AGRA
Sustainably Growing Africa's Food Systems

Empowering Africa's Food Systems for the Future

Africa Agriculture Status Report | 2023

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Foreword

Africa, a continent of immense potential, stands at a crucial juncture. Home to some of the world's most fertile lands, abundant resources, and a burgeoning young population, it remains paradoxically ensnared in the grip of food insecurity, malnutrition, and challenges such as climate change, post-harvest losses, and inefficient supply chains. The urgency to empower and transform African food systems is not merely an agricultural or economic imperative but a moral, social, and ecological one.

The 2023 report, "Empowering Africa Food Systems for the Future," highlights the ways in which Africa is uniquely positioned to redefine its future and pave a sustainable and resilient path for generations to come.

In delving into the assessment of food systems failures, the report confronts some harsh truths. Despite being home to nearly 60 percent of the world's uncultivated arable land, Africa remains a net food importer spending billions annually to meet its food demands. A large fraction of its population still grapples with chronic hunger and malnutrition. Yet, it does not stop at just assessing failures; it moves forward to take stock of the robust and diverse food systems that form the lifeblood of the continent.

Chapters on revolutionizing African food systems, innovative financing, and the infusion of knowledge and innovation present practical solutions. From leveraging the transformative potential of the African Continental Free Trade Area (AfCFTA) to harnessing the power of the digital revolution, there are many potential pathways to change. Balancing sustainability with nutrition offers a nuanced perspective on a critical challenge reminding us that it is not just about producing more food but better food for everyone. Additionally, as the report shines a spotlight on the demographic dividend, we recognize that Africa's youth can and should be the vanguard of this transformation.

The urgent need to empower and transform African food systems transcends borders and sectors calling upon policymakers, farmers, entrepreneurs, youth, and every stakeholder to rally around a shared vision. It is a vision of an Africa that is self-reliant, where no child goes to bed hungry, and where environmental sustainability, gender equality, and resilience abound. The journey ahead may be challenging, but the promise it holds is worth every effort. This is the key message of the 2023 AASR.

Dr. Johan Swinnen
Director General, International Food Policy Research Institute (IFPRI)
Managing Director of Systems Transformation, CGIAR

Preface

At the heart of a thriving continent lies a vital lifeline: its food systems. Africa, with its abundant natural resources, rich cultural tapestry, and dynamic population, stands at a crossroads in its journey towards resilient and sustainable food systems. As we gaze upon the horizon of this transformation, the 2023 Africa Agriculture Status Report (AASR23), titled "Empowering Africa's Food Systems for the Future" offers a comprehensive outlook into the opportunities and challenges that lie ahead.

The report begins by exploring the structural failures hindering the transformation of Africa's food systems for sustainable healthy diets for all. It examines the prevailing state of food systems in Africa offering a meticulous analysis of what ails these systems and some of the opportunities for remedy. The stocktaking draws from a recently launched Food Systems Countdown Initiative (FSCI) framework of indicators to benchmark progress on transformation. This year's report also uses the United Nations Sustainable Development Goals (SDGs) and the Comprehensive African Agriculture Development Program (CAADP) framework indicators to assess overall progress towards global and continental commitments.

The AASR23 delves into the specifics of the status of food systems by deepening the understanding of the vulnerabilities, appreciating the game-changing role of digital revolution in harnessing the demographic dividend while addressing sustainability and nutrition components. All this while exploring innovations in knowledge and financing as viable solutions to the myriad of outlined challenges.

The findings reiterate that empowering African food systems requires a multi-faceted approach that includes technological advancements, innovation and knowledge, digital revolution, trade, and innovative financing for a sustainable future. The increasing threat of climate and non-climate shocks and stressors only make the promotion of practices that build resilience and sustainability even more essential. While these challenges amplify the vulnerabilities of Africa's food systems, it is crucial to recognize the compelling potential for transformative interventions; many initiatives from climate-smart agriculture practices to infrastructure development and policy reforms are already addressing these challenges with promising results. With innovative financing and cutting-edge knowledge and innovation, African food systems can overcome these challenges to ensure food and nutrition security for all.

It is important to recognize that Africa is at a critical juncture with the number of its young people expected to reach 200 million people by 2030. This increases the urgency to provide productive employment and entrepreneurial opportunities. With the strong current focus on digitalization, automation, and now artificial intelligence (AI) as sure-fire solutions for Africa's food systems, the youth are strategically placed to effectively leverage them to infuse innovation and energy into transforming the continent's food systems landscape.

In examining how intra-African trade can bolster food systems transformation on the continent, the report shows that while African governments are committed to tripling intra-African trade in agricultural commodities and services by 2025 as part of the commitments of the 2014 Malabo Declaration, this aspiration appears far-fetched; intra-African trade continues to dwindle from its peak in 2013 to less than 15 percent in 2022. Nonetheless, the African Continental Free Trade Area (AfCFTA), the main instrument in driving this agenda, has the potential to significantly transform food systems in Africa. It is poised to do so by increasing market access, ensuring reduced tariffs and non-tariff barriers, advancing food safety and quality standards across jurisdictions, and increasing the diversity of produce from different regions.

Meanwhile, this report strives to show that Innovative Finance is not just a buzzword – it is an essential tool for Africa's journey towards sustainable, resilient, and inclusive food systems. As the continent faces the dual challenges of rapid population growth and climate change, finding new financing mechanisms will be paramount in shaping a prosperous and secure food future for all its citizens. Through green bonds, impact investing, and other innovative financial tools, investments can be directed towards sustainable agricultural practices that protect the environment, enhance biodiversity, and combat climate change.

Public investments remain essential, but the scale of transformation required in Africa's food systems necessitates significant private sector engagement. Innovative financing can leverage private capital by offering blended finance solutions combining public and private funds to de-risk investments.

This publication is a product of immense scholarly effort and valuable thematic expert contributions to the core chapters that I anticipate will stimulate evidence-based discourse and generate the ideas that will push the continent forward.

I am most grateful to the authors for their efforts and support to the much-needed knowledge, analytics, and evidence on empowering African food systems for the future. I also appreciate the editor and external reviewers for their professionalism, guidance, and insights towards promising pathways for empowering food systems in Africa.

Before delving into the chapters that follow, it is essential to recognize that this report is not just a passive reflection but an active call to arms. It is an invitation to collaborate, innovate, and contribute to a collective mission: empowering African food systems for present and future generations.

As you embark on this journey through the pages, may you be inspired, informed, and instigated to action. The future of African food systems beckons and with it the promise of a nourished, vibrant, and resilient continent.

Dr. Agnes Kalibata
President
AGRA

Acknowledgements

This year's Africa Agriculture Status Report (AASR) underscores the need and urgency to empower African food systems for the future. It is a call for a multi-faceted approach that fosters innovations including technological advancements, digital revolution, policy reforms, infrastructure development, and innovation and knowledge. This publication is authored by a multi-disciplinary team of experts and institution contributors.

On behalf of AGRA, I am indebted to the technical editor of the 2023 AASR Dr. John M. Ulimwengu, who guided the development of the content as well as editorial support. We are grateful for the leadership of AGRA under its President, Dr. Agnes Kalibata, who has been a champion in engaging various stakeholders in relaying the urgency in transforming African food systems and encouraging African's boldness to find solutions to the challenges. We would also like to express our gratitude to Jane Njuguna as coordinator of the 2023 AASR and the further support of Boaz Keizire, Amath Pathé Sene, and Michael Odumbe. We acknowledge the contribution of AGRA staff and units—Policy and State Capability, the Hub For Agricultural Policy Action (HAPA), and the Monitoring, Evaluation, and Knowledge Management Units that worked tirelessly to ensure that the theme and the chapters were well crafted.

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It is our hope that this report stimulates meaningful engagements and actions, contributing to the broader continental efforts in empowering African food systems for the future.

Andrew Cox
Chief of Staff and Strategy AGRA

Acronyms and Abbreviations

AARR	Annual average rate of reduction
AASR	Africa Agriculture Status Report
AASR23	2023 Africa Agriculture Status Report
AATM	Africa Agriculture Trade Monitor
ABC Fund	Agri Business Capital Fund
ACP	The Africa Common Position on Food Systems
ADB	Asian Development Bank
AFBDGs	African Food-Based Dietary Guidelines
AfCFTA	African Continental Free Trade Area
AfDB	African Development Bank
AGFEP	Academy of Global Food Economics and Policy
AGRA	Alliance for a Green Revolution in Africa
AI	Artificial intelligence
AICCRA	Accelerating Impacts of CGIAR Climate Research for Africa
AIDA	Accelerated Industrial Development for Africa
AIP	Continental Africa Water Investment Programme
AMEA	Agribusiness Market Ecosystem Alliance
APTERR	Asean Plus Three Emergency Rice Reserve
ASEAN	Association of Southeast Asian Nations
ASYCUDA	Automated System for Customs Data
AT	Action Tracks
ATEX	Africa Trade Exchange
AU	African Union
AUDA-NEPAD	African Union Development Agency-New Partnership for Africa's Development
BDS	Business Development Services
BIAT	Boosting Intra African Trade
BR	Biennial Review
CAADP	Comprehensive African Agriculture Development Program
CGIAR	(formerly called) Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Center
COMESA	Common Market for East and Southern Africa
CTA	Technical Centre for Agriculture and Rural Cooperation
DAC	Development Assistance Committee
DFIs	Development finance institutions
EAC	East Africa Community
ECA	(United Nations) Economic Commission for Africa
ECOWAS	Economic Community of West African States
FAO	(United Nations) Food and Agriculture Organization
FBDG	Food-Based Dietary Guidelines
FDI	Foreign direct investment
FSCI	Food Systems Countdown Initiative
FSIN	Food Security Information Network

GAIN	Global Alliance for Improved Nutrition
GCF	Green Climate Fund
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse gas
GHI	Global Hunger Index
GIRSAL	Ghana Incentive-Based Risk-Sharing Scheme for Agricultural Lending
GIS	Geographic information system
GTI	Guided Trade Initiative
GVA	Gross value added
HAPA	(AGRA) Hub For Agricultural Policy Action
ICT	Information and communication technology
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IFPRI	International Food Policy Research Institute
IGREENFIN	Inclusive Green Financing Initiative
IITA	International Institute of Tropical Agriculture
IMF	International Monetary Fund
INGOs	International non-governmental organizations
ITU	International Telecommunication Union
KfW	German Development Bank
LDCs	Least Developed Countries
LPSS	Leveraging Private Sector Strategy
MSMEs	Micro small and medium enterprises
NCD	Non-communicable disease
ND-GAIN	Notre Dame Global Adaptation Index
NGOs	Non-governmental organizations
NTBs	Non-tariff barriers
NTMs	Non-tariff measures
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
PAPSS	Pan-African Payment and Settlement System
PESA	(Costa Rica's) Program for Ecosystem services
PIA	Programme for Infrastructure Development in Africa
PoU	Prevalence of undernourishment
R&D	Research and development
RECs	Regional economic communities
SADC	Southern Africa Development Cooperation
SDGs	(United Nations) Sustainable Development Goals
SDU	(AgDevCo's) Smallholder Development Unit
SME	Small and medium enterprises
SOFI	State of Food Security and Nutrition in the World
SPS	Sanitary and phytosanitary
STB	Science and Technology Backyard
STISA	Science, Technology, and Innovation Strategy for Africa

STR	Simplified Trade Regime
SWIFT	Society for Worldwide Interbank Financial Telecommunication
TEF	Tamwil El Fellah
TFP	Total Factor Productivity
TMA	TradeMark Africa
TMEA	TradeMark East Africa
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change's
UNFSS	UN Food Systems Summit
UNICEF	United Nations Childrens' Fund
USD	United States Dollar
VCM	Voluntary carbon market
WCA	West and Central Africa
WDR	Water-Saving and Drought-Resistant Rice
WFP	World Food Program
WHO	World Health Organization
WIPO	World Intellectual Property Organization

1 Empowering African Food Systems for the Future

Prof. Joachim von Braun[1], John M Ulimwengu[2], Apollos Nwafor[3], Sibusiso Nhlengethwa[4]

Overview

Overall, Africa's food system is failing to deliver sustainable healthy diets to all, largely due to the combination of climate change, conflict, economic instability, low agricultural productivity, and the impacts of the COVID-19 pandemic. With over 20 percent of the continent's population (roughly 257 million people) undernourished, Africa bears the heaviest burden of malnutrition (FAO, 2022). Child malnutrition is a significant challenge in many African countries. While progress has been made in some areas, high levels of malnutrition persist. Over 20 million people and at least 10 million children faced severe food shortages in Africa due to crop failure and four consecutive dry seasons (UNICEF, 2022). Projections by the United Nations Economic Commission for Africa (ECA) indicate that Africa's annual food imports will increase significantly by a factor of seven from USD 15 billion in 2018 to USD 110 billion by 2025 and by a factor of three from the current USD 43 billion (ECA, 2021). There are several factors contributing to the perceived failure or underperformance of Africa's agricultural sector leading to a dismal food and nutrition security outlook. The use of outdated farming practices and the low adoption rate of improved agricultural technologies also contribute to low productivity. Issues such as monoculture, lack of crop rotation, and poor soil management are still prevalent across the continent. Poor infrastructure in terms of roads, storage, and processing facilities limits access to markets and increases post-harvest losses. Moreover, many African farmers and other food systems-related businesses lack access to finance and credit facilities that would enable them to invest in improved agricultural technologies and inputs. However, it is important to note that the situation varies widely across countries and regions.

Numerous challenges and external impacts including extreme weather events and climate change, recurrent outbreaks of pests and diseases, limited availability and low adoption of yield-increasing technologies have put African food systems at a critical point. The tremendous increase in food demand emanating from the region's burgeoning population has exacerbated the situation. There has been a notable increase in global hunger with the African continent unpropitiously affected—in 2021, between 702 and 828 million people were affected by hunger (Ordu and Ntungire, 2023). With this grim backdrop, it is extrapolated that nearly 670 million people will still be facing hunger in 2030—8 percent of the world population, which is the same as in 2015 when the 2030 Agenda was launched. These hiccups on the continent indicate that policies are no longer delivering improved marginal returns in alleviating hunger, food insecurity, and malnutrition in all its forms. Governments with fragile economies are also facing fiscal constraints to transform agrifood systems. This is the opportunity for governments to re-examine their support for food and agriculture (FAO, WFP, UNICEF and WHO, 2021). In the current recessionary context, public spending and investments become particularly important because many private investors (including agrifood systems actors) are more risk averse in terms of agrifood systems investments as these systems tend to be more on the high-risk, low-reward spectrum in terms of monetary reward, especially in the short term. The extent to which efforts to repurpose food and agricultural support will be successful will depend on the political economy, governance, and the incentives of relevant stakeholders in a local, national, and global context. In context, agrifood systems need to be transformed in ways that ensure they deliver lower cost and safe nutritious foods that make healthy diets more affordable for all, sustainably and inclusively (FAO, 2022).

While Africa is yet to fully recover from the socioeconomic repercussions of the COVID-19 pandemic, the global financial and macroeconomic situation with high-interest rates and inflation is

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hampering investment and fiscal space in many countries. The Russia-Ukraine conflict poses a problem for commodity and food markets with many African countries adversely affected (Arndt et al., 2023). Food insecurity in sub-Saharan African countries has risen since 2015 and the situation has worsened as a result of these global drivers as well as domestic causes including wars and conflicts (Wudil et al., 2022). The Russia -Ukraine war has disrupted global energy and food markets resulting in a surge in prices of agricultural inputs, energy, and food. Russia and Belarus[5] export approximately 20 percent of the world's nitrogen fertilizers and 40 percent of the world's exported potassium respectively. Russia and Belarus produce more than a third of global potash hence the heavy sanctions imposed on both countries have reduced the accessibility of potash in the world market (International Fertilizer Association, 2019). The impact of these disruptions in the global supply chain of agricultural inputs, i.e., fertilizer, has been greatly felt by sub-Saharan African countries that source some of their fertilizer supplies from Russia, Belarus, and Ukraine. Furthermore, this impact is exacerbated by multiple climatic shocks and the lethargic macroeconomic recovery from the COVID-19 pandemic.

While fertilizer prices have been comparatively high in Africa due to deficient infrastructure and policies, these disruptions have caused the prices of fertilizers to surge even further increasing by approximately 78 percent to the average prices in 2021 (Hebebrand & Glauber, 2023). Prices of Nitrogen fertilizers have surged to well over USD 1,000 from roughly USD 500–550 in 2021. In sub-Saharan Africa, there is still a heavy reliance on imported cereals especially wheat and maize from the rest of the world. Of particular concern is that sub-Saharan Africa imports 37 percent of its cereals from both Russia and Ukraine and with the impasse between the two countries, sub-Saharan Africa's food security is sternly dented (Nhlengethwa et al., 2022). The continent is particularly vulnerable to climate-related disasters such as droughts and floods. These events are increasingly leading to crop failures, livestock deaths, and spikes in food prices, in turn undermining food and nutrition security (IPCC, 2021). The implications of the surge in prices of inputs (i.e., fertilizer) have negatively affected agrifood system transformation on the continent. There is a dire need to enhance the adoption and use of improved farm inputs to spur inclusive agricultural transformation through agri-food systems.

African countries affected by conflict have higher rates of acute and chronic malnutrition as conflict disrupts food systems, impairs investments, limits access to food and healthcare, and increases displacement (WFP, 2020). With the socio-economic ramifications already substantial, the situation remains highly unpredictable with the ongoing effects of climate change on agricultural production. Africa must seek opportunities in the current crises to reduce its dependence on food imports by enhancing the resilience of its food systems (Hailemariam Dessalegn, 2023). The rebuilding of economies after the COVID-19 pandemic and conflicts offers a unique opportunity to transform African food systems and make them resilient to future shocks ensuring environmental sustainability and healthy nutrition for all. To make this happen, major shifts are required at various scales including changes in policies, practices, institutions, structures, innovations, and processes to build much-needed resilience to current and future shocks.

The coordination of actors in various subsystems in African food systems, their interests, and activities in ways that produce better outcomes is also important. To address these challenges and identify the opportunities, a comprehensive food systems perspective is called for and should also guide implementation actions with system-wide effectiveness and efficiency. This requires properly considering the four key interlinked building blocks of food systems, i.e., production and processing, markets and trade, income and employment, and nutrition, and health (von Braun et al., 2021). Moreover, the food systems cannot be strengthened in isolation because they are linked to climate, biodiversity, and political and innovation systems.

Transforming African food systems to be more sustainable, efficient, and capable of meeting the needs of the region's rapidly growing population is an immense challenge with numerous social, economic, and environmental constraints. Many African farmers lack access to modern farming technologies that can improve yield and sustainability. This is largely due to the high costs associated with such technologies and the lack of infrastructure for their implementation (Jayne et al., 2014).

Climate change is causing unpredictable weather patterns leading to issues such as droughts, floods, and pests that harm agricultural productivity. Land

5 Russia's heavily sanctioned neighbour and ally – EU sanctions Belarus-kali, Belarus's main potash producer, and its export arm, Belarusian Potash Co.)

degradation and loss of biodiversity further contribute to these challenges (Carleton, 2022). Across the continent, significant portions of crops are lost after harvesting due to a lack of proper storage and processing facilities. This leads to less food being available for consumption and sale impacting food security and farmers' incomes. Poor transportation and logistics infrastructure make it difficult for farmers to access markets and consumers, which limits the capacity of farmers to sell their produce and reduces the availability of fresh produce in markets (FAO, 2017). In many African countries, there are still complex issues around land ownership and rights emanating from matriarchal and patriarchal systems. Many African farmers do not have formal titles to their land, or insecure land tenure, which can lead to insecurity and inhibit investment in land improvements. Women play a significant role in agriculture across Africa but often have fewer land rights than men due to cultural and legal barriers (Doss et al., 2014). This can in turn limit their access to credit and other resources negatively impacting productivity and food security. These issues can discourage long-term investment in land and sustainable farming practices and lead to disputes and instability (Deininger & Byerlee, 2011). Addressing these challenges requires comprehensive land reforms that recognize and protect the rights of small-scale farmers, women, and other marginalized groups, as well as measures to prevent and resolve land conflicts.

The adoption of policies that do not support smallholder farmers, lack of investment in agricultural research and development, and weak institutions are also impeding the transformation of African food systems. Despite the crucial role that agriculture plays in many African economies, it often receives a low share of public expenditure, and private investment is often limited (Kamenya et al., 2022). Many farmers lack access to credit, limiting their ability to invest in their farms and improve productivity. Finally, women play a significant role in African agriculture but often face discrimination and have fewer opportunities, resources, and rights than men, affecting overall productivity and sustainability.

Africa has several robust frameworks that if institutionalized hold promise in addressing the persistent structural barriers in its food systems, paving the way for a complete and successful structural transformation. The African Common Position paper (AUC & AUDA-NEPAD, 2021) on food systems highlights key action areas involving national, regional, and continental interventions with necessary thematic and sector coherence, alignment, and interdependences. The position also underscores the urgent need to pursue sustainability and resilience as a means of achieving food systems transformation through (i) strengthening and harnessing Africa's growing local food markets; (ii) catalyzing rapid expansion in agricultural and food productivity and production, (iii) boosting investment financing for Africa's food systems transformation agenda, (iv) ensuring access to safe and nutritious food for all, and (iv) repurposing support policies to reduce the cost and increase the availability of nutritious foods, which is important for recovery from crises and building long-term resilience. Recent studies on repurposing existing public funding for food systems support show potential for significant benefits in reducing the cost of nutritious diets, improving food security and nutrition, and reducing GHG emissions.

Empowering the relevant actors[6] in African food systems for the future will involve a multi-faceted approach that fosters innovations including technological advancements, organizational innovations, policy changes, infrastructure development, and science and education (von Braun et al., 2021). The use of advanced technologies such as precision agriculture can increase crop yields and resource efficiency. For example, remote sensing technologies, drones, and AI can help in disease detection, crop monitoring, and optimized irrigation. Given the increasing threat of climate change, it is essential to promote practices that are resilient to climate change and can also mitigate its effects. This includes techniques like agroforestry, conservation farming, and climate-smart livestock management.

Infrastructure development in terms of irrigation, storage facilities, and transport can significantly reduce post-harvest losses and improve market access for farmers. Strengthening local food markets, for instance through supporting local value chains, promoting agro-processing industries, and improving market information systems, can boost local economies and make them more resilient to shocks. Promoting sustainable farming practices through organic farming, permaculture, and other practices that improve soil health and biodiversity is also critical. These techniques can increase farmer income as they reduce dependency on expensive imported inputs.

6 Empowering food systems refers to the process of making the systems that produce, distribute, and consume food more resilient, equitable, and sustainable. It involves improving access to healthy food, reducing waste, supporting sustainable farming practices, and increasing the voice and influence of marginalized groups within the food system

Women and young people play a critical role in African agriculture and policies and programs that enhance their access to land, education, and resources can significantly contribute to food system transformation.

Many African countries have started developing pathways for systems transformation. Paving these pathways and strengthening those walking on these pathways is the investment and reform opportunity of this decade. The 2023 AASR sheds light on selected drivers of food system transformation for their critical role in the effectiveness and sustainability of African food systems. The objectives of this year's report include:

- *Assess the current state*: provide a comprehensive overview of Africa's current food system, including the status of selected African countries concerning food systems transformation and showing where the gaps are and areas that require further action. What lessons are we learning from these countries?
- *Identify challenges and opportunities*: identify the key challenges facing African food systems including climate change and other shocks and stressors. The report also highlights the potential of digital technology innovative financing, and the African Continental Free Trade Area (AfCFTA) to significantly transform food systems in Africa.
- *Evaluate existing policies and initiatives*: the report proposes specific strategies for empowering African food systems. These strategies will be evidence-based and tailored to the unique challenges and opportunities of different sub-regions and countries in Africa.
- *Africa's demographic dividend*: how can the process of food systems transformation involve youth and women?
- *Knowledge and innovation*: the report makes recommendations for future knowledge and innovation. This includes identifying key research gaps, proposing new initiatives or policies, and recommending ways to improve the implementation of existing innovation initiatives and the national and regional agri-food systems innovation landscapes.
- *Environment*-nutrition tradeoffs: the report demonstrates the current environmental-nutrition trade-offs of regionalized African food supplies and consumption and examines the variation in food supply, consumption, and compliance with food-based dietary guidelines in Africa as well as the environmental impact variation associated with food supply in Africa.

Innovation and knowledge

Innovation and knowledge play crucial roles in transforming food systems. The growing global population and impacts of climate change have posed significant challenges to African food systems necessitating sustainable and efficient approaches. Innovation can take many forms in the food system including technological, social, institutional, and policy innovations (FAO, 2021).

Technological innovations are often the most visible, with new technologies such as precision agriculture, vertical farming, and alternative proteins offering potential solutions to enhance productivity, improve sustainability, and reduce environmental impacts. For example, precision agriculture allows for more efficient use of inputs (like water and fertilizers) leading to increased crop yields and reduced environmental impacts (Zhang et al., 2019). Social and institutional innovations such as new business models, participatory approaches, and improved farmer networks can facilitate access to resources, knowledge sharing, and market access (FAO, 2014).

Policy innovations such as effective climate policies or investment in public goods like agricultural research can foster an enabling environment for sustainable food system transformation (Mazzucato et al., 2020). Knowledge, particularly in the form of research and education, underpins many of the aforementioned innovations. Research helps generate the evidence needed to drive technological, social, and policy innovation while education equips farmers and other food system actors with the skills to implement these innovations (Pretty et al., 2011).

Evidence generated through research is critical for driving the adoption of sustainable farming practices. For instance, research has demonstrated the benefits of conservation agriculture and agroecology, which can help mitigate climate change, improve soil health, and enhance biodiversity (Altieri et al., 2012). Training and education are vital for enabling farmers and other food system actors to implement new practices and technologies. Knowledge-sharing platforms using digital opportunities, farmer field schools, and extension services are all examples of how education can support food system transformation (FAO, 2016).

Trade

Trade, which features among the CAADP/Malabo commitments[7], can play a significant role in empowering African food systems through the encouragement of diverse food production, creation of employment opportunities, stimulating economic growth, and improving overall food and nutrition security. Indeed, trade can encourage the production of a more diverse range of crops, which can lead to improved nutrition and food security. Diversifying food production can reduce dependence on a single crop and make food systems more resilient to shocks such as drought or disease (FAO, 2017). Trade can stimulate economic growth by enabling farmers to sell their products in wider markets, both within and beyond national borders. This can lead to increased income for farmers, which can be reinvested in farming practices to increase productivity (World Bank, 2020). Trade can also improve food security by allowing countries to import food when local supplies are insufficient or too expensive. In this way, trade can help to stabilize food prices and ensure that people have access to the food they need (World Food Programme (WFP), 2018).

Operational since January 2021, AfCFTA is one of the largest free trade areas in the world by number of participating countries. The Agreement aims to create a single continental market for goods and services with free movement of persons and investments. AfCFTA has the potential to significantly transform food systems in Africa in various ways:

i) Increased market access: by reducing tariffs and non-tariff barriers, the AfCFTA could open up new market opportunities for farmers and food businesses, enabling them to reach consumers across the continent;
ii) Strengthened regional supply chains: AfCFTA could stimulate the development of regional value chains, leading to more processing and value addition within Africa. This could help to reduce post-harvest losses, create jobs, and increase the availability of processed and value-added food products;
iii) Improved food security: by facilitating trade, AfCFTA could improve access to food and contribute to food security. It could also enhance resilience by enabling countries to import food from within Africa in response to localized shocks or shortages.

However, there are also potential challenges and risks:

i) Increased competition: lowering trade barriers could expose small-scale farmers and businesses to increased competition from larger, more efficient producers elsewhere in Africa;
ii) Unequal benefits: the benefits of AfCFTA may not be evenly distributed and could depend on factors such as countries' competitiveness, infrastructure, and policy environment, which may result in some countries, sectors, or groups benefitting more than others;
iii) Implementation challenges: implementing AfCFTA and ensuring compliance will be a complex task requiring significant institutional capacity and political will.

Demographic dividend

The demographic dividend refers to the economic growth potential that can result from shifts in a population's age structure mainly when the share of the working-age population (15 to 64 years) is larger than the non-working-age share of the population (14 years and younger and 65 years and older). Africa is expected to experience a significant demographic dividend as the continent has the youngest population globally (UN, 2023). It is projected that this young population will be the bulk of the global workforce in the future. However, this dividend will only be harvested if the investment in the human resources of youth is forthcoming, i.e., investments in child nutrition, youth education, training, and strengthened colleges and universities. This demographic dividend can contribute to food system transformation in several ways. The increased youth population can be involved in various stages of the food value chain including production, processing, distribution, and

7 "Commitment to Boosting Intra-African Trade in Agricultural Commodities and Services

5. We commit to harness markets and trade opportunities, locally, regionally and internationally, and to this end we resolve to:
   a) triple, by the year 2025, intra-African trade in agricultural commodities and services;
   b) create and enhance policies and institutional conditions and support systems to:
      - simplify and formalize the current trade practices;
      - fast-track the establishment of Continental Free Trade Area (CFTA) and transition to a
      - a continental Common External Tariff (CET) scheme;
      - increase and facilitate investment in markets and trade infrastructure;
      - promote and strengthen platforms for multi-actors interactions;
      - strengthen and streamline the coordination mechanism that will facilitate the promotion African common position on agriculture-related international trade negotiations and partnership agreements" (Exert from AU (African Union). 2014. The Malabo Declaration on accelerated agricultural growth and transformation for shared prosperity and improved livelihoods. African Union Commission, Addis Ababa, Ethiopia).

marketing. This can increase food availability, access, and affordability. Harnessing this demographic dividend can lead to increased productivity in agriculture and a transformation of food systems (World Bank, 2021). The younger population tends to be more adaptive and innovative. This demographic can utilize, adapt, and innovate agricultural technology that improves farming practices, reduces post-harvest losses, and enhances market access (FAO, 2021). A younger population can also influence policies related to food systems through advocacy and leadership. They can push for policies that ensure food security, climate-smart agriculture, and sustainable practices (IFAD, 2019). Finally, investment in education for the young population can result in an improved understanding of sustainable farming practices, nutrition, and food systems, leading to a long-term transformation in the way food is produced, processed, and consumed (UNESCO, 2020). In the context of food systems, the demographic dividend could have several implications: i) labor supply: a large working-age population can provide the labor needed for agricultural production, food processing, and distribution. However, this requires investments in skills development and decent job creation in the food system; ii) food demand: a larger working-age population also means more potential consumers of food products. This could stimulate demand and drive innovation in food production, processing, and marketing; iii) innovation and entrepreneurship: young people often bring new ideas and energy to the food system. They could drive innovation and entrepreneurship in areas like agri-tech, food processing, and alternative food networks; iv) urbanization and dietary transitions: in many regions, the demographic transition is accompanied by urbanization and changes in diet and lifestyle. This could lead to increased demand for processed foods, convenience foods, and diverse diets thus impacting food systems.

Digital revolution

The digital revolution has significant potential to transform African food systems and improve food security across the continent. Digital technologies can enable precision agriculture, which involves using data and technology to manage agricultural inputs (like water and fertilizer) more efficiently. For instance, satellite imagery and remote sensing technologies can help farmers monitor crop health, predict yields, and optimize irrigation. Mobile technologies can provide farmers with access to real-time market information such as prices, demand, and supply trends. This can help farmers make informed decisions about what to plant and when to sell potentially increasing their incomes. Digital technologies can improve the traceability and efficiency of food supply chains. For instance, blockchain technology can provide a secure and transparent record of transactions helping to prevent fraud and improve the quality and safety of food. Digital technologies can support climate-smart agriculture by providing farmers with information about weather patterns and climate risks. This can help farmers adapt their practices to changing climatic conditions. While the digital revolution offers significant potential, it is also important to recognize the challenges that must be addressed for this potential to be realized. These include issues such as the digital divide (the gap in access to digital technologies), data privacy and security, and the need for appropriate regulatory frameworks. There is also a need for capacity building to ensure that farmers and other stakeholders have the skills and knowledge needed to use digital technologies effectively.

Innovative financing

Innovative financing refers to a range of non-traditional mechanisms to raise additional funds for development on top of traditional sources such as taxation or borrowing. These methods often involve partnerships between public, private, and philanthropic sectors and may include impact investing, blended finance, green bonds, and social impact bonds. It is important to note that innovative financing is not only about generating additional funding but also about making existing funding more effective and efficient. Innovative financing can play a significant role in transforming African food systems in several ways. Many African countries lack the necessary funding to transform their food systems. Innovative financing mechanisms like impact investing or blended finance can mobilize private capital to fill this gap. For example, the African Development Bank's (AfDB) "Feed Africa" strategy aims to attract USD 1 billion in investment to modernize Africa's agriculture sector (AfDB, 2016). Innovative financing can incentivize sustainable farming practices contributing to environmental preservation and climate change mitigation. For instance, green bonds and climate-smart loans can fund projects that reduce greenhouse gas (GHG) emissions or help farmers adapt to climate change. The Tropical Landscapes Finance Facility, for

example, issues green bonds to finance sustainable agriculture and renewable energy projects in developing countries (Louman et al., 2020). Innovative financing can also help manage the risks associated with agricultural activities. For instance, weather-index insurance products can protect smallholder farmers against climate-related risks. The African Risk Capacity, a specialized agency of the African Union (AU), provides weather insurance for member states helping them manage climate risks and protect food-insecure populations. In some cases, innovative financing may be a source of seed capital for agrifood start-ups fostering innovation and entrepreneurship. Impact funds such as AgDevCo's Smallholder Development Unit (SDU), provide long-term capital to agriculture small and medium enterprises (SMEs) in sub-Saharan Africa, supporting innovations that can transform local food systems.

Environmental-nutrition tradeoff

There are substantial trade-offs in the pursuit of environmental sustainability and nutritional adequacy. For example, reducing meat consumption can decrease GHG emissions but may also reduce the intake of essential nutrients particularly in regions where nutritional deficiencies are prevalent. Similarly, expanding the cultivation of certain crops to replace animal-based foods can lead to monocultures, which can reduce biodiversity, increase vulnerability to pests and diseases, and potentially exacerbate food insecurity if crop failure occurs. Balancing environmental sustainability and nutritional needs in transforming African food systems is a critical issue that requires a multi-faceted approach. While there is need to maintain high productivity to ensure food security, it is equally important to promote agricultural biodiversity. Diversification of crops and livestock can contribute to more balanced diets and enhanced resilience of food systems, reducing vulnerability to pests, diseases, and climate change (Frison et al., 2011). Implementing climate-smart agricultural practices such as conservation agriculture, agroforestry, and improved livestock and manure management can enhance productivity, resilience, and the capacity of agricultural systems to sequester carbon, thus contributing to both nutritional and environmental outcomes (Lipper et al., 2014). Consumption patterns also have a significant role to play. Encouraging diets that are high in plant-based foods and low in resource-intensive animal-based foods can contribute to both better health and reduced environmental impact (Lipper et al., 2014). Reducing post-harvest losses and waste, enhancing local processing to add value and increase shelf life, and improving market access can all contribute to more efficient and sustainable use of resources in the food system (Affognon et al., 2015). All in all, it is important to ensure that policies in different sectors (e.g., agriculture, environment, health, and trade) are aligned towards sustainable and healthy food systems. Fiscal and trade policies can be used to influence both production and consumption towards sustainability and nutrition goals (HLPE, 2017).

Recommendations and the Report's Key Messages

Building effective, efficient, and sustainable food systems that reflect Africa's transformation agenda requires more than a declaration. Bold actions are needed. This is the purpose of this year's report. To recover the loss in progress, regenerate Africa's agricultural transformation, and act within the limited time urgent actions are needed including:

Policy reforms to repurpose public support towards food and agriculture systems that invigorate economic recovery after the slump due to the exogenous shocks. These are outlined in a detailed stocktake of African food systems at a time of crisis (Chapter 3). The policy reforms may commence from land tenure—land governance is a proven pathway to achieving transformational change and impact that will help secure Africa's future for the benefit of all its families. With political will from African Governments and support from development partners, the plan to improve land governance in Africa could inject about USD 4.5 billion into the global economy within a decade (World Bank, 2019).

Reforms in repurposing current public expenditure towards production infrastructure investments. With an estimated infrastructure gap of up to USD 107.5 billion a year, Africa must attract private capital to accelerate the building of critical infrastructure needed to unleash its potential to be the global economic powerhouse. African countries can jump directly into the global economy by building well-targeted infrastructure to support competitive industries and sectors in industrial parks and export-processing zones linked to global markets. Poor infrastructure shaves up to 2 percent off Africa's average per capita growth rates (AfDB, 2018). By repurposing governments' efforts toward the adoption of Production and Post-

production Technology with appropriate technology, it is estimated that an additional 96 million hectares in SSA can be irrigated by smallholders potentially benefitting up to 369 million people.

Assessment of Structural Failures of African Food Systems (Chapter 2). Even though substantial progress has been made in food production, processing and distribution, significant challenges and failures persist in African food systems leading to an alarming state of food and nutrition security across the continent. There is a requirement to emphasize the systemic weaknesses contributing to these failures accenting the urgent need for integrated, cross-sectoral interventions to ensure a resilient, equitable, and sustainable food future for all. This calls for a comprehensive and multi-faceted approach to address the complexities and challenges of food systems in Africa. There is thus a strong need for collaboration, innovation, and sustained commitment from all stakeholders to reverse these failures and curtail the challenges. Furthermore, this is a roadmap for future actions guiding the continent towards food systems where every African will have access to sustainable healthy diets. There is need to build capacity for regular and systematic review of the weaknesses and strengths of African food systems. A conducive environment that fosters investments in local food production, processing, and distribution would be instrumental in reducing dependence on imports and enhancing resilience against global market shocks. The adoption and implementation of AfCFTA need to be expedited. Climate-smart agriculture is critical to mitigate and adapt to climate change and its implementation is therefore imminent. New policies need to ensure gender and youth equity, emphasize nutrition-sensitive agriculture, and foster public-private partnerships.

Revolutionizing Africa's Agrifood System Transformation (Chapter 4). This requires a holistic approach that combines enhanced agricultural productivity, improved infrastructure, enhanced market access, and climate-resilient practices to boost investment, trade, and collaboration across sectors to drive economic growth, poverty reduction, and food and nutrition security. Africa is a net importer of staple foods estimated at USD 50 billion net import bill for all food products in 2021, with USD 18 billion net import bill for sub-Saharan Africa. This could grow at least 50-60 percent and potentially double over the next 10 years. The World Bank estimates that the cost of inaction for African food systems will be roughly USD 200 billion a year, which is more than ten times the cost of acting now to adapt. Africa has the potential and natural assets to significantly increase staple food production and achieve a resilient and secure food supply and fostering equitable, coherent, and transparent food system governance will sustainably catalyze agrifood systems transformation in Africa. There is renewed urgency and optimism as well as the opportunity to learn from recent disruptions to African food systems precipitated by the war in Ukraine. The food crisis presents a valuable opportunity for the continent to engage at various levels to develop a medium-/long-term plan to build a secure, resilient, and sustainable food supply for Africa (FAO, IFAD, UNICEF, WFP & WHO, 2022). The Food Systems Transformation plan should comprise repurposed political will to reform agricultural policies along with legal, regulatory and institutional framework reforms. Second, increased investments in production infrastructures – energy/electricity, information and communication technology (ICT), and transport and water infrastructure. Third, increased investments and adoption of production and post-production technology will be necessary. Fourth, expedited implementation of the African Continental Free Trade Area (AfCFTA). Fourth, investments towards agricultural water management are denoted as a key driver for agri-food systems; USD 64 billion is required annually to meet the 2025 Africa water vision of water security for all yet only USD 10–USD 19 billion/year is invested in water infrastructure. Fifth, soil health and fertility are critical - 99 percent of Africa's soils are deficient in phosphorous and the continent's application of P fertilizers needs to increase by 8-12 times to achieve self-sufficiency in maize production by 2050. The sixth significant driver of agri-food systems is trade, which stimulates the development of value chains leading to more processing and value addition in Africa. This could help to reduce post-harvest losses, create jobs, and increase the availability of processed and value-added food products (FAO, 2022).

AfCFTA—A driver for Africa Food Systems (Chapter 5). AfCFTA has the potential to significantly transform food systems in Africa in various ways: i) increased market access; (ii) strengthened regional supply chains; and (iii) improved food security. if fully implemented, AfCFTA could raise households' income by 9 percent by 2035 and lift 50 million people out of extreme poverty. Africa could see foreign direct investment (FDI) increase by between 111 percent and 159 percent under AfCFTA. Wages would rise by 11.2 percent for women and 9.8 percent for men by

2035, albeit with regional variations depending on the industries that expand the most in specific countries. If the goals of AfCFTA are fully realized, 50 million people could escape extreme poverty by 2035 and real income could rise by 9 percent (World Bank, 2022).

Turning adversity into opportunity: How Can Demographic Dividend Empower African Food Systems? (Chapter 6). The new agriculture era plays a central role in providing productive employment and entrepreneurial opportunities for young people in Africa. In this era, solutions lie in digitalization, automation, and artificial intelligence. Tech-savvy youth can be instrumental in transforming the food systems in their nations. While the potential to harness this demographic dividend is exciting, without the necessary investments, a large and unproductive workforce could place an enormous burden on African food systems. Africa could add nearly 200 million people to the workforce by 2030, and about 800 million people by 2050 becoming home to the largest and youngest population by 2050. Taking a supply-side "labor-forward" view of this workforce opportunity and intensifying production could provide some incremental work opportunities in the agricultural sector. A demand-side "market-back" view of these demographic trends in African food systems could provide opportunities for businesses and their workforces to satisfy consumer demands. Consumer spending has been and will continue to be the biggest contributor to Africa's gross domestic product (GDP) growth. Today's world is driven by many new technologies including blockchain, artificial intelligence (AI), and the internet. Compared with older farmers, young farmers are more innovative and better adopters of modern technologies. Youth can turn this digital revolution into climate action for sustainable food systems in Africa (Mapanje & Mushongachiware, 2022).

Innovative Financing Models for Food System Empowerment (Chapter 10). Innovative financing refers to mechanisms that generate funds for investment beyond traditional methods. In the context of food systems empowerment, innovative financing can involve several approaches. These might include microfinance, crowdfunding, social impact bonds, pay-for-success contracts, and various forms of blended finance that combine public and private funding sources. Such mechanisms can provide capital to smallholder farmers, support agricultural innovation, enhance supply chain resilience, and stimulate local food economies.

Innovations and Knowledge for Food System Empowerment (Chapter 9). Innovations and knowledge are critical factors for transforming African food systems. These transformations can involve changes in how food is produced, distributed, and consumed, and can be driven by various types of innovation including technological, social, institutional, and policy innovations. Technological innovation in food systems can involve new farming techniques such as precision agriculture and vertical farming, novel food processing methods, or innovative food products (like alternative proteins). Such innovations can help increase food production efficiency, reduce environmental impact, and offer healthier, more diverse food choices. Social and institutional innovations can involve new ways of organizing and governing food systems such as alternative food networks, participatory guarantee systems, or fair-trade initiatives. These can help make food systems more inclusive, equitable, and responsive to local needs. Knowledge plays a crucial role in driving and supporting these innovations. This can involve scientific research but also traditional and local knowledge, and the sharing and co-creation of knowledge through collaboration and dialogue among diverse food system stakeholders.

Empowering Africa's Food Systems with the Digital Revolution (Chapter 7). In Africa, digitalization of food systems has already yielded a wide range of benefits such as real timely price, market, and farm-related information, safer financial transactions, value chain linkages, improved productivity and income, lower costs, and women empowerment benefits (Birner et al., 2021). In several countries in the region, the public sector, private industry, non-profit organizations, and the international community have all played important and distinct roles in creating sustainable digital food systems solutions although there is differential access to digital technologies both within and across countries (Nyström & Giacometti, 2022). Even with the progress achieved, scaling up is low and the involvement of the private sector is limited. The digital divide, long gestation periods, high initial costs, low uptake, lack of sufficient and sustainable funding, regulatory weaknesses, research, analytical and technical capacity constraints, limited knowledge, and awareness are all contributing factors to the slow pace of progress. To combat the digital divide, policies should focus on reducing the cost of communication and must be anchored in human resource policies that address low digital skills in the population, especially

among vulnerable groups, through tailored digital skills programs. To ensure private sector involvement and scaling up of digital solutions, policies need to be dynamic and incorporate appropriate regulations to spur the benefits of efficiency, social, and environmental gains, while addressing competition, taxation, data protection, and privacy concerns. Digitalization requires complementary infrastructure development and should be spearheaded by the state with support from other stakeholders (Rose and Dinesh, 2021). To achieve the digital revolution, improve farmers' access to local context-specific knowledge through kiosks managed by relevant food systems actors like farm leaders, marketing agents, and service providers. Aside from multistakeholder engagement to strengthen coordination and collaboration among digitalization actors and players, multiple streams of capacity strengthening should be pursued to train extension staff, rural development professionals, farmer producer organizations, marketing agents, associations of women groups, youth entrepreneurs, and agribusiness operators on technical and digital innovations.

Accounting for the Environmental–Nutrition Tradeoff in African Food Systems (Chapter 8). The prevailing hunger, malnutrition, and evidence of widespread environmental harm due to food production, supply, and consumption trends provide evidence of a failing food system. The increasing rates of chronic diseases, continual prevalence of malnutrition, and increasing environmental harm call for a transformation of global food systems, particularly in Africa. However, any transformation will require understanding the status of the African food basket and how it measures the desired food system outcomes. Starchy staples constitute the largest share of the African food supply. The animal-sourced food components in Africa's food supply are generally lower (247 g/capita/day) than the 334 g/capita/day recommendation in the EAT-Lancet diet. The dominance of starchy staples alongside lower animal-sourced foods and fruits and vegetable supply is accountable for the region's high burden of micronutrient (vitamin A, iron, zinc, folate, B vitamins, and calcium) deficiencies. A transformation of African food systems will require a critical focus on improving nutrition while ensuring that the current environmental impacts are not exacerbated.

Conclusion

Africa, with its vast arable lands and youthful population, holds the potential to not only ensure food security for its people but also play a crucial role in the global food system. However, the continent is still grappling with myriad challenges from climate change to infrastructural gaps and inadequate policies, which require proactive and innovative solutions.

In this report, experts have delved deep into the intricacies of African food systems highlighting both the opportunities for transformation and the challenges that lie ahead. The report's in-depth assessment and stocktaking analysis of Africa's food systems provides valuable insights into both the challenges and opportunities. Africa's rich agricultural potential combined with its diverse cultures, youthful population, and emerging technologies offers a hopeful outlook for a food-secure Africa. To capitalize on these opportunities and pave the way for a robust and sustainable food system, the following recommendations are put forth.

Infrastructure development, from rural roads to storage facilities, can significantly reduce post-harvest losses and improve market access, ensuring that farmers get better returns and consumers receive fresher produce. Fast-tracking the operationalization of AfCFTA will be a game-changer. By removing trade barriers, harmonizing standards, and facilitating intra-Africa trade, AfCFTA has the potential to trigger successful food systems transformation. When fully implemented, AfCFTA is expected to increase intra-African trade by 53 percent, and Africa's trade with the rest of the world by 15 percent.

Traditional financing models should be complemented with innovative solutions such as agri-business bonds, and green financing to drive investments into the agricultural sector and food systems at large. There is a need for cutting-edge financial strategies and models that can propel African food systems into a sustainable future and their transformation requires long-term public capital. This report calls for strong commitment to research and development in agro-tech, sustainable farming practices, and other innovative solutions that can propel Africa to the forefront of global food production. All stakeholders in African food systems

should promote systematic innovations for multiple wins such as productivity, nutrition, climate adaption, and mitigation and inclusion of smallholders, women, youth, and other disadvantaged groups. Establishing platforms for knowledge sharing should allow African countries to learn from each other's successes and challenges, accelerating transformation across the continent.

The adoption of digital tools from mobile banking to precision agriculture holds the promise to increase efficiency, reduce costs, and connect stakeholders throughout all food systems components. However, inadequate physical infrastructure, limited access to ICT, lack of relevant information, asymmetric benefits, absence of appropriate legislative and regulatory infrastructure, financial constraints, and data privacy issues are often highlighted as key concerns for the expansion of digitization in food systems.

Striking a balance between productivity and sustainability is crucial. successful transformation of African food systems will require a critical focus on improving nutrition while ensuring that current environmental impacts are not exacerbated. Governments develop policies that incentivize sustainable and productive practices. For example, initiatives that promote sustainable agricultural practices and biofortification of crops can ensure both environmental health and nutritional adequacy.

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2 Assessing Structural Failure of African Food Systems

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Key messages

1. The assessment uses a broad range of indicators covering food systems activities, outcomes, and drivers. It also highlights innovations and initiatives that are showing promise at country level.
2. Despite progress in food production, processing, and distribution, significant challenges and failures persist leading to an alarmingly poor state of food and nutrition security across the continent.
3. The assessment underscores systemic weaknesses contributing to these failures, emphasizing the urgent need for integrated, cross-sectoral interventions to ensure a resilient, equitable, and sustainable food future for all.
4. The findings of this chapter call for a comprehensive and multi-faceted approach to address the complexities and challenges of food systems in Africa. They also emphasize the need for strong collaboration, innovation, and sustained commitment from all stakeholders.

Brief on food systems

A food system encompasses all processes and infrastructure involved in feeding a population: growing, harvesting, processing, packaging, transporting, marketing, consumption, and disposal of food and food-related items (Ericksen, 2008). It also includes the inputs needed and outputs generated at each step. A food system operates within and is influenced by social, political, economic, and environmental contexts. It also interacts with other systems such as health, water, and energy. The High-Level Panel of Experts (HLPE) on Food Security and Nutrition of the Committee on World Food Security defines food systems as follows: "Food systems gather all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation, and consumption of food, and the outputs of these activities, including socio-economic and environmental outcomes." (HLPE, 2014)

This definition emphasizes the multi-dimensional nature of food systems and how they interact with human health and environmental sustainability. The concept of a food system also considers the governance, economics, and social and cultural dimensions of food. This includes the resources and processes involved in producing food, the actors and relationships involved in food production and consumption, and the outcomes of these activities including nutritional status, socioeconomic growth, and environmental sustainability (Ericksen, 2008).

A food system failure therefore implies a significant dysfunction at any or multiple stages of this chain that can disrupt the ability of the system to adequately provide food to the population. One of the first signs of a food system failure is insufficient food production. This could be due to a variety of factors such as poor agricultural practices, soil degradation, water scarcity, or extreme weather events related to climate change (IPCC, 2019).

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Even when enough food is produced, failure in the distribution system can prevent it from reaching the people who need it. Moreover, food may be physically available but not affordable to some segments of the population (FAO, 2020). High levels of food waste and loss, either post-harvest or at the consumer level, can also indicate a failure of the food system. Globally, about one-third of food produced is wasted, which speaks to systemic inefficiencies (FAO, 2011).

If a food system leads to widespread negative health outcomes such as obesity and malnutrition, or contributes significantly to environmental degradation, it could be considered failing (Global Nutrition Report, 2020). A food system's inability to withstand shocks, such as pandemics, economic crises, or climate-related disasters, and provide a stable supply of nutritious food can also be seen as a failure (HLPE, 2020).

Using the above description, it is fair to assume that African food systems face various structural failures, which can impede their ability to ensure food security and promote sustainable development. These failures stem from a combination of social, economic, and environmental factors. Smallholder farmers, who constitute a significant portion of Africa's agricultural workforce, face constraints such as limited access to modern inputs, inadequate infrastructure, and lack of technical knowledge. These challenges hinder productivity and exacerbate food insecurity (Jayne et al., 2014). Africa is highly vulnerable to climate change, experiencing extreme weather events such as droughts and floods. These climatic risks disrupt agricultural production, leading to crop failures, livestock losses, and reduced food availability. Many African countries struggle with fragmented markets, inadequate transportation networks, and limited storage and processing facilities. These challenges hinder farmers' ability to access markets, leading to post-harvest losses and reduced income. Incoherent policies, weak institutional frameworks, and limited financial resources hamper the development of the agricultural sector in Africa. Inadequate support for research, extension services, and farmer organizations restricts innovation and resilience. Insufficient storage facilities, inefficient value chains, and inadequate processing technologies contribute to significant post-harvest losses in African agriculture. These losses diminish food availability and income for farmers.

The objective of this chapter is to assess the failure or underperformance of different components of African food systems using existing vulnerability indices. Based on evidence, the chapter provides recommendations for policy and practice to improve the resilience of these food systems and prevent failure.

Why assess Africa's food systems failure?

Africa's food systems are prone to various shocks and stressors largely due to factors such as climate variability, economic volatility, political instability, and public health crises. These factors can pose significant challenges to the continent's food security. Africa is particularly vulnerable to climate-related shocks, including droughts, floods, and erratic rainfall, which can have devastating effects on crop production and livestock health. This vulnerability is exacerbated by the fact that many African countries rely heavily on rain-fed agriculture (IPCC, 2014).

Fluctuations in global commodity prices, sudden changes in exchange rates, or economic recessions can significantly impact the affordability and availability of food. The COVID-19 pandemic has further demonstrated the vulnerability of Africa's food systems to such economic shocks (FAO, 2020). Political instability, conflicts, and governance issues can disrupt food production and distribution, prevent humanitarian aid from reaching those in need, and lead to population displacement, all of which increase food insecurity (World Bank, 2020).

Epidemics and pandemics can disrupt food systems by impacting labor availability for agricultural activities, altering trade patterns, and straining social protection systems. The Ebola crisis and the COVID-19 pandemic have shown how health crises can affect food security (FAO, 2020). Rapid population growth and urbanization in Africa pose additional stressors to the region's food systems as they increase demand for food and can lead to unsustainable agricultural practices (UN, 2019).

Shocks to food systems can have severe economic impacts, particularly for countries where a significant proportion of the population is engaged in agriculture. Identifying failures can help mitigate these economic impacts. Identification of failures can also help in planning and policymaking for sustainable development. This includes policies related to agriculture, rural development, environment, and social protection. In many African countries, food system failures lead to conflicts, particularly over scarce resources. Identifying these failures can contribute to conflict prevention and peacebuilding efforts.

By identifying failures, appropriate interventions can be implemented to enhance the resilience of food systems thus improving food security. A resilient food system can better withstand shocks and stressors ensuring continuous and adequate access to food. Failures can lead to reduced food variety and quality negatively impacting the nutritional status of populations. Identifying and addressing these failures is key to improving nutritional outcomes.

Methods and data

Identifying a point of failure in a food system requires a thorough understanding of the entire food system continuum and its interrelated components from food production to consumption and waste disposal. This could include decreases in crop yield or livestock production due to a variety of factors such as soil degradation, water scarcity, loss of biodiversity, or the impact of climate change (IPCC, 2019).

Failure can be the result of supply chain disruptions. These could be caused by infrastructure problems, logistical issues, market failures, or trade restrictions that prevent food from being transported from areas of surplus to areas of deficit (FAO, 2020). Even when food is available, if people cannot afford it or physically access it due to factors such as poverty, conflict, or geographical remoteness, this can indicate a point of failure in the food system (World Bank, 2018).

If food cannot be safely stored, processed, and consumed or if it lacks the necessary nutritional quality, this is a critical point of failure (World Health Organization, 2015). High levels of food waste and loss at any stage of the food system can indicate a system failure (FAO, 2011).

