenges (Ndhlovu & Mhlanga, 2023). However,

scaling these solutions requires addressing structural issues such as inadequate internet connectivity, low digital literacy and high implementation costs. Collaborative efforts involving governments, private sectors and international organisations will be crucial to ensuring that these technologies reach the most vulnerable populations and achieve lasting impact.

14.4.2 Eastern Africa

Eastern Africa, home to some of the continent's fastest-growing economies, has embraced digital technologies to revolutionise its agricultural sector (Karagiannis & Paleologou, 2025). The region is traditionally known for its unique challenges, including population pressure, land fragmentation and frequent droughts exacerbated by climate change. To address these issues, innovative start-ups and research institutions have introduced cutting-edge solutions like autonomous drones and AI-powered chatbots, which are transforming how farmers interact with their environment and markets (Magomba & Ng'atigwa, 2024). One standout initiative is the Nuro Project, a Kenyan venture that employs autonomous drones to deliver agricultural inputs such as seeds, fertilisers and even fodder to remote farms (Nuro Project, 2025). Traditional supply chains in rural areas in Kenya are often inefficient, with delays leading to missed planting seasons or livestock deaths during droughts (Kiaka & Kimana, 2024). The advent of Nuro has cut delivery times by 50%, ensuring that farmers receive critical inputs when they need them most (Mokone & Ndhlovu, 2025). For example, pastoralists in northern Kenya benefited from Nuro's drone-delivered fodder during severe droughts, reducing livestock mortality by 20% (Kiaka, 2024). This innovation saves lives and strengthens food security by safeguarding livestock assets, which are vital for nutrition and income generation in pastoral communities.

Complementing physical delivery systems is the Mkulima GPT Project, an AI-powered chatbot designed to assist farmers with queries related to crop management, market prices and government subsidies (Mkulima GPT Project, 2025). Unlike

traditional extension services, often underfunded and inaccessible to many smallholders, Mkulima GPT operates on widely available mobile phones, providing instant and accurate information. A Telemala (2024) pilot study showed that Mkulima GPT improved farmer awareness of best practices, resulting in a 12% increase in maize yields in Tanzania (Magomba & Ng'atigwa, 2024). Coffee growers in Uganda further demonstrated the chatbot's utility by using it to optimise irrigation schedules, achieving a 15% improvement in bean quality (Bunn et al., 2019). By democratising access to expert advice, the Mkulima GPT Project empowers farmers to adopt sustainable practices and maximise productivity, significantly contributing to regional food security.

These innovations reflect a broader trend in Eastern Africa towards leveraging technology to bridge gaps in agricultural value chains (Jegede & Muchie, 2024). However, challenges remain, particularly around affordability and scalability. While autonomous drones and AI chatbots offer immense potential, their adoption hinges on overcoming barriers such as high operational costs, limited digital infrastructure and varying levels of technological literacy among farmers. Addressing these issues will require strategic investments in education, infrastructure and policy frameworks that support inclusive digital transformation (Butcher et al., 2021).

14.4.3 Central Africa

Central Africa, often overshadowed by its more digitally advanced neighbours in East and Southern Africa, faces significant challenges in adopting digital agriculture initiatives. The region has limited access to technology. This hinders the development of robust digital ecosystems. Despite these hurdles, some promising efforts are emerging, signalling a gradual but steady shift towards technological integration in agriculture. Platforms like Farmcrowdy originally pioneered in Nigeria but now expanding into Cameroon, are beginning to connect smallholder farmers with buyers and investors, fostering market

linkages that were previously non-existent or inefficient (AppAfrica, 2019). Similarly, mobile money services such as MTN Mobile Money are being integrated into agribusinesses to facilitate payments, loans and financial inclusion for rural farmers (Akinwale et al., 2023). However, while these initiatives hold immense potential, their impact remains constrained by systemic barriers such as poor internet connectivity, low smartphone penetration and limited digital literacy among farmers (Farmcrowdy, 2025). Addressing these challenges will be critical to scaling digital solutions in Central Africa and unlocking their transformative potential for food systems.

Farmcrowdy's expansion into Cameroon reflects the platform's ambition to address the structural inefficiencies plaguing agricultural value chains across the sub-region, and not only in Nigeria. Farmcrowdy operates as an e-commerce and investment platform that connects smallholder farmers with urban investors willing to fund their operations in exchange for returns on produce sales. This model not only provides farmers with much-needed capital but also helps them access premium markets, thereby increasing their incomes. For example, poultry farmers in Cameroon who joined Farmcrowdy reported improved profitability due to better access to feed suppliers and larger markets in urban centres. By creating a direct link between producers and consumers, platforms like Farmcrowdy can help reduce reliance on exploitative middlemen, who often dominate traditional supply chains in Central Africa. However, the success of such initiatives depends heavily on overcoming logistical challenges, including inadequate transportation networks and high transaction costs.

Mobile money services like MTN Mobile Money represent another critical pillar of digital innovation in Central Africa. These platforms enable farmers to receive payments for their produce instantly, secure microloans and manage finances without relying on traditional banking systems, which are often inaccessible in rural areas. According to IFAD (2022), mobile money has become a lifeline for many smallholders, particularly women and youth, who face disproportionate barriers to financial inclusion. For

instance, cassava farmers in the Democratic Republic of Congo (DRC) have used MTN Mobile Money to pay for inputs during planting seasons, avoiding the need for cash advances from local traders at exorbitant interest rates. Additionally, cooperatives in Gabon have leveraged mobile money to pool resources and invest in shared equipment, enhancing productivity and reducing operational costs. While these examples highlight the transformative potential of mobile money, its adoption remains uneven due to factors such as inconsistent network coverage and limited awareness of its benefits among rural populations.

Despite these promising developments, Central Africa's digital agriculture landscape continues to grapple with significant structural barriers. Poor internet connectivity remains one of the most pressing issues, with large swathes of the region lacking reliable broadband or even basic cellular coverage. This lack of infrastructure severely limits the reach of digital platforms, making it difficult for farmers to access real-time information, online marketplaces or advisory services. Moreover, low smartphone penetration exacerbates the problem, as many farmers still rely on feature phones that cannot support advanced applications. Even when devices are available, affordability remains a challenge, with many households unable to invest in smartphones or data plans. Finally, digital literacy levels are alarmingly low, particularly among older generations, creating a skills gap that hinders the effective use of digital tools. Addressing these barriers will require coordinated efforts from governments, private sector players and international organisations to invest in infrastructure, provide affordable devices and deliver training programmes tailored to the needs of rural communities.

Scaling digital agriculture in Central Africa also necessitates innovative financing mechanisms to ensure inclusivity. Public-private partnerships could play a pivotal role in bridging funding gaps, enabling start-ups and agribusinesses to develop context-specific solutions that cater to the unique challenges faced by farmers in the region. For example, donor-funded pilot projects could test the viability of drone-based delivery systems for agricultural inputs in remote

forested areas where road networks are either non-existent or unreliable. Similarly, collaborations between telecom companies and agritech start-ups could lead to the development of low-cost, SMS-based advisory platforms that do not require smartphones, thus reaching a broader audience. Such initiatives would enhance productivity and contribute to climate resilience by equipping farmers with tools to adapt to changing environmental conditions.

In conclusion, while Central Africa lags behind other regions regarding digital agriculture adoption, there are clear signs of progress. Initiatives like Farmcrowdy and MTN Mobile Money demonstrate the potential of technology to transform food systems by improving market access, facilitating payments and empowering smallholder farmers economically (Ondoa et al., 2023). However, realising this potential requires addressing deep-rooted infrastructure, affordability and education challenges. With targeted investments and collaborative efforts, Central Africa can harness the power of digital innovation to build resilient and sustainable agricultural systems that benefit all stakeholders, from farmers to consumers.

14.4.4 West Africa

West Africa, a region characterised by its diverse agricultural landscapes and vibrant smallholder farming communities, has emerged as a hotspot for digital agriculture innovations aimed at addressing long-standing challenges such as labour shortages, market inefficiencies and post-harvest losses (Degila et al., 2023). Among the most impactful initiatives are Hello Tractor, Farmerline and AgroCenta, each of which addresses different facets of the agricultural value chain while contributing to increased productivity, profitability and sustainability (Miine et al., 2024). These platforms exemplify how technology can democratise access to resources, knowledge and markets, empowering smallholder farmers to compete in both local and global economies. Their success stories underscore the transformative potential of digital tools in reshaping

West Africa's food systems, though challenges remain in ensuring equitable access and scalability (Asante et al., 2022).

Hello Tractor, often described as the 'Uber for tractors', has revolutionised mechanisation in West Africa by providing smallholder farmers with affordable access to tractors via a mobile app. Developed in Nigeria, Hello Tractor addresses one of the region's biggest barriers to agricultural productivity: the lack of affordable machinery. Traditionally, smallholders have relied on manual labour or hired expensive tractor services, which are often unavailable during peak planting seasons. Daum et al. (2020) found that Hello Tractor reduced labour costs by 30% and increased land preparation efficiency by 40%, enabling farmers to cultivate larger areas within shorter timeframes. For example, rice farmers in Ghana who used Hello Tractor saw a 25% increase in production due to timely ploughing, which allowed them to take full advantage of favourable weather conditions (Daum et al., 2020). By democratising access to mechanised equipment, Hello Tractor has not only enhanced productivity but also reduced the drudgery associated with manual farming, freeing up time for farmers to engage in other income-generating activities (Kolapo & Didunyemi, 2024). Furthermore, the platform's innovative 'pay-as-you-go' model ensures affordability, making it accessible even to resource-constrained farmers. However, scaling this initiative requires addressing challenges such as maintenance of machinery, fuel availability and farmer training on optimal tractor usage.

Another ground-breaking initiative is Farmerline, a Ghanaian start-up that provides digital advisory services, market linkages and financial products to smallholder farmers through SMS-based platforms. Farmerline's approach is particularly relevant in West Africa, where extension services are often underfunded and inaccessible to many farmers (Buah, 2017). By leveraging widely available mobile phones, Farmerline delivers actionable advice on crop management, pest control and best practices directly to farmers' devices (Farmline, 2025). Sarku et al. (2021) reported that Farmerline's advisories improved cocoa yields by 18% in Côte d'Ivoire, a country that produces

over 40% of the world's cocoa. In southwestern Nigeria, cocoa cooperatives achieved a 10% reduction in post-harvest losses through Farmerline's logistics support, which includes guidance on proper storage and transportation techniques (Adedugbe, 2023). Beyond advisory services, Farmerline also facilitates access to financial products such as loans and insurance, helping farmers mitigate risks and invest in their operations (Dumas et al., 2025). This holistic approach enhances the capacity of smallholders to compete in global value chains, particularly in high-value crops such as cocoa, coffee and cashews. Nevertheless, the platform's effectiveness depends on consistent engagement with farmers and continuous updates to its content to reflect evolving agricultural needs.

AgroCenta, another Ghanaian platform, focuses on connecting smallholder farmers to markets while offering transparent pricing information to eliminate exploitative middlemen (AgroCenta, 2025). One of the most pervasive challenges in West African agriculture is the dominance of intermediaries, who often purchase produce at unfairly low prices and resell it at inflated rates. AgroCenta addresses this issue by creating a transparent marketplace where farmers can negotiate directly with buyers, ensuring fair trade. FAO (2021) noted that AgroCenta increased farmers' incomes by 20% by streamlining transactions and eliminating unnecessary intermediaries. For instance, maize farmers in northern Ghana accessed premium buyers through AgroCenta, boosting their profits by 25% (AgroCenta, 2025). This initiative underscores the importance of transparency and direct market access in empowering smallholder farmers economically. Additionally, AgroCenta's integration of payment systems ensures that farmers receive prompt payments, reducing cash flow constraints and enabling reinvestment in their farms. However, scaling AgroCenta's impact requires addressing challenges such as low digital literacy, limited internet connectivity and resistance from entrenched middlemen who may perceive the platform as a threat to their livelihoods.

Collectively, these initiatives highlight the multifaceted ways in which digital technologies can address the structural inefficiencies plaguing West Africa's agricultural sector. From mechanisation and advisory services to market transparency, platforms like Hello Tractor, Farmerline and AgroCenta are transforming how farmers interact with their environment and value chains. However, achieving widespread adoption and impact hinges on addressing barriers such as affordability, accessibility and education. Collaborative efforts involving governments, private sector players and international organisations will be crucial to ensuring that these innovations reach the most vulnerable populations and contribute to building resilient, inclusive and sustainable food systems across West Africa.

14.5 Policy Recommendations

This review shows that digital initiatives hold immense potential to transform African agriculture and food systems, boosting productivity, enhancing food security and improving livelihoods for smallholder farmers. However, achieving this potential requires well-designed and executed policies that address existing challenges and leverage opportunities. Policies for developing African agriculture and food systems need to focus on five key areas, as summarised in the following sub-sections.

14.5.1 Enabling Infrastructure and Connectivity

African governments and their private partners need to invest in expanding rural digital infrastructure where most African farmers are located. There is a vital need to prioritise investment in affordable, reliable and accessible internet connectivity, especially in rural and remote agricultural areas. This should include expanding mobile network coverage, promoting fibre optic infrastructure and exploring alternative technologies such as satellite internet where traditional infrastructure is challenging.

African governments also need to adopt and implement policies that lessen the cost of digital services and devices for farmers and other food system actors. This could include the provision of subsidies, tax breaks for technology providers and promoting local manufacturing of affordable digital tools. Countries like South Africa have already adopted this policy path, although corruption and mismanagement compromise the effort (Majova & Ndhlovu, 2023). In addition, governments and private partners need to invest in off-grid and renewable energy solutions, such as solar power, to power digital devices and infrastructure in areas with unreliable electricity supply.

14.5.2 Digital Literacy and Capacity Building

Tailored digital literacy programmes must be introduced for farmers and other food system actors. African governments can develop and implement practical, farmer-centric digital literacy programmes that are culturally sensitive, delivered in local languages, and focus on the specific digital tools and applications relevant to farming practices (for instance, using mobile apps for market prices, weather forecasts and pest alerts). In addition, agricultural extension workers may also be equipped with digital skills and knowledge to efficiently and effectively advise farmers, in particular, on using digital tools and integrating them into their farming practices. These extension workers can also be empowered to serve as intermediaries in bridging the digital divide. It is also vital for African governments to foster digital skills among young people in rural areas, encouraging them to adopt digital solutions for agriculture and creating agribusiness opportunities.

Furthermore, gender-responsive approaches are needed as part of the collective empowerment efforts. Governments need to design programmes that specifically address the digital literacy and access gaps faced by women farmers, ensuring their full participation and benefit from digital initiatives. This is crucial, particularly since

women make up the majority of farmers in Africa (Ndhlovu, 2025c).

14.5.3 Data Governance and Ecosystem

There also needs to be robust data governance frameworks. African policymakers must establish clear and strong data governance policies protecting farmers' data privacy and security. Farmers, in particular, should maintain control over their data and benefit from its utilisation. In addition, African governments should promote open data ecosystems. This can be achieved through encouraging the development of open and accessible agricultural data platforms. This will enable data sharing among stakeholders (e.g. among farmers and other food system actors), foster innovation and enable the development of new digital services. Developing and promoting common data standards and interoperability protocols is also necessary to ensure seamless data exchange between different digital platforms and applications. Furthermore, African governments need to incentivise farmers and other food system actors to collect and share data while ensuring ethical data practices and clear benefits for data providers.

14.5.4 Innovation and Entrepreneurship

African governments also need to foster public-private partnerships (PPPs). Through various government departments, collaboration between governments, private sector companies, technology providers, and research institutions needs to be encouraged to co-develop, pilot and scale digital agricultural and food system solutions. This can involve joint funding, resource sharing and expertise exchange.

African governments need to create enabling environments for agri-tech start-ups through incubators, accelerators, access to funding and simplified regulatory processes. This will drive innovation and develop locally relevant solutions.

Political stability is also vital to allow these programmes to run smoothly. In addition, they also need to invest in research and development for new digital technologies tailored to the specific needs and challenges of African agriculture and food systems, including precision farming tools, AI-powered systems and blockchain for supply chain traceability. Furthermore, governments need to ensure that digital solutions are user-centric and address the actual needs and challenges faced by food systems actors through participatory design and feedback mechanisms.

14.5.5 Policy Integration and Harmonisation

African governments also need to mainstream digital agriculture into national strategies. This can be achieved by integrating digital agriculture explicitly into national agricultural investment plans and broader national development strategies. There is also a need to promote regional cooperation and harmonisation of digital agriculture policies and strategies, aligning with initiatives such as the African Union's Digital Agriculture Strategy (DAS) and the CAADP. This will enable cross-border solutions and knowledge sharing. In addition, governments should strengthen institutional frameworks for digital financial services in agriculture, such as mobile money, digital credit and insurance, to improve access to finance by food system actors, particularly farmers. Furthermore, governments need to establish clear policies on intellectual property rights for digital agricultural innovations to encourage development and adoption.

By executing these policy recommendations, African countries can develop a vigorous and inclusive digital agricultural and food systems ecosystem that empowers farmers, enhances productivity, and contributes significantly to food security and sustainable development across the continent.

14.6 Conclusion

This chapter identified digital initiatives in African agricultural and food systems and discussed the potential impact of these digital initiatives on African agriculture and food systems. The review showed that several African countries are adopting and implementing digital initiatives to develop their agricultural and food system sectors. East and Southern Africa are the hub of these initiatives, with South Africa and Kenya taking the lead. This is probably due to the size of their economies. The review also showed that digital initiatives in all sub-regions are mainly concentrated in the production component of food systems, mainly farming, with minimal innovation in other components such as food processing, storage and distribution.

In view of the findings, this chapter concludes that despite the regional challenges, including climate change, resource constraints and some pockets of political instability, African governments are trying to develop their food systems, particularly through farming. Many African governments lack adequate resources to pursue their development agendas and, therefore, could be focusing on agriculture due to the affordable resources required in the sector. In addition, most Africans have indigenous farming knowledge. Therefore, this explains why farming tends to receive development attention ahead of other food system components.

It is recommended that African governments help enable infrastructure and connectivity, support digital literacy and capacity building, ensure data governance and ecosystem, foster innovation and entrepreneurship, and ensure policy integration and harmonisation as part of the effort to promote the adoption and implementation of digital initiatives in African agriculture and food systems. Future research should explore ways international investors can be mobilised to prioritise funding for the agricultural sector and food systems activities.

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Advancing Sustainable Food Processing for Resilient and Inclusive Food Systems in Africa: Strategies, Challenges, and Opportunities 15

Beauty Zindi 

15.1 Introduction

The impending threat of global food security matched with the growing population has propelled food and agriculture stakeholders to prioritize quality nutrition consumption, agriculture and food innovation, and circular economy in these current uncertain temperature conditions (Boon & Anuga, 2020). Sustainable food processing is essential for building resilient and inclusive food systems in Africa, ensuring food security, reducing post-harvest losses, and enhancing economic opportunities for local communities. Africa faces several interlinked challenges, including rapid population growth, urbanization, climate change, and food supply chain inefficiencies, which necessitate urgent and innovative solutions in food processing. With the continent's population projected to reach 2.5 billion by 2050, ensuring food availability, affordability, and nutritional quality will require a shift toward sustainable and efficient food processing systems that minimize waste and maximize value addition (Affoh et al., 2022). Despite Africa's vast agricultural potential, the continent still grapples with high post-harvest losses, food wastage, and a weak agro-processing industry,

which limit its ability to achieve food security and economic self-sufficiency. According to the Food and Agriculture Organization (FAO) (2022) post-harvest losses in sub-Saharan Africa exceed 30% of total food production, primarily due to poor storage, inadequate processing facilities, and limited access to markets. These losses undermine farmers' incomes and threaten food availability, making sustainable food processing a key strategy for improving food system resilience.

Additionally, the shift toward sustainable food processing is crucial for climate adaptation and environmental sustainability. Traditional food processing methods often rely on inefficient, high-energy consumption techniques that contribute to environmental degradation (Abdulai, 2022). Adopting green technologies, renewable energy sources, and resource-efficient processing methods can reduce the environmental footprint of food processing while improving productivity and profitability (Araya & Lee, 2024). Innovations such as solar drying for fruits and vegetables, energy-efficient milling for grains, and bio-based packaging solutions are already being piloted in several African countries to enhance sustainability.

Beyond food security and environmental concerns, sustainable food processing presents a significant opportunity for economic transformation and job creation. The agro-processing sector has the potential to stimulate industrial growth, provide employment, and promote inclusive economic development. Countries such

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as South Africa, Nigeria, Ghana, and Kenya have invested in agro-industrial parks and food processing hubs, creating a foundation for value-added food production and increased participation in regional and international markets (Dsouza et al., 2023). However, many small and medium-sized enterprises (SMEs) in food processing still struggle with financial constraints, lack of technical expertise, and limited market access, necessitating targeted interventions to support their growth (Amede & Whitbread, 2022). It is against this background that this chapter identifies the key strategies for advancing sustainable food processing in Africa, analyzes the challenges faced in implementing sustainable food processing practices, particularly for small-scale processors and rural communities in Africa; and explores the opportunities for scaling up sustainable food processing through policy interventions, private sector investments, and regional cooperation in Africa.

This chapter is organized as follows: The following section reviews the literature that is related to the study. This is followed by an outline of the research methodology that was adopted. After that the key strategies for advancing sustainable food processing in Africa are discussed under several sub-sections. It then discusses the challenges and opportunities faced when implementing sustainable food processing practices in Africa, respectively. Lastly, conclusions are drawn from the findings and the discussion.

15.2 Literature Review

Africa's food system is highly diverse, shaped by various climatic conditions, agricultural practices, and socio-economic structures. However, inefficiencies in food processing contribute significantly to food insecurity, with an estimated 30–50% of harvested produce lost due to inadequate preservation, transportation, and storage (Molotoks et al., 2021). Traditional food processing methods, while culturally significant, often lack scalability and sustainability. Meanwhile, modern industrial food processing remains concentrated in a few urban centers, limiting access for

rural communities. Abdulai (2022) mentions that sustainable food processing through the adoption of renewable energy, improved preservation techniques, and value-addition to agricultural products offers a pathway to reducing food losses, increasing farmer incomes, and fostering economic inclusion. Global frameworks such as the United Nations Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 12 (Responsible Consumption and Production), emphasize the need for sustainable food processing systems. Governments, development agencies, and private-sector players are increasingly recognizing the importance of integrating sustainability principles into food processing to enhance food security and economic resilience (Kumar & Agrawal, 2020).

Despite Africa's abundant agricultural resources, food insecurity and economic exclusion remain prevalent due to inefficiencies in food processing. The lack of sustainable and scalable food processing infrastructure leads to significant post-harvest losses, low-value agricultural exports, and limited access to nutritious food (Jayne & Sanchez, 2021). Furthermore, small-scale food processors, particularly women and rural entrepreneurs, face barriers such as inadequate financing, limited technical skills, and weak market linkages (John, 2024). These challenges undermine the potential of food processing to contribute to a resilient and inclusive food system. While there are emerging efforts to promote sustainable food processing, the adoption of environmentally friendly and resource-efficient techniques remains slow due to factors such as high initial costs, limited research and development, and weak policy implementation (Kumar & Agrawal, 2020).

15.3 Overview of Food Processing Systems in Africa

Food processing systems in Africa remain underdeveloped despite the continent's vast agricultural potential. A significant portion of agricultural

produce is exported in raw form, with minimal value addition, limiting economic benefits for local farmers and processors (Nchanji & Lutomia, 2021). In many African countries, inadequate infrastructure, high energy costs, and limited access to modern food processing technologies contribute to inefficiencies in the sector. As a result, post-harvest losses remain alarmingly high, with estimates suggesting that up to 40% of perishable foods such as fruits, vegetables, and dairy products are lost before reaching consumers (Saiz-Rubio & Rovira-Más, 2020; Zindi & Ndhlovu, 2025). These losses undermine food security, reduce incomes for farmers, and increase reliance on food imports.

In Nigeria, the lack of adequate food processing facilities has led to massive post-harvest losses, particularly in the tomato industry (Quarshie et al., 2023). Despite being one of the largest producers of tomatoes in Africa, Nigeria imports tomato paste due to insufficient local processing capacity. Similarly, Ghana faces challenges in cocoa processing, with the majority of its cocoa beans exported raw, while foreign processors capture most of the value-added benefits (Ofori et al., 2021). To address this, the Ghanaian government has implemented policies to encourage local processing, such as the Ghana Cocoa Board's initiatives to increase domestic cocoa grinding capacity.

On the other hand, some African countries have made progress in developing their food processing industries to enhance food security and economic growth. Quarshie et al. (2023) mention that Ethiopia's agro-processing sector has seen considerable investment, particularly in coffee and dairy processing and it has established agro-industrial parks aimed at supporting small and medium-sized enterprises (SMEs) in food processing. This has contributed to job creation and increased the availability of processed food products in local and export markets. Similarly, in South Africa, the food processing industry is one of the most advanced on the continent, with strong integration between agriculture, manufacturing, and retail (Abdulai, 2022). The country has developed large-scale food processing industries, such as maize milling, meat processing, and

dairy production, which help stabilize food supply chains and create employment opportunities.

Despite these advancements, challenges persist. Many small-scale food processors across Africa struggle with limited access to finance, high production costs, and weak supply chain linkages. Additionally, food safety standards and regulatory compliance remain obstacles for businesses looking to expand into regional and international markets. In Kenya, small-scale dairy processors have faced difficulties in meeting quality and safety standards required for export, limiting their market reach (Tostado, 2022). Addressing these challenges requires targeted policies that support technology adoption, infrastructure development, and access to financing for food processors.

15.4 Methodology

The chapter used a qualitative desktop research method to collect data from the existing literature. This method involved gathering and analyzing existing literature from various credible sources, including academic journals, policy reports, government publications, industry white papers, and reports from international organizations such as the Food and Agriculture Organization (FAO). By systematically reviewing these sources, the study was able to examine the current state of sustainable food processing in Africa, highlight key strategies adopted in different regions, identify major challenges facing the sector, and explore potential opportunities for growth and innovation (Babbie, 2020). The data collection process focused on sourcing relevant literature that provided insights into technological advancements, regulatory frameworks, financial barriers, and the role of stakeholders in promoting sustainability in food processing. Special attention was given to case studies from African countries that have successfully implemented sustainable food processing initiatives. Secondary data was critically assessed to ensure its relevance, reliability, and credibility, with a preference for peer-reviewed studies, official government statistics, and reports from reputable institutions (Kumar, 2019).

For data analysis, a thematic approach was used to organize and interpret the collected information. Thematic analysis involved identifying recurring themes, patterns, and relationships within the literature to develop a structured understanding of the subject (Van Thiel, 2021). The data was categorized into key thematic areas, such as sustainable processing technologies, challenges, and opportunities for innovation. Trends and gaps in the literature were also analyzed to highlight areas requiring further research or policy intervention. Additionally, a comparative analysis was conducted to assess how different African countries have approached sustainable food processing, drawing lessons from both successes and failures.

15.5 Key Strategies for Advancing Sustainable Food Processing in Africa

Advancing sustainable food processing in Africa requires a multifaceted approach that addresses environmental, economic, and social challenges while ensuring food security and economic growth. The following key strategies can help enhance sustainability in food processing across the continent.

15.5.1 Adoption of Innovative Technologies in Food Processing

The adoption of innovative technologies in food processing across Africa is playing a transformative role in enhancing food security, reducing post-harvest losses, and improving economic opportunities. Many African countries face challenges such as inadequate infrastructure, limited access to electricity, and inefficient supply chains, which contribute to significant food wastage (World Food Programme (WFP), 2021). However, the integration of modern food processing technologies is helping to address these challenges by improving efficiency, extending the shelf life of food products, and ensuring higher quality standards (Zindi &

Ndhlovu, 2025). From solar-powered preservation methods to digital monitoring systems, these advancements are reshaping the food processing industry in Africa. In Ghana, the Sunhut solar drying technology is being used by small-scale farmers to dry mangoes, pineapples, and other fruits, making them available throughout the year and opening new market opportunities for exports (Pickson & Boateng, 2022). Traditional drying methods, such as open-air drying, often expose food to contamination and lead to nutrient loss. By using solar dryers, farmers can significantly improve food quality, increase storage duration, and reduce dependency on fresh seasonal harvests.

Cold chain logistics is another critical area where technological advancements are making a difference. In Kenya, companies like Solar Freeze have introduced solar-powered cold storage solutions that enable smallholder farmers to store perishable products such as dairy, fruits, and vegetables for longer periods (Wineman et al., 2022). This has significantly reduced post-harvest losses and improved farmers' incomes by allowing them to sell their products at better prices rather than rushing to offload them before they spoil. In Rwanda, the government, in partnership with private firms, has invested in refrigerated transport and cold storage facilities, improving the dairy industry by ensuring milk reaches processing plants in good condition, reducing spoilage rates, and increasing profitability for farmers (Amede & Whitbread, 2022). In South Africa, major agribusiness companies are integrating Internet of Things (IoT)-enabled monitoring systems to track temperature and humidity levels in food storage facilities, ensuring optimal conditions for perishable goods (Abdulai, 2022). This has significantly improved compliance with food safety regulations and reduced food losses during storage and transportation. Additionally, in Nigeria, the Tomato Jos initiative has introduced improved tomato processing technologies, enabling local farmers to produce high-quality tomato paste and reduce dependence on imported products (John, 2024). By using mechanized processing techniques, the initiative has not only extended the shelf life of tomatoes but has also created employment opportunities within the agro-processing sector.

15.5.2 Enhancing Energy Efficiency in Food Processing

Enhancing energy efficiency in food processing is a crucial step toward sustainable agricultural and industrial development in Africa. High energy costs, unreliable power supply, and dependence on fossil fuels have long been challenges for food processors, particularly small and medium enterprises (Abdulai, 2022). By transitioning to renewable energy sources such as solar, biogas, and hydroelectric power, food processing businesses can significantly reduce operating costs while lowering their carbon footprint. In Ethiopia, agro-processing firms have integrated biomass-powered systems into their production processes, utilizing agricultural waste such as coffee husks, sugarcane bagasse, and crop residues to generate energy (Araya & Lee, 2024). In Kenya, dairy cooperatives and slaughterhouses are investing in biogas digesters that convert organic waste into energy for processing milk, meat, and other products. Pawlak and Kołodziejczak (2020) mention that the use of biogas not only cuts energy costs but also addresses waste management challenges by turning agricultural and food waste into a valuable resource. In Ghana, breweries and food processing firms are also adopting biogas systems to generate power from fermentation by-products, reducing their reliance on non-renewable energy sources (Ofori et al., 2021). This has reduced reliance on expensive fossil fuels and provided an environmentally friendly alternative for powering food production facilities.

Solar energy is another renewable source that is transforming food processing efficiency across Africa. In South Africa, companies such as Tiger Brands have invested in solar power solutions to reduce dependency on the national grid and ensure a stable power supply for food processing plants (Reardon et al., 2021). The company has installed solar panels on its production facilities, cutting electricity costs and reducing greenhouse gas emissions. Similarly, in Nigeria, small-scale food processors are using solar-powered milling and drying equipment to enhance productivity in grain and cassava processing (Quarshie et al.,

2023). This shift to solar energy has helped businesses remain operational despite frequent power outages, a common challenge in many African countries. Hydroelectric power is also playing a significant role in advancing energy efficiency in the food processing sector. In Rwanda, the government has prioritized the development of small-scale hydroelectric plants to provide sustainable energy solutions for agro-processing industries (Uzokwe et al., 2022). In Uganda, similar initiatives have been implemented, where micro-hydro projects power rural food processing units, enabling farmers to add value to their products before selling them to larger markets (Abdulai, 2022). These plants supply reliable electricity to tea and coffee processing factories, ensuring uninterrupted operations and reducing production costs.

15.5.3 Promoting Value Addition to Agricultural Products

Promoting value addition to agricultural products is a key strategy for improving food security, increasing farmer incomes, and driving industrialization in Africa. Many African economies are heavily reliant on agriculture, yet a significant portion of produce is exported in raw form, limiting the potential economic benefits (Amede & Whitbread, 2022). This shift also enables African nations to compete in global markets by exporting finished and semi-finished products rather than low-value raw materials. Ghana has One District, One Factory (1D1F) initiative launched by the government, focuses on establishing food processing factories across the country to transform raw agricultural materials into high-value products. In Ghana cassava, a staple crop is now being processed into flour, starch, and ethanol for both local consumption and export and also cocoa, a major export commodity, is increasingly being processed into chocolate and cocoa powder within the country instead of exporting raw cocoa beans (Zindi & Ndhlovu, 2025). This initiative has not only increased the income of local farmers but has also created jobs in

agro-processing industries, contributing to economic growth.

In Nigeria, efforts to promote value addition in the tomato industry have reduced reliance on imported tomato paste. The establishment of large-scale tomato processing plants, such as the Dangote Tomato Processing Factory, has enabled local farmers to process fresh tomatoes into paste and other by-products (Pickson & Boateng, 2022). Similarly, in Ethiopia's honey industry, value addition has transformed honey production into a lucrative sector. Ethiopia is one of Africa's largest honey producers, but for many years, most of its honey was sold in raw form (Molotoks et al., 2021). Now, with investments in processing technology, Ethiopian honey is being refined, packaged, and branded for both local and international markets.

In Rwanda, significant investments in coffee processing have transformed the industry, allowing smallholder farmers to move up the value chain. Traditionally, Rwanda exported raw coffee beans with minimal processing, which limited the profits earned by local farmers. However, with increased investment in coffee washing stations, roasting facilities, and packaging plants, Rwandan coffee is now exported as a high-quality, finished product (Ayanlade & Radeny, 2020). This has significantly increased revenues for farmers and positioned Rwanda as a premium coffee exporter in international markets. In Kenya dairy industry, investments in milk processing have led to the production of long-life milk, cheese, yogurt, and butter (Abdulai, 2022). Previously, farmers struggled with market fluctuations and milk spoilage due to inadequate refrigeration. However, with improved processing facilities and cold chain logistics, Kenya has developed a robust dairy industry that supplies both domestic and export markets (Life Africa, 2022). Companies like Brookside Dairy and New KCC have played a significant role in processing raw milk into high-value dairy products, stabilizing farmer incomes and ensuring year-round supply.

15.5.4 Strengthening Market Linkages and Supply Chains

Many food processors, especially small and medium-sized enterprises (SMEs), face challenges in accessing reliable markets due to inefficient distribution networks, inadequate infrastructure, and limited access to market information. A well-structured market linkage system ensures that food products reach consumers in a timely manner, improves food security, and creates new economic opportunities (Araya & Lee, 2024). The Twiga Foods in Kenya has pioneered a mobile-based supply chain system that links smallholder farmers directly with urban food vendors and retailers (Pawlak & Kołodziejczak, 2020). Traditionally, farmers relied on middlemen, who often manipulated prices and delayed payments. Twiga Foods eliminates intermediaries by providing a digital marketplace where farmers can sell their produce directly to buyers. Similarly, AgriZone in Ghana operates an online marketplace that allows farmers and food processors to sell products directly to consumers and businesses (Abdulai, 2022). By using mobile applications and digital payment solutions, the platform streamlines transactions and provides real-time market insights, helping food processors adjust their production based on demand. In Nigeria, Farm crowdly has adopted a similar approach by enabling smallholder farmers to connect with agro-processors and distributors, creating a seamless supply chain that enhances food security and economic growth (Nugroho et al., 2021).

Beyond digital solutions, strengthening regional trade through initiatives like the African Continental Free Trade Area (AfCFTA) presents a major opportunity for African food processors (Pawlak et al., 2020). The AfCFTA aims to create a single market for goods and services across the continent by reducing tariffs and trade barriers. This agreement allows food processors to expand their customer base beyond national borders, enabling them to access larger markets.

The Golden Valley Agricultural Research Trust (GART) in Zambia has leveraged regional trade agreements to export processed maize, soybean, and groundnut products to neighboring countries like Zimbabwe and the Democratic Republic of Congo (Kumar & Agrawal, 2020). This has not only boosted Zambia's food processing sector but has also contributed to regional food security. In East Africa, Azam Bakeries in Tanzania has successfully expanded its operations by exporting baked goods such as bread, biscuits, and flour to Rwanda, Kenya, and Uganda (Warsame et al., 2023). By leveraging regional trade agreements and improving logistics, the company has been able to scale up production and meet the growing demand for processed food in neighboring markets. Similarly, in West Africa, Promasidor Ghana, a leading food processing company, has benefited from regional trade policies that allow it to export dairy and nutritional products to other ECOWAS countries (Quarshie et al., 2023).

15.5.5 Supporting Small-Scale Food Processors and Cooperatives

Supporting small-scale food processors and cooperatives is essential for fostering inclusive economic growth and enhancing food security in Africa. Small and medium-sized enterprises (SMEs) form the backbone of the food processing sector, providing employment opportunities and adding value to agricultural produce (May & Mentz-Coetzee, 2021). However, these enterprises often face significant challenges, including limited access to financing, outdated equipment, inadequate infrastructure, and weak market linkages. One of the most impactful initiatives is Tanzania's Small Industries Development Organization (SIDO), which provides small-scale food processors with training, affordable processing equipment, and business development support (Ndhlovu & Mhlanga, 2024). The SIDO has established small industrial clusters where food processors can access modern machinery for processing cereals, fruits, and dairy products at a subsidized cost. This initiative has enabled rural food

entrepreneurs to scale their businesses, improve product quality, and compete in larger markets. Wineman et al. (2022) pointed out that in Ghana, the Rural Enterprise Programme (REP), supported by the government and international development partners, provides technical assistance, financial support, and market access to small-scale food processors. The program helps entrepreneurs acquire processing machinery, develop business skills, and comply with food safety regulations. Cooperatives have also played a crucial role in strengthening small-scale food processing. In Kenya, the Murang'a Avocado farmers' cooperative has empowered small avocado growers by providing access to shared processing facilities, storage solutions, and direct export markets. Abdulai (2022) mentioned that instead of selling raw avocados at low prices to middlemen, cooperative members now process their produce into avocado oil and other value-added products, increasing their earnings significantly.

Similarly, in Ethiopia, honey cooperatives have supported small-scale beekeepers by providing modern honey processing equipment and access to international markets. The Ethiopian government, in collaboration with organizations like SNV Netherlands Development Organization, has established honey processing centers where small-scale producers can refine and package honey according to global standards (Araya & Lee, 2024). This has increased Ethiopia's honey exports, providing sustainable incomes for thousands of rural beekeepers. In Nigeria, the Anchor Borrowers' Programme, launched by the Central Bank of Nigeria, provides loans to small agro-processors and farmers, enabling them to invest in better equipment and expand production (Kumar & Agrawal, 2020). This initiative has particularly benefited rice millers, who have used the funds to modernize processing facilities, improve packaging, and enhance the quality of locally milled rice. In South Africa, organizations like the South African Agro-Processing Support Scheme (APSS) provide funding to small and medium agro-processors to enhance productivity and market access (Ndhlovu, 2024). The program prioritizes enterprises that process locally sourced agricultural products, supporting

the government's broader strategy of promoting food self-sufficiency and reducing imports.

15.6 Challenges Faced When Implementing Sustainable Food Processing Practices in Africa

Despite the potential benefits of sustainable food processing, Africa faces several challenges in its implementation. These challenges stem from economic, technological, regulatory, and infrastructural limitations that hinder progress in adopting environmentally friendly and efficient food processing practices.

15.6.1 Limited Access to Finance and Investment

One of the biggest challenges facing small-scale food processors and rural communities in Africa is the lack of financial resources to invest in modern processing equipment, renewable energy solutions, and improved storage facilities. Many small agro-processors operate informally, making it difficult for them to access formal credit. Financial institutions often consider them high-risk due to their lack of collateral, high-interest rates, and limited financial literacy (Ndhlovu & Mhlanga, 2024). Without adequate financing, small processors are unable to modernize their operations, leading to inefficiencies, low productivity, and significant post-harvest losses. In Nigeria, small-holder farmers and processors in the cassava industry struggle to secure loans to invest in mechanized processing. Many still rely on traditional methods, which limit their ability to produce high-quality, value-added cassava products such as cassava flour, starch, and ethanol (Ayanlade & Radeny, 2020). This has constrained their ability to compete with larger industrial processors and meet the growing demand for cassava-based products.

Similarly, in Ghana, cocoa farmers and processors face financial challenges in expanding their

operations. Many small cocoa processing businesses, which produce cocoa butter, powder, and chocolate, lack the capital to invest in modern machinery that meets international standards (Dsouza et al., 2023). In Kenya, dairy processors face financing constraints that limit their ability to invest in cold storage and pasteurization technology. Small-scale dairy cooperatives often operate without proper refrigeration, leading to high levels of milk spoilage before reaching markets (Jayne & Sanchez, 2021). In South Africa, agro-processing SMEs face similar funding challenges, particularly in the fruit and vegetable processing sector. Many small businesses lack the financial capacity to invest in solar-powered drying technology, which could extend the shelf life of fresh produce and reduce post-harvest losses (Pawlak & Kołodziejczak, 2020).

15.6.2 Weak Market Linkages and Limited Access to Technology

Weak market linkages and limited access to technology pose significant barriers for small-scale food processors in Africa. Many small food processing businesses struggle to connect with broader markets due to poor distribution networks, lack of branding, and intense competition from imported processed foods (Saiz-Rubio & Rovira-Más, 2020). In rural areas, inadequate infrastructure and limited access to modern technologies further exacerbate these challenges, restricting the growth potential of small-scale processors and their ability to expand their market reach. In Kenya, small-scale fish processors along Lake Victoria face particular challenges in selling their products and many of these processors lack cold storage facilities, which results in high spoilage rates as fish deteriorates quickly in the absence of refrigeration (John, 2024). Moreover, inefficient transportation networks make it difficult to get the fish to market in time for sale, leading to significant losses. The absence of reliable cold chain logistics further hampers their ability to supply markets beyond their local areas.

In Nigeria, smallholder farmers and processors in the palm oil industry also face difficulties in accessing broader markets. Many small-scale processors lack access to modern processing technologies that would enable them to produce higher-quality palm oil products, such as packaged and branded oils (Wineman et al., 2022). The lack of branding and packaging makes it difficult to differentiate their products in the market, where they face stiff competition from both larger processors and imported palm oil. The absence of digital platforms to connect them with a wider customer base has limited their ability to expand their market reach and access consumers beyond their immediate communities (Wezel et al., 2020). In many rural areas, food processors lack access to online marketplaces and mobile payment solutions, which could help them reach customers in distant markets. For example, small-scale processors in Ghana often sell their processed products in local markets with little opportunity to expand to national or international buyers (Zindi & Ndhlovu, 2025). Pickson and Boateng (2022) mentioned that without access to digital platforms like Jumia (an African e-commerce platform), they are unable to tap into broader regional and international markets, thereby limiting their growth potential.

15.6.3 Challenges in Meeting Food Safety and Regulatory Standards

Small-scale food processors in Africa face numerous challenges when it comes to meeting food safety and regulatory standards, which are crucial for ensuring the quality and safety of food products, as well as for gaining access to international markets. These challenges are often compounded by the high costs of certification, lack of awareness regarding regulations, and inadequate government support. Many small-scale food processors are unable to navigate the complex regulatory landscape, making it difficult for them to comply with the standards required to expand their businesses, compete with larger companies, and access lucrative export markets (Ayanlade & Radeny, 2020).

In Tanzania, small-scale honey processors face significant challenges in meeting food safety and certification requirements. Amede and Whitbread (2022) noted with concern that the strict food safety regulations that are necessary for obtaining export certification are often out of reach for small producers due to the high costs associated with certification processes. These costs, which include fees for testing, lab analysis, and compliance with international standards, make it difficult for small honey producers to compete with larger, established companies that can afford such expenses. Similarly, in Ghana, small cocoa processors struggle to meet international quality standards such as Fair Trade and Rainforest Alliance certifications, which are necessary to access high-value international markets (Brass-escio et al., 2021). The stringent food safety regulations, which require adherence to quality control practices, appropriate packaging, and traceability of products, often overwhelm small-scale processors who lack the technical knowledge and financial capacity to implement such systems.

In Kenya, small-scale dairy processors face similar challenges in meeting food safety and regulatory requirements. Many small processors lack the infrastructure to implement hygiene and quality control measures, such as cold storage and pasteurization equipment, which are necessary to ensure product safety and meet the Kenya Bureau of Standards (KEBS) requirements (Pickson & Boateng, 2022). The costs of certification for domestic markets, as well as the export certifications required to access international markets, are prohibitive for small dairy processors, particularly those in rural areas. In South Africa, although there are well-established food safety regulations and quality standards, small food processors still face difficulties in complying with the stringent rules set by organizations like SABS (South African Bureau of Standards) (Saiz-Rubio & Rovira-Más, 2020). Many small-scale processors in rural areas struggle with limited access to resources, including laboratories for product testing and technical experts to guide them through the certification process (WFP, 2021). This leaves them at a disadvantage when competing with larger companies that

have the necessary infrastructure and expertise. The costs of obtaining HACCP (Hazard Analysis Critical Control Point) certification or ISO standards are often prohibitive for small processors, who also struggle with inconsistent supply chains, making it difficult to ensure the quality and safety of products (Fikru et al., 2023).

15.6.4 Climate Change and Environmental Challenges

Climate change poses a growing and significant challenge to sustainable food processing in Africa, affecting agricultural production, increasing the risk of food spoilage, and disrupting supply chains. Changes in weather patterns, such as unpredictable rainfall, prolonged droughts, and increased frequency of extreme weather events, have far-reaching effects on the availability of raw materials, the quality of agricultural produce, and the efficiency of food processing industries (Abdulai, 2022). In South Africa, the Western Cape province has been heavily impacted by water scarcity caused by climate change, which affects both agriculture and food processing. Wine producers face challenges as unpredictable rainfall patterns reduce grape harvests, impacting the production of wine and other grape-based products. The increased frequency of droughts in areas where food processing industries are located further stresses water availability, which is essential for cooling systems, cleaning processes, and other food production activities (Zindi, 2024). Moreover, improper waste management in the food processing industry in Africa contributes to environmental degradation. Similarly, small-scale meat processors in Uganda and Tanzania frequently lack the necessary infrastructure to properly dispose of waste materials such as blood, bones, and offal, which leads to contamination and environmental hazards (Shang et al., 2024).

In Zambia, the impact of climate change has been particularly severe for maize meal processors, who rely on consistent maize production for their operations. Unpredictable rainfall patterns and extended dry seasons have led to fluctuating

yields, making it difficult for processors to source a steady supply of raw maize. For instance, the 2018 drought in Zambia reduced maize production by as much as 30%, forcing processors to scale back production or shut down temporarily (Ndhlovu & Mhlanga, 2024). These climatic shifts not only hinder the profitability of food processing industries but also disrupt food security, particularly in rural areas where maize is a staple crop. Similarly, in Kenya, extreme weather events such as droughts and flooding have significantly impacted the agricultural sector, leading to supply chain disruptions for food processors (Picksonn & Boateng, 2022). Climate. For example, coffee and tea production has been affected by rising temperatures and irregular rainfall, leading to lower yields and inconsistent supply for processors (Affoh et al., 2022). Small-scale fruit and vegetable processors are also facing challenges as flooding damages crops and droughts reduce overall harvests.

15.7 Opportunities for Scaling Up Sustainable Food Processing in Africa

Despite the challenges, there are significant opportunities to scale up sustainable food processing in Africa. These opportunities stem from advancements in technology, policy reforms, increasing consumer demand for sustainable products, and greater investment in the food processing sector. Leveraging these opportunities can help transform the continent's food systems, ensuring food security, economic growth, and environmental sustainability.

15.7.1 Policy Interventions to Support Sustainable Food Processing

Governments across Africa play a pivotal role in fostering sustainable food processing by implementing effective policy interventions, offering incentives, and establishing regulatory frameworks that encourage local value addition, reduce

dependence, and enhance food security (May & Mentz-Coetzee, 2021). These interventions are vital for scaling up the food processing sector, promoting job creation, and improving the quality and availability of processed food products. Ghana has developed Ghana's One District, One Factory (1D1F) initiative, which aims to establish at least one agro-processing factory in each district of the country and this initiative has been instrumental in promoting local value addition, particularly in the processing of cocoa, cassava, and fruit juices (Brassescio et al., 2021).

Furthermore, companies such as Kasapreko, which produces fruit juices, and Afrotex, which processes cassava flour, are beneficiaries of the initiative. Jayne and Sanchez (2021) affirm that through this policy, Ghana has significantly reduced its reliance on imported processed foods while simultaneously creating jobs, particularly for smallholder farmers who supply raw materials to the factories. Similarly, in Ethiopia, the government has introduced agro-industrial parks to support small and medium-sized enterprises (SMEs) in the food processing sector and these parks are designed to provide infrastructure, logistical support, and technical services to food processors, enabling them to scale up operations (Popkin, 2021). The Hawassa Industrial Park, which includes agro-processing facilities for products such as fruit juices, vegetable processing, and grain milling.

More so, in Kenya, the government's policy interventions to support agriculture and food processing include providing subsidies and technical assistance to smallholder farmers and food processors (Saiz-Rubio & Rovira-Más, 2020). This includes market linkages, such as initiatives like Twiga Foods, which connect smallholder farmers to urban markets through a digital platform, improving the efficiency of food distribution. Moreover, Nigeria has established policies to boost the cassava processing industry, which is a key part of the country's economy. The National Cassava Policy aims to increase the processing of cassava into value-added products such as cassava flour, starch, and ethanol (Pawlak & Kołodziejczak, 2020). The policy provides incentives such as loans, subsidized processing

equipment, and training programs for farmers and processors.

15.7.2 Private Sector Investments in Food Processing Technologies

The private sector plays a crucial role in driving innovation, improving efficiency, and expanding the capacity of food processing industries in Africa. By investing in modern processing technologies, renewable energy solutions, and digital supply chains, private companies can significantly enhance the sustainability and competitiveness of the sector. In Kenya, the Twiga Foods company has pioneered the use of digital platforms to connect smallholder farmers with food processors and retailers, which has resulted in more efficient food distribution and reduced post-harvest losses (Zindi & Ndhlovu, 2024). Through a mobile app, Twiga Foods links farmers directly to urban food vendors, eliminating intermediaries and improving the speed and efficiency of food supply chains.

In Nigeria, the Dangote Group is a private sector investment can drive food processing growth. The Dangote Rice Mill in Kebbi State is one of the largest rice processing facilities in the country and has the capacity to process millions of tons of rice annually (Enilolobo et al., 2022). This investment has created thousands of jobs, not only within the factory but also for farmers supplying the mill. In Ghana, Olam International, invested in state-of-the-art processing plants for cocoa and cashew nuts, which have helped increase the value-added exports of these commodities (Warsame et al., 2023). By investing in advanced milling technologies and automated systems, Olam has improved efficiency, reduced waste, and expanded the production capacity of local food processors. In South Africa, Tiger Brands, one of the largest food companies in the country, has made significant strides in reducing its environmental impact by investing in solar energy to power its food processing plants (Life Africa, 2022). This investment in clean energy reduces operational costs by lowering electricity

bills and also aligns with global sustainability goals by reducing greenhouse gas emissions.

15.7.3 Adoption of Renewable Energy for Sustainable Processing

The adoption of renewable energy sources such as solar, wind, and biogas plays a pivotal role in making food processing more sustainable while also reducing operational costs and carbon footprints. In many African countries, where access to reliable and affordable energy is a significant challenge, renewable energy solutions offer an attractive alternative to traditional, fossil fuel-based energy systems (Nchanji & Lutomia, 2021). The integration of renewable energy in food processing not only helps lower energy costs but also improves environmental sustainability by reducing the dependence on non-renewable resources. The expansion of renewable energy solutions in food processing also contributes to energy security in rural areas, where access to reliable and affordable electricity is often limited (Saiz-Rubi & Rovira-Más, 2020). Additionally, this transition aligns with global goals for sustainable development, including SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action), making renewable energy a key enabler of sustainable food processing in Africa.

In Uganda, small-scale food processors, especially in rural areas, are adopting solar-powered dryers to extend the shelf life of fruits and vegetables. These solar dryers allow producers to dry their produce in a cost-effective and energy-efficient manner, significantly reducing post-harvest losses. Nchanji and Lutomia (2021) pointed out that since fruits and vegetables are highly perishable, solar drying offers a sustainable solution for smallholder farmers to preserve their harvests without relying on expensive and unreliable electricity or costly fuel-powered drying methods. Similarly, in Rwanda, biogas energy has

been successfully integrated into dairy processing plants to cut energy costs and reduce carbon emissions. Dairy processing is highly energy-intensive, with processes such as milk pasteurization and cheese production requiring significant amounts of heat and electricity (Amede & Whitbread, 2022). By utilizing biogas, derived from organic waste such as manure, Rwanda's dairy processors are able to reduce their reliance on grid electricity or fossil fuels, resulting in substantial savings. Furthermore, biogas production not only provides a renewable source of energy but also helps in managing agricultural waste, contributing to circular economy principles by reducing the environmental footprint of the dairy industry (Araya & Lee, 2024). This sustainable approach supports energy security in rural areas, where access to conventional energy sources can be limited or costly.

15.7.4 Strengthening Research, Innovation, and Capacity Building

Investing in Research and Development (R&D) can drive innovation in food processing technologies, improve food safety, and enhance product quality. African universities and research institutions can collaborate with the private sector to develop new food preservation techniques, packaging solutions, and efficient processing methods. In South Africa, the Council for Scientific and Industrial Research (CSIR) has partnered with food processing companies to develop innovative food preservation technologies that extend the shelf life of perishable products (Ayanlade et al., 2020). Additionally, training programs for small-scale food processors in countries like Tanzania and Senegal have helped improve food safety standards and processing efficiency. Expanding such initiatives across Africa enhances skills development and technological adoption in the food processing sector.

15.7.5 Access to Finance for Small and Medium-Sized Food Processors

Access to affordable financing remains one of the most significant challenges for small and medium-sized food processors in Africa. Many of these businesses face difficulties in securing capital to scale their operations, adopt modern processing technologies, or implement sustainable production practices. In Kenya, the Agriculture Finance Corporation (AFC) plays a key role in providing low-interest loans to agro-processors. Wineman et al. (2022) pointed out that loans are designed to enable processors to invest in essential processing equipment, such as modern mills, refrigerators, and packaging systems, which are critical for improving the efficiency and quality of food products. By offering affordable financing, the AFC allows food processors to adopt modern processing techniques, ultimately helping them scale their businesses and meet market demands.

Similarly, in Ghana, the government has established the Ghana Incentive-Based Risk-Sharing System for Agricultural Lending (GIRSAL) to support food processors in accessing credit. The GIRSAL works by sharing the risk of lending to agro-processors, which reduces the financial risk for commercial banks and encourages them to offer loans to small and medium-sized food processors (Abdulai, 2022). By making loans more accessible, GIRSAL helps processors secure the capital they need to invest in modern technologies, enhance food safety, and improve market competitiveness. This initiative is particularly crucial for small processors who may not have access to traditional forms of collateral or credit history, which are often required by banks.

In addition to these national schemes, there are various other financing models that are supporting small-scale food processors across the continent. Microfinance institutions (MFIs) and impact investors are increasingly becoming key players in the food processing sector by offering tailored loans and equity investments to small processors (Jayne & Sanchez, 2021). In Nigeria the microfinance institutions have partnered with food processing cooperatives to provide small

loans to members who would otherwise not be able to access financing from commercial banks (Nchanji & Lutomia, 2021). These microloans can be used to purchase basic equipment, improve production efficiency, and boost product quality, thereby increasing the overall capacity of small food processors.

The rise of innovative financing models is also supporting sustainable development in the food processing sector. Blended finance approaches, which combine public and private sector funds, are particularly promising for driving investments in sustainable food processing (Jayne & Sanchez, 2021). In countries such as South Africa, where the food processing industry is relatively advanced, development finance institutions (DFIs) are partnering with private investors to provide capital for green technologies, such as solar energy systems, to power food processing plants (Pawlak & Kołodziejczak, 2020). These investments not only reduce operating costs for processors but also contribute to climate resilience and environmental sustainability.

15.8 Conclusion

Advancing sustainable food processing is essential for strengthening Africa's food systems, ensuring resilience against climate change, improving food security, and fostering economic inclusion. Sustainable food processing involves adopting environmentally friendly technologies, reducing food waste, and enhancing the nutritional value of processed foods while ensuring affordability and accessibility for diverse populations. Given Africa's growing population and increasing urbanization, innovative and sustainable food processing methods can play a pivotal role in reducing post-harvest losses, improving value addition, and creating employment opportunities across the agricultural value chain.

Despite its potential, several challenges hinder the advancement of sustainable food processing in Africa. Limited access to modern technology, inadequate infrastructure, energy constraints, and insufficient financial investment pose significant barriers to progress. Additionally, fragmented

policies, weak regulatory frameworks, and limited technical expertise often slow down the adoption of sustainable processing methods. Small-scale food processors, who form the backbone of Africa's food sector, face difficulties in accessing funding, complying with food safety standards, and integrating into formal markets, further exacerbating inequalities in the food system.

However, there are numerous recommendations to drive sustainable food processing forward. Strengthening public–private partnerships, enhancing research and development, and investing in digital innovations can help bridge existing gaps. Governments and development partners can support small and medium-sized enterprises (SMEs) by providing financial incentives, technical training, and regulatory support. Furthermore, integrating renewable energy solutions into food processing facilities, promoting circular economy practices such as upcycling food waste, and utilizing indigenous knowledge can contribute to both environmental sustainability and economic growth.

Moving forward, a multi-stakeholder approach is crucial to advancing sustainable food processing in Africa. Policymakers must develop and implement clear policies that promote sustainability while ensuring inclusivity, particularly for smallholder farmers, women, and youth. Investment in infrastructure, digital tools, and capacity-building initiatives will be vital in overcoming current barriers. By leveraging innovation, collaboration, and policy reforms, Africa can build a resilient and inclusive food system that not only meets current demands but also safeguards food security for future generations while contributing to broader sustainable development goal.

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Harnessing Indigenous Knowledge and Modern Technology for Resilient Food Production in Dryland Countries

16

Miriam Hofisi  and M. T. Lukamba

16.1 Introduction

Globally, nearly 690 million people face hunger today, highlighting the critical challenge of achieving food security in an era where climate change poses unprecedented risks (FAO et al., 2020). Concurrently, there is a growing push, especially among youth, for urgent action to mitigate climate change impacts. This amplifies the need for solutions that simultaneously address the reduction of food security, adaptation, and reduction of greenhouse gas (GHG) emissions.

Agriculture, a cornerstone of many economies, contributes significantly to global GDP and sustains the livelihoods of approximately 2.5 billion people worldwide (FAO, 2017). However, the sector is also a major emitter, accounting for nearly one-third of global anthropogenic GHG emissions (Crippa et al., 2021). Despite these challenges, agriculture offers substantial potential to contribute to global climate goals through transformative practices that reduce emissions while fostering resilience (FAO, 2019).

Transforming agri-food systems—spanning crops, livestock, fisheries, aquaculture, agroforestry, and forestry—is an urgent priority. This transformation requires integrated, multi-sectoral, inclusive, gender-transformative, and

pro-poor approaches. Harnessing synergies between climate adaptation and mitigation is essential, as sustainable agricultural practices must simultaneously increase productivity to meet the Sustainable Development Goals (SDGs) (FAO, 2019). This balance is crucial for ensuring food security for current and future generations, while addressing the global climate crisis.

Against this backdrop, Climate-Smart Agriculture (CSA) has been lauded as a plausible solution to transform agro-food systems in the face of climate change uncertainties and the growing demand for food. The critical aim of CSA is to “sustainably increase agricultural productivity and incomes, adapting and building resilience of people and agri-food systems to climate change, and reducing and /removing greenhouse gas emissions” (FAO, 2021a, 2021b, p. 2).

Be that as it may, CSA on its own is not sufficient. Incorporating traditional knowledge into climate-smart agriculture has been further known to ameliorate the conditions in agriculture. CSA benefits significantly from using traditional institutions, kinship ties, and norms. These elements provide a robust framework for knowledge dissemination, collective action, and cultural continuity, critical for successfully integrating traditional practices with modern technology. Traditional institutions, kinship ties, and norms are critical in facilitating the acceptance and diffusion of CSA practices. By respecting traditional governance systems, CSA programs can foster trust, ensure equitable resource distribution,

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and enhance community ownership of projects. These strategies also encourage the intergenerational transfer of knowledge and skills vital for long-term sustainability.

There is growing evidence of the usefulness of climate-smart agriculture (CSA) in addressing food security and climate change in Africa (Abegunde & Obi, 2022; Ogisi & Begho, 2023). However, adoption rates among smallholder farmers remain low due to several constraints, including resource limitations, institutional barriers, and socio-economic factors (Abegunde et al., 2019; Wakweya, 2023). Integrating indigenous knowledge and local institutions into CSA practices is also known to enhance the adoption and scaling of CSA (Amare & Gacheno, 2021; Makate, 2019).

Despite wide-ranging technological innovations, integrating traditional knowledge and technological innovation to improve the availability of staple crops remains underexplored. There is a dearth of literature on the absence of detailed strategies to effectively incorporate informal institutions (IK, norms, kinship ties) into climate-smart agriculture innovation programs to enhance technology transfer. This chapter examines the existing institutions for indigenous knowledge, how knowledge can be harnessed, and the benefits of combining modern technology and traditional knowledge.

16.2 Methodology

This chapter uses a Qualitative Comparative Analysis-Based Research Synthesis (QCA-RS) approach, following the framework outlined by Onwuegbuzie and Weinbaum (2017). QCA-RS is principally suitable for synthesising qualitative findings across various case studies. This allows for cross-country comparisons.

Additionally, this method systematically identifies key factors influencing IKS and technology adoption and interactions between institutional factors, policy mechanisms, and indigenous knowledge systems (IKS) in Botswana, Namibia, and Zimbabwe. This approach uses qualitative

constant comparison analysis, enabling a structured comparison of different institutional conditions influencing the integration of modern technology into indigenous knowledge governance. This approach is grounded in the Constant Comparison Method approach developed by Glaser (1965). It entails iterative coding and categorisation of information to identify themes and patterns. The constant comparison method is especially plausible for identifying institutional conditions across Botswana, Namibia, and Zimbabwe.

This chapter makes use of the document analysis to collect data. Document analysis is predominantly suitable for this study because it systematically identifies challenges and opportunities at the intersection of indigenous knowledge and climate-smart agriculture. Additionally, it helps trace historical and policy developments across various institutional contexts. Data sources include reports from relevant agencies such as the Food and Agriculture Organisation, academic literature, and policy frameworks on Botswana, Namibia and Zimbabwe. The documents were selected based on their relevance to the study's themes, ensuring a comprehensive examination of policy landscapes and institutional practices. The analysis involves thematic coding to compare institutional conditions across cases systematically.

16.3 Conceptual Exposition

16.3.1 Climate-Smart Agriculture

According to Lipper et al. (2014), CSA is “an approach for transforming and reorienting agricultural systems to support food security under the new realities of climate change” (Lipper et al., 2014, p. 1068). Thus, climate-smart agriculture seeks to reduce the effects of climate change and simultaneously strengthen agricultural production. Similarly, FAO (2021a, 2021b) expounds the approach to Climate-Smart Agriculture (CSA) as a three-pronged approach “to transform agricultural systems to support food security under the changing climate. It focuses on three main pillars, which are:

- Sustainably increasing agricultural productivity and incomes.
- Adapting and building resilience to climate change.
- Reducing and/or removing greenhouse gas emissions where possible (FAO, 2021a, 2021b).

In addition to adaptation to climate change challenges, agri-food systems must be transformed to meet the SDGs. With rampant hunger across the world where 690 million are exposed, it has been imperative to coin strategies that can ameliorate contemporary food-related challenges. As such, FAO came up with the Climate Smart Agriculture (CSA), which is made up of five strategies listed below:

- Expanding evidence base for CSA
- Supporting enabling policy frameworks
- Strengthening national and local institutions
- Enhancing funding and financing options, and
- Implementing CSA practices at the field level (FAO, 2021a, 2021b)

The critical aim of CSA, as mentioned by FAO, is to “sustainably increase agricultural productivity and incomes, adapting and building resilience of people and agri-food systems to climate change, and reducing and/or removing greenhouse gas emissions” (FAO, 2021a, 2021b, p. 1). These strategies benefit smallholder farmers, indigenous groups and women affected by climate change. This study focuses on strengthening local institutions by combining indigenous knowledge with CSA in adapting to climate change. Concurrently, one of the key findings from FAO (2021a, 2021b) is that knowledge sharing and practices are essential to meet all five action points of CSA.

16.3.2 Indigenous Knowledge (IK)

Indigenous Knowledge refers to “the unique, traditional, and localised knowledge held by Indigenous peoples or local communities, which has been developed through experience, adaptation to environmental conditions, and cultural

context over generations. It often encompasses agriculture, health, resource management, and spiritual practices. Indigenous knowledge is dynamic and evolves through interactions with external systems, while maintaining its core traditional principles” (Berkes, 2012). As construed by Berkes, Indigenous Knowledge (IK) is endowed with valuable insights into sustainable resource management practices that indigenous communities have developed over generations (Makate, 2020, p. 128). Berkes et al. (2000) underscore the importance of IK in monitoring and managing ecosystem processes, and its aim is ecological resilience. A diverse array of local practices, including species management, crop rotation, and many others, contribute to sustainability in agriculture. There are social mechanisms that support these practices and are preserved and transferred. They include knowledge transmission to the younger generation, local institutions for leadership and regulation, cultural internalisation, and the development of appropriate norms. Many traditional management systems utilise local conservation knowledge to understand environmental feedback and guide resource management decisions. These systems share parallels with adaptive management approaches, mostly in their emphasis on learning feedback and handling environmental uncertainty and unpredictability (Berkes et al., 2000).

Concurrently, the United Nations Educational, Scientific, and Cultural Organisation (UNESCO) (2002) defines IK as “the understandings, skills and philosophies developed by societies with long histories of interaction with their natural settings. Remarkably, indigenous knowledge constitutes a set of practices developed over time, can be relied on by farmers to predict weather or environmental uncertainties, and can be used to manoeuvre complex ecological challenges such as droughts among farmers. Additionally, such knowledge usually applies to local contexts with specific climatic conditions and may not be regarded as universal truths or practices. As such, it is commonly noted that indigenous knowledge is enmeshed with people’s cultures and norms.

Adefila et al. (2024, p. 124) similarly reify that traditional agricultural practices steeped in

African cultural values can help the agricultural sector adapt to climate change vagaries. In addition to strengthening adaptation methods, using traditional methods empowers local communities and instils environmental stewardship. However, the value of these adaptation strategies is hardly acknowledged and exists in isolation from modern technologies. Traditional knowledge is loaded with insights about biodiversity, water conservation, soil health, pest control strategies unique to localities (Adefila et al., 2024, p. 124). The wealth of insights in traditional knowledge comes from a time-tested understanding of the environment and climate.

Adefila et al. (2024: 124) acknowledge that traditional knowledge is often overlooked due to its informal nature and methodology of production, especially when compared to smart agricultural practices. However, even though indigenous knowledge is orally passed from generation to generation, its production almost mimics the scientific process of knowledge production because it is tried over time and adaptable to changing climate conditions (Adefila et al., 2024, p. 125). Practices such as crop rotation, agricultural moon and solar calendars emanate from knowledge acquired from an intimate relationship with the environment. Further, what makes indigenous knowledge attractive to crop production in agro-based economies is that it is more likely to benefit most small-scale farmers.

To further harness the relevance of indigenous knowledge and ensure sustainable food systems, policy must reflect them. Huambachano et al. (2022) stress that policies regarding food systems need to be formed through co-creation with locals with diverse knowledge systems and experience with place-based needs and aspirations. Therefore, participation is highly recommended to ensure sustainable food systems. A sustainable food system delivers food security and nutrition for all so that the economic, social, and environmental bases to generate food security and nutrition for future generations are not compromised (Nguyen, 2018, p. 1). Therefore, policy formulation in developing countries such as Zimbabwe and Namibia must have policies that reflect the

importance of sustainable food systems by emphasising the importance of indigenous knowledge.

Indigenous knowledge is unique because it connects humans with their environment on a deeper and spiritual level. As noted by Huambachano et al. (2022), indigenous knowledge connects living beings with others, and it connects them with the environment. Opaskwayak Green Scholar Sean Wilson notes that traditional knowledge is based on kinship ties, relationships that do not merely shape reality, but are reality. Remarks from Opaskwayak denote the importance of kinship ties to agriculture. Indigenous knowledge centred on ties between land, nature, and human beings denotes an intertwined relationship of the three to live in harmony. Furthermore, traditional knowledge constantly evolves, and newly acquired adaptation strategies are transmitted through culturally provided channels to other generations. Therefore, knowledge is not static; it embodies evolving ways of creating new knowledge locally as the climate changes.

The passing of knowledge from generation to generation is done between the young and old, making these ties central to social reproduction and socialisation (Huambachano et al., 2022). According to Huambachano et al., “The cultivation of food not only provides us with food security but also represents a suite of knowledge sovereignty, and self-determination”. Also, UNESCO underscores how kinship ties enhance sustainability due to their interlinkages with ancestral practices and traditions that are passed down. Similarly, agrobiodiversity knowledge regarding plant species and animals is territorially confined and embedded in songs, rituals, recipes, and ceremonies. To this end, people in North and South America and Africa embrace and cherish their biocultural heritage as a means of crop preservation.

Furthermore, the exchange of assets such as land, finance, wisdom, practices and experiences is all transferred through kinship ties. Regarding food systems, knowledge networks include active and young recipients with relations with elders where knowledge is intimately passed down (Huambachano et al., 2022). As

such, they become a reservoir of local knowledge. The youth/young play an integral role in passing down knowledge since they are invited to participate in farming networks. These are intentional endeavours to impart skills and knowledge acquired over centuries. This knowledge, considered invaluable by ancestors, is revered as a deity known to enhance sustainable agri-food systems. When knowledge is valued as noted above, and is compatible with innovation or at least open to innovation, it makes climate change coping strategies an attainable fit. Innovation in this regard is not reduced to mean new ideas but also to 'developing assemblages of old and new practices, recognising technology and local and social innovations in diverse intergenerational knowledge systems, including indigenous systems' (Huambachano et al., 2022).

16.3.3 Informal Institutions

Informal institutions are the unwritten rules, norms and practices that govern behaviour at the communal level. The networks, norms, trust in communities, institutions, and values enable individuals to work together. In this study, these institutions include traditional leadership, farmer field schools, kinship ties and community-based adaptation approaches, which are known as intermediaries through which adaptation can be adopted amongst smallholder farmers in rural communities (Makate, 2020). The council of elders, a traditional leadership structure, is a decision-making and information structure respected amongst communities. If information or CSA approaches are channelled through these social capital elements, community uptake becomes attainable. Likewise, farmers share knowledge in communal farmers' field schools, including climate-resilient practices. Therefore, such institutions must be utilised as important channels through which CSA can be channelled. Therefore, social capital in this study refers to the informal institutions, and this conceptualisation borrows from the Social Capital Theory.

16.3.4 The Social Capital and Diffusion of Innovation Theories

Social capital theory can be traced to the "Social Capital" essay by Bourdieu. From this essay, scholars have been convinced that "the ability of individuals to acquire resources is based on social relations or broader social structures". Coleman in Schmid and Robinson (1995: 59) define social capital as "all human relationships in the value of these aspects of social structure to actors as resources that they can use to achieve their interests." Coleman's conceptualisation of social capital entails "obligations, expectations and trustworthiness of structures and institutions, information channels and norms as effective channels." Therefore, social capital determines the collective behaviour of communities and is a critical element for adopting practices applicable to communities.

Further to that, the trust that is built through kinship ties is also essential in decision-making. Wossen et al. (2015) state that while social capital or kinship ties are essential in farmland management, social capital also depends on a household's degree of risk aversion. In the case of existing substantial social capital, adaptation is more straightforward when climate change strategies tap into existing social capital. In the same vein, Hansen and Roll (2016) reiterate that social capital is the mainstay of adopting agronomic technology practices. Existing relationships among communities often facilitate the diffusion of new technologies, reinforcing Rogers' (1962) Diffusion of Innovation Theory (DOI). DOI explains how innovations, such as modern agricultural technologies, spread within a social system over time. He et al. (2016) further emphasise that social capital can be an information-sharing mechanism. It follows that trust is the basis for information sharing amongst communities of kinship ties. Therefore, social capital facilitates cooperation on essential climate change activities.

Han et al. (2022) in their study observed that social trust holds a significant impact on farmers'

willingness to adopt new technologies in China. Also, social networks are essential in the persuasion stage of the innovation diffusion process, especially if they align with kinship-based structures. According to Han et al. (2022: 1368), the promotion of new technologies such as CSA holds several benefits, which include “optimising inputs; improving efficiency of resources utilisation; improving allocation efficiency of agricultural production factors; improving the general environment; promoting transformation of agriculture by improving quality of production”. Therefore, exploring ways to catalyse the adoption processes remains imperative.

He et al. (2015: 105) concurrently stress that kinship ties can influence relatives to adopt certain practices, which is important in the knowledge phase of innovation diffusion. Those close relations reduce the cost of search by making information more asymmetrical and reducing supervision costs. In their study, Saptutyingsih and Nurahyani (2022: 8) found that 68% of farmers were willing to adopt strategies due to Indonesia’s high degree of social capital. In addition to kinship, social capital is also a network of relationships that farmers’ families and stakeholders gradually establish in the communication process and their ability to use these relationship networks to obtain needed resources (Quisumbing & Kumar, 2011). Additionally, social capital is a community of acquaintances linked by geography, blood or kinship (Sunday, 2019: 14).

Additionally, to gain the cooperation of communities, it is important to invest in local institutions. According to Ostrom (1990), to successfully govern the environment, it is important to cooperate with all members due to the shared nature of natural resources. Thus, effective governance involves collaboration from various parties (Pennington, 2008). Moreover, social capital acts as a “soft constraint” that governs and guides the community’s behaviour through shared ethical standards and values. This soft constraint also guards against “laggards” who are slow to adopt innovations from free riding or prioritise self-interest over the common good (Hartmann & Herb, 1990).

From a policy perspective, social capital may also be considered productive input. Similarly, Gouglas North emphasises how institutions reduce transaction costs by leveraging social capital. Relying on shared norms lowers the costs associated with monitoring and enforcement (Peng). Additionally, using the diffusion of innovation framework, social capital is critical in reducing uncertainty about new technologies, expediting their adoption, and enhancing sustainability by embedding innovations in trusted community structures.

16.3.5 Intersection of IK and CSA for Smallholder Farmers

Indigenous knowledge systems have been incorporated into CSA in several places (Bhattacharyya et al., 2020). Agroforestry, where trees are incorporated into farming systems to promote biodiversity, demonstrates the two’s potential in fighting climate change effects in agriculture. Likewise, indigenous communities have developed weather forecasting systems by directly observing nature (FAO, 2021a, 2021b). Although precision may be difficult to ascertain in some cases, CSA can potentially increase predictability. Regarding soil fertility, farmers in Latin America developed complex intercropping and crop rotation, which helped reduce pests and diseases in crops (Adger et al., 2009).

According to Sekhar et al. (2024), India has several examples illustrating the success of integrating traditional and modern CSA. In Karnataka and Kerala, India, agroforestry modernised tree breeding, which resulted in increased productivity and improved sustainable agricultural practices. Additionally, permaculture has been integrated into modern farming practices in Tamil Nadu and other parts of India (Sekhar et al., 2024). These agricultural practices mimic natural ecosystems and show the positive benefits of integrating indigenous knowledge and CSA.

Using data-driven innovations, such as GIS, marks a transformative step in the evolution of agricultural practices. GIS and remote sensing

technologies have increased the precision of forecasting climatic conditions. According to Sekhar et al. (2024), these technologies “have enabled a more nuanced understanding of soil health, topography, and micro-climate conditions, which are crucial for traditional farming practices like crop rotation and water management”. Moreover, CSA has enhanced farming efficiency and modernised it by making agriculture less labour-intensive. Harnessing clean energy such as solar for irrigation has improved water management, especially in drought-prone areas. Organic pesticides, bio-fertilisers, spreaders, organic pesticide sprayers, post-harvest management, and crop rotation are all traditional knowledge integrated into modern technology. Post-harvest loss management, a fundamental aspect in subsistent farming, can be ameliorated by solar dryers and eco-friendly storage solutions, which improve the efficiency of preserving and storing harvests (Sekhar et al., 2024).

Ethiopia’s *wonfel* system, which is otherwise known as collective labour, has been integrated with CSA technologies like drip irrigation. Also, seed diversity in India has harnessed kinship ties. Developing seeds used traditional technologies and was enhanced with modern resilience and soil conservation breeding techniques. Traditional methods like the *zai* pits were combined with mechanised planting to enhance soil fertility and water retention. The Andean communities of South American communities all adopted terracing. It was combined with scientific approaches, and they also used indigenous tree species for improved soil fertility and GIS mapping for planning (Bhattacharyya et al., 2020). Therefore, integrating indigenous knowledge and CSA has the potential to help smallholder farmers adapt to climate change vagaries.

16.4 Case Studies

Botswana

Botswana has 5–6% arable land of its total land area, and half of the population lives in rural areas. The major agricultural activities are

livestock production and crop farming. The farms are primarily small-scale with a few large-scale, commercial farms (FAO, 2021a, 2021b). Livestock production constitutes more than 80% of the productive value of agriculture. Half of the population depends on subsistence agriculture, but 75% of its cereal needs are imported, including maize and sorghum (FAO, 2021a, 2021b). The country aims to reduce or bring down its bill for agricultural imports. The sector is still fundamental and has the propensity to spawn economic diversification in Botswana. Although the sector is outcompeted by mining in contributing towards the national GDP, agriculture contributes to the livelihoods of most of Botswana’s rural population. Therefore, opportunities for harnessing indigenous knowledge are high.

FAO (2021a, 2021b) states that smallholder farmers use indigenous knowledge for various purposes. In addition to knowledge, farmers engage in rituals and agricultural practices in rural communities, especially at the beginning of the rainy season. Traditional norms encourage cooperation and reciprocity among communal people. These norms are used to support skills and technology transfer as well. They are also useful in cases where cooperation is needed, such as building water retention structures and water management.

Kinship ties are also essential in enhancing collaboration and resource sharing. They are unique because people share knowledge along kinship ties, and uptake of interventions such as CSA is likely to increase as people with a common identity share knowledge. They jointly adopt practices such as terracing and afforestation, which involve collective labour and investment. Furthermore, families mentor their younger members, especially on pest control, seed selection, and many other practices. Lastly, kinship ties enable knowledge sharing, tools, and livestock sharing. Norms and cultural values are usually endowed with knowledge and a deep respect for nature. Africa is known for its strict adherence to norms that give reverence to forests and water bodies.

One of the challenges observed in Botswana is the vacuum that exists between indigenous knowledge and CSA. FAO also undertook a study

to investigate the challenges of the adoption of CSA amongst smallholder farmers. FAO acknowledge the importance of indigenous knowledge and agriculture, but little is known about how traditional institutions can be used to enhance the effects of CSA. In addition, FAO reported that the adaptation policy was ineffective due to its failure to address context-specific problems that farmers experienced. The project implemented by FAO entailed studying the existing crop farming and livestock rearing knowledge and CSA strategies. FAO observed that the lack of strategies for leveraging indigenous institutions to make CSA more productive was compelling. In its project, FAO (2021a, 2021b) coordinated the integration process with the Ministry of Agricultural Development and Food Security of Botswana and the Botswana University of Agriculture and Natural Resources. Institutions or practitioners need to gain detailed insights into how informal institutions can be leveraged to have resilient, sustainable food production. Their interaction resulted in the strategies for different agroecological zones. The CSA strategies imbued with traditional knowledge eventually culminated in the development of materials, including indigenous practices and CSA.

This endeavour that FAO implemented in Botswana also entailed an investigation of best practices. This culminated in producing and presenting their findings to the government officials in a policy brief. Informal institutions such as community councils, elders' groups, and tribal leadership are crucial groups that serve as repositories and emitters or transmitters of indigenous knowledge. These institutions were notably endowed with several strategies that they can employ to transmit this knowledge. First, they facilitate knowledge sharing by using their youth to transmit traditional practices like intercropping, soil fertility management, and water conservation.

Namibia

Although Namibia is essentially an arid place, with only 2% of its land receiving sufficient rainfall, agriculture still supports 70% of its population (Business Scouts for Development, 2020: 1). Cereals such as millet, maize and sorghum

are produced, and they constitute approximately 5% of its agricultural production capacity. Subsistent farmers produce tubers, which form 15.97% of the sector's production value (Fortnato & Enciso, 2024, p. 8). Subsistent farmers struggle with constrained market access, poor seed quality, and drought (Business Scouts for Development, 2020: 1). Beef production is the top producer with 26.84% production value coming from it (Fortunato & Enciso, 2023, p. 9). Namibia exports beef, grapes, sheep/goat and charcoal, with a combined value of 77% (Fortunato & Enciso, 2023, p. 9). However, Namibia imports grains, vegetables, dairy, pork and poultry mainly from South Africa Netherlands, Germany, Russia and Morocco (Business Scouts for Development, 2020: 1). Overreliance on imports to meet daily food needs often exposes the country to shocks that may happen at global level (Business Scouts for Development, 2020: 1). The government also supports sourcing locally produced foods. Regardless of its aridity, there is potential for the agricultural sector to produce more food to feed itself and reduce the amount of imported food.

In terms of indigenous knowledge, rural Namibians use an array of traditional knowledge systems to determine optimal planting times using seasonal cues such as the appearance of insects, ground vibrations as a sign for rainfall and many others (Bollig, 2023, p. 36). Livestock farmers practice adaptation strategies like rotational grazing, drought-tolerant livestock breeds and livelihood diversification to survive the ever-increasing droughts. Concurrently, there is an apparent vacuum between the existence of CSA and its uptake and the incidence of indigenous knowledge in the CSA.

The notable CSA and indigenous knowledge strategies in Namibia include the Improving Rangeland and Ecosystem Management (IREMA). It is a climate-smart project implemented by the University of Namibia and the Namibia University of Technology, and it was initiated to assist climate change-stricken livestock farmers in rural Namibia (Maphalala & Mpofu, 2023). This project is also supported by the Environmental Investment Fund of Namibia

and the Green Climate Fund, a United Nations-operated fund that works closely with it. IREMA gives 21 goats (including 1 bull and 20 does) to identify farmers in Sesfontein, Fransfontein, and Warmquelle, which are parts of Kunene. Farmers are prohibited from selling them until they return them in batches so that other farmers may benefit. Over 50 farmers in Kunene benefited from this project. Results discussed in Namibia were drawn from the study undertaken by the IREMA project.

The Namibian agriculture sector's challenges include a lack of context-specific technologies, stunted productivity, and climate variabilities (Fortunato & Enciso, 2023, p. 7). Farmers in Namibia struggle to tailor technologies suited for their local conditions; hence, the sector is grappling with harnessing the benefits of climate-smart agriculture. The lack of technologies that can increase yields is also closely tied to the failure to increase production without expanding cropland. According to Fortunato and Enciso (2023, p. 8), an increase in cereal yields is attributable to expanding farmland rather than adopting technologies that encourage higher production. Regrettably, cereal production, which is still stuck to the 1960s records, is further threatened by the incessant effects of climate change.

What makes the Namibian agricultural sector unique is its inability to resolve the stagnant productivity despite being an imperative issue. Moreover, the production value of foods like tubers can be one aspect of agriculture that can be invested in, given their production value. Its value of 15.97% places it at the second most valuable agricultural activity, meaning investing in it can also help subsistent farmers to sustain their livelihoods. For the government to transform Namibia's productivity, it must confront the above-stated challenges and climate change problems. The country grapples with land degradation, decreased soil fertility, bush encroachment, and other effects of climate change. Furthermore, the country is naturally dry, and these challenges constrain productivity. CSA, coupled with indigenous knowledge, holds.

Bolig (2024), as a sociologist, endeavoured to study indigenous institutions and CSA in Namibia using the IREMA project. The challenges that have

affected this project are poor conceptualisation of climate change for farmers, frequent droughts and constrained resources from the government, and overlooking indigenous knowledge that affects the implementation of this project. According to Bolig (2023: 39), indigenous knowledge and CSA have not been optimally harnessed in rural Namibia due to the lack of knowledge of climate change amongst poor farmers. Although they are aware that the climate is changing, they do not understand that climate change is projected to worsen and that there is a need to implement long-term strategies for agriculture.

In addition to poor understanding that may misinform farmers, the precision of indigenous knowledge was also compromised due to climate change. Moreover, reports on the IREMA project indicate that the toolkits that were developed to assist livestock farmers in Kunene did not “dig too deeply into local experiences” Bolig (2023: 42). In observation of the impact of Namibian droughts on indigenous people, Bolig observed that “They were generally not well-informed about the causes of these global environmental changes”. In the verbatim Bolig (2024: 43) reported that, “some informants equated the recent multi-year drought to previous long-term changes in precipitation. Many thought predicting drought years via traditional forecasting methods was increasingly difficult. While the presence or absence of pods on the mopane (*Colophospermum mopane*) or the *Faidherbia albida* tree and the behaviour of birds and insects helped predict weather conditions, they were not reliable predictors anymore” (Bolig, 2023, p. 42). The above-stated observation further demonstrates the information vacuum between indigenous communities and CSA strategies.

Zimbabwe

Zimbabwe's economy is generally agro-based, and agriculture accounts for about 20% of the national GDP, generates 40% of the country's foreign earnings and employs over 60% of the population (Asare-Nuamah et al., 2022, p. 166). Agriculture contributes 11.3% of the national GDP and 16% of export earnings. Maize, sorghum, millet, wheat, cassava, cotton, tobacco, coffee, sugar cane, peanuts and livestock rearing

are the primary agricultural activities (Makate, 2020). The sector is dualistic, consisting of large-scale commercial farms and smallholder farms. Smallholder farmers dominate the sector, comprising approximately 70% of the agricultural population and contributing significantly to food security and rural livelihoods (Asare-Nuamah, 2022, p. 166). Smallholder farmers in Zimbabwe typically operate on small plots of land, which average 1–5 ha (Mushore et al., 2021, p. 2). Smallholder farmers produce major crops, including maize (the staple), sorghum, millet, groundnuts, and cotton. Small-scale livestock farming, especially cattle, is also common (Fig. 16.1).

Most smallholder farms rely on seasonal rainfall, making them highly vulnerable to climate variability (Matsa, 2020). Smallholder farmers often lack access to financial resources, quality inputs (seeds, fertilisers), modern technologies, and reliable markets (Mhlanga & Ndhlovu, 2023). As such, agriculture does not make a significant contribution to the economy. However, its widespread relevance to smallholder farmers demonstrates the untapped latent potential that the sector has for the economy as well as the livelihoods of farmers. Figure 16.2 also shows

the contribution of individual crops to the national GDP.

16.5 Climate Change Impact and Existing Adaptation Strategies

Makate (2019) projects that cereal crops are bound to be negatively affected by climate change by a 60% reduction, especially in maize, 50%; sorghum, 35%; rice, 20%; wheat 13%; and 13% barley. Due to climate variability, rain-fed crop yields are also projected to decrease by 50%. The average global temperatures are also rising beyond the 1.5 °C threshold. Climate change variability is projected to worsen in sub-Saharan Africa, and smallholder farmers will bear the brunt.

The agricultural sector in Zimbabwe is gravely affected by erratic rainfall patterns, prolonged droughts, and rising temperatures, and most farmers depend on rain-fed farming. These changes exacerbate food insecurity and the livelihoods of smallholder farmers. Smallholder farmers plant drought-resistant crops, use early planting methods, stagger planting times, and diversify livelihoods to cope with climate

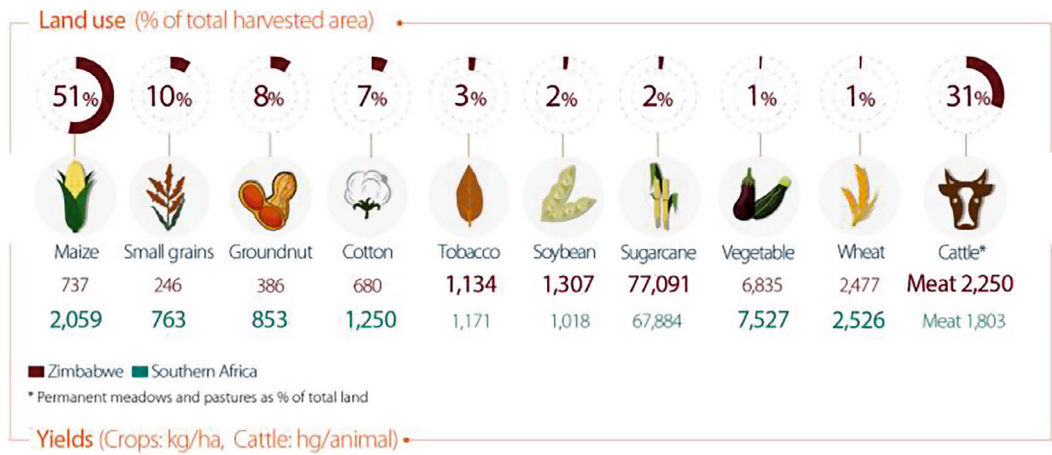


Fig. 16.1 Percentage of area harvested per crop. *Source* Climate Smart Agriculture Zimbabwe (2024)

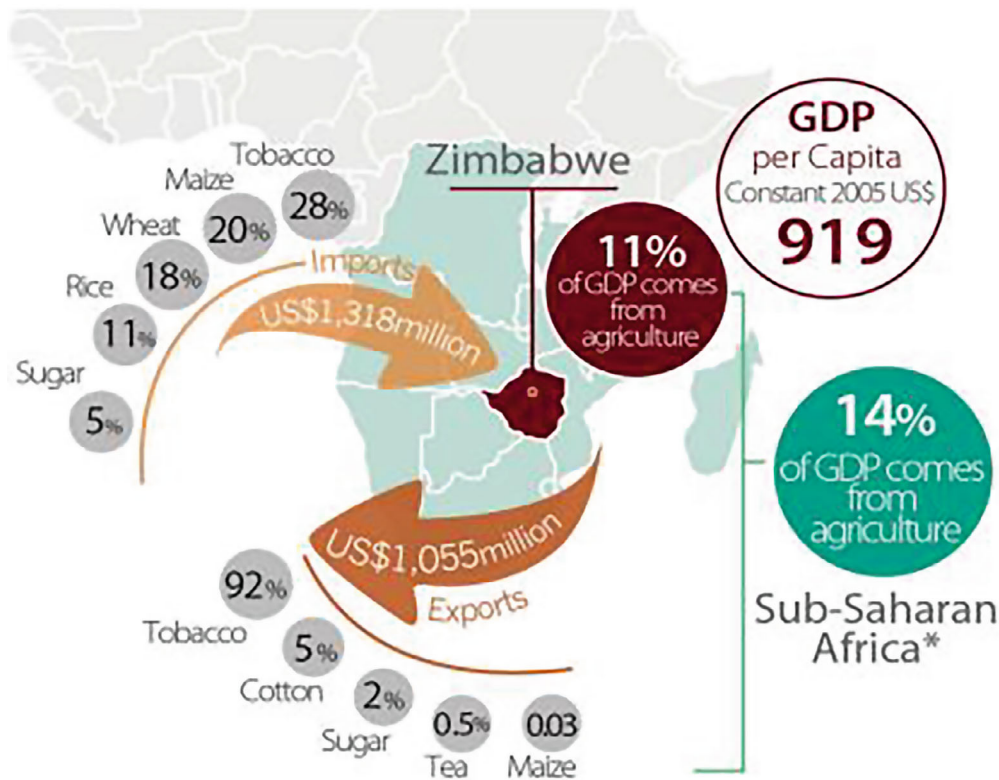


Fig. 16.2 Contribution of individual crops to the national GDP in Zimbabwe. *Source* Climate Smart Agriculture Zimbabwe (2024)

change (Mushore et al., 2021). In conservation, smallholder farmers implement minimum tillage, crop rotation, and mulching to enhance soil fertility and maintain soil moisture. Also, farmers implement water harvesting techniques such as zai pits, small dams, and drip irrigation to alleviate scarce water availability. However, very few farmers have access to irrigation. In addition to adaptation, small-scale farmers also employ mitigation strategies such as afforestation and preservation of wetlands. Farmers also leverage traditional knowledge through collective labour and livestock mobility.