A comprehensive assessment of every point of failure in African food systems is beyond the scope of this chapter. Instead, following Ulimwengu et al. (2020), we compare the average values (benchmarks) of world vulnerability indices against Africa's. When an increasing index is expected, three clusters are defined: i) Africa's average is above or equal to the upper benchmark[3]; ii) Africa's average is between the upper and the lower benchmarks; and iii) Africa's average is below the lower benchmark (failure).

3 For some indicators, higher values represent better outcomes; for others it is the reverse; this chapter therefore defines benchmarks (upper/lower) based on the type of indictor: upper/lower benchmark =1.15/.85*world average; the 15 percent boundaries around the world average are arbitrarily set to differentiate between countries which are closer to the average and those which are not.

Given the wide range of indices included in this chapter, world averages provide a general standard to compare how individual countries are performing. Many development indicators tie into international agreements and targets such as the Sustainable Development Goals (SDGs). Using global averages can provide a reference point to gauge progress towards these shared goals. By comparing African countries to global averages, one can identify gaps and areas of disparity. This is important for policy planning, resource allocation, and attracting international assistance or cooperation.

Considering that the relationship between food system failure and vulnerability is deeply intertwined, this paper uses available vulnerability indices to identify points of food system failure. A food system prone to vulnerability is more likely to fail when faced with various shocks or stressors. A vulnerable food system can be highly sensitive to shocks such as climate change, economic volatility, conflict, or disease outbreaks. For example, a system reliant on a single type of crop (low diversity) can be highly vulnerable to a failure in food availability if a disease affects that crop (IPCC, 2014). On the other hand, food systems can fail because of existing vulnerabilities. For instance, the COVID-19 pandemic exposed vulnerabilities in global food systems including weaknesses in food supply chains and inequities in food access (HLPE, 2020).

There can also be feedback loops between food system failure and vulnerability. For example, repeated failures can make a food system more vulnerable over time by depleting resources, increasing dependence on external aid, or eroding trust and social cohesion (FAO, 2016).

Table 1 (in Annex 1) provides the list of vulnerability indicators per food systems components and sources. This chapter dropped some indicators and merged others depending on the availability of data from both a quantity and quality perspective. Below is a brief description of each data source.

As described below, these indicators are drawn from different sources. They are further grouped into different food systems components following Ericksen (2008). These include food systems activities, outcomes, and drivers. Moreover, for harmonization, this chapter rescaled certain indicators by multiplying or dividing by 10,100 or 1000. Hence, an index with (*,**,***) or (#,##,###) means it was multiplied or divided by 10,100 or 1000. This does not change the ranking.

United Nations Economic Vulnerability Index (EVI)[4]

The EVI is a measure of structural vulnerability to economic and environmental shocks. High failure indicates major structural impediments to sustainable development. The EVI is composed of eight indicators, grouped into an economic and environmental sub-index with each indicator carrying an equal weight of 1/8. Original values for each EVI indicator are converted into index numbers using a max-min procedure.

University of Notre Dame Global Adaptation Index (UN-GAIN)[5]

The Notre Dame-Global Adaptation Index (ND-GAIN) Country Index is a free open-source index that shows a country's current vulnerability to food system disruptions. ND-GAIN's Vulnerability Index uses 45 core indicators to measure vulnerability from 1995 to the present. ND-GAIN assesses vulnerability through six life-supporting sectors: food, water, health, ecosystem services, human habitat and infrastructure. Each sector is in turn represented by six indicators.

Global Food Security Index[6]

The Global Food Security Index (GFSI) is a dynamic, robust quantitative and qualitative benchmarking model that provides an objective framework for understanding the drivers and challenges of food security in countries around the world. The GFSI measures the fundamental aspects of food security across three core issues: i) Affordability, which measures the ability of consumers to purchase food, their vulnerability to price shocks, and the presence of programs and policies to support consumers when shocks occur; ii) Availability: this considers the sufficiency of the national food supply, the risk of supply disruption, national capacity to disseminate food, and research efforts to expand agricultural output; and iii) Quality and safety: this takes into account the variety and nutritional quality of average diets as well as food safety.

4 United Nations. 2022. EVI Indicators. https://www.un.org/development/desa/dpad/least-developed-country-category/evi-indicators-ldc.html

5 University of Notre Dame. 2022. University of Notre Dame Global Adaption Index. https://gain.nd.edu/

6 Economist impact. 2022. Global Food Security Index (GFSI). https://impact.economist.com/sustainability/project/food-security-index/

Results and discussion

Food systems activities

Access to agricultural inputs and services

As shown in Figure 2.1, Africa as a whole is way below the lower benchmark for all indicators for agricultural inputs and services. Going by this chapter's classification, this indicates potential structural failure which is likely to affect the rest of food system.

Lack of access to agricultural inputs and services can indeed have a significant impact on food systems. Key inputs and services include quality seeds, fertilizers, agricultural machinery, irrigation systems, advisory services, credit, and insurance. Without these, farming can become less efficient and productive leading to potential failures in food systems. Without access to services such as agricultural insurance and credit, farmers are highly vulnerable to risks such as weather events or price fluctuations, which can lead to crop failure and financial losses thereby threatening the stability of food systems. Limited access to extension services that provide training and advice on sustainable farming practices can lead to land degradation, loss of biodiversity, and depletion of water resources, which undermine the sustainability of food systems. Overall, lack of access to agricultural inputs and services can contribute to food system failures by reducing productivity, increasing vulnerability to risks, promoting unsustainable practices, limiting market access, and inhibiting innovation and adaptation. Ensuring broad access to these inputs and services is therefore essential for a resilient and sustainable food system.

Agricultural research and development

Like with access to agricultural inputs and services, Africa is lagging in terms of agricultural research and development (R&D) (Figure 2.2). The gap is more pronounced for commitment to innovative technologies where Africa represents only 58.9 percent of the world average. While agricultural R&D is not the only factor affecting Africa's food systems, it is a crucial component that can trigger a chain of failures if not adequately supported. Therefore, investing in agricultural R&D should be a priority for African governments and international development partners.

R&D plays a crucial role in improving productivity, enhancing food security, and promoting sustainable agricultural practices. It is pivotal in enhancing agricultural productivity by developing new technologies, crop varieties, and farming practices.

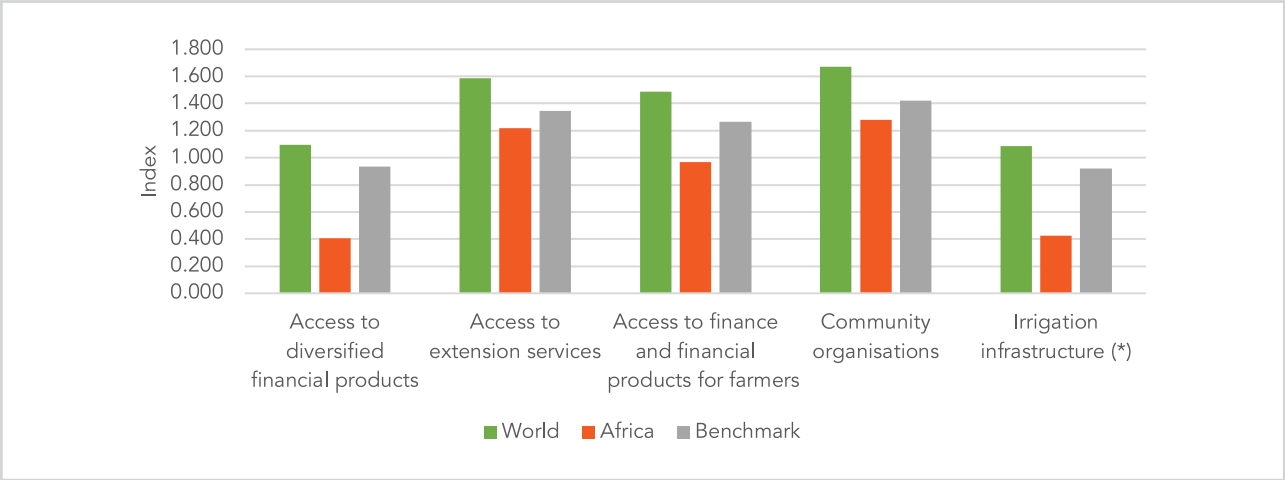

Figure 2.1: Agricultural inputs and services
Source: Authors

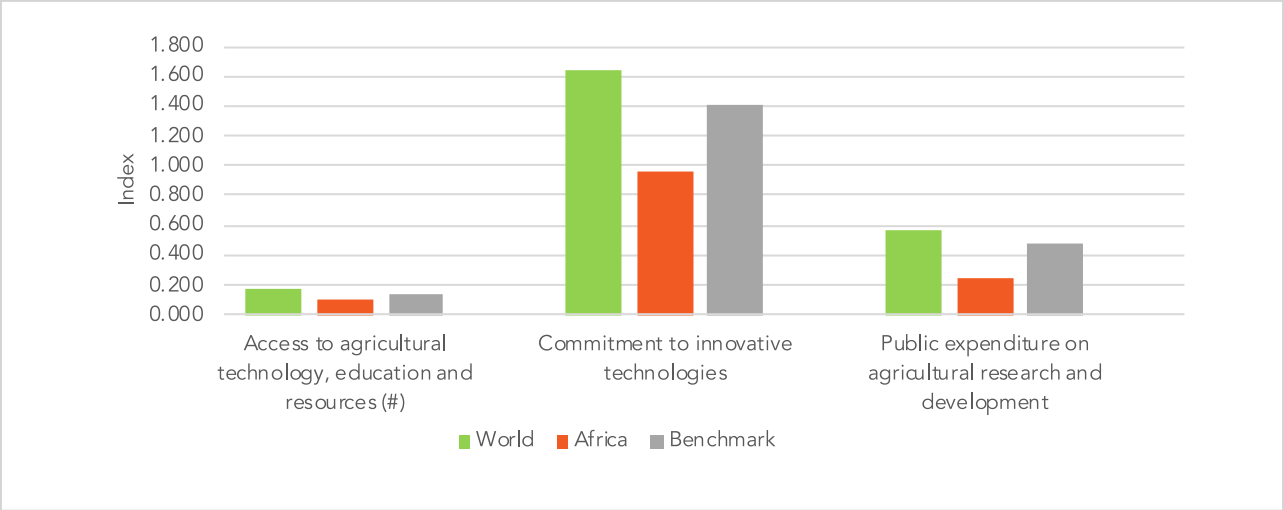

Figure 2.2: Agricultural research and development
Source: Authors

Limited investment in agricultural R&D can impede the growth of productivity leading to stagnant or declining food production (Evenson and Gollin, 2003). Research helps in the development of solutions such as the production of climate-resilient and pest-resistant crop varieties. Without sufficient R&D, farmers may be more vulnerable to the impacts of climate change and pest outbreaks leading to increased food insecurity. R&D in agriculture also contributes to improving the nutritional quality of food crops through biofortification and other means. Lack of research could lead to calorie-rich but nutrient-poor diets exacerbating malnutrition and other health problems (Bouis and 2017).

Agricultural production

Agricultural production plays a vital role in shielding Africa food systems against structural failure. Increased agricultural production can lead to greater food availability, which is a key pillar of food security. Higher yields can reduce dependence on food imports making countries less vulnerable to global food price fluctuations or disruptions to international supply chains (FAO, 2020). Moreover, agriculture is a main source of income for many households in Africa. Enhancing agricultural productivity can therefore boost income levels, reduce poverty, and enable households to afford a more varied and nutritious diet, thereby improving food access, another key pillar of food security (World Bank, 2019).

Figure 2.3 paints a mixed picture of agricultural production with the most significant findings highlighted below.

The continent is still paying farmers less than 85 percent of the world average. Ensuring fair farmgate prices is a critical component of promoting food security, reducing poverty, enhancing agricultural productivity, and ensuring the long-term sustainability of Africa's food systems. It is important for both domestic policies and international trade rules to consider the impacts of farmgate prices on small-scale farmers.

Food loss and waste is a significant problem in Africa's food systems and impacts food security, economic growth, and environmental sustainability. While exact figures can vary, the magnitude and impacts of the problem are considerable. In sub-Saharan Africa, food loss is estimated at 15.9 percent and 17.2 percent in quantity and in caloric value (FAO, 2019). In Africa, food loss primarily occurs during harvesting, storage, processing, and distribution. This is often due to inadequate infrastructure, lack of access to markets, limited agro-processing facilities, and poor storage capabilities.

Sustainable agriculture, defined as practices that meet current food and textile needs without compromising the ability of future generations to meet their needs, is a critical goal for the African continent. However, Africa faces multiple challenges in achieving this goal. The African agriculture sector often suffers from underinvestment, both from domestic governments and international donors. This restricts the sector's ability to implement and scale sustainable farming practices. The adoption of new technologies, including sustainable farming practices, is often low in Africa due to factors such as lack of access to credit, lack of information, high perceived risks, and limited capacity to innovate. Policies and institutions that support sustainable agriculture, including agricultural research and extension services, land tenure systems, and regulatory frameworks for agri-environmental practices, are often weak or lacking on the continent.

Cereal yields in Africa are still very low compared to the world average. Low cereal yields can directly lead to reduced food availability, threatening food security. This can be particularly problematic in Africa where a significant proportion of the population relies on cereals such as maize, rice, and sorghum as staple foods. African countries with low cereal yields may become more dependent on food imports, which can expose them to global food price spikes and trade disruptions. This can in turn increase the vulnerability of their food systems (Clapp, 2017). To improve cereal yields, interventions are needed at multiple levels including enhancing access to improved inputs, promoting sustainable soil management practices, improving pest and disease management, expanding irrigation, and implementing climate-smart agriculture practices.

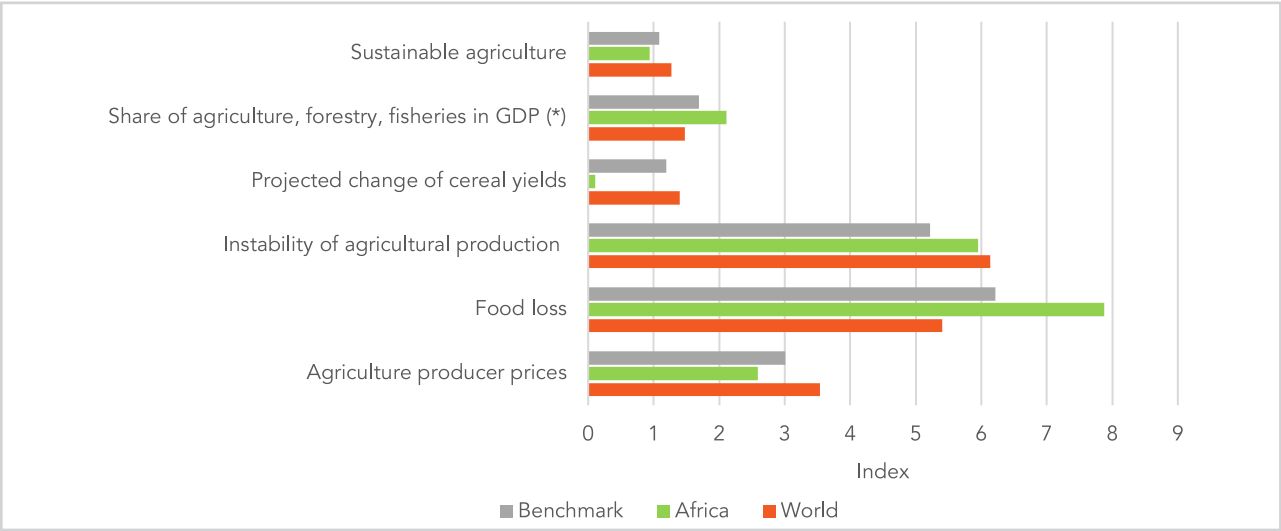

Figure 2.3: Agricultural production
Source: Authors

The food system outcomes

Food availability

Food availability is a critical component of food security, and its disruption can significantly increase the failure of food systems. Extreme weather events such as droughts, floods, or heatwaves can significantly reduce food availability by damaging crops and livestock. This is especially a concern as climate change increases the frequency and severity of such events. For example, southern Africa experienced severe droughts in the 2019/2020 growing season. This led to a significant decrease in maize production, a staple food in the region (FAO, 2020). Pests and diseases can also significantly affect food availability; the 2020 locust infestation in East Africa devastated crops and threatened food availability for millions of people in the region (FAO, 2020). Economic downturns or inflation can reduce people's purchasing power, limiting their access to food. This was evident during the 2007-2008 food price crisis, which led to increased food insecurity worldwide due to reduced access to food. Similarly, the COVID-19 pandemic-induced recession has significantly impacted people's ability to afford food, particularly in low-income communities (World Bank, 2020).

With respect to food availability, as shown in Figure 2.4, Africa is failing on economic availability as there are too many people under the poverty line and income inequality is high here compared to the world average. Access to market data and mobile banking is still a challenge and the continent's dependency on chronic food aid is high compared to the world average although it is below the lower benchmark. However, the dietary availability of key micronutrients such as zinc, vitamin A, and iron is higher here than the world average and change in average food costs is way below the lower benchmark.

Food utilization

Food utilization, another critical dimension of food security, refers to how the body uses food to meet its needs. It involves dietary diversity, adequate energy intake, and the body's ability to absorb and use nutrients in the food consumed. Poor food utilization can constitute a failure in food systems.

As expected, food utilization is one of the failing components of Africa food systems. As shown in Figure 2.5, except for prevalence of obesity, all other indicators are above the upper benchmark indicating a poorer performance than the world average.

Even when sufficient food is available, poor utilization due to inadequate diets or illness can lead to malnutrition, including undernutrition, micronutrient deficiencies, and being overweight or obese. This can have severe health consequences, particularly for children, who may suffer from stunting, wasting, and cognitive deficits. Poor food utilization can also be caused by or contribute to infectious diseases. For example, diarrhea diseases can inhibit nutrient absorption, while malnutrition can weaken the immune system and make individuals more susceptible to infections (Thapar & Sanderson, 2004). Finally, contaminated food can lead to illnesses,

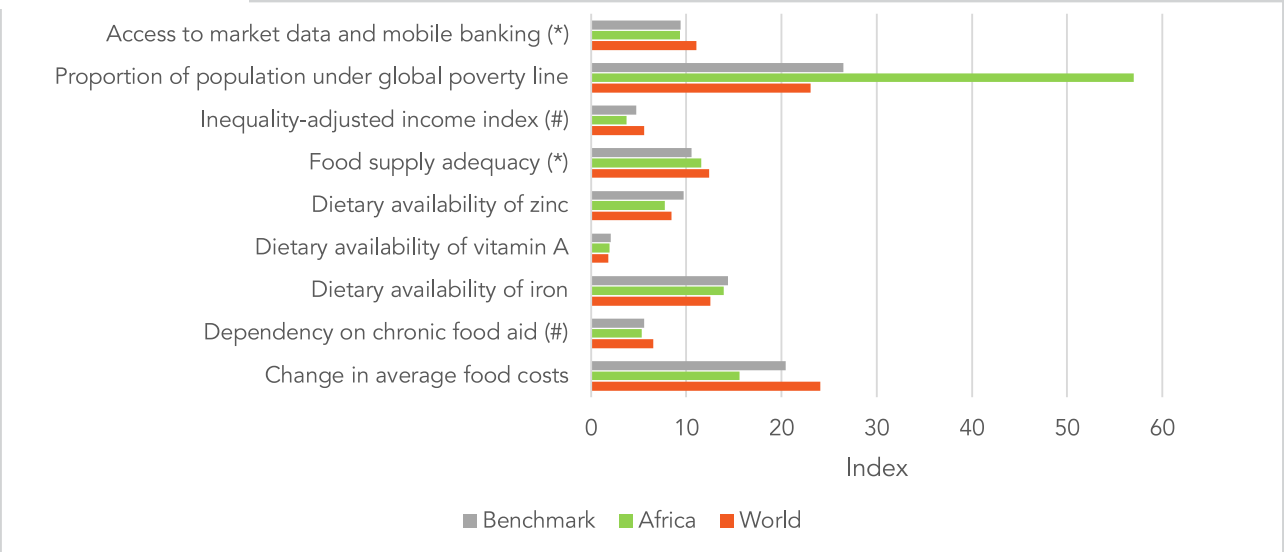

Figure 2.4: Food availability[7]

7. Due to insufficient data, indicators for food availability, accessibility, processing and retailing are combined in this chapter.

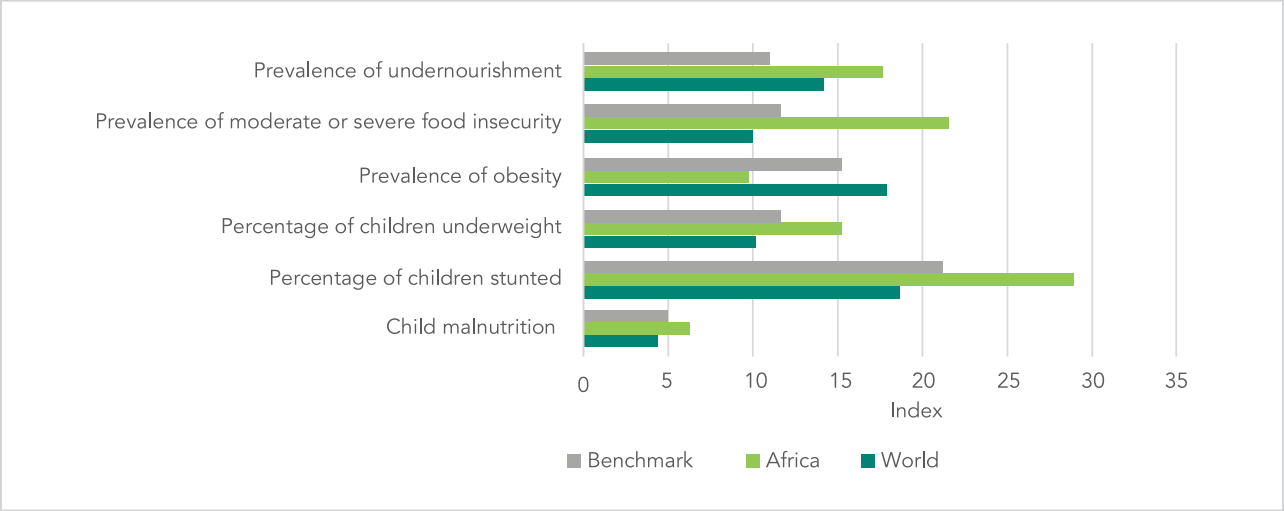

Figure 2.5: Food utilization
Source: Authors

which can inhibit nutrient absorption and utilization. Issues of contamination include microbial contamination, pesticide residues, and aflatoxin contamination (fungal), which is a significant problem in some African countries.

Drivers of food systems

Food safety nets programs

Regarding specific policy programs such as food safety nets, Africa is below the benchmark on three (coverage, funding, and operation) of the four indicators (Figure 2.6). The continent is slightly below the world average index but above the benchmark on the presence of food safety net programs. In other words, while the continent hosts a decent number of food safety net programs, their management is still very poor due to several factors including lack of data, political interference, or logistical challenges, especially in remote or conflict-affected regions. Food safety net programs are critical to ensuring food security and resilience of food systems, especially for vulnerable populations. Their absence or ineffectiveness can indeed contribute to the failure of food systems, particularly in Africa.

In the absence of effective food safety nets, households are more vulnerable to shocks such as droughts, floods, or economic crises that can disrupt local food production or make food unaffordable. This can lead to severe food insecurity and malnutrition (World Bank, 2018). Food safety net programs are crucial

8 Due to insufficient data, indicators for food availability, accessibility, processing and retailing are combined in this chapter.

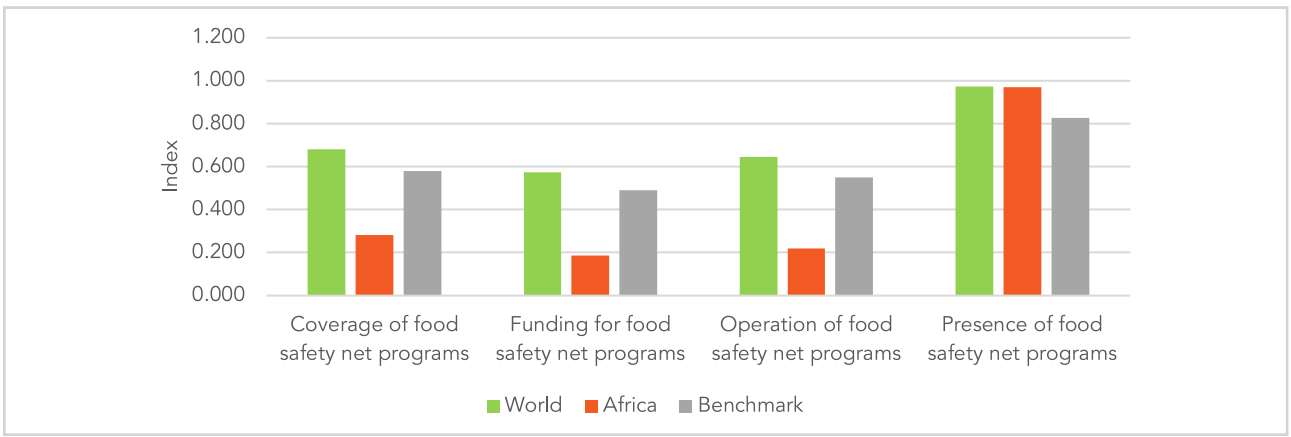

Figure 2.6: Food safety nets programs
Source: Authors

for alleviating poverty and reducing inequality, both of which can influence food security. Without such programs, the poor may not have sufficient resources to access food leading to malnutrition and other health problems (FAO, 2017). Lack of food safety nets can also affect long-term development outcomes. Malnutrition, particularly among children, can have long-term impacts on physical and cognitive development, affecting productivity and economic growth in the long run (UNICEF, 2019). In times of food crises, the absence of effective food safety nets can lead to social unrest, which can further destabilize food systems and disrupt food production and distribution (WFP, 2020).

Water quality and availability

Water plays a critical role in all aspects of food systems from production to processing; its availability and quality can significantly contribute to the failure of these systems. All water indicators point to high concern for Africa with access to reliable drinking water and dam capacity below the point of failure and freshwater withdrawal rate and water dependency ratio far above the benchmarks (Figure 2.7).

Water is a critical component of food systems and its availability, quality, and management can greatly impact their vulnerability. Water scarcity can severely limit agricultural production, especially in regions that rely on rain-fed agriculture. This can directly impact food security by limiting the amount and diversity of food produced. Conversely, too much water due to flooding can also damage crops and reduce yields. Climate change can affect water availability through changes in precipitation patterns and increased evaporation rates. In many parts of Africa, this could lead to increased water stress making agriculture a more challenging endeavour and contributing to food insecurity (IPCC, 2014). Access to and management of irrigation systems can play a vital role in enhancing agricultural productivity. However, many regions in Africa have limited access to such systems thereby increasing vulnerability to water stress.

Land and soil degradation

The levels of forest change and grassland in Africa are similar to those in the rest of the world (Figure 2.8). However, land degradation is higher than the benchmark while the continent's soil organic content falls below the benchmark. Land degradation, which includes soil erosion, desertification, deforestation, and loss of biodiversity poses a significant risk to food systems, especially in Africa where agriculture forms the backbone of many economies and sustains the livelihoods of many people. Land degradation can reduce the productivity of agricultural land lowering crop yields and the supply of food. This can cause food prices to rise, negatively affecting food security (Lal, 2015). Degraded lands often have less capacity to absorb or store water, making them more vulnerable to drought and other extreme weather events associated with climate change. This can exacerbate food system vulnerabilities particularly for communities that are heavily dependent on rain-fed agriculture (IPCC, 2019).

Trade

Trade can have both positive and negative impacts affecting food availability, access, utilization, and stability. It can enhance food availability and diversity by enabling countries to import food that they

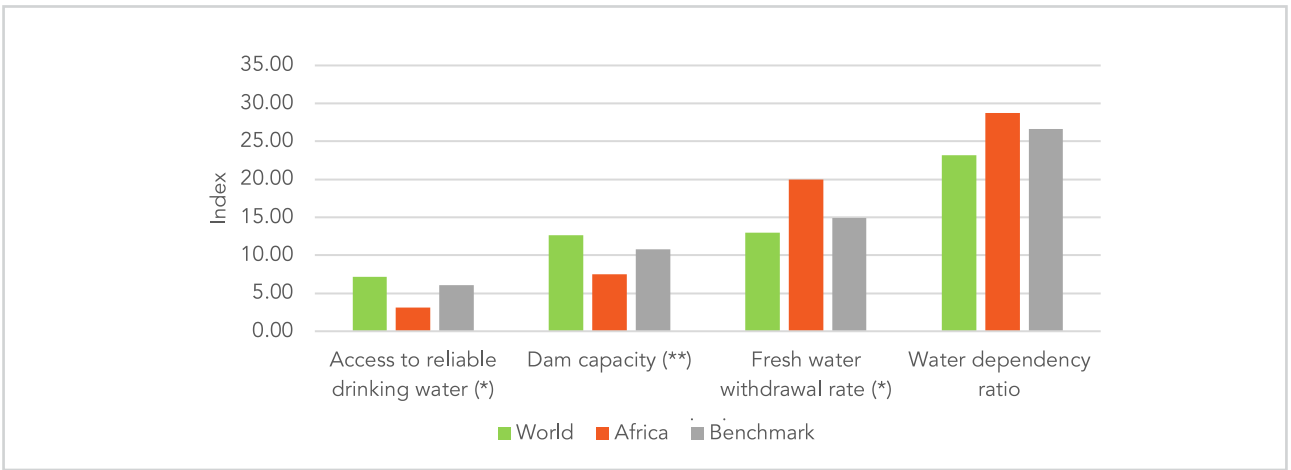

Figure 2.7: Water
Source: Authors

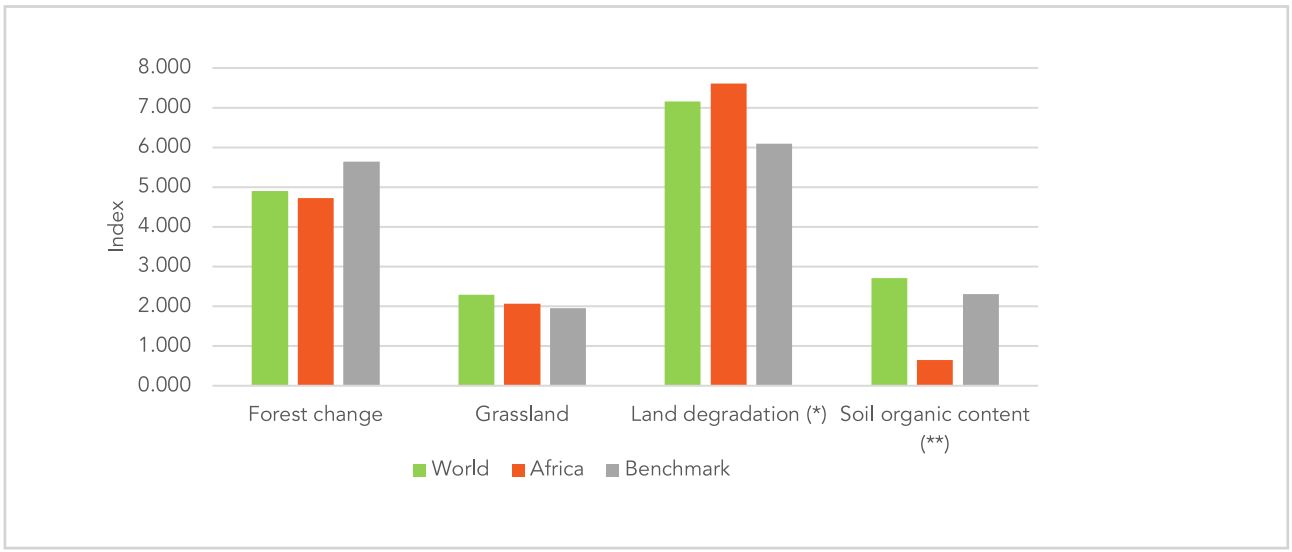

Figure 2.8: Land and soil
Source: Authors

cannot produce efficiently or in sufficient quantities themselves. For example, countries with limited agricultural capacity due to adverse climatic conditions can still ensure food availability through imports. Trade that subscribes to good international standardization guidelines can help stabilize food prices by smoothing out regional supply and demand imbalances. For instance, if a crop failure occurs in one part of the world, imports from other regions can help mitigate the impact on food prices. However, global food markets can be subject to significant price volatility influenced by factors such as energy prices, exchange rates, and market speculation. Such volatility can pose risks to food security particularly in countries that are heavily reliant on food imports. Trade barriers such as tariffs and quotas can limit access to food while disruptions to trade due to conflicts, policy changes, or logistical challenges can create food shortages and increase prices (FAO, 2020).

Except for "trade freedom", Africa's position in trade is systematically below the benchmark (Figure 2.9). Most significant is instability in the export of goods and services, high dependency on food import, and high agricultural import tariffs compared to other regions.

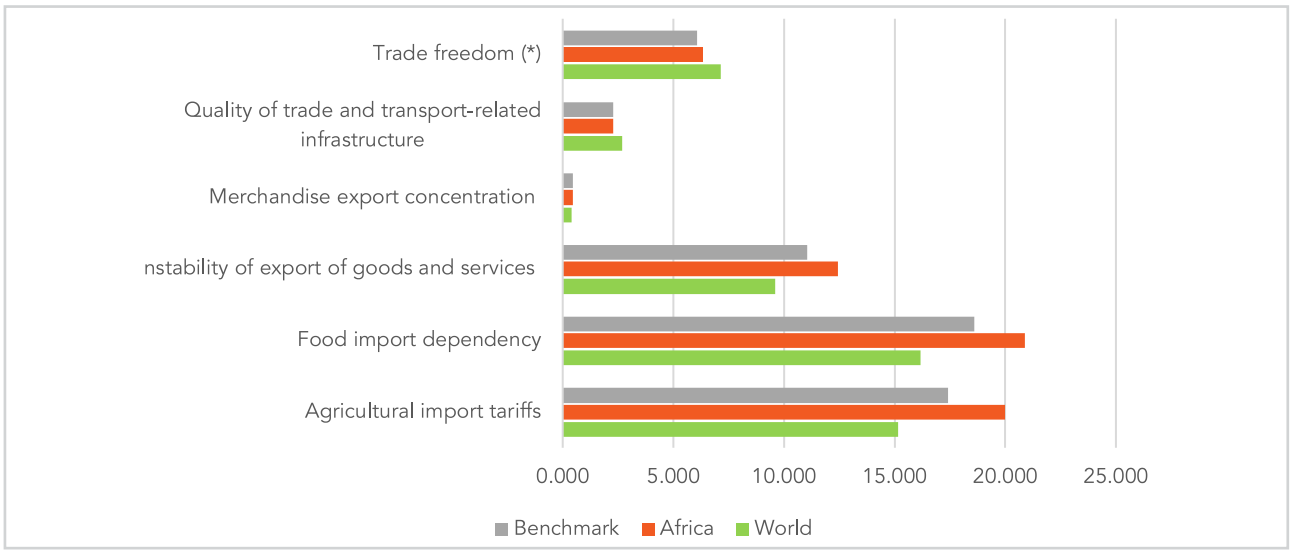

Figure 2.9: Trade
Source: Authors

Many African economies rely heavily on the export of a few key commodities for a significant portion of their income. When export markets are unstable, this can lead to fluctuations in national income, which can have knock-on effects on food systems. For instance, it can disrupt investment in agricultural development and infrastructure, affecting food production (World Bank, 2015). Export instability can undermine food security. For example, if a country relies on exporting certain commodities to earn the foreign exchange necessary to import food, fluctuations in export earnings can disrupt the ability to import the necessary food items, thus affecting food availability (FAO, 2019).

A high dependency on food imports can create vulnerabilities in Africa's food systems in several ways. Countries that are highly dependent on food imports can be significantly adversely affected by global food price volatility. Sudden increases in global food prices can lead to increased food prices domestically, exacerbating food insecurity (FAO, IFAD, UNICEF, WFP and WHO, 2017). Importing food requires foreign currency and countries with limited foreign exchange reserves may struggle to finance the necessary food imports. Moreover, high spending on food imports can strain fiscal resources, diverting funds away from other important areas such as infrastructure development or education. High dependence on food imports can also undermine the development of the domestic agricultural sector. It can discourage investment in local food production leading to reduced agricultural productivity and resilience (UNCTAD, 2013).

In some cases, high agricultural import can potentially induce failure. Import tariffs make imported food more expensive, which can increase food prices overall especially in countries that are heavily reliant on food imports. Increases in food prices can exacerbate food insecurity among vulnerable populations and import tariffs can limit the variety of food available in the market, which could negatively impact diet diversity and nutritional outcomes (World Bank, 2020). While import tariffs are often used to protect domestic producers from foreign competition, they can also discourage efficiency and innovation by insulating domestic producers from global market signals and competition (OECD, 2018). Import tariffs are not only applied to food but also to agricultural inputs like fertilizer, machinery, or seeds. Higher costs for these inputs can lower the productivity of domestic agriculture.

Demographic shifts

Demographic shifts such as population growth, aging, urbanization, and migration can trigger food systems failure. The demographic indicators included in this chapter suggest a high risk of failure for African food systems (Figure 2.10). The rapid growth of informal settlement populations in the region can contribute to the vulnerability and potential failure of food systems for several reasons.

Informal settlement dwellers often face high levels of food insecurity due to low incomes, unstable employment, and limited access to affordable and nutritious food. High food prices in urban areas compared to rural areas further compound this issue

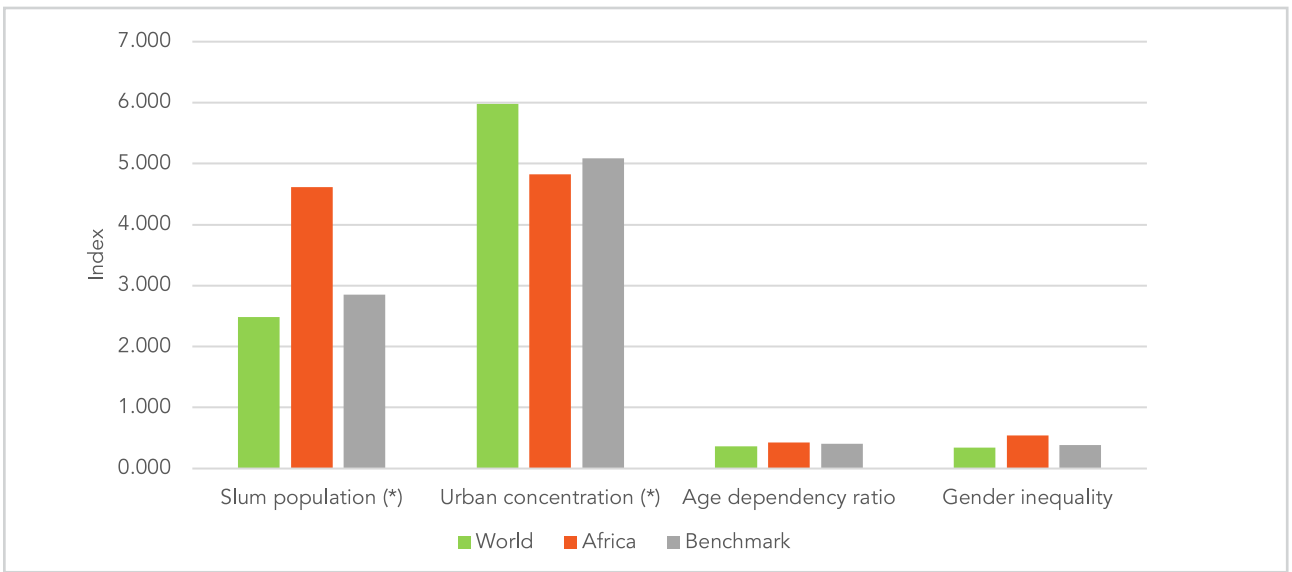

Figure 2.10: Demographic shifts
Source: Authors

(Tacoli, 2017). Urban informal settlement dwellers typically have limited access to land for agriculture making them highly dependent on food purchases rather than production. This makes them particularly vulnerable to food price fluctuations (Rakodi, 1999). Poor infrastructure such as inadequate water, sanitation, and waste management systems in these areas can create environments conducive to the spread of diseases. This can directly impact the health and nutrition status of populations in informal settlements and indirectly affect food systems by reducing the productive capacity of these populations (Corburn and Riley, 2020).

Age dependency ratio is a measure of the number of dependents (people younger than 15 years or older than 64 years) compared to the working-age population (people aged 15-64 years). A high age dependency ratio can potentially create a risk of failure for Africa's food systems. In many African countries, agriculture is labor-intensive. A high age dependency ratio means there are fewer working-age people to contribute to agricultural labor, which can decrease agricultural productivity. A high age dependency ratio means a larger proportion of people need to be fed relative to those who can work and produce food. This can increase pressure on the food supply and potentially exacerbate food insecurity.

Urban concentration, that is, population density within urban areas, also has an impact on food systems. As the world becomes more urbanized, the number of people living in cities continues to rise leading to higher concentrations of people in urban areas. As urban concentration increases, food demand shifts from staple crops to more diverse diets including fruits, vegetables, and animal products. This can stimulate transformation in the agriculture sector to meet these changing demands. Urban concentration necessitates more complex food supply chains, which can contribute to the transformation of food systems. This includes the increased need for food storage, transportation, processing, packaging, and retailing (Reardon et al., 2019). It can exacerbate issues related to food security such as access to and affordability of healthy food and drive changes in policy and innovation to ensure that urban populations have reliable access to nutritious food (Battersby & Watson, 2018).

Women play a pivotal role in African food systems and gender inequality can create significant risks for the functioning and resilience of food systems in Africa. However, women's roles in and contributions to various aspects from production and processing to distribution can be both challenging and transformative, given the socio-economic and cultural dynamics of different African regions. Women often have less access to important resources such as land, credit, agricultural inputs, technology, and training compared to men. This gender gap can significantly limit agricultural productivity. Women are commonly responsible for food preparation and childcare, and their knowledge and resources are crucial for household food security and nutrition. Gender inequality can limit their access to resources and opportunities, leading to negative outcomes for food security and nutrition (World Bank, 2015).

Disaster management

On disaster management, Africa is failing except for disaster preparedness where its index is higher than 85 percent of world level (Figure 2.11). Effective disaster management plays a crucial role in mitigating the impact of shocks on food systems and preventing system failure. Whether natural (such as floods, droughts, or hurricanes) or human-induced (such as conflicts or economic crises), shocks and stressors can have severe effects on food production, distribution, and access. There is need for programs that include measures to proactively prevent new disaster risks, reduce existing ones, and manage residual risks. For example, implementing early warning systems for droughts or floods can help farmers prepare and potentially reduce the impact on crop yields. After a disaster, efforts focused on rebuilding and rehabilitating food systems can help restore food production and distribution quickly, preventing long-term food shortages. This might include supporting farmers to replant crops after a flood, or rebuilding infrastructure to enable the transport of food to markets (World Bank, 2015).

Governance

The continent's poor governance is quite alarming. Africa's average is below the benchmark in seven of the ten indicators included in the governance section. In other words, Africa still has a long way to go to improve the quality of its governance as part of overall effort to transform African food systems (Figure 2.12).

In this context, governance refers to the way power is exercised in the management of a country's economic and social resources. When governance is weak, it can have a negative effect on food systems. Poor governance can lead to ineffective policy implementation, which can have a detrimental impact

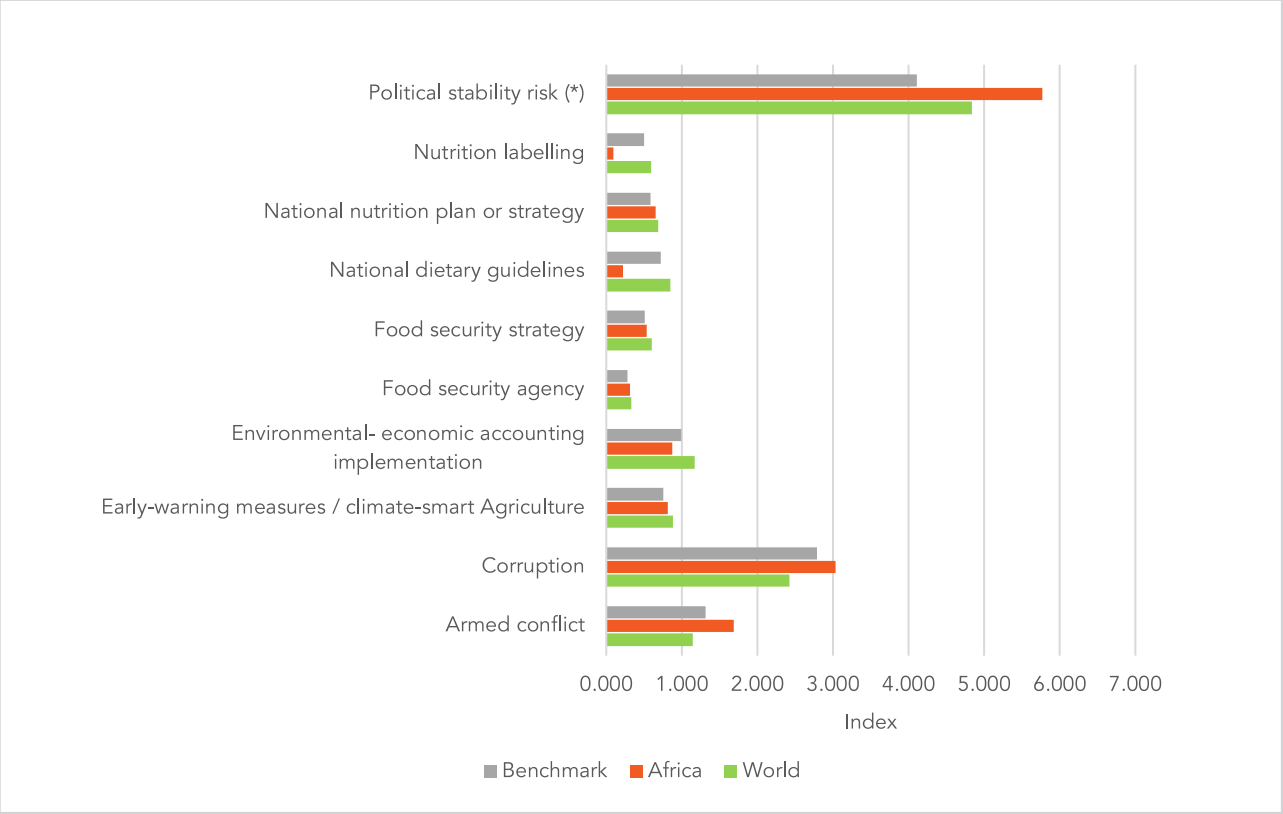

Figure 2.12: Governance
Source: Authors

on various aspects of food systems such as agricultural productivity, food security, and sustainability. For example, policies aimed at supporting smallholder farmers or promoting sustainable farming practices may not achieve their intended outcomes if not implemented effectively (FAO, 2016).

Corruption can distort food systems for example by diverting public resources away from necessary investments in agriculture, food storage, and distribution systems. This can also deter private investment and stifle innovation. Poor governance can exacerbate inequalities, including those based on class, ethnicity, and gender. These inequalities can in turn lead to social unrest, which can disrupt food production and distribution (World Bank, 2017). It can also erode public trust in institutions, which can undermine collaborative efforts to transform food systems and adapt to challenges such as climate change (OECD, 2013).

Energy and roads

As expected, Africa's position with respect to electricity access and paved roads is far from the desired state (Figure 2.13). While its remoteness and landlockedness is slightly below the world average, it is still above the failure benchmark.

The average rate of access to electricity in sub-Saharan Africa has been reported to be approximately 48 percent (UNCTAD, 2023). However, this average conceals significant disparities between countries and between rural and urban areas. In many urban areas, access to electricity can be relatively high while in rural areas, it can be extremely low. For instance, in countries such as Burundi and Chad, less than 10 percent of the population has access to electricity. Several countries have made significant strides in increasing access to electricity, thanks in part to the expansion of grid infrastructure and the rise of off-grid solutions such as solar home systems and mini-grids. For example, Kenya's access rate nearly tripled in five years rising from 27 percent in 2013 to 75 percent in 2018 partly due to the Government's ambitious electrification efforts and the growth of the off-grid solar industry (UNCTAD, 2023).

Africa has approximately 31 kilometers of paved road per 100 square kilometers of land compared to 134 kilometers of paved road for the same area in

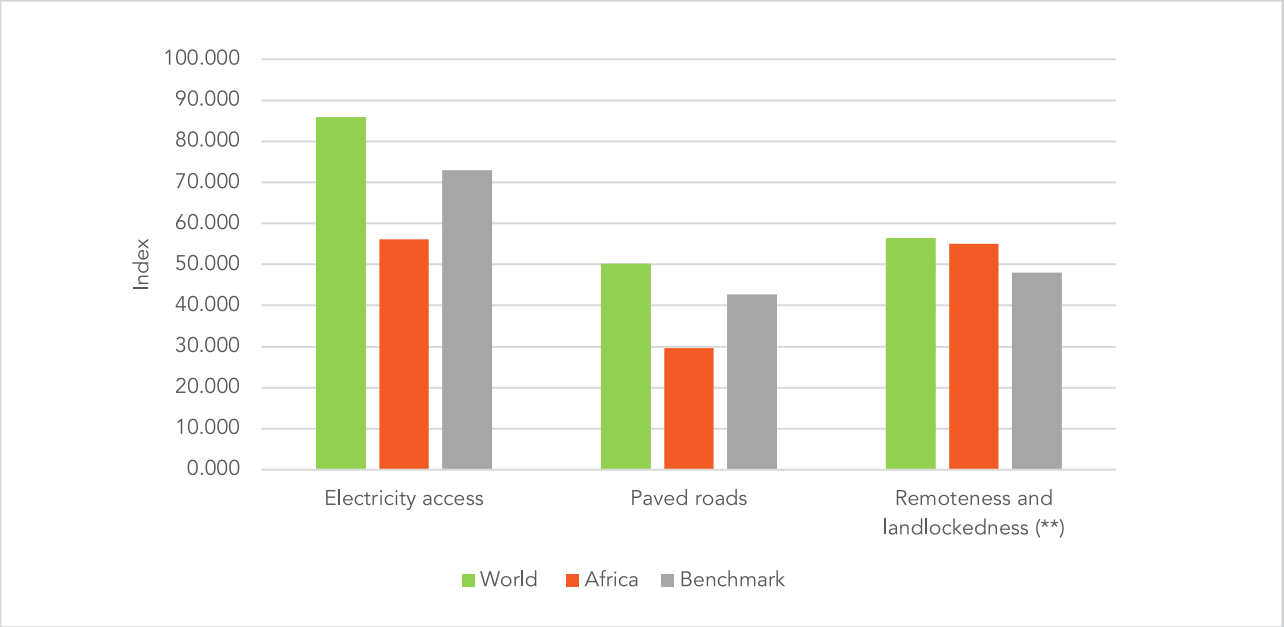

Figure 2.13: Energy and roads
Source: Authors

other low-income countries (Holtz and Heitzig, 2021). Furthermore, rural areas, where a significant portion of the population lives, are particularly underserved. The state of roads in Africa has a significant negative impact on the economy, access to markets, provision of healthcare and education, and the overall quality of life. Paved roads are essential for connecting people to markets, enabling trade and economic activity, and facilitating access to essential services.

Energy and roads or, more broadly, infrastructure and energy, are critical components of a functional food system. Their deficiencies can increase the vulnerability of food systems in Africa. Lack of energy can limit the use of mechanized farming equipment, whose use would play an important role in increasing productivity and efficiency. Irrigation, which is critical in areas with irregular rainfall, often also depends on energy for pumping water. Furthermore, energy is needed for food storage, including maintaining a cold chain for perishable goods, without which high post-harvest losses can occur (Kitinoja et al., 2011). Adding value to agricultural products through processes such as milling for grains or pasteurizing for milk also enhances their nutritional value and extend their shelf life. These processes often require energy.

Poor road infrastructure can limit farmers' ability to get their produce to markets thereby reducing their income and potentially leading to food waste by extension. It can also make it more difficult for consumers, particularly in rural areas, to access diverse and nutritious foods (Porter, 2014). Poor roads often increase the cost of transportation, which can lead to higher food prices. This can reduce access to food, particularly for low-income households. Good transport infrastructure is also crucial for resilience to shocks. For example, in the event of a drought, it can facilitate the transport of food from surplus to deficit areas (World Bank, 2016).

Addressing energy and infrastructure challenges is therefore a crucial part of strengthening food systems in Africa and reducing their vulnerability. This requires investments in infrastructure development and energy technologies that are suitable for the African context, including renewable and off-grid solutions.

Health services

Robust health services can help reduce the vulnerability of food systems in Africa by maintaining a healthy workforce, promoting good nutritional practices, ensuring food safety, managing disease outbreaks, and mitigating the health impacts of climate change. The findings of this chapter suggest that sanitation facilities in Africa fall notably short of world standards and that the continent is still highly dependent on external resources for health services (Figure 2.14). On the other hand, Africa fares much better on medical staff and projected change of deaths from climate-induced diseases.

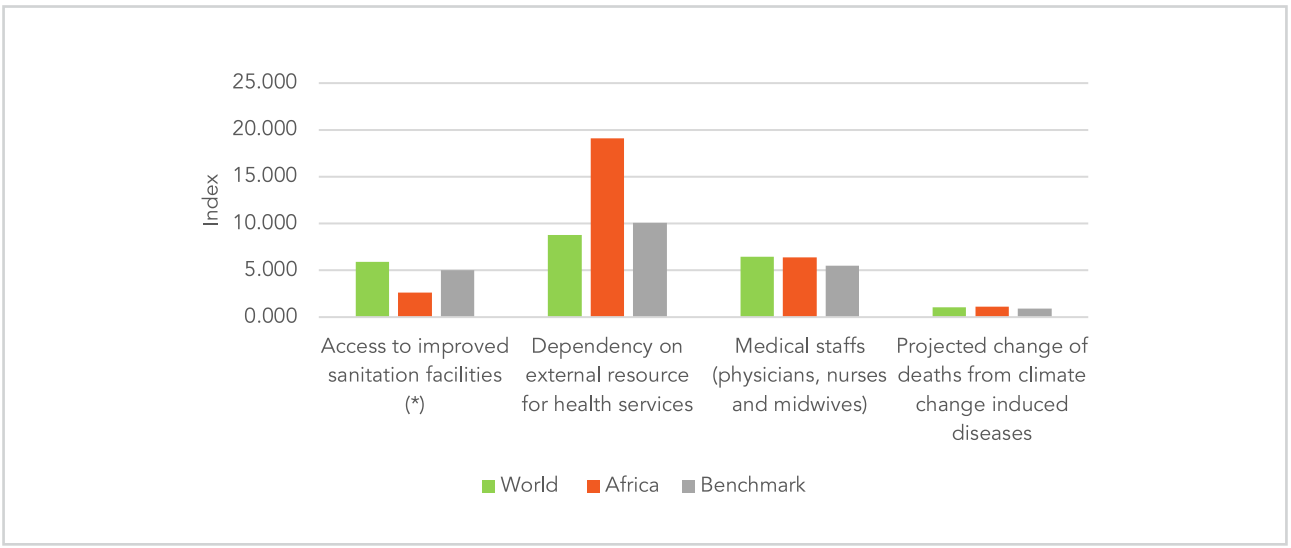

Figure 2.14: Health services
Source: Authors

Poor health can significantly reduce labor productivity in the agricultural sector, adversely affecting food production. For instance, diseases such as HIV/AIDS and malaria can incapacitate a large portion of the workforce resulting in reduced agricultural output (Barnett and Whiteside, 2002). Health services can influence nutritional outcomes through their impact on care and feeding practices. Health professionals often provide advice on infant and young child feeding, which can improve nutritional status and reduce the risk of malnutrition (Bhutta et al., 2013). From providing education on safe food handling practices to monitoring and controlling foodborne diseases, health services play a crucial role in ensuring food safety. Unsafe food can lead to illness, which not only affects health but can by extension also impact food security by reducing workforce productivity and increasing healthcare costs.