Arid regions in Matabeleland and Masvingo have reported increased yields due to CSA practices, and areas where small grains have been promoted, food security has been improved. Irrigation Projects introduced in Chivi and Gwanda enhanced crop production and ensured year-round crop production in drier seasons. Matsa (2020)

reports that smallholder farmers in Zimbabwe have also experienced cases of integrating modern technology and indigenous knowledge. Resilience strategies used by farmers include using crop varieties, water management practices, and diversified livelihood strategies to adapt to climate change. However, the agricultural sector in Zimbabwe is not without challenges. Smallholder farmers lack market access, and institutional inefficiencies hinder adaptation (Asare-Nuamah, 2022; Mushore et al., 2021).

16.5.1 Lack of Financial Capital

According to Matsa (2020), many smallholder farmers do not have the financial capital to

invest in adaptation technologies. As such, adaptation may not be scaled up despite its usefulness. Further, constrained access to weather forecasts and knowledge about climate-resilient practices also hampers effective adaptation. Asare-Nuamah et al. (2022) argue that one of the challenges smallholders encounter in adaptation is that national policy on climate change and adaptation does not speak to local contexts. It follows that different localities need tailored strategies, and policy is usually uniform in its approach. The government in Zimbabwe has also done little to invest in drought-resistant cereals like millet and sorghum as an alternative to maize. Despite the financial burden of climate-smart agriculture, it remains imperative that agriculture supports the livelihoods of many smallholder farmers (Matsa, 2020).

16.5.2 Policy on Climate Change Adaptation

The other challenge smallholders encounter is that national policy on climate change adaptation does not speak to local contexts. The lack of a responsive policy is also observable in developing drought-resistant seeds. The government in Zimbabwe has done little to invest in drought-resistant cereal crops such as millet and sorghum as an alternative to maize, which is vulnerable to drought (Asare-Nuamah et al., 2022). Despite the financial burden of climate change in agriculture, this remains imperative because the sector supports the majority of households in Zimbabwe. Negligible investment in the sector is bound to exacerbate the effects of climate change, given the continued occurrence of a polycrisis. Climate change has contributed to a 1 to 5% decline in agricultural production per decade for the past 30 years. These deleterious effects are especially adverse for agro-based economies (Mashizha et al., 2017). Further, poor policy in Zimbabwe is reflected in the financial, technological, informational, and institutional challenges (Asare-Nuamah et al., 2022).

Willingness to scale up CSA is demonstrated by isolated cases where farmers adopted CSA. In

particular, farmers in Zimbabwe's drier agroecological zone 4 adopted CSA strategies. At least 100,000 farmers have started using CSA strategies (Makate, 2020). Smallholder farmers received free training and free subsidised inputs, which were a major driver for uptake. The European Union and DFID Protracted Relief Program are behind this programme, and they aim to include at least 130,000 farmers with training and support. Sustained adoption is hindered by a lack of labour-saving technologies, such as ox-drawn reapers, a two-wheeled tractor for seeding, and limited grazing land for mulching used in CSA.

16.5.3 Intersecting Indigenous Knowledge and CSA

Countries like Botswana, Mali, and Somalia have been observed to use climate change strategies by understanding indigenous knowledge. In Senegal, Farmer Field Schools (FFS) have been harnessed to enhance CSA, ameliorate the vulnerability of communities, and increase adaptation. Communities relying heavily on their natural environment for livelihoods are more susceptible to changing climatic conditions. Simultaneously, these communities are a basis for change if indigenous knowledge of the environment can be bolstered with CSA to co-create resilient food systems. According to FAO (2021a, 2021b), farmers who have interacted with their environment accumulate "sophisticated knowledge and practices" about their environment. Their environment has evolved for centuries, and the knowledge that has been accumulating helps tailor local, specific climate adaptation strategies. In Somalia, the presence of CSA strategies among small-scale farmers includes crop rotation (where women fence off grazing land), and growing alfalfa, Sudan grass, and the collection of fodder plants form part of adaptation in a land that is pestered by droughts.

On the contrary, the only counterintuitive tradition that the Somalians do is the exclusion of women from decision-making and land ownership processes. As reiterated by FAO (2021a, 2021b, p. 3), it is important to note that the agricultural sector is not only an economic activity, but also

an environmental and social one. Rural poverty, climate change vagaries, and price volatility, among others, bedevil the sector. What complicates the agricultural sector in Africa is the existence of the above stated challenges plus heavy dependence on rainfall, low input use and low productivity, declining soil fertility, poor financial services, complex land tenure arrangements, limited infrastructure, underdeveloped markets, demographic pressures, high transport costs and erratic weather conditions (FAO, 2021a, 2021b, p. 3). With the additional challenge of constrained resources, smallholder farmers can hardly exploit economies of scale. For the above-stated reasons, African agriculture struggles to meet the demand for food (FAO, 2021a, 2021b, p. 3).

16.5.4 The Role of Local Institutions in Climate-Smart Agriculture

FAO (2021a, 2021b) notes that informal institutions, together with the government, NGOs, and donor organisations, play a fundamental role in the fight against climate change problems. Local institutions are key in supporting and empowering farmers to adopt CSA strategies. Likewise, the Paris Agreement encourages countries to report on climate change mitigation and adaptation. Under this binding agreement (to be transparent and make interval reports as required by the UNFCCC), states are implored to attach significant value to the agricultural sector as spelt in the UNFCCC under Article 13 of the Paris Agreement. The majority of developing countries still need to have strong institutional and technical capacities.

Bollig (2023: 38) noted the mistaken assumption that indigenous people have inferior knowledge about adaptation strategies, which development professionals often hold. In his droughts and adaptation strategies study, the author underscores that farmers' indigenous knowledge must be treated with due diligence/respect. According to Bollig (2023), rural Namibians have exceptional traditional adaptation knowledge, such

as following animals to reach pastures. Also, the Ovahimba people's adaptation in dry conditions includes eating the *omukange* (*Commiphora Africana*) to survive. In noting these strategies, Bollig expressed concern over government-initiated projects that ignore indigenous knowledge and practices.

Farmers may often resent CSA if climate adaptation projects overlook local knowledge. As reiterated by social capital theorists, it becomes difficult for farmers to adopt foreign strategies without trust. In his study of Zimbabwe, Makate (2020) observed the same phenomenon in his Zimbabwe study. Therefore, it is imperative to treat local knowledge as local people value it to increase uptake. Additionally, implementing participatory research approaches may also catalyse the incorporation of indigenous knowledge into CSA. Adger et al. (2009) also posit that the systematic undervaluation of indigenous knowledge is counterintuitive to the uptake of CSA. Chambers (1997) also critiques how government and development professionals impose their reality on communities they seek to help instead of gaining insights into the recipients. To empower these communities, it is essential to employ participatory interventions by tapping into the social capital in rural communities. Therefore, policy and any intervention targeting farmers must treat local institutions regarded as trustworthy social capital as key channels to catalyse the incorporation of indigenous knowledge into CSA.

16.5.5 The Technology Divide Challenge

Despite CSA and indigenous knowledge, uptake of these challenges remains concerning (Abegunde et al., 2019). They posit that the transfer of CSA is technology-oriented. Firstly, rural farmers do not have access to technologies such as the internet, and have constrained access to smart gadgets that are compatible with technology. In addition, there is negligible context-specific orientation in areas where technology exists. In such instances as reported in Zimbabwe, the government must invest

in bridging technologies. While bridging the existing technological divide may be expensive, it may be worthwhile for governments or development professionals to tap into social capital by targeting technology transfer to key stakeholders, such as communal leadership. Leaders can be trained or given gadgets for weather forecasting and receiving agriculture-related information. As channels of communication, these institutions may help farmers by disseminating information to their communities.

16.5.6 Poor Communication

Subsistent farmers are more vulnerable to climate change. Lack of awareness, among other challenges, affects the knowledge of adaptation, thus affecting management. Agrawal (2010) and Ajibade and Eje (2017) suggest that integrating local institutions and indigenous knowledge is critical to improving climate change management. As observed in the Namibian case, farmers had limited knowledge of the impact of climate change, affecting their choice of adaptation strategies in the short term. They anticipated rain would eventually come, yet they were supposed to invest in long-term strategies. In Botswana, it was also noted that they worked in isolation and their ability to predict weather was waning with the increasing droughts. FAO adds that indigenous knowledge is inadequate on its own, but if complemented and validated by CSA, resilience also increases.

Adoption of climate-smart agriculture is particularly low in sub-Saharan Africa, and Makate (2020) stresses the importance of complementing CSA with indigenous knowledge. Local institutions play a critical role in adopting climate-smart agriculture, and community perception is equally essential for uptake. Agrawal (2010) underscores local institutions' influence when adopting CSA through their impact or their role in information gathering and dissemination, skills development and capacity building, resource mobilisation, networking and leadership. If the governments of Botswana, Namibia, and Zimbabwe could invest in projects where indigenous predictors are studied and validated by GIS technologies,

adaptation strategies would be stronger. Local institutions can be leveraged as a source of social capital and utilised as vehicles for raising awareness and promoting the adoption of CSA.

16.5.7 Other Factors

Other factors outside of indigenous knowledge's impact that determine or affect uptake or adoption include the competing interests of private companies and communities. Private companies may promote CSA strategies such as seeds for private gain, while communities are more interested in the common good of all. In particular, in Tanzania, farmers prefer to devise their own CSA for controlling erosion, predicting cropping dates and patterns, and livestock diversification. Likewise, Ghanaian farmers also demonstrated greater interest in selling locally made pesticides to suppress striga (Makate, 2020, p. 167). On the contrary, local institutions can also be counterintuitive to the development of adaptation of climate-smart agriculture through their gender norms and culture, which exclude women from land ownership and key decision-making.

In Kenya, women and the poor resort to informal networks for improved seeds; hence, networks like women's groups, churches, and others were influential in enhancing the flow of information. Likewise, farmers in Nyami Nyami, Kariba, Zimbabwe received much help from local institutions such as church leaders who notably engage stakeholders to support local farmers, and credit groups also mobilise for credit of smallholder farmers. Local institutions can also be vehicles of exclusion, especially our cultural norms that exclude people with low incomes and women.

16.6 Conclusion

This study underscores the critical need to integrate traditional knowledge with CSA to improve the resilience of food systems in the face of climate change. By examining case studies in Botswana, Namibia, and Zimbabwe, there is a demonstrable synergistic approach that can effectively address

the agroecological challenges farmers resident in these regions face, where erratic rainfall, erosion, and soil nutrient depletion are problematic.

Findings highlight that technological innovations offer significant potential, but their effectiveness is significantly amplified when augmented with indigenous knowledge systems. Often passed down through generations, traditional practices are endowed with valuable insights into environmental and climatic patterns and sustainable farming strategies. These range from drought-resistant crop varieties, soil and water conservation methods, and livestock management strategies honed over centuries.

The study discovered that the majority of projects and policies implemented to introduce adaptation strategies among smallholder farmers:

- Undervalue the role played by local institutions in the uptake of climate-smart agriculture. Often, policy intervention does not exploit the benefits of observing and leveraging channels such as local leadership, norms, values, and indigenous knowledge. That approach introduces other identifiable problems for farmers.
- Farmers do not understand the effects of climate change, mostly due to a lack of understanding and access to information informing them of the dire climatic conditions. As such, their decisions on agriculture become counter-intuitive and unsustainable.
- Farmers lack access to information on climate change and often do not know their local climate forecasts; concurrently, their indigenous knowledge lacks precision due to climate change. Also, existing knowledge is not written in terms that local community members can all comprehend.

Therefore, with the above-stated challenges, integrating indigenous knowledge into CSA has been lethargic despite the potential to bolster smallholder farming in arid regions. However, suppose development practitioners and governments can harness the existing local institutions by streamlining language, treating local knowledge as valuable and treating local institutions as capital that can be used, introducing technology

for weather forecasting. In that case, local knowledge and CSA can immensely enhance Botswana, Namibia and Zimbabwe food systems.

16.7 Recommendations

The Forum for the conference held in Accra, Ghana, in 2022 also aimed to engender agricultural development to cushion it against the ever-changing climate change for smallholder farmers through integrating indigenous knowledge and CSA.

The following recommendations draw immensely from the literature review and a toolkit developed at an Agricultural Research in Africa (FARA) conference in Ghana. The Traditional Indigenous and Local Knowledge Tool (TILKIT) is a weather monitoring and forecasting tool that uses local community knowledge, complemented by modern technology. TILKIT has been implemented in the Upper East Region of Ghana, the Senegal River Valley in Senegal, the Oromia Region of Ethiopia, Maharashtra, India, and Southwestern Bangladesh. Position adaptation cases have been reported in these areas, and development professionals aspire to scale this to areas still affected by climate change. This represents a good example of how technology can use traditional knowledge.

TILKIT uses indigenous knowledge to map vulnerabilities; for instance, it uses consensus-based ethnographic indicators. These indicators are used to forecast hazards based on the behaviour of identified indicators. This is an approach by smallholder farmers in Zimbabwe, Namibia, and Botswana. Notably, traditional knowledge in these countries already relies on ethnographic methods. However, given that sometimes their precision is affected by climate change, the knowledge must be complemented by tools such as TILKIT to help with sustainable adaptation strategies.

Further to complementing traditional knowledge, the TILKIT tool is also user-friendly because it is streamlined and presented in a language and terms that communities can all understand, while it is also empirically compared

to conventional weather reports. This approach concurs with the Chamber's empowering local communities by prioritising their needs. By using terms familiar to farmers, local communities get empowered by CSAs, which know about communicating adaptation strategies. Therefore, harnessing communication channels as social capital helps farmers understand the implications of climate change and helps them make informed decisions.

By giving local weather forecasts, the TILKIT tool scales down to local conditions, making it especially applicable to rural communities with varied climatic conditions. As such, adaptation strategies become more effective for farmers who rely on rain-fed agriculture for crop farming. Not only does it hold the potential to improve production, especially in arid conditions like Kunene in Namibia, and zone 4 agroecological zones in Zimbabwe, but it also improves the precision of planting calendars. Lastly, local weather forecasts can also tap into existing institutions if they are usable to community members.

TILKIT was reported to be adaptable to varied user participation, and they vary from individuals, groups, and communities, which is especially important for farmers. This is especially compatible with the social capital standpoint, where communities use networks such as kinship ties or traditional leadership councils as trustworthy information channels to adopt adaptation strategies. TILKIT has been implemented in Kenya, Tanzania and Uganda. Therefore, the above-stated strategies are valuable in integrating local institutions into CSA for sustainable food systems.

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Empowering Women in African Food Systems: A Pathway to Enhanced Food Security and Community Well-Being

17

Winnet Hokoza 

17.1 Introduction

Food security is defined as when all humans, regardless of location, time or place, have physical, social and economic access to adequate, safe, and nutritious food that sufficiently meets their dietary needs and food preferences to lead an active and healthy life (Peng & Berry, 2019). Food security entails adequate food production worldwide and addressing inequalities in food distribution, affordability and access, which adversely impact vulnerable populations, including women, children and disadvantaged populations (Aryal et al., 2022). Gender inequality in food systems represents a critical barrier to achieving food security, community resilience, and sustainable development. Women, the backbone of agricultural production and household provisioning, face systemic barriers that hinder their full participation and contribution to food systems (Malapit et al., 2020). These inequalities manifest in limited access to land, credit, technology, and decision-making platforms, perpetuating cycles of poverty and insecurity (Balasha et al., 2022). Globally, women account for nearly half of the agricultural labour force and play a vital role in food production, processing and distribution (Acosta et al., 2025). However, gender based

inequality in access to resources and opportunities persists (Rachmawati et al., 2025). Despite their significant contributions to farming, women own less than 15% of agricultural land worldwide (Agarwal et al., 2021). Global problems such as economic instability, climate change, and food price volatility disproportionately affect women, as they often lack the financial resources and decision-making power needed to adapt to these shocks (Jorgensen, 2024). International frameworks and initiatives, such as the United Nations' Sustainable Development Goal 5 on gender equality and Goal 2 on zero hunger, have emphasised the importance of addressing gender inequality in food systems (Mkandawire et al., 2021). However, progress has been slow as global agricultural policies and programs often fail to adequately account for the unique challenges faced by women, leading to missed opportunities for fostering inclusive and sustainable food systems.

Gender inequality is pronounced mainly in Sub-Saharan Africa. Women in the region make up to 80% of the agricultural labour force and are primarily engaged in smallholder farming and subsistence agriculture (Bryan et al., 2024). Women, although critical in food production, are shown to be systematically excluded from their access to productive resources. For example, women in the region own less than 15% of agricultural land, and even when they do own land, it is often smaller in size and of lower quality compared to land owned by men (Adebayo &

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Worth, 2024). Further, female farmers in Sub-Saharan Africa struggle to receive credit, agricultural inputs like fertilisers and seeds and extension services which offer technical training (Adebayo & Worth, 2024). A study by Perelli et al. (2024) highlights that women receive less than 10% of the credit available to smallholder farmers in the region, limiting their ability to invest in modern agricultural practices. The burden of unpaid care work further restricts their ability to participate fully in agricultural activities, leaving them disproportionately vulnerable to shocks such as droughts, floods, and economic crises (Bryan et al., 2024).

Nationally, Zimbabwe and Mozambique provide compelling case studies of the gendered dimensions of food systems. Both countries are characterised by deeply entrenched patriarchal structures that marginalise women in decision-making and resource allocation (Chipuriro, 2023). In Zimbabwe, for example, women constitute 60% of the agricultural workforce but own less than 20% of agricultural land (Dzvimbo et al., 2018). Similarly, in Mozambique, women are heavily involved in subsistence farming yet struggle to access credit due to discriminatory practices (Gove, 2022). These structural obstacles not only interfere with food security but also diminish the communities' resilience, especially during times when women suffer the most in the rural areas due to the impacts of climatic shocks like droughts and floods. Climate change exacerbates all these challenges. Women farmers in sub-Saharan Africa often rely on rain-fed agriculture, which is highly susceptible to climate vulnerability (Fekete, 2024). Research indicates that women have fewer resources and opportunities to adapt to climate-induced challenges, such as adopting climate-resilient crops or accessing information on sustainable farming practices (Secretariat, 2022). This lack of resilience undermines food security and increases the vulnerability of entire communities.

This chapter seeks to address the pervasive gender inequalities in African food systems, with a specific focus on Zimbabwe and Mozambique. The chapter discusses the structural barriers that marginalise women and explores the

transformative potential of women's empowerment in agriculture. The chapter starts by analysing the current status of women's empowerment in food systems in Zimbabwe and Mozambique. The chapter underscores women's critical contributions to food security and community resilience, emphasising their potential to drive transformative, inclusive and sustainable change in food systems. The chapter also explores successful localised strategies, cooperatives and institutions that have empowered women in Zimbabwe and Mozambique. This helps illustrate how grassroots approaches can enhance women's access to resources, improve agricultural productivity, and foster community resilience. Considering the systemic nature of the problem, the chapter examines the role of national and regional policy frameworks in perpetuating or addressing gender inequality in food systems. This helps identify opportunities for policy reforms that prioritise gender-sensitive agricultural programs, participatory governance structures, and legal protections for women's rights to land and resources. The chapter lastly builds on analysing systemic barriers, grassroots strategies, and policy gaps to provide actionable recommendations for transforming food systems in Zimbabwe, Mozambique and beyond. It aims to inspire further research, policy innovation, and grassroots action by illustrating how empowering women in agriculture can dismantle systemic injustices, enhance food security, and promote women's empowerment in food systems.

17.2 Theoretical Framework: Intersectional Feminism

Intersectional feminism provides a theoretical approach that explores how different social identities (gender, race, class, ethnicity, sexual orientation and age) overlap to contribute to oppression and privileges experienced by individuals (Meliou et al., 2024). This approach emphasises that women do not experience discrimination uniformly; instead, their experiences are influenced by the overlapping systems of power and inequality they navigate (Robinson, 2018).

Intersectional feminism aims to comprehend the mutual intricacy of these interactions, promoting a more multidimensional and versatile perspective on gender equality that could tackle the peculiarities of gender-based issues of various women. In this chapter, the theory serves as a vital framework for understanding women's empowerment in African food systems. This theory highlights that women's experiences in food production and security are not homogeneous; various intersecting identities, including race, ethnicity, socio-economic status, and cultural norms, shape them. Central to the theory are the following key concepts.

17.2.1 Multiple Identities and Context-Specific Analysis

Intersectional feminism acknowledges that women's experiences are not defined only by gender. However, they are also influenced by other attributes that cut across gender, including race, class, ethnicity, and socio-economic status. In the study context, the concept is crucial for understanding the diverse experiences of women and how these experiences shape their roles in agriculture and food security. The identities of each woman, with identities entwined with ethnicity, socio-economic status, age, education, and geographic areas of residence, merge to form distinctive challenges and opportunities (Mafongoya, 2022). An example is how women from different ethnic backgrounds may face varying cultural expectations and access to resources. In some communities, certain ethnic groups may be marginalised, impacting women's ability to participate in food production and decision-making processes.

Socio-economic status, together with age, further complicates these identities. Women from wealthier backgrounds may have better access to land, technology, and markets, enabling them to engage more effectively in food systems (Kosec et al., 2023). Conversely, low-income individuals might be disadvantaged by the system,

including their exclusion from credit and training. In Zimbabwe, the historical context of land reform and economic challenges has profoundly impacted women's agricultural roles (Tirivangasi et al., 2023). Women, particularly those from rural areas, often face barriers related to land ownership and access to resources. Traditional gender norms limit their decision-making power, while intersecting identities, such as ethnicity and socio-economic status, exacerbate these challenges (Naz, 2022). Women from marginalised ethnic groups find it even more challenging to claim land rights or secure financial support for agricultural initiatives. In Mozambique, the situation is similarly complex. Women play a crucial role in food production, yet they often experience systemic inequalities that hinder their participation in agricultural markets (Gove, 2022). The country's diverse ethnic groups contribute to varying cultural practices and expectations regarding women's roles in farming. Women from urban areas may have access to different opportunities than those in rural settings, where traditional practices dominate.

The concept of multiple identities has significantly enriched the understanding of women's involvement in food systems by addressing numerous gaps that conventional frameworks often overlook. The recognition that women do not experience food systems solely through the lens of gender is a critical gap that this theory has closed. Traditional analysis frequently focuses on gender as a singular category, neglecting how other identities, such as ethnicity, socio-economic status, age, and geographical location, intersect to shape women's experiences. Conventional narratives often portray women as passive participants or victims of circumstances, overlooking their active roles in agricultural production and community leadership. The chapter seeks to integrate the concept of multiple identities to examine the challenges and opportunities women in Africa face in agricultural contexts. Highlighting the systemic inequalities these diverse groups of women face helps identify their plight and informs comprehensive targeted interventions that can dismantle barriers and encourage empowerment.

17.2.2 Systemic Inequalities

Systematic inequalities are key components explained through the intersectional feminism theory. Systemic inequalities refer to the entrenched disparities and disadvantages embedded within society's structures and institutions (Haslanger, 2023). These inequalities are not merely the result of individual actions or choices; they arise from historical, social, economic, and political contexts that perpetuate unequal access to resources, opportunities and rights (Kumari, 2023). Systematic inequalities can manifest in various forms, including but not limited to race, gender, class, ethnicity, age, and disability, often intersecting to create complex layers of disadvantage (Bixby, 2024). In this context, systemic inequalities play a crucial role in understanding the dynamics of women's empowerment in food systems, particularly in Zimbabwe and Mozambique. This context highlights how various intersecting factors create barriers for women in agriculture, impacting their ability to participate fully and equitably.

The historical context of systemic inequalities in Zimbabwe and Mozambique is pivotal for understanding the current challenges women face in agriculture. Colonial legacies, characterised by land dispossession and discriminatory policies, have created disparities affecting women's access to land and resources (Chipenda, 2024). For instance, during colonial rule, land was often allocated to male settlers and local male elites, marginalising women's rights to land ownership. This historical injustice has resulted in a persistent gender gap in land ownership, critical for agricultural production (Tom, 2024). Women, who comprise a significant portion of the agricultural workforce, often find themselves without the legal backing to claim land, severely limiting their capacity to engage in farming as an economic activity (Quan et al., 2021). The historical marginalisation of women in agricultural policies has led to a lack of support for female farmers. In both countries, post-independence policies have sometimes failed to

address gender disparities, perpetuating systemic inequalities adequately.

Institutional frameworks in Zimbabwe and Mozambique are critical in understanding systemic inequalities that affect women in food systems. Policies related to land tenure, access to credit, and agricultural support often reflect and reinforce patriarchal norms, leading to unequal opportunities for women. In Zimbabwe and Mozambique, land registration processes are biased towards male heads of households, making it challenging for women to claim land rights even if they are actively involved in farming (Lidström, 2014). This is further fuelled by the ineffective implementation of gender-responsive policies found within institutional frameworks. Most agricultural policies in Sub-Saharan Africa do not consider the specific challenges women face, such as balancing household responsibilities with farming; in cases where policies have been amended to incorporate such issues, implementation is still minimal. This oversight leads to ineffective support systems that fail to empower women. In light of these policies, women feel discouraged from participating in agricultural cooperatives or community meetings, thereby missing opportunities to voice their needs and share knowledge.

The chapter utilises the concept of intersectionality to critically examine the multifaceted nature of systemic inequalities affecting women in food systems in Zimbabwe and Mozambique. Women are not a monolithic group; their experiences are shaped by a combination of factors, including ethnicity, age, socio-economic status, and geographic location. Women from marginalised groups commonly face unique challenges related to both their gender and social groups, limiting their access to land, resources, and support networks. This intersectional lens adopted in the chapter helps reveal the complexities of women's empowerment, providing a more comprehensive understanding of the systemic barriers women face, leading to more effective and inclusive policy recommendations.

17.3 Methodology

The study employs a systematic review methodology. The approach allows for a comprehensive synthesis of existing literature, focusing on the relationship between women's empowerment and food security. The review process involves several phases, including a thorough search of academic databases, filtering of relevant studies, and thematic analysis of the findings. To identify patterns and gaps in the existing knowledge base, the study categorises the literature into key themes such as women's roles in agricultural production, access to resources, and the impact of empowerment on community well-being. This design facilitates a comprehensive understanding of how gender dynamics influence African food systems, ultimately contributing to policy recommendations and future research directions.

Data sources for this research include peer-reviewed journal articles, reports from international organisations, and grey literature relevant to women's empowerment and food security in Africa. The search was conducted across multiple academic databases, including JSTOR, Web of Science, and Google Scholar, ensuring a broad and diverse collection of literature. Key terms used in the search included 'women's empowerment', 'food security', 'gender dynamics', and 'African food systems'. Inclusion criteria were established to filter studies based on their relevance to the African context, focusing on those published between 2000 and 2024. Studies that did not specifically address gender dynamics, lacked empirical evidence, or did not address the geographic focus of Sub-Saharan Africa were excluded. This temporal scope ensures that the review captures the most current research and theoretical advancements in the field, providing a solid foundation for understanding the role of women in enhancing food security and community well-being. The filtered studies were then categorised according to key themes, including women's roles in food production, access to resources, and the impact of empowerment on food security and community well-being. Such thematic organisation made it easy to systematically compare the insights of different studies

and identify patterns, trends, and gaps in the existing literature. A narrative analysis approach was then employed to analyse the collected literature. This involved summarising and interpreting the findings to highlight key themes related to women's empowerment in food systems. The analysis focused on the implications of these themes for social equity and community well-being, providing critical evaluations and recommendations for future research and policy interventions.

17.4 Results and Discussion

17.4.1 Current Status of Women's Empowerment in Food Systems

Literature indicates that in both Zimbabwe and Mozambique, women play a vital role in agricultural production, constituting a significant portion of the workforce. In Zimbabwe, women contribute to approximately 60% of agricultural activities, particularly in smallholder farming, vital for household food security (Tirivangasi et al., 2023). Women in Zimbabwe are primarily responsible for growing staple crops such as maize and vegetables, which are essential for family nutrition (Dzvimbo et al., 2018). Their engagement, however, often occurs in informal settings, with many women engaging in subsistence farming rather than commercial agriculture. This predicament resembles Mozambique, where women account for approximately 50% of agricultural labour (Dzvimbo et al., 2018). Women in this region are heavily involved in cultivating food crops and are increasingly participating in cash crop production, such as cashew nuts and cotton (Mole, 2000). The current status of women's empowerment in food systems in both countries can be understood through the following lens.

17.4.1.1 Cultural Norms and Gender Dynamics

Women's participation in the decision-making process around agricultural production is notably poor in both countries. The cultural standards

in both countries establish significant boundaries for agricultural family decision-making processes (De Brauw, 2015). The cultural framework in Zimbabwe currently dictates that men maintain full control over important agricultural choices regarding plant selection, market timing and spending decisions (Tirivangasi et al., 2023). Politicised societal beliefs that grant economic control to men marginalise women from household and community decisions since they lack authority over economic activities (Chiweshe et al., 2015). The cultural norms prevalent in rural societies maintain that men lead economic operations, yet women should remain confined to domestic responsibilities (De Brauw, 2015). Women face restricted access to formal decisions at community meetings and agricultural cooperatives because people misunderstand their role in economic matters. Women face persistent marginalisation that usually leads to the exclusion of their crucial insights into farming practices, which will potentially boost sustainability and productivity levels.

17.4.1.2 Informal Decision-Making Influence

The review also highlights that despite the barriers to formal decision-making, women in both countries often exert informal influence within households. While men make overarching decisions, women frequently manage day-to-day agricultural activities and household food production (Adam et al., 2020). In both, women play a central role in crop selection and management, often making crucial decisions that reflect their understanding of household nutritional needs and local agricultural conditions (De Brauw, 2015). Women typically prioritise cultivating staple crops and vegetables essential for family sustenance, such as maize, beans and leafy greens (Mudzengerere, 2012). An analysis of reviewed literature indicates that the focus on crops that provide essential nutrients by women contributes to the health and well-being of their families and enhances local food systems. Women's hands-on experience allows them to adapt crop management practices to changing environmental conditions, demonstrating their significant influence in

ensuring agricultural resilience within communities.

Women in Zimbabwe and Mozambique often manage allocating resources within the household, including seeds, fertilisers, and labour. Female informal decision power elevates daily farming operations, although males retain control over financial assets (Matshe & Young, 2004). The allocation decision of resources by women relies on their cultivated understanding related to optimal crop production needs (De Brauw, 2015). Women decide both seed storage for future cultivation and family labour distributions that will lead to the best possible outcomes (Adam et al., 2020). The effective management of resources is essential for boosting agricultural productivity and enabling households to provide food for themselves under economic restrictions and reduced external support.

Female family members hold notable traditional authority regarding the traditional domestic activities linked to food preparation and consumption. The role of women as principal household food managers determines all aspects of meal preparation, including sourcing food items and managing food-related budgets (Murendo et al., 2018). Women base their decision-making on family nutritional needs, cultural traditions, and ingredient access (Kairiza & Kembo, 2019). Through their family nutrition role, women directly determine the quality of health outcomes by providing balanced meals to their family members. It is worth noting that, when women prioritise diverse and nutritious food options, they effectively contribute to immediate family well-being and long-term community health, even though their contributions often go unrecognised in formal discussions about food security and agricultural policies.

The informal decision-making influence of women in agriculture is deeply rooted in their knowledge and expertise. Women often possess valuable insights into local agricultural practices, pest management, and sustainable farming techniques gained through years of experience (Nemarundwe, 2010). This expertise enables them to make informed choices about crop management, soil health, and resource utilisation

(Murendo et al., 2018). This equips women with valuable knowledge and insights, which is often overlooked in discussions about decision-making power. Intersectional feminism highlights that the ability to influence decisions informally does not equate to true agency. Women in Zimbabwe and Mozambique manage household food production and negotiate crop choices, but their contributions are often undervalued in formal settings. Literature suggests that recognising and validating these informal roles is essential for understanding the full scope of women's influence and for promoting their participation in formal decision-making processes. When women's expertise is validated and integrated into formal decision-making processes, it can lead to more effective agricultural strategies and improved community outcomes.

17.4.1.3 Women's Access to Resources in Zimbabwe and Mozambique

Access to land is one of the most critical resources impacting women's empowerment in food systems in Zimbabwe and Mozambique. In both countries, women often face significant land ownership and tenure security barriers due to cultural norms and legal frameworks that prioritise male land rights (Ghebru & Girmachew, 2019; Pankhurst & Jacobs, 2019). In Zimbabwe, historical land reform policies have indeed contributed significantly to gender disparities in land ownership (Goebel, 2005; Pindiriri & Zwizwai, 2022). The Land reform program, which started in the early 2000s, was meant to redistribute land owned by white commercial farmers to black people of Zimbabwe. However, these policies often favoured men as the primary landholders, leaving women marginalised regarding land ownership and access (Pindiriri & Zwizwai, 2022; Tom, 2024). This lack of secure land tenure limits women's ability to make long-term investments in their farming practices and undermines their economic independence (Chiweshe et al., 2015). In Mozambique, while the national constitution supports women's rights to land, implementation at the local level remains inconsistent (Lidström, 2014; Quan et al., 2021). Many women farm

on land informally held or controlled by male relatives, leading to insecurity and vulnerability (Quan et al., 2021). When women lack access to land, their ability to grow crops, generate income and contribute to household food security is severely restricted, hindering their overall empowerment.

Access to financial resources is a critical component of women's empowerment in agricultural production. In Zimbabwe and Mozambique, women often encounter significant barriers that limit their ability to secure financial services (Pomerai, 2024). Traditional norms frequently position men as the primary economic actors (Gumbo et al., 2021). Women often lack the necessary collateral, such as land or property, to use to access loans, further entrenching their financial dependency (Pomerai, 2024). Micro-finance initiatives have emerged as a potential solution to women's financial challenges in both countries (Malapit et al., 2020). These initiatives provide small loans tailored to the needs of women farmers, enabling them to invest in their agricultural activities (Kurebwa, 2024; Malapit et al., 2020). In Zimbabwe, successful microfinance programs have been associated with improved household incomes and increased participation in decision-making (Kurebwa, 2024). Similarly, in Mozambique, women participating in micro-finance initiatives often report greater financial independence and enhanced family and community roles (Tadesse et al., 2025). It can be deduced from the literature that when women have control over financial resources, they are more likely to invest in education, healthcare, and nutrition for their families, contributing to broader community development.

When women access financial resources, their decision-making power within households and communities often increases. Financial independence allows women to make choices about agricultural practices, resource allocation, and household investments without relying solely on male family members. This shift can lead to more equitable household dynamics and greater recognition of women's contributions to agricultural production if well integrated. In Zimbabwe, women who control financial resources have been found to

influence key decisions related to crop management and household expenditures (Gumbo et al., 2021). Similarly, in Mozambique, empowered women were reported to be more likely to participate in community discussions and advocate for their needs, thereby challenging traditional gender norms (Tadesse et al., 2025). Making independent financial decisions enhances women's agency and fosters a sense of empowerment that extends beyond agricultural contexts.

17.4.2 Contributions of Women to Food Security and Community Resilience in Zimbabwe and Mozambique

17.4.2.1 Agricultural Production

The agricultural input of women in Zimbabwe and Mozambique matters greatly because it sustains food security and stimulates local economic development. The responsibilities of these women extend from planting seeds to weeding the land, and they perform both harvesting and post-harvest operations (Magwegwe et al., 2024). The continued direct involvement of women allows them to grow fundamental crops like maize, beans, and vegetables, which they need to sustain their household nutrition (Adam et al., 2020). Women who understand local farming practices and planting varieties effectively manage agricultural risks by adapting to changing conditions and achieving best yields (Malapit et al., 2020; Mudzengerere, 2012). Women in numerous rural regions maintain the role of primary soil managers as they cultivate small agricultural regions which provide sustenance for their families (De Brauw, 2015). Available research indicates that women's work provides enough food for their families and produces excess products that enter local markets for sale. Women farmers in both nations demonstrate an enduring commitment to agriculture despite resource constraints because their agricultural resilience stands out (Aryal et al., 2022; Jorgensen, 2024; Malapit et al., 2020). The identification of women's dedication together with

their food system involvement remains essential for improving food security conditions and sustainable agricultural approaches, which benefit everyone.

17.4.2.2 Food Processing and Preservation

Women in Zimbabwe and Mozambique are heavily involved in food processing and preservation, which is vital for enhancing food security. Women in both countries' food processing and preservation activities are essential in advancing food security. The women practice processing methods to lengthen perishable food durability, including grain milling, fruit drying, and vegetable preservation (Motsi, 2021). The traditional methods decrease waste and enhance the use of resources while generating new household earnings. The processing methods used by women usually blend cultural values with environmental responsibility (Matsa & Mukoni, 2013). Through converting crops into marketable goods, women enhance food variety and nutritional standards in their community settings (Murendo et al., 2018). Households acquire the ability to collect food during lean periods through processing to ensure continuous access to nourishing meals throughout the year. The monetary returns from food processing operations create wealth that women can redirect to their families and local communities. Women are essential in strengthening food security and resistance, and promoting sustainable livelihoods by developing this area.

17.4.2.3 Market Access and Trade

Women actively participate in local and regional markets in Zimbabwe and Mozambique, playing a crucial role in food systems by selling surplus produce and processed foods (Chipuriro, 2023; Malapit et al., 2020). Market trade activities provide women with crucial income streams that help support their families and advance community growth. Through cooperatives, both countries enable women to join together for group marketing that strengthens their negotiating ability and delivers better prices (Mhembwe & Dube, 2017; Tadesse et al., 2025). The unified way

of working enhances personal living conditions and helps communities create stronger bonds and become more durable. Local economies benefit from women entering markets, and the availability of steady food supplies persists throughout their communities. Through participation in trade, these organisations assist their communities in maintaining full authority over their food provision. Women persist in innovative work through adaptation by developing strategies that help them overcome restrictions on their access to credit and market information. The marketplace benefits greatly from their involvement, demonstrating their crucial role in maintaining economic stability and food security.

17.4.2.4 Innovative Agricultural Practices

Women in Zimbabwe and Mozambique are at the forefront of adopting and promoting innovative agricultural practices that foster sustainability and resilience (Otte et al., 2018). Sustainable farming methods used by many farmers include agroecology, organic farming, and permaculture to achieve healthy soil, protect water resources, and bolster biodiversity (Mapfumo et al., 2022). Local ecological understanding allows these women to implement intercropping and crop rotation practices that enhance productivity alongside environmental result reduction (Makate et al., 2018). Most women steer community-based sustainable agriculture programs, which permit them to teach their farming expertise to other members of their community. Through their creative methods, women reduce the impacts of climate change and enhance the total strength of food systems (Mapfumo et al., 2022). Women who focus on sustainable methods help sustain agricultural development in their local territorial areas for the long term. Additional support through training and resources for these initiatives should be recommended because it will enhance their positive effects on food security. Women demonstrate their power to effect positive transformation in the food systems by focusing on sustainable agricultural methods.

17.4.2.5 Community Leadership and Advocacy

Women are increasingly taking on leadership roles within their communities in Zimbabwe and Mozambique, advocating for their rights and the needs of their families in food systems (Chipuriro, 2023; Malapit et al., 2020). Women must actively participate in farm-related governmental decisions concerning agriculture and food security to establish inclusive practices. Women combine forces by creating groups and networks which help them advocate for gender equity policies that also support sustainable food systems (Chipuriro, 2023). Women activate advocacy to gain visibility for their distinctive problems, including insufficient access to resources and limited decision-making authority. Their leadership promotes teamwork among communities, thus they become more capable of solving food insecurity problems together. Men and women use cooperatives and community gardens as channels to provide education while empowering local women to learn and develop their capabilities. When communities endorse women leaders, they build food systems that integrate diversity and withstand challenges, serving the population equitably.

17.4.3 Intersectionality and Diverse Experiences of Women in Food Systems

Women encounter different experiences in food systems because their social identities, such as gender, ethnicity, socio-economic status, and geographic area, influence each other.

Women from different socio-economic levels in Africa encounter specific challenges when interacting with food systems. The possession of education and financial resources with agricultural technology by women from rich backgrounds results in better productivity and empowerment (Makate et al., 2019). Studies show women across Zimbabwe who receive credit funding will spend their money more proactively on

agricultural supplies by 20% (Gumbo et al., 2021). Women from socio-economically disadvantaged backgrounds encounter extensive barriers, such as constrained access to land and credit, that obstruct their productive agricultural participation (Kurebwa, 2024). Rural women in poverty-stricken areas of Mozambique struggle to obtain money for essential agricultural investments, which sustain their economic challenges (Tadesse et al., 2025). Policies aimed at disadvantaged women are necessary because gender and socio-economic status combine to create an immediate need for targeted interventions that support their economic growth while enhancing food security for their communities.

Review of existing literature also indicates that the issue of women's empowerment in food systems is closely tied to geographic disparities, where women from rural and urban areas have different experiences. These disparities are influenced by factors such as access to resources, education, markets, and social services, which vary considerably across different regions (Makate et al., 2019). In Zimbabwe and Mozambique, rural women often face more significant challenges than their urban counterparts. In Zimbabwe, a significant population resides in rural areas, where women primarily engage in subsistence farming (Manzeke-Kangara et al., 2024). These women frequently lack access to markets, transportation, and agricultural extension services. In Zimbabwe, rural women are 30% less likely to receive agricultural training than men, limiting their ability to adopt new technologies or improve their farming practices (Tirivangasi et al., 2023). This isolation not only hinders their productivity but also restricts their economic opportunities, perpetuating cycles of poverty (Manzeke-Kangara et al., 2024). A similar pattern emerges in Mozambique, where rural women are often isolated from resources and markets, exacerbating food insecurity (Ghebru & Girmachew, 2019). Approximately 80% of women in Mozambique work in agriculture, but many lack access to essential services like healthcare and education, further limiting their empowerment (Gove, 2022).

The accessibility of markets defines the primary factors determining women's empowerment within food systems. The lack of market infrastructure and sufficient access to selling points constrains rural women from accessing markets in both countries. Market information accessibility is only 10% for rural women in Zimbabwe because this prevents them from getting fair prices during negotiations (Acosta et al., 2025). In Mozambique, many rural farmers must depend on intermediaries for agricultural product sales because their market knowledge deficit allows intermediaries to steal lower financial returns from them (Gove, 2022; Mole, 2000). A key difference exists between urban women who obtain better market access for investment in more lucrative agricultural activities. Moving from farming in rural areas to urban agriculture presents multiple problems (Lidström, 2014; Malapit et al., 2020). Women in urban areas experience various systemic obstacles, making competing against larger agricultural operations while operating small agricultural enterprises difficult. The unequal market conditions between women in urban areas require investments to enhance market information systems alongside resources in women-based rural locations. Implementing these strategies for rural women will achieve better financial independence through effective competition.

Through intersectionality, education is a foundation that shapes empowerment for women in their food system interactions. Cultural and geographic restrictions block many women in both countries from getting an education, especially those who live in rural areas or belong to deprived ethnic communities (Acosta et al., 2025; Mahofa et al., 2022). The literacy rates between male and female citizens differ substantially in Zimbabwe's rural communities because women demonstrate a 67% literacy level, whereas men achieve an 85% literacy rate (Pomerai, 2024). Women from low-income homes face greater barriers that prevent them from getting a quality education since their families cannot afford it (Pomerai, 2024). Mozambican cultural beliefs

make education more important for boys than girls, leading rural girls to receive education half as often as boys (Manhisse & Ogawa, 2024). The lack of gender equality in education collides with women's potential to use modern agricultural approaches, access agricultural support services, and defend their land ownership claims (Bello et al., 2020; Choudhury & Castellanos, 2020). The economic class levels of individuals intersect with schooling opportunities to create cumulative obstacles for women. Young girls from lower-income families have to help generate household income, which causes them to abandon their education, according to Manhisse and Ogawa (2024) and Pomerai (2024). Girls in Mozambique are withdrawn from school to work on household work and farm activities, which reduces their prospects according to Makate et al. (2018). Women from privileged financial circumstances possess better opportunities to succeed academically using exclusive educational resources that allow them to take agricultural training (Bello et al., 2020). The inequality in education creates an ongoing poverty cycle because agricultural training and better food security measures require proper education to develop.

17.4.4 Success Stories and Best Practices: Women-Led Initiatives and Organisations Towards Empowerment in Food Systems

Zimbabwe and Mozambique have made notable strides in empowering women within the agricultural sector through various initiatives. These include the following.

17.4.4.1 Chomuzangari Women Cooperative (CWC)

The cooperative operated in 2017 at Masvingo Chivi District (Chomuzangari Women Cooperative, 2025). The CWC established its operations to support the socio-economic needs of rural Zimbabwean women (CWC, 2025). The cooperative maintains its status as a Charity

Commission for England and Wales registered entity to provide education-based women's empowerment through skill development and sustainable livelihood programs. The cooperative maintains a core crop cultivation business where they grow maize, beans, and vegetables (Chomuzangari Women's Cooperative, 2025). The cooperative strengthens its operations by prioritising collective action methods as one of its essential advantages. Members who join the cooperative utilise pooled resources to buy seeds, fertilisers and equipment, thus lowering prices while improving productivity. The cooperative trains its members to use sustainable farming practices and gives instructions regarding financial stewardship and marketing methods (Chomuzangari Women's Cooperative, 2025). Agricultural extension officers train these women farmers, who collaborate with them to receive cutting-edge skills and knowledge. The members of Chomuzangari Cooperative now receive improved harvest results alongside better incomes due to cooperative membership benefits. The cooperative formed direct partnerships with nearby markets, allowing members to sell their products without price exploitation. The cooperative's structure provides its members a network to connect and build unity using shared goals (Chomuzangari Women's Cooperative, 2025). The cooperative conducts routine conferences which combine agricultural method improvement sessions with discussions about health care and nutrition education, as well as women's empowerment studies. Through this complete method, more women have gained authority in community leadership, and they now actively resist conventional gender expectations and defend their legal entitlements. Chomuzangari's achievements highlight how group power, along with agricultural women's initiative, support creates transformative success.

17.4.4.2 Women and Land Zimbabwe

Women and Land Zimbabwe (WLZ) operates as Zimbabwe's leading organisation, fighting for women's land rights while advocating gender equality in agricultural operations. WLZ emerged in 2002 to handle longstanding problems of

property ownership inequalities that have disadvantaged women (Women and Land in Zimbabwe, 2025). The organisation directs its efforts to empower women through different core areas within land issues. The organisation gives women access to legal education and advocacy efforts to show them their rights for land ownership and usage. Through regional workshops across different areas, WLZ trains women to understand land laws, inheritance rights, and the value of obtaining land ownership control (Women and Land in Zimbabwe, 2025). The organisation mounts decisive policy campaigns through strategic alliances with government bodies to create supportive legislation about women's land rights. The organisation actively participates in land reform policy development through campaigns so female voices are included during legislative stages. The continuous lobbying by WLZ led to breakthroughs in land policy enforcement, which rewards women's agricultural contributions while providing improved land ownership access. The organisation developed strategic alliances with different stakeholders and organisations to build supportive structures which assist women (Women and Land in Zimbabwe, 2025). Women gain access to financial services and credits through microfinance institutions, enabling them to invest in their agricultural operations. Women's awareness about their rights has improved significantly in rural areas because of WLZ activities, which produced concrete improvements in the living conditions of the women (Women and Land in Zimbabwe, 2025). Women who receive benefits from WLZ programs state that these initiatives help them secure better food and generate more money while giving them stronger control in their family environments and local groups. WBZ's work demonstrates that women require land rights as a basic requirement to achieve their food system empowerment.

17.4.4.3 TechnoServe

The nonprofit organisation TechnoServe takes a business-oriented approach to eliminate poverty across developing nations. The organisation operates in Mozambique by developing agriculture through its programs that concentrate on teaching

smallholder farmers, especially women, about improving their standard of living (TechnoServe, 2024). Through its training programs, TechnoServe teaches its participants optimal agricultural methods in combination with business strategy knowledge and market development access, which elevates their farming success and profit capabilities (TechnoServe, 2024). The organisation develops entrepreneurship skills while promoting self-independence, which serves as a fundamental catalyst for agricultural transformation across Mozambique.

TechnoServe successfully trained female agricultural producers in Nampula province through an intervention program built to advance maize farming outcomes (TechnoServe, 2024). The training sessions about agriculture management, money skills and market planning led women farmers to experience substantial productivity growth. Improved food security and higher earnings benefited the trainees' families, who obtained three times more farm output (TechnoServe, 2024). Besides training the farmers, TechnoServe established connections between these producers and local purchasers, thus helping the farmers obtain reasonable payment for their crops. By participating in this initiative, women elevate their economic position and strengthen community resilience and food security.

17.4.4.4 Cooperativa de Produtores de Alimentos e Serviços de Desenvolvimento (COOPDASI)

The COOPDASI organisation focuses on establishing food security and sustainable farming methods for female small-scale farmers who are part of its membership. The cooperative promotes communal farming practices by permitting its members to unite at resource-sharing levels and exchange helpful information (Sitoe et al., 2022). The cooperative encourages shared resources, which lowers expenses as members increase their production output. The cooperative approaches agriculture with sustainable methods that protect the community's environmental and social aspects (Sitoe et al., 2022). The training program of COOPDASI led a female

group of trainees to become successful practitioners of sustainable farming techniques. These agricultural workers learned crop rotation and organic farming at the session, after which their crop production improved. Through its activities, the cooperative created a community seed bank that offered superior seeds to members, thus improving farm yields. Through these initiatives, women see increased earnings and simultaneously help enhance the food security levels of their communities. COOPDASI members have united to create stronger connections while enabling their women members to lead agricultural development independently.

17.5 Lessons Learnt and Way Forward

17.5.1 Empowerment Through Education and Training

The level of education women acquire determines their involvement in agricultural activities. The combination of economic barriers and social norms results in less school participation by girls throughout both African nations, as highlighted by Manzeke-Kangara et al. (2024). The educational disparity prevents women from attending classes about modern agricultural practices and business management principles. The agricultural sector requires essential professional training combined with education as an essential tool to boost women's capabilities. Such programs implemented by TechnoServe deliver training to women farmers for advanced agricultural practices, financial management skills, and marketing methods. The acquired knowledge increases their productivity and provides them with the competencies needed to become community leaders. Education and training are recommended as a clear pathway for women's empowerment in food systems. Women achieve more prosperous business and economic results because their knowledge of sustainable operations and business practices enables them to understand agricultural environments better.

17.5.2 Access to Land and Resources

Women face barriers in agribusiness because they do not have sufficient control over land ownership rights. Women in Zimbabwe encounter legal and social barriers that block their path towards claiming land rights, even after land reforms were put in place to boost female land access. The culture of Mozambique supports men in inheriting land, which keeps women perpetually excluded from obtaining property rights. Access to essential resources is an essential element that significantly impacts women's accomplishments within agricultural settings and food systems on a broad scale. Women and Land Zimbabwe has dedicated its initiatives to fight for women's access to land ownership because this ensures both greater agricultural productivity and economic autonomy. Women with secure land tenure can make farm investments because they know they will benefit from their work. Collaborations between entities offering such platforms help women access agricultural inputs and financial services, resulting in sustainable agricultural activity growth.

17.5.3 Networking and Collaborations

Building community support networks is vital for empowering women in agriculture. In both countries, women's cooperatives and groups provide essential platforms for sharing resources, knowledge, and experiences. The power of networking and collaboration cannot be overstated. The Chomuzangari Cooperative exemplifies how creating supportive networks can enhance women's agricultural practices. The formation of cooperatives allows women to pool resources, share knowledge, and provide mutual support. This collaborative approach helps them overcome challenges and increases their bargaining power in the market. Taking up from such initiatives, mentorship programs that connect experienced female farmers with newcomers can be adopted to foster an environment of learning

and growth, where knowledge is shared, and confidence is built.

17.5.4 Technology Adoption

Findings indicate that women experience unequal levels of access to technology, even though its adoption is a fundamental tool to boost agricultural participation. Lacking access to information and technological tools restricts women from learning market principles and agricultural knowledge. Modern technology is a key factor influencing how female farmers interact with their agricultural fields. Borrowing from COOPDASI, it delivers mobile applications that give farmers vital information regarding market prices and weather predictions. Digital literacy programs can therefore be scaled up to protect women, especially those in rural areas, from technological exclusion so they can use their advanced capabilities to develop better agricultural practices and better their lives.

17.5.5 Policy Advocacy

The effective participation of women farmers requires gender-sensitive policies because they help overcome the institutional obstacles that hinder their agricultural progress. Women and Land Zimbabwe directly interacts with decision-making officials to create land reform measures that secure female agricultural rights. Organisations implement policy strategies to create system-wide change by recognising specific barriers farmers face. When authorities make ongoing investments to simplify women's land access and financial resource acquisition, outputs of agriculture and economic conditions improve substantially.

17.5.6 Market Access and Value Addition

Findings indicate that women lack adequate access to markets, knowledge, and expertise on

the value addition of their produce. This has a negative impact on their effective participation in food systems. Therefore, it can be recommended that women farmers need enhanced access to markets to enhance women's empowerment in food systems. An example from TechnoServe shows how women can enter profitable markets through TechnoServe initiatives, improving their financial stability and sustainability. Women cooperatives, on the other hand, have the potential of jointly promoting their products to increase marketing possibilities as well as their products' market accessibility. Women who engage in agricultural product processing activities will experience substantial gains in profitability. The manufacturing process of transforming raw materials into packaged products enables women to enhance their financial gains and, at the same time, instigate job creation opportunities for their local communities.

17.5.7 Community Support and Cultural Change

Building support from communities, along with changing outdated gender beliefs, functions as the base to develop women's agricultural contributions. Men who join gender equality programs are partners for women to achieve equal opportunities in their communities. Mass education sessions conducted among men and women at the community level develop cultural understanding of gender equality benefits while promoting teamwork. Community-wide discussions at Chomuzangari Cooperative lead to greater community respect for women farmers while gaining broad support for agriculture-related activities, which produce benefits that extend to all community members.

17.6 Conclusion

The chapter demonstrates how women are fundamental to African food systems, especially in the Zimbabwean and Mozambican agricultural operations, food processing initiatives, and local

community stability. The agricultural workforce includes large numbers of women who struggle to achieve empowerment and adequate contributions due to barriers throughout the systems. Women face significant obstacles, including restricted access to land ownership, scarce financial resources and limited decision-making power, which simultaneously diminishes their potential and total efficiency of food systems. Women who hold significant roles in farming often lack land tenure security, which prevents them from investing in agriculture and limits their agricultural benefits. Women face significant barriers to credit and training access because of cultural norms and discriminatory practices that impede their opportunity for growth. Food systems stakeholders who value women's knowledge and innovation potential will ensure women's access to powerful resources needed to secure sustainable food security. When women achieve empowerment, all social inequities can be resolved, and women's complete potential can be used to generate substantial community transformations. Empowering women in communities allows them to boost sustainable productivity, which enables better food security outcomes and improved community well-being conditions for everyone.

A systematic change requires multiple strategies to resolve these broad-based problems. The establishment of supportive policies that protect women's land ownership rights, financial resource equity, integration of women's indigenous knowledge and expertise, focused agricultural training, and financial education is fundamental for securing women's empowerment. Policymakers must implement gender-based management systems that recognise how women experience farming ecosystems differently. The establishment of women-centric networks enables members to exchange resources with each other, which builds their market power through collective knowledge sharing and experience sharing. Community dialogues about gender norms and the roles of women in food systems should be pursued actively to shape a supportive social atmosphere. Educational programs about gender equality benefits should reach men and women

to break down societal limits on female engagement. These strategies both enable women and enhance food system strength, so they become ready to serve everyone in the community. A joint effort toward achieving gender equality in food systems sets the stage for broad advantages, creating secure and flourishing conditions for every participant.

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Innovation Pathways for Food System Transformation in Southern Africa: Three Countries at Different Development Stages 18

Emmanuel Ndhlovu 

18.1 Introduction

In June 2014, the African Union adopted the Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods. The declaration is a set of goals providing the roadmap for Africa's agricultural vision to be achieved by the year 2025. Together with the Sustainable Development Goals (SDGs), the declaration signifies a commitment to reduce poverty, end hunger and double the agricultural productivity and income of small-scale farmers in their countries (African Union (AU), 2014; United Nations (UN), 2015). This declaration was overdue, particularly in light of Africa's food challenges, with the number of food-insecure people increasing. Approximately 27.4% (about 333.2 million people) of the African population was classified as severely food insecure (Food and Agriculture Organisation (FAO), 2017), while 20% was undernourished in 2016 (World Health Organisation (WHO), 2018). Africa's food system needs to be fixed. According to Parwada and Marufu (2023), compared to other sub-regions, Southern Africa's agricultural productivity is very low. The primary causes for this low productivity are unutilised arable lands, poor soils,

infrastructure and poor policies, as well as climate change, hyperinflation, energy crises, conflicts and pandemics (Bjornlund et al., 2020). With most economies in the sub-region based on agricultural activities (Ndhlovu, 2021), low productivity levels have enormous negative implications for development and industrialisation prospects.

Among the several interventions proposed by policymakers and academic scholars is the adoption of innovation and transformation through technology integration. Digital tools have been widely acknowledged for their potential to transform industries, including food systems, from pre-production and production stages to food processing, storage, transportation and consumption (Goedde et al., 2021; Smidt & Jokonya, 2022). Technological and institutional innovations could be called upon to revolutionise the African food systems to ensure food security. In 2013, the African Union founded the SMART Africa initiative, which is intended to achieve socio-economic development through Information and Communications Technology. The initiative entailed firming up broadband connections and the integration of e-government features. The member states are also committed to promoting e-agriculture and e-commerce and harmonising policies and frameworks. In addition, members are committed to increased farming productivity, increased demand for goods, expanded markets, attracted investments and created new industries and jobs.

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However, adopting or scaling up technological and institutional innovations has proven difficult mainly because effective technological and institutional innovation hinges on various factors (Haug et al., 2021; Mhlanga & Ndhlovu, 2023). These factors include local and regional policies, environments, input and output flows, social learning and prospects of behavioural change (Glover et al., 2019). This chapter contributes to current debates on the prospects of food system transformation in Africa, focusing on technological adoption and integration in food systems. The definition of ‘innovation’ adopted in this study is the one given by the High-Level Panel of Experts (HLPE) (2019, p. 15), which defined it as a process by which ‘individuals, communities or organisations generate changes in the design, production or recycling of goods and services, as well as in the surrounding institutional environment including changes in practices, norms, markets and institutional arrangements, which may foster new networks of food production, processing, distribution and consumption’.

The article (i) identifies potential digital technologies usable in the food systems chain and (ii) identifies opportunities and barriers for technological and institutional innovations in three countries in Southern Africa, namely South Africa, Botswana and Malawi. The exploratory nature of the article makes it a potentially interesting read for policymakers working on agriculture. It could also make a valuable read for students, academics and other stakeholders within food systems. Highlighting the political nature of food system transformation, this article also conscientious politicians on the potential actions ideal for sustainable food systems transformation.

The article proceeds as follows: After this introduction, the second section summarises food systems as the conceptual framework for the study. The third section outlines the research methodology. The fourth section reviews existing literature on the potential of technology in transforming food systems. The fifth section presents and discusses the key issues identified in the study that align with the set objectives. The last section concludes the discussion and outlines recommendations.

18.2 Materials and Methods

This chapter drew on secondary sources, primarily the reports and websites of purposefully selected companies and programmes contributing to technological innovation in the food systems of South Africa, Malawi and Botswana. The Human Development Index (HDI) was used to identify countries for analysis. The HDI is a multipart index that measures average accomplishment in three basic dimensions of human development: a long and healthy life, knowledge and a decent standard of living. The selected countries are in three different stages of development. Botswana, with a Gross Domestic Product (GDP) of \$17.5 billion and a GDP per Capita of \$7,247.6 in 2021 (World Bank (WB), 2022), the country is characterised as one of the few countries in the Southern Africa region displaying positive development. South Africa has a significantly unsustainable economy, with 62.7% of the population living below the poverty line of an upper-middle-income country in 2023 (WB, 2024). Structural problems and poor economic growth have weakened progress towards poverty reduction, with the Gini coefficient at 0.67 in 2018. High inequality is preserved by an exclusion legacy and a weak economy, often failing to create job opportunities for the growing number of job seekers. With South Africa having a low HDI of 0.713, the country is among countries with frail development conditions. On the other hand, Malawi belongs to the league of countries with the poorest countries globally, with a low HDI of 0.51 and ranked number 170.

In South Africa, the following companies and digital technology programmes were identified: Aerobotics PTY LTD, Agri LED PTY LTD, AquaCheck, CAN Agri PTY LTD, FRUIT-LOOK, IQ Logistica, IrriCheck, Khula Project, Mezzanine, Nosetso, Ooka PTY LTD and Revolite Systems. In Malawi, the following were selected: Africa Windmill Project, Home of Hope Youth Network, Copacetic Soil Consultants, Charissa Farms, Green Growth Development Malawi, Maziko FinTech Solution Limited and the Youth Progressive Environmental Solution. The following were selected for analysis for Botswana: Bug’s Life PTY LTD, Anton Tech PTY

LTD, Botswana Institute for Technology Research and Innovation and Macbain PTY LTD T/A Agronardo. All the companies and programmes were selected based on the author’s judgement regarding the availability of adequate and quality information on websites about innovation in food systems. All the links to the websites are provided in the list of references (Agri LED PTY LTD, 2024).

The chapter adopts a conceptual approach which is informed by the author’s experiences as a food system and agriculture digital technology researcher to identify the opportunities and barriers for innovation and institutional change. The researcher is widely published in these areas (Mhlanga & Ndhlovu, 2023; Ndhlovu, 2024a; Ndhlovu & Mhlanga, 2023, 2024). Through content analysis, the author investigated the text on selected companies’ websites and programmes. This ensured that all conclusions are based on the consulted websites. Thematic data analysis—a method in which recurrent themes are identified from the available data—was used. Themes were generated deductively.

18.3 Conceptual Framework: Food Systems

A food system denotes the diverse activities through which food passes, from production

(on farms—includes crop, livestock and poultry production), processing and storage (canning and cutting to complex manufacturing), to distribution (transportation and trade) and consumption (individuals, households and food outlets) (Juri et al., 2024; Ndhlovu & Mhlanga, 2024). Food system activities should, however, also include pre-production (agriculture input (seed, chemicals and fertilisers) manufacturing) and after-consumption activities (Spoilage, waste and disposal). FAO (2013) defined the food system as:

...the entire range of activities involved in the production, processing, marketing, consumption and disposal of goods that originate from agriculture, forestry or fisheries, including the inputs needed and the outputs generated at each of these steps [and also involving] the people and institutions that initiate or inhibit change in the system as well as the socio-political, economic and technological environment in which these activities take place.

Figure 18.1 summarises the food system chain and the various actors involved in each node within the chain.

A food system is characteristically described as a linear (Ndhlovu, 2024a) or circular (Ericksen, 2008) arrangement of activities. There are short and long food supply chains. The shortest food chain is when food is harvested from the garden or field and goes straight to the table. This supply chain is simple and manageable yet highly vulnerable to socio-economic, political and environmental factors. It is mainly dominated by

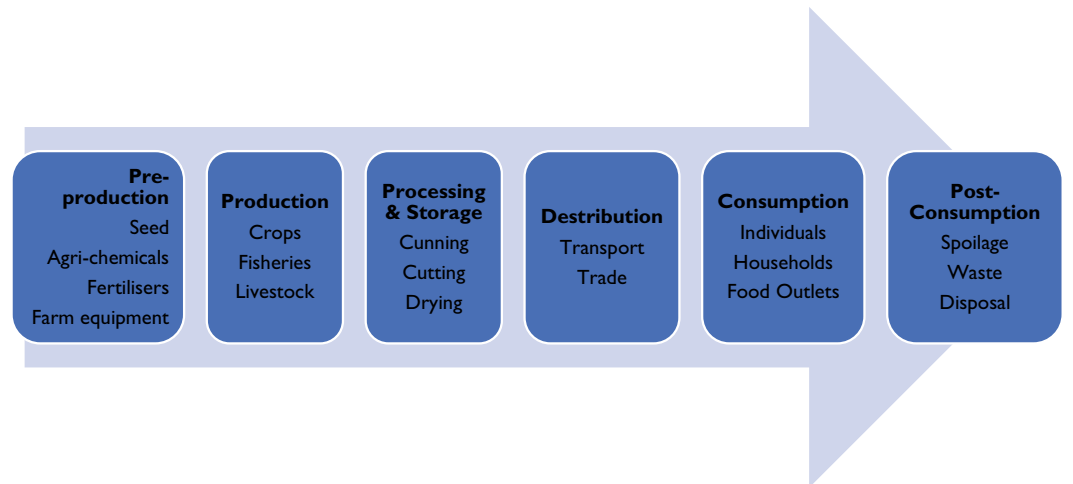


Fig. 18.1 Food system chain. Source Author

smallholder and peasant producers operating from inadequate sources. The long food system supply chain covered in this study is highly complex and globalised. It involves a variety of actors closely connected and working on or towards a particular product. This system is complex, highly mechanised and more developed. It ensures that regions (locally and internationally) that do not produce a particular food item have access to it through contemporary processes of global interconnectedness. Due to its complexity, it is argued that the level and nature of technology integrated into the food system play an important role in how the system works (Goedde et al., 2021; von Braun et al., 2021). Every food system is integrated through a collection of activities that are part of the whole: production, processing, storage, transportation and consumption (Al-Jawaldeh & Meyer, 2023).

Every food system is influenced by several aspects, ranging from socio-political, economic and environmental aspects. Thus, how a food system functions depends on how each of these aspects operates and interlinks with the other factors that also exert their presence in it. The ideal outcome of a food system is food security—food utilisation, availability, access and stability (Eriksen, 2008). The ideal result should also include health, social, environmental, economic and nutrition.

This study examines the possibilities of digital technology integration across the entire food system to explore the opportunities for technological innovation to transform the food systems and to identify barriers to technological and institutional innovations in the selected countries. The theoretical being maintained is that digital technologies have the potential to help transform food systems but that actors in Southern Africa face several challenges in integrating novel technologies.

18.4 Literature Review: Digital Technology in Africa's Food Systems

The literature on the potential of digital technology to transform African agriculture abounds

(Haug et al., 2021; Parwada & Marufu, 2023; Smidt & Jokonya, 2022). Agricultural digital transformation is the integration of digital interventions in the sector (Parwada & Marufu, 2023). The literature indicates that the digitalisation of agricultural tools can fast-track the transformation of the sector, making it more efficient and sustainable (Baumüller & Addom, 2020; Kudama et al., 2021). In the Lawra District of Ghana, Abdulai et al. (2017) found that digital technologies helped farmers to respond to climate change impacts and sustain productivity. In a literature review study that covered several Sub-Saharan countries, Ayim et al. (2022) found that farmers who used tools such as mobile phones, the Internet and computers tended to have information and respond better to farming challenges. In Nigeria, Daum et al. (2021) observed that farmers using digital platforms managed to hire tractors for tillage in time to engage in their farming activities. In Uganda, McCampbell et al. (2021) noted that smallholder banana farmers who used digital tools sustained productivity and had more farming information than those who did not use these technologies. Aguera et al. (2020) found that using digital technologies can also positively transform the agricultural sector in South Africa. In Zimbabwe, Parwada and Marufu (2023) observed that although dominated by the commercial sector, digital agriculture was a useful modern technology used in agriculture to enhance the precision application of inputs like fertilisers, pesticides and water, increasing efficiency that led to high farm outputs (both quantity and quality). Therefore, adopting digital technology in agriculture, particularly among smallholder farmers who comprise most of Africa's farmers, can transform the sector and increase productivity, profitability and resilience to several socio-economic and environmental challenges.

However, the digitisation rate in the African agriculture sector has been slow, particularly among smallholder farmers who produce 80% of Africa's agricultural output (Parwada & Marufu, 2023; Tsan et al., 2019). Although the adoption of digital technologies to improve efficiency and production is widely recommended, various

factors constrain the common adoption of these tools.

The following section of the chapter identifies potential digital technologies usable in the food systems chain and identifies barriers to technological and institutional innovation in the sub-region.

18.5 Findings: Innovation in Agriculture

The findings of this chapter are presented under two sub-sections, namely, digital technologies in agriculture and barriers to technological and institutional innovation.

18.5.1 Digital Technologies in Agriculture

South Africa

Many digital tools can be used across food system chains. These include precision agriculture applications used during food production, biotechnology and mobile platforms, which utilise Artificial Intelligence (AI), robots, drones, sensors, GPS, satellite imagery and control systems which can be used across different stages of the food system. In South Africa, some home-grown innovations have been steered by several projects and companies to revolutionise industries, including the agriculture sector. Taking advantage of the country's policy consistency, political stability and stable economy, agriculture technology companies have rapidly evolved in South Africa. These include Aerobotics PTY LTD, a data analytics firm that uses aerial drone and satellite imagery, machine learning algorithms and AI to detect areas with nutrient deficits, pest infiltrations, diseases or irrigation issues on farms (Aerobotics, 2024). These detections are done much earlier, giving farmers enough time to make data-driven decisions, respond appropriately and evaluate the agricultural practices' success over time. The innovations wield much potential to reduce input costs and wastage, decrease the impact of crop diseases and pests, and

thus increase yields and reduce losses. These technologies have revolutionised the production stage of the South African food system. These technologies are helping smallholder farmers increase production and, hence, profits. For instance, drones can be used to plant seeds and apply fertiliser faster than human abilities, thus reducing labour costs. These technologies increased efficiency and effectiveness within the production phase of the food system.

Big data analytics is also a significant technological breakthrough in South Africa. They can enable farmers and other food systems actors to interpret huge amounts of data and get in-depth insights into food system activities. Using this technology, food system actors, such as farmers and suitable transporters, predict rainfall amounts and flood possibilities in a given season and respond appropriately. For instance, in crop production, AI-powered data analytics can be used to detect and identify diseases and pests, as well as monitor soil health without necessarily using laboratory equipment (Alliance for a Green Revolution in Africa AGRA, 2017; Sampene et al., 2022).

Driverless machinery is also standard in some farms, although primarily used in large-scale farms. Cloud-based platforms are being used to control the speed of these types of machinery as they spray chemicals and apply fertiliser, plough and during harvesting fields. Agro-robots are also deployed to detect and kill weeds and pests in targeted areas using cameras and sensors, thus increasing chances for high yields. When used successfully, these technologies can also contribute to increasing farm yields (Nosetso, 2024).

Another initiative is the Nosetsa, a cloud-based water management solution for agribusiness and farms. With water shortages on the rise due to climate change, this initiative reduces the water used in traditional irrigation farming by two-thirds while ensuring that yield levels are sustained or improved. Another company that provides similar services is IrriCheck, which provides software which optimises the irrigation scheduling and maximises production through optimal water usage (IrriCheck, 2024). In the

Western Cape, FruitLook is another technology being used by farmers to help them use water in deciduous fruit and grape farming in more efficient and climate-smart ways (Ntoyanto-Tyatyantsi & Amadi-Echendu, 2021). Technologically advanced drones with hyper-spectral, multi-spectral or thermal sensors are also used in irrigation to detect dry field parts that need additional moisture. Some drones are used to compute the vegetation index and ascertain the crop concentration and health (FruitLook, 2024).

Similarly, AquaCheck manufactures and supplies quality and reasonably priced soil moisture monitoring equipment developed to optimise soil water management. Some of the products include self-irrigation software as well as full agronomy support tools (Aqua Check, 2024).

The Khula initiative is also a digital software and mobile marketplace platform connecting farmers with suppliers and other traders. Through the platform, farmers are able to sell their produce directly to retailers, export agents, traders and wholesalers. Farmers can also use the platform to buy inputs (Khula, 2025). By reorganising supply chains and reducing the barriers related to market access, Khula is empowering farmers, particularly smallholders, to access resources and information, thus increasing their incomes. Similarly, Ooka provides small-scale farmers a marketplace for their produce. The ADAMA Grow Mobile App also integrates data-driven technologies and analytics, thus enabling farming to know where to sell produce. It also helps them with reliable data on prices and weather patterns (Adama, 2024).

Another initiative is the Mezzanine, which is a member of the Vodacom group. This initiative provides detailed solutions for agribusinesses to network and do business with farmers. Some tools include a mobile solution called DigiFarm through which farmers can efficiently interact with service providers to procure farm inputs (Mezzanine, 2024). Connected Farmer is another digital solution. This mobile solution links agribusinesses and farmers by digitising the value chain, from pre-production in input industries and farm production to product consumption in households and food outlets. MyFarmWeb is another digital agriculture platform that enables commercial farmers to

access consolidated information across the chain, procuring the best inputs at competitive prices and increasing the profitability of farming.

Another company that has introduced innovation in the agriculture sector is the Biotikum Company. This company designs and produces high-quality, cost-effective microbial additives, which include host-specific animal probiotics, microbial silage inoculants and soil inoculants to improve the agricultural industry.

Ooka PTY LTD and Revolute Systems South Africa also offers agricultural technology products to aid farmers in increasing their yield and efficiency. The products include orchard development and harvest equipment and are meant to lower production costs and improve the quality of produce. The objective is to improve the competitiveness and profitability of farming (Ooka, 2024; Revolute Systems, 2024).

The Tessara Company also manufactures preservation sheets for grapes, litchis, blueberries, tomatoes and cut flowers (Tessara Company, 2024). The company provides laminated sulphur dioxide-based plastic sheets to protect produce, thus allowing customers to keep flowers and fruit fresh during transport. These products are used across the various nodes of the food system chain to reduce wastage. Blockchain technologies are also being used within agriculture value chains to consolidate the system for more accessible and shorter delivery times to markets (Ntoyanto-Tyatyantsi & Amadi-Echendu, 2021). Blockchain technologies can also connect networks within the industry to facilitate peer-to-peer dealings in self-organising communities among actors within the food system chain in South Africa. Blockchain can also enable the realisation of transparency since information cannot be altered once entered into the system and is accessible across the value chain. Data such as the number of inputs used, thus ensuring efficiency by monitoring and avoiding wastage, can be recorded through Blockchain technology.

The IQ Logistica also offers a platform to assist South African farmers to effectively and efficiently manage agricultural operations (IQ Logistica, 2024). The software is used to handle budgeting, inventory and farm data across the

different stages of farming operations to ensure greater productivity. Farmers also access several services, such as insurance and finance, through the tool.

AgriLED also provides digital tools to facilitate controlled environment agriculture. These comprise hydroponics systems, LED Grow lamps and automation within the closed environment. This technology allows for factory or automated indoor farming to be practised. Instead of farming in the soil, plants are grown under LED lights in a water-based solution through a hydroponic indoor mechanism that allows plants to be grown throughout the year. The CAN Agri in Pretoria also uses this type of farming for vegetable production. With shortages ongoing, non-traditional farming methods can help boost production and promote efficiency within the food system (CAN Agri, 2024).

Another technology being used is the harvest of the sun's heat and the use of solar energy. In South Africa, load-shedding lasted up to 6 h since 2020. With the advent of 4IR, renewable energy sources such as solar photovoltaic energy are being harnessed to power farming and other equipment (Ndhlovu & Mhlanga, 2023). Using digital technologies to harvest sun, wind and geothermal energy, the South African agriculture sector is slowly weaning itself and reducing its reliance on depleting non-renewable energy sources.

Malawi

The Africa Windmill Project makes water-pumping equipment designed for agricultural use. The equipment is designed locally using domestic materials so that it is easily accessed, repairable and understood by local farmers. The pump is portable, 85% efficient, easy to operate, user and environmentally friendly since it does not produce any emissions into the atmosphere. The pump costs around US\$70 and is affordable to Malawian smallholder farmers, thus enabling them to increase productivity through irrigation farming and strengthen the production node of the Malawi food system chain (Africa Windmill Project, 2024).

Home of Hope Youth Network is a local youth-lead group which works with rural youth farmers

in smart agribusiness and environmental conservation to increase income generation among these farmers, improve food security in the community and provide modern farming technologies and services to farmers to increase productivity and profitability whilst mitigating climate vulnerability. The network thus supports activities mainly in the production stage of the food system (Home of Hope Youth Network, 2024). It, however, also supports the other stages of the system since increased food production means more processing, transportation and retail by intermediary actors and increased or better consumption.

Copacetic Soil Consultants are a Regenerative Land Management Firm working on improving agricultural soil productivity through a blend of biologically-powered and tech-driven means guided by big data, precision agriculture and empowered local personnel (Copacetic Soil Consultants, 2024).

Charissa Farms is an agribusiness entity operating in different food system stages. It produces, processes and markets the farm crops, both perennial and non-perennial crops. The aim is to improve household livelihoods with nutritious rice, wheat, yellow corn and orange potatoes, which are organically produced and achieve zero hunger, food security and economic empowerment of communities through activity participation (Charissa Farms, 2024).

Green Growth Development Malawi are agroecology designers, Farmers and Entrepreneurs working to renew landscapes, secure diverse and abundant nutrition and provide income opportunities for farmers. It seeks to help Malawian smallholder farmers shift from extractive, underproductive mono-crop agriculture to assorted and profuse food forests and high-yielding regenerative agriculture practices, which can give more diverse crop yields and income opportunities through off-take and value-adding markets.

Maziko FinTech Solution Limited is a technology company focused on revolutionising the agricultural sector through its innovative platform, the Milimonline Agri-Food Marketplace. The platform connects farmers directly with buyers, streamlining the supply chain and ensuring fair

prices for all stakeholders (Maziko FinTech Solution Limited, 2024).

Youth Progressive Environmental Solution engages in waste management. It collects waste and recycles it into products such as Biomass Briquettes, Biogas and Organic Manure. In Fig. 18.1, this company is placed within the post-consumption food system stage and is helping reduce waste as well as manage the environmental impact of food waste.

Botswana

The Bug's Life PTY LTD (2024) collects organic waste and processes it into a slurry, then fed to 5-day-old Black Soldier Fly larvae to produce two products, namely, Larvae Frass—an excellent fertiliser. This product is then harvested, packaged and sold to vegetable, crop and fruit farmers. The other product is larvae: The larvae are harvested and dried using an industrial oven and then packaged and sold to poultry, swine and fish farmers. Furthermore, the dried larvae are ground into protein powder and sold to animal feed manufacturers. Thus, this company has both the pre-production and post-consumption nodes of the food system.

The Macbain PTY LID T/A Agronardo sells agricultural inputs to farmers to correct the inadequate distribution of inputs, including livestock and poultry feeds, to the farming community in and around Molepolole. The company also provides agribusiness consultancy to people who intend to venture into agribusiness but need more technical know-how (Macbain PTY LID T/A Agronardo, 2024).

The Pure Aero Farm in Botswana specialises in vegetable and fruit farming, mainly lettuce, tomatoes, berries and various herbs, through an innovative process called Aeroponics. The company uses tower farms in vertical greenhouses without soil, fertiliser or pesticides (Pure Aero Farm, 2024). Although expensive to set up, these innovations can enable farmers to produce without dealing with constraints such as land. Given the limited land use, innovation also helps reduce farming's environmental impact.

Anton Tech is a digital research company working in the farming space. The company

developed solutions that use image data that is remotely sensed from devices to detect pests and diseases, predict Soil Organic Carbon levels and give recommendations on the treatments or appropriate interventions to apply. These include unmanned Aerial Vehicles, satellites and other devices with a Camera.

The Botswana Institute for Technology Research and Innovation (BITR) also conducts needs-based technology research, providing sustainable, innovative solutions through co-creation and collaboration. BITR also promote precision farming in which farmers can use satellite data, sensors and drones to monitor soil conditions, moisture levels and crop health in real time. This technology is crucial given Botswana's water scarcity.

The findings show that the three countries have different levels of innovation. However, although South Africa represents countries with frail development conditions, the countries have shown positive progress regarding innovation across the food system chain. On the other hand, although Botswana is categorised among countries with positive development achievements, the country has yet to show significant agricultural innovation, just like Malawi. In this country, development is characterised as having failed.

Another aspect that emerged from the study is that agricultural innovation in all three countries is concentrated in the production stage of the food system, mainly crop farming. There are also some minimal innovations in the pre-production stage, with some companies producing inputs such as animal feed and manure. The study shows that there are minimal innovations in the other food system nodes. This exhibits limited value addition within the food systems of these countries. Given the profitability of value addition to products, factors could deter innovation in all the food system nodes in the selected countries.

18.5.2 Barriers to Technological and Institutional Innovation

Several factors, including governance, economic, resource, social and cultural knowledge, serve as opportunities or barriers to the food system innovation of the identified countries.

Governance Factors

Institutional change and the subsequent innovation within food systems hinged on governance (Ndhlovu, 2024b). Governance is about a particular country's policies, laws and regulations. Good governance is when the laws, regulations and policies are predictable and harmonious, with the citizenry supporting the administration (Zindi & Ndhlovu, 2023). The opposite is terrible governance. Governance also entails accountability and state effectiveness, including administrative skills. Except for Botswana (at least at the time of writing), South Africa and Malawi face widespread maladministration, with rampant corruption and state capture widely reported (Enaifoghe et al., 2021; Ukwandu, 2019). There are also poor policies that fail to attract investment, unclear policies, a lack of political will and hyperinflation (Makoza, 2024; Tione, 2020).

The issue of maladministration in African countries is detailed in reports supported by the African Union. For instance, it is posited that most African countries on the continent lack effective modalities, including political will, to ensure high-quality administration (Badiane et al., 2018). Pigford et al. (2018) argue that policy execution involves governing actor exchanges, exchanges, and collaborations in a manner that combines different factors which favour innovation. Haug et al. (2021) observed that South Africa and Malawi displayed limited potential to execute policies to attain commitments such as the Malabo Declaration. To change the conditions of agricultural innovation, these countries need to ensure that commitments and policies are well-funded and implemented. In doing so, competent and skilled personnel must be appointed. These countries are governed by revolutionary political parties that mainly use cadre deployment in

making appointments. This results in unqualified and unskilled people being appointed to key positions.

In addition, state institutions should be given independence so corrupt officials can be prosecuted. In South Africa, the office of the Public Protector should be strengthened to deal with corruption and state capture. In Malawi and Botswana, whistle-blowing by private citizens and other non-governmental actors should be taken seriously so that resources meant for agricultural development are not redirected to personal use or used to accrue political capital by politicians.

Economic Factors

Inadequate market access, inflation and improper risk management are some of the economic factors that impede food system innovation. In all three countries, limited financial access has been one of the challenges for food systems. In Botswana, Seleka et al. (2024) found that due to inadequate financial access by smallholder farmers, the agricultural sector remains underdeveloped. In South Africa, poor financial access by female land reform beneficiaries hampered agricultural development. It was also observed that in South Africa, women were the most affected, particularly smallholder farmers (Ndhlovu & Majova, 2023). In Malawi, Mpata (2020) report that despite policies on financial inclusion, smallholder farmers were highly excluded, thus affecting their capacity to contribute meaningfully.

Due to inadequate financial access, the food systems of all three countries remain underdeveloped (Mpata, 2020; Ndhlovu & Majova, 2023; Seleka et al., 2024). Haug et al. (2021) report that in Malawi, low maize price is the main marketing challenge. In Botswana, low prices for livestock products affected how farmers invested in their farming activities (Svotwa et al., 2023). Haug et al. (2021) also reported that the low profitability of crop and milk production in South Africa and Malawi represented a significant challenge. To deal with the low farm gate prices issue, the Malawian government introduced some systems for floor prices and input subsidies (Haug & Wold, 2017). However, it has been argued that while these interventions have been supportive,

the subsidies have not reached far and farmers tend to prefer selling their produce to private traders who offer low prices because the Agricultural Development and Marketing Corporation takes too long to arrive in their villages. Low profits mean that farmers need more funds to acquire new technologies for their activities and introduce innovative methods.

Resource Factors

Aspects such as land, water, seeds and credit access are some resource factors that can act as barriers to innovation. In Botswana and Malawi, small land sizes by farmers and the need for more capital by food system actors have significantly affected overall food system development (Svotwa et al., 2023; Tladi, 2018). In most cases, innovation requires equipment, seeds and agrochemicals investment. Access to these essential resources can help food system actors to innovate. In South Africa, land reform beneficiaries lack adequate access to credit, mainly due to a lack of creditworthy records, as lenders continue to prefer established commercial farmers (Majova, 2023). It was also found that although some farmers accessed credit and loans, they mainly used them to meet other household needs, other than to improve their agricultural activities (Makoza, 2024; Ndhlovu & Majova, 2023).

In food systems, specifically in farming, access to quality inputs is essential for innovation. In Malawi and Botswana, it was found that one of the factors which hampered productivity was the use of seed from the previous harvest instead of tested seed (Haug et al., 2021; Seleka et al., 2024). In some countries, private traders, such as agro-dealers (within the pre-production stage of the food system) and marketers, are the most crucial source of improved inputs (Ndhlovu, 2021; Ndhlovu & Dube, 2024). In Malawi, however, cooperatives and the government are the most common sources of improved seed (Majanga, 2016; Nkuna et al., 2018). Private leaders and marketers rarely fund the purchase of new technology or innovative pursuits. Therefore, private dealers cannot be relied on as a source of innovation. The capacity of various food system actors in the three countries to innovate requires

well-functioning state-led systems that can help food system actors with high-quality, affordable inputs. However, socio-economic challenges have often seen financial resources being channelled towards other priorities, leaving food system actors, particularly smallholder farmers, with little state support to pursue innovation.

Cultural and Social Factors

The social and cultural factors that hinder innovation with food systems include gender disparities in decision-making and social capital development. In all three countries, women dominate farming, as men pursue off-farm activities in urban areas while women remain in rural areas. However, since innovation often requires additional resources such as labour and other inputs, most women in the three countries lack the resources to fund their farming activities (Jew et al., 2020; Ndhlovu & Majova, 2023). It was, however, also found that decision-making power within families is still controlled by men in Malawi (Djurfeldt et al., 2018) and South Africa (Ndhlovu & Majova, 2023) despite women dominating the sector. This situation leaves women with no power to adopt or recommend innovations on farms or within their agribusinesses.

Gender roles and labour demands are also vital when innovating food systems. For instance, women were observed to perform over half of the agricultural tasks in the selected countries (Djurfeldt et al., 2018; Haug et al., 2021). In this view, innovation efforts need to consider women's needs. For instance, technological innovations that disregard gender realities might not be helpful if women cannot use them. In all the selected countries, technological innovation seemed to disregard gender roles. Available technologies were designed to be used by all genders, with women struggling to use some of the manual equipment, especially for farming. Malapit et al. (2019), however, found that although technological innovations may improve food productivity and incomes for farmers (production), they do not automatically lead to food and nutrition security (consumption). This means that although innovation can improve operations within other stages

of a food system, this does not mean that the improvement will be felt across the other stages.

Knowledge Factors

Knowledge factors related to innovation include access to and availability of information about markets and technologies, for instance. All three countries have policies that promote pluralistic extension systems and policies, mainly focusing on smallholder farmers. However, the overall coverage of extension support needed to be improved, with many smallholders not being visited or visited by any extension workers in the Gauteng Province, South Africa (Majova, 2023). The same pattern was observed in Botswana (Svotwa et al., 2023; Tladi, 2018) and Malawi (Makoza, 2024; Mpata, 2020; Tione, 2020). Innovation and the adoption of digital technologies are possible when people have information about possible innovations, appropriate and affordable technologies and the benefits of such innovations. In the Gauteng Province, South Africa, Majova (2023) observed that land reform beneficiaries with knowledge about technologies and access to extension support often integrated technologies into their operations.

Overall, the barriers to innovation across the food systems of the selected countries extend across all barrier categories. For most food system actors, dealing with these barriers is a challenge. External support, either by governments or private actors, is needed to improve the capacity to innovate, especially by smallholder farmers. However, other actors also exist, such as those within processing, storage and transportation food system nodes, who may have enough capacity to engage in innovation and are willing to participate in technological trials and change. The ability to innovate differs among the three countries and food system actors within the same country. South African food system actors are doing better in innovation than their counterparts in Botswana and Malawi. Malawi could be experiencing slow food system innovation due to its poor socio-economic status, while Botswana, although categorised as having positive development, could prioritise the development of other sectors instead

of agriculture. However, considering the percentages of the populace of the three countries engaged in the agriculture sector, the current levels of innovation need to be better to support the food system revolution and rural development through farming.

18.6 Conclusion

This article explored the innovation and transformation prospects of Southern Africa's food systems using Botswana, Malawi and South Africa. These countries were selected based on their development conditions: Botswana (positive development), South Africa (frail development) and Malawi (failed development). The findings show that innovation and transformation were taking place regarding digital technology integration and using improved inputs in farming. However, overall, there needs to be more innovation and transformation within the food systems of the three countries. It was also observed that much of the innovation and transformation was primarily within the production node of food systems. Much of the focus in all the countries was on farming, while the other food system nodes were experiencing insignificant innovation and transformation. The value addition of agricultural products through processing was minimal, thus making products fetch little profits and generating funds for more innovation. The countries, however, differed in their levels of innovation and transformation. South Africa tended to have more practical projects, and companies engaged in innovation projects in farming and agribusiness. Botswana and Malawi had very few such projects. The article concludes that the progress in South Africa could be linked to its land reform programme, which has given land access to many farmers with different levels of resources and expertise.

This study recommends that governments and private partners help steer the innovation campaign. With most of the food system actors being smallholder farmers engaged in the production node, these actors significantly allocate adequate resources to pursue innovation without

help. Therefore, food system innovation and transformation is a product of the prevailing political economy. Government officials can gain insights from the findings presented here to transform their food systems. Other countries in the sub-region can draw on the recommendations made in this study to inform their commitment to transforming their food systems.

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Exploring the Potential of Marginalised Small Grains for Achieving Food Security Under Climate Change

19

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19.1 Introduction

Climate change poses a significant threat to global food security, particularly in regions where agriculture is heavily reliant on rainfall and other climate-sensitive resources (Froehlich et al., 2018). Tropical and subtropical countries are particularly vulnerable to the effects of climate change, which can lead to more frequent and severe droughts, flooding and other extreme weather events that can devastate agricultural production (Dikitanan et al., 2017). In this context, the potential of marginalised small grains, such as millets, sorghum and quinoa, to contribute to food security and climate resilience has gained increasing attention.

These small grains are often overlooked in favour of the major cereal crops like rice, wheat and maize, despite their nutritional value and ability to thrive in harsh, drought-prone environments. The increasing challenges posed by climate change

necessitate innovative approaches to food security, particularly in semi-arid regions where traditional crops struggle to thrive. Marginalised small grains, often overlooked in favour of mainstream cereal crops, offer a promising solution to these pressing challenges. These grains, such as millet, sorghum and amaranth, are inherently resilient to drought and heat, making them well-suited to the erratic conditions resulting from climate change. Additionally, their diverse nutritional profiles present an opportunity to enhance dietary variety and health within vulnerable populations. Recognising the potential of these crops not only contributes to enhancing food availability but also supports sustainable agricultural practices that capitalise on local biodiversity. As we delve into this exploration, it becomes essential to assess how these small grains can be integrated into broader agricultural systems to bolster food security in a rapidly changing climate.

The existing literature highlights the important role that small grains can play in achieving food security under the constraints of climate change. A study in Andhra Pradesh, India, found that millets, such as finger millet and pearl millet, are important risk mitigation strategies for households in drought-prone areas, as they can be used as contingency crops when the planting of major cereals is delayed due to late rains (Froehlich et al., 2018). Additionally, research has shown that small grains are more nutrient-dense than major cereals, providing higher levels of protein, fibre, vitamins and minerals (De Lima et al., 2021; Lawrence

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et al., 2020). This makes them particularly valuable for addressing malnutrition and improving the overall nutritional status of vulnerable populations. Small grains also have greater resilience to abiotic stresses, such as drought, heat and poor soil fertility, compared to many major cereal crops. This ability to thrive in marginal environments makes them a promising option for boosting agricultural production in regions impacted by climate change.

Food security challenges in semi-arid regions are exacerbated by climate change, which significantly impacts agricultural productivity and livelihoods. In areas such as Zimbabwe's agro-ecological regions IV and V, persistent low rainfall creates a precarious food situation, compelling farmers to seek alternative crops and innovative cultivation methods to enhance resilience. Studies indicate that long distances to markets and limited access to credit and extension services serve as critical barriers to effective agricultural practices and market participation, ultimately affecting food availability and security (Dube-Takaza et al., 2022). Moreover, the effects of climate variability, manifesting as unpredictable rains, high temperatures and frequent droughts, intensify the vulnerability of communal farmers who rely heavily on agriculture for sustenance. Consequently, these farmers develop adaptation strategies to address the adverse impacts, yet they often find themselves struggling against the compounded challenges of food insecurity and poverty (Bjornlund et al., 2022; Gukurume, 2013a, 2013b). Addressing these interconnected issues is vital to ensuring food security in semi-arid regions. This chapter explores the potential of these marginalised small grains to bolster food security under climate change, examining their agronomic, nutritional and socioeconomic benefits, as well as the challenges and barriers to their wider adoption.