The capacity of health systems to manage disease outbreaks can also impact food systems. For instance, outbreaks of diseases such as Ebola can disrupt food systems as they can limit agricultural activities and disrupt markets due to fear and restrictions on movement (Elston et al., 2017). Health services are also essential in managing the health impacts of climate change, which can influence food systems. For instance, as mentioned earlier in this chapter, increases in the prevalence of climate-sensitive diseases such as malaria can adversely affect agricultural productivity. The capacity of health services to manage these diseases can therefore indirectly impact food systems (Watts et al., 2021).

Not all is gloomy, there are promising spots

This chapter aims to highlight the points of failures and challenges in African food systems. The previous section therefore endeavors to capture the gravity of the situation and not downplay the issues. However, this chapter also acknowledge the resilience, adaptability, and strength of African communities many of which have faced and overcome adversities in the past and have the capacity to do so in the future. This section thus highlights instances where specific interventions have had a significant positive impact on food systems in Africa including promising innovations, initiatives, and policies.

Climate-Smart Agriculture (CSA). This refers to agricultural practices designed to enhance resilience, increase productivity, and reduce greenhouse gas emissions. Implementing CSA in Africa is crucial due to the continent's vulnerability to climate change and its dependence on agriculture. Several countries have initiated CSA or related programs:

- *Conservation agriculture:* It includes minimal soil disturbance (no-till farming), permanent soil cover, and crop rotation. In Zambia and Zimbabwe, conservation agriculture practices have led to increased maize yields (Thierfelder and Wall, 2009).
- *Agroforestry*: It integrates trees into farming systems. In Kenya, the adoption of agroforestry has been promoted as a CSA practice that improves soil fertility and offers diversified income (Coe et al., 2014).

- *Weather-based insurance schemes*: In 2009, Syngenta Foundation launched Kilimo Salama in Kenya with a pilot project offering index insurance to 200 farmers. In 2012, more than 51,000 farmers in Kenya and 14,000 in Rwanda subscribed (IFC, 2013). In Kenya, premiums paid averaged KES 19 million and KES 33 million in 2011 and 2012 respectively[9]. In 2014, the program became ACRE, a for-profit company. In 2016, ACRE had more than one million subscribing farmers in Kenya, Rwanda, and Tanzania, insuring more than US$56 million against various types of weather hazards. Cumulatively, by 2018, over 1,700,000 farmers in Kenya, Tanzania, and Rwanda insured over $181 million against a variety of weather risks underwritten by UAP Insurance Kenya, CIC Insurance Group Limited, APA Insurance, Heritage Insurance, UAP Insurance Tanzania and SORAS Insurance Rwanda (ACRE, 2023). Crops insured include maize, sorghum, coffee, sun -flower, wheat, cashew nuts and potato, with coverage against drought, excess rain and storms.

- *Improved water Management*: Water management in Africa is a crucial issue given the continent's diverse hydrological environments and the challenges posed by rapid population growth, urbanization, agricultural expansion, and climate change. Organizations such as the Nile Basin Initiative aim to improve cooperation among Nile riparian countries (Cascão and Nicol, 2016). In Tanzania, rainwater harvesting techniques have been introduced to supplement water sources (Kahinda et al., 2007). With many African countries reliant on groundwater, sustainable extraction and use are vital. In Ghana, groundwater provides a significant portion of drinking water supplies (Pavelic et al., 2012).

- *Irrigation:* The Office du Niger is one of the largest irrigation schemes in West Africa. It is a semi-autonomous government agency in Mali that administers a large irrigation scheme in the Ségou Region of the country. Water from the Niger River is diverted into a system of canals at the Markala Dam 35 kilometers (22 miles) downstream of Ségou. The water is used to irrigate nearly 100,000 hectares (390 sq miles) of the flat alluvial plains to the north and northeast of Markala that form part of the Delta mort (You et al., 2011).

9 The United States Dollar to Kenya Shilling exchange rate ranged between KES 76 and KES 108 to 1 USD in 2011 and 2012

Mechanization. Agricultural mechanization in Africa has undergone various transformations over the years providing solutions to labor-intensive practices and increasing agricultural productivity. Tractor-hiring services have become increasingly popular in countries such as Nigeria (Takeshima and Salau, 2015). Some parts of Zambia and Zimbabwe are adopting mechanized conservation farming techniques (Thierfelder et al., 2012). The use of treadle pumps in Malawi and solar-powered irrigation systems in Burkina Faso is rapidly expending (Burney et al., 2013). Senegal and Tanzania are examples of the push for modern rice milling plants (Demont and Rizzotto, 2012).

Digital technology. The integration of digital technology into African food systems has shown promising advances in recent years. Digital innovations have provided solutions to longstanding challenges in agriculture and food distribution. In Kenya, M-Pesa has revolutionized how money is transacted (Jack and Suri, 2016). The iCow app offers Kenyan farmers advice on livestock rearing (Fabregas et al., 2019). Using blockchain technology to track and verify the origins and handling of agricultural products is becoming more popular. For example, Twiga Foods in Kenya has explored using blockchain to enhance transparency in food supply chains (Kamilaris et al., 2019). Digital marketplaces are connecting farmers with consumers and buyers. Farmcrowdy in Nigeria digitally links farmers with sponsors who fund farming cycles in return for a share of the profits (Nakasone et al., 2014). The Grameen Foundation's FarmerLink program in Ghana uses digital profiling (Grameen Foundation, 2018). The use of drones for aerial surveillance of farms to monitor crop health, assess damage, and guide precision agriculture interventions is spreading across the continent. Several African startups such as AcquahMeyer Drone Tech in Ghana, offer drone-based services to farmers (Turner et al., 2012). Using drones to map fields, monitor crop health, and guide interventions is becoming more popular. For example, drone technology is being used in Ghana for crop surveillance (Adu et al., 2019).

Research and development. Agricultural research and development R&D in Africa has undergone considerable advances in recent decades driven by the need to ensure food security, address changing climate patterns, and cater for a growing population. These advances span a range of domains from biotechnology to farming practices and policy formulation. The Drought Tolerant Maize for Africa (DTMA) project is one example of the increasing introduction and adoption of high-yielding, drought-

resistant, and disease-resistant crop varieties across the continent (Atlin et al., 2017). There is ongoing research on soil conservation, sustainable land management, and agro-ecological practices in countries such as Zambia and Zimbabwe (Giller et al., 2009). R&D on non-chemical and environment-friendly methods of managing pests and diseases in agriculture such as push-pull technology for controlling stem borer pests in maize is also picking up steam in the continent (Khan et al., 2014). Several initiatives are focusing on agricultural practices and varieties that enhance the nutritional content of foods. This includes the HarvestPlus program, which promotes biofortified crops such as vitamin A-rich sweet potatoes and iron-rich beans across the continent (Saltzman et al., 2013).

There are several promising initiatives aimed at transforming food systems in Africa. Addressing various challenges including food security, agricultural productivity, value chain development, and resilience to climate change, these initiatives represent a growing commitment at both continental and national levels to transform Africa's food systems:

The Africa Food Systems Forum (formerly AGRF): the annual gathering brings together various stakeholders including governments, civil society, and the private sector to discuss and commit to programs, investments, and policies for food systems transformation.

The Comprehensive Africa Agriculture Development Programme (CAADP): the African Union Commission-African Union Development Agency (AUC-AUDA CAADP)/Malabo Declaration aims to bring about agricultural transformation and improve food security and nutrition across Africa.

AGRA: AGRA works to increase food security and improve incomes for millions of smallholder farmers in Africa through targeted investments in seeds, soil health, and market access.

Transforming African Agricultural Universities to meaningfully contribute to Africa's Growth and Development (TAGDev): this initiative focuses on building the capacity of African agricultural universities and emerging graduates to better serve the agricultural sector.

The African Seed Access Index (TASAI): TASAI seeks to promote the creation and maintenance of enabling environments for competitive seed systems serving smallholder farmers. The initiative evaluates and tracks seed sector performance in African countries.

Technologies for African Agricultural Transformation (TAAT): supported by the African Development Bank, TAAT focuses on taking proven agricultural technologies to scale ensuring that millions of farmers have access to the latest innovations in agricultural science.

Adaptation for Smallholder Agriculture Programme (ASAP): funded by the International Fund for Agricultural Development (IFAD), ASAP focuses on enhancing the resilience of smallholder farmers against climate change challenges.

One Planet Fellowship: this is a leadership development program that builds a network of African and European scientist leaders equipped to address climate change challenges for Africa's smallholder farmers.

Concluding remarks

While this assessment provides a comprehensive overview of African food systems and their inherent challenges, it is crucial to acknowledge the constraints posed by lack of consistent and high-quality data. The dynamic and multifaceted nature of food systems necessitates granular, timely, and context-specific data for an accurate depiction of realities on the ground. Several components of the food system remain under-represented due to data paucity, potentially leading to gaps in analysis and understanding.

Despite these challenges, this chapter has endeavored to provide a holistic analysis, drawing from the best available resources. We advocate for increased investments in data collection, harmonization, and dissemination initiatives. Strengthening data infrastructure will not only enhance future assessments but will also empower policymakers, practitioners, and communities to make informed decisions and track progress more effectively.

In summary, the assessment of food system failures has unveiled a multifaceted web of challenges that stretch from production to consumption. While daunting, these challenges provide a clear call for a concerted response from governments, the private sector, communities, and individuals alike. It is evident that the repercussions of inaction are not just confined to hunger and malnutrition but extend to economic,

social, and environmental domains, potentially undermining progress made in several areas.

These challenges range from environmental and agricultural to economic, social, and political factors. Africa is particularly vulnerable to climate change with impacts including changing rainfall patterns, rising temperatures, and more frequent and severe weather events. These changes can reduce agricultural productivity, affect the availability and stability of food supplies, and increase the risk of food insecurity.

Many parts of Africa suffer from limited resources such as water, land (due to degradation), and low soil fertility. These factors can limit the amount and quality of food produced. Inadequate infrastructure, including transport, storage, and processing facilities, can limit market access for farmers and increase post-harvest losses. This can reduce farmers' income and increase the price of food for consumers.

Policy and governance issues, including inadequate support for agricultural R&D, limited access to credit and inputs for farmers, and trade policies, can affect the functioning and resilience of food systems. Conflict and political instability can disrupt food production and distribution, limit access to markets, and exacerbate food insecurity.

The insights from this assessment not only offer an understanding of where and how systems are failing but also shed light on potential intervention points. Indeed, while these challenges can contribute to vulnerabilities in Africa's food system, it is also important to recognize the potential for resilience and transformation. Many initiatives ranging from climate-smart agricultural practices to infrastructure development and policy reforms are underway to address these challenges. With sufficient investment and support, Africa's food system has the potential to overcome these challenges and ensure food and nutrition security for all.

Finally, the choices the continent will make in response to this assessment will shape the food system landscape for generations to come. The findings in this chapter are not just a reflection of the current challenges but also a roadmap for future actions, guiding the continent towards food systems where every African will have access to sustainable healthy diets.

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Annex 1: Table 1: Vulnerability indicators

	Variables	Source
1.Food system activities		
1.1. Inputs	Agriculture capacity (Fertilizer, irrigation, pesticide, tractor use)	IND-GAIN
	Access to finance and financial products for farmers	GFSI
	Access to diversified financial products	GFSI
	Agriculture producer prices	GFSI
	Access to extension services	GFSI
	Community organisations	GFSI
	Irrigation infrastructure	GFSI
1.2. Agricultural research and development	Public expenditure on agricultural research and development	GFSI
	Access to agricultural technology, education and resources	GFSI
	Commitment to innovative technologies	GFSI
	Access to agricultural technology, education and resources	GFSI
1.3. Producing food	Projected change of cereal yields	IND-GAIN
	Share of agriculture, forestry, fisheries in GDP	UN-EVI
	Instability of agricultural production	UN-EVI
	Volatility of agricultural production	
	Food loss	
	Sustainable agriculture	
1.4. Processing and packaging food	Crop storage facilities	GFSI
	Access to market data and mobile banking	GFSI
1.5. Distributing and retailing food	Planning and logistics	GFSI
	Road infrastructure	GFSI
	Air, port and rail infrastructure	GFSI
2. The food system outcomes		
2.1. Food availability		
	Change in average food costs	GFSI
	Inequality-adjusted income index	GFSI
	Food supply adequacy	GFSI
	Dependency on chronic food aid	GFSI
	Dietary availability of vitamin A	GFSI
	Dietary availability of iron	GFSI
	Dietary availability of zinc	GFSI
2.2. Access to food	Change in average food costs	GFSI
	Proportion of population under global poverty line	GFSI
	Inequality-adjusted income index	GFSI

	Variables	Source
2.3. Food utilization	Child malnutrition	IND-GAIN
	Prevalence of undernourishment	GFSI
	Percentage of children stunted	GFSI
	Percentage of children underweight	GFSI
	Prevalence of severe food insecurity	GFSI
	Prevalence of moderate or severe food insecurity	GFSI
	Prevalence of Obesity	GFSI
2.4. Food safety	Presence of food safety net programmes	GFSI
	Funding for food safety net programmes	GFSI
	Coverage of food safety net programmes	GFSI
	Operation of food safety net program	GFSI
3. External drivers		
3.1. Water	Projected change of annual runoff	IND-GAIN
	Projected change of annual groundwater recharge	IND-GAIN
	Fresh water withdrawal rate	IND-GAIN
	Water dependency ratio	IND-GAIN
	Access to reliable drinking water	IND-GAIN
	Dam capacity	IND-GAIN
3.2. Weather	Projected change of warm period	IND-GAIN
	Projected change of flood hazard	IND-GAIN
3.3. Ecosystems services	Projected change in biome distribution	IND-GAIN
	Ecological footprint	IND-GAIN
	Engagement in international environmental conventions	IND-GAIN
	Protected biomes	IND-GAIN
3.4. Land and soil	Land degradation	GFSI
	Grassland	GFSI
	Forest change	GFSI
	Soil organic content	GFSI
3.5. Globalization and trade	Quality of trade and transport-related infrastructure	IND-GAIN
	Food import dependency	IND-GAIN
	Merchandise export concentration	UN-EVI
	Instability of export of goods and services	UN-EVI
	Agricultural import tariffs	GFSI
	Trade freedom	GFSI

	Variables	Source
3.7. Urbanization	Urban concentration	IND-GAIN
	Slum population	IND-GAIN
3.8. Demographic shifts	Age dependency ratio	IND-GAIN
3.9. Leadership and Governance	Armed conflict	GFSI
	Political stability risk	GFSI
	Corruption	GFSI
	Food security strategy	GFSI
	Food security agency	GFSI
	National dietary guidelines	GFSI
	National nutrition plan or strategy	GFSI
	Nutrition labelling	GFSI
	Nutrition monitoring and surveillance	GFSI
	Climate finance flows	GFSI
	Environmental- economic accounting implementation	GFSI
	Early-warning measures / climate-smart Agriculture	GFSI
	Commitment to managing exposure	GFSI
3.10. Socio-cultural context	Gender inequality	GFSI
3.11. Energy	Projected change of hydropower generation capacity	IND-GAIN
	Dependency on imported energy	IND-GAIN
	Electricity access	IND-GAIN
3.12. Infrastructure	Paved roads	IND-GAIN
	Remoteness and landlockedness	UN-EVI
3.14. Health	Projected change of deaths from climate change induced diseases	IND-GAIN
	Projected change of length of transmission season of vector-borne diseases	IND-GAIN
	Dependency on external resource for health services	IND-GAIN
	Access to improved sanitation facilities	IND-GAIN
	Medical staffs (physicians, nurses and midwives)	IND-GAIN
3.15. Shocks and stressors	Disaster preparedness	IND-GAIN
	Victims of disasters	UN-EVI
3.16. Natural resources	Dependency on natural capital	IND-GAIN
	Pest infestation and disease mitigation	GFSI
	Risk management coordination	GFSI

3 A Stocktake of Africa's Food Systems

Tinashe Kapuya[1], Vine Mutyasira[2], Lawrence Haddad[3], and Boaz B Keizire[4]

Key Messages

1 Tracking commitments made at the UN Food Systems Summit (2021) is complicated by the absence of a holistic and science-based framework to assess progress in food systems transformation in Africa. Such frameworks allow for more transparent and objective monitoring of food systems change over time.

2 The chapter draws from the recently launched Food Systems Countdown Initiative (FSCI) framework of indicators to provide a baseline of progress on transformation. Reference is also made to the subset of indicators under the United Nations SDGs and the CAADP framework, to assess overall progress towards global and continental commitments.

3 Out of the 50 indicators outlined in the FSCI framework, sub-Saharan African countries are performing worse than the global average in a total of 32 indicators mostly related to diets, nutrition, and health. On the other hand, sub-Saharan African countries are performing better than the global average in the remaining 18 indicators, including those on food systems GHG emissions and biosphere integrity. The region is also doing relatively well in terms of shared vision and strategic planning to drive food systems transformation as evidenced by the presence of national food systems transformation pathways.

4 When assessed against key continental and global commitments, Africa is still off-track with respect to eliminating hunger, malnutrition, and poverty by 2030. From a CAADP point of view, there is a concurrence of results when compared with the SDGs. However, CAADP's Agricultural Transformation Scorecard reveals that 21 out of 55 countries are making good progress. However, mapping the 47 CAADP indicators onto the five UNFSS Action Tracks reveals declining performance of the continent in transforming its food systems.

5 Overall, Africa's progress in food systems transformation remains relatively mixed; the main drivers include population growth (leading to rising scarcity for land, and demand for food), climate change and extreme weather events, economic transformation, global health crises and conflicts, and technological advancements. Intra-regional trade, rising food prices, and climate change are seen to be immediate and high impact drivers that could lead food system transformation in the future.

6 Going forward, the continent will need to invest more in data to enhance evidence-based policies and accountability mechanisms to drive the transformation agenda. There is a real opportunity for the UNFSS+4 in 2025 to have a strong focus on identifying, analyzing, and learning from food system change since UNFSS+2. The continent will also need to adopt budget monitoring tools such as the IFAD/World Bank 3FS tool, to effectively track financial flows and guide smart investment decisions.

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Introduction

With less than a decade remaining to achieve the SDGs, the world faces a critical juncture to accelerate agrifood systems transformation. Growing levels of global hunger, malnutrition, and poverty have awakened the world to the reality that the food system is failing to deliver for humanity and hence needs to change. The 2023 State of Food Security and Nutrition in the World report shows that while several efforts have been made towards eradicating hunger, it continues to increase in Africa (FAO et al., 2023). In addition, current food systems have exacerbated negative environmental outcomes such as environmental degradation, biodiversity loss, and accounting for 21 to 37 percent of GHG emissions (IPCC, 2023). More disturbingly, the failure of food systems to provide balanced nutrition imposes serious economic costs on global health systems with diet-related health costs linked to mortality and non-communicable diseases projected to exceed USD 1.3 trillion per year by 2030 (Hendriks et al., 2021).

One in four people in Africa faced hunger over the past five-years, with 278 million of its citizens – essentially one third of the global total – going to bed hungry in 2022 (FAO et al., 2023). This means that Africa bears the heaviest burden of hunger in the world and implies that the goal of ending hunger by 2030 – a CAADP target and SDG 2 – is now virtually beyond reach.

Similarly, in 2021, the negative effects of the COVID-19 pandemic pushed an estimated 30 million people into extreme poverty (Aikins and McLachlan, 2022). This means that Africa will fail to attain SDG 1 on ending extreme poverty by 2030, which will exacerbate the hunger challenge. In fact, the United Nations (2022) Africa Sustainable Development Report notes that poverty rates remain high in Africa, that at least 492 million people will be left in extreme poverty by 2030, and at least 350 million people by 2050 under prevailing trends.

These high-level statistics and trends are alarming. They not only evoke a sense of urgency for Africa to transform its food systems but, more so, point to a need for a deeper understanding of the status quo. As the continent looks towards the implementation of transformative interventions, the fundamental question is where countries stand in relation to the drivers of food system transformation. It is in this spirit that the UN hosted the 2023 UN Food Systems Stocktaking Moment in July 2023 to review commitments to action from the 2021 Food Systems Summit.

While African leaders have made commitments to food systems transformation, including the priorities laid out in the Africa Common Position to UNFSS, there is no comprehensive and science-based mechanism to track food systems change across the continent. This chapter provides an overview of African food systems benchmarking key indicators against SDG targets and global averages and thus providing a reference point to track progress and guide decision-makers. The chapter has five major objectives:

(i) Examine the overall context of the transformation of African food systems highlighting performances against continental and global commitments.

(ii) Describe African food system commitments and targets and assess progress against them.

(iii) Examine the state of African food systems and how to measure them.

(iv) Examine the key drivers shaping African food systems' transformation including emerging opportunities, shocks, and constraints.

(v) Discuss necessary actions to accelerate Africa's progress towards meeting food systems commitments and targets.

As such, the chapter begins with a brief background and context of African food systems transformation followed by reflections on African countries' food system commitments at UNFSS and how the continent has performed vis-à-vis the key Action Tracks. The subsequent section draws from the Food Systems Countdown Initiative (FSCI) to benchmark the performance of Africa's food systems against global weighted averages. The chapter goes on to discuss some of the key drivers shaping African food systems transformation including challenges and opportunities. The chapter concludes with high-level insights and recommendations to inform further discourse on the quest for resilient and sustainable food systems in Africa.

The Context of African Food Systems Transformation: Performance against continental and global targets

Progress against the SDGs

The African Centre for Statistics of the UN Economic Commission for Africa (UNECA, 2023) launched the Africa SDGs Progress Dashboard, which tracks progress towards the SDGs and the likelihood of their achievement by 2030. The dashboard shows that since 2000, Africa has made the least progress on SDG 2 (zero hunger), SDG 8 (decent work and economic growth), SDG 10 (reduced inequalities), and SDG 12 (responsible consumption and production) as illustrated in Figure 3.1. The dashboard shows that current trends will need to be reversed to achieve SDG targets on poverty, food security, deforestation, biodiversity, and water use efficiency, among others.

Hunger

According to the 2023 State of Food Security and Nutrition in the World (SOFI, 2023), in 2022, between 690 and 783 million people in the world faced hunger. This is roughly 122 million more people than before the COVID-19 pandemic (FAO et al., 2023). The prevalence of undernourishment (PoU) escalated from 8 percent in 2019 to 9.3 percent in 2020 and rose further, albeit at a slower rate, to 9.8 percent in 2021. From 2021, the PoU decreased slightly to average 9.2 percent in 2022. Regional comparisons show that with one in five people facing hunger in

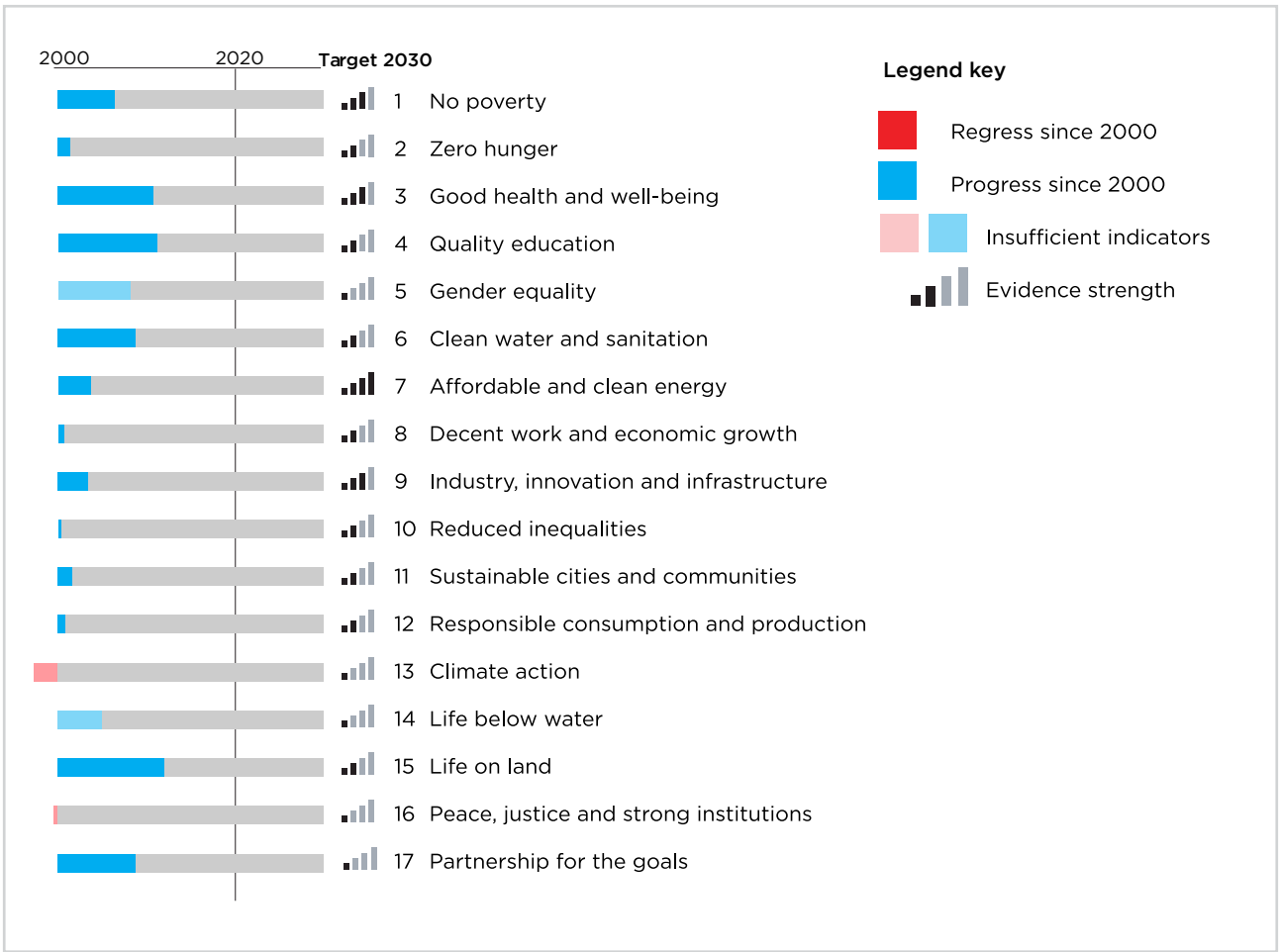


Figure 3.1: Africa's progress towards meeting the SDGs
Source: Africa UN Data for Development (2023)[1]

1 https://ecastats.uneca.org/unsdgsafrica/SDGs/SDG-progress

2021, Africa bears the greatest burden of malnutrition and poverty. In 2020, about 85 percent of sub-Saharan Africa's population could not afford a healthy diet. The International Food Policy Research Institute (IFPRI) 2023 Global Food Policy further notes that about 282 million people across the continent are facing food insecurity and are undernourished. This is more than twice the share in any other region of the world (IFPRI, 2023).

Some 18 percent of Africans are undernourished, compared to the world average of 9 percent (see Annexure 3 and 4). Sub-Saharan Africa – mainly western Africa, eastern and Middle Africa – are driving high hunger levels, with the trend over the past decade showing an upsurge of 116.7 million in the population of undernourished people who had increased from 164.9 million in 2012 to 281.6 million by 2022 (see Figure 3.2). Overall, the number of people facing hunger in Africa has increased by 11 million since 2021 and by more than 57 million people since the outbreak of the pandemic (FAO et al., 2023).

Africa envisaged a reduction in hunger that is primarily driven by doubling crop yields and reducing post-harvest losses. Global cereal yields average of 4.15 tons/ha – more than two-and-a-half times the average African cereal yields (1.63 tons/ha). Part of the reason for the Africa's poor yield is low usage of inputs such as fertilizer, which, despite growing considerably since the Abuja Declaration of 2006 (see Figure 3.3), has not reached the 50kg/ha target to achieve yield-driven growth.

Meanwhile, post-harvest losses in Africa have remained exceptionally high, with the continent losing an estimated 9.6 million tons[5] of maize per annum, a considerable amount of grain that could have otherwise boosted food security significantly (APHLIS, 2023). Post-harvest losses for maize in sub-Saharan Africa range between 14.97 percent and 17.37 percent, which, despite being comparatively lower than other parts of the developing world e.g., Bangladesh (23%), still calls for improvements to avert hunger and improve food supply.

5 https://www.aphlis.net/en/data/tables/dry-weight-losses/XAF/all-crops/2021?metric=tns

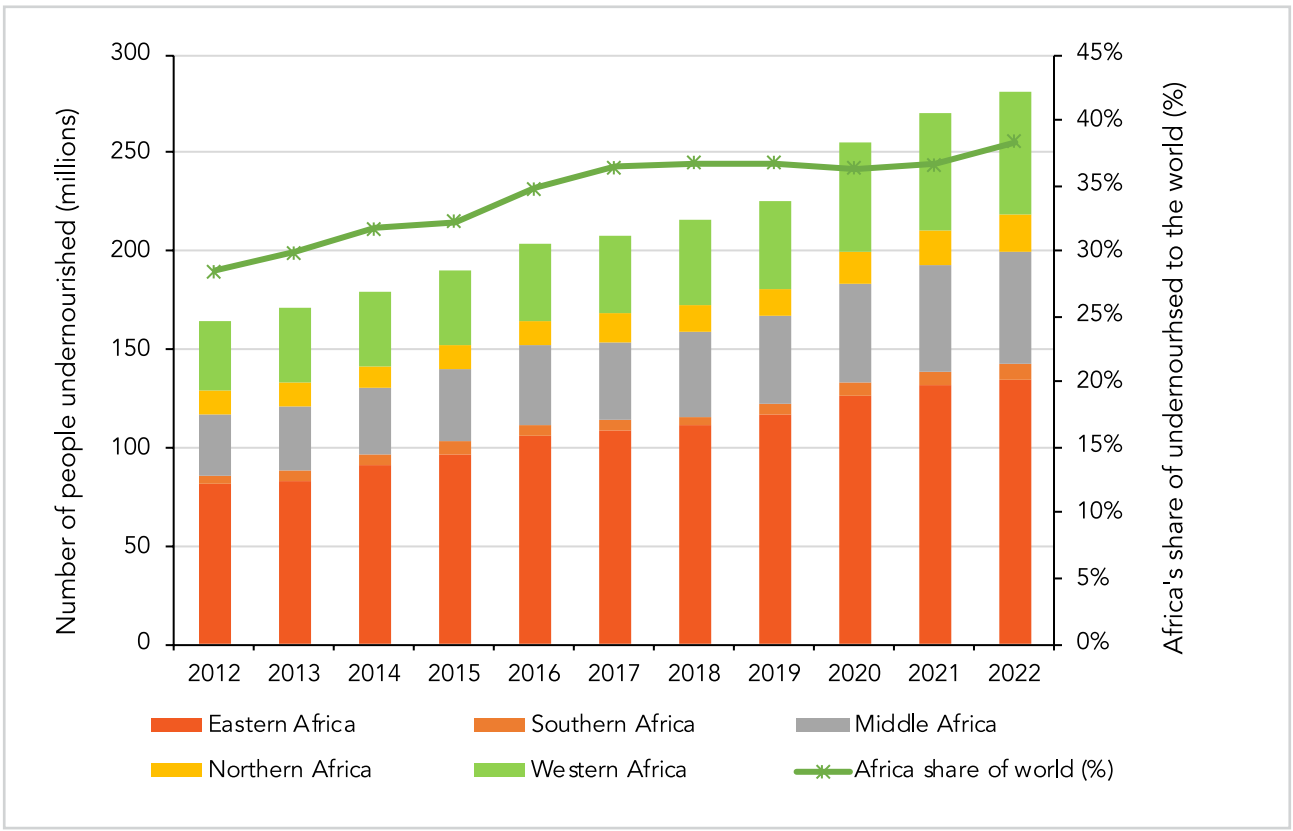


Figure 3.2: Prevalence of undernourishment in Africa (2012-2022)
Source: FAO (2023)

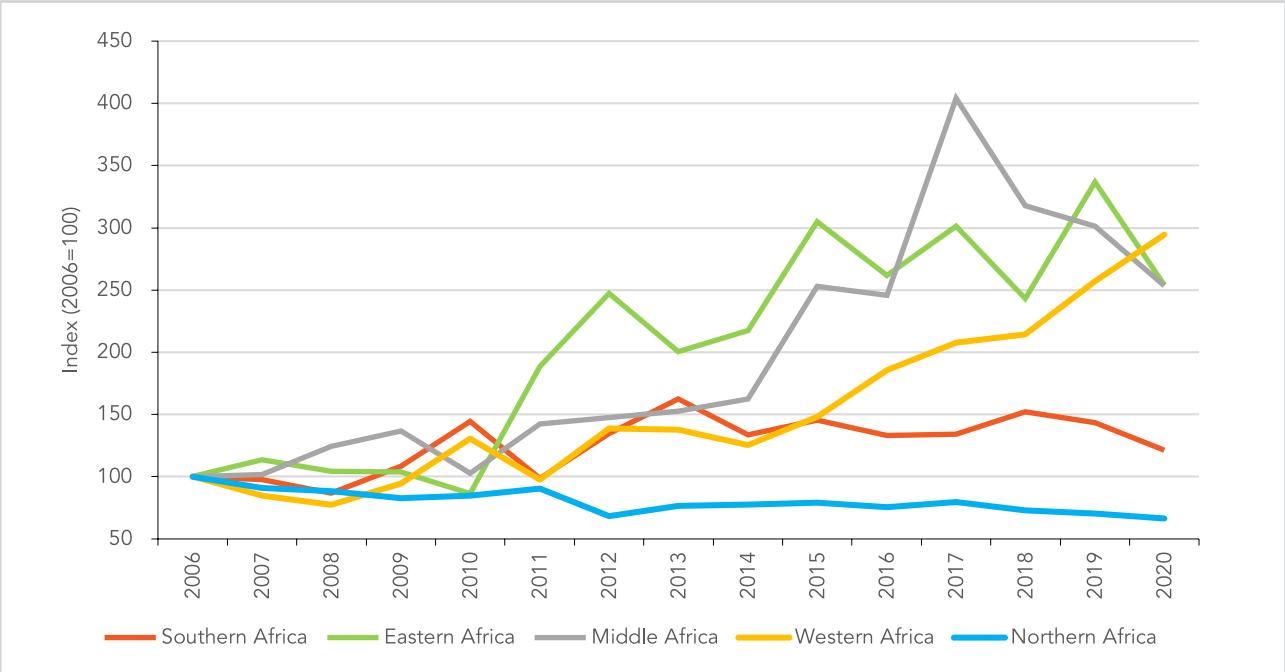


Figure 3.3: Index for fertilizer consumption in Africa, 2006-2020 (2006=100)

Source: Computed from World Bank (2023)

Poverty

The World Bank (2023) macro poverty outlook for sub-Saharan Africa indicates that growth conditions remain insufficient to reduce extreme poverty and boost shared prosperity in the medium to long term. In 2022, economic growth in the region slowed to 3.6 percent down from 4.1 percent in 2021 and is projected to slow down even further to 3.1 percent in 2023. A recovery of per capita income growth projected at 1.2 percent for 2024 and 1.4 percent in 2025 still falls short of accelerating poverty reduction to the region's pre-pandemic path. The public debt in sub-Saharan Africa has more than tripled since 2010 with the fiscal deficit of the region widening to 5.2 percent of GDP in 2022 up from the estimated 4.8 percent of GDP in 2021. The COVID-19 pandemic and other exogenous shocks have disrupted food systems and livelihoods in Africa and curtailed the significant strides of the past few decades across the continent.

Africa seeks to halve poverty by 2025 (CAADP) and end poverty in all its forms everywhere by 2030 (SDG) through inclusive agricultural growth (and transformation). However, Africa's agricultural sector is growing at a pace marginally lower than that of the world (i.e., 2.6% per year against 2.7%). That said, it is important to note that growth of the continent's agricultural sector is much less than the targeted 6 percent per annum set under the CAADP Agenda. Delving into the regions, southern Africa is the only region that surpasses the 6 percent growth target (8.23%) with the other sub-regions achieving annual growth rates of between 1 percent and 2.6 percent.

From a trade perspective, Africa relies significantly on food imports and regional economic integration has been a key lever to ensure that African countries trade more among themselves. However, by 2022, African countries only import less than a quarter (22.9%) of their import demand for food from other African countries, far below the likes of the European Union (EU), which have attained levels of around 70 percent of intra-regional trade. The continent is yet to attain its target of tripling the share of cross-border trade among African countries (Africa's intra-regional trade is discussed later in the chapter).

In terms of the region's poverty levels, nearly one in three Africans (28.57%) live below USD 2.15 per day, compared to the global average of 8.25 percent[6]. However, the average population below the poverty line in sub-Saharan Africa is much higher and is estimated

6 Estimates from other sources compute a higher proportion of the population below the poverty line. For instance, RESAKSS (2023) estimate 32.35% (2019 data), based on a poverty headcount ratio at US$1.90 a day (2011 PPP).

at 34.78 percent. Sub-regional differences give a much more diverse picture with almost half of Middle Africa under the poverty line compared to 42.17 percent of East Africa and these two sub-regions driving sub-Saharan Africa's exceptionally high poverty levels.

Malnutrition

Africa's target of improving nutrition and reducing the share of child stunting and underweight children to 10 percent and 5 percent of the child population respectively by 2025 remains elusive. Overall, 32.5 percent of all African children under the age of five are stunted against a global average of 22 percent. From a regional perspective, stunting remains exceptionally high across all parts of sub-Saharan Africa (ranging from 30.06% and 39.15%) (See Annexure 3).

Moreover, more than halfway through the SDGs, Africa is worryingly off-track to meet the global reduction of stunting target. Estimates (WHO-UNICEF-World Joint Child Malnutrition, 2023) show that the reduction of stunting rates is lagging most in Africa. Figure 3.4 shows the annual average rate of reduction (AARR) to meet the reduction of global stunting target. The results show that the required AARRs between 2022 and 2030 are greatest in Middle Africa, Oceania (excluding Australia and New Zealand) and Western Africa[7].

Progress against CAADP Goals and Targets

The African Union's 3rd CAADP BR Report (2021) observed that the continent is not on track to meet the ending hunger by 2025 commitment. The report showed that only one country, Rwanda, is on-track to achieving the CAADP Malabo commitments by 2025. This is a worrying trend given that 4 Member States were on-track in 2019 during the second Biennial Review cycle, and 17 in the inaugural BR cycle. However, the reports notes that although the remaining 50 Member States are not on-track, 21 of them are regarded as progressing well against the 7.28 benchmark, as shown in the scorecard in Figure 3.5.

The overall agricultural transformation score for the continent is 4.32, which is roughly 59 percent of the benchmark of 7.28 and points to the need for accelerating CAADP implementation to build a resilient African food system. An analytical study of data from the CAADP BR on 46 indicators from 2014 to 2018 observed that while CAADP has raised the political profile of agriculture on the continent and promoted incentive-orientated agricultural policies, there has been limited progress in tackling nutrition challenges in their complexity (Benin, 2018). The study also found that fertilizer use, irrigation development, and agriculture growth rate have declined over time from 2014 to 2018. Productivity challenges have persisted on the continent; despite agricultural productivity increasing 13 percent on average every year between 2015-2020, crop yields have remained stagnant at under 30 percent of global averages in Africa. Consequently, the continent has largely remained a net-importer of food estimated at over USD 50 billion per year, the bulk of which comes from importing basic and processed foods (mainly wheat, edible oil, maize, and rice). At least 82 percent of Africa's basic food imports come from outside the continent. The continent is thus not realizing its potential to feed itself.

7 UNICEF / WHO / World Bank Group (2023). Levels and trends in child malnutrition. https://www.who.int/publications/i/item/9789240073791

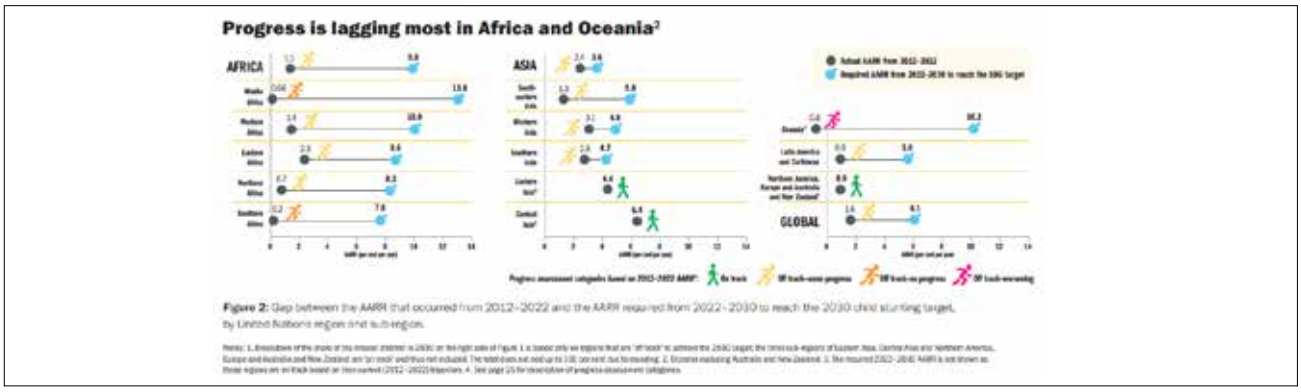


Figure 3.4: Gaps between the AARR that occurred from 2012–2022 and the AARR required from 2022–2030 to reach the 2030 child stunting target.

Source: UNICEF/WHO/World Bank Group (2023)

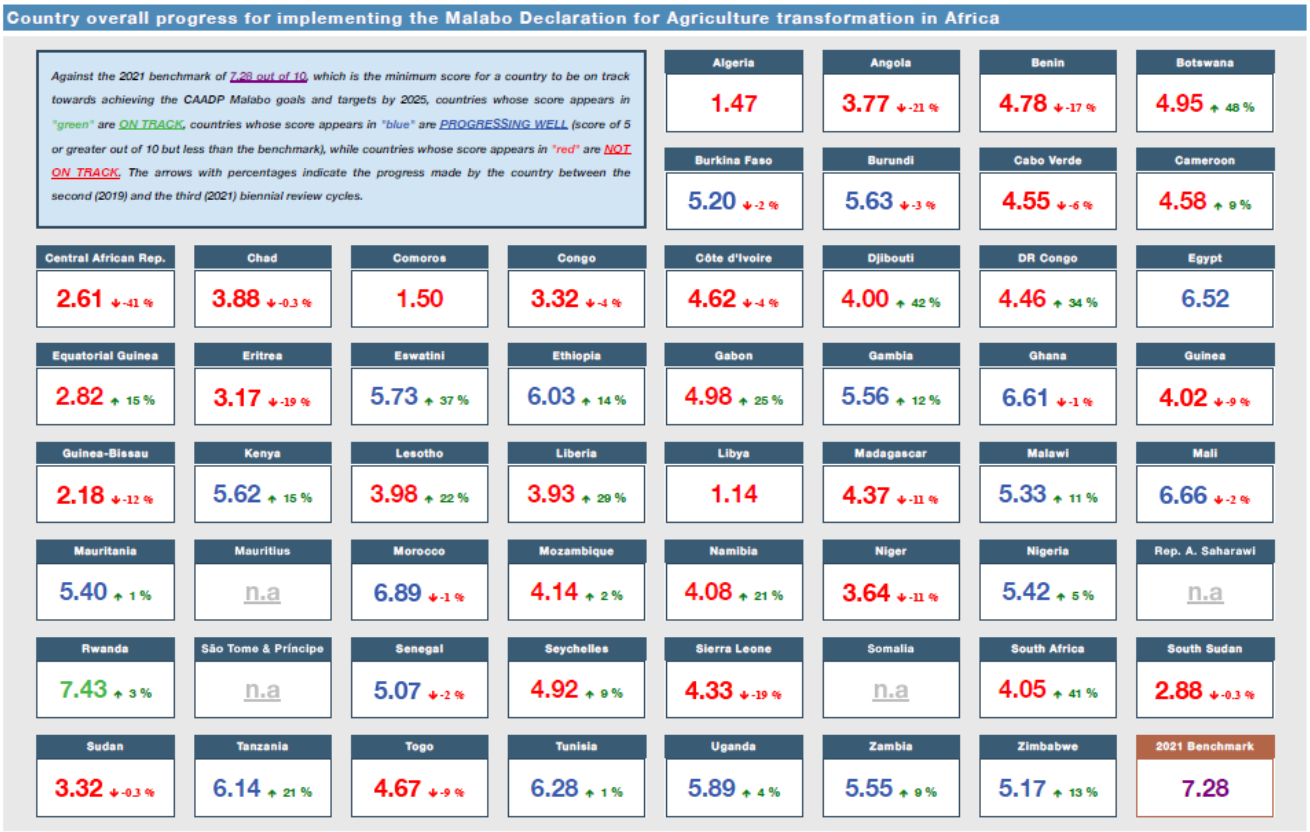


Figure 3.5: The African Agriculture Transformation scorecard

Source: CAADP BR report (2021)

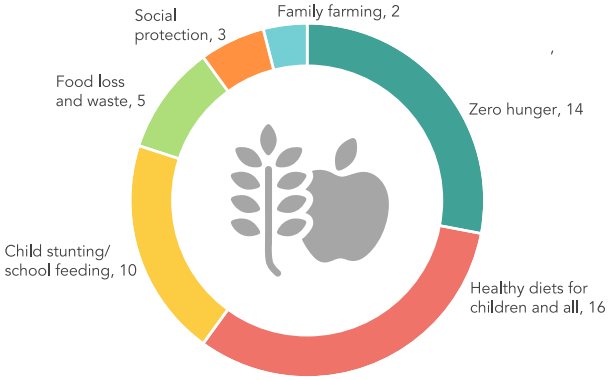
African food systems commitments and progress against them

Aligning African priorities with UNFSS Action Tracks and Coalitions

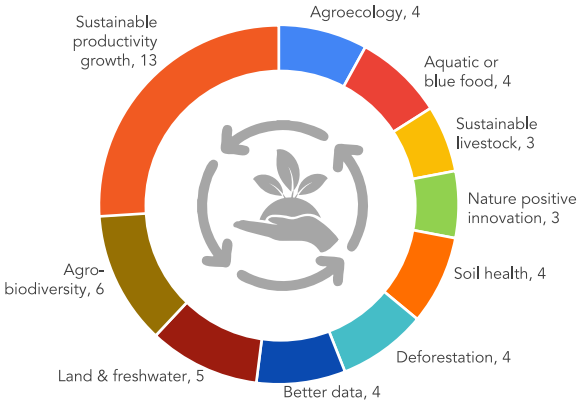
Prior to UNFSS, Africa developed the African Common Position on Food Systems, which set out a clear continental vision on food systems transformation. The common position provided an opportunity to examine context-specific solutions to challenges hindering the achievement of core food systems-related goals and targets in various development frameworks including the SDGs, the AU's Agenda 2063, and CAADP-Malabo commitments. The UNFSS 2021 was also an important step in reframing the thinking on what African food systems need to deliver over the coming decades. Now is the opportunity to take stock by re-assessing identified strategies for advancing these food systems.

A handful of countries submitted national pathways ahead of the UNFSS in September 2021. By February 2023, at the regional preparatory meetings for the Food Systems Stocktaking Moment, 37 African countries had submitted national pathways for transformation (UN Food Systems Coordination Hub, 2023). It is important that the remaining 18 countries develop national pathways for food system transformation. Without a plan, it is difficult to transform such a complex system.

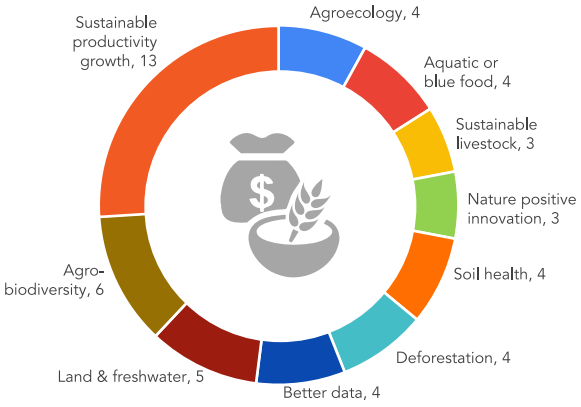
Figure 3.6 summarizes key commitments and coalitions based on statements delivered by Heads of States and the country pathways reports. For illustrative purposes, only Action Tracks (AT) for which data was complete are shown. Overall, 30 African countries committed to AT1 (ensure access to safe and nutritious food for all), 28 to AT3 (boost nature-positive production), 19 to AT4 (advance equitable livelihoods), and 23 to AT5 (build resilience to vulnerabilities, shocks, and stresses).



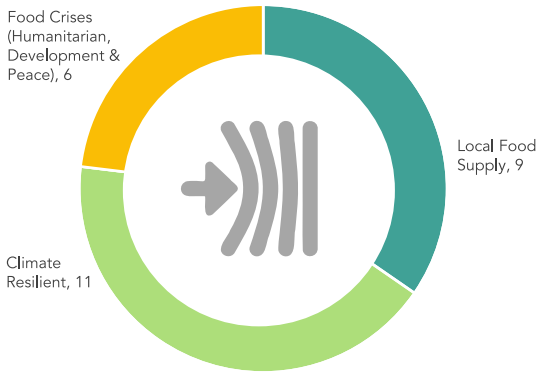
Action Track 1: Ensure access to safe and nutritious food for all



Action Track 3: Boost nature-based solutions



Action Track 4: Advance equitable livelihoods



Action Track 5: Build resilience to vulnerabilities, shocks, and stresses

Figure 3.6: Number of African countries in Coalitions for Food Systems Transformation
Source: Authors' computations based on UNFSS reports

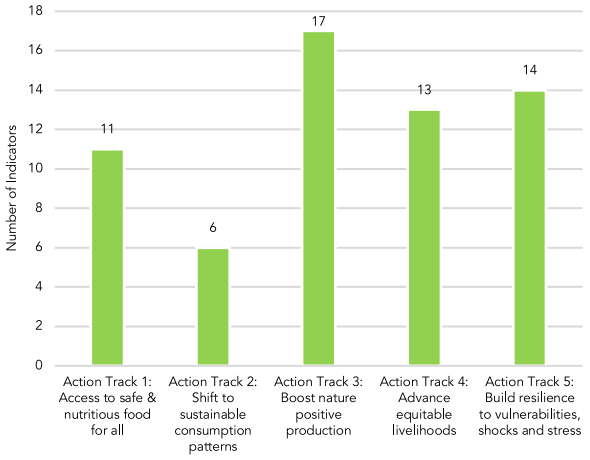
Progress against Action Tracks areas based on CAADP indicators, 2019-2021

There is currently no official comprehensive way to assess African food system transformation. One approach is to compare the 3rd CAADP Biennial Review Report (which coincided with the 2021 UNFSS) to the 2019 report and map the 47 CAADP indicators onto the five UNFSS Action Tracks. Of the 47 BR performance indicators and as shown in Figure 3.7, 11 indicators fall under AT1 (access to safe and nutritious food for all), six under AT 2 (shift to sustainable consumption patterns), 17 under AT3 (boost nature-positive production), 13 under AT4 (advance equitable livelihoods), and 14 under AT5 (build resilience to vulnerabilities, shocks, and stress).

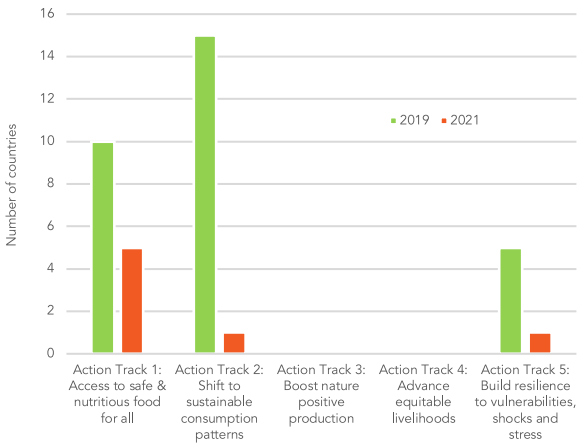
An assessment of the change in performance indicators between the previous 2nd and 3rd BR cycles is done to give an indication of how Member States are performing in transforming their food systems. As shown in Figure 3.6, the results indicate that:

- With respect to the indicators under AT1 (access to safe & nutritious food for all), 10 Member States[8] were on-track in 2019, compared to only five Member States[9] in 2021.

8 Cabo Verde, Gambia, Mali, Mauritania, Rwanda, Seychelles, Eswatini, Tanzania, Tunisia and Zimbabwe
9 Eswatini, Gambia, Mali, Tunisia, and Zimbabwe



Number of BR performance indicators by the UN Food System Summit's Action Tracks



CAADP implementation by the UN Food System Summit's Action Tracks (number of Member States achieving target in 2019 and 2021)

Figure 3.7: Mapping of CAADP indicators on UNFSS and number of countries meeting targets.
Source: 3rd CAADP BR report (2021)

- With respect to the indicators under AT2 (shift to sustainable consumption patterns), 15 Member States[10] were on-track in 2019, compared to only 1 (Egypt) in 2021.
- With respect to the indicators under both AT3 (boost nature-positive production) and AT4 (advance equitable livelihoods), no country was on track across the two review periods.
- With respect to the indicators under AT5 (build resilience to vulnerabilities, shocks, and stress), five Member States[11] were on track in 2019 compared to 1 (Rwanda) in 2021.

The overall trend suggests the performance of the continent in transforming its food systems has declined between the two review periods. This also mirrors the general deterioration in performance in achieving the Malabo Declaration goals and targets.

The State of African food systems transformation and how to measure their performance

The UNFSS+2 Stocktaking Moment held in July 2023 served as the first global follow-up to the 2021 UNFSS and provided a new opportunity to review commitments and assess progress towards the implementation of national food systems transformation pathways. The FSCI emerged from the Summit to fill this gap. During the 2023 UNFSS Stocktaking Moment, the Countdown highlighted the work in Schneider *et al.* (2023), providing baseline data for 50 indicators that can be used to measure and track performance of the food systems of all countries in the world towards 2023 (see Annexure 2).