This chapter starts with an introduction to climate-resilient small grains (such as millet, sorghum) for food security in semi-arid regions in Africa. Then, a detailed literature review that gives an overview of the small grain's

agronomic resilience, nutritional quality and socioeconomic advantages, alongside adoption challenges. A methodology, results and detailed discussion on literature and case studies that explore the potential of small grains, lowering production trends in African countries (e.g., Zimbabwe). It ends with a conclusion and recommendations.

19.2 Literature Review

Small grains such as millets, sorghum, quinoa, teff and amaranth constitute a critical and often overlooked group of crops with immense agronomic, nutritional and socioeconomic benefits, particularly in the situation of climate change and food insecurity. Their abiotic stress resistance of natural origin against extreme drought, heat stress and poor soil fertility makes them very well-suited for cultivation in risk-prone semi-arid and marginal soils where major cereals perform poorly in Africa. Aside from their greater adaptability to the environment and shorter growth periods, small grains provide higher-quality diets with increased protein, fibre, vitamins, minerals and health-enhancing phytochemicals and often a lower glycemic index, thereby countering malnutrition and chronic disease. Socioeconomically, they add food sovereignty, preserve traditional crop or knowledge systems, empower women and small farmers with diversified incomes and market linkages, and strengthen local resilience. But realisation of their potential is hindered by serious impediments, including inadequate investment in research, declining output, erosion of their genes and limitations on processing capacity and market access.

19.2.1 Agronomic Benefits of Small Grains

Small grains, such as millets, sorghum and quinoa, have several agronomic advantages that make them well-suited for cultivation in the face of climate

change. These crops are generally more tolerant of abiotic stresses, such as drought, high temperatures and poor soil fertility, compared to major cereal crops. Research has shown that millets, for example, can withstand drought conditions better than other cereals, as they have efficient water-use strategies and can continue to produce grain even under severe water scarcity. Additionally, small grains are often more resistant to pests and diseases, reducing the need for chemical inputs and making them a more sustainable option for resource-poor farmers.

The incorporation of marginalised small grains into sustainable agricultural practices presents a viable pathway to enhance food security in semi-arid regions, particularly under changing climatic conditions. Small grains such as millet, sorghum and teff are known for their resilience to drought and poor soil quality, making them well-suited for areas facing climate volatility. Studies indicate that these crops not only contribute to crop diversity but also enable smallholder farmers to adapt to unpredictable weather patterns fostered by climate change. For instance, in India, small farmers, who constitute a significant portion of the rural populace, experience dire consequences from climate variability; adopting agro-ecological practices associated with small grains can bolster resilience through improved soil health and biodiversity (Bargout, 2014). Additionally, evidence from Zimbabwe reveals that contract farmers cultivating small grains demonstrate higher productivity, driven by better access to resources and market integration (Dube-Takaza et al., 2022). Hence, prioritising marginalised small grains is imperative for fostering sustainable agriculture and achieving food security.

Beyond their resilience to environmental stresses, small grains also have shorter growing seasons and can be cultivated in a wider range of agro-ecological zones, including semi-arid and marginal lands. This flexibility can be particularly advantageous in the face of shifting climate patterns, as it allows small grains to be integrated into diverse cropping systems and production strategies.

19.2.2 Nutritional and Health Benefits

In addition to their agronomic advantages, small grains also offer significant nutritional and health benefits. Many small grains, such as millets, sorghum and quinoa, are more nutrient-dense than major cereals, providing higher levels of protein, fibre, vitamins and minerals. For example, finger millet is a rich source of calcium, iron and other micronutrients, making it particularly valuable for addressing issues of malnutrition and hidden hunger (Ashoka et al., 2020a, 2020b).

The rising challenges posed by climate change necessitate a re-evaluation of agricultural practices, particularly in semi-arid regions where food security is paramount. Small grains, such as millets and sorghum, exhibit remarkable nutritional benefits, including high fibre, essential vitamins and minerals, making them a vital component of dietary diversity in vulnerable populations. Their adaptability to harsh climate conditions, such as drought and poor soil, positions them as resilient crops capable of thriving where conventional grains may fail. This resilience is especially crucial for smallholder farmers, who represent a significant demographic in regions vulnerable to climate volatility and socioeconomic insecurities (Bargout, 2014). Furthermore, these 'orphan' millets have gained renewed attention for their role in supporting food security amid the adverse impacts of both climate change and the COVID-19 pandemic, highlighting the urgent need for policies that promote their cultivation and integration into mainstream agriculture (Babele et al., 2022).

Sorghum and millets have also been shown to have a lower glycemic index compared to other cereal grains, which can be beneficial for managing diabetes and other metabolic disorders. Furthermore, small grains often contain higher levels of phytochemicals and antioxidants, which have been linked to various health benefits, including reduced risk of chronic diseases such as heart disease and cancer. These nutritional and health advantages make small grains a valuable complement to major cereal crops in efforts to improve food and nutrition security, particularly

in the context of climate change, where access to a diverse and nutrient-rich diet is crucial.

19.2.3 Socioeconomic Benefits

The economic viability of small grains in semi-arid regions is increasingly critical, particularly in the context of climate change and food security challenges. Small grains, such as millet and sorghum, are inherently resilient to harsh environmental conditions, making them suitable candidates for cultivation where conventional grains may fail. These crops often require less water and can thrive in poor soil conditions, presenting a sustainable alternative to high-input agricultural practices that contribute to soil degradation and water scarcity (Dayawansha et al., 2024). Moreover, fostering the cultivation of these marginalised grains can empower local farmers, particularly smallholders who constitute a significant demographic in regions vulnerable to climate volatility, as they often bear the brunt of agricultural instability (Bargout, 2014). By investing in agricultural practices that enhance the productivity and marketability of small grains, communities can bolster their food security strategically and sustainably, while contributing positively to local economies and ecosystems.

Small grains can also play an important role in improving the socioeconomic status of marginalised communities, particularly smallholder farmers in developing countries. Many small grains are traditional crops that have been cultivated for generations by indigenous and rural communities, and they often hold significant cultural and religious significance. Promoting the cultivation and consumption of these grains can help to preserve traditional knowledge, strengthen local food systems and enhance the resilience of these communities in the face of climate change.

In the context of achieving food security in semi-arid regions, the market potential and value chain development for marginalised small grains such as millet, sorghum and amaranth present significant opportunities. These crops, often overlooked in favour of mainstream cereals like maize, are well-adapted to harsh climatic conditions and

exhibit resilience against climate change. Recent studies underscore the importance of enhancing the market value of these grains through targeted investments in research and development, which can facilitate their integration into local and global food systems (Erenstein et al., 2022). Furthermore, building a robust value chain involves not only improving production techniques but also addressing market access, processing capabilities and consumer awareness. By fostering collaboration among local farmers, policymakers and researchers, marginalised small grains can be positioned as crucial players in sustainable food strategies, meeting both nutritional needs and economic goals amidst changing environmental landscapes (Seddon et al., 2021).

Moreover, the cultivation of small grains can provide a valuable source of income for smallholder farmers, as they often command higher market prices compared to major cereal crops. This can be particularly beneficial for women farmers, who are often responsible for the production and processing of these crops. Integrating small grains into agricultural systems and food value chains can also create new economic opportunities, such as the development of value-added products and the expansion of local and regional markets.

19.2.4 Challenges and Barriers

Despite the many potential benefits of small grains, there are also significant challenges and barriers to their wider adoption and integration into food systems. One of the key challenges is the lack of investment and research in these crops, particularly compared to the major cereal crops. As a result, there are often gaps in our understanding of their optimal agronomic practices, processing technologies and market potential. Another barrier is the declining production and consumption of small grains, as they have been largely displaced by the dominance of major cereal crops, such as rice and wheat, in many regions. This has led to the erosion of traditional knowledge and the loss of genetic diversity, which can make it more difficult to develop

climate-resilient varieties of these crops. Additionally, small grains often face challenges in terms of processing and storage, as they may require specialised equipment and infrastructure that is not readily available in many rural areas. This can make it more difficult for smallholder farmers to effectively process and market their crops, limiting their ability to capture the full economic benefits.

19.3 Materials and Methods

To explore the potential of small grains for achieving food security under climate change, this research chapter adopts a multidisciplinary approach, drawing on insights from agronomy, nutrition and socioeconomic studies. The chapter used the methodology, which involved the following key components:

Literature review: An in-depth review of the existing literature on the agronomic, nutritional and socioeconomic benefits of small grains, as well as the challenges and barriers to their adoption, drawing on the sources provided. Case studies: Analysis of case studies from different African countries and contexts to highlight the successful integration of small grains into local food systems and the factors that have contributed to their adoption.

The chapter synthesised the findings from these various components to provide a comprehensive analysis of the potential of small grains for achieving food security under climate change, as well as recommendations for policy, research and development interventions to support their wider adoption. It highlighted the agronomic benefits of small grains, such as their resilience to climate stresses, their ability to thrive in marginal environments and their compatibility with diverse cropping systems.

19.4 Results and Discussion

The research chapter presented the findings from the literature review, case studies and stakeholder interviews, demonstrating the multifaceted

benefits of small grains for achieving food security under climate change. The review of the available literature suggests that small grains, such as millets, sorghum and quinoa, have significant potential to contribute to achieving food security under climate change. These crops offer a range of agronomic, nutritional and socioeconomic benefits that make them well-suited for cultivation in marginal environments and climate-stressed regions.

The agricultural landscape of semi-arid regions has undergone a notable transformation in recent decades, characterised by a discernible decline in the production of small grains, impacting food security, economic stability and ecological balance within these vulnerable ecosystems. This trend is not merely a statistical anomaly but rather a complex interplay of multifaceted factors, including shifting climatic patterns, evolving agricultural policies, technological advancements favouring alternative crops and socioeconomic pressures that collectively influence farmers' decisions and land-use practices (Bhatnagar-Mathur et al., 2012). Intensifying climate change has emerged as a primary driver, with altered precipitation patterns, increased frequency of droughts and elevated temperatures posing significant challenges to the cultivation of small grains, which are particularly sensitive to water stress and temperature fluctuations; the consequences of climate change include substantial effects on agricultural output owing to changing rainfall patterns, temperatures, floods, droughts and detrimental effects on water and land resources (Ali et al., 2020). These changes critically affect communities reliant on rain-fed agriculture, reducing crop yields and water availability, especially in regions already prone to drought (Berhe et al., 2023).

According to a study in Zimbabwe, the small grain output has been steadily decreasing over the past 14 years, despite initiatives to promote small grains (Chanza, 2018; Gukurume, 2013a, 2013b). There has been a decline in both productivity and area. In contrast to the anticipated level of 2 to 4 t ha⁻¹, the Crop and Livestock Assessment report for the 2012–2013 season showed extremely low national average productivity levels of sorghum (0.32 t ha⁻¹), pearl millet (0.3 t ha⁻¹) and finger

millet (0.24 t ha^{-1}). Since most farmers are no longer willing to plant finger millet, the harvest has been declining dramatically each year. Considering climate change and variability, increasing small grain yield is essential to ensuring food and nutrition security (Matthew, 2015). One critical aspect contributing to the decline in small grain production is the alteration of global rainfall amounts and seasonality, which has a direct impact on rain-fed crops (Murray-Tortarolo et al., 2018). Shifting rainfall patterns not only diminish overall productivity but also disrupt traditional planting schedules, leading to reduced yields and increased susceptibility to pests and diseases.

Agronomically, small grains are generally more tolerant of abiotic stresses, such as drought, high temperatures and poor soil fertility, compared to major cereal crops. Research has shown that millets, for example, can withstand drought conditions better than other cereals, as they have efficient water-use strategies and can continue to produce grain even under severe water scarcity. Additionally, small grains are often more resistant to pests and diseases, reducing the need for chemical inputs and making them a more sustainable option for resource-poor farmers (Ashoka et al., 2020a, 2020b).

Beyond their resilience to environmental stresses, small grains also have shorter growing seasons and can be cultivated in a wider range of agro-ecological zones, including semi-arid and marginal lands. This flexibility can be particularly advantageous in the face of shifting climate patterns, as it allows small grains to be integrated into diverse cropping systems and production strategies.

The agricultural sector in Southern Africa is largely composed of smallholder farmers who face numerous challenges, including variable environmental conditions, limited access to resources and market uncertainties (MacCarthy et al., 2018). The production of small grains, such as sorghum, millet and teff, holds significant importance in the region due to their resilience in marginal environments and their nutritional value for local populations (Abalu & Hassan, 1998). However, shifts in agricultural practices, climate change impacts and socioeconomic factors are influencing the

production trends of these vital crops (Mundia et al., 2019).

The expansion of maize cultivation in sub-Saharan Africa is occurring at an unsustainable rate, potentially reducing crop diversity and harming the environment (Santpoort, 2020). This expansion is driven by a combination of factors, including population growth and policy measures emphasising increased production through new technologies, which sometimes overshadow the needs of smallholder farmers, who are crucial for food security in the region (Santpoort, 2020). As previously stated, climate change and variability have increased the frequency of droughts and extended dry spells in both marginal and high potential locations (Dube & Phiri, 2013; Kebede & Nicholls, 2012). The fall in small grain production could be linked to the inadequate incentives provided to farmers who produce them. These incentives outcompete tiny grains for farmland access. The government has also funded the development of high-yield maize varieties, as well as the distribution of free maize seed to smallholder farmers.

Climate change is expected to have a substantial impact on agricultural productivity in Southern Africa, with projections indicating reduced rainfall, increased temperatures and greater variability across the region (Nhemachena et al., 2020). These changes can negatively affect the yields of staple crops, particularly maize, potentially leading to food insecurity for millions of people (Tesfaye et al., 2015). However, climate change also provides an opportunity to promote the cultivation of drought-tolerant crops such as sorghum and millet, which are better adapted to drier conditions and can offer a more stable source of food and income for farmers in marginal environments.

Smallholder farmers are not mechanised, so have labour-related issues in the production of small grains such as sorghum and millet, prompting them to prioritise maize production. These issues include the high cost of cultivating sorghum and millet in comparison to maize. According to Alumira and Rusike (2005) and Matthew (2015), growing labour costs in small grain production have impacted many farm operations, including land preparation, weeding, bird

scaring, harvesting and grain processing. Furthermore, maize's ease of processing in comparison to traditional staples such as sorghum and millet is one of the reasons why it became popular in Zimbabwe's semi-arid regions during the green revolution (Alumira & Rusike, 2002; Matthew, 2015).

The potential of small grains to contribute to food security and climate resilience is clear, but realising this potential will require concerted efforts to address the various challenges and barriers that currently limit their wider adoption (Khanal & Wilson, 2019; Kumar & Kalita, 2017). Key strategies for promoting the use of small grains in the face of climate change include increasing investment and research in small grains to improve their agronomic performance, processing technologies and market potential.

Developing policies and programs that support the cultivation, processing and marketing of small grains, particularly for smallholder farmers and marginalised communities. Promoting the consumption of small grains through public awareness campaigns, school feeding programs and the development of value-added products. Strengthening the links between small grains and local food systems, traditional knowledge and cultural practices to enhance the resilience of these systems. By taking a comprehensive, multi-faceted approach to supporting small grains, we can unlock their potential to contribute to food and nutrition security, climate change adaptation and the livelihoods of marginalised communities around the world.

The findings reveal the significant potential of small grains to enhance food security in semi-arid regions, particularly under the pressures of climate change. Evidence indicates that these crops are not only adaptable to variable climatic conditions but also require less water and input compared to traditional staples. This adaptability suggests that integrating small grains into agricultural practices can diversify diets and improve resilience against food scarcity, thereby addressing nutritional needs and reducing dependency on major crops susceptible to climate risks. Furthermore, these grains present valuable opportunities for local economies by encouraging the

cultivation of indigenous varieties, which can empower marginalised farmers. As such, future food security strategies should prioritise the incorporation of small grains into policy frameworks and agricultural extension programs, fostering sustainable practices that optimise local resources while promoting biodiversity, thus securing food availability for vulnerable populations in increasingly challenging environments.

19.5 Conclusion

The exploration of marginalised small grains presents a vital avenue for enhancing food security in semi-arid regions amidst the challenges posed by climate change. These crops demonstrate resilience to drought, foster biodiversity and contribute to sustainable agricultural practices, offering an efficient means to mitigate food scarcity. The integration of small grains into local diets can significantly alleviate nutritional deficiencies while also supporting the economic resilience of farming communities. However, there are also significant challenges and barriers to their wider adoption, including a lack of investment and research, the erosion of traditional knowledge and challenges in processing and storage. Thus, policies promoting the cultivation and consumption of these grains could lead to broader socioeconomic benefits, ultimately aiding in the overarching goal of sustainable human development in vulnerable areas. To fully realise the potential of small grains, a multifaceted approach is needed that addresses these challenges and barriers. As climate change continues to exacerbate existing agricultural challenges, prioritising marginalised small grains is not merely an agricultural choice but a necessary strategy for adapting to changing environmental conditions and ensuring food security for future generations.

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Part IV

Case Studies

Exploring the Beverage Politics in Southern Africa's Food Systems

20

Aphios Nenduva  and Allan Tapiwa Maganga 

20.1 Introduction

Every human society produces beverages with various raw materials and reasons. African societies use maize, millet, sorghum, rapoko and fermented wild fruit products, for instance, *mauyu*, *masawu*, *tarmarinda* and *mapfura*, among others. There are various reasons and cultural beliefs surrounding the manufacture and use of each beverage. Indigenous beverages produced in Africa are a form of cultural heritage to the societies which produce them. In Zimbabwe and Zambia, it was found out that *kombucha*, tamarind juice, *masawu* juice, *mauyu* juice and *amarula* juice, which are traditional ready-to-drinks, have managed to penetrate the market of well-established beverage giants like Coca-Cola and lured most of their customers. These wild fruits and small grain products seemed to pose a disruptive product innovation through market counter-penetration. In the past, Coca-Cola brands and other fizzy drinks used to dominate the market through their strong distribution network, which enabled them to reach even the most remote areas of the country. Through its strong

marketing strategy, Zimbabweans and Zambians were engrossed in its products as loyal disciples and quickly replaced their traditional drinks in their diet. Homemade and other traditional beverages were misrepresented and ridiculed as drinks associated with backwardness, poverty, and inferiority. Citizens in these countries were 'colonised' by Western brands and forgot about their local drinks. However, technological innovations in the food industry have reshaped the beverage industry with locally produced drinks occupying the centre stage. Shops on the outskirts of the cities in Zimbabwe and Zambia have filled their shelves with non-fissure drinks.

Vutete and Vutete (2016) aver that the shift in consumer behaviour on beverages coexisted with health and wellness campaigns, which have revolutionised many people's feeding habits, where customers are preferring their traditional diet, which is free from sugars and foods saturated with fat. In this regard, what remains puzzling is what has led to this overhaul, where customers dumped their 'original drinks' which used to associate with an affluent lifestyle, going for organic and non-fissure brands? This is against a background that people who drink fizzy drinks and bottled beer were/are seen as superior to those who take organic and unrefined local drinks. In Africa, locally made beverages are intended for individuals as well as collective consumption. For instance, kombucha and other ginger drinks are being used as sex enhancing drinks by people battling with erectile dysfunction in

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Zimbabwe and Zambia. Against that background, Kufakurinani (2024, p. 86) adroitly advises that the story of the trade in sex enhancers is part of the broader story of the Zimbabwean economic crisis that has generated widening unemployment, and a deepening informal sector dubbed the '*kukiya-kiya* economy' (Jones, 2010; Masawi et al., 2023). *Kukiya-kiya* means making do with what is available to get by in an economy for survival. Against that background, the Zimbabwean economy created fertile ground for opportunists such as informal traders to sell, advertise and even mislead people whilst they are making huge amounts of profits from people's ignorance. Therefore, the economic quagmire that is being experienced by Zimbabweans selling imported beverages is a result of the emasculating policies enacted by the government, which had a debilitating impact on citizens who turned to street vending to eke a living.

The history of Kombucha can be traced to China in the Northeastern city of Manchuria. (Greenwalt et al., 2000; Goh et al., 2012; Salafzoon et al., 2017). Through trade routes and globalisation, the drink spread to China's neighbouring countries. According to Pakravan et al. (2018), Asian countries are the major consumers of *kombucha*. In these countries, the drink is consumed for various reasons, although some of them are culturally oriented. For Greenwalt et al. (2000), *kombucha* is used to treat non-communicable diseases, although its use is not substantiated with scientific evidence. Some people also use it as a catalyst to improve their digestive system. Therefore, this clearly shows the multi-purpose and fluid roles of *kombucha* in different communities. Zimbabweans started taking *kombucha* through trade links with Zambia, where informal traders smuggled the drink. Due to the collapse of the local industry and economic meltdown in the country, many informal traders resort to buying goods from neighbouring countries as South Africa, Zambia, Botswana and Mozambique. It is through these informal traders that *kombucha* and other drinks were smuggled from Zambia to Zimbabwe. Despite the ban of these drinks by the Zimbabwean government, informal

traders preferred them because their market remained and expanded unabated than soft drinks from major multinational companies. Notably, the introduction of these non-fissure drinks coincided with health awareness campaigns where people worry much about the development of non-communicable diseases and sugar content in their foods. This has been exacerbated by information sharing through social media, where these drinks are claimed to boost the immune system, and sex drive, as well as reduce sugar levels in the body. Kufakurinani (2024, p. 87) opines that:

Both the trade in and the consumption of sex enhancers must be understood within [a] broader context. Popular commentary suggests there is increased uptake of sex enhancers by young and middle-aged men, which links to the sense of a crisis of masculinity caused by economic difficulties.

Be that as it may, the dispersion and spawning of non-fissure drinks in a collapsed economy like Zimbabwe is caused by a myriad of factors. It seems pressure imposed by economic crisis emasculated and castrated most of the active men because they are failing to provide for their families, hence, they end up psychologically entrapped and fail to perform in bed. For Africans, the hallmark of marriage as an institution is having children and satisfying the conjugal rights of both partners. Failure to fulfil these conjugal rights expected by your partner is labelled as subhuman since the marriage institution is revered and sacred. Against that background, for sex to be enjoyable, there is need to create a conducive environment which stimulates the sexual organs. Thus, due to the economic quagmire the country is experiencing, most of the men in Zimbabwe are undergoing stress, depression and hypertension, which negatively impacts on their social life at home with families. Studies have concluded that, for the male sexual organ to work properly, it needs enough blood supply plus messages from the brain to trigger the process. Then, when the environment is not favourable, especially as a result of depression, anxiety and other factors, manhood and fertility will automatically be affected. In Africa, masculinity is based on men's abilities to provide for their families and partners; failure to provide is emasculating (Nenduva, 2012). To

strike a balance between societal expectations of manhood and providing for the family in a 'dog-eat-dog' economy like Zimbabwe, men end up looking for sex enhancing herbs/drinks. Bourdillon (1997, p. 45), commenting on the relationship between consumption of beverages and culture, notes that beverage consumption is closely related to culture, economic status and biology. However, if it is not properly managed, it can lead to social and health problems. Against that background, this chapter interrogates how functional beverages with cultural orientation have increased their footprint by pushing 'mainstream beverages' to the periphery through disruptive innovation. We argued that the surge in uptake of non-fissure drinks in Zimbabwe and Zambia by most people, especially males, is a way of reclaiming their manhood, which has been destroyed by a comatose economy in a neocolonial environment.

20.1.1 Methodology

The study is qualitative, and it aims to understand perceptions of people in Zambia and Zimbabwe in relation to their dietary shifts. It seems there is a surge in the consumption of non-carbonated beverages as compared to carbonated beverages like Coca-Cola, Pepsi and others. In this study, qualitative research gives a comprehensive picture of the behaviour of Zimbabweans and Zambians from an insider perspective. Therefore, the reasons why consumers' behaviour has shifted from carbonated soft drinks to non-fizzy beverages produced from indigenous fruits are understood through the views given by people during interviews. In the words of Creswell (2007), qualitative researchers understand that there are multiple realities; hence, when gathering data, their presence during and after an event is essential for them to capture the nuances and context of evolving events. In this study, these beverages have been conveniently selected because the researchers are residents of Zimbabwe who operate small business shops selling food-stuffs and other products. The researchers have in-depth knowledge of the politics of beverages through lived and liveable experiences with their

customers in business. In this paper, we are not interested in quantifying statistical information on the consumption of carbonated drinks and non-fizzy drinks. Since the research is qualitative, our focus is to understand the experiences of people in the community and how their culture shapes their choices of beverages in Zambia and Zimbabwe. Of worthy noting in this study is the view that culture can rebrand certain beverages to make them gain prominence, while at the same time it can denigrate some beverages. Oral and open-ended interviews were conducted with various customers and shop owners in Harare, Kariba, and Livingstone. Data gathered through cell phone audio recordings were transcribed and analysed through textual analysis. A key question is whether the latitude to choose which drink to consume and not to consume is based on logical reasoning backed by scientific evidence or is a result of mob psychology based on social media information.

20.2 Theoretical Framework

In theorising the findings of beverage politics in Zimbabwe and Zambia, the paper utilised Disruptive Innovation Theory. The concept of Disruptive Innovation was first used by Clayton Christensen in the book *The Innovator's Dilemma* (1997). Christensen (2013) argue that 'disruption is influenced by new technologies which entered the marketplace by providing more cost-efficient products and services which address the needs of consumers with diverse financial backgrounds, for instance, the haves and the have-nots'. In relation to the beverage industry, this is a situation whereby a smaller company like the manufacturers of kombucha drinks, mauyu juice, masawu juice and other ginger drinks are successfully challenging established incumbent businesses like Coca-Cola and Pesi, which are giants in the beverage industry. These small companies innovate by tapping local resources to manufacture goods which address the needs of the local people. Thus, their innovation involves a new product (*mauyu* juice), new processes (packaging of mauyu juice in a bottle), opening a new market (selling *mauyu* juices as sex enhancers), new ways of

organising business and new sources of supply (Porter & Ketels, 2003). Therefore, in contextualising disruptive innovation, we view it as a situation whereby established and renowned firms like Delta Beverages are shaken up or stumbling due to competition from small companies producing non-fissure drinks. In the beverage industry, through disruptive business models, we see mainline drinks produced by Delta beverages being shoved by non-fissure drinks, which are simple, less expensive, and rapidly supplied through the informal market and affordable alternatives. Regarding disruption theory, Windahl (2015) posits that through disruption, customers' values, beliefs, and benefits would shift to suit their present needs. In Zimbabwe, the previously shunned beverages produced from indigenous resources have taken over the beverages industry. In light of the above, it is pertinent to interrogate beverage politics to understand how beverage production, distribution and consumption have been shaped by innovation in Zimbabwe and Zambia.

20.3 Literature Review

Globalisation has brought freedom for many beverage businesses to trade beyond the borders of the country of incorporation. However, scholars have argued that globalisation seems to favour established multinational companies at the expense of local beverage companies. Research has established that 'Coca-Cola is the world's leading player of non-alcoholic beverage manufacturer and distributor, having a global market share of 48% (Luo, 2022). The Coca-Cola drink was developed by the renowned pharmacist John Pemberton in 1886. Although it is one of the world's internationally recognised non-alcoholic drinks, fluctuations in food consumption and production levels have increased competition worldwide. As a result of the demand for food supply, innovation is not only unavoidable but a necessity in the beverage industry. In this regard, the wellness wave that is sweeping the African continent, drawing inspiration from the rich heritage, continues to take centre stage in

the beverage industry. Recent launches include beverage products infused with traditional ingredients like *masawu* juice, *mauyu* juice, *tarmarind*, *amarula* juice, *kombucha* drinks and ginger drinks, among others. In line with the growing wellness movement, there has also been an increase in demand for natural and organic energy drinks across Africa. Researchers at BioMed Central (BMC) Nutrition offer that food choices go beyond nutrition and satiety, and this usually determines a people's health. According to a Joint WHO/FAO Expert Consultation (2002) study, drinks which are high in calories and added sugars are some of the major contributors to chronic diseases such as hypertension and heart-related problems. Despite the fact that demand for soft drinks and carbonated beverages is increasing on a daily basis due to dietary shifts in Southern Africa, public health groups have issued a strong warning to consumers on the dangers associated with these drinks, which include risks of diabetes and obesity, among others. Such insights are vital in this study as they help to inform what shaped the Zimbabwean and Zambian beverage landscape.

A study conducted by Scully et al. (2017) established that in Australia, adolescents are the major consumers of non-alcoholic soft drinks, and these include energy drinks and fruit drinks. This high intake of non-alcoholic beverages by the youth is attributed to their appealing taste, marketing and convenience. The feeding and drinking habits of youth are usually controlled by their palate. In Australia, male adolescents and young adults have greater exposure to commercial television, and they have extra money to spend on soft drinks and other consumables. Higher television viewing increases their appetite for drinks since advertisements have the power to shape human behaviour and thought. Thus, marketing technology that percolates into every orifice is designed to achieve a single goal, separating the consumer from his/her money. Studies on the power of advertising show that health-related warnings on tobacco packages and alcohol containers are usually clear. Hence, this results in positive results on information dissemination concerning tobacco and alcohol abuse. However, pertaining to the dangers of consuming carbonated drinks, the information

is not very clear. Therefore, as a way of minimising the consumption of sugar-sweetened drinks, some governments tend to introduce a sugar tax in their countries. The assumption is that this will discourage their consumers, hence they will go for healthier alternatives like water. The Australian method is oriented towards reducing the consumption of soft drinks because of their hazardous, subtle effect on health.

More related to the above is Idumah et al. (2020)'s study on the uptake of non-alcoholic fizzy drinks in Nigeria. The research established that Nigeria is one of the countries experiencing high temperatures in Africa, which they attributed as a major contributor to the consumption of soft drinks. It seems most people consume soft drinks as a way of adding fluids to their bodies. Additionally, the study also attributes the high consumption of carbonated drinks to population growth, rural to urban migration, and a lack of bottled water. Thus, although people might be aware of the dangers associated with overconsumption of soft drinks, at times it is difficult to adhere to health regulations because of the desire to satisfy the palate. Similar to that, a study by Vartanian et al. (2007) concluded that excess consumption of these carbonated drinks poses health challenges to the body. Research on the effects of carbonated drinks, particularly soda, shows that their nutritional benefits are outweighed by their health effects, which include diabetes, fractures and dental caries (Scully et al., 2017). Therefore, with the surge of non-communicable diseases attributed to poor feeding habits in Southern Africa, especially among the youth, it is pertinent to strengthen awareness campaigns on the effects of carbonated drinks on health, especially among adolescents, since their consumption patterns of food are usually influenced by their palate and the peers surrounding them. Idumah et al. (2020)'s study opine that contemporary health awareness campaigns should be rich with information explaining the challenges related to poor feeding habits on people's health. Due to the health and wellness wave, it seems the majority of people in Zimbabwe and Zambia now advocate for the consumption of healthy non-carbonated drinks

made from millet, maize, rapoko and indigenous wild fruits. These drinks are categorised as 'healthy' because of their absence of other foreign ingredients, which are likely to have long-term health implications for people. In understanding beverage politics in Southern Africa, we established that the views of these scholars are essential as they help us to understand consumer perceptions and reasons for the shift in feeding habits from carbonated soft drinks to locally produced drinks. We noted that culture and the health wellness wave are at the centre of influencing the eating habits of people since food choices are usually shaped at the family and community level.

Pachave (no date) examines the consumption patterns of people in India on carbonated drinks. The study established that in India, consumption patterns of people on beverages have changed. These changes are caused by various market dynamics and the choice of customers, among other factors. Consumers appear to shift from carbonated beverages towards water, unsweetened tea and kombucha. Although kombucha does not contain some natural sugars, it is one of the drinks which captured the attention of many people. It appears many people prefer kombucha over carbonated drinks as it helps them to provide water to the body without adding any sugars. The study established that the consumption of functional beverages, which are likely to provide energy, is also on the rise. These are consumed for various reasons. In Southern Africa, these drinks are usually consumed by drivers to enhance mental focus. According to Pachave (no date), fizzy drinks consumption has declined by 15–20% as compared to previous years. However, he also predicted an increase of 35% of the market of non-fizzy drinks. Furthermore, non-carbonated drinks are preferred by almost 75% of urban customers. That being the case, Pachave, (no date)'s study resonates with the current research in that both of them focus on shifts in consumption patterns of carbonated beverages in Southern Africa, although Pachave's focus was on India. In the past years, the Zambian and Zimbabwean populace lampooned on their traditional foods and drinks, which they looked at with scepticism

and scorn as diets for the poor and unpalatable in the modern world. They elevated carbonated drinks as a vehicle of earning respect and status in their communities. Little did people know that they were jeopardising their lives through excessive consumption of these drinks. In this study, this 'dietary correction,' of shifting from carbonated beverages to non-fizzy drinks warrants investigation as it helps to understand how culture has impacted on the feeding habits of people in Zimbabwe and Zambia.

A study by Mwape (no date) in Zambia entitled '*Homemade Hibiscus-based drink for a healthier nation*' discusses the potential benefits and nutritional value and composition of the drink, its health benefits and potential as a natural alternative to commercially available beverages. In this study, they established that hibiscus flowers are well-known for both their culinary uses and their traditional medicinal properties, such as Rich in antioxidants, supporting heart health, aiding weight management, having Anti-cancer properties, supporting digestive health, boosting immune system, promoting liver health, hydrating and as a refreshment. The study also establishes that hibiscus flowers, which is a key ingredient in homemade drink have shown positive results in lowering blood pressure and exhibit anti-cancer properties due to their rich antioxidant content (Hopkins et al., 2013). Therefore, dietary shift from carbonated drinks to healthier beverages in Zambia is exacerbated by health and wellness campaigns where consumers are constantly reminded about the dangers of drinking carbonated drinks. These viewpoints are essential in enlightening people on the key points which has led to the displacement of carbonated drinks by non-carbonated drinks in Zimbabwe and Zambia.

Phiri et al. (2022) discuss the perks associated taking indigenous fermented beverages in Zambia. The study established that these drinks made from small grain cereals are rich in terms of nutrients as compared to carbonated drinks produced by internationally recognised companies. Also, the study concluded that drinks made from sorgham like *chibwantu* and *munkoyo* have the ability to lower hypertension and other NCDs related illnessess (Awika

et al., 2003). Drawing inspiration from the rich heritage of African botanicals and natural ingredients the authors illustrate how the rich and traditional beverages can alleviate most of the non-communicable diseases emanating from over consumption. Therefore, in this study, the consumption of locally produced beverages in Zambia and Zimbabwe should not be seen through the lenses of satisfying the physiological needs of man by filling the belly, it is a cultural practice which should be understood within a broader cultural framewok. This is also buttressed by Lyons (2007) that 'tell me how you eat, and I will tell you what you are'. This implies that, in the African worldview, food is the giver of life as summed up in by the African and Zimbabwean cultural hero Oliver Mtukudzi's (2005) song *Murimi munhu*. In the song, Mtukudzi applauds the farmer for the indispensable duty of feeding the nation. The voice is the song reiterated that for anyone to be what you are, it is because of eating food produced by the farmer. Therefore, food is predominant because each day as people eat and drink, they choose either to invite a disease or to be free from the disease. Thus, they decide to add years to their life or shorten it through their eating habits.

Related to the above is a study by Ashaolu and Adeyeye (2022) on African functional beverages. The study established that people consuming drinks which have other health benefits which are beyond nutrition only are on the rise in the world. The surge in the number of people taking these drinks is usually exacerbated by persuasive advertisements which convince people to believe that they can perform wonders after taking them. The trajectory of thought of these scholars resonates with emerging trends of beverage politicking in Zambia and Zimbabwe where products designed in Africa, for Africa, by Africans are taking centre stage in the beverage industry. Science technology and innovation is playing a critical role in producing more foods/ drinks with improved traits such as ginger drink and *kombucha*, among others. This ongoing research becomes handy in that it unpacks how African functional beverages are gaining momentum, driven by the global movement supporting health and wellness.

Vutete and Vutete (2016) examines the shift in consumer priorities from carbonated drinks to *mahewu* in Zimbabwe's beverage landscape. In their study they highlighted that fizzy drinks, concentrated juices, beers, and other well-known beverages' market base is shrinking on a daily basis. The shrinking market is attributed to disruptive market intervention caused by the acceptance of *mahewu* whilst dropping carbonated drinks. It seems Zimbabweans have positively accepted *mahewu* and other locally produced beverages which were previously misconstrued as drinks for the poor and backward people. The acceptance of *mahewu* in the market have shocked these companies because people seem to have a nostalgic feeling on their traditional food. *Mahewu* seems to be a symbol of identity to Zimbabweans who are victims of cultural dislocations and are taking what Stewart (2004) calls 'a flight in search of vision' in relation to their drinks. Thus, by taking pride in their traditional drink, Zimbabweans' perceptions on *mahewu* resonates with p'Bitek, (1986, p. 12)'s words that, 'the pumpikin in the old homestead must not be uprooted'. In his context, it implies that old-age tradition and foods should be kept sacred since these are the pillars which buttress a people's future. Furthermore, similar to Vutete and Vutete (2016) is a study by Gadaga et al. (1999) which also concur on the view that traditional fermented products are rich in nutrients but the producers need to adhere to food handling safety standards when preparing these foods. Against that background, it shows that the views of these scholars are essential in unpacking beverage politics and the displacement of fizzy drinks on the marketplace by local products as ginger, and kombucha, among others.

This section was a reconnaissance of the factors which contributed to the shoving and displacement of fizzy drinks (carbonated beverages) in Zambia and Zimbabwe. It has highlighted that the rapid boom in the sale of locally produced beverages is not only ideological but a counterattack of the subtle beverage war between the west and Africa. Yoking oneself from foods and beverages that you cannot grow in your region will result in dependence syndrome hence they advocate for

disruptive innovation to give what Gwekwerere (2013) calls 'voice space and authority' to Africa's local beverage industries. The following section will pay attention to the findings of the study.

20.4 Findings

A cursory glance of the study's findings exposes that beverage politics has a long historical background which traces back to the colonial era where Africans were displaced from their culture, language, food, and history. Fizzy drinks like Coca-Cola brands and Pepsi were seen as modernity and part of life such that Zimbabweans and Zambians were colonised by these western brands. Thus, beverages mirror real life and culture of a people fulfilling Hauck- Lawson cited in Almerico (2014, p. 3)'s assertion that "what one eats or chooses to eat communicates aspects of a person's identity or emotion in a manner that words alone cannot". Colonial history teaches us that, with the advent of colonisation in Africa, associating with traditional culture or foods was often confronted with ridicule. Thus, the repulsive atmosphere created by colonialism has planted seeds of self-hatred, self-pity, and regret among Africans. That being the case, after independence, most of the Africans had internalised a sense of inferiority complex such that by associating with traditional food stuffs one was misconstrued as a laggard trying to roll back time. Against that background, traditional beverages were relegated to the periphery by carbonated soft drinks.

Data from the interviews conducted exposes that locally produced beverages are a fast-moving consumer goods consumed for several reasons in various occasions. Drinks like *tamarind*, *mauyu* juice, *masawu* juice, *kombucha*, ginger drinks, power plus among others have dominated the beverage market displacing well-known brands such as Coca-Cola and Pepsi. Findings reveal that the prevalence of an informal economy in Zimbabwe exacerbated the displacement of 'mainstream' brands like Coca-Cola, Pepsi and others in the market in favour of new brands. Most shops in the outskirts of the city owned

by local people have filled their shelves with these locally produced brands. In Harare, these brands are on demand as revealed by one shop owner in an interview with the Newsday online reporter May 22, 2022. The shop assistant says, 'We sell more than sixty bottles of *kombucha* per day, and we have made sure that we always have it in stock because it's on high demand' (www.newsday.co.zw). Under the same roof, there are also different soft drinks such as Fanta, Coca-Cola, Sprite, Pepsi and others but the sales of other carbonated fizzy drinks have drastically declined compared to those of functional beverages. Data provided by shop owners indicate that most of their customers are males between the age of 16–50 years. Several reasons were given for the consumption of these local beverages. Chief among the reasons were economic, cultural and health-related issues.

Data gathered from retailers selling *mauyu* and *masawu* juices shows that the surge in the sales of these drinks resulted from the health and wellness wave which has engulfed most of the African countries. According to Mbhenyane (2017) 'indigenous plants in Zimbabwe have the potential to transform the country's food security if they are carefully studied'. There is need to collaborate with indigenous people and scientists in order to come up with homegrown solutions to the challenges people are facing. Thus, the introduction of the heritage-based education has prompted innovation and production of new products by local producers where people tend to use locally available resources to display their creative potential. Respondents indicated that Zimbabwe is 'a storehouse of traditional wild fruits in which people's rich cultural heritage in terms of foods, herbs, spices, vegetables, and fruits are usually underutilised. Wild fruits like *mauyu* and *masawu*, *nhenge*ni are cheaply available in the bush. These fruits are seasonal but the climatic conditions in Zimbabwe are good such that each season comes with its own unique fruits. Therefore, the introduction of Education 5.0 has opened new floodgates in as far as innovation is concerned. If properly managed, each season in Zimbabwe is likely to come with a new beverage extracted from fruits widely available in that season. Thus, youths

from Vocational training centres, Poly Technical colleges and Universities, in Zimbabwe and Zambia have the opportunity to put into practice the skills they learnt from schools. Education 5.0 plays a synergistic role by connecting people with their culture and heritage. One respondent traced the creative potential of Africans on beverages through the production of *ice-lolo* juice. *Ice lolo* are juices produced from fermented *mauyu* fruits which are mixed with sugar just like *mahewu*. They are packed in small plastics sachets like *freezits* and sold when they are frozen. Statistics from shops on the outskirts of cities in Zimbabwe and tuckshops in high density suburbs shows that locally produced beverages have the highest sales. Through education, wellness campaigns and the prevalence of non-communicable diseases, low-income earners have started to appreciate their local Indigenous foods and beverages prompting individuals to see themselves as active participants rather than distant observers of innovation and industrialisation.

The displacement of carbonated and sugary drinks from the market was also attributed to their increasing risk of NCDs. One of the participants averred that, 'when people adopted the western lifestyle, they also adopted their diseases'. Excessive consumption of carbonated drinks is associated with western lifestyle and this has negative effects on health. Therefore, the views of the discussant serve to explain that when Africans adopted this lifestyle, they have also adopted diseases associated with the diet. According to (Tucker et al., 2006) the consumption of 'sugar-sweetened drinks has detrimental effect on health leading to teeth decay and other non-communicable diseases. In the early 1990s, cases of non-communicable diseases were very few in Zimbabwe and Zambia as compared to the present situation. By adopting the sedentary western lifestyle, Zimbabweans have exposed themselves to non-communicable diseases because they do not have strong health support systems to manage these diseases. Studies by Malik et al. (2010) posit that consuming one or two soft drinks a day increases one's chances of contracting type 2 diabetes by twenty five per cent. Therefore, there is a core-relation between one's

feeding habits and the chances of developing non-communicable diseases. This explains why these diseases are referred to as 'lifestyle diseases'. Against that background, one can argue that the emergence of non-fissure drinks on the market to displace carbonated drinks is a blessing in disguise to Zimbabweans and Zambians as they are sitting 'on a botanical goldmine of indigenous plants that exhibit anti-obesity, anti-cancer, anti-diabetic as well as anti-ageing properties' (Van Wyk & Gorelik, 2017). In these communities, non-carbonated locally produced drinks which have other benefits beyond nutrition are referred to as 'healthy drinks'. In relation to *kombucha* and other drinks, they are much recommended because of their multipurpose functions which address various needs of the community. Idumah et al. (2020) posit that 'drinks manufactured through the traditional fermentation process are beneficial to the body since they have lower risks of causing the development of non-communicable diseases'. In Zimbabwe and Zambia, 'healthy drinks' refers 'to drinks made from crops and fruits and they are usually manufactured through the traditional fermentation process.' The drinks are classified as healthy because apart from their nutritional content, 'they are free from artificial ingredients' which is believed to have far reaching health problems to the consumers. As highlighted by one respondent highlighted that, 'consumption of carbonated beverages places a double burden on African health care system since they promote obesity and other non-communicable diseases'. The point here is that consumption of carbonated drinks has wreaked havoc and inflicted pain on Zimbabweans and Zambians just as parasites do to unsuspecting hosts.

Linking the disruptive theory and innovation in Zimbabwe and Zambia, a Zimbabwean graduate from Harare Poly Technical College reveals that the introduction of Education 5.0 and the Integrated Skills Expansion Outreach Programme (ISEOP) in Zimbabwe's institutions of Higher have equipped youths with survival skills to manufacture their own products using local resources. The ISEOP programme prioritises innovation, research and entrepreneurship and sharpens these competencies to enhance industrial development,

by equipping young people with practical skills to earn a living. The crumbing of Zimbabwe's formal industry in the post 2000 promulgated the development of indigenous informal industry. In the case of *kombucha* and other juices produced from local resources, graduates from institutions of higher learning use their advertising skills on digital platforms to manipulate people's desires. In advertising, advertisers thrive on raising emotions of people for them to develop an interest on certain products. Products manufactured are advertised as natural, healthy, and originally made from the people's indigenous fruits as *mauyu*, *masawu*, garlic and ginger. Data gathered through interviews revealed that among the supposed medical benefits that come with taking drinks made from local indigenous fruits is their ability in aiding digestion, cleansing of the male reproductive system, boosting the immune system, and treating back pain. Pertaining to the conditions necessary for the production of *kombucha* respondents revealed that kombucha-like beverages are manufactured through the traditional fermentation process. This makes it easy for people who have studied Food Science and Technology at vocational training centres and poly technical colleges to produce these drinks. According to the Sunday Mail Online reporter on 7th of February 2025, police in Harare recovered illicit *kombucha* drink at a house in Waterfalls. These drinks were being illegally manufactured by individuals at a house in Waterfalls and the police acted on a tipoff and managed to apprehend them (www.sundaymail.co.zw). In light of the above findings, beverage politics in Zimbabwe and Zambia is a struggle for space and authority between local industries and western established brands which are being pushed by disruptive innovation and the wellness wave in Africa. The following subsection discusses findings of the study.

20.5 Discussion

The study revealed that non-alcoholic drinks are the most popular beverages consumed globally on a large scale. The reason being that the

youth occupy the world's biggest population and hence there is a core relationship between youth population and non-alcoholic drink consumption. Zimbabwean and Zambian beverage industry is flooded with a variety of both local and foreign suppliers leaving customers with a difficult decision to make about which product to choose at any given time, presumably motivated by patriotism, ethnocentrism, and intentionality. Elaborating on the issue of the increase in consumption of non-alcoholic soft drinks in Zimbabwe and Zambia, the study established that reasons for the consumption of soft drinks vary from one community to another. In this study, we established that the consumption of soft drinks in Zambia and Zimbabwe has changed due self-gratifying benefits, taste, attractiveness, availability, and healthiness. Of late, people have shifted from drinking more carbonated drinks to locally produced drinks which pose lower risks of non-communicable diseases. The findings of the study seem to resonate well with waThiong'o (1993, p. 60) that '[food] is a product of a people's history [which] embodies a whole set of values by which a people view themselves and their place in time and space'.

At face value, the consumption of beverages in Zimbabwe and Zambia seems to be normal but a closer analysis of it shows that there are profound changes which have happened. Hauck–Lawson cited in Almerico (2014, p. 3) says:

What one eats or chooses to eat communicates aspects of a person's identity or emotion in a manner that words alone cannot. Food choices tell stories of families, migration, assimilation, resistance, changes over times and personal as well as group identity.

Whereas the beverage politics in Zimbabwe and Zambia can be understood as a 'subtle war' between western brands and African brands, in this study we view it as part of a broader story of economic crisis that has generated widening unemployment and deepening informal sector. Higher consumption of kombucha and other ginger drinks by males between the ages 20–48 has a direct link with economic difficulties people are facing in these two countries. A popular commentary given suggests that there is increase in the uptake of

kombucha and other locally produced beverages by young and middle-aged men, because of the crisis of masculinity caused by economic difficulties. From the interviews conducted, with shop owners in the outskirts of the city and tuck-shop owners in high density suburbs, ninety per cent of them linked locally produced beverages with sex enhancers. Kufakurinani (2024, p5) echoes similar sentiments in his study on sex enhancers that 'The [male] engine has no power because of stress... Of course, the engine wants enough blood supply plus messages from brains. But the head is full of messages about hunger, rent and debt, etc.' In light of that, it shows that locally produced beverages have both economic and social functions because they are affordable, promotes healthy eating habits as well as boosting men's performance thereby stabilising African homes and families. Thus, if masculinity is based on the men's ability to satisfy his partner in bed and providing food, locally produced beverages are fine-tuned to address the needs of autochthonous people. They are context specific.

Unlike multinational companies which produce products suiting all cultures, local producers use a strategy which is completely different. Some respondents also cited *mahewu* and *mauyu* juice as drinks mixed with indigenous aphrodisiac herbs to boost male virility in bed. They indicated that, production of guns, pornography and drugs are some of the highest lucrative businesses in the world. Therefore, they classify sex as a business which can be enhanced through the production of sex enhancers. Most of the respondents unanimously agreed that African men can drink whatever is produced provided the product has the ability to boost male virility. They cited that manhood in the African context is defined not merely by being a good provider and protector of the family but by being able to last long in bed. Against that background, this is the main reason which has increased the sales of non-carbonated drinks, like *mahewu*, ginger drinks, *kombucha*, powerplus among others; displacing reputable drinks like coca-cola and pepsi.

The introduction of Education 5.0 (Heritage based curriculum) is also seen as one of the key

drivers to the development of informal sector in Zimbabwe. This curriculum provides students with opportunities to engage in critical thinking, problem solving, and innovation within a context that values Zimbabwe's traditions, indigenous knowledge systems and natural resources. Thus, the introduction of this education system allows students from vocational training centres, poly-technical colleges and universities the opportunity to design and create a well-rounded educational experience that responds to both global and local needs. Graduates from institutions of higher learning seized innovation to create new value in drinks using locally available resources such as *masawu*, *mauyu*, *tarmarind*, ginger, *amarula* among others. They manufactured local drinks using a combination of traditional knowledge and technological literacy. Manufacturers of local drinks tap from the Sankofan approach that "it is not taboo to go back and fetch what you forget" (Stewart, 2004, p. 03). After realising that several people are paying the ultimate price of ignorance by contracting lifestyle-related diseases, through excessive consumption of carbonated drinks they counter penetrate markets previously dominated by western brands and shoved them to the periphery. However, of worthy noting in this study is the sustainability of the local beverage industries in addressing the needs of the community. Interestingly, through disruptive innovation, local brands have managed to expand their market by supplying goods which satisfy the needs of their customers utilising information technology for operational efficiency. Substitution by elimination and the winner-take-all mentality which is the backbone of capitalism is being used by local brands to gain momentum and traction in the beverage industry.

20.6 Recommendations

In advancing the ongoing debates on the necessity to revolutionize beverage politics, the chapter recommends that African governments must harness science and innovation to produce local drinks which meet international standards in terms

of food processing, packaging and distribution to the consumers. Methods used to produce these beverages need to adhere to food safety and nutrition concerns as contamination of food has far reaching consequences on health. Therefore, in promoting indigenisation and the growth of local producers in Southern Africa, the governments should ensure that preparation, storage and serving of foodstuffs should be strictly monitored to avoid contamination. This can be achieved through implementing policies and regulations which addresses the needs of the local people. Therefore, it is also pertinent that, Zimbabwe and Zambia should review their curriculum to ensure proper health education of students from primary level on the nutritional benefits of healthy drinks. This is a non-negotiable principle which should be fostered because any country's future is in the hands of the youths. Hence there is need to undergo a decolonisation process through the promotion of local beverages. Chinweizu (1987) teaches us that decolonisation means denial of the West's authority and withdrawal of allegiance from their products. Thus, in the school curricula, physical health and nutrition education should be compulsory to all learners to inculcate a culture of healthy diet from tender age.

20.7 Conclusion

This paper is set to explicate the embedded politicking of the beverage industry in Zimbabwe and Zambia. In this chapter, we established that locally produced beverages in Zambia and Zimbabwe have managed to attract the attention of customers pushing away internationally recognised brands as Coca-Cola and Pepsi, among others. In the past, these brands used to dominate the market as enjoying economies of scale. We also established that, the colonial-type of Education adopted by former British colonies which cherished anything associated with the west as civilisation and development worked in cohorts in denigrating African beverages creating a sense of inferiority complex, self-hatred and self-pity thereby eroding the confidence of people on homemade beverages. Commenting on how the

west has thwarted the creative genius of Africans in all their spheres of life Woodson (2006, p. 6) posits that:

If you can control a man's thinking you do not have to worry about his action. When you determine what a man shall think you do not have to concern yourself about what he will do. If you make a man, feel that he is inferior, you do not have to compel him to accept an inferior status, for he will seek it himself. If you make a man think that he is justly an outcast, you do not have to order him to the back door. He will go without being told, and if there is no back door, his very nature will demand one.

Cognisant of the above, of late, Africans have managed to reclaim and re-centre their lost heritage by recognising the nutritional value, healthiness and role played by their local non-carbonated beverages produced from indigenous fruits. In Southern Africa, consumers are becoming more knowledgeable as they increasingly evaluate nutritional content and health benefits of their drinks. They believe that good health is acquired by consuming their traditional African diet which include vegetables, legumes and foods free from saturated fat. Therefore, high consumption of carbonated drinks is likely to endanger their lives. Of worthy noting in this study is the belief by consumers that non-carbonated locally produced drinks as *kombucha*, power plus and other ginger drinks have aphrodisiac elements which boost male virility. This has boosted the market of these drinks especially by male customers who are still sexually active. Against that background, these drinks foster family unity and cohesion amongst partners since male virility is highly cherished amongst African families. This brings stability and confidence to both partners in the family. Thus, Zimbabwe and Zambia must take advantage of their richness in indigenous fruits and take serious steps towards modernising the beverage industry to achieve sustainable food security.

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Challenges Hindering the Production of Food Crops in Community Gardens in Jozini Local Municipality of South Africa

21

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21.1 Introduction

In 2023, about 2.37 billion people worldwide struggled to access adequate food, 864 million of whom experienced severe food insecurity (Food and Agriculture Organisation of the United Nations, 2023). Therefore, about a quarter of the world's population face food insecurity due to inadequate access to food. In the Republic of South Africa (RSA), a survey conducted by Statistics South Africa (Stats SA) showed that about 2.6 million households (15%) out of 17.9 million are food insecure and 1.2 million (6%) households are severely food insecure (Stats SA, 2023). Moreover, Von Fintel and Smit (2024) note that food insecurity reached a peak in 2023, stating that 1.8 million people in South Africa did not meet the minimum kilocalorie (kcal) requirements. They also indicate that the availability of raw food per person in the country declined from 2.8 in 2017 to 2.6 in 2022 (Von Fintel & Smith, 2024). The cultivation of food crops in community gardens has been identified as a mechanism to improve household food security, especially in rural areas of the country where agricultural land is available for the production of food for home consumption and income generation. Mary et al. (2009) note

that a community garden is defined as a section of land located in an urban or rural environment that is used to produce food or flowers and that benefits both communities and individuals.

A community garden is a piece of land that is used by a group of people who work as individuals or together to produce food (Mthisazwe, 2018). Furthermore, a community garden is a place to grow food crops, flowers and/or herbs in the company of friends and neighbours (Chauke, 2016). Because of the potential of community gardens to produce various types of food crops consumed by local people, they are often established in both urban and rural settings where agricultural land is available for members of the community. The establishment of community gardens is recognised as an important strategy for improving local food supplies and increasing opportunities for open space, greenery, leisure and recreational activities (Mary et al., 2009). The production of food in the proximity of local communities enables community gardens to improve the socio-economic status of resource-poor households in both rural and urban settings. Consequently, community gardens are viewed as a feasible vehicle for alleviating poverty, improving food security, promoting income generation and reducing the cost of food (Shackleton & Roberts, 2018; Tigere & Moyo, 2022). On that account, Mkhize (2011) observes that community gardens are established with the intention of eradicating poverty, building strong relationships, supplementing food from the market and providing

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produce to orphans and vulnerable children. Community gardens can be used as a mechanism to improve household food security and social cohesion among community members. For example, Ntuli (2024) reported that farmers join community gardens to share knowledge and to improve the availability and accessibility of food in households. In addition, Modibedi et al. (2020) found that community gardens contribute to food availability by providing vegetables to farmers' households.

Community gardens have improved the food security and nutrition of community members while also fostering community development, providing financial benefits, enhancing community members' health and facilitating community cohesion and trust (Chauke, 2016; Mudzinganyana, 2012). From a health perspective, Mthisazwe (2018) found that community gardens play a crucial role in promoting healthy communities by providing fresh produce for a balanced diet and reducing the risk of cardiovascular diseases through the physical activity involved in gardening. Gardening naturally promotes physical fitness since it is labour-intensive work that requires physical strength. Participation in community gardens also offers various social and economic benefits. For example, Shisanya and Hendricks (2011) and Tigere and Moyo (2022) found that community gardens create job opportunities, helping members improve their livelihoods. Therefore, community gardens play an essential role in the provision of income for poor families (Gumede, 2016). Modibedi (2018) found that the main reason for farmers' participation in urban community gardens in the Emfuleni Local Municipality in Gauteng, South Africa, was to grow food for home consumption and to generate income by selling their produce. In Lepelle-Nkumpi Local Municipality of South Africa, Malahlela (2014) discovered that most farmers earned an income from their involvement in community gardens. It is not surprising that most farmers rely on community gardens for an income since they have no reliable sources of income. The majority (60%–80%) of people involved in community gardens in South Africa do not earn an income from formal employment and business (Malahlela, 2014; Mfaku,

2019; Modibedi et al., 2020; Mpanza, 2008). Therefore, community gardens are perceived as a source of employment and income generation by most members. The sustainability of community gardens is important because it improves the livelihoods of farmers and their households by providing reliable sources of food and income.

From a social impact perspective, Mthisazwe (2018) found that community gardens help reduce crime by fostering unity among community members. When community members work together in the gardens, they build familiarity, fostering unity and trust. Social cohesion and shared interests encourage collective efforts to combat crime. Moreover, community gardens provide a forum for social networking in which participants can come together to discuss a variety of community issues related to food security, such as local patterns of food production and distribution, unemployment rates and government policies affecting food access (Raiteke, 2015). Owing to the benefits associated with participation in community gardens, governments in many countries have implemented policies and support programmes aimed at improving agricultural production and the livelihoods of farmers in small-holder farming, including community gardens. The support provided by governments includes the provision of agricultural inputs, equipment, infrastructure, extension services, land, training and the like. In KwaZulu-Natal, South Africa, the Provincial Department of Agriculture and Rural Development has been promoting and supporting community garden programmes to increase food production for poor and vulnerable households (Zabuloni, 2023). Despite the recognition and support of community gardens as a strategy to improve the livelihoods of poor communities, food insecurity and poverty remain widespread in rural areas of South Africa. For example, it was found that about 93% of people living in rural households in KwaZulu-Natal are poor (Mosasane & Oyekale, 2021). High levels of poverty have also been reported among beneficiaries of farmer support programmes in other farming communities of South Africa. Nkgudi et al. (2022) found that the Ilima-Letsema programme in the Midvaal Local Municipality of

South Africa did not significantly help farmers to earn an income above the food poverty line or the lower-bound poverty line.

Given the significance of community gardens in South Africa, scholars have developed an interest in studying their role and operations through different research philosophies, approaches, design strategies, data collection methods and analytical techniques. For example, studies have been conducted on the contribution of community gardens with respect to the following issues: household food security (Shisanya & Hendriks, 2011; Mthethwa, 2012; Mudzinganyana, 2012; Tembo & Louw, 2013; Malahlela, 2014; Shackleton & Roberts, 2018; Modibedi et al., 2020; Naicker, 2021); poverty alleviation (Matshotyana, 2012; Mkhize, 2011; Mthethwa, 2012); income generation (Malahlela, 2014; Matshotyana, 2012; Mpanza, 2008; Mudzinganyana, 2012; Shackleton & Roberts, 2018; Tigere & Moyo, 2022); the combating of hunger (Mkhize, 2011; Tembo & Louw, 2013); employment creation (Mkhize, 2011; Tigere & Moyo, 2022); the effects of climate change (Naicker, 2021); social dynamics and sustainability (Lewis, 2013); and capacity to operate community gardens (Kanosvamhira & Tevera, 2024). In addition, the shortcomings of community gardens in South Africa have been explored because they determine the sustainability of the gardens (Mpanza, 2008; Naicker, 2021; Shackleton & Roberts, 2018). In general, most studies conducted in South Africa have focused on the social, economic and financial impact of community gardens.

From a social perspective, most of the quantitative studies cited above found that community gardens do not adequately improve household food security or alleviate poverty. Income generated from farming activities in community gardens is insufficient to sustain the livelihoods of farmers and their households. The results of qualitative studies paint a different picture, showing that the impact of community gardens is valued, even though it was not quantified to establish if most farmers benefitted from community gardens. Qualitative and mixed-method approaches were used in most studies that evaluated the challenges experienced

by community gardens. Consequently, they identified various challenges, such as water shortages, limited access to markets, insufficient inputs, crop pests and diseases and reduced crop yields due to climate change, among others. While new challenges were identified in each study, there were also overlapping issues. Therefore, there is a degree of polarisation regarding the impact of community gardens on the livelihoods of beneficiaries and the challenges faced by farmers in these agricultural settings. Considering the significant role smallholder farming plays in the enhancement of farmers' livelihoods, it is imperative to regularly evaluate the operations of community gardens and their ability to sustain agricultural production. In light of the above, there is a need to conduct a study about challenges associated with the cultivation of community gardens in rural areas of South Africa. The purpose of this study is to investigate challenges that hinder the production of food crops in community gardens in the Jozini Local Municipality of South Africa.

21.2 Literature Review

According to Thompson et al. (2007), community gardens have origins that date back to 100 BC in the United Kingdom (UK). Furthermore, during World War I (WWI), severe food shortages in the UK and the United States of America (USA) sparked a need for community gardening. In South Africa, the origins of community gardens date back to 1913 with the introduction of the Land Act, which classified farmers as either black or white. In KwaZulu-Natal (KZN), community gardens were a prominent phenomenon even before the province became a self-governing territory in 1972 (Mpanza, 2008). Most community gardens were established in times of social and economic stress and resulted from the efforts of various social reformers.

In urban areas, community gardens are primarily located in public open spaces (Corrigan, 2011; Kanosvamhira & Tevera, 2024). In some countries, these gardens can also be found on state properties, including municipal buildings and nurseries (Kanosvamhira & Tevera, 2024). In

addition, hospitals, schools, prisons and old age homes have also established community gardens (Corrigan, 2011). Owing to their varying locations, the size of community gardens is not standardised since access to farmland differs from one area to another. For example, Mpanza (2008) reported that in the Hlanganani area of KZN, the size of community gardens ranges from 5 000 square metres (m^2) to 10 000 m^2 , with an average size of 6 000 m^2 . Smaller gardens ranging from 70 m^2 to 2 000 m^2 can be found in East Harlem, New York City (Petrovic et al., 2018). In the Bronx, New York City, USA, garden sizes vary, with 30% measuring less than 500 m^2 , 20% ranging from 501 m^2 to 1 000 m^2 and 50% exceeding 1 000 m^2 (Ottmann et al., 2012). Jettner (2017) found that in Southern food deserts in the USA (specifically in Richmond city), the average size of community gardens is 1 981 square feet (ft^2). The literature presented above highlights the diversity of garden sizes, documenting both very small and large gardens.

Community gardens serve as a source of fresh, affordable and nutritious food for household consumption in rural and urban areas (Shisanya & Hendricks, 2011; Mudzinganyana, 2012; Modibedi, 2020). Community gardens produce diverse field crops, fruit, vegetables and other types of food that are consumed regularly by members involved in the gardening activities. According to Mpanza (2008), Mudzinganyana (2012), Nkosi et al. (2014) and Modibedi et al. (2020), farmers of community gardens cultivate food crops such as cabbage, onions, spinach, sweet potatoes, potatoes, tomatoes, lettuce, beetroot, pumpkin, butternut, fruit and carrots. Some farmers also grow flowers in their community gardens (De Bruin, 2018). Furthermore, Modibedi (2018) reported that farmers cultivate Chinese cabbage, green beans, green pepper and chomolia. In some regions, the types of vegetables produced include jalapeños, peppers, beans and okra (Ottmann et al., 2012). The literature presented above shows that various food crops are produced in community gardens, depending on the area, climate and farmers' needs.

Although urban and rural community gardens have been reported to achieve significant success,

they also face challenges that can hinder their food production capabilities and sustainability. In some instances, the challenges threaten the existence of the gardens because farmers find it difficult to adapt to new realities. In the eThekweni Metropolitan Municipality in KZN, community gardens consistently face challenges such as shortages of equipment, poor fencing and a lack of extension services (Ntuli, 2024). Furthermore, Naicker et al. (2023) reported shifting rainfall patterns, temperature fluctuations and crop diseases as constraints experienced by farmers during food crop production in the Umdoni Local Municipality, KZN. Nzama and Ntini (2022) identify a lack of institutional support, vandalism and an inadequate water supply as constraints that hinder food production in community gardens in the eMachobeni area in KZN. In addition, Mudzinganyana (2012) identifies start-up costs, inadequate skills and knowledge among farmers, crime, climate change, poor project design, poor management and monitoring, unrealised expectations and a lack of sustainability as difficulties faced by farmers during food production in the Msunduzi and uMngeni Local Municipalities, KZN. Mkhize (2011) found that difficulties experienced by community gardens in KwaNgqolosi in the eThekweni Metropolitan Municipality included issues such as the distance to gardens, inadequate fencing, birds eating the produce, water shortages, a lack of irrigation schemes and land ownership concerns. In addition, Mthethwa (2012) found that constraints faced by community gardens in KwaMsane, KZN, were land and water shortages, a lack of garden tools and a lack of market access. Mpanza (2008) reported that challenges encountered by community gardens in the Vryheid, Bergville and Eshowe districts of KZN included inadequate water supply, damage caused by livestock, a lack of inputs, damage caused by pests, poor crops, theft of produce, a shortage of markets and a lack of interest in gardening. Moreover, Ndlovu (2007) reported that community gardens in Umbumbulu, KZN, faced challenges such as the loss of extension officers and the proliferation of weeds. Lastly, in Knoxville, USA, community gardens face constraints such as a lack of management skills,

poor infrastructure maintenance, issues related to land accessibility and ownership and difficulty obtaining funding (Raiteke, 2015). The studies mentioned above indicate that almost all community gardens face challenges in one way or another, based on the local context.

21.3 Methodology

21.3.1 Study Area

The Jozini Local Municipality (JLM) is one of four municipalities in the uMkhanyakude District Municipality of KwaZulu-Natal, South Africa. The municipality is located in the northern part of the province and covers an area of 3 057 km² (Jozini Local Municipality, 2023). According to a census conducted by Stats SA, JLM has a population of about 199 723 people (Stats SA, 2022). Moreover, the municipality has 31 771, 2 901, 965 and 187 formal, traditional, informal and other dwellings, respectively. Economic activities in the municipality include farming, tourism, gaming, forestry and fisheries. Agricultural production in the municipality includes livestock, poultry, grain crops, vegetables and fruit (Jozini Local Municipality, 2023).

21.3.2 Study Approach and Sampling Procedure

A mixed-method approach was adopted for the study. A survey was conducted among 240 farmers from 50 community gardens in JLM. A survey research design was chosen because it allows for the collection of information from a large sample, facilitating the generalisation of findings to the broader study population. A scientific sampling formula was used to arrive at the sample size of 240 participants. According to the sampling formula for calculating sample size, $n = N/(1 + Ne)^2$, where n = sample size, N = total population, e = error tolerance (0.05) and 1 = a constant value (Slovin, 1960). According to the information received from the municipal office of the KwaZulu-Natal Department of Agriculture and

Rural Development (KZNDARD) in Jozini, there were 601 farmers from 50 community gardens in JLM. Therefore, the study population (N) was 601 farmers from all community gardens in the municipality. To ensure that farmers from community gardens were fairly represented in the study, stratified sampling procedures were used to determine a sample size proportional to the number of farmers in each garden (stratum). Thereafter, simple random sampling was used to select participants from each community garden.

21.3.3 Data Collection Methods

Before data collection commenced, permission and ethical clearance for the study were obtained from the KZNDARD and the University of South Africa (Unisa), respectively. Ethical clearance was granted by the Research Ethics Committee of the College of Agriculture and Environmental Sciences (CAES), Unisa, under the following reference number: 2021/CAES_HREC/010. Data were collected telephonically through the administration of a semi-structured survey questionnaire and recorded in Microsoft Word and Excel 2016. Telephonic interviews were chosen due to Covid-19 regulations and protocols, which limited human movement and the execution of certain physical activities during the pandemic in 2020 and 2021. To ensure trust between the researchers and the participants, agricultural advisors rendering extension services to the community gardens in JLM informed all the farmers to expect phone calls from the research team. This course of action ensured that potential participants were comfortable to speak with the researchers telephonically and would provide reliable information. In addition, the participants were requested to give verbal consent before the telephonic interview sessions started. Consent was only requested after an informed consent letter had been read to the participants to ensure they fully understood the study aim and objectives, the benefits of the study, voluntary participants' right to withdraw from the study, and the confidentiality of the information provided.

21.3.4 Data Analysis

Qualitative data from open-ended questions were analysed using thematic analysis, which involved the identification of themes and codes. Thereafter, frequency and percentage calculations were used for purposes of further analysis. Version 26 of the Statistical Package for the Social Sciences (SPSS) was used to analyse quantitative data. Descriptive statistics, including mean, standard deviation, standard error of the mean, frequencies, percentages and coefficient of variation, were used for univariate analysis.

21.4 Results

21.4.1 Characteristics of Community Gardens and Respondents

The study findings showed that 50 community gardens were listed in the records of the KZNDARD in Jozini. The average garden size was 46.5 hectares (ha), ranging from a minimum of 0.5 ha to a maximum of 300 ha. The standard deviation and standard error of the mean obtained were 83.24 and 5.36, respectively. The community gardens varied greatly in size, as indicated by the coefficient of variation (CV) of 179%. According to Mucha (1994), a CV above 150% is considered extremely high. Therefore, some community gardens had access to large farmland, whereas others operated on small portions of land. The high variation in garden size was evident from the transformed data, which showed that 46% of the community gardens were ≤ 5 ha, while 25% had more than 30 ha. Overall, 46% of the community gardens were ≤ 5 ha, followed by 25% that were larger than 30 ha, 22.5% that ranged from 5.1 ha to 10 ha, 3% that ranged from 25.1 ha to 30 ha and 3% that ranged from 10.1 ha to 15 ha. Therefore, two-fifths of the community gardens in the study area can be classified as smallholder farms because their size was ≤ 5 ha.

The above classification is based on the use of farmland size to categorise farms and producers (farmers) in the South African context. The high

variation in the size of community gardens can be attributed to the allocation of land reform farms to groups of farmers. For example, in the Ndumo and KwaJobezineshe areas in KZN, community gardens are larger, ranging from 80 to 300 ha, because land was provided by the government through the Land Redistribution Programme to various households that were farming in groups or individually. However, in the Bonelani, Vukuzenzele and Sukumasenze areas, the size of community gardens ranges between 4.4 ha and 6.0 ha because land was provided by traditional authorities. Some farmlands in JLM were classified as community gardens. The classification of farmlands as community gardens can be disputed because land was allocated to individual farmers rather than being farmed collectively, which is typical in most community gardens. In smallholder irrigation schemes in South Africa, farmland is allocated to individual farmers. For example, Van Averbek (2012) reported that an average plot size of 0.157 ha from 3 760.1 ha of land was allocated to 3 250 smallholder farmers in the canal irrigation schemes in the Vhembe District Municipality of South Africa. Each plot holder was farming independently in the smallholder plot allocated to him/her. In JLM, another reason for the high variation in farmland size is that most community gardens are located in rural areas where the allocation of land is governed by tribal authorities, traditional chiefs and headmen. In these arrangements, the size of farmland designated for community gardens can be negotiated between community members and tribal authorities.

The results in respect of community garden membership indicated that the average number of farmers per garden was 12, with a minimum of one (1) and a maximum of 52. Some of the reasons for the presence of a single member in certain gardens was that members had relocated in search of better employment opportunities or had married and moved away from the community. For example, a male gardener from the Bonelani community garden who was interviewed on 7 May 2021 said that *'other garden members have left to work in eThekweni'*. A male farmer from the Vukuzenzele community garden who was interviewed on

Table 21.1 Respondents' farming experience and working period in community gardens ($n = 240$)

Item	Farming experience	Working period in gardens		
		Daily hours	Weekly days	Monthly days
Mean	12.5	6.2	5.4	21.7
Std. error of the mean	0.71	0.10	0.06	0.25
Std. deviation	10.92	1.62	0.97	3.91
Minimum	1	2	3	12
Maximum	37	10	7	30
Coefficient of variation (%)	91	26	19	17

Source Survey data 2021

20 June 2021 said that *'one member got married and relocated; so, she cannot participate in the garden activities'*. In some instances, disagreements between garden members forced members to leave community gardens, even though relocation did not occur. It is not surprising that some members left community gardens in search of better employment opportunities because income generation is one of the main reasons people are involved in farming. For example, it was found that 87.1% of respondents participated in community gardens to produce food for home consumption and to earn an income. In respective order, the other proportions of respondents, 7.9% and 5% were involved in gardening activities to produce food for home consumption and to earn an income. The quest to diversify their income was prevalent among the respondents because 54% of them had a social grant as an additional source of income. Of the group of social grant recipients, 36.2 and 17.9% of respondents received a child support grant and a pension grant, respectively. In addition, it was found that none of the respondents were employed before joining community gardens. Therefore, the respondents regarded community gardens as a source of employment. From a racial affiliation and language perspective, it was found that all the participants were black Africans whose home language was isiZulu. This was expected because isiZulu-speaking people make up the majority of Africans in KwaZulu-Natal (the study area). In addition, women were dominant among the group of farmers who participated in the study—63.3% of respondents were females while 36.7% were males. Therefore, it

is evident that women play a major role in the production of food crops in community gardens in JLM.

Apart from the findings presented above, information about the respondents' farming experience, the respondents' working period in community gardens, and the types of food crops produced in the community gardens was collected and analysed. Table 21.1 shows the results regarding the respondents' farming experience and working period in community gardens. Table 21.1 indicates that, on average, the respondents have been farming for 12 years, with a minimum of one (1) year and a maximum of 37 years. The standard deviation was 10.92 and the standard error of the mean was 0.71. A high degree of variation was evident, as indicated by a CV of 91%. The results imply that both highly experienced and inexperienced farmers were involved in the production of food crops in community gardens in JLM. Furthermore, Table 21.1 indicates that the average daily working hours, the average number of weekly working days and the average number of monthly working days in community gardens were 6.2 h ($SD = 1.62$), five days ($SD = 0.97$) and 22 days ($SD = 3.91$), respectively. The CV for weekly and monthly working days was < 20%, indicating low variability, while the average CV for daily working hours was 26%. This suggests that, despite some respondents reporting longer working hours, the variation in daily working hours, weekly working days and monthly working days in community gardens was relatively low. Overall, the study findings indicate that farmers in community gardens in the study area worked less

than eight hours per day, five days per week and fewer than 30 days per month. Therefore, it is very likely that farmers in some community gardens did not work over weekends.

As part of the description of community gardens in JLM, information about the types of food crops cultivated was collected and analysed. The findings revealed that community gardens in JLM produced a diverse range of crops, such as vegetables and field crops. The results presented in Table 21.2 show that most respondents cultivated different vegetables in their community gardens. The types of food crops produced in most (>50%) of the community gardens were leafy vegetables, namely, cabbage (96.7%) and spinach 91.3%. Root vegetables such as beetroot (80.7%) and carrots (55.8%) were also cultivated in more than half of the community gardens. Vegetables such as tomatoes, green peppers, onions and butternut were cultivated by less than half of the respondents. In respect of field crops, maize (75.4%) and soya beans (51.7%) were cultivated by more than half of the respondents. None of the tuber vegetables (potatoes, cassava, sweet potatoes and yams) were cultivated by more than half (>50%) of the respondents. The results indicate that cabbage was the most popular food crop in the study area, whereas butternut was the least popular. Cabbage is widely used for relish and salads. Moreover, potatoes were the dominant tuber vegetable and maize was the dominant field crop. Maize is used to make maize meal, which is a staple food in the study area.

21.4.2 Challenges Hindering the Production of Food Crops

Most respondents mentioned poor fencing as the main challenge that hinders the production of food crops in community gardens, followed by inadequate irrigation systems, and water shortages. Furthermore, respondents also mentioned a shortage of farming skills and training, a lack of transport to markets, and poor roads to production sites as challenges they experienced. These challenges have a negative impact on the success and

Table 21.2 Types of food crops produced in community gardens in the study area ($n = 240$)

Type of food crop	Frequency	Percent (%)
<i>Leafy vegetables</i>		
Cabbage	232	96.7
Spinach	219	91.3
<i>Root vegetables</i>		
Beetroot	194	80.8
Carrots	134	55.8
<i>Field crops</i>		
Maize	181	75.4
Soya beans	124	51.7
Groundnuts	21	8.8
Sugar cane	21	8.8
<i>Tuber vegetables</i>		
Potatoes	83	34.6
Sweet potatoes	61	25.4
Cassava	62	25.8
Yams	46	19.2
<i>Fruit vegetables</i>		
Tomatoes	80	33.3
Green peppers	75	31.3
Butternut	53	22.1
<i>Bulb vegetables</i>		
Onions	68	28.3

Source Survey data 2021

sustainability of community gardens that produce food crops in the study area. A detailed explanation of the results regarding the various challenges mentioned by the respondents is provided from Sects. 21.4.2.1 to 21.4.2.14.

21.4.2.1 Poor Fencing

The majority of respondents (55.4%) identified poor fencing as a major challenge in community gardens. Farmers indicated that due to poor fencing, animals and community members interfered with community gardens' produce. For example, theft of produce was common in unfenced gardens. This finding is supported by the following selected responses from participants: A male gardener from the Amathongwana community garden who was interviewed on 30 May 2021 said: 'Our community garden is not fenced, and

animals interfere with our production by grazing some of the crops'. A female farmer from the Balamhlanga community garden who was interviewed on 1 June 2021 said: *'We fenced our community garden with tree branches and that kind of a fence is not proper to protect our produce from animals and people'*.

21.4.2.2 Inadequate Irrigation Systems

A total of 47.5% of respondents identified inadequate irrigation systems as a constraint. Farmers reported that their community gardens did not have irrigation systems, forcing them to rely mostly on watering cans. Considering that the size of community gardens in JLM ranges from 5 to 300 ha, irrigating such large areas without a proper irrigation system presents a significant challenge. Inadequate irrigation has a negative effect on the production of food crops, especially vegetables that rely entirely on irrigation water. As a result, some crops wither and die, resulting in low yields. Some participants said the following about a lack of irrigation systems: A male farmer from the Ingudu community garden who was interviewed on 12 May 2021 said: *'We use limited watering cans to irrigate bigger portions of cultivated land, and we get tired every day, thus resulting in poor irrigation'*. A male gardener from the Insonyama community garden who was interviewed on 4 July 2021 said: *'We use old pipes for irrigation, and they are leaking, and they waste water, which is a limited resource for us'*.

21.4.2.3 Water Shortages

A total of 20.4% of respondents identified water shortages as a challenge that hinders agricultural production in community gardens. Farmers indicated that insufficient water for irrigation purposes hampers the growth and quality of crops. In some areas, farmers used tap water for irrigation, but it was not always available. For example, in some community gardens, tap water could be unavailable for up to a week. The following statements from respondents support this finding: A female farmer from the Ithembaletu community garden who was interviewed on 24 May 2021 said: *'We*

do not have a dam or river in our area. We rely on tap water provided by the government. Sometimes three days pass without irrigation in the produce because there is no water in the taps'. A male gardener from the Jabulani community garden who was interviewed on 27 May 2021 said: *'We do not have water for irrigation at the garden. We rely heavily on rainfall water; therefore, we need a borehole to sustain our production'*.

21.4.2.4 Lack of Market Access

A total of 16.3% of respondents identified a lack of market access as a challenge for community gardens. Farmers indicated that they were unable to access markets capable of buying their produce in bulk, leaving them reliant on direct sales to community members. As a result, farmers were often forced to leave their crops in the gardens even if they were ready for harvesting. This delay had a negative impact on the quality of the produce because many crops have a short shelf life. The following statements by respondents support this finding: A female farmer from the Khiphindlala community garden who was interviewed on 10 July 2021 said: *'We do not have a market to sell our produce in bulk'*. A male gardener from the Lukatini community garden who was interviewed on 15 July 2021 said: *'Our produce got rotten in production sites because we do not have a market to sell them. Therefore, it becomes waste, which affects our business income negatively'*.

21.4.2.5 Shortage of Garden Equipment

A shortage of garden equipment was identified as a challenge by 10.8% of respondents. Respondents indicated that they had insufficient garden equipment such as hand hoes, spades and wheelbarrows. As a result, garden members could not work at the same time to carry out tasks like land preparation, planting and weeding. They had to rotate the use of available tools, preventing the optimal utilisation of human labour in community gardens. Some respondents said the following in this regard: A male farmer from the Makhoenyeni community garden who was interviewed on 26 June 2021 said: *'We have insufficient watering*

cans, and we rotate the use by members'. A female farmer from the Masekweni community garden who was interviewed on 28 June 2021 said: *'We use our hands to remove weeds because we do not have weed control tools'*.

21.4.2.6 Shortage of Mechanisation

A total of 9.6% of respondents identified a lack of mechanisation as a challenge for farmers in community gardens in JLM. Farmers mentioned that the unavailability of tractors and implements delayed some farming activities. Larger gardens were particularly affected by a shortage of mechanisation because cultivation with hand tools was not feasible given the scale of operations. This finding is supported by the following responses from respondents: A female gardener from the Masiphilisane community garden who was interviewed on 17 May 2021 said: *'We do not have tractors and implements for ploughing, and some cultivation activities are delayed. This is not good because it results in poor production'*. A male farmer from the Mesuliwezinyembeni community garden who was interviewed on 29 May 2021 said: *'Without a tractor is impossible to plough big land; currently we plough using hand hoes'*.

21.4.2.7 Internal Conflicts

A total of 8.8% of respondents identified internal conflicts among community garden members as a challenge. Disagreements over governance and financial management led to some members withdrawing from garden activities or resigning from community gardens. The withdrawal or resignation of members resulted in labour shortages during the cultivation of crops, negatively affecting crop production in community gardens. Some respondents said the following in this regard: A male farmer from the Mhlaba community garden who was interviewed on 8 May 2021 said: *'We are fighting for positions amongst ourselves in the garden'*. A female gardener from the Mjindi community garden who was interviewed on May 17, 2021 said: *'Some community garden meetings could not be finished due to members disagreeing on important issues'*.

21.4.2.8 High-Input Costs

A total of 5.9% of respondents identified high input costs as a challenge for farmers in community gardens. Inputs such as seeds, seedlings, fertilisers (organic and chemical) and pesticides play an important role in the production of food crops. However, the high costs of these inputs led to the underutilisation of farmland in community gardens, preventing the optimal use of available land. Consequently, agricultural production and crop yields declined. The size of cultivated land was not proportional to the resources available, implying that food crop production was low among resource-poor farmers in community gardens. The following statements by respondents support this finding: A female farmer from the Nakokwakho community garden who was interviewed on 21 July 2021 said: *'Seedlings are too expensive, and we are not able to plant the whole community garden'*. A female farmer from Ndlamiyane who was interviewed on 22 July 2021 said: *'We are facing challenges of high input costs, which makes it difficult to plant all available land'*.

21.4.2.9 Crop Pests

A total of 5.0% of respondents identified crop pests as a challenge that affects the productivity of community gardens. Respondents stated that the quality of their produce declined due to pests that attacked their crops. In community gardens where farmers could not afford pesticides, the damage caused by pests reduced crop yields. Some respondents remarked as follows in this regard: A female farmer from the Odongeni community garden who was interviewed on May 10, 2021 said: *'We do not have chemicals to control pests that attack our crops and vegetables'*. A female gardener from the Qedusizi community garden who was interviewed on May 11, 2021 said: *'Pests interfere with our production and compromise the quality of the produce'*.

21.4.2.10 Lack of Funding

A small portion (4.6%) of respondents identified a lack of funding as a challenge that hinders agricultural production in community gardens. Farmers mentioned that it was difficult to secure

funding from financial institutions because they did not have collateral. In some community gardens, funding was needed for installing irrigation systems, purchasing garden tools and equipment (such as spades, garden forks, rakes, tillage implements and planters), and acquiring agricultural inputs and other resources necessary for sustainable crop production. Without funding, some gardens struggled to sustain operations and to achieve optimal productivity. Some respondents made the following remarks about the lack of funding: A male farmer from the Senzosethu community garden who was interviewed on 21 July 2021 said: *'We are willing to use our land extensively, but we do not have enough money to cover all garden activities'*. A female farmer from the Silandelumnotho community garden who was interviewed on 22 July 2021 said: *'Our community garden relied on financial contributions from its members because we are unable to secure funding from financial institutions'*.

21.4.2.11 Delayed Government Support

A total of 2.9% of respondents identified delayed government support as a challenge in their community gardens. Respondents indicated that although they appreciated the assistance provided by the government, the assistance was sometimes delayed. In resource-limited community gardens, planting was delayed when government support was not received on time. These delays had a negative impact on crop yields and quality, particularly in the case of seasonal crops. This finding is supported by the following responses from respondents: A female farmer from the Sinothando community garden who was interviewed on May 30, 2021 said: *'We receive fertilisers late from government when planting season has already passed'*. Similarly, a male farmer from the Siphilangemvula community garden who was interviewed on May 30, 2021 said: *'We receive seedlings while planting season has already gone by'*.

21.4.2.12 Shortage of Farming Skills and Training

A small percentage (1.7%) of respondents identified a lack of farming skills and training as a barrier to successful and sustainable food crop cultivation in community gardens. Some farmers had limited farming skills because they had not received any formal training before joining the gardens. Respondents indicated that they had never been trained in plant production, financial management and business management, yet they were responsible for these activities. This lack of expertise made it difficult for farmers to sustain food crop production and to manage the financial affairs of community gardens. Respondents made the following remarks in this regard: A female farmer from the Siphithuba community garden who was interviewed on 3 June 2021 said: *'We need training on plant production'*. Moreover, a male farmer from the Siyanqoba community garden who was interviewed on 6 June 2021 said: *'We need training on new venture creation to understand how to run a business'*.

21.4.2.13 Lack of Transport to Markets

A small percentage (1.3%) of respondents identified a lack of transport for getting their produce to markets as a challenge in community gardens. Owing to a lack of transport, farmers were unable to deliver their produce to markets. As a result, some produce decayed before it could be sold. This lack of transportation had a negative effect on overall productivity. This finding is supported by the following remarks by respondents: A female farmer from the Skhokho community garden who was interviewed on 18 July 2021 said: *'We do not have transport to deliver produce to the markets and customers who are located further from the garden'*. A female farmer from the Sukumani Bafazi community garden who was interviewed on 21 July 2021 said: *'We do not have transport to deliver produce to markets and customers while it is fresh and still in good condition'*.

21.4.2.14 Poor Roads to Production Sites

One respondent (0.4%) indicated that poor roads negatively affected the transportation of produce from the community garden to storage facilities and the market. The farmer sometimes lost produce that could not be taken to the market. In addition, the quality of produce deteriorated when it remained in the field or in storage for longer than anticipated. This finding is supported by the following statements: A male farmer from the Vukani Bomama community garden who was interviewed on 26 July 2021 said: *'There are no proper roads to our garden. Available roads are muddy, and we cannot take produce out of the garden when it rains'*. Moreover, a female farmer from the Vukuzenzele community garden who was interviewed on 28 July 2021 said: *'Sometimes we have to use wheelbarrows to move the produce out of the garden'*.

21.5 Discussion

It was found that poor fencing, inadequate irrigation systems and water shortages were the main challenges faced by farmers participating in community gardens in JLM. This finding is consistent with previous research, which identified poor fencing, water shortages, a lack of irrigation and land ownership as significant challenges in community gardens (Mkhize, 2011; Mpanza, 2008; Mthethwa, 2012; Ntuli, 2024). It was found that farmers were unable to protect their produce against theft owing to a lack of proper fencing, and the quality of produce was compromised by insufficient irrigation. A lack of market access and a shortage of gardening tools were also identified as difficulties faced by farmers in JLM. In support of this finding, Mthethwa (2012) found that farmers faced challenges due to a lack of gardening tools and limited access to markets for selling their produce. It was found that farmers were unable to work in their community gardens optimally due to a shortage of equipment. In addition, farmers were unable to sell their produce at formal markets since

the markets were not easily accessible. Therefore, it is possible that farmers cultivated smaller portions of their gardens because they did not have reliable markets for selling their produce on an ongoing basis. High input costs, crop pests and delayed government support were also identified as obstacles faced by farmers in the study area. Mpanza (2008) and Nzama and Ntini (2022) similarly reported that difficulties faced by community gardens included a lack of inputs, damage caused by pests, vandalism and poor crops. The study findings showed that farmers were unable to purchase adequate inputs to cultivate crops. As a result, cultivation was sometimes delayed and/or occurred on a limited scale. Furthermore, the quality of produce was low in some instances due to persistent attacks by pests. Farmers affected by high inputs costs were more likely to produce low-quality products since pesticides form part of production inputs.

The issue of delayed government support is concerning because the aim of community gardens is to provide food for farmers and their households and to generate income. Therefore, it is crucial for gardeners to develop a business model that will sustain community gardens and reduce their reliance on government support programmes. The reliance of community gardens on government support is not surprising because, as noted by Mudzinganyana (2012) and Nzama and Ntini (2022), these gardens consistently face challenges such as start-up costs, inadequate skills and knowledge among farmers, crime, climate change, poor project design, poor management and monitoring, unrealised expectations and a lack of sustainability. It is very likely that community gardens in JLM encounter similar challenges, which is why they rely on government support programmes. Furthermore, previous research conducted by Raiteke (2015) revealed that community gardens face challenges such as a lack of management skills, infrastructure maintenance, land accessibility and ownership and limited access to funding. These studies highlight that almost all community gardens face challenges in one way or another. Moreover, the above

studies show that community gardens experience different and multiple challenges that have a negative impact on their sustainability and success.

21.6 Conclusion and Recommendations

The findings of the study revealed about 14 challenges that affect food crop production in community gardens in the Jozini Local Municipality. The main challenges, ranked by significance, included poor fencing, inadequate irrigation systems and water shortages. These challenges were identified by more than one-fifth of respondents. Most of the challenges identified in the study align with findings of other researchers. A concerning aspect is that some of the challenges have a negative impact on the sustainability of community gardens. In conclusion, while the study confirms that community gardens can yield positive outcomes, the achievement of these outcomes may be hindered by challenges associated with farming and gardening.

Regarding inadequate irrigation systems and water shortages, it is recommended that farmers of community gardens drill boreholes, build water storage facilities and install irrigation systems in the gardens in order to improve the production and quality of produce. It is suggested that farmers of community gardens attend workshops and training on group dynamics, leadership and project governance and management in order to manage conflicts that affect agricultural production. Furthermore, farmers should use their savings from the income generated by community gardens to invest in production inputs, to purchase farming equipment and to build fences to protect their gardens against damage caused by animals. Lastly, farmers should rent transport to take their products to larger markets.

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Sorghum Production Systems and Farmers' Trait Preferences in Dryland Areas of Zimbabwe: Implications for Local Food Systems

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22.1 Introduction

Sorghum (*Sorghum bicolor* (L.) Moench) is the fifth most important food security crop globally and has the potential to play a central role in the food systems of Africa's dryland farming areas, where production is increasingly challenged by recurring droughts, heat waves, and soil degradation (Ajeigbe et al., 2018; Salim et al., 2017). As a staple cereal in arid and semi-arid regions, sorghum contributes significantly to household nutrition, livestock feed, and the broader food economy, particularly in regions where maize, wheat, and rice often fail

due to climatic constraints (Xiong et al., 2019). It has wide adaptation and tolerance to high temperatures and moisture stress. The ability of sorghum to do well in these areas is explained by its heterotic mechanisms that allow for greater biomass and yield production within a shorter season compared to other cereals, an inbuilt "stay green" mechanism that allows it to optimize photosynthesis even under stress, including lodging and desiccation tolerance abilities (Blum, 2004; Chemura et al., 2020). The fact that many smallholder farmers in Zimbabwe are located on marginal lands makes sorghum the best alternative staple crop in such areas.