The framework acknowledges the strong complementarity of food systems and the SDGs and provides a mechanism and reference for annual monitoring and assessing the effectiveness of food systems policies in achieving the objectives of transformation. The FSCI framework monitors food

10 Burundi, Cabo Verde, Central African Rep., Côte d'Ivoire, Ghana, Guinea, Madagascar, Mali, Rwanda, Senegal, Sierra Leone, Eswatini, Togo, Tunisia, Uganda
11 Ghana, Mali, Morocco, Rwanda and Tunisia

systems across five themes, namely (i) diets, nutrition, and health; (ii) environment, natural resources, and production; (iii) livelihoods, poverty, and equity; (iv) governance; and (v) resilience and sustainability (Schneider et al., 2023). The FSCI comprises a total of 50 indicators across these themes measuring various aspects of food systems. In this section, we look at the indicators to highlight the current state of African food systems against global averages, with a particular focus on sub-Saharan Africa (see Table 3.1).

Table 3.1: Percentage deviation of sub-Saharan African weighted mean from global weighted mean, sign aligned to desirable direction of change

Domain	Indicator		Units	Desired Direction of Δ	Global weighted Mean	sub-Saharan Africa	
						Regional weighted mean	% deviation from global mean
Diets, nutrition, and Health							
Food environments	1. Cost of a healthy diet		US $ PPP per person/day	↓	3.3	3.4	-1.1
	2. Availability of fruits & vegetables	Fruits	grams per capita/ day	↑	223.8	169.5	-24.3*
		Vegetables	grams/capita/ day	↑	246.8	123.6	-50***
	3. Retail value of ultra-processed foods		US PPP per capita	↓	204.0	41.2	79.8***
	4. % Population using safely managed drinking water services (SDG 6.1.1)		% population	↑	66.3	20.3	-69.3***
Food Security	5. Prevalence of Undernourishment (SDG 2.1.1)		% population	↓	9.4	20.5	-116.7***
	6. % Population experiencing moderate or severe food insecurity (SDG 2.1.2)		% population	↓	29.5	60.3	-104.1***
	7. % Population who cannot afford a healthy diet		% population	↓	42.3	84.9	-100.8***
Diet quality	8. MDD-W: minimum dietary diversity for women		% population, women 15-49	↑	65.7	52.4	-20.2**
	9. MDD (IYCF): minimum dietary diversity for infants and young children		population, 6-23 months	↑	31.8	23.1	-27.4***
	10. All-5: consumption of all 5 food groups		% adult population (≥15 y)	↑	39.0	25.0	-35.8***
	11. Zero fruit or vegetable consumption	Adults	% adult population (≥15 y)	↓	10.8	13.7	-26.1
		Children 6-23 months	% population, 6-23 months	↓	39.1	42.6	-8.9
	12. NCD-Protect		points (out of 9)	↑	3.8	3.1	-19.7***
	13. NCD-Risk		points (out of 9)	↓	2.1	1.8	17.1
	14. Sugar-sweetened soft drink consumption		% adult population (≥15 y)	↓	18.9	27.2	-44*

Domain	Indicator		Units	Desired Direction of Δ	Global weighted Mean	sub-Saharan Africa	
						Regional weighted mean	% deviation from global mean
Environment, natural resources, and production							
Greenhouse gas emissions	15. Food systems greenhouse gas emissions		Kt CO2eq (AR5) per capita	↓	82,463.9	51790.6	40.9*
	16. Greenhouse gas emissions intensity, by product group[$]	Cereals (excl. rice) †	kg CO2eq/kg product	↓	0.2	0.1	17.3**
		Beef	Kg CO2eq/ kg product	↓	30.3	74.8	-147*
		Cow's Milk	kg CO2eq/ kg product	↓	1.0	3.8	-288***
		Rice	kg CO2eq/ kg product	↓	1.1	1.6	-46.8*
Production	17. Food product yield, by food group	Cereals†	tons/ha	↑	40.7	16.4	-59.8***
		Fruit†	tons/ha	↑	136.7	77.2	-43.5***
		Beef	kg/animal	↑	231.5	148.4	-35.9***
		Cow's milk	kg/animal	↑	2676.6	499.0	-81.4***
		Vegetables†	kg/ha	↑	197.0	57.1	-71***
Land	18. Cropland expansion (relative change 2003-2019)		%	↓	19.1	59.0	-209.1**
Water	19. Agriculture water withdrawal as % of total renewable water resources		% total renewable	↓	16.9	4.2	75***
Biosphere integrity	20. Functional integrity: % agricultural land with minimum level of natural habitat		% agricultural land	↑	88.3	90.6	2.6
	21. Fishery health index progress score		units	↑	21.4	12.3	-42.3*
Pollution	22. Total pesticides per unit of cropland		kg/ha	↓	1.8	0.4	77.4***
	23. Sustainable nitrogen management index		units	↑	0.7	0.9	24.3***
Livelihoods, Poverty, & Equity							
Poverty and income	24. Share of agriculture in GDP		% GDP	↓	4.4	18.2	-315.3**
Employment	25. Unemployment, rural		% working age population	↓	5.7	5.5	4.4
	26. Underemployment rate, rural		% working age population	↓	7.3	15.9	-116*
Social protection	27. Social protection coverage		% population	↑	55.8	22.5	-59.7***
	28. Social protection adequacy		% welfare of beneficiary households	↑	21.0	16.8	-20
Rights	29. % Children 5-17 engaged in child labour		% children 5-17	↓	9.4	22.0	-134.9***
	30. Female share of landholdings		% landholdings by sex of operator	↑	16.8	18.1	-13.3

Domain	Indicator		Units	Desired Direction of Δ	Global weighted Mean	sub-Saharan Africa	
						Regional weighted mean	% deviation from global mean
Governance							
Shared vision and strategic planning	31. Civil society participation index		Units	↑	0.6	0.7	18.4***
	32. % Urban population living in cities signed onto the Milan Urban Food Policy Pact		%	↑	7.2	8.4	16.4
	33. Degree of legal recognition of the Right to Food[12]		Units	↓	1.9	1.8	8.3*
	34. Presence of a national food system Transformation pathway[13]		Units	↑	0.6	0.8	23.3*
Effective implementation	35. Government effectiveness index		Units	↑	0.1	-0.8	-756.9***
	36. International Health Regulations State Party Assessment report (IHR SPAR), food safety capacity		Units	↑	69.4	44.9	-35.3
	37. Presence of health-related food taxes		Units	↑	0.3	0.2	-47.5
Accountability	38. V-Dem Accountability index		Units	↑	0.3	0.5	62.5
	39. Open Budget Index Score		Units	↑	43.1	37.6	-12.7
	40. Guarantees for public access to information (SDG 16.10.2)		Units	↑	1.9	0.5	-11.5**
Resilience & Sustainability							
Exposure to shocks	41. Ratio of total damages of all disasters to GDP		Units	↓	0.3	0.1	74.8***
Resilience capacities	42. Dietary sourcing flexibility index		Units	↑	0.7	0.7	-3.6*
	43. Mobile cellular subscriptions (per 100 people)		Subscribers per 100 People	↑	105.5	87.6	-17.4**
	44. Social capital index		Units	↑	0.5	0.4	-23.6***
Agro- and food diversity	45. Proportion of agricultural land with minimum level of species diversity (crop and pasture)		% Agricultural Land	↑	22.5	31.5	40.1*

12 1 = Explicit protection or directive principle of state policy, 2= Other implicit or national codification of international obligations or relevant provisions, 3 = None

13 0 = No, 1 = yes

Domain	Indicator		Units	Desired Direction of Δ	Global weighted Mean	sub-Saharan Africa	
						Regional weighted mean	% deviation from global mean
	46. Number of plant genetic resources for food and agriculture secured in either medium- or long-term conservation facilities (SDG 2.5.1)		Thousands	↑	161.4	12.8	-92.1***
	47. Number of animal genetic resources for food and agriculture secured in either medium- or long-term conservation facilities (SDG 2.5.1)		Units	↑	4.4	1.3	-70.2***
Resilience responses or strategies	48. Coping strategies index		% Population	↓	38.5	39.4	-2.4
Long-term	49. Food price volatility		Units	↓	0.7	0.8	-1.9
outcomes	50. Food supply variability		Kcal per Capita/ Day	↓	29.9	33.6	12.5

Notes/Key

*** p < 0.001; ** p < 0.01; * p < 0.05

↑ Denotes "more is better" indicators. The higher the score the better the performance.

↓ Denotes "less is better" indicators. The lower the score the better the indicator performance

Denotes indicators where Africa is performing significantly (statistically) worse than the global average

Denotes indicators where there is no statistically significant difference between Africa and the global average

Denotes indicators where Africa is performing significantly (statistically) better relative to the global average

Source: Indicators and data from Schneider et al (2023), analyses from authors of this chapter

The results give an important baseline and frame of reference to guide African food systems discussions. The results can also guide the design of policies and solutions to leverage agrifood systems transformation for healthy diets from sustainable systems on the continent. One way to track African food systems would be to compare data for the indicators in Table 3.1 and Annexure 2 with their values in 2024 and subsequent years. The indicator values will be adjusted annually as new data comes onstream. A missing piece of the work, however, is the development of benchmarks for each of the indicators. This is still work in progress. A consensus on the benchmark values would have to be developed across a wide range of stakeholders.

At present, the best available way to assess status is to compare sub-Saharan Africa to global averages. Table 3.1 provides a broad picture of sub-Saharan Africa's status against each of the indicators. Interestingly, nearly all indicators relating to diets, nutrition, and health are below global averages, and most of the deviations are statistically significantly different from zero. Several studies also indicate that

sub-Saharan Africa is among the regions with the lowest cereal self-sufficiency ratio (Van Ittersum *et al.*, 2016).

Indicators of environment, natural resources, and production show that aggregate cereal yields are roughly 60 percent below the global average while crop land expansion indicators point to an over-reliance on area expansion and extensification as the main sources of increased food production. In fact, the 2021 Africa Agriculture Status Report (AASR) showed that roughly 75 percent of agricultural production growth since 2000 came from the expansion of area under cropland, and only 25 percent from crop yield improvements (AGRA, 2021). Fuglie et al. (2020) also noted that cereal yields in sub-Saharan Africa rose by only 38 percent in the 38 years between 1980 and 2018. This is roughly a third that of South Asia and Southeast Asia during the same period. There is debate around whether sub-Saharan Africa can feed its growing population without major expansion of agricultural area and associated environmental challenges such as biodiversity loss and GHG emissions. Clearly, bolstering the region's food security and positive nutrition outcomes should be achieved through sustainable forms of agricultural growth driven by productivity improvements and more regenerative land management practices.

Across the sub-Saharan Africa region, resilience, and sustainability indicators, namely resilience capacities, resilience responses and long-term strategies score mostly below global averages. The AASR (2021) also showed that most indicators of sustainability and resilience for sub-Saharan Africa such as the percentage of households residing on degrading soils and forest area and energy depletion show negative trends. The African continent's resilience capacity, measured by the social capital index, is roughly 24 percent below the global average. For the continent, the Notre Dame Global Adaptation Index (ND-GAIN), which summarizes a region's or country's climate change vulnerability and its readiness to improve resilience, averages 38.97 compared to a global average of 49.01 (ND-GAIN, 2023). Given that nearly 290 million people are employed in agrifood systems in Africa (Davis et al., 2023), bolstering resilience and sustainability of food systems should be an urgent priority for African governments.

Building resilience will require substantial state capacity to respond effectively to shocks and stressors as well as proactiveness in anticipating and dealing with emergent threats. However, while the continent shows commendable progress in terms of shared vision and strategic planning as measured by the presence of a national food system transformation pathway, the overall government effectiveness index is 756.9 percent below global averages.

Key drivers shaping African food systems transformation

For at least two decades, empirical analysis and evidence has pointed to African food systems undergoing fundamental transformation. The AASR (2022) highlights six mega-trends that will continue to shape food systems over the next decade. These fall into six categories, namely:

(a) **Rural population growth and associated rising land scarcity**. This requires policy responses that promote productivity-enhancing technologies, innovations in sustainable land management and agronomic practices, and significant investments in research, development, and extension (RD&E).

(b) **Rapidly rising urban populations fuelling a stable and constantly-increasing demand for food**. This requires governments to expand and broaden the range of crops and animal products for which services are offered and supported by national RD&E systems. This would include high-value fruits and vegetables and other crops with expanding commercial potential.

(c) **Economic transformation whose main features include rising wage rates and per capita incomes**. This calls for policies and regulations that promote employment and private investment in upstream and downstream stages (including cross-border trade) of agrifood value chains.

(d) **Climate change and increasing incidence of extreme weather events**. These are driving the need for greater regulation to reduce agricultural GHG emissions and the promotion of the sustainable agronomic practices (i.e., the conversion to no-till and minimum tillage practices to enhance carbon sequestration and the inclusion of legumes in crop rotations to fix soil nitrogen, etc.)

(e) **Accelerated pace of technical innovation in communications, information, and supply chains**. This includes the wider application of digital innovations and platforms to connect smallholder farmers to

input and output markets and services to facilitate the adaptation of food systems to shocks and rapid changes in demand and supply.

(f) **Ongoing global health crises, regional conflicts, and economic disruptions**. The (effects of the) COVID-19 pandemic and Russo-Ukraine conflict are driving food prices and continue to exacerbate food insecurity throughout the continent.

The drivers underpinning these mega-trends are outlined in Annexure 5. Amid these mega-trends, Africa has only made limited progress in meeting two high-level CAADP goals and SDGs (i.e., ending/halving poverty and zero hunger). Several factors are stalling progress, namely:

(a) Low access to productive assets and limited access to public services both of which limit the capacity of households to utilize opportunities (Fox, 2019).

(b) Africa's predominant reliance on natural resources for income growth instead of more inclusive sectors such as agricultural and rural development, which are a key source of livelihood for 85 percent of the poor population (Aikins and Mclachlan, 2022).

(c) High fertility rates leading to high population growth and in turn lower growth per capita incomes (Fox, 2019),

(d) Low productivity of smallholder agriculture, low educational status, climate change, corruption, wars and conflicts, and fluctuation of food prices (Owolade *et al.*, 2022).

While these factors are suppressing progress towards achieving the important goals of ending hunger and poverty, some key specific drivers are likely to play a more instrumental role in advancing food systems transformation over the immediate to near-term. Among them include (i) deepening regional economic integration of the African continent, (ii) high and increasing food prices, and (iii) vulnerability to climate change.

Intra-regional trade in food commodities

Commitment 5 under CAADP seeks to triple intra-regional trade in agricultural commodities and services by 2025. Implementing regional integration efforts – primarily the AfCFTA – could account for 80 million more Africans moving out of extreme poverty (World Bank, 2022). The CAADP goal of boosting intra-African trade is defined by a target to triple intra-African trade in agricultural commodities and services by the year 2025. If non-food and agricultural inputs such as fertilizers are included, African countries traded only 22 percent of their total agricultural commodities. The trend of Africa's intra-regional trade can be divided into two periods:

(a) Pre-2013 when the share of Africa's trade in the continent peaked to 28.7 percent in 2013. This was primarily driven by the opening up of new regional markets in COMESA and the SADC Free Trade Area.

(b) Post-2013, when the share of Africa's trade in the continent stagnated and then steadily declined as market integration efforts stalled with the proliferation of non-tariff barriers (NTBs), persistently low farm productivity, and a growing reliance on the world market for food. (See Figure 3.8).

Tripling intra-regional trade, as targeted by the CAADP, implies that Africa must increase the share of agricultural commodities traded among its countries to at least two thirds (66%) of total agricultural trade. It is therefore not surprising that the CAADP Biennial Review (2022), revealed that the continent is not on track to achieving the target. According to the third CAADP BR report, only five Member States (Botswana, Djibouti, Nigeria, Senegal, and Sierra Leone) were on track with respect to tripling intra-regional trade in agricultural commodities by 2025 compared to twenty-nine (29) in 2019.

The African Continental Free Trade Agreement (AfCFTA) came into force in January 2020 creating a single market arrangement that is expected to deepen and broaden market access for African countries to enable more intra-regional trade. In October 2022, AfCFTA kicked off its Guided Trade Initiative (GTI) – a pilot project among eight countries (Cameroon, Egypt, Ghana, Kenya, Mauritius, Rwanda, Tanzania, and Tunisia) – to trade some 96 products that are part of the 90 percent "category A" adopted tariff offers. With the GTI expected to provide the impetus and momentum for intra-regional trade within the AfCFTA single market arrangement, there are expectations for deeper and expanded trade in food as the continent begins to progressively open its market to other African trading partners.

However, for deeper regional economic integration to occur at scale, and to achieve the target of tripling intra-regional trade, African countries must effectively implement more reforms that can create an enabling

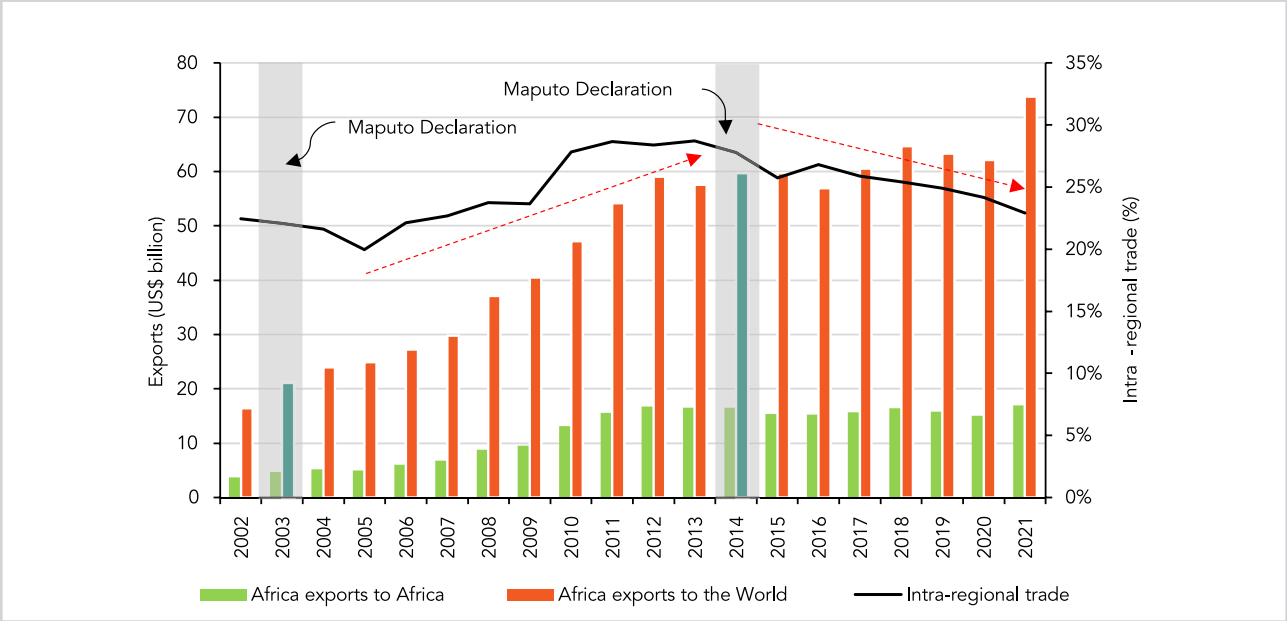


Figure 3.8: Trends in intra-regional trade in food and agricultural goods (2002-2021)
Source: ITC Trademap (2023)

environment (CAADP Biennial Review, 2022). There is evidence to show that African countries are making positive steps towards improving the trade environment. The Biennial Review (2022) reported that despite not making the benchmark score of five points, 18 countries across the continent are making significant progress in improving the overall trade environment by building infrastructure and trade facilitation measures that reduce the cost of trade.

Rising food prices/costs of healthy diets

The growing food and nutrition crises are also epitomized by the rising cost of securing a healthy diet. FAO has tracked and reported on the cost and affordability of a healthy diet to bring global attention to the fact that low disposable income relative to the high cost of food is one of the most serious impediments to accessing nutritious foods essential for a healthy, active life. The 2022 report shows that a sharp increase in global consumer food prices in the second half of 2020 has translated directly into an increased average cost of a healthy diet – this increased the cost of a healthy diet in sub-Saharan Africa by 12 percent from USD 3.20 per person per day[14] in 2017 to USD 3.58 in 2021 (see Table 3.2).

14 The cost of a healthy diet in Africa, while lower than Asia (US$3.72), Latin America and the Caribbean (US$3.89) per person per day), it is well above that of Northern America and Europe (US$3.19) and Oceania (US$3.07).

Table 3.2: Cost of a healthy diet (PPP dollar per person per day), 2017-2021

	2017	2018	2019	2020	2021	% Change between 2017 and 2021
World	3,30	3,36	3,43	3,51	3,66	+11,1%
Africa	3,22	3,27	3,31	3,38	3,57	+10,8%
sub-Saharan Africa	3,20	3,25	3,28	3,36	3,58	+12,0%
Eastern Africa	2,93	2,97	3,01	3,09	3,29	+12,3%
Southern Africa	3,64	3,65	3,71	3,84	4,06	+11,7%
Middle Africa	3,29	3,29	3,30	3,37	3,55	+7,9%
Northern Africa	3,42	3,51	3,60	3,58	3,47	+1,7%
Western Africa	3,25	3,34	3,37	3,45	3,71	+14,3%

Source: FAO (2023)

These increases reflect the effects of inflation in global consumer food prices stemming from the economic impacts of the COVID-19 pandemic and the Russia-Ukraine conflict mainly through disruptions in supply chains and effects on global grain, fertilizer, and energy prices leading to shortages and fuelling even higher rates of inflation. About 85 percent of sub-Saharan Africa's population could not afford a healthy diet. In terms of absolute numbers of people, an average of 27 million more people in sub-Saharan Africa could not afford a healthy diet in 2022. Most of these people (21 million) live in eastern and western Africa.

Climate Change

Climate-related disasters, especially droughts, have a relatively more substantial impact on medium-term growth in sub-Saharan Africa than in other regions of the world (Pondi et al., 2022). Pondi *et al*. (2022) go on to assert three distinct investments that are important in creating resilience to specific types of climate-related interventions.

- Resilience to droughts requires combined investments in electrification and irrigation infrastructure. Access to irrigation is tracked under the CAADP BR reporting framework, with results showing that there has been a general increase in the size of land irrigated across Africa compared to the 2015 baseline. East African land under irrigation has increased by 97 percent from 2015 while the proportion of land under irrigation in western, southern and central Africa has grown by 68 percent, 58 percent and 54 percent respectively. Meanwhile, northern Africa increased the proportion of land under irrigation by 12 percent between 2015 and 2021 (CAADP, 2023).
- Minimizing impact from floods and storms requires significant investments in health care and education systems to avert health-related crises and generate innovations that can mitigate negative effects, respectively.

Overall, resilience-building requires access to finance, telecommunications, and intensive use of agricultural machinery (Pondi *et al*., 2022). The use of sustainable mechanization in agriculture in Africa remains relatively low compared to other continents. The third CAADP BR (2023) reported that about 65 percent of farm power is human, 25 percent is draught, and 10 percent is engine power.

Important to note is that several African countries are making meaningful progress towards enhancing the resilience of livelihoods and production systems to climate variability and other related risks. These include Burundi, Cabo Verde, Morocco, Rwanda, Ethiopia, Ghana, Mali, and Seychelles. A total of 32 other African countries continue to make improvements in this area but have not yet reached the continental benchmarks. Given the nature and frequency of climate-related shocks, the improvements in resilience to climate change that are noted in the CAADP BR assessments remain vulnerable to being wiped out. As such, it will be important to increase investments to consolidate these gains.

What needs to be done to accelerate Africa's progress towards meeting food systems commitments and targets?

Generally, SDGs are the global blueprint through which states can address poverty, inequality, climate change, environmental degradation, peace, and justice, to achieve a "sustainable future for all". ECA data shows that Africa is off track to meet the SDGs. From a food systems perspective, the 2022 CAADP Biennial review report shows that only five countries are on track for the indicators under AT1 (nourishing people), one for AT2 (shift to healthy and sustainable consumption patterns), none for AT3 (boost nature positive production at scale) and AT4 (advance equitable livelihoods and value distribution) and only one for AT5 (build resilience to vulnerabilities, shocks and stresses). These numbers were significantly higher in the previous biennial assessment.

The Countdown indicators provide data for 50 indicators for all African countries. Africa is worse off relative to global averages on indicators on diets, nutrition, and health as well as food environments (cost of healthy diets), food security, diet quality, and dietary diversity metrics. However, the continent outperforms global averages on GHG emissions indicators and the proportion of agricultural land with minimum level of species diversity. Resilience indicators are also mostly in the red, an indication that although the continent is not a net emitter GHG, it still bears the brunt of shocks related to climate change and other exogenous shocks.

The context, including factors related to and the effects of COVID-19 and the Russia-Ukraine war, remains challenging. However, this makes it even more imperative that Africa accelerates actions towards food systems transformation as a key to achieving global and continental targets. These efforts need to be guided by comprehensive and science-based frameworks that foster accountability and provide clear reference points to incentivize policy action.

Although most of the quantitative indicators from FSCI thematic areas paint a rather dismal picture for Africa when compared to global averages, qualitative data tells us that some progress is being made in some domains, albeit not enough. Africa is increasingly showing commitment to driving the transformation agenda forward as epitomized by the development of national food system transformation pathways and investment plans. However, while this provides much-needed signs of progress, to truly accelerate progress, several things articulated in the upcoming section should happen concurrently.

In terms of driving the transformation agenda forward and enhancing inclusion, accountability, and monitoring mechanisms:

- Countries that do not have food systems pathways should be encouraged and supported to develop them. These pathways should be developed into fully-fledged and context-specific food systems strategies and investment plans.
- Given the demographic profile of Africa, promoting the voice of youth, especially girls and young women, is essential to food system transformation. The voices of these groups must be not only heard, but also acted on. This means that they must be meaningfully and intentionally included in decision-making processes.
- African governments need to adopt more food system indicators, such as those in the Countdown initiative, into CAADP and set targets for them. This will set priorities, promote learning, and strengthen accountability.
- African governments need to adopt the new IFAD/World Bank budget tool for food systems transformation (3FS Tool). Launched by the President of Niger at the UNFSS+2, the tool will be instrumental in constructing food system budgets to show how much and where domestic resources are being allocated and where resources are being programmed by country donors. This will support and inform decisions on resource reallocation.
- The ecosystem of support for African countries encompassing the UN, development finance institutions (DFIs), the Development Assistance Committee (DAC), and international non-governmental organizations (INGOs), requires more organization and coherence to better support African governments.

African governments should lead the call for the UNFSS+4 in 2025 to have a strong focus on identifying, analyzing, and learning from food system change since UNFSS+2.

In terms of specific investments in food systems:

- African governments need to unleash the potential of their businesses to invest in food system transformation by de-risking the production, supply and consumption of food that is nutritious, environmentally sound, and generates more and better jobs. They can do this through a variety of fiscal policies.
- There is need to increase funding for food system transformation. Donors should consider setting up a time-bound African Food System Transformation Fund that would focus on meeting the transition costs of establishing and changing budgeting processes, data collection, policy coherence and financial reallocations to better track and support food system transformation.
- Given the impact of climate change on African food systems, policies that promote climate-smart agriculture and food systems are critical. This can include promotion of drought-resistant crop varieties, sustainable farming practices, and effective water management techniques.
- Market access and trade policies: Policies that enhance market access can facilitate food system transformation by allowing farmers to participate in local, regional, and international value chains. This could involve reducing trade barriers, improving market information, and supporting farmers to meet market standards.
- Nutrition-sensitive policies: In addition to increasing productivity, it is important to focus on improving the nutritional quality and safety of food. This can be achieved through policies that promote diversification of food production, food

fortification, diversification of agricultural R&D, food based dietary guidelines, nutrition education and healthy sustainable diet campaigns.

- Investment in agricultural research and development: Policies that promote investment in agricultural research and development can spur innovation, enhance productivity, and foster sustainability. This includes developing improved seed varieties, efficient farming techniques, and post-harvest technologies.
- Infrastructure development: Investments in infrastructure, such as roads, irrigation systems, storage facilities, and electricity, are crucial for supporting productive, resilient, and sustainable food systems. These improvements can reduce post-harvest losses, facilitate low-cost access to markets, and promote value addition.
- Extension services: Strengthening agricultural extension services can help disseminate knowledge on modern farming techniques, improved seeds, pest management, and climate-smart practices to farmers.
- Social protection programs: Social protection programs, such as cash transfers, can help buffer vulnerable households from shocks, reduce poverty, and potentially stimulate demand for nutritious food and investments in their production, procurement, processing, and marketing.

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Annexes

Annexure 1: Synthesis of Action Tracks and Coalitions by African Countries

Action area	Coalitions	Countries in Coalitions	Proposed game-changing interventions gathered from food system pathways presented at the UNFSS in Sept 2021
Nourish all people	Zero hunger	Algeria, Benin, Burundi, Central African Republic Egypt, Eswatini, Ghana, Kenya, Morocco, Nigeria, Republic of Congo, South Sudan, South Africa, Seychelles	• **Malawi**: Strengthen local food supply chains by establishing local food hubs in each district. • **Mozambique**: Implementation of support programmes to vulnerable groups: support provision under the "food for work" approach and provision of production kits loans. • **Namibia**: Regional governments to spearhead various crop and livestock projects for nutrition, income generation, and equitable livelihoods. • **South Africa**: Youth, graduates and women must be elevated by prioritization, fast tracking and growing their number in access to land and participation in the food system to ensure food and nutrition security at household level. South Africa's biological resources diversity must include indigenous breeds and the "forgotten" and neglected crops to broaden the food basket and mitigate food security risks through diversification. Launch, enhance and fund the already existing centrally coordinated food system governance structure, i.e., the Food Security Council, with a clear mandate, roles and responsibilities supported by clear policies, legislation planning, and governance. • **Seychelles**: Transform the food value chain to build a more productive and competitive local food production system. • **Zimbabwe**: Scale up community level "nutrition sensitive" agriculture interventions to drive diversified crop and livestock production, including promoting the production of biofortified crops.
	Healthy diets for children and all	Burkina Faso, Burundi Central African Republic, Chad, Cote d'Ivoire, Eswatini, Gabon, Ghana, Kenya, Madagascar, Mauritius, Nigeria, South Sudan, South Africa, Somalia, Zimbabwe.	• **Botswana**: Include indigenous foods in the local food systems. Provide nutrition and food safety education along the food chain, including street vendors. Develop food dietary guidelines for the vulnerable groups including the elderly. • **Eswatini**: Promote healthy eating and lifestyle. Promote Nutritious Indigenous foods. Support School Feeding Programme. • **Malawi**: Diversify AIP and scale up investments in integrated nutritious value chains for crops, livestock, and fisheries (including indigenous value chains). Promoting consumption of nutrient rich foods and re-introduce nutrition frontline workers (home-craft workers). • **Namibia**: Strengthen efforts to promote people centered health diets through nutrition education and advocacy. Promote dietary diversification, mainstreaming of indigenous crops in daily diets. • **South Africa**: Healthier lifestyles must be promoted through public awareness campaigns to educate consumers on food to serve their nutritional values. Food safety standards should be improved throughout the value chain across provinces to ensure quality food reaches all households and communities. • **Seychelles**: Activate healthy living educational programmes to reverse the obesity trend and other diet related diseases. • **Zimbabwe**: Promote and enforce food safety standards in both formal and informal food markets to protect consumers in a process led by the government of Zimbabwe (GoZ) and partners. In addition, the decentralization of the government analyst laboratories (GAL) to provincial level is recommended. MoHCC should put in place a Food Safety Act. Initiate the setting agro-food processing industries across the food value chains to ensure value addition and increase access to healthy and sustainable diets-driven.

Action area	Coalitions	Countries in Coalitions	Proposed game-changing interventions gathered from food system pathways presented at the UNFSS in Sept 2021
	Child stunting/ school feeding	Benin, Burundi, DRC, Egypt, Gambia, Kenya, Liberia, Morocco, South Africa, Senegal	• **Mozambique**: Increased coverage for food programmes: school feeding programmes, first 1 000 days Programme (food support for pregnant women and children up to two-years old), programmes for rehabilitation and expansion of water and sanitation networks. • **South Africa**: Awareness campaigns conducted on the importance of breastfeeding to mother and child to prevent stunting, child, and adult obesity in households. • **Zimbabwe**: Improve the nutritional status of people in Zimbabwe through Home nutrition and schools gardening, including traditional vegetables; Maternal Micronutrient Supplementation; Good Manufacturing Practice (from Farm to Fork); Adapt and Adopt the Complementary Feeding Framework for improving young children's diets. Expand the home-grown school feeding program (HGSFP) to improve nutrition for school children and create a market for locally produced foods including biofortified crops (orange maize, iron rich beans, orange sweet potatoes and pearl millet) to increase farmer incomes and bolster their livelihoods.
	Food loss and waste	Algeria, Botswana, Cote d'Ivoire, Malawi, South Sudan	• **Algeria:** Food waste program • **Botswana**: Control of post-harvest, storage, processing, and consumption food losses. • **Malawi**: Introduce a holistic approach to food waste management through measurement, separation, recycle, re-use and produce valuable products such as organic fertilizer and eco-bricks. • **South Africa**: Reducing food waste through incentivizing repurposing of food, agro-processing opportunities, supporting redistribution of healthy food products and using 4IR to link actors. • **Zimbabwe**: Reduce post-harvest losses through utilization of appropriate technologies and value addition via investments in agro-processing infrastructure in rural areas.
	Social protection	Burundi, Morocco, Niger	• **Niger:** Support building resilience and recovery Assistance to populations in fragile areas affected by various shocks (security, climatic, health, economic, locusts, etc.) will be provided through the Nexus-Emergency-Development-Peace approach. Adaptive intervention mechanisms including social protection measures will be favored. Adaptive social protection measures will be promoted as a priority in areas affected by insecurity and various crises by creating a single functional register of beneficiaries of social safety net programs. • **South Africa**: Strengthen existing national social protection systems' design and implementation to enhance their impacts on poverty reduction, health and malnutrition and human capital development by linking to and improving food systems' performance, inclusiveness, and resilience. • **Zimbabwe**: Expand Nutrition sensitive social assistance and protection initiatives to reach vulnerable households with nutrition services and programs that focus on production of nutritious foods
	Family farming	DRC, Zambia	
Nature based production	Agroecology	Madagascar, Morocco, Senegal, Zambia	• **Senegal:** improving the production, processing, marketing, and consumption of quality agro-sylvo-pastoral and fishery products.
	Aquatic/ blue food	Ghana, Kenya, Mauritania, Namibia	

Action area	Coalitions	Countries in Coalitions	Proposed game-changing interventions gathered from food system pathways presented at the UNFSS in Sept 2021
	Sustainable livestock	Djibouti, Eritrea, Kenya	
	Nature positive innovation	Madagascar, Malawi, Zambia	• **Malawi**: Scale up natural resource management practices such as land restoration, farmer managed natural regeneration, agro-ecology, permaculture, conservation agriculture, and catchment conservation measures.
	Soil health	DRC, Egypt, Mauritius, Namibia	• **Namibia**: Promoting climate smart and regenerative agriculture practices and micro-organisms build-up to ensure soil fertility, moisture retention and carbon storing, to reverse biodiversity loss, halt bush encroachment, improve pastures, and restoration of the ecosystem to unlock ecosystem benefits.
	Deforestation	Cote d'Ivoire, Gabon, Morocco, Zambia	
	Better data	Eswatini, Ghana, Kenya, Nigeria	• **Eswatini**: Establish an Integrated Digital Agri-data and Information Systems that support a digital registry of farmers and value chains players and their activities in the food systems function.
	Land and freshwater	Burkina Faso, Djibouti, Mauritius, Somalia, Zambia	
	Agrobiodiversity	Burkina Faso, Cote d'Ivoire, Gabon, Mauritius, South Sudan, Zambia	• **Burkina Faso:** Diversified agro-sylvo-pastoral fishery and wildlife production, sufficient, of quality and in line with sustainability.
	Sustainable productivity growth	Botswana, Burundi, Eritrea, Eswatini, Gabon, Ghana, Lesotho, Mauritania, Niger, Republic of Congo, South Sudan, Senegal, Seychelles	• **Gabon:** the adoption and implementation of the National Land Use Plan • **Congo:** Capacity building of actors along value chains. Support the integration of agricultural educational programs linked to environmental and nutritional challenges. Promote sustainable management practices of soil, water and biodiversity. Promote sustainable waste management. Mobilize innovative financing (carbon credit, etc.) to finance agroecology. • **Republic of Congo:** Adopt agricultural policies that considerably reduce the vulnerability of farmers and processors due to their structural dependence on inputs (seeds, fertilizers, pesticides, young animals, packaging, etc.) and technologies (spare parts, skills) from foreign countries that may themselves also be paralyzed by a pandemic or other crises, by relocating strategic production systems and promoting the integration of innovations and the results of local scientific research. • **Niger:** Strengthen research and innovation for sustainable food systems. Promote and strengthen agricultural extension and advisory support. • **Senegal:** Building resilience of food systems. • **Seychelles**: Embed sustainability and climate smart international standards and recommended practices (ISARP) in the local ways of working.

Action area	Coalitions	Countries in Coalitions	Proposed game-changing interventions gathered from food system pathways presented at the UNFSS in Sept 2021
Equitable Livelihoods, Decent Work, & Empowered Communities	Decent Work and Living Incomes and Wages for all Food Systems Workers	Benin, Cote d'Ivoire, Mauritania, Mauritius, South Sudan	
	Women & girls	Burundi, Chad, DRC, Gambia, Ghana, Liberia, Madagascar, Morocco, Nigeria, South Sudan	• **Burundi:** Promotion of the gender dimension for resilient food systems • **Chad:** Promote the empowerment of youth and women in food systems • **Botswana**: Provide links to market networks, especially for smallholder farmers, women and the youth, to stimulate food production. • **Malawi**: Build agribusiness skills for all gender categories, particularly women and youth. • **Zimbabwe**: Empower women and youths, including through greater access to and control over land and productive resources, an essential step towards closing the gender gap in agriculture, leading to considerable gains in productivity and production.
	Indigenous Peoples (IPs)	Botswana, South Africa	
	Youth engagement / employment	Burundi, Chad, Gambia, Kenya, Liberia, Madagascar, Nigeria, Republic of Congo, South Sudan	• **Republic of Congo:** Mobilize and encourage biotechnological, technological and ICT innovations to attract more young people to agricultural professions and solutions to the challenges of current food systems for sustainability, resilience and adaptation to climate change.
Build Resilience to Vulnerabilities, Shocks, and Stresses	Local Food Supply	Benin, Djibouti, DRC, Gabon, Mauritania, Republic of Congo, South Africa, Somalia, Seychelles	• **Mozambique**: Support to agricultural value chains development and integration: access to improved inputs, technical assistance for smallholder farmers, establishment of subvention schemes and financing throughout value chains (agriculture, livestock, and fishery) • **Republic of Congo**: Supervise and support the endogenous "Field insurance" initiative on a pilot scale to support the resilience to shocks and social protection of small producers in the face of multiple impacts, including the impact of human-wildlife conflict which is becoming endemic and growing in certain departments. • **South Africa**: Smallholder producers should be comprehensively supported to farm sustainably and ensure food availability and income retention at community level. • **Seychelles**: Transform the food value chain to build a more productive and competitive local food production system.

Action area	Coalitions	Countries in Coalitions	Proposed game-changing interventions gathered from food system pathways presented at the UNFSS in Sept 2021
	Climate Resilient	Cote d'Ivoire, Gabon, Ghana, Kenya, Lesotho, Liberia, Madagascar, Mauritius, Namibia, Nigeria, South Sudan	• **Lesotho**: Training of extension officers, farmers, and agro-input dealers in climate-smart agricultural technologies • **Malawi**: Invest in digitized and localized early warning systems including anticipatory models for proper disaster preparedness. Scale out climate insurance products such as crop and livestock index-based insurance services. Invest in large-scale and multi-purpose water harvesting infrastructures through public-private partnership. • **Namibia**: Development of disaster proof food system infrastructure, strengthen climate adaptation infrastructure and early warning systems for enhanced preparedness and response capacity to mitigate the impact of climate change on food production and ensure sustainability of production. • **South Africa**: The productivity of natural ecosystems through improved land and water use planning, climate adaptation and mitigation practices and environmental governance must be continued to promote food security particularly to low-income communities that depend directly on natural resources for their subsistence and livelihoods. • **Seychelles**: Embed sustainability and climate smart international standards and recommended practices (ISARP) in the local ways of working. • **Zimbabwe**: Invest in productivity enhancing technologies, including improved seeds and animal breeds adapted to the changing climate.
	Food Crises - the Humanitarian, Development and Peace	Central African Republic, Chad, Djibouti, Malawi, Somalia, Tunisia	• **Central African Republic:** Strengthening the resilience of vulnerable communities through development of agricultural value chains. • **Chad:** Strengthen the resilience of households and communities most vulnerable to crises and disasters. • **Malawi**: Invest in digitized and localized early warning systems including anticipatory models for proper disaster preparedness. Construction of disaster preparedness infrastructure e.g., dykes.

Source: UNFSS (2022)

Annexure 2: Drivers of food system Transformation in Africa

Mega-trend		Policy response actions	
Exogenous driver	**Consequences**		
Population growth	- Land scarcity, rising land prices	(i)	Promoting access to quality education to enable rural youth to succeed in off-farm and non-farm pursuits.
	- Land subdivision	(ii)	promoting the performance of national agricultural research, development, and extension systems to accelerate technical innovation and productivity growth on existing agricultural land; and
	- Elimination of fallowing; failure to restore nutrients and organic matter land degradation	(iii)	Supporting land tenure arrangements that protect the rights of local communities while simultaneously supporting equitable land transfers that enable productive and entrepreneurial farmers to acquire land and thereby accelerate structural transformation processes.
	- Rapid urbanization and rapid increases in the demand for marketed food	(iv)	Focus on increasing funding for, and performance and accountability of, African national agricultural research and extension systems in delivering on technical innovation and productivity growth for tens of millions of African smallholder farmers;
		(v)	Encouraging the international CG system to build the capacities of national, regional, and continentally-led systems more effectively and assist these systems in carrying out their own priorities rather than developing separate priorities that may dilute CG efforts to assist African R&D&E systems to achieve their own objectives; and
		(vi)	Assist national research and extension systems in expanding the range of crops and animal products for which services are offered, according to their priorities and objectives, e.g., to include high-value fruits and vegetables and other crops with expanding commercial potential.
Economic transformation	- Rising wage rates and per capita incomes in select countries	(i)	Ask and empower the regional and national agricultural research and development and extension (R&D&E) and policy research systems to generate and deliver labor-saving practices and technologies, including innovative forms of mechanization appropriate to smallholder agriculture, to support farmers' aims of reducing labor input per hectare cultivated.
		(ii)	Promote mechanization rental markets by reducing tariff rates on spare parts, irrigation equipment, and other labor-saving technologies.
	- Increased share of the labor force moving from farm to off-farm employment	(iii)	Adopt enabling policies and regulations that promote employment and private investment in upstream and downstream stages (including cross border trade) of agrifood value chains.
	- Rising per capita incomes leading to dietary change, and in turn, increased demand for meat/fish, processed foods (e.g., cooking oil)	(iv)	Promote technical innovations and sound management practices for production and value addition of livestock, fish, fruits and vegetables, oilseed crops, etc.

Mega-trend		Policy response actions
Exogenous driver	**Consequences**	
Climate change and variability	- More extreme weather, leading to downward pressure on yield growth, increased variability and risk in agricultural production, deforestation, and less resilient and unsustainable food system	(i) Elevate to an urgent national priority the development of a more resilient and sustainable food system, including efficient production and diversity of inputs that are adapted to the evolution of local agro-climatic conditions. (ii) Regulate the reduction of agricultural GHG emissions as one of the key sectors driving global climate change. (iii) Promote the conversion to no-till and minimum tillage practices to enhance carbon sequestration, inclusion of legumes in crop rotations to fix soil nitrogen and reduce inorganic nitrogen application and commensurate reductions in nitrous oxide (which is 300% more potent as a GHG than carbon dioxide). (iv) Improved livestock feeding practices could reduce emissions from gastro-enteric fermentation, and that could involve the transition from grain- to pasture-fed beef which both reduces enteric fermentation while enhancing soil carbon sequestration in Africa's rangelands.
Continued reliance on land extensification as the main source of agricultural production growth	- Land degradation and deforestation	(i) Shift to intensification and promote the concept of soil health. This includes more focus on the subsoil, soil protection through all-year round vegetation, deep root system
Chronically low government investments in agricultural R&D and Extension	- Slow rate of agricultural yield and productivity growth - Over-reliance on extensification rather than intensification	(i) Raise public investment in national ag R&D&E (ii) Building local capacity and organizational effectiveness of local R&D&E (including synergies between national ag universities and NARS)
Rapid advancement in global rollout of new technology (especially IT/ communications, private sector seed development, drones, etc)	- Improved access to information - Regulation and less resistance to adoption of GMOs, and regulation - Governments are listening to scientists more. - Increased use of technologies (e.g., digital technologies, plant breeding technologies	(i) Increase public investment in national agriculture research, development and extension to strengthen the capacity of food systems to adapt digital innovations (ii) Collaboration of public extension services with content moderators on digital platforms to ensure greater oversight over the content targeted at smallholder farmers as well as safeguard farmer privacy

Mega-trend		Policy response actions
Exogenous driver	**Consequences**	
Increased prevalence of global pandemics and disruptions	- Increased sense of global community and need for coordinated responses. - Perceptions that countries need to become more self-sufficient in food and agro input production. - Volatility in agricultural inputs and commodity prices. Changing relative importance of major crops	(i) Support food systems by prioritizing investments in local wet markets and opening of new trade corridors that are connected to major sources of raw materials. (ii) Investment in rural infrastructure and logistics, as well as back-bone intraregional trade infrastructure linking production, pro-cessing and consumption regions or markets will be important for reducing post-harvest food waste and building resilience to supply-chain and non-covariate shocks.

Annexure 3: Selected indicator performance for SSA against CAADP targets using a Food Systems Lens

Food System Components	Targets	Indicators	Northern Africa	Middle Africa	Southern Africa	Eastern Africa	Western Africa
Social, Economic and Political sub-System	Allocate at least 10% of public expenditure to agriculture	Government agriculture expenditure (% of total expenditure)	1.75%	3.01%	1.93%	4.88%	2.24%
	To sustain annual agricultural GDP growth of at least 6%	Agriculture value added growth rate (%)	1.02%	1.64%	8.23%	2.57%	2.51%
	Triple intra-African trade in agricultural commodities and services	Africa imports of food as a share of imports from the world (%)	4.7%	10%	37.5%	27.6%	12.2%
	50% reduction on poverty by 2025 (relative to 2014 levels).	Poverty Headcount Ratio at $2.15 a day (2017 PPP) (%)	3.71%	49.04%	20.83%	42.17%	27.09%
Food supply system	Zero hunger by 2025 (CAADP), and by 2030 (SDG)	Prevalence of undernourishment (% of population)	4.62%	32.67%	15.85%	25.52%	31.57%
	Reduce post-harvest losses by 50% by 2025 (relative to 2014 levels)	Post-harvest loss (%)	-	17.11%	14.97%	17.09%	17.37%
	At least double productivity by focusing on inputs, irrigation and mechanization.	Cereal yield (tons/ha)	2.43	1.20	1.76	1.34	1.40
	Increase fertilizer usage to 50kg/ha by 2016	Fertilizer consumption (kg/ha of arable land)	32.58	7.14	47.13	29.71	22.14
Environmental System	Increase the proportion of farm, pastoral and fisher households that are resilient to climate and weather-related risks to 30%	(Notre Dame Global Adaptation Initiative) Country Index	-	-	-	-	-
Health System	10% child stunting by 2025	Prevalence of stunting, height for age (% of children under 5)	16.1%	39.15%	30.06%	33.85%	31.57%
	5% underweight children	Prevalence of underweight, weight for age (% of children under 5)	4.81%	20.97%	10.06%	18.92%	19.53%

4 Revolutionizing Africa's Agrifood System Transformation

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Key Messages

1. **Revolutionizing Africa's agrifood system transformation requires a holistic approach** that combines enhanced agricultural productivity, improved infrastructure, enhanced market access, and climate-resilient practices to boost investment, trade, and collaboration across sectors driving economic growth, poverty reduction, food and nutrition security.

2. **Integrating continental frameworks** by leveraging CAADP, AfCFTA, PIDA, and ACP in the context of the SDGs and Agenda 2063 is critical to achieving sustainable and resilient agrifood systems in Africa.

3. **Fostering equitable, coherent, and transparent food system governance** will sustainably catalyze agrifood systems transformation in Africa.

4. **Prioritizing food baskets** in key regions with most suitable agroecological conditions supported by watersheds, irrigation systems, and logistics infrastructure plays a pivotal role in ensuring continent-wide agricultural growth and thus contributes to sustained agrifood transformation for the continent.

5. **Accelerating the transformation of agrifood systems** necessitates political commitment, international collaboration, and reducing trade restrictions. It also calls for prioritizing investment, promoting environmentally-sustainable practices, knowledge sharing, and innovative ecosystems including financing services and digital infrastructure.

6. **Leveraging AfCFTA to improve the functioning of markets and intra-regional trade** is the key ingredient for Africa's agricultural transformation through making the most of food basket regions' competitiveness, reducing tariffs, and enhancing trade efficiency. Recognizing the pivotal role of regional connectivity, there is need for **strategic investments that enhance trade corridors and connect production and value-addition centers with demand hubs characterized by large population centers** via improved rail and road infrastructure.

7. **A strategic phased approach is crucial for achieving Africa's food security within a decade.** This approach consists of strengthening existing food baskets in the short term (2-3 years), refining supply chains in the medium term (5-7 years), and establishing new food baskets in the long term (10+ years).

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Introduction

Transforming agrifood systems in Africa dominates policy debates with high concerns expressed about the continent's ability to feed its growing population. An array of concerns has evolved around the quantity and types of food being produced and the methods and individuals involved in its production, transportation, processing, packaging, and distribution along with their expected impacts on health and nutritional outcomes (Garnett, 2014). This chapter bridges the gap by proposing concrete short-, medium-, and long-term priority interventions that are needed to trigger production based on existing and new food basket and water basins in Africa. Equally important is the speedy implementation of the newly launched continental Free Trade Area supported by investment in infrastructure for more efficient food distribution and accessibility from production zones to high-population demand centers.

Africa's population has been increasing at an average of 3.1 percent per annum from 2010-2020 with projections that the continent's population will reach 2 billion by 2050. However, crop yields in Africa have remained stagnant at under 30 percent of global averages. The production growth of key food commodities (e.g., approximately 2.6% for cereal production) consumed in Africa did not keep pace with the population increase over the same period. It is projected that by 2050, 60 percent of Africa's population will be in urban centers at an urbanization rate of 3.5 percent per annum. With rising average incomes and changing diets, Africa's urban dwellers will demand more processed and high-value foods against a dwindling rural production sector.

Africa remains an importer of agricultural food items estimated at USD 103 billion for major food products in 2021 (approximately 39 billion net import bill annually), the bulk of which comes from importing basic and processed foods (mainly wheat, edible oil, maize, and rice), yet these can be produced by Africa[3]. At current trends, this import bill could grow by 50 to 60 percent and potentially double over the next ten years. This is disconcerting since Africa has 65 percent of the world's uncultivated land (AfDB, 2018).

Climate change poses challenges to food systems in Africa through disruptions in agriculture, water availability, and livelihoods. Simultaneously, transforming food systems to be more sustainable presents challenges in terms of addressing emissions from agriculture, supply chains, and food waste. A comprehensive approach that considers both climate change adaptation and mitigation in the context of food systems transformation is needed. The World Bank estimates that the annual cost of climate change on Africa's agrifood systems will be roughly USD 200 billion a year, which is more than ten times the cost of acting now to adapt (World Bank, 2022)[4].

Africa's agrifood systems are on a trajectory that is far from ideal and as its population grows, the demand for food will only increase. The CAADP third Biennial Review Report (2015-2021) further reveals that Africa is not on track to meet its goal of ending hunger by 2025 (AUC, AUDA-NEPAD, 2022).

As the continent faces various challenges related to hunger, malnutrition, and access to sufficient and nutritious food for its growing population, food security also remains a critical issue. The 2020 Africa Regional Overview of Food Security and Nutrition report highlights the importance of prioritizing agrifood systems transformation sustainably while addressing the challenging enigma agrifood systems are confronting (FAO, ECA, and AUC, 2021). A bold, multifaceted, multidimensional, multisectoral, and multinational paradigm shift in agrifood systems is direly needed.

The importance of agrifood systems transformation lies in its potential to combat poverty, hunger, and malnutrition at scale. Among all the opportunities available, agriculture stands out as the most promising avenue for positively impacting the lives of many Africans. Therefore, to effectively address hunger and poverty, it is essential to revolutionize African agricultural and food systems through better coordinated, sustainable, and resilient investments as enshrined in continental frameworks such as CAADP, the Programme for Infrastructure Development in Africa (PIDA), the Continental Africa Water Investment Programme (AIP), the Africa Common Position on Food Systems (ACP), and the African Continental Free Trade Area (AfCFTA).

This chapter proposes a trans-national and inter-regional approach to sustainably transform agrifood systems along trade corridors and water basins in Africa while using agricultural industrialization for value addition and the African Continental Free Trade Area (AfCFTA) as the levers of success. The chapter

3 Refer to Appendix 4A for details on values of imports, exports, and trade balance for agricultural food items.

4 https://www.worldbank.org/en/news/infographic/2022/05/10/african-food-systems-the-importance-of-climate-adaptation

revives an existing yet novel approach to sustainably transform agrifood systems in Africa by focusing on major food commodities that the continent is largely importing and has the potential to produce.

There is renewed urgency and optimism and the opportunity to learn from recent disruptions in global food markets and related supply chains precipitated by the overlapping crises of the COVID-19 pandemic and the war in Ukraine. In addition to persisting climate change stresses, which further highlight the fragilities of African agrifood systems, there has been a shift in priorities on agricultural expenditures by governments, donors, and the private sector and on increasing access to financial services by smallholder farmers (AUC, AUDA-NEPAD, 2022). With only a meager proportion of their budgets allocated to agriculture, numerous African governments have left this vital sector neglected. Development flows to agriculture have also seen a sharp decline from USD 6,642 million in 2020 to USD 5,356 million USD in 2021 marked by shifting donor priorities toward alternative fields (FAOSTAT, 2023). Seizing the momentum of this crisis, the continent is poised to develop a multilayered strategy spanning short-, medium-, and long-term plans to build a secure, resilient, and sustainable food supply.

The scope of this chapter is limited to four staple commodities namely rice, wheat, maize, and soya. Together, these commodities constitute 54 percent of the average daily per capita caloric intake and provide great opportunities to improve food security, reduce hunger and malnutrition, and alleviate poverty. A recent study showed that gains in on-farm productivity for these four crops have helped propel growth downstream in food processing and distribution (Barrett et al., 2022). While maintaining a focus on the four staple crops, it is essential to recognize that effectively addressing food and nutrition security challenges will require a broader approach that encompasses other crops; thus, the eventual initiative roll-out will adopt a more comprehensive nutrition-sensitive approach accommodating other nutrition-dense value chains such as fisheries, trees, fruits, indigenous crops, tubers, and livestock (Dixon et al., 2019).

While the approach stresses the need to sustainably transform Africa's agrifood systems as a whole and totally, the argument of this chapter complements other chapters of this publication by pointing out that sustainably boosting food supply is the basis for agrifood transformation. The chapter examines alternative production and trade scenarios based on Africa's key commodities across the regions. The analysis assumes regional perspectives to account for consumption patterns, agroecological and crop suitability characteristics, trade, and markets integration, food demand centers, and infrastructure and logistical complementarities for the continent's current and potential food baskets.

State of food insecurity, production, consumption, and trade in Africa

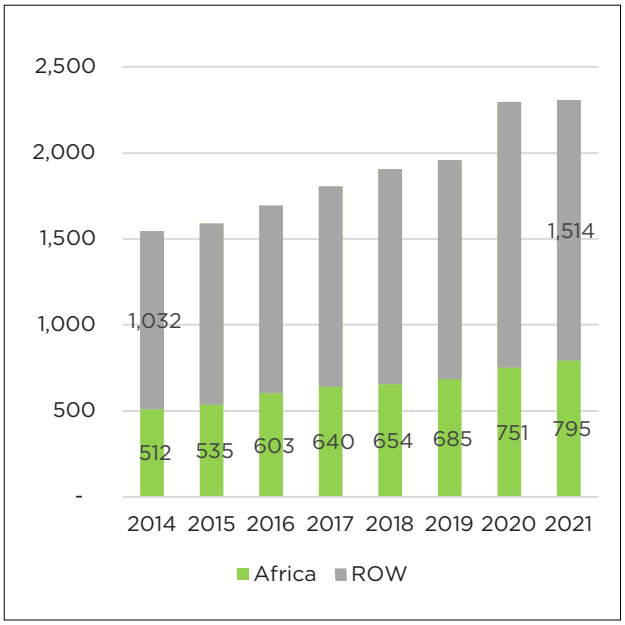
State of food insecurity

The current state of food security remains a major challenge in Africa with a significant portion of the population facing hunger, malnutrition, and food-related health issues (FAO, IFAD, UNICEF, WFP, & WHO, 2018; Chan et al., 2021). With a rapidly growing population estimated at 1.4 billion in 2021, 795 million people in Africa are moderately or severely food insecure, representing more than half of the continent's population and a third of the world's food-insecure population (Figure 4.1, Panel A). Despite Africa's vast agricultural potential, lack of access to nutritious and affordable food hinders development and economic progress.

The impacts of food insecurity have far-reaching consequences for individuals, communities, the environment, and nations including malnutrition, impaired cognitive development, reduced productivity, and increased vulnerability to diseases. Moreover, food insecurity exacerbates poverty, compromises environmental objectives, hinders economic growth, and contributes to social and political instability.

The distribution of food insecurity is disproportionally distributed across regions, with approximately 90 percent of food-insecure people living in sub-Saharan Africa led by eastern and West African regions (Figure 4.1, Panel B). More than 70 percent of Africa's food-insecure population resides in rural areas. Ironically, smallholder farmers, who produce more than 90 percent of the continent's food supply make up the majority (50%) of this population (Mwaniki, 2006).

Sustainable transformation of agrifood systems that ensures access to affordable and healthy diets is critical to feed the rapidly growing population. Africa needs to go beyond business-as-usual to successfully transform agrifood systems to address food security and nutrition issues. The worsening effects of climate



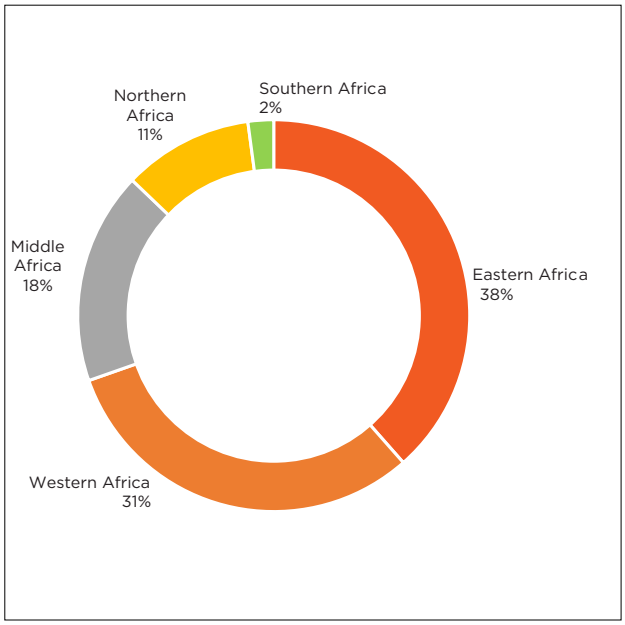


Figure 4.1. Number of moderately or severely food insecure people (million) (annual value)
Source: Authors' own calculation using FAOSTAT data

change, recurring climate shocks, and disruptions in food supply chains from the COVID-19 pandemic and the Russia-Ukraine conflict call for urgent rethinking of Africa's food sovereignty.

The fact that up to 795 million Africans are moderately or severely food insecure suggests that agrifood systems from production and processing to distribution, consumption, environmental and nutritional health are failing to meet the needs of the population. Improving the performance of agrifood systems in Africa is contingent on the performance of agricultural production to provide nutritious and affordable food for all and become more efficient, resilient, inclusive, and sustainable. Figure 4.1 shows the number of moderately or severely food insecure people in millions.

Food import bill

The African continent faces a significant challenge in achieving food security, primarily due to its status as a net importer of food. In fact, the overall import bill for crops and livestock in Africa stands at approximately USD 50 billion with sub-Saharan Africa accounting for approximately 44 percent of this total with an import bill of USD 22 billion (Figure 4.2, Panel A). In other words, North Africa, with a population of 256 million (roughly a fifth of the African population), contributes to more than half (56% or 28 billion) of the total crops and livestock import bill (Figure 4.2, Panel A).

Narrowing the focus to four key staple crops namely wheat, rice, maize, and soya gives continued cause for concern. Sub-Saharan Africa's net import bill for these staple crops alone is about USD 18 billion (Figure 4.2, Panel A). Among these crops, wheat, palm oil, and rice stand out as the largest net imports, whereas Sub-Saharan Africa achieves an almost neutral balance of trade on maize (Figure 4.2, Panel B). For purposes of the rest of this analysis, this chapter considers these four staples but recognizes the need to consider a broader more diverse set of crops to achieve food security (Dixon et al., 2019).

This chapter focuses on achieving higher outcomes of agrifood systems by examining all regions and proposing specific regional solutions to address challenges around low agricultural productivity, weak infrastructure, limited intra-regional markets, policy coherence, and governance issues.

Maize, rice, wheat and soya production and consumption in Africa

Maize, rice, wheat, and soya constitute major sources of food ingredients in Africa. Achieving food security in Africa thus requires the sustained production and trade of these commodities.

Figure 4.3 displays trends in production and consumption (exports, animal feed, seed, manufacturing, losses, human) in Africa while Figure 4.4 is a bubble representation of the size of import

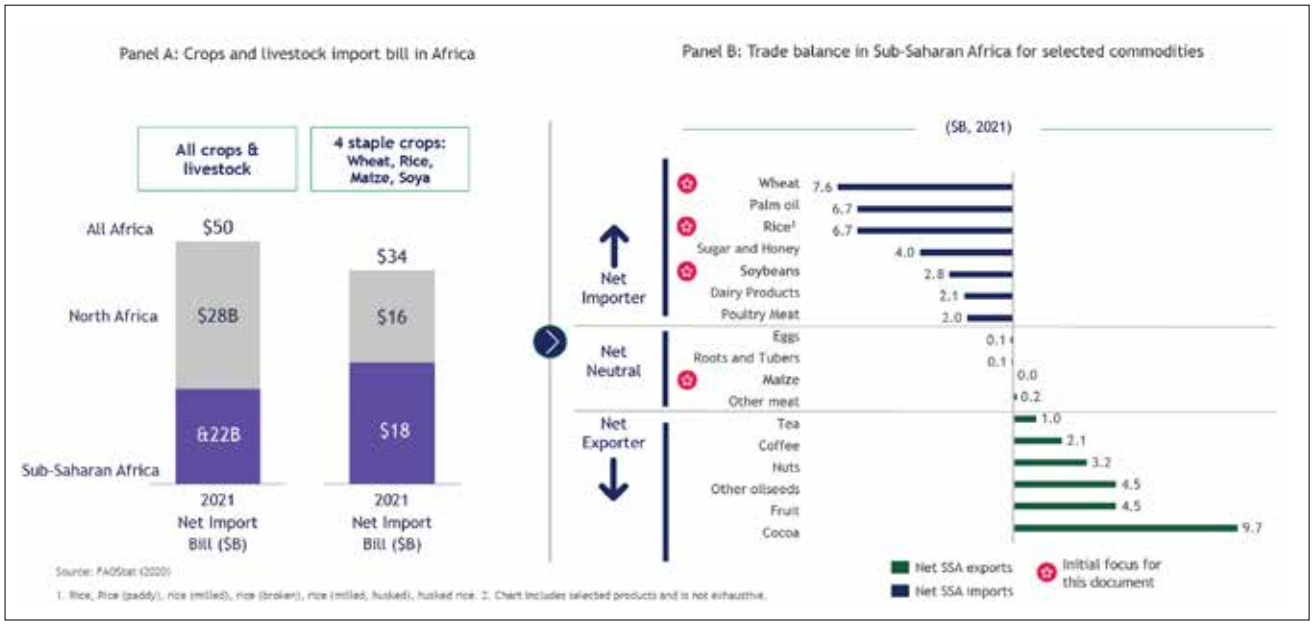


Figure 4.2. Import bill and trade balance for selected commodities in Africa
Source: African Union Commission (2023)

given the levels of production and consumption for maize, rice, wheat, and soya for the different sub-regions namely eastern Africa, middle Africa, northern Africa, southern Africa, and western Africa.

Maize

Maize is the single most-widely produced and consumed cereal crop in Africa. A crucial food security crop in the region, maize provides a significant portion of daily caloric intake for millions of Africans. It is considered an affordable and accessible source of nutrition, particularly in regions with limited access to diverse food options. Maize production, consumption, and import trends are largely affected by global shocks such as disruptions caused by the COVID-19 pandemic and the Russia-Ukraine conflict and by climate-related factors such as droughts, floods, cyclones, and other extreme weather events.

Maize is a vital staple crop in the African diet and its production has shown a general upward trend growing at an average rate of 3.6 percent between 2010 and 2020 (Figure 4.3, Panel A). However, this growth has been achieved by area expansion rather than significant improvements in productivity. Investing in agricultural development, improved farming practices, and increased adoption of hybrid maize varieties could be a game changer for the 3.8 percent rate of growth

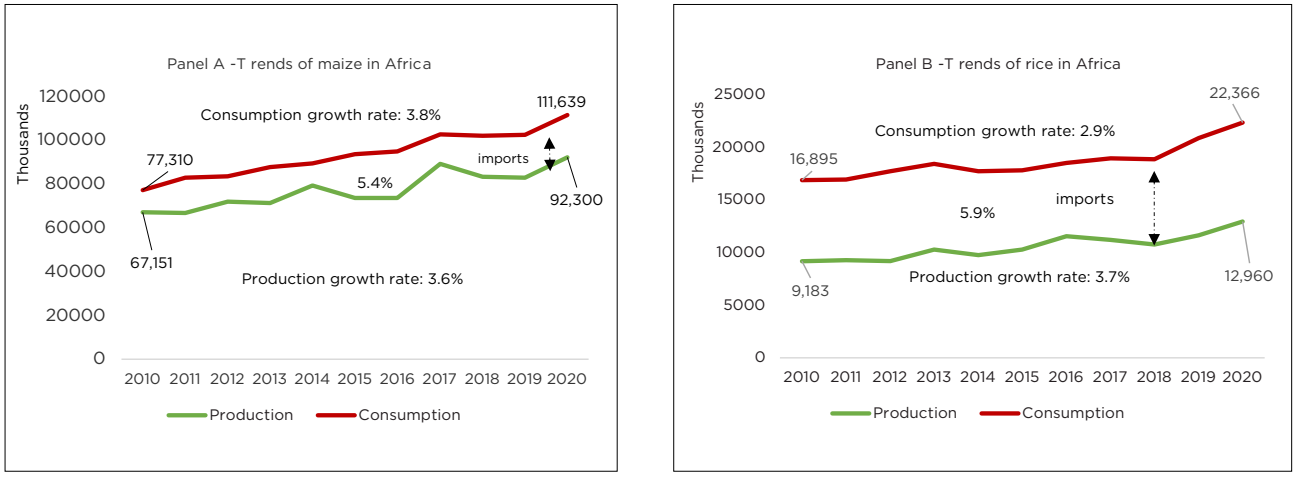
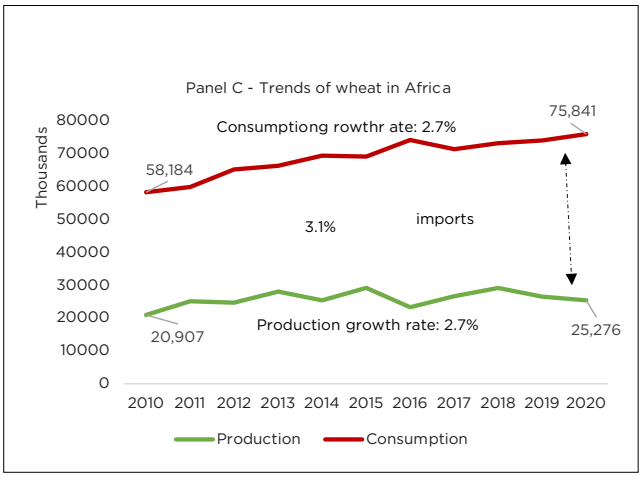


Figure 4.3. Production and consumption trends of maize, rice, wheat, and soya in Africa between 2010-2020 (1000s of Tons)
Source: Authors' own calculation using FAOSTAT data (https://www.fao.org/faostat/en/#data/SCL)



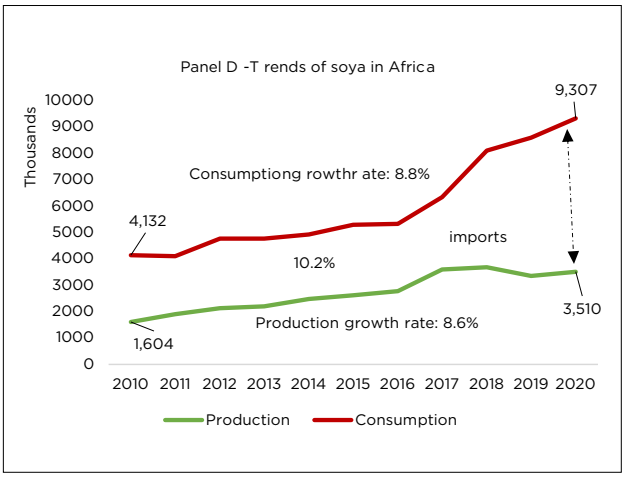


Figure 4.4. Size of major commodity imports by African region (3-year average; 2018-2020)
Source: Authors' own calculation using FAOSTAT data (https://www.fao.org/faostat/en/#data/SCL)

in maize consumption (slightly higher than production growth) (Figure 4.3, Panel A). The rising demand for maize is due to population growth, changing dietary habits, and use of the crop in various industries including as a primary source of animal feed (livestock and poultry), biofuels, and processed food products. It is worth noting that any unmet domestic consumption is sourced through imports from international markets. Most of Africa's maize imports are driven by northern Africa, which imports about above 16 million tons of maize and accounts for 84 percent of total maize in Africa (Figure 4.4, Panel A). Other African sub-regions are close to self-sufficiency to meet their maize demand for human consumption, animal feed, seed utilization, manufacturing, and other uses.

Rice

Rice consumption in Africa has been steadily increasing over the past decade due to population growth, urbanization, changing dietary habits, and increasing incomes in certain regions. Production has also been gradually increasing at an average rate of 3.7 percent between 2010 and 2020 (Figure 4.3, Panel B). The growth in production is the result of rice initiatives implemented by many countries particularly in West Africa (e.g., Nigeria, Mali, Senegal, Cote D'Ivoire, Burkina Faso) to boost domestic production, enhance food security, and reduce import dependency. Despite increased production, African countries continue to import a significant portion of their rice to meet growing demand; between 2010 and 2020, the total rice import nearly doubled from 6.7 to 11.2 million tons at an average annual growth rate of 5.9 percent (Figure 4.3, Panel B). Over the same period, rice consumption increased by 2.9 percent annually reaching an import high of 22.4 million tons (Figure 4.3, Panel B).

There are wide regional disparities in rice production, consumption, and imports patterns. Western Africa is the leading importer of rice in Africa importing slightly below 5 million tons. The sub-region is also the dominant producer and consumer of rice on the continent (Figure 4.4; Panel B). Another major rice supplier and consumer is eastern Africa; the sub-region imports 2.7 million tons on average representing 58 percent of its total consumption (Figure 4.4; Panel B). This pattern is expected as eastern Africa is the largest populated region in Africa; as the population grows and dietary habits change, more people are turning to rice as a staple food. The convenience of preparation and availability of processed rice products have contributed to this shift in consumption patterns. Large imports are therefore necessary to bridge the gap between supply and demand.

Wheat

Africa relies heavily on wheat imports to meet domestic demand leading to a high dependency on foreign suppliers. Many African countries rely heavily on wheat imports to meet domestic consumption needs as local production often falls short of demand. Recent global political development has demonstrated that importing wheat can pose challenges for African economies, especially for leading regional wheat importers such as northern Africa (27 million tons) followed by eastern Africa (12 million tons) and western Africa (9 million tons) (Figure 4.4, Panel C).

Wheat production has been growing at a rate of 2.7 percent annually between 2010 and 2020 (Figure 4.3, Panel C). Its production faces myriad challenges including limited suitable arable land, water scarcity, climate change impacts, and limited access to modern agricultural technologies. Despite increasing local production and continued efforts to improve self-sufficiency, enhance food security, and create employment, Africa's wheat production still lags consumption demands. Several North African countries such as Egypt, Morocco, and Algeria have been the continent's leading wheat producers while other countries, including Ethiopia and South Africa, have also shown efforts to increase wheat production to reduce dependency on imports and enhance food security.

Wheat consumption in Africa has steadily risen at an average annual rate of 3.1 percent between 2010 and 2020 (Figure 4.3, Panel C) driven by population growth, urbanization, changing dietary habits and preferences, and increasing disposable incomes. The increasing demand for wheat in Africa presents opportunities for investors in agribusiness and value-addition processing industries to invest more in the sector. It is also important to mention that the rising consumption of wheat-based products can have both positive and negative nutritional implications. While wheat products can be a source of essential nutrients, overreliance on highly processed wheat-based foods might contribute to health issues such as obesity and diet-related diseases.

Soya

Soya production, consumption, and imports in Africa have been rapidly expanding at annual rates of 8.6 percent, 8.8 percent, and 10.2 percent respectively in recent years (Figure 4.3, Panel D). Southern Africa is the highest regional producer followed by western and eastern Africa (Figure 4.4, Panel D). Several African countries have started investing in and expanding their cultivation of soya following increasing demand for domestic consumption and for exports. Governments and private investors have encouraged farmers to adopt soya as a cash crop with advancements in agricultural practices and technology supporting this expansion.

In addition, as the population becomes more health-conscious and environmentally aware, there has been a shift toward plant-based protein diets in Africa. This has nourished the interest in making soya an attractive alternative option for animal-based protein sources such as meat. Soya is rich in essential nutrients such as protein, dietary fiber, vitamins, and minerals.

The consumption of soya and soya-based products can be a means of combatting malnutrition and improving overall nutrition in many African countries. Soya has also been increasingly used in the food processing industry to create a wide range of products such as soy milk, tofu, soy-based meat substitutes, and soy flour. This trend is driven by growing urbanization and changing dietary preferences in the region. It is noteworthy that the expanding livestock sector in Africa has also contributed to increased soya consumption in the form of animal feed.

Despite the growth in domestic production of soya and the rise of vegetarian and plant-based diets, many African countries still import significant quantities of soya and soya products. This is driven by the increasing demand for soya as an animal feed ingredient and raw material for food processing industries. Some countries lack the infrastructure and technology to meet their domestic demand entirely, leading to the need for imports. This is probably the pattern depicted in northern Africa, the largest soya consumer and importer (5 million tons) but the lowest regional producer (Figure 4.4, Panel D).

Selected countries' self-sufficiency

The question of whether Africa can be self-sufficient in strategic commodities by 2050 remains a key discussion point in current food systems transformation initiatives. Figure 4.5 displays the self-sufficiency ratios for maize, rice, wheat, and sozya for selected African countries and illustrates that countries are struggling to achieve self-sufficiency for wheat and rice production. Western and most eastern African countries depend almost exclusively on wheat imports to meet domestic demand with a self-sufficiency ratio above 80 percent (Figure 4.5). For rice, Mali, Malawi, and Tanzania are net exporters with existing potential for further rice expansion to feed regional markets.

An impressive improvement has been realized in Nigeria and Burkina Faso, which have nearly achieved rice self-sufficiency, while countries such as South Africa, Tanzania, and Uganda have achieved self-sufficiency and even export maize and soya. It is essential to note that soya volumes remain relatively low overall. Trade balances and data can fluctuate from year to year with some sources indicating that Ethiopia is nearing self-sufficiency in wheat and Zambia occasionally produces surplus wheat that could potentially be traded to nearby countries. However, the challenge lies in the expected rapid increase in consumption making it increasingly difficult to close the gaps.

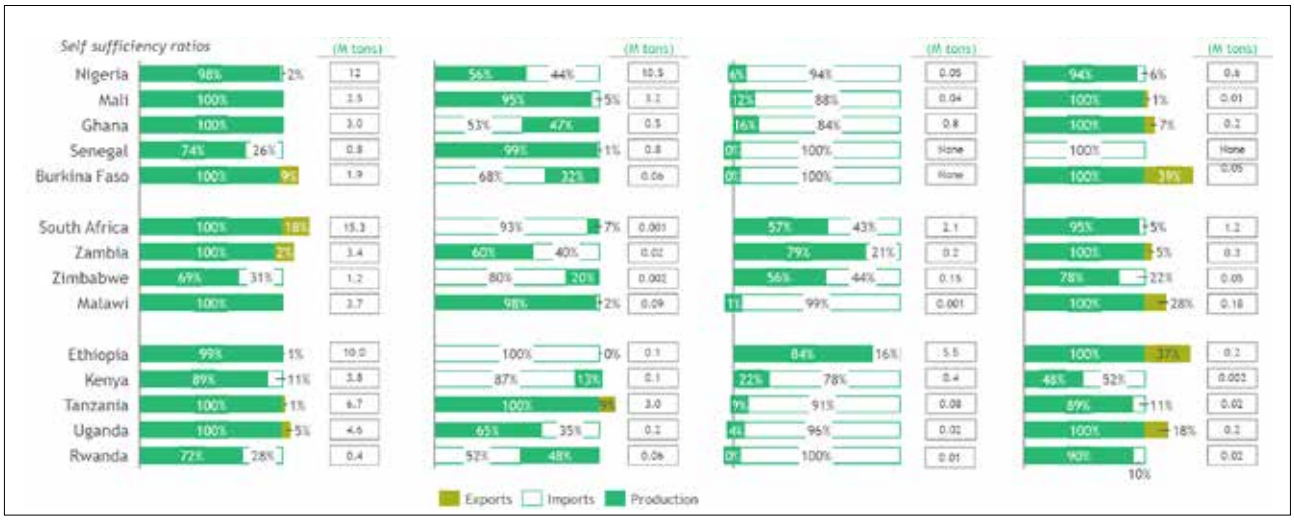


Figure 4.5. Self-sufficiency ratios for maize, rice, wheat, and soya for selected African countries
Source: African Union Commission (2023).

Underscoring the cost of inaction

The urgency to address the impact of climate change on African agrifood systems cannot be overstated. Alarming estimates from the World Bank show that if no immediate action is taken, the estimated cost of inaction on agrifood systems is projected to reach USD 200 billion in water management ($90 billion), research facilities ($70 billion), land restoration ($26 billion), and infrastructure ($13 billion) (Figure 4.6). This looming threat demands swift action to prevent catastrophic consequences.

IFPRI's "Business-as-Usual" scenario for food consumption and production in sub-Saharan Africa shows a concerning picture for staple crops such as maize, wheat, rice, and soya. The IFPRI model foresees a substantial widening of the consumption-production gap by at least 50 to 60 percent by 2035. With increasing populations and mounting climate pressures, the region is expected to incur a net financial expenditure of over USD 30 billion within a decade. Furthermore, some sources even indicate the possibility of this gap expanding to over USD 100 billion in the next five to 10 years exacerbating the strain on food security.

However, hope lies in taking decisive priority interventions to mitigate the impact of climate change on African agrifood systems. Proactive adaptation measures are estimated at USD 15 billion annually (Figure 4.6), a significant investment with the potential for substantial returns. By allocating these financial resources to improve climate adaptation measures, African nations can build a more robust and secure agrifood system for the future. Investments in water management, including irrigation schemes, water storage and the promotion of climate-smart technologies, can pave the way toward a more sustainable, equitable, and food-secure future in Africa.

The time to act is now; without action, the repercussions of inaction could be catastrophic. Governments, international organizations, private sector, and civil society must collaborate to address the challenges at hand with investments in R&D, climate-resilient infrastructure, and knowledge exchange as essential components of the collective response. By 2050, an additional approximately 70 million people could be at risk of being undernourished with the food import bill predicted to double. Such consequences threaten to plunge vast populations into hunger and poverty straining resources and exacerbating existing inequalities in Africa.

The private sector has a huge business opportunity to unlock the region's immense agricultural potential while uplifting millions from poverty and creating decent and dignified jobs. Policymakers should implement and align cross-country policies and regulatory frameworks that incentivize private sector investments specifically in agribusiness development.

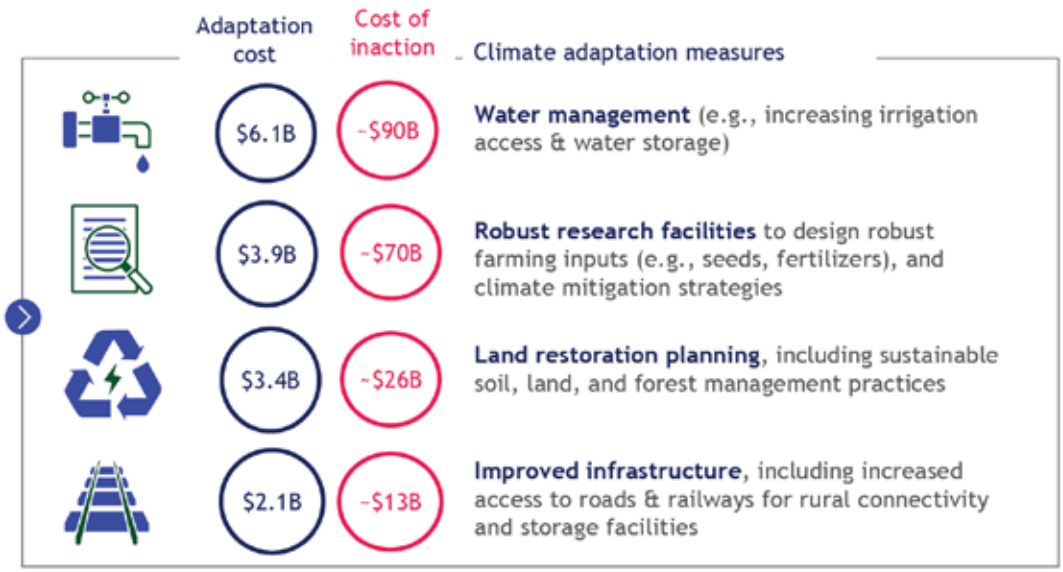


Figure 4.6. Cost of inaction and adaptation to reverse the business-as-usual approach.
Source: African Union Commission (2023); Adapted from the WB (2022; https://www.worldbank.org/en/news/infographic/2022/05/10/african-food-systems-the-importance-of-climate-adaptation)

Priority interventions projecting the potential for agrifood systems in Africa

This section puts forward three priority interventions to transform agricultural landscapes, enhance supply chains, and promote climate resilience in the quest to build sustainable and resilient agrifood systems in Africa.

The first intervention entails prioritizing existing and new food baskets and water basins, that is, multi-country supply sheds that are strategically located with robust potential for production and easy access to trade corridors and demand centers. Agricultural productivity will be enhanced around these priority areas to meet domestic food needs of sub-regions.

Linked to the above, the second priority intervention focuses on accelerating and building resilience for the transformation of agrifood systems by promoting innovative and environmentally-friendly sustainable practices to boost agricultural productivity.

Recognizing the significance of regional connectivity, the third priority intervention aims to improve infrastructure in trade corridors and focuses on key demand centers characterized by large populations. Investing in and upgrading transportation networks can ease the movement of goods and connect production areas with large population demand centers. This interconnectedness will foster a more integrated and dynamic food ecosystem across the continent.

Before discussing priority interventions, this section brings together how the proposed plans are anchored on continental frameworks that have guided investment flows and policy decisions on the continent.

Integrating continental frameworks

A comprehensive plan towards sustainable and resilient food systems and addressing the root causes of the food crisis in Africa should include enhancing agricultural productivity, improving infrastructure, fostering access to global markets, and implementing climate-resilient practices. This would entail integrating key continental frameworks such as CAADP, AfCFTA, PIDA, AIP, and ACP, the Science, Technology, and Innovation Strategy for Africa (STISA-2024), Boosting Intra African Trade (BIAT), Accelerated Industrial Development for Africa (AIDA), and the AU Data Policy Framework all in the context of Africa's Agenda 2063 and the SDGs by 2030.

As a continental framework for developing agriculture in Africa, CAADP provides countries with opportunities for boosting investment to stimulate growth in the agricultural sector bringing together the public and private sectors at the continental, regional, and national levels to increase investment, improve coordination, share knowledge, successes, and failures, encourage one another, and promote joint and separate efforts[5].

5 https://www.nepad.org/cop/comprehensive-africa-agriculture-development-programme-caadp

The set of goals and targets embedded under CAADP/the Malabo Declaration priority commitments (i.e., enhancing investment finance in agriculture, ending hunger in Africa by 2025, reducing poverty by half in 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 and other related risks) serve as a strong foundation for Africa's integrated strategy on food systems transformation.

The AfCFTA framework was brokered by the AUC and Member States with the general objective of integrating trade across the continent. Intra-African trade has long been limited by restrictive and unharmonized trade policies and regulations across countries and within regional economic communities (RECs) coupled with outdated or non-existent border and transport infrastructure, among other challenges. Ultimately, the flagship Agenda 2063 agreement represents a major opportunity for countries to enhance growth, reduce poverty, and broaden economic inclusion while aligning with the spirit of CAADP/the Malabo Declaration.

On its part, PIDA's overall strategic objective is to enable Africa to finally build a common market through improving access to integrated regional and continental infrastructure networks (roads, railways, and ports)[6] while boosting the competitiveness of Africa's goods and products[7]. The Africa Water Investment Programme (AIP) is a subset of PIDA that aims at increasing the investment outlook for water security and sustainable sanitation. One of targeted outcomes is accelerated delivery of critical water infrastructure to address the water-health-energy-food-ecosystems nexus and meeting the needs of water dependent growth sectors[8].

The African Common Position on Food Systems brings these frameworks together and outlines key priorities and ambitions on key issues shaping Africa's food systems. It aims at mobilizing policymakers and galvanizing global and regional efforts toward achieving development goals. The position focuses on catalyzing agricultural productivity, boosting investment in food systems, ensuring access to safe and nutritious food, and harnessing local food markets. Over the next ten years, targets include: doubling agricultural productivity; expanding hybridization of key crops; increasing irrigation coverage; improving grain storage; investing in infrastructure; promoting regional trade; and developing off-take markets in value chains. Expected impacts include increased production and competitiveness, a thriving USD 1 trillion food industry, improved food, and nutrition security, enhanced supply chain infrastructure, and job creation for youth and women (AUDA-NEPAD, 2021).

Priority Interventions to transform agricultural landscapes, enhance supply chains, and promote climate resilience

Priority Intervention 1: Prioritizing food baskets and water basins

This section argues that current major production areas – food baskets – in most suitable agro-ecological zones form the backbone of African food security and economic prosperity. Existing watersheds in each region can play a pivotal role in sustaining local communities and contributing to the continent's agricultural landscape and ecosystems. Figure 4.7 maps the production areas to sustain food supply, watersheds (surface water and groundwater) to support irrigation systems, proximity to transportation infrastructure (rail and road for food accessibility between production centers and areas of consumption), and proximity to urban centers (Figure 4.7).

The dominant rice and maize-producing regions spanning the West African belt feature a vibrant agricultural sector nurturing these staple crops and fostering the growth of vital substitutes such as cassava and yam. Countries such as Nigeria, Ghana, and Mali stand as potential agricultural powerhouses for improving the production and productivity of staple crops to attain higher food nutrition and security outcomes in the sub-region. This agricultural powerhouse owes its existence to the presence of important water basins such as the Niger River and the Volta, among others, which provide irrigation support during dry seasons and increase crop yields.

In the eastern Rift Valley, Ethiopia, Kenya, and Tanzania emerge as major wheat and maize-producing countries endowed with good fertile soils marked by volcanic activity and unique topography essential to ensuring a steady supply. The fertile region owes its agricultural abundance to the availability of water resources, including lakes of the Great Rift Valley such as Lake Tana and Lake Victoria, which provide essential irrigation support contributing to agricultural growth and food security in the region.

6 Annual investment cost to improve infrastructure in major trade corridors under PIDA is estimated to be ~$35 billion.

7 https://www.nepad.org/programme/programme-infrastructure-development-africa-pida

8 https://aipwater.org/

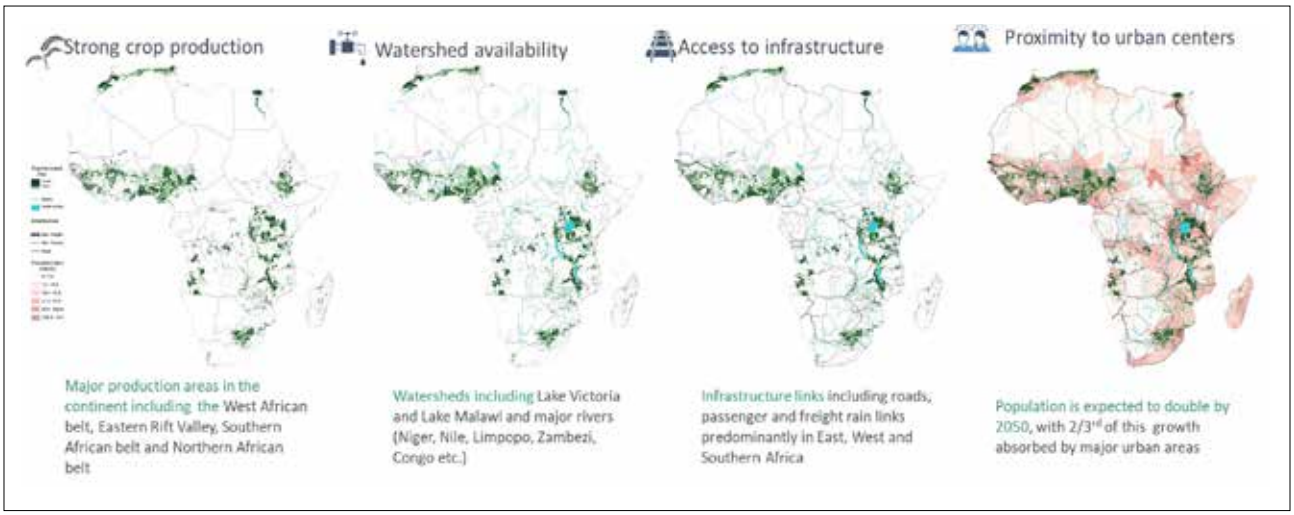


Figure 4.7. Map of crop production, watershed, infrastructure, and urban centers in Africa
Source: African Union Commission (2023)

Maize, rice, and soybean production are dominant in the southern African belt. Countries like South Africa and Zambia cultivate vast fields around the Zambezi and Limpopo rivers, providing essential irrigation opportunities for sustaining the productivity of staple crops and making the region a key player in Africa's food security.

In the northern African belt, Morocco and Egypt are the dominant wheat producers. This agricultural success could be due to the presence of the Nile River offering potential extensive irrigation systems to support the growth of wheat and secure its supply.

In addition to existing food basket around the water basins, this section argues that there is huge potential to develop at least three new food baskets in the long term (approximately 10 years) namely through the expansion and convergence of[9]:

- Senegal/Volta/Niger food basket for Senegal, Mauritania, Malta, and Niger
- Limpopo River Basin food basket for southern Mozambique and Zimbabwe
- The Nile/Gibe River Basin food basket for South Sudan, southern Ethiopia, northern Kenya, and north-eastern Uganda

These new food basket areas could help alleviate pressure on existing production zones and supply sheds. However, establishing a new food basket requires additional analysis to understand the investment and timeline needed to develop them and what policies, infrastructure, (including irrigation and logistics), and productivity investments are needed to achieve the full potential for a sustained agrifood transformation in Africa while taking into account additional value chains (crop and livestock) beyond the four analyzed here.

In addition, water agendas should ensure water security by adopting climate-resilient policies for sustainable water management and aquatic blue food diversity. These agendas can be driven by ensuring sustainable access to adequate quantities and quality of water, enhanced efforts for transboundary water cooperation, and protection of water resources.

Priority Intervention 2: Accelerating and building resilience for the transformation of agrifood systems

As mentioned previously, transforming agrifood systems in Africa is a critical step towards achieving sustainable agricultural productivity, enhancing supply chains, and building climate resilience. The transformation of agrifood systems will be a cornerstone in combating climate change by adopting regenerative agricultural practices, reducing GHG emissions through sustainable approaches, and modes such as sustainable intensification with optimized water use in irrigation, moderating the use of synthetic fertilizer, reduced trade restrictions, and changes in consumption and diet patterns. Implementation requires political will, international cooperation, generation and exchange of knowledge and best practices, and financial resources to support producers and value chain actors across Africa to operate the necessary transformations. In addition, innovative

9 Refer to Appendix 4B, 4C, AND 4D for details about the new food baskets.

ecosystems are required. These include innovative financing services, data, digital infrastructure, and wider research, development, and demonstration. For instance, financial institutions know that climate change is a problem in African agriculture but farm-level data is lacking. There is thus need to develop guidance in using climate model tools to determine the adaptation risks they can finance and define incentives for banks and farmers or producers. Across the continent, numerous investment strategies have accelerated this transformation spanning from investments in irrigation and mechanization to increasing the use of inorganic fertilizers and the adoption of modern seed varieties. In addition, political and institutional barriers, financing and investment needs, and extension services have helped ignite the transformation of the agricultural basis. Each region's unique agricultural landscape and the specific crop potentials demand tailored strategies to increase productivity, enhance supply chains, including cold chain-based associations, and build climate resilience. By investing in these transformative measures, Africa is forging a path toward sustainable food nutrition and security.

Countries such as Senegal, Mali, Ghana, and Nigeria have embraced transformative measures in rice, maize, cassava, livestock, and fisheries production and initiated irrigation projects to harness the region's water resources and enhance agricultural productivity (Molle, 2009). Mechanization is also gaining ground with the adoption of modern farming machinery to streamline farming operations and increase yields (Famakinde, 2017). Additionally, the promotion of improved seeds and advancements in soil health management through appropriate fertilizer use has contributed to the region's agricultural transformation (Leenaars, 2018).

Northern African countries such as Morocco, Algeria, Tunisia, and Egypt have put their efforts around wheat, fisheries, and aquaculture for agrifood transformation. Irrigation has played a vital role in boosting agricultural productivity and ensuring food security in these arid countries (Hassan et al., 2018). Mechanization is also being integrated into agricultural practices to enhance efficiency and productivity in wheat cultivation (Magruder, 2018). Furthermore, initiatives promoting soil health and responsible fertilizer use have been implemented to sustain agricultural growth in challenging environments (Griliches, 2018).

Middle/Central Africa, encompassing countries like Cameroon, the Democratic Republic of Congo (DRC), Gabon, and Chad, focuses on rice, soybean, livestock, and aquaculture. The region is exploring irrigation systems to tap into water resources addressing issues of water scarcity and enhancing agricultural output (Thompson, 2018). Mechanization is also being introduced to facilitate farming activities, particularly in rice and soybean cultivation (Severini et al., 2018). Additionally, there is growing emphasis on promoting soil health and using appropriate fertilizers to support sustainable crop production (Diagne et al., 2019).

Southern Africa, represented by countries such as Zambia, Zimbabwe, and South Africa, prioritizes rice, maize, and soybean production. Irrigation systems have been implemented to maximize crop yields and adapt to changing climate patterns (Kamara et al., 2016). Mechanization is also advancing in the region with the adoption of modern farming technologies contributing to increased productivity in maize and soybean farming (Makhura, 2016). Improved seeds and soil health management practices have also been introduced to enhance agricultural resilience (Heisey et al., 2016).

Finally, in the eastern Rift Valley, countries like Ethiopia, South Sudan, Kenya, and Uganda are focusing on wheat, maize, and livestock. Efforts to harness irrigation and improve water management have increased agricultural productivity and resilience in the region (Kassie et al., 2018) and mechanization is being promoted to modernize farming practices and increase the efficiency of crop production (Tadesse, 2016). Moreover, the sub-region is embracing advancements in improved seeds and sustainable soil management practices to enhance the region's agricultural potential (Mudege et al., 2020).

Priority Intervention 3: Improving intra-regional trade and markets

Bolstering Africa's agricultural transformation will depend on how the region can develop its markets, leverage regional competitiveness from its food basket, and facilitate fluid and less costly exchange of goods and services between regions and countries. Strong output markets create incentives for agriculture transformation through investing in efficient production methods and technologies. Agriculture transformation in Africa must leverage the opportunities created under AfCFTA in opening markets by cutting down tariffs, reducing non-tariff barriers, and facilitating trade by improving the policy and services environment. Nonetheless, for this to happen, concerted efforts must be made to

invest strategically in priority food baskets to realize production potential and enhance access to trade corridors and demand centers through improved trade infrastructure, particularly rail and road networks, to connect production areas with demand centers.

As clearly depicted in Figure 4.7, production centers do not always correspond with areas of high population growth (e.g., production in Ethiopia, population expansion in Somalia, South Sudan, Horn of Africa). To enhance cross-country and regional connectivity between production centers and areas of consumption, the development of rail and road infrastructure in addition to harmonization of policies and regulations is crucial. It is thus critical to improve infrastructure in trade corridors that connect to food baskets to reduce net imports and increase food security. As demonstrated by this map, existing infrastructure provides a foundation that can be leveraged by current or potential food baskets' trade and movement of goods. However, more investment in efficient infrastructure projects is still required to better connect production areas with current and future demand centers.

Trade corridors with intra-country, cross-country, and cross-region potential include the northern (Kenya-Tanzania, Rwanda-Uganda) corridor, the Nacala (Tanzania-Malawi-Mozambique), the southern (South Africa- Zambia – Kenya) corridor, the Middle Africa (Chad-Cameroon-CAR-Congo) corridor, and West Africa (Senegal-Mali-Burkina Faso-Niger, Senegal-Cote D'Ivoire, Nigeria-Benin-Togo-Ghana-Cote D'Ivoire) corridor.

Apart from improving trade corridor infrastructure, targeted investments must be made to improve the trade environment. This will include reducing or altogether eliminating trade barriers and ensuring predictable agriculture and trade policies to transform agrifood systems. Particular attention must be paid to ensuring regional food security through facilitating cross-border trade in border regions that depend on food supply from neighboring countries. Countries must thus avoid inward-looking policies such as import and export restrictions and be committed to measures that do not constitute non-tariff barriers to trade. Where these occur, there must be a quick mechanism for eliminating them. In addition, it would be crucial to improve the services environment through liberalizing services sectors such as transport, financial services, movement of natural persons, and telecommunication services as well as suitable reforms in these sectors to facilitate trade. Digital services present substantial potential in services trade as they would facilitate linkages to buyers and sellers across the continent, simplify payment and settlement systems, and improve customs/border operations including certification processes.

Phasing approach for the implementation of priority interventions

Taking a phased approach is essential to ensuring Africa's food security within a decade as follows:

- In the short term (2-3 years), African countries should concentrate on strengthening production in existing food baskets, optimizing their potential and resilience (Figure 4.8).
- In the medium term (5-7 years), the focus of African countries should shift toward refining supply chains and expanding the reach of sustainable practices (Figure 4.8).
- In the long term (10+ years), African countries should establish new food baskets creating additional sources of agricultural productivity and ensuring the long-term sustainability of food systems (Figure 4.8).

With this priority intervention, a future where Africa's food systems are abundant, resilient environmentally conscious, and socially equitable is envisioned (e.g., safety-nets, protection). By combining focused efforts, transformative practices, infrastructure enhancements, and a phased approach; there is the confidence that sustainable and resilient agrifood systems will take off harnessing secured and nutritional food outcomes.

Governance for future Africa's Food Systems

The implementation period of the CAADP/Malabo Declaration comes to an end in 2025. With only two years remaining, AUC and AUDA-NEPAD have commenced discussions to shape the post-Malabo agenda.

The re-planning process for the next generation of CAADP shall take into consideration emerging trends and evidence such as food systems approach, worsening climate change shocks, and other noteworthy considerations. In fact, in evolving discourse surrounding African agrifood systems, age, generational, and gender unemployment gaps, particularly among youth and women, have emerged as a pivotal concern impacting both the labor force and the continent's economy. The integration of

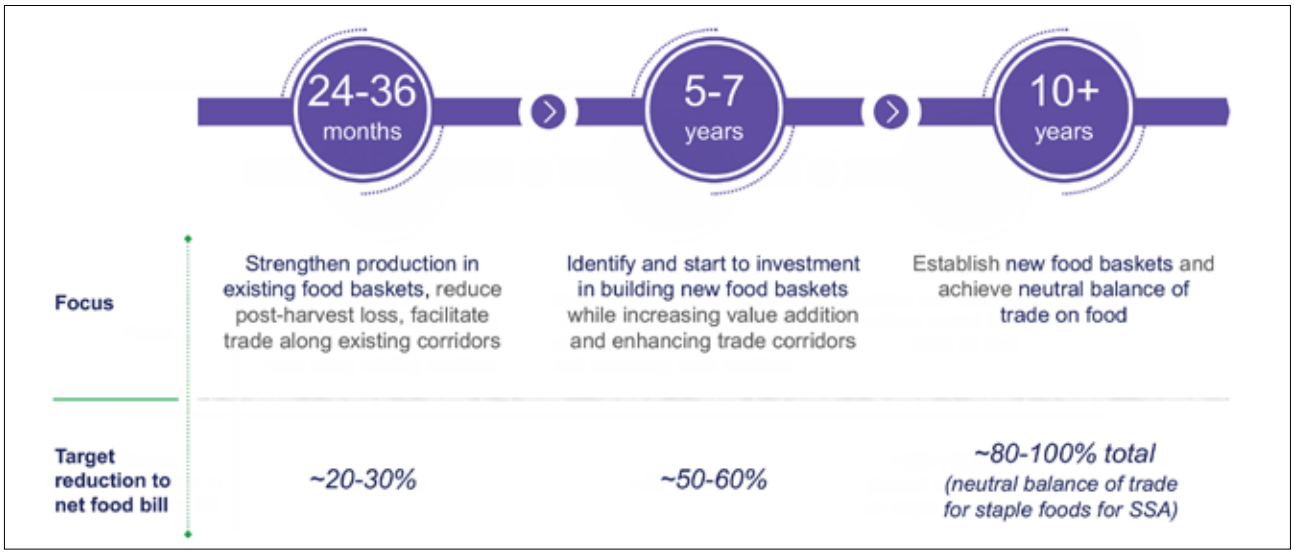


Figure 4.8. Short, medium, and long-term priority intervention phased approaches
Source: African Union Commission (2023)

cutting-edge digital technologies ranging from AI and blockchain to machine learning and even e-commerce has also captured attention. Concurrently, issues of land and water degradation often stemming from practices such as deforestation and intensive soil tillage have gained prominence alongside climate change.

Moving forward, there is need to accelerate the implementation of the CAADP Business Plan (2022–2025) and support countries to mainstream food system pathways in their national agricultural investment plans (NAIPs) in the remaining period to 2025.

Africa is home to the world's youngest and fastest-growing population, burgeoning cities, and bold innovations with a population expected to double to 2.5 billion by 2050. By 2040, the continent will be home to 12 cities of more than 10 million people and 19 others with populations between five and ten million each (McKinsey Global Institute, 2023).

For Africa to sustain such human potential and turn prevailing challenges into opportunities, the continent will require governance and institutional innovations for its future food systems. The post-Malabo re-planning process offers a great opportunity for an equitable, coherent, coordinated, and transparent design and review of mechanisms such as policies, legislation, finances, institutions, and delivery models, as well as monitoring and evaluation across key sectors (economic, social, health and environmental). The continent shall also capitalize on innovations in local food systems, markets, and improved coordination among stakeholders at local, national, sub-regional and regional levels. Overall, among the key dimensions to consider for food system governance are a) defining context-specific goals and targets for food systems transformation; b) fostering cross-sectoral coordination; c) strengthening territorial governance; d) facilitating effective multi-level governance; e) institutionalizing support for food systems governance; and f) strengthening governance of public expenditures on food systems (UNFS, 2021).

Conclusions and Recommendations

Considering the imminent threat posed by climate change and the potential consequences of inaction, there is a real urgency to address the challenges facing African agrifood systems. Africa's untapped agricultural potential and ability to learn from global disruptions offer a unique opportunity to build and shape resilient and sustainable agrifood systems for the continent.

The proposed priority interventions in this chapter offer a comprehensive roadmap for transforming agricultural landscapes, enhancing supply chains, and promoting climate resilience across the continent. If strategically implemented, these interventions can pave the way for a sustainable and secure transformation of African agrifood systems.

The emphasis of the first intervention on prioritizing existing and new food basket and water basins as

multi-country supply sheds holds significant promise. These regions can become the backbone of Africa's food security, providing essential resources for sustained agricultural growth.

Coupled with the second priority intervention's focus on innovative and environmentally-friendly practices such as climate-smart technologies and sustainable farming methods, African countries can significantly boost agricultural productivity to meet the growing demands of their populations.

The third intervention underscores the importance of infrastructure development in trade corridors to connect production and demand centers. Integrating modern transportation networks can facilitate the efficient movement of goods and services reducing net imports and enhancing regional and cross-border trade.

The financial implications of inaction underscore the pressing need for proactive adaptation measures. The substantial investment required to address climate change impacts, estimated at USD 15 billion annually, can yield substantial returns in improved food security, economic stability, and poverty reduction. On the other hand, the consequences of inaction are potentially leaving millions at risk of hunger, food insecurity, malnutrition, and poverty and perpetuating existing social and economic inequalities.

Furthermore, the adoption of the proposed priority interventions coupled with leveraging regional competitiveness, facilitating cross-border trade, and investing in essential infrastructure can drive the transformation needed to address food security challenges, mitigate the impact of climate change, and ensure a prosperous future for all Africans.

By embracing these recommendations and working collaboratively, Africa can emerge as a global leader in building resilient and equitable agrifood systems for generations to come. Leveraging the opportunities that AfCFTA presents can stimulate intracontinental trade and market growth strengthening Africa's position in global agrifood systems.

Collaboration among governments, international organizations, the private sector, and civil society is essential to realize these priority interventions and sustainably transform Africa's agrifood systems. Policymakers must prioritize cross-country policies and regulatory frameworks that incentivize private sector investments in agribusiness development to foster economic growth while ensuring sustainable practices. African countries' diverse agricultural landscapes call for tailored and coherent governance strategies across countries in each REC and at the continental level.