Evidence shows that there are increases in the frequency, magnitude, and impacts of production challenges in agriculture, threatening livelihoods and economies worldwide (Cinner et al., 2018; Dietz et al., 2021). The increased occurrence and severity of droughts, more severe pests and disease pressure, and low soil nutrient supply, combined with slow developments in technologies to deal with such challenges, have limited the potential for sorghum production in many areas (Chepng'etich et al., 2015). Considering current population growth and climate change, sorghum is expected to reduce the current food deficit and contribute to resilient food systems and nutritious source of calories for both humans and livestock (Abdalla & Gamar, 2011).

There is pressure for crop breeding and improvement efforts to improve sorghum to meet the high expectations of helping with the predicted

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socio-economic and climatic conditions, not only in marginal areas but also in areas that will turn marginal under climate change. The reported average smallholder yields of sorghum across Africa are very low. For example, in Zimbabwe, they range between 0.3 and 0.5 t/ha⁻¹ (Phiri et al., 2019), which is far below the average yield of 2–3.5 t/ha under commercial production (Maphosa et al., 2024). These low yields are attributed to the use of low-yielding varieties (Sakadzo et al., 2021). In addition, many farmers continuously grow maize in these dry areas due to a lack of preferences for sorghum (Brazier, 2015). Current breeding programs focus on developing hybrid sorghum varieties that are high-yielding and resilient to adverse conditions (Beshir & Wegary, 2014; Drabo et al., 2019). These hybrids are characterized by crop specific traits such as high yield, tolerance to pests, diseases and drought. Most of these cultivars may fail to possess multiple traits which presents challenges when identifying potential varieties for farmers to grow. It is therefore important to consult farmers in each locality to understand traits which they prefer. Developing hybrids that are relevant to farmers will improve variety adoption rates (Ceccarelli et al., 2009; Tongoona et al., 2017), thereby increasing household income and improving the food security of smallholder farmers. There are no studies carried out to get information from farmers on the relevant traits they consider important in sorghum varieties, relevant to Masvingo province. Engaging farmers in Participatory Rural Appraisals (PRA) provides an opportunity to gather pertinent information for decision making, allows the dissection of challenges, and the consequent formulation of intervention approaches (Makanda et al., 2011; Tongoona et al., 2017).

22.2 Review of Related Literature

Despite significant investments in plant breeding and agricultural research, the adoption of improved sorghum varieties across Sub-Saharan Africa remains uneven. There is growing evidence

of a disconnection between the traits emphasized by breeding programs and the actual needs and preferences of the farmers who grow crops (Ayenon et al., 2017; Ceccarelli et al., 2009; Drabo et al., 2019; Melesse et al., 2021). Globally, major research highlights indicated bias toward yield among breeding programs while farmers tend to value a broader suite of traits, including drought tolerance, grain quality, alternative uses and post-harvest performance (Melesse et al., 2021; Mwamahonje et al., 2021). These characteristics are crucial not only for the resilience of their production systems but also for meeting market and household consumption demands. This divergence in priorities has been identified as a key contributor to the slow uptake of improved varieties. For instance, James et al. (2013) argued that while high yield and resistance to pests and diseases are fundamental breeding targets, they do not fully encapsulate the spectrum of characteristics that farmers deem essential. Farmers in some areas frequently cite the importance of traits such as drought resistance, adaptability to local agro-ecological conditions, grain texture, and culinary qualities (Mrema et al., 2017; Mwamahonje et al., 2021). These traits often play a more significant role in determining a variety's suitability for a particular locale than yield alone.

According to Drabo et al. (2019), farmers choose varieties based on factors which responds to production challenges, consumption patterns and market attributes. These crop specific attributes suggestion have been highlighted in some adoption studies in Zimbabwe. A recent study by Maphosa et al. (2024) identified challenges faced by sorghum farmers in Matabeleland North such as drought, and indicated the need for the development of drought-tolerant sorghum varieties as crucial for farmers. In another study, Melesse et al. (2021) identified preferences for dual-purpose sorghum in Matabeleland which is important for the provisions of food and feed for livestock. In another study, Makanda et al. (2011) conducted a survey on the awareness of farmers on the importance of dual-purpose sorghum varieties in Zimbabwe. While this study provided a clue to the trait preferences, there is a gap in understanding trait preferences by farmers who

grow grain sorghum used as human food. In addition, Masvingo province as one of the major centers of sorghum production has been neglected, hence this study was carried out (MLAFWRD, 2024; Zimstats, 2019). The majority of studies in Zimbabwe have concentrated on quantitative traits like yield and resistance to biotic stresses (Magaisa et al., 2021; Makanda et al., 2011; Mukondwa et al., 2020; Mutava et al., 2011; Muzira et al., 2021; Nhamo et al., 2019), while qualitative traits such as taste, brewing quality and grain color that influence farmers' choices have been largely neglected. This oversight has resulted in improved varieties that, despite their agronomic potential, fail to resonate with the cultural and practical realities of local farming communities. The existing literature suggests that bridging this gap requires a more nuanced understanding of the socio-cultural factors that drive varietal preferences. This study therefore focused on the traits which farmers consider important, in selecting sorghum varieties and how these traits can influence food systems design.

This chapter aimed to characterize the sorghum production systems in four major dryland districts of Zimbabwe, identify farmers' trait preferences, understand the coping strategies used by farmers to deal with sorghum production constraints, and provide evidence to guide breeding and selection that enhances food system sustainability in dryland Zimbabwe. The study is significant in its contribution to understanding how smallholder farmers' priorities, seed access, and adaptive practices shape sorghum's role in food systems. The findings will inform more responsive and inclusive breeding programs that align with farmer demand, address climate challenges, and support nutrition, income generation, and sustainability in Zimbabwe's dryland food systems. By integrating farmer perspectives into varietal development, the study can enhance the potential for improved adoption, productivity, and resilience of sorghum in marginal environments. The chapter covers a brief overview of sorghum production, production systems, and challenges in sorghum production. This was achieved through surveys, focus group discussions and field observations.

The results and discussion were presented with implications for breeding and food systems highlighted.

22.3 Materials and Methods

22.3.1 Study Areas

The study was conducted in four adjacent districts located in the southeastern part of Zimbabwe in Masvingo Province, namely Masvingo, Chiredzi, Bikita, and Gutu (Fig. 22.1). These districts were selected as they have the highest concentration of sorghum farmers in the past five years and good crop suitability potential within the province (Muzira et al., 2021; Zimstats, 2019). These areas represent the semi-arid to arid areas of Zimbabwe, which are commonly used for sorghum production. They are located in agro-ecological regions III (semi-intensive farming region with livestock production, cash, and fodder crops), IV (semi-extensive region suitable for farm systems based on livestock and resistant fodder crops), and IV (extensive farming region with drought-resistant small grains or irrigated agriculture) (Manatsa et al., 2020). Farmers in these areas practice mixed crop and livestock farming, which is the predominant source of their livelihoods. Chiredzi district is dominated by fersiallitic soils with sporadic occurrences of vertisols and sialitic soils dominated by clay. Masvingo district is dominated by sialitic soils that are well-drained, shallow to moderate, and deep loamy sands. Gutu is in agro-ecological region 3, where fersiallitic soils are dominant, characterized by shallow to deep medium coarse-grained sandy loams. Crop production is mainly rainfed, and crop growth varies depending on the season. Bikita is located in natural region 4, with sporadic occurrences of sodic, lithosols, and sialitic soils. Most of the soils in this district are well-drained, medium-to coarse-grained loamy sands, which are usually *peraferrallitic* or *orthoferrallitic* soils (Anderson et al., 1993; Manatsa et al., 2020).

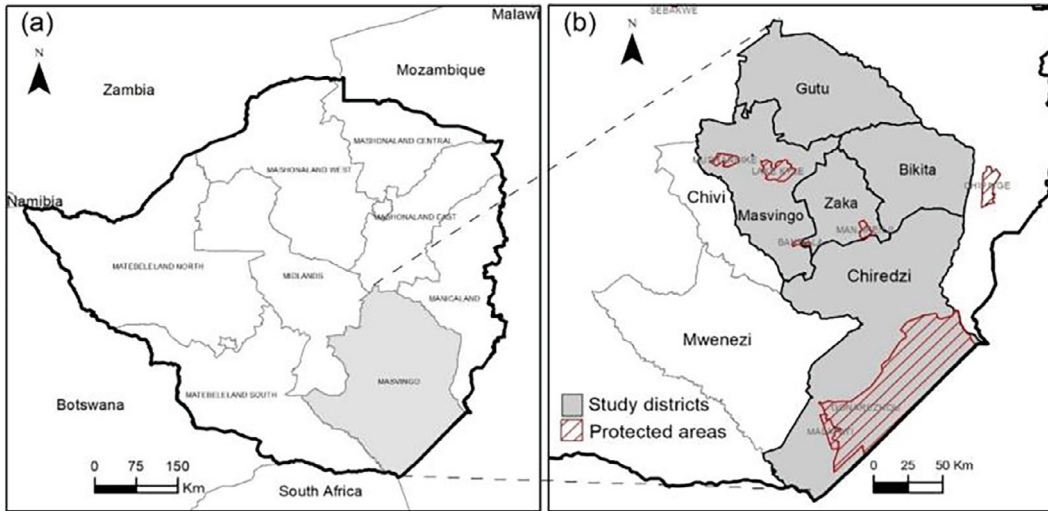


Fig. 22.1 Map showing the location of the study districts in **a** Zimbabwe and **b** Masvingo province. *Source* Authors

22.3.2 Sampling Method

A multistage random sampling method was employed to select participants to arrive at the household level (Creswell & Creswell, 2017). Four districts from the seven in the province, namely Bikita, Chiredzi, Gutu, and Masvingo, were systematically chosen for this study after consulting Agritex and secondary information sources. These four districts were identified as having the highest concentration of sorghum farmers, and highly representative of sorghum production environments (Muzira et al., 2021; Zimstats, 2019) making the exercise more efficient within these districts alone. In addition, only four districts could be covered by the available resources for the project. In each selected district, information concerning sorghum production in prior years, area coverage, duration, and intensity was obtained from Agritex. The second-stage selection was based on sorghum production statistics over the past five years, in which the highest sorghum-producing wards were selected from each district. Two wards were selected in each district. For each of the eight selected wards, a random sample of five farmers were chosen for validation to ensure reliability of the information from Agritex. For each of these farmers, verification of farmer details was done through

phone calls, identifying farmers name, location, contact details and cropping history in brief. This was done to ensure reliability of farmer databases provided by Agritex, as well as making sure the information likely to be obtained is relevant for the study. In each ward, a random sample of 40 sorghum-producing households was selected. After initial screening, there were 14 non-responses and invalid responses which could not add value to the survey, and hence were removed from the analysis to remain with a total of sample of 146 households across the four districts.

22.3.3 Data Collection and Analysis

A mixed-method approach was used in this study, utilizing both quantitative and qualitative methods (Joshi, 2013). A mixed-methods approach was used to enhance triangulation, completeness, and comprehensive coverage of the study, which provides strong inferences while simultaneously offsetting the weaknesses of each method (Creswell & Creswell, 2017; Joshi, 2013). Data were collected through structured questionnaires, focus group discussions, and observations made through transect walks across farmers' fields. Questionnaires were used

Table 22.1 Basic socio-demographic profile of farmers across districts

Variable		Masvingo	Chiredzi	Gutu	Bikita	χ^2	<i>p</i>
Gender	Males	83.3	64.5	61.4	27.3	18.2 ***	
	Females	16.7	35.5	38.6	65.7		
Age	Mean years	54.2	49.8	54.1	52.3	0.24	ns
Family size	Mean	9.1	6.6	3.7	5.0	2.7	ns
Sorghum experience	Years	12.4	11.1	4.4	6.6	4.9	ns
Land size	ha	5.0	8.2	2.2	1.1	7.3	ns
Education	None	17.1	32.3	0.0	2.9	76.8	***
	Primary	34.3	45.2	64.4	57.1		
	Secondary	45.7	22.6	28.9	34.3		
	Tertiary	2.9	0.0	6.7	5.7		

ns: Not significantly different at $p < 0.05$, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Sources Authors

to collect information on demography, cropping systems, the impact of drought and other production constraints, drought coping mechanisms, varietal and trait preferences, seed sources, planting dates, and the general management of the crops. A total of 64 members participated in six focus group discussions across the four districts, each comprising of at least eight members. Observations provided information, such as drought effects in the field, maturity periods of different varieties grown, crop diversity, and cultural practices in each field. Quantitative and qualitative data were collected through questionnaires and analyzed using graphs, chi-square (χ^2), and analysis of variance in R (R Core Team, 2022).

22.4 Results

22.4.1 Characteristics of Sorghum-Producing Households

The results showed a significant variation in demographic characteristics, such as gender ($\chi^2 = 18.2$, $p < 0.001$) and education ($\chi^2 = 76.8$, $p < 0.001$) across the four districts. Masvingo, Chiredzi, and Gutu districts had more males than females, whereas Bikita was dominated by females. Overall, across the districts, the results show that sorghum production systems are

dominated by men at a ratio of three men to two women, although this is as high as four men to one woman in districts, such as Masvingo. These men tended to be older with mean age around 50 years in all the districts and had varied experience in sorghum production that averaged from 4.4 years in Gutu district to 12.4 years in Masvingo district (Table 22.1). Sorghum farmers were not highly educated, as the majority of them reached the primary level in their education across the four districts. Landholding averaged 4.1 ha across the districts, with the smallest average being for Bikita district and the highest in Masvingo, with no significant variation ($p > 0.05$) between the districts. There were no significant differences ($p > 0.05$) in age, family size, or farming experience in sorghum across the four districts (Table 22.1). The overall picture of a sorghum production system in Zimbabwe is that of an older male with primary school education farming on approximately 4 ha of land with approximately 8 years of experience in sorghum farming.

22.4.2 Varietal Adoption and Cropping Systems by Farmers

Table 22.2 shows the different cropping systems and varietal adoption rates by gender and district. More males adopted hybrids and landraces than

Table 22.2 Varietal adoption levels and cropping systems by gender and district

Variable	Gender		Districts				Statistics	
	M	F	Masvingo	Chiredzi	Gutu	Bikita	χ^2	<i>p</i>
<i>Varietal adoption</i>								
Hybrids	45.6	26.3*	0	93.5	31.8	0	53.5	***
OPVs	56.2	93.0**	100	64.5	93.2	100	2.9	ns
Landraces	50.6	36.8	72.2	1.6	54.5	20	31.8	***
<i>Cropping systems</i>								
Seed rates (kg/ha)	6.4	6.6	7	5	6	7	0.44	ns
Planting depth (mm)	37.2	33.4	30	50	50	45	6.14	ns

ns: Not significantly different at $p < 0.05$, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$
Source Authors

females, whereas females adopted more OPVs than males. Some districts significantly adopted hybrid sorghum varieties compared to others ($p < 0.05$). About 93.5% of farmers in Chiredzi adopted hybrid sorghum, with 31.8% adopting in Gutu. OPVs grew in all districts, and there were no significant differences in the adoption rates ($p > 0.05$). Differences were also noted in landrace adoption across districts. Masvingo District had the highest proportion of farmers growing landraces (72.2%), while Chiredzi had the least (1.6%). There were no variations in the seeding rates or planting depths, as shown in Table 22.2.

A high proportion of males reported significantly higher ($p < 0.05$) monocropping compared to females, who on the other hand had a double (35.1%) the proportion of men (16.7%) practicing intercropping across the districts (Fig. 22.2). Similar land proportions were allocated to sorghum by both males and females (38.3% and 35.5%, respectively). More land was allocated to sorghum in Chiredzi district than in other districts, with more than half of the land allocated to sorghum (Fig. 22.2). The highest proportion of farmers who were growing sorghum in pure stands was in Chiredzi (94.4%), whereas the highest proportion of farmers who were intercropping was in Bikita (65.7%). Production of sorghum as a monocrop (pure stand) was highest in Chiredzi (94.4%), Masvingo (80%), and Gutu (85%), while intercropping was dominant in Bikita, as more than a third of the land was under intercropping.

22.4.3 Important Sorghum Traits Identified by Farmers

Farmer preference for traits did not vary significantly across the four districts. In Masvingo, drought tolerance was considered the most important trait, followed by grain yield, meal quality, and bird tolerance. However, grain yield was considered the most important trait by farmers in Chiredzi and Gutu. Chiredzi, however, ranked striga resistance as the second challenge, yet striga resistance in the other districts was considered less important. It is interesting to note that Bikita considered drought tolerance to be the most important trait, followed by nutrition or meal quality in their preferences. Farmers in Chiredzi ranked days to maturity as the 3rd most important trait, while it was ranked 4th in Bikita, and 5th in Gutu and Masvingo districts. Bird management in sorghum is one aspect which is critical in sorghum production. Bird tolerance was ranked 4th in Gutu and Masvingo, while in Bikita and Chiredzi it was ranked 5th and 6th, respectively. Pests and disease tolerance were not considered important in all districts. Overall, grain yield was the most important trait, followed by drought tolerance, meal/nutritional quality, bird tolerance, striga resistance, and pest and disease tolerance (Table 22.3).

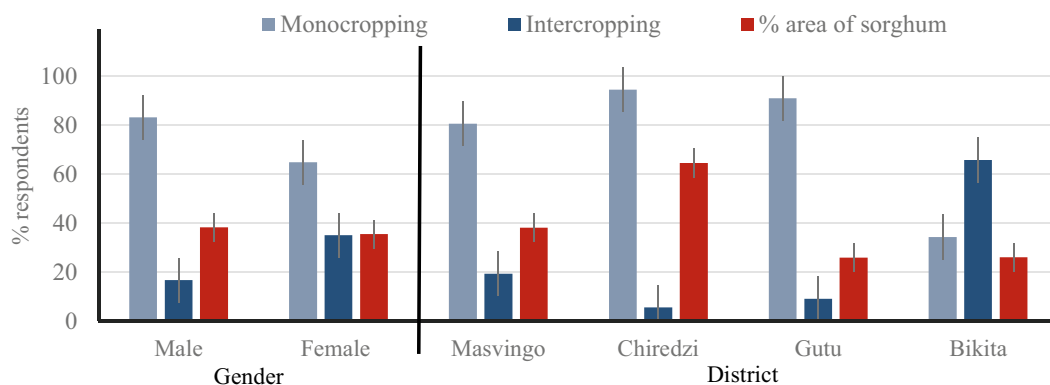


Fig. 22.2 Proportion of sorghum farmers practicing monocropping, intercropping and their proportion of land area allocated for sorghum production. *Sources* Authors

Table 22.3 Seven most important sorghum traits considered by farmers

Crop attribute	Bikita	Chiredzi	Gutu	Masvingo	Mean score	Rank
Grain yield	1.31 ^a	1.29	1.22	1.3	1.28	1
Drought tolerance	1	2.52	1.27	1.14	1.48	2
Nutrition/meal quality	1.06	2.44	1.64	1.56	1.68	3
Days to maturity	1.74	2.34	2.05	2	2.03	4
Bird tolerance	2.2	2.57	1.9	1.92	2.15	5
Striga resistance	2.97	1.96	2.57	2.39	2.47	6
Pest and disease tolerance	2.37	3.2	2.59	3.08	2.81	7

^a 1 = Most important, 2 = important, 3 = neutral, 4 = less important, and 5 = not important

Sources Authors

22.4.4 Farmers' Sources of Seed and Information

The results shows that the majority of the farmers (42%) grew retained seeds, while 26% received seeds from various government intervention programs such as command agriculture or presidential seed support schemes. Information from FGD revealed that households can receive seed ranging from one kg up to a maximum of 15 kg seed enough to cover three hectares. Research institutes also play an important role, being responsible for 16% of all sorghum seeds produced by farmers across the districts (Fig. 22.3). Research organizations such as ICRISAT, CIMMYT, and the Department of Research and Specialist Services (DRSS) play a critical role in seed distribution among farmers. Smaller contributions also came from NGOs (6%), which work on crop production programs

and seed houses where farmers buy directly in all the districts where the study was conducted. Farmers also acknowledged the contribution of the extension department in providing information regarding sorghum varieties and production, with a percentage score of 83.6% (Fig. 22.3). Farmers also shared information within their communities (29.5%), which was similar (28.8%) to that of farmers who reported receiving agronomic information from media (radio, television, and newspapers). The least considered sources of information were agro-dealers and research institutes.

22.4.5 Factors Hindering Sorghum Productivity in the Four Districts

Three-quarters of the farmers identified low-yielding varieties as the major factor hindering

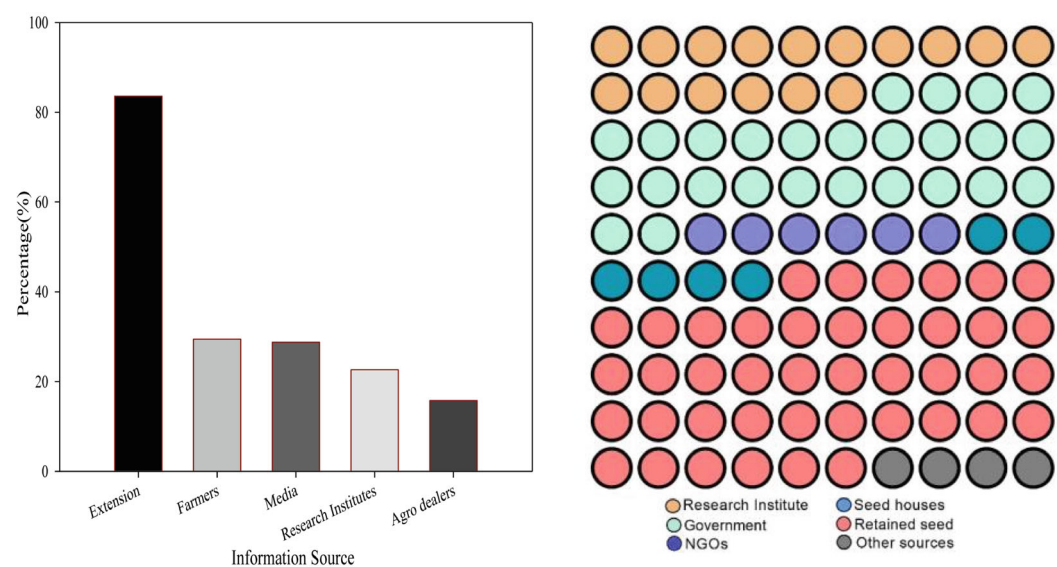


Fig. 22.3 Reported **a** Sources of agronomic information for farmers **b** Sources of seed for sorghum farmers in the districts. *Source* Authors

sorghum productivity in all districts. Almost all farmers rely on OPVs and landraces. In addition, the fact that farmers continuously recycle their seeds compromises the potential of these varieties to perform consistently across many seasons. The use of low-yielding varieties coupled with labor shortages and high input costs tends to limit the yield potential of these varieties. Drought was the second most limiting factor for sorghum production. The four districts are located in the drylands of Masvingo Province and receive rain below 500 mm per annum. Qualia birds and fall armyworm were also identified as the third most limiting factors for sorghum production, affecting two-thirds of the farmers across the four districts. Farmers mostly grow white sorghum for food which is also vulnerable to birds. The high cost of production inputs remains another major challenge in sorghum production. The cost of seeds, fertilizers, chemicals, and herbicides remains a thorn in their flesh, limiting productivity in about one-third of the farms interviewed. Most farmers rely on aid from the government through different schemes providing inputs, which are normally not reliable every season. Other lesser challenges identified were labor and marketing challenges (Fig. 22.4).

22.4.6 Mitigation Strategies by Farmers

Respondents in this study showed that they are well experienced with uncertainties and risks with regard to sorghum production and food shortages. Farmers have developed dynamic and evolving coping strategies such as conservation farming practices (35%), with early planting being practiced by 29.5% of farmers, while diversified farming was practiced by 27.4%. Conservation farming, confirmed through field observations, involves the use of mulch, minimum tillage, pot holes, and tied ridges in some instances. Diversified farming, which involves the integration of crops and livestock on farms, is a major safety net for food security. Almost all households interviewed had livestock, such as cows, goats, sheep, chicken, rabbits, or doves. These were major sources of income when crops fail to do well in a season. In addition, farmers grew sorghum with other crops such as finger millet, pearl millet, cotton, groundnuts, cowpeas, bambaranuts, pigeon pea, sesame, and watermelon, which provided a source of food when sorghum failed in the field. All of these crops were also used as intercrops or in rotations with

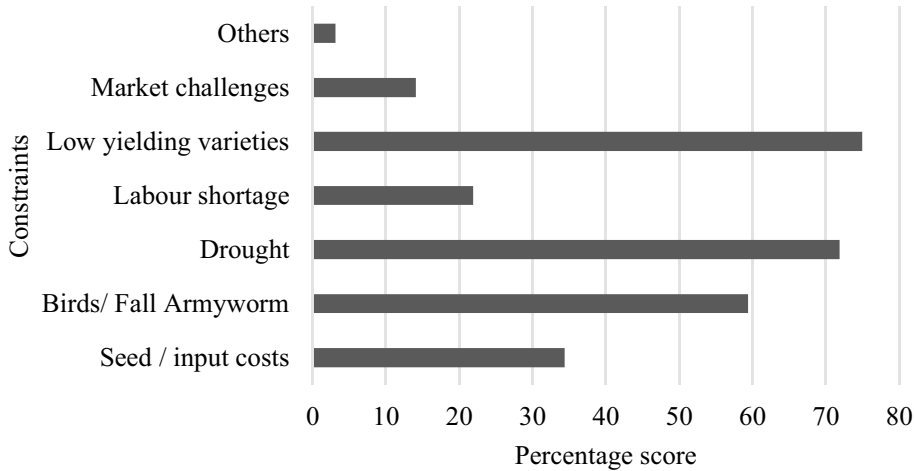


Fig. 22.4 Constraints to sorghum production in the four districts of Zimbabwe. *Source* Authors

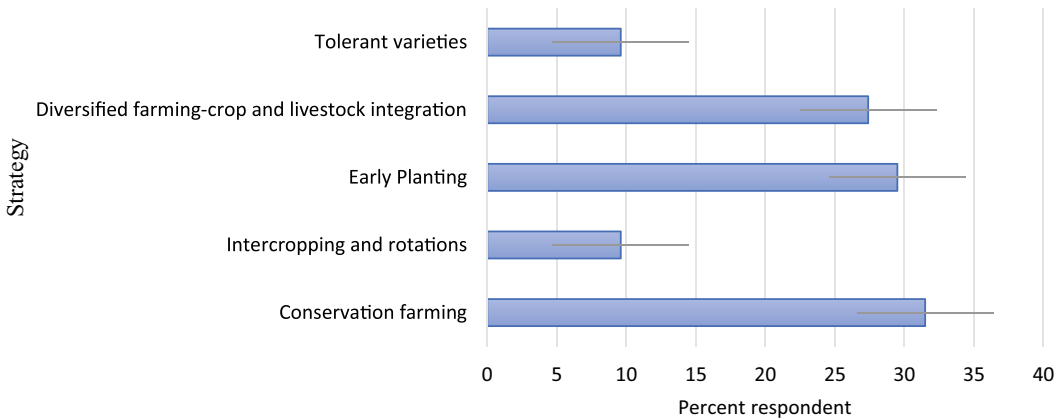


Fig. 22.5 Drought mitigation strategies by farmers in the four districts. *Source* Authors

sorghum at different intervals by approximately 9.6% of the respondents. The use of drought-tolerant varieties was less common in all districts, with only 9.6% of farmers identifying some varieties as drought-tolerant (Fig. 22.5).

22.5 Discussion

In this chapter, the focus was to gain insights into sorghum farmers' production practices, trait preferences, seed sources, challenges, and how they cope with such challenges within the broader context of food systems in Zimbabwe. Understanding these factors is crucial for strengthening the functionality of food systems particularly in

marginal areas where sorghum plays a crucial role in food and nutrition security, livelihoods and resilience to climate shocks. The perspectives and realities of farmers are foundational to guiding variety development and deployment strategies that not only respond to market needs but also align with the ecological, socio-economic, and cultural dimensions of local food systems.

The results reveal gendered patterns in varietal adoption, with men more likely to grow landraces and hybrids, while women predominantly cultivate open-pollinated varieties (OPVs). This disparity reflects underlying gendered access to productive resources such as land, capital, and information which are critical in accessing inputs like hybrid seed. As hybrids typically require

upfront investment and resource availability, men are structurally better positioned to adopt them. This observation underscores the need for gender-responsive breeding and food system interventions, including tailored credit schemes, inclusive extension services, and gender-sensitive varietal development that addresses both agronomic and socio-cultural traits valued by women (Ashby & Polar, 2019; Voss et al., 2021).

OPVs remain dominant in Masvingo, Gutu, and Bikita districts due to their adaptability, moderate input requirements, and integration of traits from diverse breeding efforts over time. This mirrors broader trends across many smallholder food systems, where farmers balance productivity with risk minimization and cultural utility (Mrema et al., 2017). The continued use of landraces, despite their lower yield potential, points to their role in maintaining agrobiodiversity and fulfilling socio-cultural and culinary roles in household food systems (Andiku et al., 2021). Such landraces provide valuable genetic material for future breeding, especially under climate stress. There is a compelling need to document, characterize, and integrate these landraces into breeding pipelines to enhance local adaptation and strengthen food system resilience (Andiku et al., 2021; Bantilan et al., 2004; Mrema et al., 2017).

The increased adoption of hybrids in Chiredzi is mainly a result of the intrusion of different companies that contract farmers with specific hybrids suitable for beer brewing. Chiredzi district has rich black fertile soils, which require less fertilizer to attain optimum yields. As hybrids require fertile soils, only farmers in Chiredzi can afford to grow hybrids without fertilizers, with no significant yield penalties (Deb et al., 2004; Mwamahonje et al., 2021). Therefore, the adoption of hybrids in districts with poor soils requires investments in soil nutrition, which is a challenge for most farmers. Complimentary efforts from breeders producing hybrids for limited soil nitrogen and government efforts to subsidize sorghum input packages will help improve hybrid adoption in other areas. Low adoption rates for improved sorghum varieties among farmers in other districts may be an indication that hybrid technology transfer was not sufficiently carried

out in other areas, in addition to farmers perceiving technology negatively. Hybrid seeds are generally more expensive than OPVs and landraces (Kante et al., 2017), which might have prompted farmers to resort to low-cost sorghum seeds for production. For improved food security, the need for enhanced adoption of high-yielding hybrids will improve food security.

Field observations showed greater crop diversity in fields where women were the household heads. Sorghum was grown in association with cowpeas, beans, pumpkins, watermelons, and cucumbers. This reflects the role of women in enhancing food and nutrition security, emphasizing their role as stewards of dietary diversity, within food systems (Andiku et al., 2021). Sorghum breeders need to develop varieties that can confer such advantages. Plant breeders need to develop intercropping-specific varieties by studying the benefits, trait correlation, variance components, and heritability of useful traits (Bourke et al., 2021; Moore et al., 2023).

Farmers in Chiredzi dedicated over half of their land to sorghum production, indicating the crop's strategic importance in local food systems under conditions unsuitable for maize and other staples. Chiredzi is located in the agro-ecological region 5, which favors the production of sorghum and other drought-tolerant crops and livestock rearing, with major limitations in growing other crops. Farmers in Chiredzi have realized the importance of sorghum as a food security crop. This study may draw more lessons from Chiredzi farmers as a hub for sorghum production than from other districts. The priorities of these farmers in varietal selection and breeding may need to be given careful attention to have a greater impact. In addition, expansion of area and productivity for sorghum in other districts can be built on knowledge transfer of the production model, agronomic practices, and structure of the value chain in the Chiredzi district.

Grain yield emerged as the most critical trait across all districts, reflecting sorghum's role in addressing food availability. While most farmers still produce sorghum primarily for household consumption, traits like drought tolerance, striga resistance, and early maturity were also highly valued. These traits reduce yield losses in the

face of climate and pest pressures, underscoring their relevance to food system stability (Batista et al., 2019; Mukondwa et al., 2021). More efforts need to be invested in breeding drought-tolerant sorghum lines. Striga tolerance is also considered to cause significant yield losses in major cereal crops in Zimbabwe (Gwatidzo et al., 2020; Ronald et al., 2016). This observation implies that breeding priorities targeting Chiredzi should incorporate drought and striga tolerance into high-yielding varieties to enhance their adoption. Early maturity is considered important in all districts. Early maturity varieties offer opportunities to escape yield-limiting factors, such as drought, striga, pests, and bird damage. Observations from this study concur with previous studies on trait preferences (Melesse et al., 2021; Mrema et al., 2017; Orr et al., 2016). However, integrating all preferred traits into a single variety is challenging, as these traits may come from various sources and may be tangent to each other (Chen & Ow, 2017; Moenizade et al., 2020). Having multiple seed options where a farmer can choose a variety with the most prioritized trait could be a starting point, while breeders are working on gene stacking to combine multiple genes into one variety.

The production of sorghum from the retained seeds was not surprising. Sorghum production in Zimbabwe is dominated by landraces and OPVs, which are recycled before new seeds are obtained. Similar observations have been made for various crops in many developing countries, where farmers save seeds from their harvest to plant. (Andiku et al., 2021; Ayenan et al., 2017; Melesse et al., 2021). The dominance of the informal seed system may be the root cause of insecure food systems. There is a need to strengthen seed systems in the country to improve the physical and genetic purity of seeds grown for improved productivity. Moreover, extension services emerged as a key source of information, confirming their centrality in knowledge transfer for improving productivity and innovation uptake (Musara et al., 2019) regarding sorghum varieties, production information, weather reports, and pest and disease identification, which are critical for improving production.

Several constraints limit farmers' sorghum production. The greatest constraint is the availability of low-yielding varieties in the market. The sorghum seed value chain is dominated by low-yielding landraces and OPVs, with limited hybrids that are unsuitable for all regions in the country. The production of low-yielding varieties coupled with labor shortages, unavailability of inputs, drought, pests, and diseases poses a further threat to sorghum productivity. Breeding programs in Zimbabwe need to focus on the production of high-yielding adapted sorghum hybrids with farmers' preferred traits (Mushoriwa, 2020). Several studies have evaluated the importance of hybrids in sorghum for adoption in arid and semi-arid regions of Africa (Makanda et al., 2011; Mindaye et al., 2016; Mukondwa et al., 2021). These constraints are symptomatic of systemic weaknesses within the food system, particularly in marginalized areas. Addressing these challenges will require coordinated action from breeding programs, policymakers, private seed companies, and farmer organizations. Efforts must focus on developing high-yielding, stress-resilient, and locally adapted hybrids that respond to farmers' preferences and production constraints.

Finally, the integration of crop and livestock systems in these dryland areas is a key feature of local food systems. Farmers grow dual-purpose sorghum varieties for both grain and stover to support livestock feed, a critical strategy for coping with climate-induced crop failures. Crop improvement initiatives should consider such multifunctionality by breeding sorghum varieties suited for food, feed, and intercropping. These innovations will enhance the overall sustainability and adaptability of food systems in drylands.

22.6 Conclusion

The chapter revealed different sorghum cropping systems across districts, showing variability in farmer characteristics, proportion allocated to sorghum, challenges faced, and preferred traits. High grain yield, drought tolerance, and good meal quality were cited as the most important

traits. These findings reaffirm the centrality of sorghum within local food systems—not only as a staple food but also as a key component of integrated crop-livestock systems, cultural practices, and gendered livelihoods. Strengthening these food systems will require aligning breeding priorities with farmers' realities by developing sorghum varieties that are high-yielding, climate-resilient, and tailored to diverse agro-ecologies and social contexts. Enhancing seed system infrastructure, expanding access to extension services, and integrating gender-responsive and nutrition-sensitive breeding approaches are critical steps toward more inclusive and sustainable sorghum-based food systems in Zimbabwe's drylands.

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Feasts, Foodways and Community Resilience: Recasting Communal Feasting as Food Security Intervention in Maseru Central, Lesotho

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23.1 Introduction

Food security continues to be a global challenge (Babu & Sanyal, 2009), including in Lesotho. The faces persistent challenges regarding access to a sufficient supply of safe and nutritious food, a prerequisite for healthy development and an active life. The World Food Programme (WFP) reports that 56% of Lesotho households cannot afford a nutritious diet, and 35% of the inhabitants are food insecure (WFP, 2025). Lesotho also faces a threefold burden of malnutrition (undernutrition, overnutrition and micronutrient deficit) (UNICEF Lesotho, 2025; WFP, 2025, 2019; Government of Lesotho, 2018). In 2025, the Integrated Food Security Phase Classification (IPC) projected that nearly 335,000 individuals (22% of the rural inhabitants) would be in IPC Phase 3 (Crisis), in comparison to 403,000 residents in May 2024. Such stark realities of hunger remain the quintessential image through which aid agencies, researchers and the media convey the scale of hunger in Lesotho. Indeed, the existential hope for Basotho *is* for the hunger to stop (Pepene, 2024).

In July 2024, an estimated 700,000 Basotho faced extreme hunger because of successive La Niña and El Niño phenomena from 2021 to 2023 (Selikoe, 2024). Between 2021 and 2023, La Niña events resulted in excessive rainfall and below-average crop production (International Federation of Red Cross & Red Crescent Societies, 2024). The 2023/2024 El Niño worsened the drought and heatwaves, leading to an estimated yield reduction of 60% in maize in 2024 (Food and Agriculture Organization (FAO), 2024). In response, the Prime Minister of Lesotho, Ntsokoane Samuel Matekane, declared a national food insecurity disaster from July 2024 to March 2025, and appealed for national, regional and international humanitarian intervention (Selikoe, 2024).

However, this was hardly unprecedented. In 2021 and 2022, former Prime Minister Moeketsi Majoro announced a national food security emergency (Lesotho Government Gazette Extraordinary, 2021, 2022). So did his predecessors, Prime Minister Motsoahae Thomas Thabane in 2012 and 2013 (Leduca et al., 2015) and Prime Minister Pakalitha Bethuel Mosisili in 2016 2007, 2004 and 2002 (Cable News Network, 2004; Kabi, 2016; Reliefweb, 2007). However, humanitarian assistance is merely a stopgap. According to food security experts, food security must be addressed at the macro, meso and micro levels (Babu & Sanyal, 2009). For example, Runge et al. (2003) advocate for markets and infrastructure that ensure that food is both available and affordable, while Yusriadi et al. (2024)

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recommend strong institutions that incorporate gender-responsive designs, nutrition training and strategies to influence social behaviour into food security strategies. Lesotho requires macro-level policies regulating meso-level markets, infrastructure and institutions, thereby facilitating the micro-level components (e.g., individuals, households and communities) to attain food security. For example, Molapo (2009) suggests that development agencies, such as the WFP, should avoid encouraging passive acceptance of food aid. Instead, they should focus on sustainable, bottom-up development that empowers recipients rather than fostering dependency through safety nets.

A few pressing questions emerge regarding food insecurity in Lesotho: ‘What do Basotho eat in the wake of food shortages?’ and ‘How are poor households coping with hunger in such dire conditions?’ Existing research provides some insights. For instance, previous studies have shown that household nutritional diversity in Lesotho is generally low due to the limited availability of fresh fruits and vegetables and low consumption of animal-source foods (Nkoko et al., 2024c, 2024a, 2024b, 2025; Molapo, 2023; WFP, 2019). Molapo (2023) found that cereals and *moroho* were consumed in over 95% of rural and urban households for daily meals, but consumption of fruits, vegetables and meat was minimal. This supports WFP’s (2019) findings that agriculture in Lesotho is cereal-focused; that livestock is more of an asset than a food source; that fruit and vegetable consumption is far below the WHO’s recommended 400 g per day; and that 80% of dietary energy comes from energy-dense foods.

To cope with hunger, households adopt various strategies, including adjusting spending, eating fewer meals, seeking family assistance, selling livestock and undertaking casual work (Molapo, 2009). Non-farming households also source food from local shops and fast-food outlets, trade, sell wild vegetables or borrow food (Leduka et al., 2015). While these studies document dietary patterns and sourcing strategies, they overlook one key element: feasting. Anthropological literature suggests feasting is a significant yet underexplored cultural strategy. Wentworth (2016, p. 139)

defines feasting as ‘the communal consumption of large quantities of food, indulgence in calorie-rich foods or both’. Like other cultures, the Basotho commemorate special events with shared, elaborate meals (Hayden, 2001, 2016; Nahum-Claude, 2016). However, feasting’s role in hunger relief and food security remains unexamined mainly (e.g., Wentworth, 2016; Wentworth-Fournier, 2007). For instance, Leduka et al. (2015) observed that individuals attended funerals and feasts for food, but this insight was not pursued, as their research focused on urban agriculture. This chapter addresses such gaps by exploring how feasting is a coping mechanism against hunger in Maseru. The chapter gathers narratives from residents in diverse socio-economic conditions, revealing lived experiences of hunger and emerging cultural responses.

Maxwell and Caldwell (2008) identify four coping mechanisms for food insecurity: (a) altering diets to cheaper foods, (b) accessing food through unsustainable means such as credit or wild foods, (c) rationing meals and (d) reducing the number of household food consumers. While the first three strategies are widely reported in sub-Saharan Africa (SSA) (Mazenda & Mushayanyama, 2024; Miliato et al., 2021; Molapo, 2009), the fourth is rare. Only Wentworth (2016) observed it, where children in Vanuatu attended communal feasts to supplement household food shortages. Secondly, although hunger and food insecurity are well-documented in Lesotho (e.g., IFRC, 2024; Rothman et al., 2023; James, 2020), most studies emphasise agriculture, climate or economics. Few delve into the lived experiences of the hungry. This chapter seeks to amplify these voices, acknowledging them as both victims and agents navigating structural poverty. It conceptualises foodways as the cultural life of food (Darnton, 2012; Long, 2001) and portrays feasting as a mechanism through which food is acquired, consumed and shared, thereby enhancing the resilience of communities in Lesotho in the face of persistent food insecurity. This chapter also contributes to the Sociology of Food in Lesotho and beyond, offering insights into the intersections of food access, community and inequality.

Theoretically, this chapter draws from food justice and community studies. As Murray et al. (2023) describe, food justice involves systemic reform that supports food security, sustainability and agency. Community studies, meanwhile, illuminate how instrumental and reciprocal relationships among members help them cope with adversity. This chapter links these frameworks by examining how feasts act as buffers against hunger in rural and urban Maseru. The chapter also addresses multiple gaps in food security research in Lesotho. It moves beyond quantitative data to explore hunger from an emic perspective—through the eyes of those experiencing it. It expands beyond typical agricultural narratives to investigate unconventional survival strategies like feasting. It also examines social dynamics, aligning with Battersby (2012) and Molapo (2023), who stress that feasting is central yet overlooked in food policy and academic discourse. The chapter argues that feasting is a social or cultural event and a critical coping mechanism.

Furthermore, this chapter examines the connection between Ubuntu and social capital and their roles in hunger alleviation. These philosophical and relational frameworks have not been explicitly tied to food security in Lesotho. Finally, although traditional coping strategies are well-researched, feasting as a deliberate strategy remains underexplored. This chapter seeks to fill this gap. Therefore, this investigation's primary research question is: How does communal feasting function as a food security intervention in Maseru Central, Lesotho?

23.2 Literature Review

Hunger, malnutrition and famine have persisted as enduring challenges throughout history (McIntosh, 1995, p. 36). According to Onyeaka (2024), every individual has the right to access food and produce, be free from food insecurity and participate in the governance of nutrition systems. Nevertheless, hunger remains a widespread global concern (Scanlan, 2018). As of

2024, an estimated 733 million individuals experienced hunger, equal to one in five people in Africa, while 2.33 billion people were affected by food insecurity (World Health Organisation (WHO), 2025; Payne, 2024). Projections suggest that by 2030, over 582 million individuals—primarily in Africa—will suffer from chronic undernourishment, a figure comparable to 2015 levels despite international commitments to eradicate hunger by 2030 (WHO, 2025; United Nations, 2025). The 'Zero Hunger' Sustainable Development Goal may not be realised until approximately 2160 (Wiemers et al., 2024). Paradoxically, although global food production is sufficient to supply around 2,700 kilocalories per person per day, there is no effective global mechanism to distribute food solely based on need (Runge et al., 2003).

DeRose and Millman (1998) define hunger predominantly because of protein-energy malnutrition (PEM)—a combined deficiency of protein and calories, which remains the most prevalent form of hunger worldwide. They further identify three critical micronutrient deficiencies (iron, iodine and vitamin A) that present major public health challenges because of their widespread impact on large populations' corporal and cognitive functioning (DeRose & Millman, 1998). Individuals suffering from hunger often exhibit reduced productivity and limited capacity to undertake daily activities. Importantly, hunger should not be viewed as a uniform experience; while some endure chronic deprivation, others face episodic or transitory hunger (Runge et al., 2003). In countries south of the Sahara Desert, hunger is influenced by a complex interplay of structural and proximate factors, including climate change, entrenched economic deprivation, swift demographic expansion, low economic advancement, poor infrastructure and continual conflict (Fonge, 1997). DeRose and Millman (1998) argue, hunger emerges from the intersection of 'underlying causes' such as demographic and environmental instability and 'immediate causes' such as warfare and natural disasters. These dynamics result in acute 'hunger situations', exemplified by regional food shortages, household poverty and individual deprivation, which lead to adverse 'direct consequences',

including economic deterioration and physiological effects such as wasting and stunting. For instance, in 2024, of the 163 million Africans suffering from acute food insecurity, roughly 130 million (approximately 80%) lived in conflict-affected countries, where national and local coping capacities have been severely eroded (Africa Centre for Strategic Studies, 2024).