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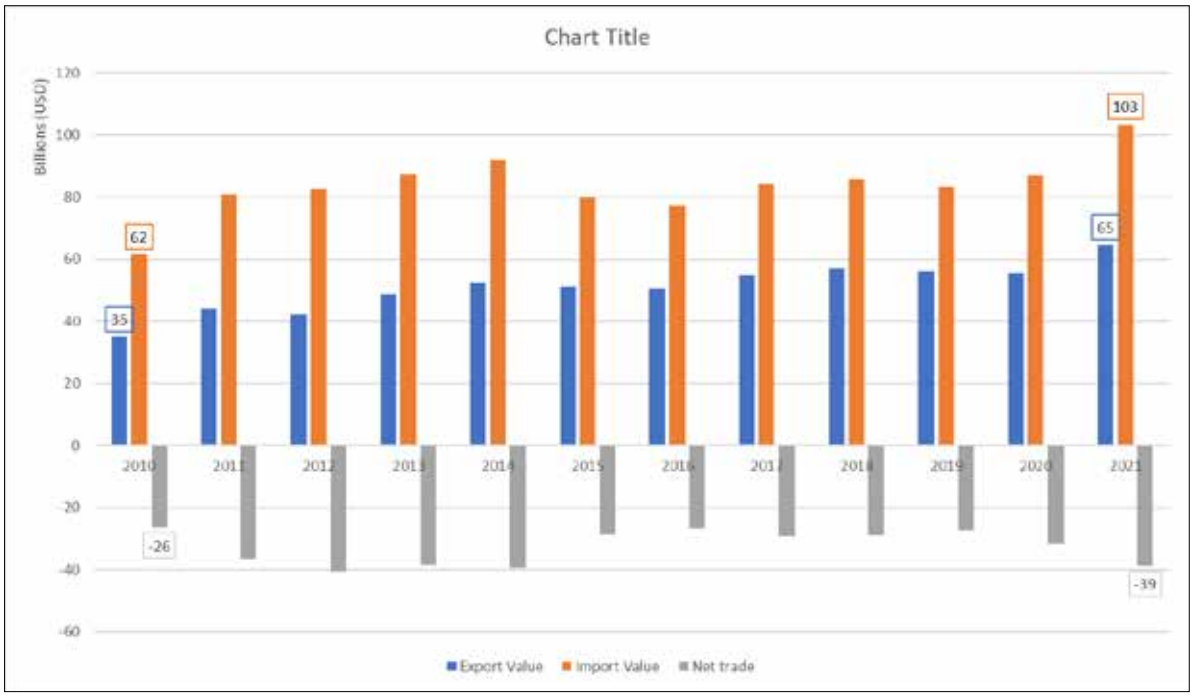
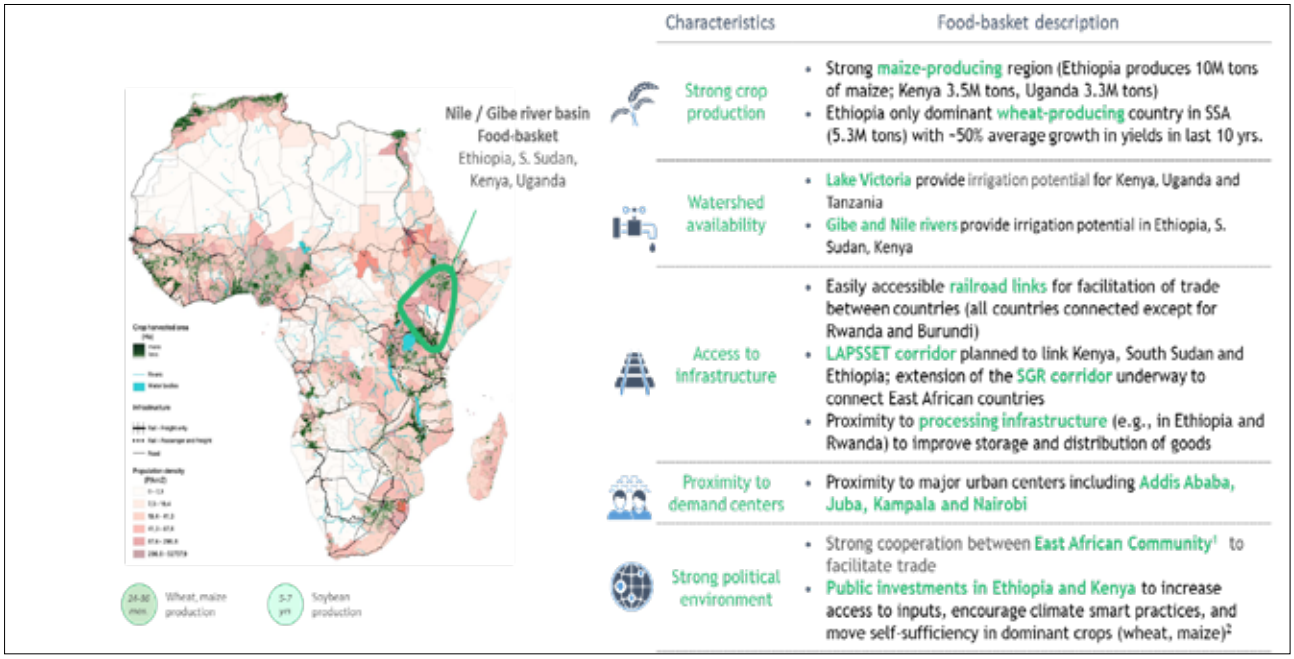
Annexes

Appendix 4A. Trends in imports, exports, and trade balance of agricultural food in Africa (USD)



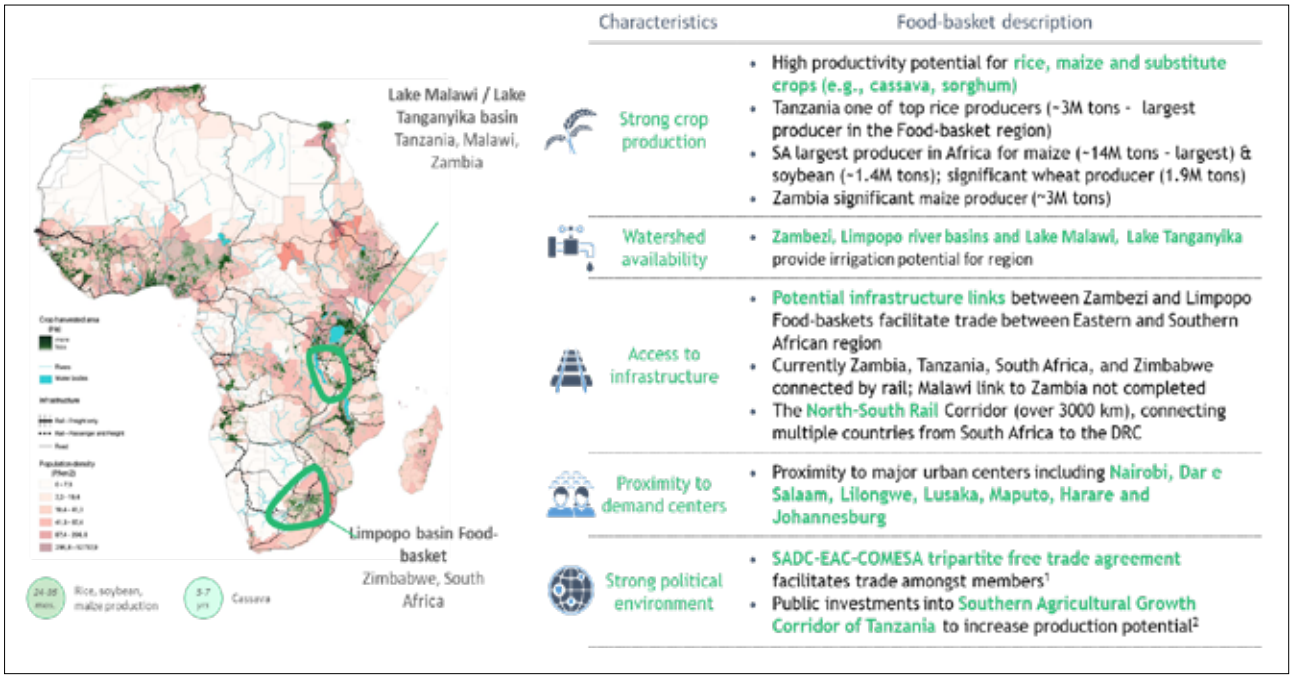
Source: Authors own calculation using FAOSTAT (https://www.fao.org/faostat/en/#data/TCL)

Appendix 4B. New food basket around the Nile / Gibe river basin



Source: African Union Commission (2023)

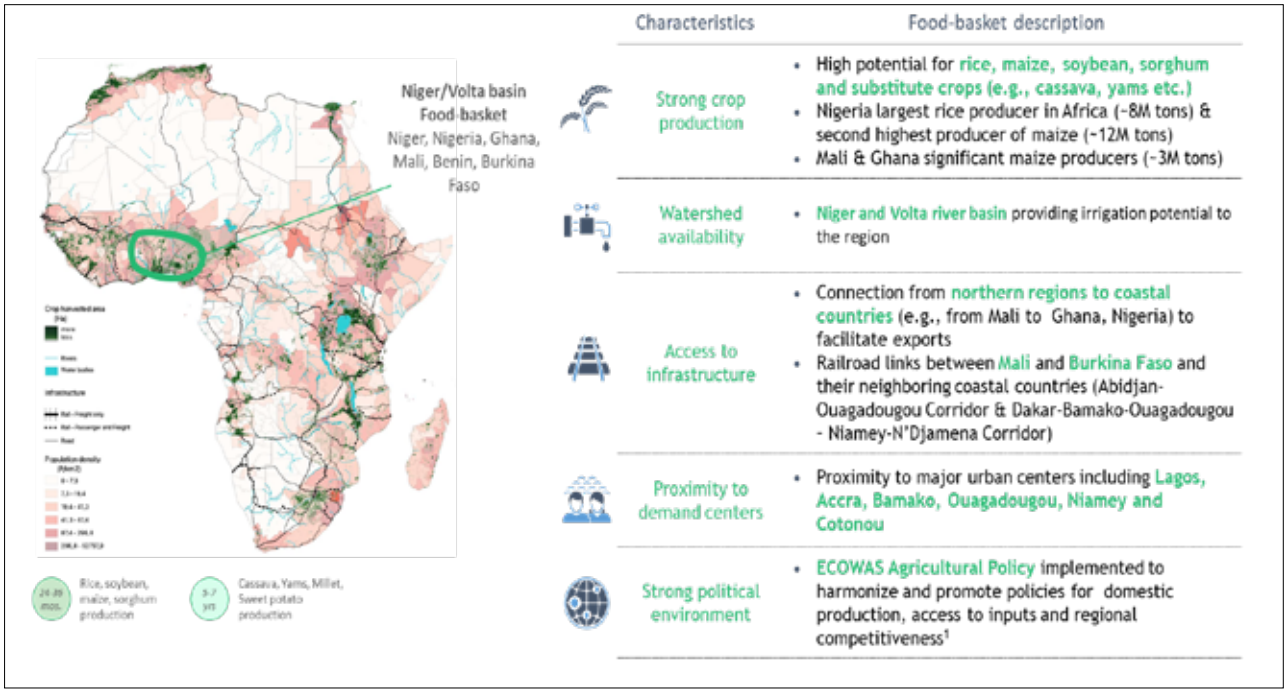
Appendix 4C. New food basket around the Lake Malawi / Lake Tanganyika basin and Limpopo basin



Characteristics	Food-basket description
Strong crop production	• High productivity potential for rice, maize and substitute crops (e.g., cassava, sorghum) • Tanzania one of top rice producers (~3M tons - largest producer in the Food-basket region) • SA largest producer in Africa for maize (~14M tons - largest) & soybean (~1.4M tons); significant wheat producer (1.9M tons) • Zambia significant maize producer (~3M tons)
Watershed availability	• Zambezi, Limpopo river basins and Lake Malawi, Lake Tanganyika provide irrigation potential for region
Access to infrastructure	• Potential infrastructure links between Zambezi and Limpopo Food-baskets facilitate trade between Eastern and Southern African region • Currently Zambia, Tanzania, South Africa, and Zimbabwe connected by rail; Malawi link to Zambia not completed • The North-South Rail Corridor (over 3000 km), connecting multiple countries from South Africa to the DRC
Proximity to demand centers	• Proximity to major urban centers including Nairobi, Dar e Salaam, Lilongwe, Lusaka, Maputo, Harare and Johannesburg
Strong political environment	• SADC-EAC-COMESA tripartite free trade agreement facilitates trade amongst members[1] • Public investments into Southern Agricultural Growth Corridor of Tanzania to increase production potential[2]

Source: African Union Commission (2023)

Appendix 4D. New food basket around the Niger / Volta river basin



Characteristics	Food-basket description
Strong crop production	• High potential for rice, maize, soybean, sorghum and substitute crops (e.g., cassava, yams etc.) • Nigeria largest rice producer in Africa (~8M tons) & second highest producer of maize (~12M tons) • Mali & Ghana significant maize producers (~3M tons)
Watershed availability	• Niger and Volta river basin providing irrigation potential to the region
Access to infrastructure	• Connection from northern regions to coastal countries (e.g., from Mali to Ghana, Nigeria) to facilitate exports • Railroad links between Mali and Burkina Faso and their neighboring coastal countries (Abidjan-Ouagadougou Corridor & Dakar-Bamako-Ouagadougou - Niamey-N'Djamena Corridor)
Proximity to demand centers	• Proximity to major urban centers including Lagos, Accra, Bamako, Ouagadougou, Niamey and Cotonou
Strong political environment	• ECOWAS Agricultural Policy implemented to harmonize and promote policies for domestic production, access to inputs and regional competitiveness[1]

Source: African Union Commission (2023)

Dr. Jean Chrysostome Ngabitsinze.

5 The AfCFTA, a Driver of Africa Food Systems Recovery

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Key Messages

1. AfCFTA has the potential to significantly transform African food systems through i) increased market access by reducing tariffs and non-tariff barriers; ii) strengthened regional value chains by stimulating their development leading to more processing and value addition in Africa; and iii) improved food security by enhancing access to food and increasing resilience by allowing countries to import food from Africa in response to localized shocks or shortages.

2. However, there are also potential challenges and obstacles that need to be overcome to capitalize on these benefits. One of these is that the benefits of the AfCFTA may not be evenly distributed. Determining factors include countries' competitiveness, trade infrastructure, and policy environment.

3. Implementing AfCFTA and ensuring compliance will be a complex task requiring significant institutional capacity and political will. While African Heads of State have fully pronounced themselves to support the initiative, these pronouncements must translate into practical commitments to eliminate all forms of barriers to movement of food and people between countries in earnest while investing in industrialization and enabling physical and soft infrastructure to ensure resilience of food systems.

4. For AfCFTA to achieve optimal benefits for all, State Parties should commit to:
   - eliminating duties on trade of all strategic agricultural products;
   - investing in and improving the trade environment;
   - identifying and eliminating all forms of non-tariff barriers in a timely manner;
   - strengthening strategic regional value chains to spur industrialization of food products;
   - establishing an enabling, transparent, and harmonized agricultural trading regime; and
   - driving inclusive policies to support the free trade area

Overview of AfCFTA – where we are

In March 2018, AU Leaders embarked on an ambitious program to create one African market through the establishment of the African Continental Free Trade Area (AfCFTA). To date, 54 members of the AU have signed the agreement, 85 percent of whom have ratified the treaty and are bound to liberalize their markets to intra-African trade. The AfCFTA Agreement covers eight protocols namely: trade in goods; trade in services; investment; dispute settlement mechanisms; intellectual property rights; competition policy; digital trade; and women and youth in trade. Negotiations on the first six protocols mentioned above have been finalised, while the last two are still under negotiation.

1 Minister of Trade, Rwanda
2 Secretary General of AfCFTA
3 President of AGRA
4 Specialist, Regional Food Trade and Resilience Program, AGRA
5 AfCFTA Secretariat
6 Director General, Ministry of Trade, Rwanda
7 Head, Regional Food Trade and Resilience Program, AGRA

The key objectives of the Agreement include[8] to:

- Create a single market for goods and services facilitated by movement of persons to deepen the economic integration of the African continent and in accordance with the pan-African vision of "an integrated, prosperous and peaceful Africa" enshrined in Agenda 2063.
- Create a liberalized market for goods and services through successive rounds of negotiations.
- Contribute to the movement of capital and natural persons and facilitate investments building on initiatives and developments in the State Parties and RECs.
- Lay the foundation for the establishment of a continental customs union at a later stage.
- Promote and attain sustainable and inclusive socio-economic development, gender equality, and structural transformation of State Parties.
- Enhance the competitiveness of economies of State Parties on the continent and the global market.
- Promote industrial development through diversification and regional value chain development, agricultural development, and food security.
- Resolve the challenges of multiple and overlapping memberships and expedite the regional and continental integration processes.

Various annexes regarding trade in goods were adopted including rules of origin, trade facilitation, non-tariff barriers (NTB), sanitary and phytosanitary (SPS) measures, among others. It was also agreed to liberalize 90 percent of tariff lines for a period not exceeding 10 years. The remaining 10 percent consists of 7 percent of sensitive products and 3 percent of excluded products; the former will be liberalized for 13 years by Least Developed Countries (LDCs) and 10 years by non-LDCs. Agricultural products make up the bulk of this 10 percent of tariff lines designated as sensitive and excluded.

Although it officially entered into force on 30th May 2019, trade under the Agreement began on 1st January 2021. To ensure operationalization of the Agreement, several initiatives have been put in place including[9]:

The AfCFTA Guided Trade Initiative. This serves as a platform to ensure meaningful trade under the AfCFTA through connecting businesses and products for export and import between interested State Parties. The Initiative requires state parties to issue AfCFTA trade documents including certificates of origin and importer and exporter declaration forms and to ensure that their customs laws and systems are aligned to AfCFTA requirements. The initiative will secure increased opportunities for SMEs, youth and women in trade and ultimately establish sustainable and inclusive economic development.

The AfCFTA e-Tariff Book. A web-based tariff book containing updated Schedules of Tariff Concessions, the AfCFTA e-Tariff Book is intended to facilitate the publication of information on the rates of duty applied by AfCFTA State Parties under their Schedules of Tariff Concessions and enhance knowledge, information sharing, and capacities in the use of tariffs, the Harmonised System, the classification of goods, and the organization of tariff-related work within customs administrations and other relevant stakeholders.

The AfCFTA Rules of Origin Manual. This covers the provisions governing the determination of the origin status of Goods under the Agreement establishing the AfCFTA, the procedures of administering the rules of origin, and the organizational requirements for implementing the rules of origin.

The AfCFTA Adjustment Fund aims to support Member States (both the public and private sectors) to adjust to the new trading environment and to address short-term disruptions arising from the implementation of the AfCFTA Agreement. The Fund is also aimed at enabling the private sector to develop capabilities to produce value-added goods and services that can be traded competitively on the continent and promoting the development of regional value chains.

The PAPSS. This is a centralized Financial Market Infrastructure enabling the efficient and secure flow of money across African borders. PAPSS works in collaboration with central banks on the continent to provide a payment and settlement service to which commercial banks, payment service providers, and fintech organizations across the continent can connect as participants.

8 AfCFTA Factsheet: A New Era of Trade in Africa – Accelerating AfCFTA implementation. April 2023

9 AfCFTA Secretariat, 2023. https://au-afcfta.org/about/; and https://www.un.org/africarenewal/magazine/february-2023/au-summit-2023-powering-trade-through-afcfta

The Non-Tariff Barriers Online Reporting Mechanism. This mechanism facilitates the identification and resolution of NTBs. The platform allows users to report obstacles encountered during cross-border trade and is accessible to businesses of all sizes and forms including informal traders and women and youth operators.

The AfCFTA Dispute Settlement Mechanism. This is a key pillar in the successful implementation of the Agreement and has been active since the operationalization of the Dispute Settlement Body (DSB) in April 2021. The Appellate Body comprises 10 Board Members. The mechanism responds to trade disputes between State Parties and acts as the enforcement arm of AfCFTA.

The AfCFTA Private Sector Strategy. This aims at delivering impact and economic recovery in the post-COVID-19 pandemic world by engaging with stakeholders from both the private and public sectors and from across the continent to ensure an inclusive approach to the implementation of AfCFTA.

Conducting **AfCFTA Regulatory Audits on Trade in Services.** These audits identify restrictions on market access and national treatment affecting the supply of services into the country as defined in the AfCFTA Protocol on Trade in Services.

Establishing **the Automotive Fund** for any investment that seeks to pursue local content development in the automotive value chain. The funding will also be used for ensuring access to consumer finance as part of the creation of demand and associated insurance products.

The AfCFTA SME Financing Facility. This is intended to catalyze access to finance for SME business activities with the aim of ensuring that market access is not just for big corporations, but is also for SMEs, particularly those led by women and young Africans.

The AfCFTA Trade and Industrial Development Advisory Council. The Council aims to advise the AfCFTA Secretariat on trade integration and transformative industrialization as part of the implementation of AfCFTA.

Progress towards tripling intra-African trade

African governments set themselves to triple intra-African trade in agricultural commodities and services by 2025 as part of the 2014 Malabo Declaration. However, this aspiration is far-fetched as intra-African trade continues to dwindle from a little over 16 percent in 2013 to less than 15 percent of total trade in 2022 (AATM 2021 & 2022). Nonetheless, there has been an improvement in intra-regional agriculture trade at the product level rather than total trade as measured by the introversion index[10] (AATM 2019). In addition, the 2021 CAADP Biennial Review Report found that Africa is not on track to achieve a tripling of intra-African trade between 2015 and 2025; the score in 2021 is estimated at 2.44 against a target of 5.0[11] (Figure 1). In fact, the number of countries on track has fallen

10 The introversion index measures the degree to which a country trades with other countries within a region. This index is based on modifications of both intra- and extra-regional trade intensity indices and compares a region/country's share in trade in the region/to the rest of the world (AATM 2019). It is the ratio of the difference between intra- and extra-regional intensity indexes to their summation.

11 Africa Agriculture Trade Monitor 2022.

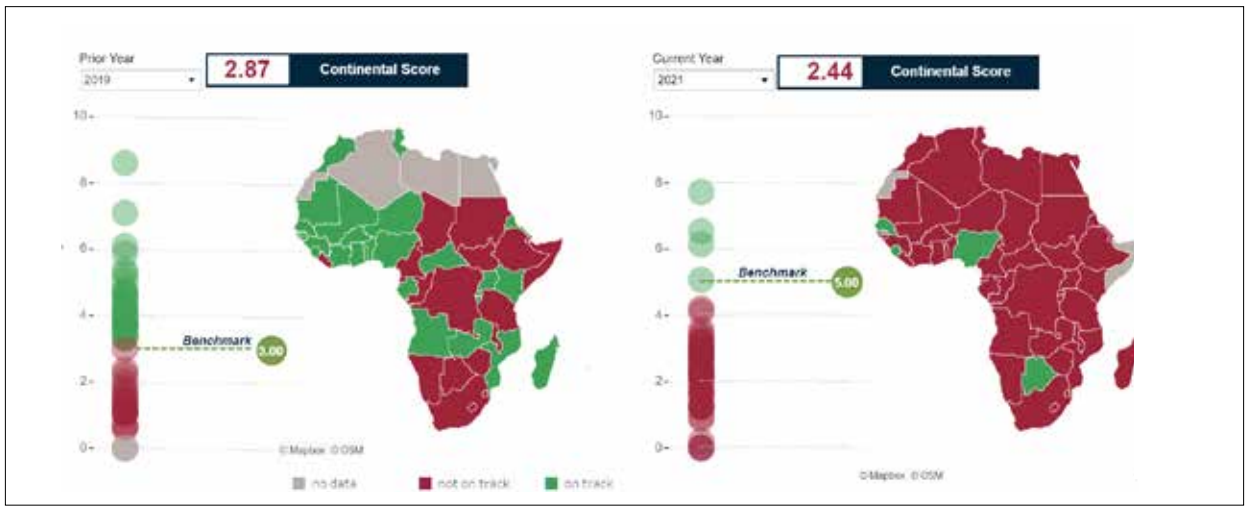

Figure 5.1. Africa's progress in increasing intra-African trade
Source: https://au.int/en/caadp/toolkit//au.int/en/caadp/toolkit

steeply from about 24 countries in 2019 to merely four countries in 2021. Several factors account for this poor performance chief among them being the recent multiple shocks of COVID-19, climate change, the Russia-Ukraine Crisis and several pockets of internal conflicts and insecurity, which have triggered more inward-looking policies such as export restrictions. This has hugely impacted Africa's productive capacity and, coupled with introspective agriculture and trade policies, limited intra-Africa trade.

Nonetheless, when fully implemented, AfCFTA as the main instrument for driving this agenda forward will increase intra-African trade by 53 percent and Africa's trade with the rest of the world by 15 percent (IMF, 2023). The success of AfCFTA in achieving this potential lies in deliberate efforts by African governments to meet the broad CAADP targets, particularly investing a minimum of 10 percent of national budget, but also in the commitments made to improve the trade environment including eliminating non-tariff barriers.

Opportunities and Constraints

AfCFTA offers a large market as a trading block with an estimated market size of close to 1.5 billion people as of July 2023.[12]. With a growing population estimated at more than 2.5 percent annually[13] and an increasing income, this market is expected to grow further in breadth and depth with projections of 178 percent growth by 2050 (FAO, 2020) providing a demand-pull for Africa's growth trajectory and trade under AfCFTA. Overall, by opening up markets in key sectors such as agriculture, manufacturing, and services, AfCFTA is expected to: drive increased product and economic diversification, competitiveness, and stronger resilience; increase the trade shares of women, youth, and locally-owned enterprises; and support the graduation of informal ventures to small and medium-sized enterprises (UNCTAD, 2021; AfCFTA Secretariat, UNDP, and UN Women 2022). In addition, implementation of AfCFTA is estimated to have substantial effects on income and poverty. For instance, the World Bank has estimated that implementation of the Agreement could lift 30–50 million people out of extreme poverty and 68 million people from moderate poverty by 2035 (World Bank 2020b, 2022). ECA estimates that AfCFTA would boost Africa's income by USD 450 billion by 2035 and increase Africa's exports by USD 560 billion mostly in manufacturing and agro-processing[14].

Despite these opportunities, Africa is far from realizing its potential as trade within the region is constrained and remains at a paltry 15 percent of total trade, far behind other regions of the world (UNCTAD, 2021). Agriculture trade within the continent was only 19.7 percent of total agricultural exports in 2019 and declined by 3.5 percent in 2020. Impressively, the share of fully processed and semi-processed agricultural products in intra-Africa trade in agriculture stands at 52.9 percent and 22.9 percent while only about 10 percent remains unprocessed[15]. The current trade environment is burdened by export and import bans, ad hoc changes in export/import permit issuance regimes, non-tariff measures, infrastructure gaps resulting in high transport costs, food losses due to poor storage infrastructure, and inadequate market information, which is particularly limiting for SMEs and marginalized groups.

Further, the impacts of the multiple external shocks of COVID-19, climate change, and the war in Ukraine have resulted in several crises such as food insecurity, high energy and fertilizer prices, increasing debt burden, and rising cost of living, among others. These shocks impacted several agri-food trade businesses as the resulting high transport and logistic costs and low output supplies disrupted trading activities (Nhemachena, C and Murwisi, K. 2020). This has led to the erosion of past successes and risks reversing Africa's poor trade integration and trade performance compared to the rest of the world. These crises are a sticking reminder that Africa has a long way to go. They are also a reflection of Africa's broken food systems characterized by a disconnect between input/production and output markets underpinned by underlying structural and infrastructural challenges. The past five years have perhaps been the most revealing in terms of what these structural challenges are, how exposed African food systems are, and how removed Africa is from the rest of the world when crisis hits.

AfCFTA offers an opportunity to reduce Africa's import deficit through harnessing Africa's unique agricultural resources to maximize local food production and consumption. Currently, demand for food in Africa exceeds domestic supply by an estimated 20 percent (FAO, 2020) making the continent a net importer of food products. Ironically, Africa loses 15.9 percent of

12 Worldometers, 2023. https://www.worldometers.info/world-population/africa-population/
13 Ibid
14 https://www.uneca.org/stories/with-the-right-policies%2C-the-afcfta-can-drive-africa%E2%80%99s-industrialization
15 Africa Agriculture Trade Monitor 2022

its food production to post-harvest loss alone without accounting for food waste (FAO, 2019). Inefficiencies in Africa's market and trade systems coupled with poor market infrastructure such as transport networks, storage facilities, and a weak trade policy environment, among others, contribute significantly to these losses. The efficient flow of trade allows food to move from surplus to deficit areas. For instance, North Africa alone accounts for more than half of the large food import bill by Africa, mostly from importing maize and wheat from outside the region (AU 2023). With the right trade logistics, this continental import bill could be reduced substantially if countries producing surplus could trade effectively with North Africa.

African countries tend to export more industrial products to each other than to the rest of the world (FAO and AUC. 2021)[16]. Opening up trade under AfCFTA is expected to further increase this trend by stimulating investments as companies strategize to competitively source and use productive resources from neighboring markets that may be traded more freely and at competitive prices under the Agreement. Market opportunities under AfCFTA can thus enhance the prospects for investments in agri-food processing and distribution as businesses establish more stable regional supplies of produce and serve larger markets. This will tend to create a demand-pull growth in many local industries that feed into these investments and create further benefits in the form of well-paying jobs for large numbers of low-skilled workers, increased average household incomes, increased domestic demand, economies that are stabilized against external shocks, and contributions to innovation and diversification (IMF, 2023; ECA, 2022; UNCTAD 2021). Trade in food products between surplus and deficit areas also allows markets to mitigate food shortages increasing resilience and regional food security. Industrial drive under AfCFTA is a sure avenue of reducing post-harvest losses and engineering the growth of African economies as it will provide both backward and forward linkages for the primary sector and the involvement of youth and women in the agri-business sector. Nonetheless, for this to be fully realized, it would be crucial to adopt supportive policies that improve the business environment and create incentives for foreign investment.

The continent's greatest challenge in reaping from the free trade area remains improving the trade environment particularly with regards to trade infrastructure, communications—where the largest opportunities lie for youth in digital trade, and productive and trade finance. The application of non-tariff measures (NTMs), which end up in NTBs (IMF, 2023) such as unjustified SPS requirements and procedures, import/export restrictions, state interventions in markets, inefficient customs procedures, high levels of informality, police roadblocks, and corruption, are also a challenge. Although tariffs within the RECs are low or zero, tariffs on imports from other RECs remain relatively high estimated at an average of 6 percent. However, NTBs, in particular custom formalities, pose more obstacles as it is estimated to be equivalent to an import tariff of 18 percent on average (AATM[17], 2019; IMF, 2023) or contribute an impact of 2-20 percent on the prices of goods and services (Moyer, et al. 2021). Today, even the most traditionally integrated cross-border trading partners are implementing policies that lean towards food self-sufficiency owing to the volatile food security situation emanating from the multiple shocks being experienced across the continent (AGRA, Food Security Monitors, editions 30-38; Nhemachena, C and Murwisi, K. 2020). Protectionist moves using trade restrictions disrupt the trade environment and displace private sector investments. The use of trade measures or non-trade measures, such as border closure or behind the border measures such as export/import licenses has had a significant impact on the flow of trade and undermines the aspirations of AfCFTA. Furthermore, in many countries in Africa, road, air, and sea transport costs remain high, export and custom procedures remain complex, trade infrastructure is limited, and deficient and limited knowledge of trade requirements restrain the participation of many private sector players in regional and continental trade (FAO, 2020; AU, AfCFTA Secretariat, and UN Women 2021).

According to UNCTAD, a total of USD 21.9 billion untapped export potential of intra-African trade remains due to trade-related frictions. The IMF estimates that a reduction in tariff by 90 percent and non-tariff barriers by 50 percent accompanied by reforms that strengthen the trade environment (trade infrastructure, financial development, telecommunication, and security) could translate to a 53 percent increase in intra-Africa trade flows (IMF,

16 https://www.brookings.edu/articles/africas-industrialization-under-the-continental-free-trade-area-local-strategies-for-global-competitiveness/; Africa Agriculture Trade Monitor (AATM) 2022.

17 Africa Agriculture Trade Monitor (AATM)

2023). Tariff and non-tariff barriers could contribute 15 percent while improvements in the trade environment could contribute 38 percent towards the 53 percent increment. The greatest win to gains from AfCFTA therefore lies in appropriate policy reforms. Transport infrastructure (including trans-border road, rail, port, and air transport networks and border and customs procedures), telecommunication infrastructure, financial development, human capital, institutions, and labor and product market regulations are critical elements of this policy environment. There is scope for adopting a more transparent trade policy based on data whose accuracy reassures the private sector about the relevance of the policy. A government policy will better achieve its goal when it is adopted in the context of reliable data and evidence of the effectiveness of the mechanisms used.

Conditions that may undermine West Africa's real market access under the AfCFTA[18]

In theory, the Economic Community of West African States (ECOWAS) Trade Liberalization Scheme (ETLS) allows for duty-free and quota-free trade of locally originating goods and products with a minimum of formalities involved. However, based on the findings of advocacy groups such as Borderless Alliance, the reality is that all forms of non-tariff barriers and trade environment challenges persist:

- **Long border crossing times and high cost of formalities** due to excessive bureaucracy and the lack of standardized and/or harmonized border procedures. This increases the time and cost of transporting food and agriculture products across land borders throughout the continent.
- **Inadequate storage facilities** leading to spoilage, deterioration, and loss while the products await buyers, especially in the off-season. This forces local producers and outgrowers to quickly dispose of their fresh produce at lower prices, which further reduces their competitiveness.
- **Excessive number of checkpoints** slow down the movement of goods and often lead to the extortion of illicit fees from drivers at these various checkpoints. In a recent fact-finding mission during the fourth quarter of 2022, Ghana Shippers Authority reported 83 checkpoints between Tema and Bolgatanga along its main Northbound corridor, including 67 for Police, 7 for Customs, 5 for Immigration and 4 for the Forestry Commission within a distance of less than 500 miles.
- **Poorly-maintained road infrastructure** especially in rural and remote production areas, accelerates post-harvest losses while goods are in transit for storage or delivery. For example, in Nigeria, farmers lose up to 50 percent of their onion harvests due to post-harvest losses.
- **Low value-addition for fresh produce** contributes to a reduced shelf life in comparison to more processed products. For example, post-harvest losses in handling, transport, storage, and processing have been estimated to account for 20-65 percent of tomatoes in Ghana. This explains the persistent volatility of the price of tomatoes on the local market especially in the main urban and coastal areas of the country.

All these factors contribute to increasing the time and cost of food and agriculture trade particularly in the context of the continuing disruptions to global supply chains and their amplified effect on food, fuel, and fertilizer costs. By enabling a shift towards more resilient and sustainable regional value chains, AfCFTA represents a real opportunity to accelerate the transformation of African agri-food trade. However, trade under AfCFTA would be limited without complementary measures to tackle the many barriers to food and agriculture trade across the continent.

Productive capacity including the ability to meet quantity and quality requirements and standards remains a daunting challenge for sustainable trade in Africa (FAO and AUC, 2021; AFDB, 2019; World Bank, 2020). Many productive sectors, particularly the agri-food sector, are still in peasant forms with limited access

18 Contributions of Ziad Hamoui, President Borderless Alliance

to productive resources such as land holding and finance. As such, there is often a lack of a consistent supply of products both for industrial purposes and human consumption, which often creates periods of temporal scarcity and gluts. Effective access to productive resources and strengthening the capacity of value chain actors to comply with standards such as SPS and technical requirements for example in labelling and packaging, would anchor the drive to integrate and promote intra-African trade. The largest sectors of the African economy, SMEs, women and youth, would only benefit from the African integration agenda if their capacities are elevated and their effective access to productive resources are enabled (AU, AfCFTA Secretariat, and UN Women 2021).

Undoubtedly, peace and political stability are a necessary precondition for the movement of people and goods across borders. Peace and political stability are necessary to build trust and confidence to attract investment. Conflicts and insecurity in certain African countries have disrupted productivity, trade flows, and productive and trade infrastructure in many parts of Africa and are pushing many people into poverty. If left unabated, these issues could erode the benefits of a free trade area (AGRA, 2023)[19]. The success of AfCFTA will depend on peace and political stability to allow productive activities including trade.

19 AGRA 2023 Food Security Monitor, editions 30-38.

AfCFTA and food system transformation

Trade is undoubtedly an important instrument in agriculture development and food system transformation on the African continent (UNCTAD 2021). The food system can be divided into four complementary systems: the food supply system (which includes farming, logistics, processing, retail, and consumption); the environmental system (which includes biodiversity and land use, climate change, and pollution and waste management); the health system (which includes prevention, care and wellness, and food safety); and the social, economic, and political system (which includes media, education and culture, policy, regulations and governance, and access and affordability)[20]. Trade measures, including those under the AfCFTA, could have an impact on various elements of the food system including farming, logistics, processing, retail, consumption, food safety, policy, regulations, and governance, and access and affordability. Stretching further, trade measures can also have an impact on biodiversity and land use, climate change, pollution, and waste management.

Indeed, trade can play a crucial role in driving the transformation of food systems in Africa including by providing opportunities for economic growth, improving food security, and fostering resilience against shocks. However, realizing these benefits requires overcoming several barriers including supply-side constraints and policy irregularities. AfCFTA can support/trigger food systems transformation in Africa through various ways, including:

Increased agriculture output

The Continental Free Trade will support both backward and forward linkages to agriculture development and growth (ElGanainy, et al. 2023). Free movement of goods and services will enable farmers to have access to critical and affordable inputs such as fertilizers, seeds, agro-chemicals, and farm equipment. Trade policy regimes should therefore support, for example, the harmonization of seed trade regulations to allow new seed companies to expand their operations and reach wider markets. On the other hand, increased market access creates a demand incentive for the expansion of agriculture production (IFPRI, 2018). Overall, market access promotes specialization and efficiency through adoption of modern technologies, hence boosting agriculture productivity and taking advantage of the complementarity of agro-ecological zones. The expansion of the market associated with increase in population and increasing average incomes presents an effective demand for agriculture food products enabling investment in production. Similarly, the prospect of access to lucrative markets can incentivize processors to invest in the expansion of their operations creating additional demand for agricultural outputs.

20 Adopted from AGRA Rwanda's Food Systems Strategy and Investment Plan (2023-2027)

Expanding market access through eliminating tariffs and non-tariff barriers

By reducing tariffs and non-tariff barriers, AfCFTA could open up new market opportunities for farmers and food businesses enabling them to reach consumers across the continent. Trade can help farmers reach larger and more diversified markets both within and outside Africa. This can increase incomes and incentivize farmers to improve productivity and quality (FAO, 2017). Market access incentivizes the commercial provision of services to farmers enabling them to produce and sell more in high-value markets in rapidly-growing urban areas and companies beyond regional borders. Implementing AfCFTA will remove barriers to trade and reduce the cost of entry and participation of smallholder farmers and traders. Trade measures can also help to preserve the environment. At the center of the list of exemptions in most trade agreements is the provision that allows State Parties to implement measures aimed at protecting human, animal, and plant life.

Promoting value addition or spurring industrialization

Efficient markets create opportunities for boosting the incomes of processors and other agricultural value chain actors. The objective of AfCFTA is to "increase the competitiveness of the economies of State Parties on the continent and in the global market" and to "promote industrial development through diversification and regional value chain development, agricultural development, and food security." This premise is based on four main constraints to intra-African trade including market fragmentation, small-size economies, lack of industrial capacity, and the export of primary products to traditional markets identified by the AfCFTA Secretariat[21]. Consequently, promoting the transformation of primary agricultural products into processed ones is at the heart of the successful implementation of AfCFTA. In fact, trade in processed goods in Africa is greater than for the rest of the world (AATM 2022; Byiers, et al. 2021).

AfCFTA is expected to stimulate the development of regional value chains leading to increased processing and value addition in Africa (IMF 2023; UNCTAD 2021). Lowering trade costs through strengthening regional trade infrastructure such as transport networks, trade finance, and telecommunications and eliminating non-tariff barriers could facilitate access to cheaper inputs and allow SMEs to participate in bits and parts of a production process that provides for cheaper food to African consumers and increases income for all participants especially SMEs and smallholder farmers. Strong regional value chains premised on agro-processing could help reduce post-harvest losses, create jobs, and increase the availability of processed and value-added food products. Efficient regional supply chains would facilitate the well-organized distribution of agricultural products and ensure timely access to nutritious food. With increased market access and appropriate support policies, local producers would be encouraged to produce higher-quality goods and meet market demands, which will boost innovation, investment, and job creation in the agricultural sector.

Promoting food security and resilience

By facilitating the movement of food from surplus to deficit areas, trade can help to stabilize food prices and ensure more equitable distribution of food. This can contribute to food security at the national and regional levels (Anderson, K., and Strutt, A. 2014). By facilitating trade, AfCFTA could improve access to food and contribute to food security by making it available at affordable prices. It could also increase resilience by enabling countries to import both agro-inputs and food from within Africa in response to localized shocks or shortages. Food loss on the continent is not only attributable to weak post-harvest practices and lack of appropriate storage facilities but also to a lack of effective access to reliable and timely markets. As a result of weak infrastructure and various obstacles to trade, much food is lost before it reaches the final consumer. AfCFTA should help to resolve these challenges once fully implemented.

Trade can help countries diversify their food sources and reduce dependence on any single crop or region, thereby improving resilience to shocks such as droughts, floods, or crop diseases (Fischer, G., and Heilig, G. K. (1997). The free flow of goods can affect all aspects of food security – i.e., availability, access, utilization, and stability. Trade influences food stocks and prices in the internal market. High food prices are a determining factor in the affordability of consumption but could also incentivize increased

21 https://trade4devnews.enhancedif.org/en/op-ed/anchoring-afcfta-trade-policy-industrial-policy

production. The shockwaves for African economies from recent disruptions in food trade from the Black Sea region due to the Russia-Ukraine conflict and regional restrictions on exports/imports of maize in the eastern and southern African regions over the past few years demonstrate the role of trade in ensuring food security. The ongoing food crisis marked by high food prices in various parts of the continent is a direct impact of trade disruptions.

Driving inclusive agri-food system transformation

Making trade deliver on food systems transformation would require leveraging on trade to drive structural productive transformation. Trade and food systems transformation are strongly interlinked in many ways as issues such as market structures, infrastructure development, productivity and composition of agricultural output, availability of high-quality inputs, quality and safety of food products, and the composition of diets affect both spectrums of work (FAO, 2020). To benefit from the market opportunities under AfCFTA, it is therefore necessary to adopt a market-oriented approach to food system transformation anchored on harnessing the large potential of African SMEs, women, and youth. Trade plays a critical role in fostering access to critical and affordable inputs including primary production inputs such as seeds, fertilizers, agro-chemicals, and industrial inputs. For AfCFTA to drive structural transformation, it must promote the free movement of agro-inputs such as fertilizers and industrial inputs by removing barriers to building regional value chains.

To ensure inclusive implementation, the AfCFTA Secretariat has developed a Private Sector Strategy that should serve as an opportunity for African enterprises to utilize regional advantages to increase competitiveness, diversify product supply, and export products with higher value-addition[22]. Trade thrives on supply consistency and efficiency. For trade to work, food systems transformation would require fixing Africa's productive capacity. Many African countries are suffering from stagnating productivity due to climatic shocks, supply chain inefficiencies, and limited use of inputs and agriculture technologies, among others.

Agricultural policies that seek to resolve supply-side constraints should go beyond food sufficiency and seek to promote agriculture as a business to attract the youth and women (FAO, IFAD, UNICEF, WFP and WHO, 2022).

Driving safe and nutritious diets

Food system transformation requires the provision of safe and nutritious diets. Well-functioning African food markets will be extremely important to people's ability to feed themselves particularly with healthy diets. Many countries are facing an increasing double burden of undernutrition and overweight or obese population. According to the 2022 State of Food Security and Nutrition in the World Report, by 2030 and 2050, at least 492 million and 350 million people respectively will be left in extreme poverty with the majority concentrated in sub-Saharan Africa (AU/ECA/ AfDB/ UNDP, 2022). In 2021, a third (278 million) of the world's total number of undernourished people (768 million), lived in Africa. As food security worsens, the number of undernourished people in Africa is projected to grow from almost 280 in 2021 to more than 310 million by 2030 (FAO, IFAD, UNICEF, WFP and WHO, 2022). Urbanization and rising income are driving a nutritional transition towards higher value and nutritious food. Improving the quality of diets is key for addressing malnutrition. WFP estimates that the majority of food aid beneficiaries are farmers whose crops frequently fail. Investing in farmers' resilience will thus play an important role in reducing the long-term need for humanitarian assistance. The nexus between nutrition, food production, trade and health is complex but future developments could contribute to the availability and accessibility of nutritious food or exacerbate negative trends.

22 https://www.un.org/africarenewal/magazine/february-2023/au-summit-2023-powering-trade-through-afcfta

Standardization: Will the transformation of food systems be Inclusive[23]?

It is clear that food systems need standards but these are often used to address consumer concerns such as reducing aflatoxin risks in grain trade. As IITA notes in its Technical Policy Paper on Aflatoxin Standards for Food[24], "Established standards can also create conditions conducive to free and fair global trade; in the absence of food standards, non-tariff barriers to trade can be unfairly imposed." The business case for these types of standards is clear for AfCFTA to succeed. The commercial interest in this type of standard is evident for the success of the Agreement. AfCFTA aims for inclusive growth, which is based on its ability to increase market access to create new opportunities for farmers and small businesses in the food sector. However, the risk is that those with less capacity and power will not be able to take advantage of these opportunities due to their ability to comply with standards. Inequality will worsen and inclusive growth will become a hollow slogan. There is **therefore a need for approaches that can support the development of the capacity of agri-SMEs and smallholder farmers to effectively compete for these opportunities.**

Agribusiness Market Ecosystem Alliance (AMEA) Network has developed a Call to Action on Business Development Services (BDS) for Agri-SMEs[25]. The first proposition of this Call to Action is that **standards are needed to improve the quality of BDS,** and that standards are necessary to ensure food safety and enable cross-border trade. However, standards are also needed to improve the support provided to farmers and agri-SMEs. **Coordinated development and implementation of standards** that enable and empower **all food system actors** to capitalize on the opportunities created by AfCFTA will therefore be crucial. For standards to be relevant to all actors in the food system, it is necessary to reflect on how they are currently used in practice. In most cases, standards are used in a prescriptive (normative) way which means that they either pass or fail. A good example of this is GLOBALG.A.P., in which a certification process is required by buyers in some export markets. The pass or fail approach means that although GLOBALG.A.P.'s goal is to benefit farmers throughout the world, in reality it can only reach a very small fraction of those farmers.

The conclusion from this is that the process of improving performance, incentivised by standards, is not reaching the majority of African farmers. At the same time, BDS provided to farmers and agri-SMEs is unproven and produces uneven results. Even if the costs are "affordable", it is unlikely that these BDS will be scaled up to transform African food systems. It **is therefore necessary to re-think how standards can enable <u>all</u> actors in the food system to improve their performance.** Several initiatives are attempting this re-think, two of which are highlighted below:

- AMEA's support for a Guideline on Professional Farmer Organizations[26], which is supported by 26 countries and is expected to become a full international standard by 2024. This informative standard is not a mandatory pass/fail document but is intended to guide all actors in the food system in designing SDGs and measuring their impact.
- In Uganda, the Ministry of Finance, Planning and Economic Development has developed a BDS Framework for SMEs[27] and two draft BDS standards have been developed[28]. These standards aim to help BDS providers develop the internal capacity needed to meet the service delivery quality expected.

23 Contribution from Mark Blackett, Network Director, AMEA
24 https://aflasafe.com/wp-content/uploads/pdf/TPP-8-Aflatoxin-Standards-for-Food.pdf
25 https://amea-global.com/wp-content/uploads/2022/06/bds-2022-final-1.pdf
26 https://www.iso.org/standard/85377.html
27 https://www.finance.go.ug/sites/default/files/Publications/National%20Business%20Development%20Services%20%28BDS%29%20Strategy%20Framework.pdf
28 https://www.africanmanagers.org/bds/

To deliver food system transformation, it will not only be necessary to look beyond the food quality standards that drive change but to also improve the support provided to farmers and agri-SMEs. The goal of food system transformation requires new approaches. Resources are constantly being squeezed, so there is significant pressure to invest in approaches that can demonstrate their potential for success. While standards are only one part of the puzzle, they are an essential part of developing confidence in future investments. It is therefore crucial to invest in developing standards that give consumers confidence but also enable farmers and agricultural SMEs to receive the services they need and deserve.

Fostering innovation

AfCFTA can serve as a crucial vehicle for fostering innovation in Africa if it can: ensure real market expansion; drive specialization and competitiveness of African enterprises, particularly in participating in regional value chains; attract foreign direct investment; spur infrastructure development; and ensure policy harmonization and coordination and knowledge sharing (Wakelin, K. (1997); Kiriyama, N. (2012). Harmonisation and coordination of policies and regulations for example can reduce trade barriers and create a more conducive environment for innovation, attract foreign investment, and stimulate local entrepreneurship. Trade can expose farmers to new technologies, practices, and varieties of crops and livestock, which can boost productivity and sustainability. It can also spur innovation by creating competition and demand for improved products (Wiggins, S., and Keats, S. (2013). Trade can therefore foster an environment conducive to innovation creating opportunities for knowledge exchange, collaboration, specialization and greater access to markets and capital. The opportunities triggered by AfCFTA can in themselves drive institutional innovations in regulating trade as countries seek to support the competitiveness of their industries and enterprises.

Critical Drivers of a beneficial AfCFTA

Exploring the crucial role of Trade in Services

AfCFTA aims at progressively liberalizing business, financial, communication, tourism, and transport services. When fully accomplished together with appropriate infrastructural investments, it would drastically reduce the cost of trading on the continent. To a large extent, AfCFTA's success depends on how committed State Parties would be to addressing the liberalization of trade in services and the accompanying reforms and infrastructural development particularly in the roads sub-sector. Inter-REC and intra-African trade remain low in Africa due to the high costs of logistics and transport, communications, finance, and business registration and operation. High transport costs in particular are attributed to poor infrastructure and are cited as a key-contributor to the low level of infra-African trade (IMF 2023).

The Case of the Cost of Poor Border Infrastructure

On average, the cost of transport in Africa is estimated to be around 30 to 40 percent higher than in other developing regions. A Cross-Border Road Transport Agency[29] assessment found that infrastructural impediments are the main driving factor behind the high transport and logistics costs associated with the lengthy processes in clearing goods at border posts and long delays along transport corridors to conduct regulatory checks at border posts, weighbridges, and roadblocks. The report further found that time spent at government regulatory stoppages for law enforcement inspections constitutes over 81 percent of the delays with customs processes taking up the lion's share of 77 percent of total standing time."

For AfCFTA to succeed, it is essential for infrastructure and trade to function in such a way as to link "food production hubs" to markets via trade corridors. The AU has identified strategic corridors that should be strengthened with adequate soft and hard infrastructure including ports, rail, and roads to connect food baskets to markets.

29 Cross-Border Road Transport Agency, 2022. Annual State of Cross-Border Operations Report, 2022.

For instance, the Limpopo River Basin is a food production hub that produces over 20 million tonnes of grain and oilseeds. There is opportunity to move 3.5 million tonnes of surplus grain from South Africa, Zimbabwe, and Zambia to deficit areas of southern and East Africa (AU, 2023). However, poor border infrastructure causes border delays of 132 529 hours per day and costs about USD 2.65 million per day[30]. This means that targeted investments in border infrastructure along the corridors linking the food basket of the Limpopo River Basin will reduce the cost of moving food across borders by USD 1 billion a year resulting in long-term benefits of improved competitiveness, increased economic activity, and income gains. Past border investments by TradeMark East Africa (TMEA, now TradeMark Africa, TMA) proved extremely successful. For instance, investments in physical infrastructure and digital portals reduced dwell times at Mombasa port from 21 days in 2009-10 to 4 days in 2021 and also resulted in an 80 percent reduction in border crossing times[31].

30 TLC & FESARTA/ Business Unity South Africa (BUSA) Report. SADC CASE STUDY: Costs of Delays – North South Corridor December 2020 and January 2021

31 TMA Strategy 3: Building Sustainable and Inclusive Trade for Africa (2023 – 2030)

Efficient financial services would be crucial. Access to credible, reliable, and affordable finance remains out of reach for most small agri-food enterprises and traders particularly women and youth (FAO, IFAD, UNICEF, WFP, and WHO, 2022). Africa's productive capacity continues to be constrained partly due to lack of access to affordable financing especially for women. A key driver of smallholder farmers' participation in regional trade markets depends on their ability to have adequate and timely access to finances to invest in assets that increase productivity and manage product quality. Although warehouse receipt systems are promising, collateral management systems around them are not yet developed. This affects the participation of financial service providers.

Similarly, payment and settlement systems remain a constraint to trade in Africa as current systems are associated with high transaction costs and delays for cross-border payments. With more than 40 individual currencies, it has been difficult to make cross-border payments in Africa without the use of third currencies. It is estimated that using the Society for Worldwide Interbank Financial Telecommunication (SWIFT) system costs the African continent nearly USD 5 billion annually[32]. AfCFTA 's annex on trade facilitation requires State Parties to adopt or maintain procedures allowing the option of electronic payment for duties, taxes, fees, and charges. In response to this problem and to facilitate trade-related payments, the African Export-Import Bank has rightly developed the Pan-African Payment and Settlement System (PAPSS) with the co-operation of the AfCFTA Secretariat. It is expected that this system will enable businesses and consumers in Africa to make cross-border payments in their local currencies, which policymakers must support.

Digital trade is the next big thing in Africa.[33]

Digital trade or e-commerce will be a deal breaker in terms of how young people will be able to participate in AfCFTA. Many experts agree that Africa has huge potential to use digital trade for the benefit of its population if appropriate policy, legal and institutional frameworks are adopted. With the majority of the African population being young and talented, Africa's technology industry has grown although the volume of digital trade is very low on the continent compared to other regions of the world. The AU's Agenda 2063 emphasizes the indispensability of building digital economies to facilitate continental integration and achieve sustainable and inclusive development. Likewise, its Digital Transformation Strategy for Africa (2020-2030) states that "integrating Africa to a single digital market will create economies of scale and opportunities to grow Africa's economies and the key to unlocking these opportunities is the ability to adapt to digital trade and financial services." It is in this context that the AfCFTA Protocol on E-Commerce is being negotiated.

A leading impediment to the timely and cost-efficient movement of goods on the African continent is the administrative burden of border and customs clearance of goods at borders and ports. UNCTAD estimates that reducing non-trade barriers (some related to border and customs administration) could

32 https://www.africanliberty.org/2022/06/20/afcfta-why-is-the-pan-african-payment-and-settlement-system-important/

33 This section received contribution from Nixon Mageka Gecheo, Senior Program Officer – Digital Systems & Solutions for Agriculture-AGRA

lead to trade gains in Africa of USD 20 billion per year compared to the USD 3.6 billion that could be achieved by the elimination of tariffs[34]. In terms of reducing trade costs, reforms to customs procedures are expected to deliver the most benefits followed by the upgrading of transport infrastructure, and other border agency reforms (Trade Law Centre, 2015). Some progress has been made in this area with many African countries investing in digital customs modernization systems, such as the Automated System for Customs Data (ASYCUDA) World[35], digitally integrated one-stop border posts, and National Single Windows. It is also vital to examine digitalization in a broader way in relation to trade. Aside from creating new or increasing existing opportunities, the effective use of ICT can also facilitate trade even if the goods or services are not digitally ordered or delivered. This is particularly true when it comes to trade facilitation. AfCFTA's annex on Trade Facilitation urges State Parties to adopt ICT in customs and related procedures such as the provision of customs information and submission of documents and goods inspection to facilitate the efficient and low-cost movement of goods across borders.

One of the efforts to digitize trade has been the creation of the Africa Trade Exchange (ATEX) by the AUC and AfreximBank, a business-to-business (B2B) e-commerce digital marketplace. ATEX facilitates bulk procurement of basic commodities and fertilizers to ensure that African countries have access to strategic supplies in a transparent manner. It is envisaged that ATEX will also serve to mitigate food supply shocks and that digital trade under the AfCFTA through the platform will enable African firms to integrate regional suppliers into their supply chains thus harnessing the resilience offered by regional value chains and the efficiency of trade facilitation to reduce tariff and non-tariff barriers. Adopting an ecosystem approach, the ATEX marketplace will be the centre of various activities including logistics, financing, and other trade services to promote African trade in essence supporting the goals of affordability and accessibility.

The role of cross-border trade, women and youth in the implementation of AfCFTA

Women and youth account for more than 80 percent of Africa's population and their involvement in cross-border trade remains substantial. It is estimated that increasing women's participation in the labor force could add 10 percent or USD 316 billion to the continental GDP by 2025 (UNCTAD, 2021). The informal sector accounts for 85 percent of Africa's economic activity and women account for 90 percent of the labor force in the informal sector[36] (UNCTAD, 2021). Cross-border trade remains an important component of intra-African trade as it is a source of employment for a significant number of women and youth. Informal cross-border trade accounts for about 40 percent of intra-SADC and intra-COMESA trade but can account for up to 90 percent of official trade flows in some African countries (UNCTAD, 2021). Although women and youth are a large constituent of both formal and informal cross-border trade, their participation is often limited to the low-value end of the supply chain and mostly restricted to the informal sector. A joint report by the AfCFTA Secretariat, the United Nations Development Programme (UNDP) and UN Women shows that despite the operationalization of AfCFTA and the active involvement of governments in the negotiations process, the women consulted had limited or no knowledge about AfCFTA, its potential benefits, or impact on their trading activities. The report further notes that the key constraints to women's participation in trade are related to limited access to information and knowledge on trade-related issues; productive and financial resources; representation in professional networks and trade associations; and lack of an enabling environment for trade activities.

The success of AfCFTA, which leverages the rich potential of women and youth, would depend on formalizing the informal sector and investing in women's skills and education. For AfCFTA to be meaningful and beneficial, conscious efforts and investments must be made to address these constraints. Youth participation in agri-food trade would involve unlocking barriers to their integration into regional value chains, particularly through the digital space. The constraints women face undermines Africa's efforts to realise its full trade potential. To improve the situation of women, African governments should adopt policies that eliminate the constraints that they face as traders. This may include specific gender-responsive policies including those that promote access to affordable finance for women and youth-led businesses.

In recognition of this, at its 13th Extraordinary Session, the Assembly of Heads of State and Government

34 International Chamber of Commerce, "Customs and Trade Facilitation": https://iccwbo.org/global-issues-trends/tradeinvestment/trade-facilitation/.

35 https://asycuda.org/en/user-countries/

36 https://www.un.org/africarenewal/magazine/january-2021/afcfta-experts-traders-call-robust-participation-women-and-youth

of the African Union (AU Assembly) committed to broadening inclusiveness in the operation of AfCFTA through interventions that support young Africans, women, and small- and medium-sized enterprises and integrating informal cross-border traders into the formal economy by implementing the simplified trade regime. To further entrench this, at its 35th Ordinary Session held in February 2022 in Addis Ababa, Ethiopia, the AU Assembly translated this commitment into the development of the Protocol on Women and Youth in Trade in the scope of the AfCFTA Agreement.

At REC level, the implementation of instruments such as the Simplified Trade Regime (STR), which promotes the formalization of informal cross-border trade and the integration of women, small-scale traders, and youth, has been underway for a have long time. This instrument is being piloted in COMESA, SADC, and the EAC, and has potential under AfCFTA. It is thus important that it is upscaled and supported to ensure that the free trade area is fully inclusive.

The crucial role of appropriate Agriculture and Trade Policies

By leveraging on its vast arable land, diverse ecosystems, and young working population, agriculture and agri-food trade presents a significant opportunity to accelerate African economic development. That said, the continent needs to resolve its many structural challenges, which fundamentally affect the competitiveness of its agriculture and food production. Agriculture and trade policies should therefore support the exploitation of these potentialities.

It is important that trade and agriculture policies on the continent are predictable and applied transparently to allow effective participation and encourage investment by potential players in the agri-food value chain. Priority should be given to eliminating NTBs and export/import restrictions. NTBs such as the multiple licences, permits, and documents required to export agricultural goods are time-consuming and costly; border procedures and SPS measures remain the most significant policy barriers to trade on the continent. NTBs are estimated to add 2-20 percent additional costs on the pricing of goods and services (Moyer, et al. 2021). Compliance with SPS measures alone accounts for 14 percent of food prices (Cadot and Gourdon 2014). Unfortunately, NTBs seem to perpetuate themselves since many governments that advocate opening up trade are the same ones that institute them. According to a COMESA report[37], in general, the share of NTMs faced by African exporters and imposed by countries that are members of the same REC is relatively high. For instance, 24 percent of NTMs faced by Kenyan exporters and 31 percent by Tanzanian exporters are imposed by EAC members. In West Africa, Côte d'Ivoire and Guinea face more NTMs imposed by ECOWAS members (36% and 66% of total NTMs, respectively).

In general, the multiple shocks suffered around the world in the recent past, including the persistence of climate change and variability, the COVID-19 pandemic, and the war in Ukraine have caused many countries to once again adopt restrictive trade measures. Many countries often apply intervention policies in the food and agricultural markets as crisis policy measures to stabilize domestic prices, ensure food security, or protect local industrial development. Typical instruments used include price subsidies, direct purchases by governments, physical food reserves, subsidies on agricultural inputs, direct imports of food stocks through government-to-government transactions, and the imposition of trade restrictions on specific crops. Improving the predictability of government interventions through transparent mechanisms and evidence-based policymaking can incentivize the private sector to increase investment and commercialize more agri-food products on the continent.

In addition, lack of harmonised standards and requirements for food products in all regions makes the application of various standards, regulations, and Standard Operating Procedures (SOPs) difficult, especially in the area of food safety and quality standards. This has resulted in repeated conformity assessments for consignments when crossing borders, which increases the time and cost of trading. Article 8 of the AfCFTA agreement on SPS urges State Parties to cooperate in the development and harmonization of SPS measures to ensure that while safeguarding human, animal, or plant life or health, they do not become unjustifiable barriers to trade. The recent IMF assessment (IMF, 2023) corroborates past assessments concluding that the greatest gains will be made on the back of appropriate agricultural and trade policies accompanied by the related reforms and investment. Governments should therefore commit to

37 COMESA Project document on "Enhancing Regional Agricultural Commodity Trade in the Common Market for Eastern and Southern Africa (COMESA)" funded by AGRA

the continental trade agenda and avoid ad hoc and self-centred food sufficiency policies that only end up limiting investments and the growth of the African economy.

What are the Policy options for driving optimal benefit of AfCFTA?

Consistent with several past assessments, the greatest gains under AfCFTA will come from investments and initiatives aimed at improving the business environment and addressing NTBs to lower trade costs to the extent that would allow MSMEs to produce and trade competitively (IMF 2023; UNCTAD 2021). Of crucial importance is the improvement of transport infrastructure, trade finance, policy irregularities, and border and behind-the-border measures related to documentation and fees. In addition, supply-side constraints limiting response to shifting regional and global demand must be addressed. Sustained and concerted efforts at building productive capacities, including addressing the ability of farmers and companies to comply with quality and safety standards, would be crucial. The section below explores non-exhaustive policy options, which recalibrate most of the recommendations from the various past studies, that would be critical to ensuring optimal benefits under AfCFTA.

Eliminate duties on trade of all strategic agricultural products

Inward and self-sufficient policies by African countries can to a certain degree be harmful in the long term when they discourage long -term investments and suppress the growth potential of industry through access to wider markets. The reduction in the utilization of productive capacity and the negative effects on the competitiveness of the private sector, which can make a profit through government protection, may in some cases explain the negative results of implementing the strategy of protecting infant industries in Africa. In fact, in the long term, policies that only encourage increased production without adequately expanding access to markets through open trade policies might end up holding back investment in the same sectors. Protectionist tendencies such as inclusion on the list of sensitive products can lead to these sectors remaining as infant, subsistence, and underperforming. It is therefore important to eliminate customs duties on the main agricultural products.

Investing and improving the trade environment

The latest study by the IMF corroborates the findings of previous past assessments asserting that the greatest gain from implementing AfCFTA would come from appropriate measures or investments in improving the trade environment. This includes transport infrastructure (including trans-border road, rail, port, and air transport networks as well as border and customs procedures), telecommunication infrastructure, financial development, human capital, institutions, harmonizing and simplifying customs procedures, and addressing restrictive product and labor market regulations. The opportunities offered by AfCFTA would be nothing more than a mirage without full implementation supported by these trade facilitation measures particularly reducing non-tariff barriers (NTBs) and investing in appropriate trade infrastructure. It is therefore imperative that African governments and development partners make concerted efforts to develop the soft and hard infrastructure critical to food trade.

Timely identification and elimination of all forms of non-tariff barriers

Empirically, countries tend to use NTBs for trade protectionist reasons once tariffs have been liberalized, and these emerging trends have been observed recently. Despite commitments to regional industrialization and the food security agenda, measures adopted by Member States in enacting NTBs such as bans on imports and exports of products are on the rise. AfCFTA must serve as a driving force for Africa's ability to feed itself ensuring that staples across the continent are fully exempted from duties and that their trade is not hindered by NTBs including ad hoc export/import restrictions. These restrictions should be avoided at all costs and the aspirations of free trade and regional integration maintained by strengthening the capacity of all players to fulfil their respective roles. Emphasis should be placed on empowering and building the capacity of the private sector, especially women and youth-led agri-food SMEs and cross-border traders, so that they clearly recognize and have the capacity to report NTBs, including the use of various RECs and continental platforms for reporting NTBs. Governments should set up the appropriate structures such as National Monitoring Committees and National Focal Points as stipulated in Annex 5 on NTBs (Articles 8 and 9) of the AfCFTA Agreement.

Strengthen strategic regional value chains to spur industrialisation of food products

An improved regional value chain can reduce the risk of investments, improve the flow of finance to the sector, and generate more income and resilience for smallholder farmers. Regional value chains are likely to break down barriers to market entry and facilitate participation in regional/continental trade for SMEs that would otherwise struggle with compliance issues. In many ways, regional value chains hold great potential for spurring Africa's industrialization agenda as raw and intermediate inputs can be competitively sourced at regional level by reducing tariffs across strategic value chains, removing trade barriers through coherent policies, and improving trade infrastructure to reduce the cost of doing business and trading. This process should go hand-in-hand with genuine liberalization and the removal of barriers to trade in services, which is key to youth's participation and resolving the challenges of trade finance and payment systems.

Establish an enabling, transparent and harmonised agricultural trading regime

Restrictive policies, including ad hoc export and import bans, are likely to subvert a productive and profitable agro-trade system. To ensure the full potential of AfCFTA, State Parties should implement coherent policies and strategies that allow the private sector to make long-term investment decisions to develop competitive capacities. This should be supported by broad macroeconomic, political and governance stability. Additionally, State Parties and development partners should support trade capacity building in areas such as food and trade standards, food safety and compliance, the expansion of market-oriented and demand-driven investment infrastructure with agricultural growth zones/corridors, and institutional capacities to support agri-SMEs' participation.

Drive inclusive policies to support the free trade area

Women and MSMEs constitute a significant portion of cross-border trade in Africa but are unfortunately disadvantaged to reap the full benefits of a free trade area. To ensure that these economic actors contribute to and benefit from AfCFTA, deliberate and specific policies and measures need to be adopted to reduce the costs of entry and participation to effectively integrate into AfCFTA. Measures such as STRs and the allocation of a share of public procurement to youth and women, SMEs, and others have proven to be reliable in integrating these groups into formal economies and reducing income and poverty disparities (UNCTAD, 2021). These kinds of measures would also ensure the systematic and gradual graduation of informal enterprises into formal small and medium-sized enterprises and should be extended. Knowledge of and access to trade opportunities and the procedures to access these opportunities have been identified as a major obstacle to the participation of women and small and medium-sized agri-food enterprises in particular. The provision of market-driven information would therefore be critical in facilitating linkages and strengthening small and medium-sized agri-food enterprises and women's participation in intra-African trade. Youth participation should be supported by the digital drive.

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6 Turning adversity into opportunity: How Africa's evolving demographics could be an asset to its food system

Acha Leke[1], Amandla Ooko-Ombaka[2], Karabo Mannya[3] and Omid Kassiri[4]

Key Messages

1 Africa could add nearly 200 million people to the workforce by 2030 and about 800 million people by 2050, becoming home to the world's largest and youngest population. The potential to harness this demographic dividend is exciting, but without the necessary investments, a large and unproductive workforce could place an enormous burden on Africa's food system. To feed this burgeoning workforce, the continent's food system will need to deliver more nutritious and affordable food more sustainably.

2 Taking a supply-side "labor-forward" view of this workforce opportunity, intensifying production could provide some incremental work opportunities in the agricultural sector. However, if the continent follows the trajectory of most regions that have achieved significant increases in output, Africa should expect a significant drop in the share of the labor force employed in agriculture and corresponding increases in higher-paying opportunities off-farm. For the demographic dividend to be a transformational driver of employment at scale in the sector, Africa will likely need to rethink labor-intensive models of agriculture, including large-scale gardening.

3 A demand-side "market-back" view of these demographic trends in African food systems could provide opportunities for businesses and their workforces to satisfy the demands of consumers. Consumer spending has been and will continue to be the biggest contributor to Africa's GDP growth, representing a more than USD 2.6 trillion opportunity by 2030 with food as the single largest spending category (~40 percent of the opportunity). By 2030, 130 million Africans could enter the consuming class – this is four times higher than the expected number in the US, China, and Europe combined. However, Africa is not yet prepared to harness this opportunity in a sustainable way with several trends that require urgent attention. For example, shifting diets and increasing consumer trends toward convenience are putting a lot of pressure on African countries' environments and health systems.

4 Potential actions for the supply side ("labor-forward") include investing in labor and capital to increase productivity and supporting smallholder farmers' investment in climate resilience while creating jobs for farmer-facing SMEs (e.g., insurance, digital productivity tools, etc.). It will also be crucial to strengthen the enabling environment that supports digital technology, R&D, innovative finance, training, and apprenticeship, including a focus on women and youth.

5 Potential actions for the demand side ("market-back") include focusing on opportunities to serve Africa's growing consumer class with investments further down the agricultural value chain in processing, logistics/storage, and retail while reducing food waste. This will be particularly important in second cities that have an opportunity to drive a step change in Africa's growth story. Increasing Africa's production and processing capacity for food products and improving regional trade through the implementation of AfCFTA will also play an important role in tapping into opportunities on the demand side.

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Introduction

In an aging world, Africa's young and fast-growing workforce represents a rich source of talent; by 2050, the continent is expected to be home to some 2.5 billion people (WEF, 2020) and could add about 200 million people to the workforce in 2030 and approximately 800 million people by 2050—four times India's contribution, at a time when China's workforce is expected to decline by roughly 180 million (Figure 1) (Kuyoro et al, 2023). However, these demographic shifts are a double-edged sword. They provide great opportunities if Africa can fully capitalize on this increased workforce and consumer base to feed more people with more nutritious and affordable food more sustainably. Conversely, without proactive measures, they could pose significant challenges including continued food insecurity and unemployment. Today, there are about 300 million food-insecure people in Africa (FAO, 2022) and this number could go up.

This chapter explores both supply-side ("labor-forward") and demand-side ("market-back") dynamics of the demographic shifts across Africa and their impact on the region's food systems.

What is the current state and outlook of Africa's workforce?

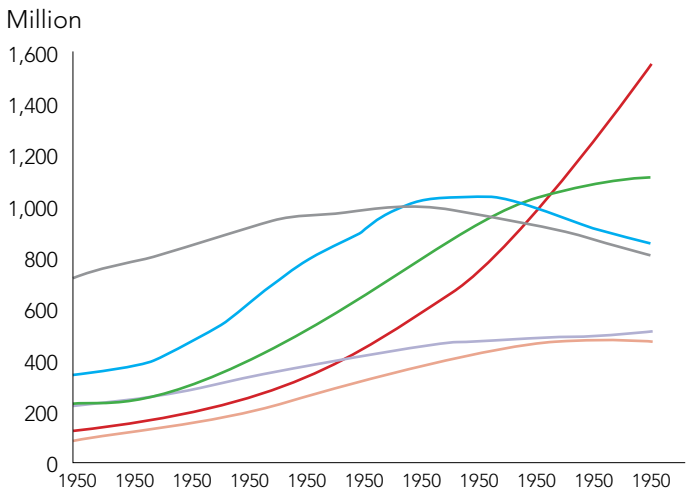
Today, Africa's workforce is approximately 800 million strong. By 2050, this number will almost double at a time when workforces in Europe and China are declining and the pace of growth in all other regions is decelerating. While the productivity and output of the agricultural sector has improved steadily over the past two decades, agricultural yields and productivity lag the standards of global peers and other sectors. At less than USD 2,000 per worker on average, Africa's agricultural gross value added (GVA) is the lowest globally. This partly explains why so many people are leaving agriculture to seek better opportunities in the services sector (Figure 6.2) (Kuyoro et al, 2023). Further, productivity across all sectors of the African economy is lower than in comparable regions of the world with the agricultural sector ranked as the lowest producing of any sector across the continent. The impact of climate change, particularly on smallholder farmers and their productivity, is significant; in the absence of countermeasures, 80 percent of smallholder farmers could face a major climate shock by 2050 that could reduce crop yields.

Supply-side ("labor-forward")

Africa's workforce could double by 2050, faster than any other region. With the right investments in labor productivity, human capital could be Africa's greatest asset and could be exported to the rest of the world. Conversely, without these investments, a large and unproductive workforce could put a significant strain on African food systems.

About two-thirds of young Africans entering the labor market lack formal secondary education; about 20 percent of those aged 15-24 years and 30 percent aged 25-34 years have no formal education. Young women are disproportionally impacted by limited

Size of the working age population (15 to 64 years old)



	2020	2050	Difference
Africa	753	1,549	**+796**
India	928	1,111	+183
China	1,035	855	-180
Europe	969	814	-156
Nothern America	480	519	+39
Latin America[1]	439	488	+49

1. Includes the carribean

Figure 6.1: Size of working age population Source: Kuyoro et al, 2023)

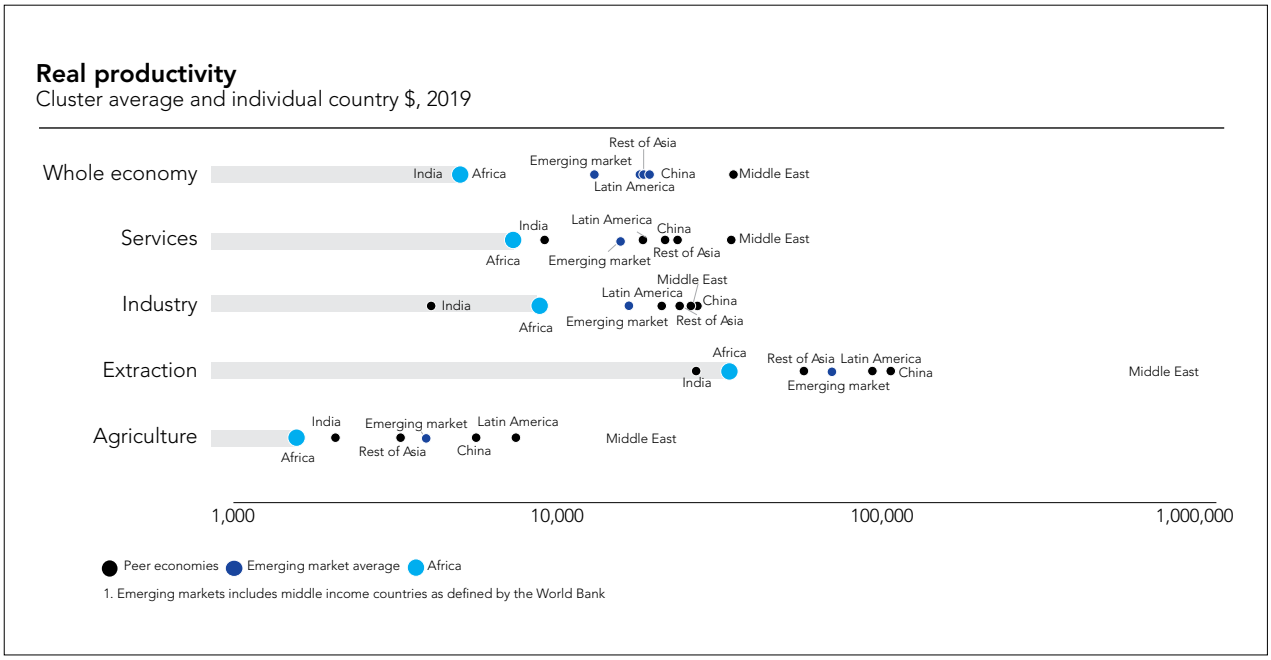


Figure 6.2: Sector real productivity across regions, 2019
Source: Kuyoro et al, 2023

education (Yeboah & Jayne, 2020a). Education and skills development remain critical in providing the emerging young workforce with access to the opportunities presented by the African food system, which include entrepreneurial activities and digital innovations.

The narrative of an aging agriculture workforce is not accurate. The average age of those employed in farming is 32-39 years, younger than commonly believed (Yeboah and Jayne, 2020b). This skews even lower for off-farm opportunities (particularly retail, which youth prefer due to lower labor and capital intensity). Off-farm opportunities in processing, packaging, transporting, marketing, distribution, and financial services also typically promote more equitable participation for women and youth. To feed this young and burgeoning workforce, Africa will need to significantly increase production. Yet the region's full agricultural potential remains untapped. Analysis indicates that with increased agricultural productivity, Africa could produce two to three times more cereals and grains than it does currently, which would add at least 20 percent more cereals and grains globally (Goedde et al, 2019).

However, if the continent follows the trajectory of most regions that have achieved significant increases in output, it should expect a significant drop in the share of the labor force employed in agriculture in search of higher-paying opportunities off-farm (FAO, 2022). Employment in the off-farm portion of the agrifood system is currently growing faster than in primary production. Over time, in a trend that is likely to persist, the primary driver of agricultural growth has shifted from big increases in the labor force to growth in real agricultural capital stock. Africa is already experiencing a shift in the labor force away from agriculture and into services (Figure 6.3).

Creating employment at scale in agriculture will likely require a different model for more labor-intensive agriculture on the continent, a provocation that while not the focus of this chapter, does merit further consideration. Home gardening has been part of tropical food production for millennia and in sub-Saharan Africa mainly focuses on staples (e.g., approximately 70 percent of maize production in Kenya is from smallholder farms). In recent history, only Asia has managed to use this model of labor-intensive agricultural production to significantly grow agricultural output by 50–75 percent within 10 years (Studwell, 2013). These yield gains in turn drove increases for consumer goods in rural areas, reducing the need to import food.

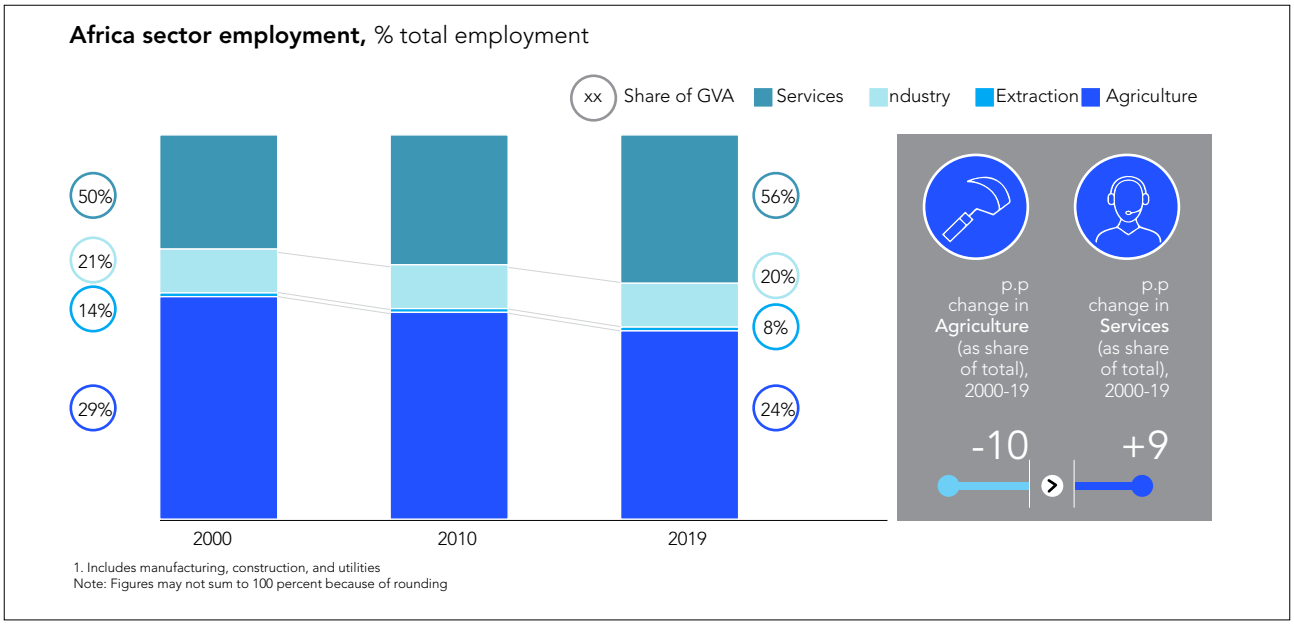


Figure 6.3: Structural shift in Africa away from agriculture into services
Source: Kuyoro et al, 2023

While the context of Asia's agricultural transformation is unique and the impact on land reforms as a driver of productivity is mixed (ASTGS 2019), today, exploring home gardens in African food systems as a pathway to significantly boosting employment in the sector is nonetheless instructive. This is particularly the case if the region can raise yields for staple products, effectively leverage water resources, ensure that access to markets can substitute for household production, including for non-staples, and allow farmers to specialize in a smaller set of foods more productively.

What are the barriers to unleashing the potential of this workforce?

Key barriers and challenges that limit agriculture productivity in Africa and disproportionately hinder young people from securing income-generating opportunities are well understood. These include: access to land, finance, services and inputs, markets, skills and expertise; potentially limiting cultural and behavioral beliefs; and the nonexistence of youth-centric agriculture policies. Although two-thirds of women are employed in agriculture and produce about 70–80 percent of food in the region, they still own less than 20 percent of the land (WEF, 2018), while less than 30 percent earn an income from agricultural work. In addition, women and youth participation continues to be limited to primary production and is less apparent in the end-to-end value chain.

Africa also faces an increase in acute weather-related events and sustained threats to productivity. More frequent and severe droughts are expected to affect agriculture and manufacturing. Today, 460 million people (36% of Africa's population), are exposed to at least one form of climate hazard such as drought, heat, water stress, or flooding. By 2050, this number is projected to nearly double to 900 million people (45% of the continent's population) in a 2°C warming scenario. Large parts of Africa could face a loss of labor productivity related to the risk of reduced effective working hours from rising heat and humidity (Bouchene et al, 2021).

This barrier is particularly acute for smallholder farmers, who generate an estimated 32 percent of GHG emissions from agriculture and are most at risk from the effects of climate change. Nearly 80 percent of smallholder farmers could be affected by at least one climate hazard by 2050. However, they remain responsible for producing a third of the world's food (Frost et, al, 2023). Adverse weather and pest-related incidents threaten to push more people, especially the most vulnerable, into poverty and destabilize local markets curbing economic growth and heightening risk for agricultural investors. African food systems need investment to improve overall productivity in the sector and create income-generating opportunities for the large workforce.

How can we turn adversity into an opportunity for Africa's young workforce?

Agriculture can play a key role in offering Africa's rising youthful population productive work and entrepreneurial opportunities (Mapanje & Mushongachiware, 2022) even if many of the opportunities will likely need to be created off-farm. A reimagined world where African talent becomes one of the continent's largest exports may be aspirational but is not impossible. Given the shifting nature of work, this talent may not need to leave the continent to fulfil this demand—even for agriculture (e.g., digital marketplaces, advisory, and supply chain management). More sophisticated approaches and digital tools are emerging (sub-Saharan Africa has developed more than 400 unique digital solutions in the past five years) to support the next productivity push even as Africa continues to ensure access to more powerful and efficient basic inputs (i.e., seeds and fertilizers), and continue with on-the-field last-mile support (such as extension services).

Agriculture remains an essential sector in Africa providing jobs and economic growth despite the recent slowdown in both areas. While R&D is critical to higher productivity growth, it remains underfunded by the public and private sectors (Pernechele et al, 2021). Over the past few years, most African countries have spent less than 5 percent of GDP on R&D. In addition to low investment in R&D, the sector is also hampered by a dearth of supportive policies that encourage relevant stakeholders to strengthen and build essential research capacity on the continent (Fugile et al 2020) (e.g., home-grown public scientists and advisors to invent solutions for Africa and more in-bound scientists resident on the continent). R&D spending alone is unlikely to be sufficient as agricultural innovations and technologies are also needed at all levels in the food system (Rubeiera, 2021). Many of these innovations on the continent are youth-led businesses that are unlocking productivity within the sector. Pula Advisors, a Kenya-based agricultural insurance and technology company, is a good example of an emerging innovation that is helping farmers protect themselves from risk and grow their incomes while Acquahmeyer, a drone service provider in Ghana, is helping farmers with monitoring and pest control.

Youth could continue to contribute to the digitization of agriculture and the creation of innovative solutions (UN Women, 2018). To achieve this, continued investment is needed to establish in the right enabling environment and capacity development (i.e., digital and business skills). Beyond investment in R&D, there are additional methods to engage women and youth in driving this innovation, such as competitions that reward participants with the means to carry out technological innovations, and the provision of funding that supports youth to build prototypes of these innovations. There is also a need for strong institutions that can provide a balanced and effective intellectual property system for innovators to enable them to monetize their innovations (Sibanda and Ogada, 2019).

Demand side ("market-back")

Consumer spending has been and will likely continue to be the biggest contributor to Africa's GDP growth, representing a more than USD 2.6 trillion opportunity, with food comprising the single largest spending category (~40 percent of the total opportunity). By 2030, 130 million Africans will likely enter the consumer class – four times higher than in the US, China, and Europe combined.

What is the current state and outlook of Africa's consumers?

Today, Africans spend approximately USD 1.6 trillion on consumption needs (Kuyoro et al, 2023). By 2030, consumers in the region could spend an additional USD 1.2 trillion (Oxford Economics, 2023)[5], 40 percent of which is focused on food (Figure 6.4), with the potential for more if the next decade of growth is fueled more by consumption spending than population growth.

Regardless of the type of growth, it is anticipated that the net increase in the working population will also mean an increase demand for food. For African food systems, this means tens of millions of new consumers will emerge in Africa every year as the population grows. Some 130 million Africans are estimated to enter the consuming class by 2030 (compared with 140 million in India, 25 million in the US, and 6 million in China, while Europe is expected to shrink by 5 million) (Kuyoro et al, 2023).

The future of consumption in Africa is linked to its vibrant cities. Although more than half (57%) of its population lived in rural areas in 2019 (where most food production happens), the continent is urbanizing faster than anywhere else globally. Since 2000, Africa's urban population has grown by 3.7 percent outpacing global population growth of 2.5 percent. Over the

5 Used database to conduct internal McKinsey & Company analysis

Growth in consumer spending by category, 2020-2030, USD, B

Growth, $ bn <$4 $4-20 >$20

	Food and beverages	Housing[1]	Transport and cards	Restaurants and hotels	Household furnishings[2]	Clothing and foot-wear	Health goods and services	Recreational goods & services	Others[3]	Total
Nigeria	91	30	14	3	7	4	3	2	9	185
Egypt	95	9	7	20	3	2	10	7	32	185
Kenya	36	4	7	3	1	1	3	1	6	60
Ethiopia	31	25	4	7	4	3	2	1	6	80
Cote D'Ivoire	21	5	5	1	4	2	1	2	5	45
South Africa	19	26	23	12	3	4	12	8	22	130
Morocco	18	13	8	2	3	2	5	2	8	60
Ghana	13	5	4	2	3	6	2	1	4	40
Rest	172	77	48	22	25	25	16	9	45	440
Total	495	195	120	70	60	60	55	30	135	1,220
CAGR, 20-30	6%	6%	7%	9%	5%	6%	5%	6%	6%	6%

Food is the single largest category of spend, with 2/3rds of the opportunities concentrated in eight countries

1. Includes accommodation and utilities – water, electricity, gas and other fuels
2. Includes household furnishings, household equipment and other housing expenditure
3. Includes Alcoholic beverages, tobacco and narcotics, Communication goods and services, Other goods and services

Figure 6.4: Growth in consumer spending by category
Source: Oxford Economics, 2023

next two decades, Africa could become mostly urban as more than 500 million people arrive in its cities and create the largest total number of urban dwellers in the world. Urbanization offers exciting opportunities for growth as consumption per capita in cities almost twice the national average (Kuyoro et al, 2023). Furthermore, the opportunity is very concentrated with eight countries[6] accounting for 80 percent of this growth.

Urbanization contributes to the transformation of food systems affecting food demand patterns and consumer preferences (Jenane et al, 2022). Increasing urban populations have also had a significant impact on rural areas due to their shift in food demand. For example, farmers may need to grow different types of food that are in high demand, improved incomes for rural populations (e.g., remittances from urban areas), and shifts in land use (where agricultural land may be converted to accommodate the continued expansions of cities. These factors present potential opportunities and challenges for rural livelihoods (de Bruin et al, 2021).

Not only is demand for food in emerging markets expected to rise dramatically because of population and income growth, but many mass-market urban consumers in these regions are likely to adopt a convenience diet comprising more calories, protein, processed and ultra-processed foods, and sugar-sweetened beverages. These diets are in stark contrast to consumption trends in rural areas. That said, there is increasing focus on health consciousness and environmentally- sustainable consumption particularly among high-income earners. This is fueling demand for healthier functional foods, such as those that offer benefits beyond basic nutrition, e.g., lowering cholesterol, and for traceable and certified foods. However, affordability is likely to remain the primary purchasing factor for the approximately 80 percent of African consumers spending less than USD 2 a day on their food needs (Kuyoro et al, 2023).

These consumer trends, including convenience and affordability, could increase demand for processed and value-added food products. However, it is essential that some of this demand is met locally if it is to provide income-generation opportunities. Today, Africa imports a significant amount of its top staple foods (i.e., wheat, palm oil, and rice), resulting in a measurable impact on local prices when global food prices for these foodstuffs rise. For example, staple food prices in sub-Saharan Africa increased by roughly 24 percent between 2020–2022 due to global factors (Okou et al, 2022). Africa's demographic trends could be an asset in developing a thriving and competitive agro-processing sector with the ability to meet these increasing demands. By 2040, consumers in East Africa and southern Africa

6 Egypt, South Africa, Morocco, Nigeria, Kenya, Ghana, Angola, and Cote d'Ivoire

are expected to reduce their unprocessed food consumption from about 30 percent to 21 percent with processed high-value-added foods including vegetable oils, dairy, ready-to-eat products, and food away from the home set to increase from an estimated 37 percent to about 50 percent (Jenane et al, 2022).

What are the barriers to unleashing the full potential of these consumers and the businesses serving them?

In the absence of expanded capacity to meet demand, Africa can expect its high food import dependencies to continue to increase for processed foods while limiting job opportunities for the growing youth workforce. Several initiatives including Africa's Agenda 2063 have tried to support and facilitate this access in agribusiness. However, women and youth remain under-represented across the value chain especially in downstream activities (AUDA-NEPAD, 2019). Constraints for women and youth include, among others, limited input provision and use and lack of capital for production, storage, logistics, and marketing.

Overall, Africa experiences several challenges which, if effectively tackled, would help address demand:

- Most African countries are net food importers (for example, Africa's agriculture trade deficit in 2018 was USD 12 billion for food products[7]) (UNCOMMTRADE, 2018) and thus susceptible to trade and other external shocks such as the COVID-19 pandemic and the war in Ukraine. In addition, rising import food prices tend to worsen the ability of some of the poorest countries to provide adequate food for their growing populations while trying to stretch their funds to cater for other important development interventions such as infrastructure (Hall et al, 2017).
- Increased demand for food, shifting diets, and increasing consumer trends toward convenience put a lot of pressure on the environment[8] and on our health systems creating a problem of malnutrition (processed and ultra-processed foods and sugar-sweetened beverages are unhealthy and contribute to obesity) (Malhotra et al, 2021).
- Food waste remains a problem. A decade ago, an estimated 120-170 kg/year of food produced was wasted along the end-to-end supply chain in sub-Saharan Africa (Cederberg et al, 2011)[9] with 30–40 percent of waste attributed to postharvest losses and processing. Although accurate and current data on waste is difficult to find especially in emerging markets, logistics, trade, and processing infrastructure are critical bottlenecks. For example, about 20-30 percent of food in Africa is lost due to limited cold chains compared to 13 percent globally.
- to two to three times higher than in other regions of the world. For example, on average, there are 11 customs delay days in Africa compared to six in India and only 25 percent of African roads are paved compared to the global average of 50 percent. In addition, trucking regulations lack harmonization; this leads to increased insurance and logistics services costs as well as revenue losses due to cost delays in transit of USD 6.2 million annually. High port charges contribute to approximately 30 percent of production costs.
- Sub-Saharan Africa's agriculture financing gap amounts to approximately USD 160–180 billion annually. Despite the sector contributing 20 percent to GDP across the continent, commercial lending for agriculture is less than 5 percent in most countries. More than 35 percent of the total gap, approximately USD 65 billion, is among SMEs with borrowing needs of between USD 25,000 and USD 1.5 million (Aceli Africa, 2020).

How can adversity be turned into an opportunity for Africa's young consumers and businesses?

Shifting diets and increased food demand (e.g., processed and convenience foods) will likely require Africa's composition of jobs to change. This can create opportunities for women and youth along the food supply chain. However, significant investment in infrastructure and initiatives is needed to reduce the gap between production (smallholder farmers), processing facilities (agro-processing, storage, and packaging) and consumers (retailers and distributors).

Firstly, there are more people to feed; import substitution presents income-generation opportunities for youth and women to continue engaging with the sector. Secondly, consumption of processed food is on the increase and will likely need more agro-processing,

7 The continent exports between $35–40 billion of agricultural products including cocoa, fruits and nuts, and tea primarily to Europe (~40 percent) and another 22 percent to North America and Asia, and imports between $45–50 billion of agricultural products (e.g., rice, maize, and wheat), and $6 billion of inputs like fertilizer. Africa had a ~$12 billion trade deficit for food products in 2018.

8 Agriculture is estimated to be responsible for 45 percent of total global methane emissions with 80 percent of agricultural methane emissions from livestock production, fermentation, and manure management) (Ahmed et al, 2020)

9 For the period of 2009-2010

storage, packaging, and providers of food away from home. Opportunities for income generation exist for intermediaries (e.g., aggregators and distributors of both fresh and processed goods) who will be responsible for delivering food to the increasing urban population. Further, youth and women can develop innovative and entrepreneurial ventures to reduce food waste. Lastly, most institutions procure a lot of food across the continent using traditional trade channels (i.e., open markets) and modern trade channels (i.e., institutional food services) that leverage food from agro-processing (Jenane et al, 2022).

Summary of action points

Youth interventions present an opportunity for mainstreaming in African food systems. With a median age of 19 years across the continent (the youngest globally), and an average age of agricultural workforce of approximately 32 years, Africa cannot continue to tokenize youth interventions. This chapter identifies five potential actions that could help turn Africa's demographic trends into an asset for the continent.

Supply-side

1. ***Invest to increase productivity (labor and capital) by separating agricultural growth strategies from social benefit programs.***

   How can African countries unleash an improvement in agricultural productivity and the farmer incomes it would deliver? Countries could separate agricultural growth strategies from social benefit programs. A government-coordinated agricultural growth strategy could focus on enabling the private sector to deliver strong economic growth and returns. By contrast, social benefit programs for those working in the sector could focus on initiatives such as direct cash transfers to smallholder farmers to achieve social objectives such as poverty reduction, rural community welfare, food security, and societal stability.

   Depending on a country's starting point, several strategies are available to transform and boost food production and productivity. Examples include shifting to higher-value production and increasing agro-processing like Rwanda has done; empowering midsize change agents by enabling farms of all sizes to mobilize through a system of traders and warehouse aggregators as in Kenya; or even developing financial solutions that use forward contracts and futures markets to help farmers hedge against volatile prices and bring stability to the market, as Egypt has done.

2. ***Support smallholder farmers to build climate resilience.***

   Smallholder farmers need the help of stakeholders such as government, development organizations and the private sector to adopt sustainable practices that will build resilience against climate change. Measures identified include animal production practices, rice-based measures[10], land-use change and intensification, and postharvest and processing loss. For example, crop production measures could include dry direct-seeding technology to increase productivity and reduce methane emissions and water reliance. Further measures could address land-use change and intensification as well as postharvest and processing losses (Frost et al, 2023).

3. ***Strengthen an enabling environment that supports digital technology, R&D, innovative finance, training, and apprenticeship for youth and women.***

   Youth innovation and entrepreneurship in African food systems must be engaged as youth will lead the workforce (UN Women, 2021). Investment opportunities abound to help micro, small and medium-size enterprises (MSMEs) in agro-processing, packing, and distribution. Tech innovators and researchers will benefit from funding. Targeted skills development and training will be crucial to youth participation.

Demand-side

4. ***Invest in Africa to be a production basin for agribusinesses and improve regional trade through the adoption and implementation of AfCFTA.***

   There is emerging interest in Africa as a production basin major agribusiness companies are increasingly integrating vertically as more traders extend into production and processing while retailers move into production and sourcing of key input commodities. There are small but rising numbers of specialized players especially on the input side. In addition, millions of smallholder farmers around the world are gradually integrating into commercial value chains. The investment

10 Agriculture is estimated to account for 45 percent of total methane emissions, 80 percent of which is from livestock production and rice production is the second largest contributor. For more information, see: Ahmed J., et al. (2020, April)., Agriculture and climate change: Reducing emissions through improved farming practices. McKinsey & Company

into agribusiness paired with equal access to employment opportunities for women and youth could lead to a strengthened workforce.

Africa's reliance on imports for seeds, fertilizers and some cereals puts pressure on its ability to reduce food insecurity. In 2021, intra-Africa trade for agriculture contributed to only 30 percent of the sources of African imports (total imports $30 billion) (UNCOMMTRADE, 2020). To increase intra-Africa trade volumes, the most critical value chains could be prioritized according to potential for import substitution, contribution to economic growth, and inclusivity of women, youth, and MSMEs, as well as feasibility. A recent analysis of AfCFTA's private sector engagement strategy suggests an opportunity to double production and trade from priority value chains including agriculture adding more than USD 5 billion annually in intra-Africa trade and creating approximately 700,000 jobs with more than half (55%) focused on youth and women (AfCFTA, 2022).

In Africa's major countries where trade volumes are highest, second cities have potential to drive economic growth and productivity and reduce overreliance on major cities (Figure 6.5). This will require getting the basics of urbanization right by identifying competitive advantages, investing to improve the enabling environment, exploring partnerships to attract investment, planning, and building green infrastructure to support food systems.

5. ***Create innovative solutions that help address and reduce food waste.***

   Youth and women can provide innovative and entrepreneurial ventures that contribute to the reduction of food waste. For example, in Burundi, farmers have developed low-cost temporary charcoal cooler storage technology options for smallholder farmers (AUDA, 2021) while Sweetunda in Kenya repurposes fruit that is no longer fresh into purées and dried fruit (Innovate UK, 2022).

Conclusion

Africa is at a critical juncture. With the expected number of young people potentially joining the workforce of 200 million people by 2030 and 800 million people by 2050, Africa could become home to the world's largest and youngest workforce 2050. In addition, consumption will continue to grow as 130 million Africans are expected to enter the consuming class by 2030. Africa's workforce will need to be able to meet the shifting and increasing food demands of these consumers necessitating significant investment in sustainable production for the continent to truly benefit from its demographic dividend.

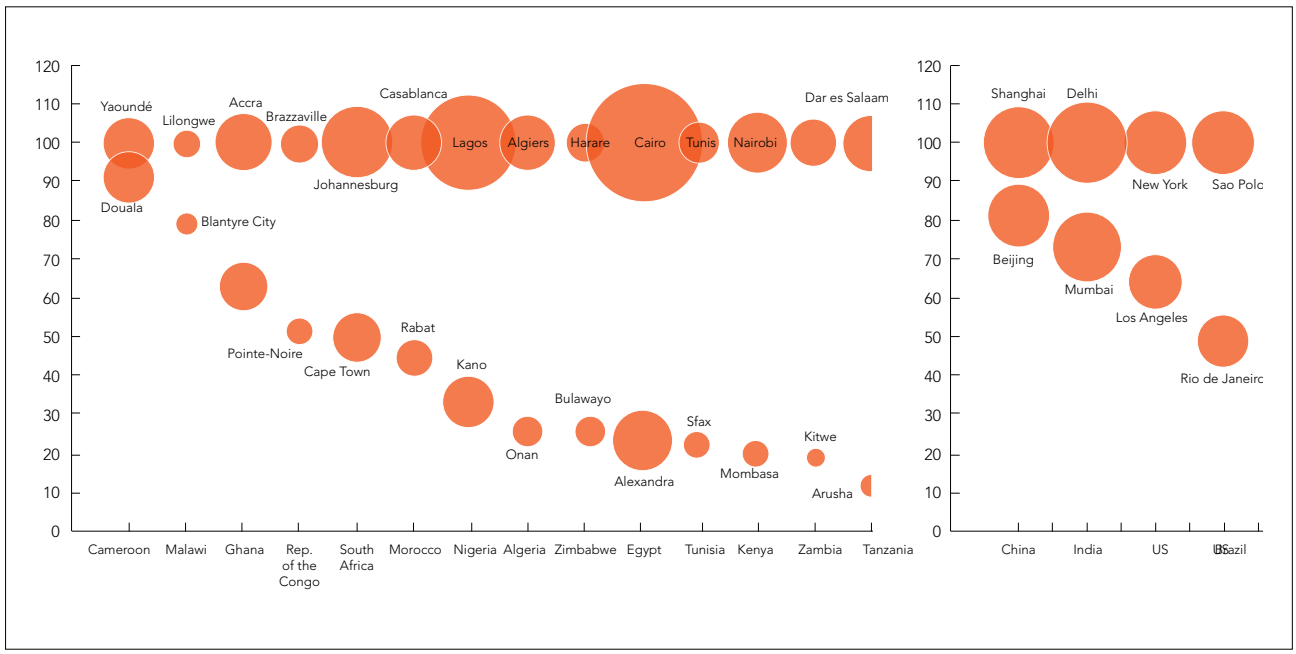


Figure 6.5: Africa's second cities can drive economic growth.
Source: Kuyoro et al, 2023

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7 Digital Revolution in Africa's Food Systems

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Key Messages

1. Digitalization in food systems can improve economic efficiency, inclusiveness, and environmental sustainability.
2. In Africa, digitalization of food systems has already yielded a wide range of benefits such as timely price, market and farm-related information, safer financial transactions, value chain linkages, improved productivity and income, lower costs, and women empowerment benefits.
3. Despite differential access to digital technologies both within and across countries, public sector, private industry, non-profit organizations, and the international community have played important and distinct roles in creating digital food systems solutions in several African countries.
4. Even with the progress achieved, scaling up is low and the involvement of the private sector is limited.
5. The digital divide, long gestation periods, high initial costs, low uptake, lack of sufficient and sustainable funding, regulatory weaknesses, research, analytical, and technical capacity constraints, and limited knowledge and awareness are all contributing to the slow pace of progress.

Introduction

In recent years, digital technology has emerged as a key intervention to address food systems challenges globally. Digital technology has wide potential ranging from reducing the costs of production by linking input sellers and buyers, improving access to information, knowledge, technological innovations, and markets to enhancing resource management at the farm level using data analytics. The digital technology spectrum is very broad ranging from farmer advisory digital videos to distributed ledger technologies and blockchain (Kim et al, 2020). It has been argued that new digital technologies can lead to a 'fourth agricultural revolution', or 'Agriculture 4.0', which encompass food systems that are high-tech, radical, and incorporate potentially game-changing technologies (Klerkx and Rose, 2020; Rose and Chilvers; 2018). However, several gaps still need to be addressed to ensure that digital technologies achieve their full potential and yield the desired objectives. Lack of adequate physical infrastructure, limited access to Information and communications technology (ICT), lack of relevant information, asymmetric benefits, absence of appropriate legislative and regulatory infrastructure, financial constraints, and data privacy issues are often highlighted as key concerns for the expansion of digitalization in food systems (Shelton et al, 2022).

Increases in food production through productivity gains have largely kept pace with the rising global population over the past several decades. Yet, food and nutrition insecurity remain a major global challenge hampering progress towards achieving the Sustainable Development Goals (SDGs) related to hunger, poverty, health, land use and climate

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change (FAO et al, 2023a). As shown by the Global Hunger Index (GHI), global progress against hunger has stagnated in recent years. In the aftermath of the COVID-19 global pandemic, the proportion of the population with insufficient access to calories has also been on the rise. The economic and social impact of the recent Ukraine crisis has further disrupted food supply chains due to trade restrictions. These shocks have combinedly caused food shortages among countries with chronic food deficits. The global effects of climate change are typified in several African countries as witnessed by rising temperature, drought, and flash floods, which are negatively impacting food systems. Under these conditions, improving the performance of food systems is imperative to achieving sustainable and inclusive food and nutrition security (Resnick et al, 2022).

In Africa, over the past several decades, extreme weather events and climate change, pest and disease outbreak, limited availability and adoption of technologies to improve yield, and exogeneous shocks have together contributed to significant food shortages and malnourishment. Nearly 20 percent of the region's population is undernourished and over 20 million people face severe food shortage due to crop failure and dry seasons. Improving food and nutrition security in Africa will require deploying all possible and available technological, institutional, and policy innovations (Brookings, 2023). Digital technology is emerging as a key technological innovation and can play a major role in improving the performance of African food systems. The questions remain - is a digital revolution in African food system possible? What does it take to scale up digital technology for the benefit of Africa's smallholder farmers? What improvements in the efficiency of food markets are possible with an African digital technology revolution? This chapter explores these issues beginning with a discussion of selected drivers of digitalization of food systems. This is followed by a conceptual framework that brings together digital services and their impact on the pathways to food system transformation. With a specific focus on the African region, this chapter then analyzes the status of digital technology interventions in African food systems and provides recommendations to address existing gaps and help develop effective and long-term digital solutions for food systems transformation.

Drivers of food systems transformation: the role of digitalization

Digitalization can be defined as the use of digital technologies and data and their interconnections resulting in new activities or changes to existing activities. Digital technologies and related products and services can transform production, management, and governance systems (OECD, 2018). The incentives for adopting digital technologies lie in finding solutions to existing or emerging challenges. The development of wireless communication and networking has led to the creation of tech mobile applications and digital platforms that provide access to valuable information. High-tech integrated management systems supported by the Internet of things (IoT), big data analytics, and artificial intelligence (AI) provide overall connectivity between smart devices and humans, transforming how products are designed, produced, and consumed (Duric', 2020; Jouanjean, 2019).

According to Birner et al (2021), digital agriculture is essentially an application of digital tools along the value chain. Digital tools can take two forms in food systems- embodied and disembodied. The embodied form is often applied in farm machinery as precision farming technologies using sensors, data analytics, and variable rate technologies. The disembodied form includes extension and advisory applications and digital platforms linking farmers with value chain actors and players. In regions such as Africa with low mechanized farming systems, digital food systems lean more towards the disembodied form.

According to Trendov et al (2019) there are five segments of digital technologies in agriculture: mobile devices and social media; precision agriculture and remote sensing technologies; big data, cloud, analytics, and cybersecurity; integration and coordination systems such as blockchain, financing, and insurance systems; and intelligent systems such as deep learning, machine learning, and artificial intelligence (Melo and Wiegel, 2023).

Digitalization can support innovations across the food value chain and increase efficiency of its system components from production to reaching consumers. Due to the rising unpredictability and variability associated with food systems, it has become difficult to rely on conventional knowledge for making forecasts and predictions. Digital technologies like data sensors can

help optimize crop yields and control pest outbreaks during crop season. These technologies can improve the growth of the food sector by aiding marketing strategies, food sales, food design, and product development. They can also support addressing environmental impacts using technologies focused on natural resource management and biodiversity (Nyström and Giacometti, 2022).

Porciello et al (2021) argue that the impact of digital technologies in food systems can be observed via different outcome categories. The first category is agriculture-led growth which leads to increases in income, productivity, employment, market efficiency, and practice change. Second, resilience-building to mitigate, adapt to, and recover from shocks and stresses in a manner that reduces chronic vulnerability and facilitates inclusive growth. Additionally, by improving environmental health and nutrition security, digital food systems can improve the health of people and the planet. Finally, digital food systems can enhance inclusivity and empowerment with knowledge and opportunities and access to resources for vulnerable groups. With regards to monitoring and evaluation for food systems, the digital revolution also incentivizes the evolution of tracking mechanisms to gather, organize, and analyze large data sets. From a government, private sector, and donor perspective, organized data can improve accountability, transparency, and traceability for value chain integration (Gardeazabal et al, 2023).

In the past decade, developing countries have witnessed a significant rise in the number of digital food systems services although several of these are still in the pilot stages, implemented on a small scale, and dependent on donor funding. The services can be categorized into digital advisory, digital financial services, e-commerce, digital procurement, and smart farming. There are approximately 400 digital agriculture solutions in sub-Saharan Africa with 33 million registered farmers (Stephenson et al, 2021). However, evidence shows that there are differences in access to digital technologies both within and across countries. Access to the internet increases with farm size and women have relatively lower access to the internet and mobile phones (Mehrabi et al, 2021). Differences can be attributed to both demand and supply side factors. Demand-side factors include literacy and numeracy skills and the need for context-specific digital solutions, relevance, usability, and cost, while supply-side factors focus on available infrastructure, cost, risk, and profitability. This indicates that the digital divide is related to factors beyond just the income dimension; it includes geography, education level, and gender (Alliance for a Green Revolution in Africa (AGRA), 2019; Aker and Cariolle, 2022). Another important aspect is that while the average age of farmers in Africa is greater than 50 years, the adoption of digital solutions tends to be higher among youth.

In the coming years, meeting the food needs of the growing global population will be a major challenge that is further exacerbated by climate change and other environmental impacts. Digital transformation of food systems can help in a wide range of goals that go beyond production to ensure the economic, environmental, and social sustainability of food systems (Hrustek, 2020). Similarly, digitalization of market information can improve disadvantaged and vulnerable groups' access to such information to better benefit from food systems transformation. Extension agents can use digital technologies to communicate with more farmers and enhance the uptake of good agricultural practices while accurate climate-related forecasts through digital platforms can improve farmers' preparedness to respond to events influenced by climate variability (Trendov et al, 2019; Digital Green, n.d.). The next section analyzes the impact pathways of digital services on food system transformation using a conceptual framework.