The literature also shows that three main analytical perspectives dominate discourse on hunger: the objective, the subjective and the emic. Objectivist approaches employ quantifiable indicators such as the Global Hunger Index (GHI), measuring stunting, wasting and undernourishment (Montero et al., 2025). Subjectivist views, by contrast, focus on moral imperatives and normative commitments to eliminating hunger (Dev et al., 2024). Emic approaches, however, foreground the embodied experience of food insecurity from the perspective of those directly affected (Roeloffs, 2025). This chapter adopts the emic stance, contending to provide a more nuanced and grounded understanding by privileging insider accounts over externally imposed definitions. As McIntosh (1995, p. 54) observes, ‘the adequacy of emic analysis is its ability to generate statements the native accepts as real, meaningful and appropriate.’ Without such experiential narratives, any comprehensive understanding of hunger remains incomplete.

The food security literature widely recognises four interrelated pillars: (1) availability—the volume of food produced; (2) access—the ability of households to obtain adequate, nutritious food; (3) utilisation—how food is stored, prepared and consumed to meet dietary needs; and (4) stability—the reliability of the other three dimensions over time (Tembo et al., 2024; Otto et al., 2021; Powledge, 2010). Agriculture production typically shapes availability, while access depends on economic capacity. Utilisation encompasses food preparation and consumption practices and stability refers to the consistency and resilience of food systems across time. Empirical studies in Lesotho largely align with this framework. Nkoko et al. (2024c, 2024a, 2024b), for instance, assessed 236 smallholder farmer households across four agroecological zones using the Household Food

Insecurity Access Scale (HFIAS) and the Household Dietary Diversity Score (HDDS). Their findings revealed that 40% of households had reliable access to adequate food, 32% were moderately food insecure, 18% mildly food insecure and 10% severely affected by food insecurity. Notably, 97% reported consuming six to twelve food groups, a diversity attributed mainly to their agricultural output. Commercial farming households also reported higher incomes and improved access to diverse foods. Similarly, Rothman et al. (2023) found that urban women in Lesotho consumed a wider variety of protein-rich foods, including eggs, chicken and full-cream milk, compared to rural women and were inclined to eat processed foods such as sausages, polony, mayonnaise, margarine and sugary beverages. Matarira et al. (2014) studied 40 households in mountainous areas and concluded that reduced crop yields due to climate change increased dependence on state and kinship support. Molapo (2009) reported that 53% of households in the southern lowlands lacked cereal reserves from the previous harvest, placing them at greater risk of food insecurity. Coping strategies included reducing meals, altering household expenditure, engaging in irregular work and relying on livestock sales and kin networks.

Meanwhile, Crush et al. (2017) reported that most impoverished households in Maseru did not rely on urban agriculture but purchased food from informal shops and supermarkets. Alarmingly, 63% of these households had a dietary intake comprising fewer than four food groups the previous day. Molapo’s (2023) more recent study of 440 households in Lesotho found higher food insecurity and food wastage in rural areas, while urban areas had greater variability in diet and preservation of food. Consistent with Nkoko et al. (2024c, 2024a, 2024b), Molapo observed that dietary diversity showed promising trends even amid high food insecurity.

While these studies underscore the importance of agricultural practices on food security and reducing chronic hunger, they provide limited insight into how food-insecure communities in urban settings navigate hunger in

contexts where formal food systems are inadequate. Notably, Leduka et al. (2015) identified that many urban dwellers in Maseru accessed food by attending communal events such as funerals and feasts where meals were served freely. This phenomenon of attending social events as a food-seeking strategy warrants further exploration. While Leduka et al. (2015) gesture towards ‘food as social participation’, their treatment is cursory. It fails to fully engage with the socio-cultural dimensions of food and eating (Germov & Williams, 2008). Thus, much of the food security literature in Lesotho overlooks this social dimension, focusing instead on agricultural productivity, climate shocks and economic indicators. Where social factors are considered, they are often limited to land use and farming cooperatives (e.g., Rantso & Seboka, 2019; Turner, 2009). A critical gap remains in understanding how communities actively respond to food insecurity, particularly since 33.9% of the Basotho population lives below the international poverty line of US\$2.15 per day (World Bank, 2023). This chapter posits that a more profound understanding lies in the ethic of *humanism* embedded in the social fabric of Lesotho. As Ndhlovu (2024) urges, it is imperative to reconsider the relevance of Ubuntu in addressing hunger and food insecurity. Drawing from moral economy frameworks, this chapter integrates the principles of Ubuntu philosophy with social capital theory to offer new insights into how marginalised households negotiate hunger through culturally embedded mechanisms of solidarity and reciprocity.

23.3 Methodology

This chapter employed a phenomenological research design as it centres on interpreting the meaning of lived experience and seeks to understand social phenomena from the perspective of individuals (McLeod, 2024). This approach facilitated an in-depth exploration of feasting as a culturally embedded food security strategy and offered insight into participants’ motivations for attending such events. It enabled a critical interrogation of the often taken-for-granted

assumptions and conventional understandings surrounding feasting practices in Maseru Central, Lesotho. The study site was Maseru, the capital city of Lesotho, located in the eastern part of the country. The study focused on three communities within Maseru Central: Ha Thetsane, Ha Matala and Ha Thamae. Within this context, the participants were residents of the three study sites. Participants were all above the age of 18.

Based on data saturation, eight in-depth interviews were conducted using a semi-structured interview guide. Fieldwork was conducted in Maseru Central, Lesotho, across three culturally significant feasts the researcher attended: a wedding, a cleansing ceremony and a funeral. These events were selected as they represent varied but representative settings where communal food sharing occurs. Participants were selected using purposive sampling due to their first-hand experience of the events of interest (Palinkas et al., 2015), ensuring that the data represented rich, relevant and diverse accounts of feasting experiences. Eight individuals (both male and female) who had attended communal feasts were invited to participate. As they shared their stories, the author learned more about ceremonies, a phenomenon not generally associated with enhancing food security and providing healthy diets in Lesotho. The time spent with participants also made the author realise that telling these stories was a way for them to air their views and reflect on their lives. Participants belonged to low-income and high-income households and were recruited at feasts. Interviews were conducted at each participant’s home within a few days of attending a feast in February and March 2025 by the author.

The data was analysed using a structured, six-step process to ensure a rigorous and meaningful explanation of the data as outlined by Naeem et al. (2023). The process began with transcribing and translating the data, identifying preliminary patterns and selecting illustrative quotations that reflected diverse perspectives relevant to the study questions. The next step was to identify keywords that encapsulated participants’ feasting experiences. Third, data segments

Table 23.1 Data analysis (Communal Feasting and Food Security)

Key theme	Subthemes	Description
Communal feasting as a food security response	1. Communal Feasts as a Direct Food Security Intervention	– Anticipation and urgency around food – Access to quality food – Socio-economic symbolism of meals – Hosts' hospitality practices – Dietary preferences by income level – Visible hunger and need
	2. Social Resilience and Support Networks	– Anticipation of future feasts – Informal communal calendar – WhatsApp and word-of-mouth communication – Reinforcement of social bonds
	3. Social Stratification and Negotiation of Access	– Hierarchical guest treatment – Gatekeeping by invitation and locality – Visual status indicators (dress) – Discrimination vs Inclusivity – Food takeaways and restrictions
	4. Health and Well-being Benefits	– Mood enhancement – Mitigation of food-related shame – Importance for chronically ill individuals – Perceived immune and digestive benefits
	5. Paradoxical Nature of Access and Value	– Access to luxury foods – Economic reliance on feasts – Cultural vs economic value – Desire for rare or non-traditional foods

were coded using concise labels that captured their essential meaning. This was followed by grouping related codes into broader thematic categories that reflected patterned meanings within the data and provided a conceptual bridge between participants' accounts and the study's objectives. The fifth step was interpreting emergent keywords, codes and themes to develop key concepts. Lastly, the findings were synthesised into a coherent whole that answered the study question. Table 23.1 summarises the findings.

The study has a few methodological shortcomings. First, its cross-sectional nature only allowed for the identification of short-term associations and not long-term causal links. Fortunately, the study design enabled participants to reflect and accurately recall and describe their experiences of attending feasts. Second, the small sample used meant that the findings may not be generalised. However, to deal with these limitations, the author spent as much time as possible engaging participants.

23.4 Findings

This chapter aimed to investigate how communal feasting operated as a culturally-embedded strategy for mitigating food insecurity in Maseru Central, Lesotho. The overarching theme, '*Communal Feasting as a Food Security Response*', encapsulates feasts' central role in offering nutritional support and social cohesion for food-insecure populations. The findings are organised into five interrelated thematic categories: (a) communal feasts as a direct food security intervention, (b) social resilience and support networks, (c) social stratification and negotiation of access, (d) health and well-being benefits and (e) the paradoxical nature of access and value. Collectively, these themes illustrate participants' recognition of hunger as a chronic and socially embedded condition, with personal experiences of food insecurity shaping both their engagement with and interpretation of communal feasting practices.

First, the subtheme ‘Communal Feasts as A Direct Food Security Intervention’ showed that feasts were more than cultural events, but were proactive responses to food insecurity and poverty, offering temporary but meaningful relief. The urgency and anticipation around mealtime at these events underscored their value. One participant mentioned that ‘*When it’s time to eat, we are already in a hurry. We know the food is going to be good*’ (Participant 8, LIH.¹). Most attendees expressed that they expected the food served at feasts to differ from their regular meals, ‘*I am tired of papa* (stiff maize cereal) *and moroho. We come to eat something different*’. A key draw was the availability of high-quality food, particularly meat, which was nutritionally prized and socially desirable. One participant noted, ‘*We come for the meat...everybody loves meat. That’s feasting food*’ (Participant 8, Female, LIH). Feasts were also perceived as a reflection of the host’s financial status. Serving red meat and vegetables signified affluence, while starch and white meat were considered modest and associated with limited resources. One participant explained that:

The food served at a feast depends on what the feast is about and what the family can afford. In some funerals, for example, they serve samp and chicken. We know that the family did not have enough money. When they serve beef and lamb, we know they have money. So, things like potatoes, pumpkin, beetroot, carrots and peas depend on whether you can afford them. However, I have never been to a feast where they only served samp. There must be meat (Participant 5, Male, LIH).

Hosts who served generous portions and adhered to timely service were praised. In contrast, those who provided minimal food or caused long delays were criticised as lacking in hospitality: ‘*You never forget that you ate a little or a lot at someone’s ceremony*’ (Participant 5, Male, Maseru, LIH). Although participants acknowledged that feasts granted access to nutrient-rich meals, dietary choices often aligned with socioeconomic status. Higher-income guests typically favoured protein and fibre-rich meals, ‘*I never eat starch. Just veggies and protein*’ (Participant

6, Female, HIH²), while those from low-income households preferred protein and carbohydrate-rich food in their meals, ‘*I like to eat samp and met. Can you imagine me eating rabbit food?*’ (Participant 1, Male, LIH). Importantly, feasts also served a critical function in addressing hunger. Attendees described scenes of urgency and high demand for food at feasts,

When it’s time for food, that’s when you’ll realise people are hungry. They just pour in... like a whistle was blown. All kinds, men, women, young men, girls...and old people. Sometimes your heart breaks when you see mothers feeding meat broth to babies. You realise that maybe this is all they can give (Participant 2, Female, HIH).

Consequently, feasts that offered abundant food were regarded favourably, regardless of the specific occasion. As one participant noted, ‘*It is in our nature as Basotho to share food*’. *Lijo ke litšila tsa meno*³ (Participant 4, Male, HIH). The subtheme ‘Social Resilience and Support Networks’ highlighted this and showed that feasts fostered strong social support systems within communities. The data revealed that, irrespective of geographic location, food-insecure individuals actively sought information about upcoming feasts to anticipate access to food. One participant noted, ‘*When we leave a feast, we already know when the next one is going to be*’ (Participant 8, Female, LIH). In addition, the findings highlighted the existence of an informal communal calendar through which upcoming events were announced and disseminated. Communication occurred digitally, via platforms such as WhatsApp and through direct verbal exchange within the community. As explained by one participant,

It is no miracle that we know where a feast is. We tell each other. There is also a WhatsApp group for that. That is how they communicate about it. If you don’t have a phone or data, you ask. You make it your business to know (Participant 8, Female, LIH).

This proactive behaviour was supported by informal yet robust community networks comprising neighbours, acquaintances and family

¹Low-income household.

²High Income Household.

³Food always ends up as waste material. It must be shared, not hoarded.

members, which played a crucial role in information-sharing and reducing feelings of alienation and social exclusion. One participant described this community dynamic:

We know everybody. Whenever someone has a feast, we tell each other. We tell our wives and children. 'Hey, on Saturday, so-and-so is celebrating this and that.' The news spread fast. That is the place to be. Come Saturday morning, we are there without fail. There will be food and traditional beer there. That's what we want (Participant 7, Male, LIH).

Thus, community-driven communication systems not only facilitated access to food but also reinforced social cohesion and mutual support among individuals facing economic vulnerability. However, the subtheme 'Social Stratification and Negotiation of Access' pointed to nuanced dynamics of both social hierarchy and inclusive/exclusive practices at communal feasts. A clear differentiation was observed in how guests were treated, often determined by social status and the nature of relations with the host. Special guests and close neighbours, particularly those with an established rapport with the host, received preferential treatment, as they were anticipated and specifically catered for. In contrast, uninvited attendees (locals and non-locals) were viewed as gatecrashers. However, by community membership, locals were treated more favourably than non-locals, who were often regarded as outsiders. As one participant recounted, '*They will tell you, 'Hey! Don't come here and finish our food'*' (Participant 3, Female, LIH).

These practices pointed to underlying social inequalities embedded even within communal and ceremonial settings. Access to food and quality of service were also influenced by visual markers of status, such as dress and physical appearance. Those perceived to be of lower status or poorly dressed were sometimes denied equal access. One participant described this discrimination, '*If you're dressed poorly, they will remove you from the line. 'Go and eat in the back. You go there, or you leave.' They don't care!*' (Participant 3, Female, LIH). Nonetheless, the findings also indicated that feasts could act as social levellers, offering opportunities for those in need to partake

in communal meals without stigma: '*Everybody can go and eat. We are all the same*' (Participant 6, Female, HIH).

Additionally, attendees were generally permitted to take food home to share with household members who could not attend, such as children, the elderly, the ill or the disabled. However, in some cases, proof was required before food could be taken away, to prevent exploitation of this practice: '*Otherwise, people would steal food and additional helpings, and we would have nothing to eat*' (Participant 7, Male, LIH). Ultimately, while the data underscored the presence of social stratification at feasts, it also highlighted how these gatherings functioned as mechanisms for reducing social exclusion, supporting dignity and fostering a shared sense of belonging among the food-insecure. As reflected by one participant, '*Everybody can go and eat. We are all the same*' (Participant 2, Female, HIH). The subtheme '*Health and Well-Being Benefits*' showed that feasts were perceived to contribute positively to participants' overall health and well-being beyond the immediate alleviation of hunger. Attendees frequently reported improvements in mood and physical condition following communal feasts. One participant stated, '*When you come to a feast, your mood improves*' (Participant 1, Male, LIH).

The communal aspect of feasting was also shown to alleviate food insecurity-related shame and depression, improving mood and reducing stress associated with food access, thus highlighting the importance of social capital for mental well-being. Feasts were also significant for individuals living with chronic health conditions such as HIV, hypertension and diabetes mellitus. These individuals preferred to attend feasts to ensure they could eat before taking medication, as reflected in the remark, '*You have to eat before drinking antiretroviral pills*' (Participant 3, Female, LIH). This underscores the dual function of feasts in supporting nutritional and medical needs. Moreover, access to diverse foods at these events was associated with perceived immune-boosting effects and general health improvements. Several participants also reported experiencing fewer symptoms of common health issues after

eating at feasts. One participant remarked, *‘Whenever I eat at a feast, I feel full. My acid reflux and ulcers don’t bother me as much’* (Participant 7, Male, LIH). These perceived health benefits and the benefit of interacting with others at the ceremony served as strong motivators for continued attendance at feasts.

Lastly, the subtheme ‘Paradoxical Nature of Access and Value’ highlights that feasts provide free food to attendees and represent a significant financial burden for hosts. One participant observed, *‘A cow can cost over M8,000, and funeral covers or family contributions usually cover this expense; if not, help is sought or the deceased is quietly buried’* (Participant 3, Female, LIH). Access to feasts was found to be governed by unspoken social norms and expectations, which served as gatekeeping mechanisms. Whereas invitations and social status often determine entry, attendance merely requires knowledge of social etiquette. Ritual practices before feasts, such as prayers, while customary, also highlighted issues of social legitimacy. Not every attendee had a specific role in the feast. Typically, hosts decide on who may lead rituals, especially as new customs like video recording bring attention to these roles: *‘You must look like you make sense to pray at someone’s feast. They don’t want to watch the video later and say, ‘But who was this person? Who let him pray?’* (Participant 4, Male, HIH). Gender roles were also evident in feast dynamics; women primarily handled preparation and facilitation, while men took leadership roles during the event. Women could express social sanction by withdrawing support from a family accused of wrongdoing. However, attendance at feasts was always widespread, including by outsiders. Food waste was rare: *‘Sometimes women punish a family... But even if they never come to cook, they will come to eat. Everybody comes to eat... Food is never wasted’* (Participant 5, Male, LIH).

Economically, feasts were seen as offering access to luxury and rare foods such as lamb and fruit, which many participants could not afford otherwise. This made feasts both culturally significant and economically important, providing nutritional diversity and access to exotic foods across socio-economic lines. One participant said,

‘I cannot afford to pay M120.00 for a kilogram of lamb. I eat it at feasts’ (Participant 3, Female, LIH). Another expressed enjoyment of rare foods: *‘I love the fruit salads and finger foods. I am happy whenever they serve them’* (Participant 1, Male, LIH). Consequently, feasts were central to the community’s social and food security landscapes.

23.5 Discussion

The findings supported the view that feasting occupied a unique position at the intersection of nutrition, culture and social structure, supporting bodily nourishment and communal belonging (Germov & Williams, 2008, p. 131). First, communal feasts were not just social events but active, culturally embedded responses to food insecurity that provided temporary yet meaningful nutritional relief and diverse diets, particularly for low-income individuals. The study demonstrated that food was a fundamental component of social gatherings, with red meat holding distinct symbolic and practical significance. The serving of red meat bore cultural and ceremonial importance, serving as a key motivator for attendance at feasts and reflecting widespread desires for enjoyable and nutritious meals (Seleshem et al., 2014; Ederer & Leroy, 2023; Choi & Lee, 2022). Its inclusion was considered essential for a varied diet and aligned with the nutritional guidelines set by the World Health Organisation (2023). Beyond its dietary role, food at feasts conveyed important social meanings: in line with Hornby and Hull (2022), the actions of hosts who offered diverse and meat-inclusive meals were perceived as morally good, while ample portions and timely service embodied Basotho values of generosity and proper social conduct. These findings substantiated Schubert’s (2018) claim that food operated not only as nourishment but also as a symbolic means of expressing and reinforcing social status. The observed demographic characteristics of guests at communal feasts in Maseru Central also served as an indicator of community hunger, particularly among

vulnerable groups such as mothers and children. This finding is consistent with the Government of Lesotho's (2019) documented stance on widespread chronic food and nutrition insecurity among children under five years. It also confirms Leseba, Vermaak and Makatjane's (2025) study, which elucidated that children from rural areas were less likely to be fed the minimum acceptable diet (MAD), while those from affluent households, and with mothers who had post-secondary education and media exposure, demonstrated a greater propensity to be fed the MAD.

Feasts were shown to be more than a practice of abundance; they were vital social strategies in times of scarcity, mitigating hunger through communal sharing. They also functioned as part of reciprocal obligations, which were crucial in scarcity (Hayden, 2001, p. 31). This confirmed that robust social networks with high levels of cohesion protect against hunger and poor nutrition and serve as safeguards by providing informational support that could provide access to food (Miller et al., 2024). It also showed that feasts embodied social resilience and support networks with a protective function and manifested strong social support systems within communities. Participating in feasts satiated social appetites and reinforced mutual aid. They also reduced alienation and isolation, confirming that opportunities for supporting and enhancing food security in Maseru Central were integrated into households' everyday lives (Mahamo, 2020). The findings demonstrated the interplay between foodways and socio-cultural norms by illustrating how cultural expectations and social etiquette regulate food consumption.

Additionally, the study revealed the 'hidden cost' of participation, referring to the unspoken norms and obligations placed on attendees, thereby underscoring the complex social contract that underpins these ostensibly gratuitous meals. The findings also highlighted the practice of taking food home for vulnerable family members (children, elderly, sick, disabled), further illustrating the inclusive, albeit regulated, nature of these foodways. This showed that feasting created a public space for negotiation and participation

(Guyer, 1992, p. 63). In the context of persistent hunger and food insecurity, it functioned as a 'strategy for survival, allowing individuals access to food otherwise unavailable and reinforcing social ties essential for mutual support' (Germov & Williams, 2008, pp. 136–137).

The study also highlighted social stratification and inclusivity/exclusion in communal feasts. Despite the overarching theme of sharing, the study identified a straightforward hierarchical arrangement of guests (invited, uninvited locals, uninvited non-locals), with differential treatment based on social status, income and community ties. Dress code and perceived social standing also influenced access and service at feasts, pointing to existing social inequalities. However, the study noted a prevailing sentiment that 'everybody can go and eat,' suggesting a lack of stigma for those seeking food, which fosters an environment conducive to addressing food insecurity. This points to a nuanced dynamic of hierarchy and fundamental inclusivity, confirming that feasts were a powerful means of expressing social identities, reinforcing social bonds and negotiating and reaffirming social hierarchies (Germov & Williams, 2008, p. 131). Feasting was also shown to alleviate food insecurity-related shame and depression, improving mood and reducing stress associated with food access, thus highlighting the importance of social capital for mental well-being. Lastly, the study showed the paradoxical nature of access and the value of feasts. While guests ate for free, feasts imposed significant costs on hosts, confirming that ceremonies burden host families (Case et al., 2008; Hornby & Hull, 2022).

In line with Hayden (2001), access to feasts was conditional on social capital. Although anyone could attend, social status, gender, invitations and knowledge of etiquette served as gatekeeping mechanisms. Rituals, while customary, increasingly reflected social legitimacy and evolving social norms. Although women mainly prepared feasts, men led feasting events. Feasts also provided crucial access to luxury foods unaffordable for many, crossing socio-economic boundaries and supporting nutritional diversity. Thus, feasts were vital for social cohesion, cultural identity and food security (Lewis, 2015; Molapo,

2023; Wentworth, 2016), pointing to the non-monetary values and social capital exchanged in these events (Fleisher, 2010; Hayden, 2001). Overall, feasting was found to be a coping mechanism for food insecurity. The data confirmed that it was more than mere celebrations of abundance, but a strategic act of mutual support that sustained social cohesion in times of crisis (Dirks, 1980, p. 31). In this way, feasts functioned as critical social institutions; they redistributed food and reaffirmed social ties, enabling communities to cope collectively with famine conditions (Dirks, 1980, p. 30). Feasting also transcends food consumption; it is a social insurance strategy (Halstead, 1987, p. 83) that enables individuals to maintain dignity, affirm social bonds and preserve identity in chronic deprivation (Molapo, 2023, p. 68).

23.6 Conclusion

Previous research in Lesotho suggested that feasting functioned as a vital—albeit frequently overlooked—survival strategy for food-insecure households (Leduka et al., 2015; Molapo, 2023). This research sought to affirm the understated part played by communal feasting in mitigating food insecurity by offering a fresh perspective on how communities constructed social resilience under conditions of scarcity. The findings revealed that communal feasting in Maseru Central was a complex and multi-layered practice, functioning as a practical mechanism for food security and a key social institution. It reinforced communal bonds, shaped local foodways and contributed to the holistic well-being of its participants. While the daily struggle for food remained a persistent challenge, feasting emerged as a meaningful, if temporary, response to urban food poverty in Lesotho. This confirmed the protective role of communal feasts and illustrated how robust social support systems yielded improved health outcomes among community members. The intersection of food and society demonstrated that, despite individual preferences,

people shared a collective social appetite, underscoring the intricate relationship between societal structures and individual agency. In this context, food transcended its nutritional function to become a powerful social resource through which communities fostered resilience and navigated the enduring challenge of food insecurity. A key insight emerging from this research was the paradoxical nature of communal feasting. However, food was offered freely; it posed severe financial burdens on hosts and entailed unspoken social obligations and norms of participation. This nuanced understanding of how communities secured access to food for their most vulnerable members contributed meaningfully to the broader literature on foodways in Lesotho. It offered practical implications for future food security interventions.

The study highlights that while communal feasting offers a valuable coping mechanism for food insecurity, it does not focus on the fundamental systemic issues leading to chronic hunger. Therefore, it is recommended that future research specifically focus on the following areas:

- *Assessing Nutritional Value:* Future studies should evaluate the nutritional content and the overall dietary contribution of the food consumed during community feasts. This would involve analysing the types of food offered and their nutritional composition.
- *Quantifying Food Access:* Research needs to study precisely the amounts and types of food that food-insecure individuals consume at these communal events. This would provide concrete data on the tangible benefits of feasting.
- *Comparing with Household Consumption:* It is crucial to compare the food access obtained at feasts with individuals' regular household food consumption. This comparative analysis would offer a deeper understanding of the nutritional and social significance of feasting and its precise role within the broader food security landscape of Lesotho and other similar regions.

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Part V

Conclusions and Policy Recommendations

Conclusion: African Governments' Policies and Interventions for Regional Agriculture and Food System Transformation

24

Emmanuel Ndhlovu 

24.1 Introduction

This chapter concludes the book *Agriculture and Sustainable Development in Africa: Resilience and Recovery Toward Sustainable Futures*. The book shows that African agriculture and food systems, particularly in Sub-Saharan Africa (SSA), are in crisis. They are facing substantial challenges, including the impacts of climate change, low productivity and inadequate infrastructure. Although Africa possesses vast arable land, traditional farming practices render it incapable of responding to most old and new challenges. The use of outdated farming practices and the low integration rate of improved agricultural technologies contribute to low productivity (Alliance for a Green Revolution in Africa (AGRA), 2022; Mabeta, 2025). Factors such as monocultures, lack of crop rotation and poor soil management are still widespread across the region (Mokone & Ndhlovu, 2025). In addition, poor infrastructure, including transport networks and food storage and processing facilities, continues to constrain access to markets by food producers and consumers. In addition, this worsens post-harvest losses (Mphaga et al., 2024). Many farmers and food system participants on the continent do not

have adequate access to financial services and resources to enable them to invest more in their activities (Ndhlovu & Mhlanga, 2023). Although the situation differs across countries and regions, the SSA is generally under strain, with hunger and malnutrition rising across all sub-regions (FAO et al., 2023). Africa has the potential to achieve food security and also play a critical role in the worldwide food system. However, it must address these challenges through proactive and innovative solutions to strengthen its food systems.

The transformation of African food systems offers opportunities to uplift millions of people out of poverty, advance nutrition and stir development in general. This, however, requires shared effort, inventive deliberation and commitment. The benefits—a well-to-do, food-secure and sustainable Africa—are well worth the sacrifice. The multifaceted nature of the problems facing African food systems and agriculture necessitates multifaceted approaches to deal with them. Most of these approaches are beyond the capacity of farmers and individual food system actors but require the collective intervention of local, national, sub-regional and regional governments. The critical role of governments in African food systems has not tended to receive sustained scholarly attention in literature. This concluding chapter seeks to close this literature gap that has practical and policy implications.

Much of the contemporary literature on African farming and food systems tends to focus on the potential of digital technologies

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to deal with the problems facing agriculture and food systems. For instance, Mnukwa et al. (2025) assessed smallholder farmers' adoption of climate-smart agricultural practices in SSA and blamed low adoption for low productivity. Ogunleke and Idowu (2025) examined the impact of climate change in Africa. Then they recommended climate-smart agriculture (CSA) as the most transformative approach to enhance agricultural productivity, resilience and sustainability while reducing greenhouse gas emissions on the continent. With their education and training and the ability to learn new technologies fast, the youth were paraded as the solution to Africa's low technology adoption challenge. Amede et al. (2023) conducted a study on sustainable farming practices in Africa. They recommended the diagnostic potential of digital technologies to build resilient and profitable smallholder agricultural systems in SSA. Danquah et al. (2025) also recommended climate-smart cropping in dealing with low productivity among smallholder farmers in SSA. In making these recommendations, studies tend to focus on how farmers must modernise their operations. The role of the nation-state remains peripheral in food systems literature.

This chapter draws scholarly attention towards the role of governments in steering the agricultural and food system agenda. Underpinned by a review of primary and secondary texts, primarily the chapters that comprise this book, the chapter identifies agricultural and food system policies and initiatives in Africa, particularly at the regional level, as guided by the AU. It highlights how governments play a crucial role in agriculture and food systems by setting the legal and regulatory framework, providing infrastructure and promoting food security and sustainability. It also reveals how governments coordinate agricultural and food systems activities, ensure food safety and foster collaboration between various stakeholders. This chapter goes beyond infrastructural development and technology adoption recommendations for African agriculture and food systems to also draw attention to the importance of African governments playing an active role in creating conducive environments for agriculture and food systems to flourish, be resilient, recover from

disruptions such as COVID-19 and climate change hazards and transform sustainably. Therefore, this concluding chapter can provide insights to African policymakers. The chapter can also motivate African farmers to hold governments accountable for the food system transformation agenda. Academics, students and different types of food system actors could also find the chapter interesting to read.

This chapter proceeds as follows: The following section summarises the challenges of African agriculture and food systems. This is followed by a discussion of the policies and initiatives meant to improve agriculture and food systems at the AU level. After that, the chapter revisits the role of governments in agriculture and food systems. Lastly, conclusions are drawn from the review.

24.2 African Agriculture and Food System Challenges

The chapters comprising this book demonstrate that African agriculture and food systems face a complex web of interconnected challenges that hinder food security, economic development and sustainability. These issues range from environmental degradation to socio-economic disparities and political instability.

The impacts of climate change and environmental degradation are some of the challenges cutting across several chapters in this book (see Chaps. 5, 11, and 19). Africa is very susceptible to climate change and variability, experiencing more and more unpredictable rainfall, prolonged droughts, storms and devastating floods. This heavily impacts crop yields and livestock, as a significant portion of African agriculture is rain-fed. In addition, it destroys infrastructure such as roads and food storage facilities. For instance, as shown in Chap. 1, in 2019, Cyclone Idai destroyed fields and crops in the Southern African countries of Mozambique, Malawi, Zimbabwe and parts of north-eastern South Africa. The cyclone also destroyed infrastructure and other types of livelihoods,

exposing many communities to poverty and food insecurity (Williamson et al., 2023). Chapter 5 also showed that in Central African countries, floods and storms also contaminate water sources and grazing lands, exposing livestock and humans to harmful toxicants and increasing the risk of foodborne diseases. In addition, rising temperatures directly impact crop yields, with many staple crops like maize and wheat projected to experience significant declines. Rising temperatures stress crops and livestock, leading to reduced cereal crop productivity, impacting even high-value perennial crops.

Many African countries are also struggling with the impacts of soil degradation due to overgrazing, deforestation, erosion and unsustainable farming practices (Mnukwa et al., 2025). These practices are leading to widespread soil nutrient depletion and acidity, reducing fertility and long-term agricultural sustainability. In addition, despite the potential for irrigation, most African agriculture depends on rainfall (see Chap. 5). Water scarcity, worsened by climate change, limits cultivation and amplifies the impact of droughts. Climate change can alter the distribution and intensity of crop pests and diseases, further threatening agricultural output.

The other challenge in SSA is low agricultural productivity. Due to inadequate resources and a lack of support, many smallholder farmers still use traditional, low-yielding methods (Ndhlovu, 2025a). There is an overall decline in investment in farm inputs like fertilisers, quality seeds and appropriate technology in many countries. Many farmers lack access to these essential resources, leading to poor productivity. There are also low levels of mechanisation within Africa's dominating smallholder farming, significantly contributing to inefficient farming practices. In Central African countries such as Chad, the heavy reliance on rain-fed agriculture makes production highly susceptible to weather variations. Further, rapid population growth and rapid urbanisation are leading to smaller farm sizes and conversion of arable land for other uses, significantly affecting food availability.

Inadequate infrastructure and market access are other challenges for SSA agriculture and food systems. Limited access to good roads, storage facilities and processing plants leads to high transaction costs for farmers and restricts their ability to access markets. For instance, Ndhlovu and Majova (2023) found that limited access to markets was the main cause of food loss and waste in the Gauteng Province, South Africa. Across SSA, a significant portion of food produced (up to 30%) is lost due to inadequate transportation and storage facilities, undermining food availability and farmers' incomes (Ambuko et al., 2025). In addition, insufficient development of output, input and credit markets, along with food safety standards, hinders farmers' participation in more profitable markets. Due to minimal value addition and product differentiation, farmers often sell raw produce at lower prices, missing opportunities for higher returns (Zindi & Ndhlovu, 2025).

SSA also experienced many economic and financial constraints that affect its agricultural and food systems sector. Poverty limits most SSA farmers' ability to purchase necessary inputs like fertiliser and technology (Ndhlovu, 2025b). Evidence also shows that many SSA farmers and agribusinesses lack access to credit and financial services, which are crucial for investment in improved practices and technologies (African Development Bank (AfDB), 2016). Despite its importance to the economy, agriculture often receives insufficient public and private investment (Ndhlovu, 2025).

Other issues significantly affecting African agriculture and food systems include a rapidly growing population that is putting immense pressure on food supply and natural resources. There is also immense food insecurity, which has worsened undernourished in SSA, with women and children particularly vulnerable (FAO et al., 2025). This is driven by poverty, conflict, climate change and economic instability. Women play a vital role in food production in SSA but frequently face systemic challenges to accessing resources, land, education and technology (see Chaps. 16 and 17). In addition, political instability and conflict in most SSA countries, such as the Democratic Republic of Congo, South Sudan and northern parts of

Mozambique, disrupt the production and distribution of food, displace communities and worsen food shortages. Furthermore, failures in poor agricultural policies and institutions contribute to slow growth and inadequate responses to challenges. Lastly, limited access to agricultural education, training and technical assistance hinders the adoption of improved practices.

Addressing these multifaceted challenges requires integrated approaches, including investments in sustainable agriculture, infrastructure development, market access, financial inclusion, climate change adaptation and policies that promote equitable access to resources and empower vulnerable populations. African countries, under the leadership of the AU and other sub-regional bodies, are adopting and implementing policies directly meant to improve food insecurity, as detailed next.

24.3 African Policies and Initiatives for Agricultural and Food Systems Transformation

Some of the policies and interventions by SSA countries to improve regional agriculture and food systems include the following:

The African Task Force on Food and Nutrition Development (ATFFND)

The ATFFND was launched by the then Organisation of African Unity (now AU), the World Health Organisation (WHO), FAO and the United Nations Children's Fund in 1987. It was established to mobilise African policymakers to vigorously adopt policies that can boost continental agriculture and food systems as the basis for development. By 1995, the positive effects of this task force were already being felt, with nutrition status seeing significant improvement, particularly for children under five years of age (AU, 2009). ATFFND served as the foundation upon which all succeeding food and nutrition actions by the AU would be based. However, due to some socio-economic factors beyond the ATFFND, it collapsed in the late 1990s.

The Maputo Declaration

In 2003, the AU adopted a '*Declaration on Agriculture and Food Security in Africa*' (The Maputo Declaration) in Maputo, Mozambique. The declaration emphasised the critical role played by the agricultural in facilitating economic development and ensuring food security. The declaration identified inadequate funding, poor water management, inadequate infrastructure in rural areas and insufficient agricultural research, as among the main causes of poor agricultural productivity in Africa. While this declaration is reported to have generated only minimal benefits overall (Kolavalli et al., 2010). Badiane et al. (2018) observed that, following the declaration, there was a positive trend for total spending on agriculture by most of the countries that had signed a Comprehensive African Agriculture Development Programme (CAADP) compact.

African Regional Nutrition Strategy (ARNS)

In 2005, the AU developed the ARNS to provide directions and guidelines on African's nutrition programmes and policies for the period 2005–2015. The AU recommended all its members to use the ARNS as a guideline to develop their national agricultural, food system and nutrition plans of actions. Within the context of ARNS, the AU committed to reactivating the ATFFND in 2015. It approved a reviewed form of the ARNS for the period 2015–2025. This also incorporated aspects of global initiatives such as the Sustainable Development Goals, as well as the AU's Agenda 2063. The ARNS's primary aim was to contribute towards the achievement of global nutrition targets of the 2011 agreed by the World Health Assembly. While the impact of this initiative is not well-documented, it highlights the commitment of African countries to adopt initiatives and policies that can transform the agricultural and food system sectors to meet the food needs of the regional population.

The Malabo Declaration

In 2014, the AU adopted the Malabo Declaration to guide African countries on agricultural growth and transformation. Member States pledged to

hold themselves accountable. This accountability would be enforced through the Biennial Review, which would be used to monitor progress on all the Malabo Declaration targets. The declaration also set targets for development outcomes in agricultural productivity, food system activities and resilience. To operationalise the declaration, the CAADP developed a strategy and roadmap that consists of goals to be achieved over three periods: 2015 to 2016 to 2020 and 2021 to 2025 (CAADP, 2015). The declaration committed to reviving the CAADP values. The declaration also committed to ensuring food security through proper conceptualisation (Kamara et al., 2019). It also sought to transcend food production to include economic growth, poverty reduction and employment creation through agricultural transformation (Mokone & Ndhlovu, 2025). Chitiga et al. (2020) observed that some countries, such as Malawi, have made significant progress in agricultural productivity and enhancing resilience by implementing the aspects of the declaration.

African Leaders for Nutrition Initiative (ALN)

The ALN was first adopted and implemented in 2018 by AU member states to overcome malnutrition and steer economic development through improved regional nutrition. The ALN became a platform for advanced political deliberations to advance regional nutrition commitments. This initiative includes an Africa Nutrition Accountability Score Card which is designed to assist countries monitor their progress in addressing undernourishment. The scorecard is also meant to streamline government efforts to prioritise investments in programmes that directly focus on food and nutrition. The initiative also supports the most of the targets set in the Malabo Declaration.

Africa Common Position Paper on Food Systems

In 2021, African countries presented to the United Nations Forum on Sustainability Standards (UNFSS) a document that outlined their position on regional food and nutritional commitments. The document provides details on the priorities and ambitions of Member States on key main problems affecting regional and global food systems (African Union Development Agency

(AUDA), 2023). Guided by regional and sub-regional policy frameworks and outcomes, the paper showcases Africa's pledge to food systems transformation. The document also examines and presents how the regional food systems can be transformed. It provides policy and investment options to transform food systems. It also emphasises practicality and, thus, provides a regional programmatic instrument to develop principal conditions for agricultural and food systems development. This implies that all efforts and programmes towards food systems development must be pursued alongside existing national plans and frameworks. Importantly, the document acknowledges the political nature of food systems and the role of nation-states in facilitating transformation.

Declaration of 2022 as the Year of Nutrition for Africa

In 2022, the AU declared the year 2022 as the continent's year of nutrition. The aim of the declaration was to develop regional agriculture and the food chain. The AU Member States wanted to use the year to focus on food insecurity as a challenge that needs to be addressed as a matter of urgency. By declaring 2022 as the year for dealing with the challenge, countries aimed to build regional food system resilience through strengthening economies and the capacity of individuals to access and utilise nutritious food.

Other Food Systems-Related Actions

Many African countries have also adopted some policies and plans focusing on their food systems. This in addition to regional efforts at the level of the AU. These include the National Programmes of Action (NAPA), the National Communications to the United Nations Framework Convention on Climate Change, National Agricultural Investment Plans (NAIPs) and Poverty Reduction Strategy Papers (PRSPs). Furthermore, the Africa climate-smart agriculture Alliance was launched to support the uptake of smart farming practices by approximately 6 million households in sub-Saharan Africa by 2021 (FAO, 2015). The Alliance is coordinated by a pan-African Steering Committee organised by

the New Partnership for Africa's Development (NEPAD), and it comprises international NGOs, the Consultative Group on International Agricultural Research (CGIAR), and FAO.

24.4 Revisiting the Role of Governments in Agriculture and Food Systems

This review shows that African governments play a multifaceted and crucial role in shaping agricultural and food system development, not only in Africa but globally. The influence of governments on agriculture and food systems extends across various dimensions, from direct support to farmers to the creation of an enabling policy environment for food production, distribution and consumption.

24.4.1 Policy and Regulatory Frameworks

It is the duty of governments to formulate national agricultural policies that guide the direction of the sector. The AU and its member states have been adopting policies meant to increase production, ensure food security, promote sustainable practices and support farmer livelihoods. At the country-level, examples include policies on land use, water management, crop subsidies and live-stock development. Countries such as South Africa and Kenya have successfully adopted policies that have led to significant developments in their agricultural and food sectors, particularly among smallholder producers (Zindi & Ndhlovu, 2025).

It is also the role of governments to establish and enforce food safety and quality standards to protect public health and ensure consumer confidence. This involves regulations on food processing, labelling, hygiene and the use of pesticides and additives (Ogunleke & Idowu, 2025). In addition, governments also regulate agricultural trade through tariffs, quotas and trade agreements. These policies influence domestic food

prices, the availability of imported foods and the competitiveness of local farmers. They can also be used to promote food security by facilitating imports during times of shortage or protecting domestic industries. Policies related to environmental protection, such as those concerning deforestation, soil erosion, water pollution and greenhouse gas emissions, are effective when enforced by governments, locally or nationally and directly impact agricultural practices and the sustainability of food systems. Further, regulations concerning agricultural labour, including wages, working conditions and rights of farmworkers, influence the social sustainability of food production and are most effective when they are overseen by governments. Therefore, the nation-state is not an appendage in agricultural and food systems development but the centre of all the efforts towards the transformation of the sector.

24.4.2 Investment and Infrastructure

Agricultural Infrastructural development is expensive for African farmers, most of whom are smallholder farmers. Therefore, it is the role of governments to invest in infrastructural development, including the construction of roads and communication networks, food storage and processing facilities and markets. In addition, it is the role of governments to support the agricultural and food system sector through investments in agricultural research and development (R&D), extension services and infrastructure (e.g., irrigation systems, rural roads, storage facilities). These investments are crucial for increasing productivity, improving efficiency and connecting farmers to markets.

Nation-states and their governments can facilitate access to credit and financial services for farmers, especially smallholders, through various mechanisms like subsidised loans, microfinance programmes and agricultural banks. For instance, in South Africa, the government is playing a leading role in mobilising funds targeted for smallholder farmers (Majova, 2023). In Zimbabwe, a poor land-related policy framework continues to

hinder financial access by smallholder land reform beneficiaries. Thus, the government serves as the basis for the trajectory which the local agriculture and food system will take.

Reliable access to energy and water is vital for modern agriculture and food systems. Governments play a role in developing and managing these essential resources, including large-scale irrigation projects and rural electrification. Much of the agricultural and food system challenges in Southern Africa is the energy crisis in the sub-region. Electricity in countries such as South Africa, Zambia, and Zimbabwe remains an issue of concern, with loadshedding lasting up to 18 h a day in Zimbabwe (Mhlanga & Ndhlovu, 2021). This negatively impacts agricultural activities and leads to food loss and waste (Twala & Ndhlovu, 2025).

24.4.3 Food Security and Nutrition

The government must always ensure that its citizens have adequate access to and utilisation of nutritious food. Through policies that promote domestic production, manage food stocks and regulate trade, governments should always strive to ensure a consistent and adequate food supply for their populations. Many African governments implement social protection programmes, such as food assistance, school feeding programmes and income support, to improve food access for vulnerable populations (see Ndhlovu, 2024). In addition, governments can also promote healthy and nutritional food consumption through public health initiatives, dietary guidelines and regulations on food composition and healthy eating promotions to influence consumer choices and encourage healthier eating habits. Further, in times of crisis (e.g., natural disasters, economic shocks), nation-states are responsible for providing humanitarian food aid and implementing emergency agricultural support to prevent food insecurity and famine. This was clear, particularly during the COVID-19 pandemic, when many African countries rolled out food assistance to their populations to shield them from hunger and malnutrition.

24.4.4 Research, Technology and Innovation

A flourishing agricultural and food systems sector is one that is supported by research, technology and continuous innovation. Governments are often the primary funders of agricultural research institutions, which develop new crop varieties, livestock breeds, farming techniques and technologies to improve productivity and resilience. These activities are usually unaffordable for individual farmers and therefore, the government often have to intervene. Governments can also support the sector by adopting policies that encourage farmers to adopt new technologies through training programmes, subsidies and extension services. By virtue of their resources, governments can collect and distribute agricultural data, market information and early warning systems to help farmers make informed decisions and respond to challenges. Governments have the resources and human resources to carry out these activities; therefore, they are better positioned to use them to support local agriculture and food systems.

24.4.5 Governance and Coordination

Food systems are complex and involve multiple sectors (agriculture, health, environment, trade and finance). Nation-states are responsible for nurturing synchronisation among different government ministries and agencies to ensure coherent and effective food policies. Governments engage with various stakeholders, including farmers' organisations, civil society groups, the private sector and international organisations. These engagements can be used to develop and implement food system strategies. In addition, the government can also help address regional disparities by adopting policies designed to reduce inequalities within the agricultural sector and ensure that remote or marginalised communities have access to resources and opportunities. In essence, governments act as critical stewards of the agricultural and food systems of countries,

balancing economic development, social equity and environmental sustainability to ensure food security and improve the well-being of their citizens.

24.5 Conclusion

This chapter concluded the book *Agriculture and Sustainable Development in Africa: Resilience and Recovery Toward Sustainable Futures*. The chapter aimed to highlight the critical role of governments in the African agricultural and food systems transformation agenda. In many agricultural and food systems debates, the role of the nation-state and governments tends to be sidelined, with transformation recommendations central on infrastructural development and technology integration. Studies fail to provide clarity on how this infrastructure should be rolled out, giving the impression that farmers are expected to develop the necessary infrastructure and integrate technologies. The chapter argues that the African agricultural and food systems sector is dominated by smallholder farmers who already face significant resource constraints. These farmers cannot provide for themselves the basic facilities necessary for an agricultural and food system revolution. Therefore, it is the role of the government to provide such facilities as part of the broader development agenda.

The chapter highlighted how the African government can or is steering its agricultural and food systems sectors. These include adopting conducive policy and regulatory frameworks, mobilising investment in agriculture and related infrastructure, rolling out food security and nutrition campaigns, particularly on healthy eating habits, promoting research, technology, innovation and governance and coordination. Therefore, governments are at the centre of the prospects for the transformation of agricultural and food systems.

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