Conceptual framework: digital services and impact pathways for food systems transformation

Given ongoing food systems challenges, recent literature identifies several pathways through which digital services can positively impact food systems. A key assumption for using digital technologies towards food system outcomes is that they are addressing an important market failure for poor rural populations, i.e., imperfect information. It is further noted that available information will only be valuable if it is contextualized for a specific market and target population. Additionally, the type of delivery is also crucial. While simple price information can be conveyed via SMS, more nuanced concepts such as use of fertilizer or intercropping might need visual presentation and require extension support to ensure accurate understanding for farmers. Moreover, the information needs to be timely and easily accessible for most, if not all, of the target audience. Even if the information is timely, relevant, and accessible, trust can alter behavior. It is thus important to ensure that the

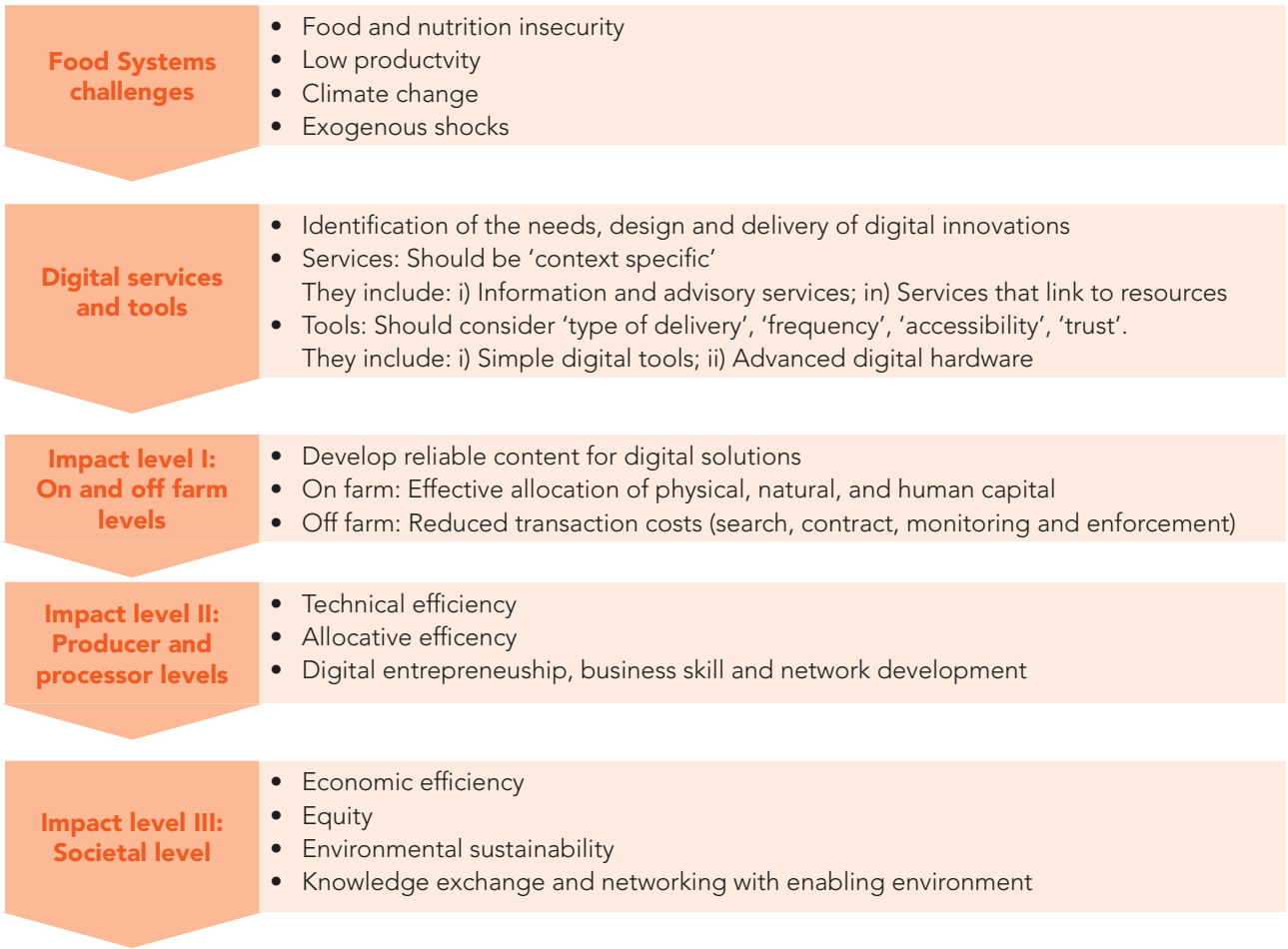

Figure 1: Digital engagement and impact pathways for food systems transformation
Source: Adapted from Abdul-Rahim et al (2023), Aker and Cariolle (2022), Addom & Baumüller (2020) and Schroeder et al (2021)

source of the information has demonstrated reliability (Aker and Cariolle, 2022). Given this backdrop, the framework presented in this section (see Figure 1) derives from Abdul-Rahim et al (2023)'s framework for farmers' engagement with digitalization in smallholder systems highlighting digital services and related tools for digitalization. A World Bank framework that shows impact pathways through which identified tools and services improve efficiency, equity, and environmental sustainability is also useful (Schroeder et al, 2021).

Two focus areas can be derived from the perspective of farmers' engagement with digitalization as highlighted by Abdul-Rahim et al (2023). The first is information and advisory services. This encompasses price information, weather advisory, and farm and agroeconomic management software. The second is services that link and connect to resources. This includes market access and mechanization linkages, digital marketplace, traceability solutions, and financial and insurance services. Digital tools and hardware are designed to provide these services. Mobile phones, radio, computers, and tablets are categorized as simple tools, while advanced digital hardware includes drones, robotics, geographic information system (GIS), field sensors, and soil/crop diagnostics.

At the on-farm level, detailed farm-level data and information on effectively using production knowledge can be obtained with these tools and services. This can enable producers and processors to employ all forms of capital more efficiently and maximize production. Off-farm, with enormous amounts of digital information having faster and wider reach, the transaction costs associated with farmers' interactions with input and output markets can be reduced with improved allocative efficiency. Such efficiency gains across the food system can improve the economic efficiency of the society. From an environmental sustainability perspective, digital tools can be used to enhance capacity to develop environmental monitoring and early warning systems. Attitudes and behaviors of food

producers and consumers can be altered through rapid diffusion of knowledge on the environmental impact of agriculture production and equity issues arising from economic, social, and spatial factors can be minimized through digital food systems. This is achieved by reducing the cost of exchanging information and improving market access, and productivity, thereby creating opportunities for vulnerable groups to get involved in value chains from which they were previously excluded (Schroeder et al, 2021).

Digitalization in African Food Systems: current status, impact stories and gaps

In 2022, the prevalence of undernutrition in Africa was 19.7 percent, a slight increase from 2021. In 2022, the prevalence of hunger also rose across Africa with hunger increasing from 22.2 percent to 22.5 percent in sub-Saharan Africa, which translates into 9 million more people experiencing hunger compared to 2021. In northern Africa, the prevalence of undernutrition rose from 6.9 percent to 7.5 percent with nearly 2 million more people facing hunger in 2022 (FAO et al, 2023b; FSIN and Global Network Against Food Crises, 2022; Oxfam International, 2023).

The nature of food systems in the region is characterized by underdeveloped markets and is driven primarily by smallholder farmers who operate on small and fragmented farms. Given this, digital agriculture has the potential to transform the food systems by improving efficient use of farm inputs and services, spatial and temporal market integration, resilience-building against shocks, value chain integration, efficient input use, and data collection and dissemination (Abay et al, 2022). For many smallholder farmers in the region, digital agriculture has already yielded a wide range of benefits such as real-time price, market, and farm-related information, safer financial transactions, value chain linkages, improved productivity and income, lower costs, and women empowerment benefits (Kudama et al, 2021).

In several countries in the region, the public sector, private industry, non-profit organizations, and the international community have played important and distinct roles to create sustainable digital food systems solutions. For instance, Rwanda has a strong policy foundation through which the Government has implemented Rwanda's National Strategy, which promotes a multi-sectoral approach led by the Ministry of Agriculture. The Strategy aims to significantly improve agricultural productivity and employment-creation capacity through digitalizing different aspects of the sector from input supplies and subsidies to advisory services. The Government has also developed a government-supported market linkage platform called E-Soko that provides timely market information to agriculture value chain actors enabling them to get a fair price for their harvest. The private sector is also a major player in the digital space; Bank of Kigali, in collaboration with Rwanda Agriculture Board, has developed a platform which digitizes supply chain management for the Government's agro-input subsidy program. International organizations such as the International Institute of Tropical Agriculture (IITA) have also piloted and expanded digital agriculture projects in collaboration with the Government and local players (Asian Development Bank (ADB) and ADB Group, 2021a). In fact, according to the recent Global Innovation Index report, Rwanda is one of the few countries which is performing above expectation on innovation relative to their level of economic development (World Intellectual Property Organization (WIPO), 2022).

In South Africa, the private sector has been at the forefront of digital agriculture transformation partnering with research institutions to scale out technologies. International companies have invested in the sector here but almost exclusively targeting large-scale commercial farmers. Precision agriculture has been an important focus area owing to its potential to dramatically reduce costs and improve resource efficiency (ADB and ADB Group, 2021b).

Côte d'Ivoire's is another example of digital agriculture being propelled by an enabling policy environment with the implementation of the 'Digital Solutions Program for e-Agriculture'. The World Bank supported 'Digital Solutions of the Project for Reducing Isolation of the Rural areas and e-agriculture', a digital agricultural platform to provide information on good farming practices to remote producers, has helped define a national strategy for digital solutions in agriculture and rural areas (ADB and ADB Group, 2021c)

Several success stories have emerged in digital agriculture in Africa. The Government of Kenya has partnered with the United Nations Development Programme (UNDP) to launch a digital literacy program for farmers. The program provides training on how to use smartphones and tablets to access agricultural information, market prices, and weather

forecasts. The program has been successful in increasing the use of digital tools by farmers and has also helped to improve their yields. The Kenyan Government introduced an open data initiative to make available economy-wide data on development, demographic, statistical and expenditure indicators in a useful digital format for researchers, private companies, information and communication technology (ICT) developers, and the public. Given the importance of the agriculture sector both from a GDP and employment perspective, the availability of data digitally has helped Kenya's agricultural technology space, incorporating disruptive agricultural technologies and making it a highly-rated digital ecosystem on the continent. Kenya also produced the continent's first wave of digital agriculture startups a decade ago (Schroeder et al, 2021; Kieti et al, 2021). DigiFarm is an important integrated mobile platform that offers farmers convenient, one-stop access to a suite of products including financial and credit services, quality farm products, and customized information on farming best practices. Developed by telecommunications giant Safaricom and the Vodafone group with support from Mercy Corps' AgriFin Accelerate program, the platform is funded by the Mastercard Foundation and hosted by Safaricom, which also provides its data hub. Nearly 60,000 digital input loans have been approved on the platform with nearly 90 percent repayment rates. Approximately, 310,000 farmers have accessed DigiFarm learning content through platform learning partners such as Arifu and iCow and more than 50,000 farmers have purchased inputs through DigiFarm's input platform (CGIAR, n.d.).

The African Development Bank (AfDB) has partnered with several stakeholders to develop a digital agriculture strategy for Africa. This strategy is designed to bring together governments, NGOs, private sector companies, and local communities to co-create solutions for digital agriculture. A study by Silvestri et al (2020) analyzed the effectiveness of complementary ICT-enabled extension services for scaling up smallholder participation by focusing on farmers' knowledge and management of legume technologies in Tanzania. The study examined several ICT technologies namely radio, SMS, and radio and SMS combined. The results show that ICT tools can increase farmer's awareness and adoption of improved legume technologies and that both awareness and adoption increase if SMS supports radio campaigns. The authors argue that the nature of ICT technology to be used should be determined by the underlying institutional environment and related constraints as well as the level of complexity of the practice or technology to be transferred, scalability, and the demographic of the target audience. The Government of Tanzania has partnered with private sector company Hello Tractor to provide tractors to farmers. This partnership has made it possible for more farmers to access tractors, which has helped them to increase productivity.

Arouna et al (2021) study the effectiveness of a mobile application which provides personalized advice on rice nutrient management in Nigeria and find that this digital extension service increased farmers' yield by 7 percent and their profit by 10 percent. The study concluded that scaling up personalized extension services could potentially improve productivity and livelihoods in the region without necessarily increasing the total amount of fertilizer used.

In Ghana, Ignitia Ghana partners with ACDI/VOCA to deliver weather forecast information to farmers via SMS. The flagship product is a 48-hour forecast message delivered daily via SMS directly to the subscriber's phone. Ignitia employs supercomputers to provide real-time weather forecasts to farmers using geospatial data collected from many locations over time. The information equips farmers to make short- and long-term production decisions (Sarku et al, 2022). A study found that Ignitia's digital tool has helped change the timing of harvest and application of chemicals indicating improved farming practices and consequently improving on-farm technical efficiency (Merci Corps, 2021).

Studies conducted in rural Niger and Ghana have found that digital agricultural extension programs can improve farmers' production and sale decisions, coordination across value chains, and farmers' negotiations with traders. Digital agricultural extension programs have also helped foster the adoption of efficient or innovative production technologies thus translating to positive impacts at both on-farm and off-farm levels. (Aker et al, 2016).

While the prospect of digitalizing African food systems promises revolutionary changes, several hurdles must be surmounted to unlock its transformative potential. Based on field interactions, the AGRA digital team highlights that stakeholders on the ground face significant challenges including digital illiteracy and related insufficient training and education, all

of which restrict the realization of the benefits of digital technologies. Unreliable connectivity hinders dependence on internet-based solutions and the upfront expenses for smartphones, tablets, drones, and other digital tools and transformative technologies can be prohibitive for smallholder farmers. The gender digital inequality is another stumbling block to digital access and diverse regulations, languages, and cultures across African countries hinder seamless scaling of digital solutions. Unclear data usage regulations raise concerns about farmers' data privacy and security. Without reliable infrastructure, digital solutions struggle to operate effectively. Inconsistent or absent basic infrastructure such as electricity, hampers the implementation of digital technologies while dependency on initial donor funding poses challenges for digital projects aiming for long-term sustainability; despite the growth of mobile money, many farmers lack access to digital financial services.

Digital agriculture transformation makes mobile phones and the internet important resources for deploying technologies and innovations. Mobile penetration and internet usage is therefore crucial to ensure effect at scale. In sub-Saharan Africa, the use of digital technologies is constrained by connectivity, content, and capability. In this sub-region, 84 percent of the population lives in areas where mobile internet services are available, yet by the end of 2021, only 22 percent used them – among the lowest usage rate in the world. In fact, despite rapid increase in the adoption of digital solutions in the region, only 13 percent of smallholders are registered for any digital service and far less are actively using such services. Since a significant proportion of Africa's population falls below the global extreme poverty line, the cost of even a basic mobile data plan may be considered high. Only about 5 percent of extremely poor households access the internet. Even though internet availability has risen in the region, constraints of the internet infrastructure and poor service quality disincentivizes even those users who are willing to pay (Begazo et al, 2023). There is still a significant heterogeneity in availability and access in and across countries. Indeed, a study by Daum et al (2022) that gathered local stakeholder groups' viewpoints on digital agriculture in Benin, Kenya, Mali, and Nigeria found that until now, digital agriculture has mainly benefitted large and wealthy farmers.

A key barrier holding back investment in digital agriculture solutions and their impact on a scale is the lack of cost-effective ways of comparing and contrasting solutions and making informed decisions on which ones will really work (Digital Agri Hub, n.d.). Additionally, farmers should be involved in digital processes to understand local conditions and develop results-oriented solutions. Doing so requires monetary and time investments. Differences in needs and requirements based on location and other relevant factors means that community-level solutions that may be highly relevant to one community may not be useful for others. For a developer, this constrains the ability to scale and gain profits by dispersing digital solutions.

The research and development (R&D) system is not fully developed in the sub-Saharan region; national agriculture research institutions face financial and human resource capacity constraints, high dependence on external funding, low youth engagement levels, and limited collaboration between research institutions and the private sector (FAO and the International Telecommunication Union (ITU), 2022).

On its part, private player involvement is marred by interrelated challenges; it lags as the ICT sector is characterized by long gestation periods, high initial costs, and low uptake. The requirements can be complex requiring site-specific databases on different crops, climates, and inputs and may have to be presented in several different local languages. Very few private entrepreneurs and investors have the financial capacity or risk-taking appetite to make such investments and innovate beyond the short term. Furthermore, it is often difficult to sell ICT services to farmers as they find the cost steep and, in comparison, the gains unsubstantial. Private sector services are thus often unsustainable in the long term and do not get enough opportunity to get anchored and scale up in the market (Bolwig et al, 2021).

The pace at which digital innovation is bringing solutions to the markets in Africa is not commensurate with changes in the rate of food systems transformation that is required to support and sustain these digital technologies (Technical Centre for Agricultural and Rural Cooperation, 2019). Instead, agricultural markets oftentimes operate in isolation, at limited scale, and high risk (Benami and Carter, 2021). As a prerequisite, precision agriculture needs sensor-equipped tractors and irrigation systems and smart phones to access weather forecasts and upload pictures. Complementary support infrastructure for services like electricity, transportation, logistics, and rural roads is also needed but is difficult to access in many cases or altogether absent (Begazo et al, 2023).

Ayamga et al (2021) highlight that in many African countries, drone regulations are either very restrictive or lacking making the process of acquiring license challenging. Their analysis of sub-Saharan Africa's current drone regulations finds that currently, there is insufficient skill and awareness among the responsible authorities to enforce regulation, and there is a need to manifest a participatory process in defining regulations. Data privacy is another concern with companies selling data collected to third parties. Relatedly, data security draws the same apprehension as data leaks can put vulnerable populations at a greater risk leading to exploitation of smallholders and individuals who lack sufficient digital literacy to understand the potential adverse outcomes. Ensuring the safety of systems thus requires both new legislation in the form of data privacy laws, and other necessities such as cutting-edge data encryption software. Stakeholder engagement on data security and protection of privacy rights at both national and regional level is currently not very strong (Shelton et al, 2022; Fox and Signé, 2022).

Recommendations for way forward and scaling up

While the digital revolution holds immense promise for African food systems, addressing these challenges is pivotal for its success. Navigating these challenges requires collaborative efforts between governments, development organizations, private sector players, and local communities. By investing in inclusive policies, infrastructure, and education, Africa can harness digitalization to revolutionize its food systems, ensuring sustainable development and enhanced livelihoods for all.

Following the foregoing analysis of digitalization of food systems in Africa, this section provides some key recommendations at the policy and governance, institutional, and capacity levels.

Policy and governance

At the policy level, creating an enabling environment for digital innovations maximizes the public benefits from digital innovations while minimizing costs. To address the challenges in scaling up, digitalization policies should first be embedded in the larger innovation framework. Although policies on ICT and the digital economy exist, these are not aligned to current food systems policies. Policy priorities and related investments should be context specific and yet broad enough to be implemented beyond individual projects. They should also be dynamic and incorporate relevant regulations to spur the benefits of efficiency and social and environmental gains while addressing privacy concerns. More countries in the region must develop dedicated policies for agricultural digitalization. Countries that already have dedicated policies in place should focus on effective implementation to enhance production, distribution, and uptake of digital technologies and services. Policies on reducing the cost of communication for example, through the internet and smart phones, will be instrumental in bridging the digital divide. Furthermore, the digital transformation should be anchored in human resource policies that address low digital skills in the population, especially among vulnerable groups, through tailored digital skills programs (Finger, 2023; Steinke et al, 2020; Abay et al, 2021; FAO and ITU, 2022).

To ensure the development of sustainable business models and participation of the private sector, policies should focus on reducing market concentration and enabling competition among digital service providers with policies for taxation, competition, and data sharing revised appropriately. Regulatory frameworks should incorporate privacy, data protection, and consumer well-being concerns and data collection should be transparent with consumer awareness on how their data is being used. Attention should also be directed to enhancing access to finance through digital applications and legal and regulatory frameworks should be developed or clarified in the context of the use of new and emerging technologies such as drones to promote the use of precision agriculture (Schroeder et al, 2021; Abate et al, 2023).

Institutional level

Digital technology such as ICT-based financial services are becoming an important part of solutions for food systems in Africa. Although mobile money has emerged as a crucial part of services that link farmers to buyers, challenges remain especially in the context of scale of operation and uptake. It is clear that market forces alone are not enough for the supply of digital solutions for African food systems, even in the face of growing demand. Digitalization requires the support of public funds. The development of complementary infrastructure on crop storage facilities, mobile networks, smart phones, Wi-Fi, computers, and cloud facilities must be spearheaded by the state with support from other stakeholders (Bolwig et al, 2021).

It would be useful to learn from the experiences of companies such as ThriveAgric, which has piloted its mobile app in a few villages in Nigeria before scaling it up to a national level. This pilot phase allowed the company to collect user feedback and improve the app using this feedback. To address digital gender inequality, AfriCrops provides an important example of designing gender-responsive digital tools, which can meet the specific needs of women farmers. For example, the tools provide information on crops that are suitable for women to grow and also provide information on how to overcome gender-specific challenges in agriculture.

In this transition phase where low digital literacy and high ICT costs may deter certain population groups from accessing relevant information, important value chain actors who do have access to digital tools can help others in their communities. Farmers' interaction with community leaders to learn more about digital tools can also improve digital literacy.

Box 1 discusses a proposed solution. However, it should be noted that the concept of 'local kiosks' acting as information hubs is not a novelty. Echoupal in India is an example of a successful network of internet kiosks run by a farmer which offers relevant information on farming practices, pricing, weather, and agricultural expert advice (FAO, 2020). In Kenya and a few other countries in Africa, Syngenta Foundation East Africa operates the farmer's hub model that identifies and empowers rural entrepreneurs (Farmers' Hub owner) to serve and link farmers in a neighborhood to value chains, key inputs, mechanization, advisory services, and gainful markets. The project has resulted in improved market access and reduced production cost, among other gains. Based on the success drivers from these two cases, this chapter proposes a kiosk model which leverages digital literacy and accessibility to related tools with key village leaders and entrepreneurs who can support small scale farmers and other vulnerable groups in the neighborhood (Syngenta Foundation for Sustainable Agriculture, 2020).

Another important aspect of institutional strengthening is multistakeholder engagement, which can improve coordination and information-sharing, drive research, and help conceptualize and deploy meaningful digital inclusion programs in excluded communities. Engagement can be through in-person consultations as well as online platforms such digital agriculture hubs at the local, national, and regional level. Targeted investments on inter-operability ecosystems must be developed to ensure that data-sharing is possible across institutions. With information available in shareable formats, stakeholders can access data on programs and initiatives that they are involved in as well as those currently being pursued by other stakeholders that they may be interested in pursuing in the digital space. Such platforms can facilitate a continuous exchange of knowledge-generation processes, context-specific practices, collective needs, and research results, which can be disseminated across food systems actors including farmers, development experts, researchers, policymakers, and the public (Gardeazabal et al, 2021).

BOX 1

Local kiosks as knowledge sharing and learning hubs

At the local level, disseminating knowledge related to digital technologies on a continuous basis can prove to be very helpful for farmers, especially those who are still experiencing the adverse effects of the digital divide. Governments can offer trainings and give payments to food systems-related service providers, farm leaders, youth entrepreneurs, and marketing agents to operate kiosks which provide up-to-date, context-specific information to farmers in local languages and act as learning hubs.

Synergies exist between kiosks and local extension systems; kiosk operators can access farmer needs and accordingly invite extension agents to interact directly with the farmers on specific topics. Extension staff can also train kiosk operators on tailored digital solutions for small-scale and vulnerable farmer groups, large-scale farm owners, and other value chain actors. Based on interactions with various actors and players approaching the kiosks, operators enhance digital literacy and can document digitalization-related success stories and challenges and share them with government officials, development partners, donors, NGOs, and the private sector for learning purposes.

Relatedly, limited collaboration between relevant stakeholders in the national food systems' research network can hamper opportunities to generate meaningful research insights and translate them into innovative solutions that address farmers' needs. It can lead to a lack of deep understanding of existing local knowledge systems, how they are constrained, and the most appropriate ways to integrate these systems with new digital innovations. Thus, investments should be encouraged in the development of analytical research capacity for agricultural initiatives including partnerships between academic programs, research institutions, and industry actors, which are tailored for improving applied research skills and creating digital food systems technologies and innovation. (Kin et al, 2020; Abay et al 2021).

Capacity level

Given the needs-based and dynamic nature of digital technologies, capacity strengthening for value chain actors, including farmers, must focus on building local-level capacity on a continuous basis. Such interventions should incorporate changing farmer needs and associated user-friendly updates to the digital tools. Depending on the scenario, training can be segmented by gender, age, and educational level to ensure inclusivity.

Taking a step back, retooling and reorienting extension and advisory staff in a timely manner is essential to achieving optimal capacity at the farm level. Flexible, data-driven, contextualized, and decentralized decision-making in agricultural advisory is key to realizing the full potential of the emerging digital innovation agenda. Local improvisation, adaptation, modification, and maintenance of digital advisory services can result in the successful adoption of digitalization in food systems. For example, as the institution providing digital services, the mobile service provider can collaborate with rural advisory services to deliver both technological innovations and high-quality content to food systems actors. Multiple streams of capacity development should be pursued for a wide scale adoption of digitalization in food systems. Furthermore, in addition to training farmers directly with digital content, extension staff, rural development professionals, farmer/producer organizations, marketing agents, associations of women groups, youth entrepreneurs, and agri-business operators should be included to receive regular updates on technical and digital innovations. Extension staff can also act as an intermediary to communicate the challenges and successes of digital transformation to the networks of service providers including private sector, government, and donors. Once the pilot projects are completed, extension institutions must be strengthened to become key digital knowledge providers for the local stakeholders for sustainability (Steinke et al, 2020; Kudama et al, 2021).

Conclusion

Digitalization has significant potential to transform African food systems and offers many new innovations that can empower the region to tap the full potential of its food systems actors efficiently and sustainably. This chapter presents a conceptual framework highlighting pathways at the on-farm and off-farm levels through which digital technology can help improve the productivity, sustainability, and inclusiveness of food systems. The chapter also analyzes the status of digital technologies in African food systems observing that although several pilot programs have been implemented in the region, there is limited evidence on actual scaling up indicating constraints from policy and governance, institutional, and capacity standpoints. Some of the issues that emerge include the digital divide, data privacy and security, lack of sufficient private sector involvement, capacity constraints, and the need for appropriate regulatory frameworks. The chapter also observes that African countries are at varying levels of digitalization. Based on the analysis of prevailing food systems related to digitalization success stories and prevailing gaps, this chapter makes several recommendations at the policy and governance, institutional, and capacity levels.

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Annex 1

The table below provides examples of agritech companies investing in digital agriculture in Africa.

Country	Company	Technology	Impact
Kenya	iCow	Mobile app	iCow provides farmers with information on weather forecasts, market prices, and agricultural advice. It has helped farmers increase their yields.
Tanzania	Hello Tractor	Mobile app	Hello Tractor connects farmers with tractor owners, making it easier for farmers to rent tractors and increase productivity.
Ghana	Farmerline	Mobile app	Farmerline offers farmers access to agricultural advice, market prices, and weather forecasts, leading to increased yields.
Nigeria	Thrive Agric	Mobile app	Thrive Agric provides farmers access to credit, insurance, and agricultural inputs, leading to increased yields.
Ethiopia	One Acre Fund	Mobile app	One Acre Fund provides farmers training and support on agricultural best practices, contributing to increased yields.
South Africa	Aerobotics	Drones	Aerobotics maps and monitors crops, helping farmers identify pests and diseases early, preventing crop losses.
Rwanda	GoodWeave	Blockchain	GoodWeave tracks the coffee supply chain, ensuring fair payment to farmers and sustainable production.
Nigeria/South Africa	Ishirika	Mobile App	Ishirika collaborates with Nigeria's NASC for digital seed certification and tracking, improving seed quality and yields.
Uganda	AfriCrops	Artificial intelligence	AfriCrops develops pest-resistant crop varieties, enhancing crop yields and reducing losses.
Africa-wide	Cellulant	Mobile Payment	Cellulant provides mobile payment solutions for farmers, enabling secure and efficient transactions.

Source: AGRA

8 Accounting for Environmental-Nutrition Trade-offs in African Food Systems

Vincent Abe-Inge[1] and Ebenezer Miezah Kwofie[1]

Key Messages

1. Africa's food supply is primarily dominated by starchy staples, with the highest supply (over 800 g/cap/day) occurring in West and Middle Africa(also known as Central or Equatorial Africa).
2. The supply of legumes, seeds, nuts, animal-source foods, and fruits and vegetables in Africa is insufficient to support the proposed dietary guidelines in the continent.
3. Southern Africa has the least supply of legumes, seeds, and nuts.
4. The type and quantity of food largely influences a region's food systems' environmental impact.
5. There is a need to tackle food and nutrition inadequacy in Africa through increased productivity of nutrient-dense and environmentally friendly foods.

Introduction

The environment-nutrition trade-off is a critical factor to consider in transforming African food production and supply systems. Food systems are significant contributors to and are severely affected by climate change. While Africa's current food system significantly contributes to biodiversity loss, land use, water use, and global warming(Crippa et al., 2021; Willett et al., 2019), the increasing rates of these environmental parameters significantly affect the role of the food system in food and nutrient supply(Cinner et al., 2022; Ortiz-Bobea et al., 2021). A major challenge for African agriculture is to meet the nutritional needs of a rapidly growing population while minimizing environmental impacts. So, the first trade-off is between achieving food and nutrition security and protecting, preserving, and restoring the natural environment(Garnett et al., 2013; Herforth & Ballard, 2016). An agricultural system focused solely on maximizing yields can negatively impact dietary diversity and quality, notably if it prioritizes staple crops at the expense of fruits, vegetables, nuts, seeds, legumes, and animal-source foods. The second trade-off is therefore between enhancing agricultural productivity (i.e., increasing yields) and improving nutritional outcomes(Herforth & Ballard, 2016). Expanding agricultural land often involves deforestation and habitat destruction leading to biodiversity loss. However, preserving natural habitats may limit the land available for agriculture. The third trade-off is thus between increasing agricultural production and preserving nature, biodiversity, and ecosystem services(Phalan et al., 2011).

Agriculture is also a significant user of freshwater resources. Balancing the water needs of agriculture with those of other sectors and ecosystems is a significant challenge partly due to the delicate balance between using sufficient water to grow adequate food without depleting freshwater resources especially in water-scarce regions(Gleick, 2014). Finally, there are also socio-economic trade-offs between pursuing environmental sustainability and achieving nutritional goals. For instance, transitioning to environmentally friendly practices may require upfront investment,

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which could be challenging for smallholder farmers. Conversely, dietary shifts towards nutritionally rich foods can sometimes have environmental implications (Agyemang et al., 2022; Hirvonen et al., 2020). For instance, a dietary shift towards animal proteins in protein-deficient regions for greater accessibility of food-based protein intake could result in higher environmental impacts.

Africa faces a unique set of challenges regarding food systems; as the population continues to grow with projections of 2.5 billion by 2050 (Food and Agriculture Organization (FAO), 2017), navigating the intricate relationship and complex trade-offs of the food system is essential. However, the availability of the appropriate indicators and frameworks to measure these trade-offs and their impact is also important. While there have been global efforts to provide guidelines on healthy and sustainable diets, these guidelines may not reflect the realities of the African context. For example, the 2019 report of the EAT-Lancet Commission on Food, Planet, Health highlights global scientific targets for healthy diets and sustainable food production. Drawing from the knowledge of health, nutrition, environmental sustainability, food systems, economics, and political governance experts, the report makes recommendations for a "planetary health diet" to optimize human health and environmental sustainability. While the EAT-Lancet recommendations provide a valuable framework for thinking about diet and sustainability at a global level, their applicability at a local level in the African context can be limited. When developing dietary guidelines and food policies, it is crucial to consider local nutritional needs, cultural preferences, economic realities, and environmental conditions.

The applicability of these recommendations to Africa - and indeed to many low- and middle-income countries - has been a topic of debate. The EAT-Lancet diet emphasizes a shift towards plant-based foods and reduced consumption of animal-source foods. However, in many African contexts, animal-source foods are an essential source of high-quality protein and micronutrients, particularly for vulnerable groups such as children and pregnant women. Some studies have raised concerns that the recommended diet may not meet the nutritional needs of these populations(Hirvonen et al., 2020). The proposed diet may further not align well with local food preferences and cultural practices in many African contexts. Food systems and dietary patterns are deeply embedded in local cultures and traditions and any dietary recommendations need to consider these factors.

The affordability of the EAT-Lancet diet in low-income contexts has also been questioned. A study found that adherence to the diet would cost USD 2.43, accounting for over 80 percent of the average daily household income per capita in low-income countries compared to only 4.4 percent in North America (Hirvonen et al., 2020).

While the EAT-Lancet diet is designed to be environmentally sustainable globally, it may not align well with local agroecological conditions and farming systems in many parts of Africa. For example, in areas with low soil fertility, livestock can play a crucial role in maintaining soil health (Van Zanten et al., 2018).

The current reality is that while often rich in diverse, locally available foods, traditional diets have also been associated with better health outcomes(FAO/WHO., 1996). Rapid urbanization, globalization, and changing lifestyles have led to dietary patterns shifting towards more processed and imported foods, which are often high in fats, sugars, and salt. These shifts have contributed to the rise of diet-related non-communicable diseases such as obesity and diabetes alongside persisting challenges of undernutrition and micronutrient deficiencies (Herforth, 2012).

Therefore, as Africa looks forward to transforming its food system, it is crucial to examine these essential elements to ensure that proposed solutions enhance agricultural productivity to meet the growing demand for food and nutritional security while remaining relevant to the context and minimizing negative environmental impacts. Achieving such environmental-nutrition co-targets requires a comprehensive understanding of the complex trade-offs involved and the development of region-specific strategies and interventions that promote sustainable agriculture, protect ecosystems, and improve nutrition outcomes. While efforts have been made to develop country-specific food-based dietary guidelines, consumers' adherence to these dietary guidelines is influenced by regional food and nutrient availability (Shiratori et al., 2023). By addressing these challenges holistically, African countries can chart a path toward resilient, inclusive, and sustainable food systems that benefit both present and future generations.

In creating a path to understanding some of these trade-offs, this chapter demonstrates the current environmental-nutrition trade-offs of regionalized African food supplies and consumption. Specifically, the chapter examines the variation in food supply,

consumption, and compliance with food-based dietary guidelines in Africa and discusses the environmental impact variation associated with African food supply. Finally, the chapter uses nutrition as an entry point to demonstrate how national nutrition adequacy maps can provide a path for setting transformation priorities. By shedding light on these trade-offs, this chapter aims to contribute to ongoing discourse on sustainable food systems and provide insights for policymakers, researchers, and practitioners working towards a healthier and more sustainable future for Africa.

African Food Supply and Consumption - the Past, Present, and Future

This section examines food supply trends and projections based on ensuring the compliance of the status quo to sustainability policies and goals. Food supply/availability influences consumption patterns (Puddephatt et al., 2020). As such, this chapter considers food supply data as proxy consumption data. Unlike supply data, data on consumption and household-level food waste and consumption behavior in Africa is scarce even though this data is necessary for estimating the actual amounts of food consumed. Overall, this chapter collected data on food supply in Africa's sub-regions from the FAOSTAT Food Balance Sheets from 1961 to 2020. Using linear regression analysis and the data collected, the chapter predicts Africa's per capita annual/daily food supplies by 2050 and 2100 answering questions on Africa's most supplied food commodities and the gap between recommended dietary and existing/projected food supply. The chapter further assesses the existing and projected food supply's compliance with global sustainable dietary recommendations.

Starchy Staples Supply

As shown in Figures 1, 2, and 3, Africa's most commonly available foods from 1961 to 2020 and by 2050 and 2100 are/will be starchy staples (cereals, grains, roots, and tubers). These include cassava, wheat, maize, rice, sorghum, potato, sweet potato, yam, and other roots such as cocoyam and taro. The supply quantities of individual starchy commodities vary widely among the different sub-regions resulting in significantly higher starchy staples in some regions. The per capita average starchy staples supply from 1961 to 2020 ranged from 566 g/day in southern Africa to 816 g/day in Middle Africa (also commonly referred to as central or Equatorial Africa). This supply was estimated to range from 608 g/day in southern Africa to 1280 g/day in western Africa by 2050 and from 644 g/day in southern Africa to 1673 g/day in western Africa by 2100, assuming the current supply rates remain unchanged. The decreasing supply of yam, sorghum, millet, and other roots in the region caused the projected starchy staple supply to decrease by 2050 in Middle Africa. A projected -3.97kg/cap/year millet supply by 2050 was observed for Middle Africa. At the same time, its cassava and cassava products will remain the highest individual starchy staple supply (263 kg/cap/year by 2050 and 344 kg/cap/year by 2100).

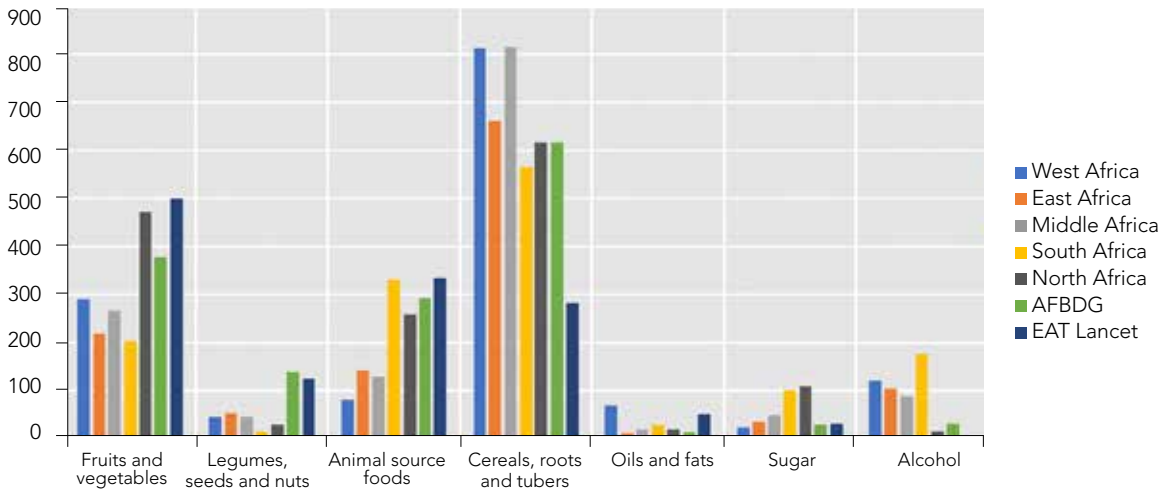

Figure 1: Average African food supply (g/cap/day) from 1961 - 2023 compared to the EAT-Lancet diet and average available African Food-Based Dietary Guidelines (AFBDGs).

Source: Authors, data from FAO Food Balance Sheets

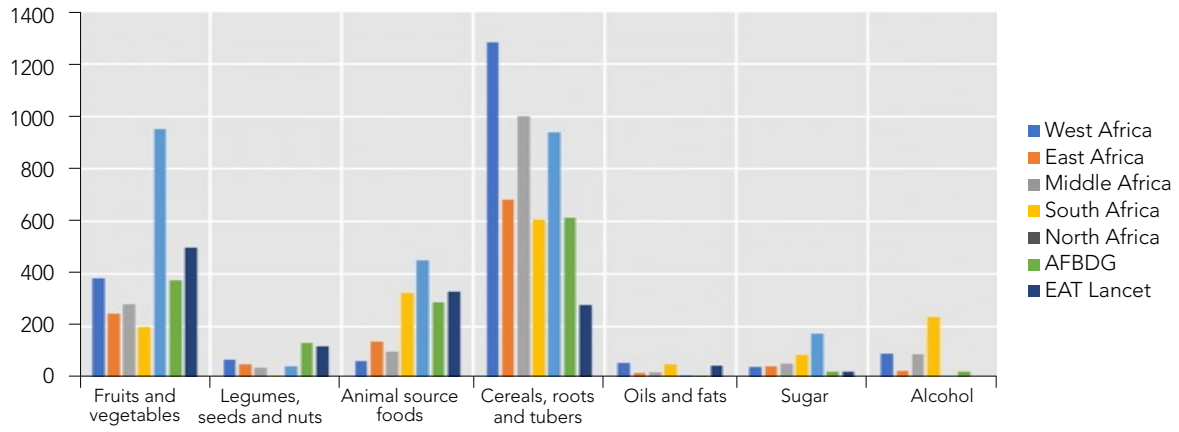

Figure 2: Projected African food supply(g/cap/day) by 2050 compared to the EAT-Lancet diet and average available African Food-Based Dietary Guidelines (AFBDGs).

Source: Authors, data from FAO Food Balance Sheets

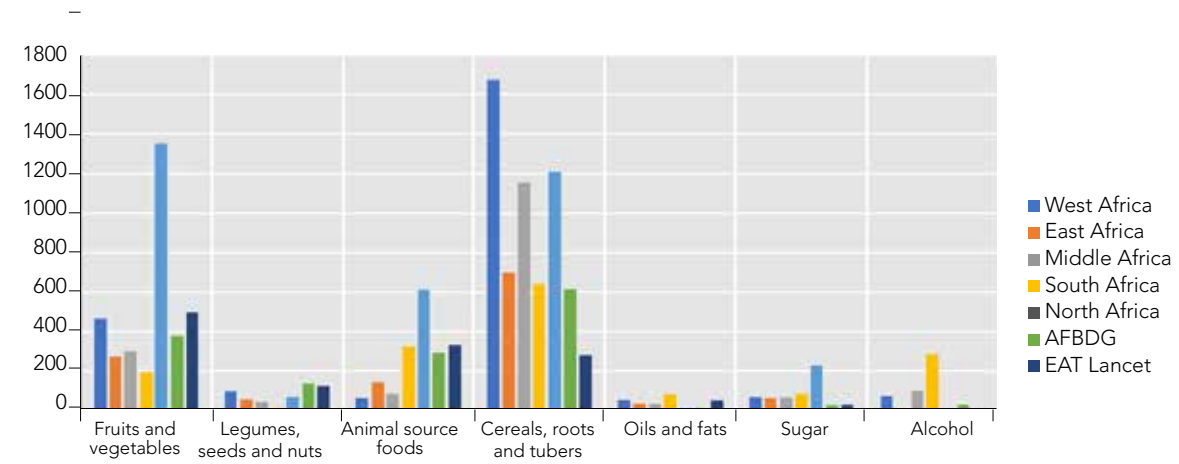

Figure 3: Projected African food supply(g/cap/day) by 2100 compared to the EAT-Lancet diet and average available African Food-Based Dietary Guidelines (AFBDGs).

Source: Authors, data from FAO Food Balance Sheets

On the other hand, the increase in total starchy staples supply in western Africa is attributable to its increasing supplies of yam, wheat, rice, maize, cassava, sweet potato, and yam. Like Middle Africa, the sorghum, millet, and other root rates were projected to decrease significantly by 2050 and 2100 in western Africa. Sorghum, millet, and other roots per capita per year were estimated to decrease from the current average supply of 30kg, 31kg, and 9kg to 22kg, 15kg, and 14kg and -1kg, 4kg, and 0.5kg respectively by 2050 and 2100. For North Africa, wheat (126 kg), maize (28 kg), rice (15 kg), sorghum (16 kg), and potato (21 kg) are the most significant contributors to the starchy staple supply per capita per year. Unlike Middle, West, and East Africa, North Africa's primary starchy staple source is wheat. The observed trend was projected to remain the same by 2050 and 2100. Southern Africa's primary starchy supply sources are maize, wheat, and potato. Although East Africa's major starchy staples are maize and cassava, the region also has the highest supply and consumption of sweet potato. This supply includes orange-fleshed sweet potato used in the region to mainly promote the consumption of Vitamin A and contribute to combating its deficiency in Africa. The starchy staples supply amounts are currently higher and will remain higher than the EAT-Lancet-recommended intake (282 g/cap/day) by 2050 and beyond, assuming unchanging supply rates (Willett et al., 2019). However, considering the average recommended intake values of starchy staples in African Food-Based Dietary Guidelines (AFBDGs), West, East, and Middle Africa have higher supplies.

In contrast, southern Africa has a lower supply, and North Africa has an equal supply. All African sub-regions except southern Africa could have more starchy staples supply than the AFBDGs values by 2050. Southern Africa could have a slightly lower supply (608 g/cap/day versus 616 g/day/day), while all sub-regions will have a higher supply than both AFBDGs and the EAT-Lancet diet by 2100. Overall, West Africa could become the most significant cereals, roots, and tubers consumer by 2050 and beyond (Figures 1, 2, and 3).

Fruits and vegetable supply

With reference to Figures 1, 2, and 3, fruits and vegetables are the second largest food source in all the African sub-regions except South Africa, where animal-source foods are the second largest. Southern Africa had the lowest fruit and vegetable supply among the African sub-regions. Its average fruit and vegetable supply from 1961 to 2020 was 74 kg/cap/year, estimated to be 73 kg/cap/year by 2050 and 72 kg/cap/year by 2100, indicating a constant supply up to 2100. In descending order, fruits, and vegetables with ample supplies in southern Africa include tomatoes, oranges, onions, bananas, apples, and pineapples. Northern Africa has the highest supply of fruits and vegetables, estimated to rise from 471g/cap/day to 951 g/cap/day by 2050 and 1354 g/cap/day by 2100. Tomatoes and oranges are the most significant contributors to North Africa's fruit and vegetable supply. Overall, the fruit and vegetable supplies of all sub-regions except South Africa are estimated to increase significantly by 2050 and beyond. Fruit and vegetable supply amounts in all African sub-regions are currently lower than the EAT-Lancet-recommended intakes. Supply levels in West, East, Middle, and southern Africa are currently lower than both AFBGDs and the EAT-Lancet-recommended intakes and may remain the same by 2050 and 2100 for Middle, East, and southern Africa. However, projections estimate that northern Africa will become the largest consumer of fruits and vegetables by 2050 with supply levels exceeding the AFBDGs and EAT-Lancet-recommended intake amounts.

Animal-source foods supply

Animal-source foods are the most significant contributor to food systems' environmental damage(Abe-Inge, 2023; Poore & Nemecek, 2018; Willett et al., 2019; Zhongxiao Sun, 2022). Compared to the animal-source food supply (924 g/cap/day) of Canada (Abe-Inge, 2023) as an example of developed nations, at 248 g/cap/day, the average animal-source food supply in Africa is lower as shown in Figure 1 and could remain lower than the EAT-Lancet recommendation (334 g/cap/day) even by 2100 (Figure 2 and Figure 3). This observation implies that Africa's animal-source food supply is generally low. Regardless, animal-source foods are the third-largest contributor to food supply of all African sub-regions except southern Africa. West Africa has relatively lower supply amounts of animal-source foods (81g/cap/day currently, 71 g/cap/day by 2050, and 63 g/cap/day by 2100), and projections indicate the trend could remain the same up to 2100.

The Middle African region has the second-lowest supply of animal-source foods (129 g/cap/day average from 1961 to 2020, 107 g/cap/day by 2050, and 88 g/cap/day by 2100). The total animal-source foods for Middle, western, and eastern Africa are significantly lower than the AFBDGs and EAT-Lancet recommendations. Meanwhile, animal-source food supply in these regions is projected to experience a decline continuously up to 2100 (Figures 1, 2, and 3). Supplies for southern Africa are only minimally lower than the EAT-Lancet but higher than the AFBDGs recommendations; a similar trend is estimated up to 2050 and 2100. Northern Africa currently has the second-highest average supply (258 g/cap/day) of animal-source foods. However, it is projected to become the highest (452 g/cap/day) in Africa by 2050 and even higher (614 g/cap/day) by 2100. This trend implies that northern African animal-source food supplies could exceed EAT-Lancet recommendations by 2050. Although dairy is the most significant contributor to animal-source foods supply in North Africa, the observed expected supply growth could also be due to the sub-region's rapidly growing rates of poultry, eggs, edible offals, and fish supplies in tandem with a steady supply rate of beef, mutton, and chevon. The low amounts of animal-source foods supplied in sub-Saharan Africa corroborate the previous findings of Chen et al. (Chen et al., 2022), which revealed that increased consumption of nutrient-dense foods, including animal-source foods, is required to combat micronutrient deficiency in Africa.

Legumes, seeds, and nuts supply

Legumes, seeds, and nuts offer valuable and sustainable alternatives as protein sources in the context of global food security and environmental sustainability (Allotey et al., 2023; Bessada et al., 2019; Goldstein & Reifen, 2022; Quintieri et al., 2023). As the

demand for protein-rich foods continues to rise with the growing population, diversifying protein sources to include legumes, seeds, and nuts is necessary and can help reduce reliance on traditional animal-based proteins while mitigating the environmental impact of food production. As illustrated in Figures 1, 2 and 3, legumes, seeds, and nuts supply in Africa is generally low. Southern Africa currently has the lowest supply followed by northern, Middle, western, and eastern Africa. While supplies in western and northern Africa are growing (expected to reach 76 g/cap/day by 2050 and 101 g/cap/day by 2100 and 51 g/cap/day and 69 g/cap/day, respectively), supplies in southern Africa are estimated to decrease to 11 g/cap/day by 2050 and 8 g/cap/day by 2100. Supply growths in eastern and Middle Africa are projected to remain constant until 2100. The low supply levels of legumes, nuts, and seeds observed in this chapter confirm previous findings of scarcity globally and point to the need for a sustainable dietary pattern shift (Chen et al., 2022).

Oils, fats, sugar, and alcohol supply

Nearly all food-based dietary guidelines often recommend that oils, fats, sugar, alcohol, and salt be consumed minimally, if not avoided altogether (FAO, 2023). This recommendation has little focus on environmental sustainability and has more to do with improving human health and increasing life expectancy. Although healthy lipids are essential to human health, consumption of excessive fats and oils is generally linked to risk of trans-fats consumption which, in turn, is linked to risk of cardiovascular disease (Meijaard et al., 2022; UNICEF, 2021). Since oils are the main contributors to the supply of lipids and mainly originate from plants, the environmental concerns of lipid consumption are minimal compared to human health concerns (Meijaard et al., 2022). Sugar intake is linked to the incidence and occurrence of obesity, diabetes, and cardiovascular disease while alcohol intake is linked to liver cirrhosis.

Except for in western Africa where supplies are higher than AFBGs (12.5 g/cap/day) and EAT-Lancet recommendations (52 g/cap/day), the supply of oils and fats in East, Middle, and northern Africa are only higher than the AFBGs recommendations but within EAT-Lancet's recommended intakes (Figures 1,2 and 3). Supplies are expected to double in southern Africa by 2050 and triple by 2100 compared to the current average supply of 28 g/cap/day. Similarly, while the supply of oils and fats in Middle and eastern Africa is projected to increase continuously up to 2100, the opposite is expected in northern and western Africa. Since excessive fats and oils consumption could lead to increased risks of unhealthy fats consumption and cardiovascular diseases (Meijaard et al., 2022; UNICEF, 2021), southern Africa could need efforts to reduce fats and oils supply to ensure healthy eating among consumers.

Sugar consumption is highest in northern Africa with the average of 109 from 1961 to 2020 expected to rise to 175g/cap/day by 2050. The sub-region's daily sugar supply per capita is 3.6 times the recommended intake (AFBDGs: 30g/cap/day; EAT-Lancet: 31 g/cap/day). This supply amount is estimated to reach 5.8 times and 7.7 times the recommended intake by 2050 and 2100 respectively. Although southern Africa has the second largest rate of sugar consumption, the rate is shrinking from a 1961 to 2020 average of 101g/cap/day to a projected consumption of 93g/cap/day by 2050 and 87g/cap/day by 2100. Like in northern Africa, sugar supplies in all other African sub-regions except southern Africa are concurrently increasing.

While experiencing a dwindling sugar supply, southern Africa's alcohol supply (176 g/capita/day), which is 5.6 times higher than the AFBG recommended intake (31 g/cap/day), is estimated to soar unabated to 236 g/capita/day by 2050 and 287 g/capita/day by 2100. Alcohol supply in Middle Africa is also estimated to increase from the current average of 88 g/cap/day to 96g/cap/day by 2050 and 103 g/cap/day by 2100. Contrarily, alcohol supplies in western, eastern, and northern Africa are falling. Overall, alcohol supplies in southern and Middle Africa are higher than legumes, seeds, and nuts supplies with beer as the largest contributor to the current and growing alcohol supply in these regions. In southern Africa, beer is predicted to account for approximately 93 percent of the alcohol supply until 2100. It is also a major contributor in all other regions where supplies are predicted to decrease. Alcoholic fermented beverages, predicted to decrease in supply by 2050 up to 2100, are the major contributors to alcohol supply in regions predicted to experience an overall supply shrinkage with time.

Summary of African Food Supply and Consumption Pattern

The African food basket is primarily dominated by starchy staples while deficient in commodities such as fruits, vegetables, legumes, nuts, and animal-sourced foods. Like all other food groups, the types and proportions of starchy staples vary across African sub-regions. From a nutrition point of view, there is little diversity in African food supply given that starchy staples are the primary food commodities across all sub-regions. Consequently, the current African food supply is inadequate for ensuring adequate and diverse nutrient intake. In addition to this undiversified food supply, there is an excess supply of unhealthy foods such as alcohol and sugar. Meanwhile, from the environmental protection point of view, the continent's current food supply pattern is deficient in plant-based proteins found as environmentally friendlier alternatives to animal proteins.

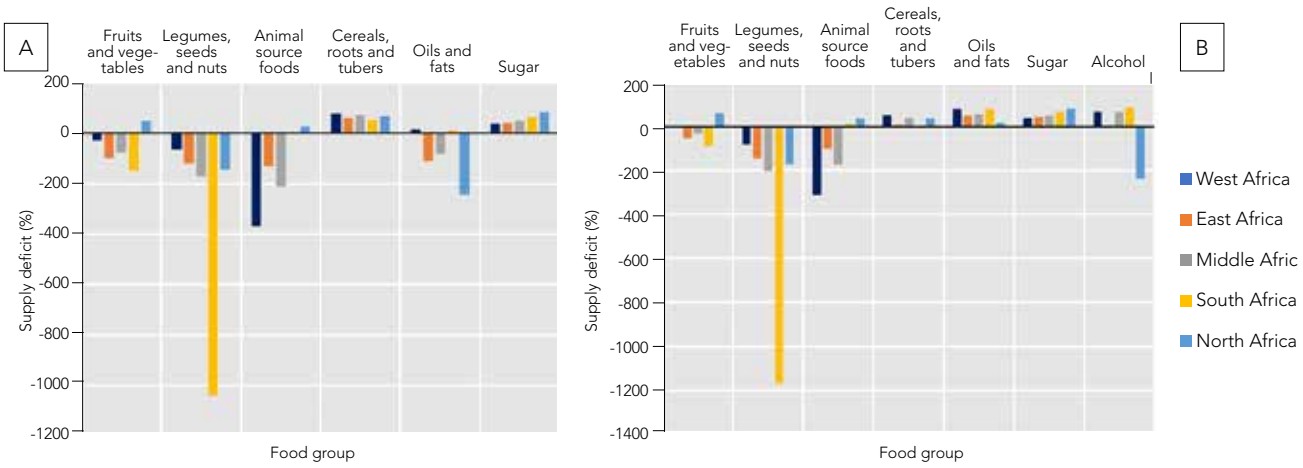

Figure 4: Average food supply deficits in Africa compared to EAT-Lancet (A) and African food-based (B) dietary recommendations from 1961 to 2020.
Source: Authors, data from FAO Food Balance Sheets.

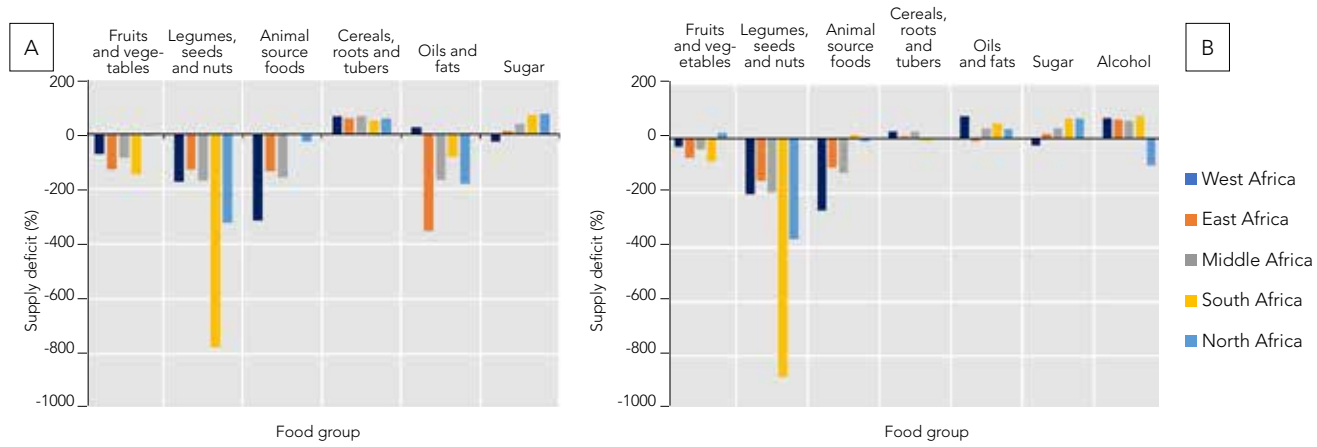

Figure 5: Projected food supply deficits in Africa compared to EAT-Lancet (A) and African food-based (B) dietary recommendations by 2050.

Source: Authors, data from FAO Food Balance Sheets

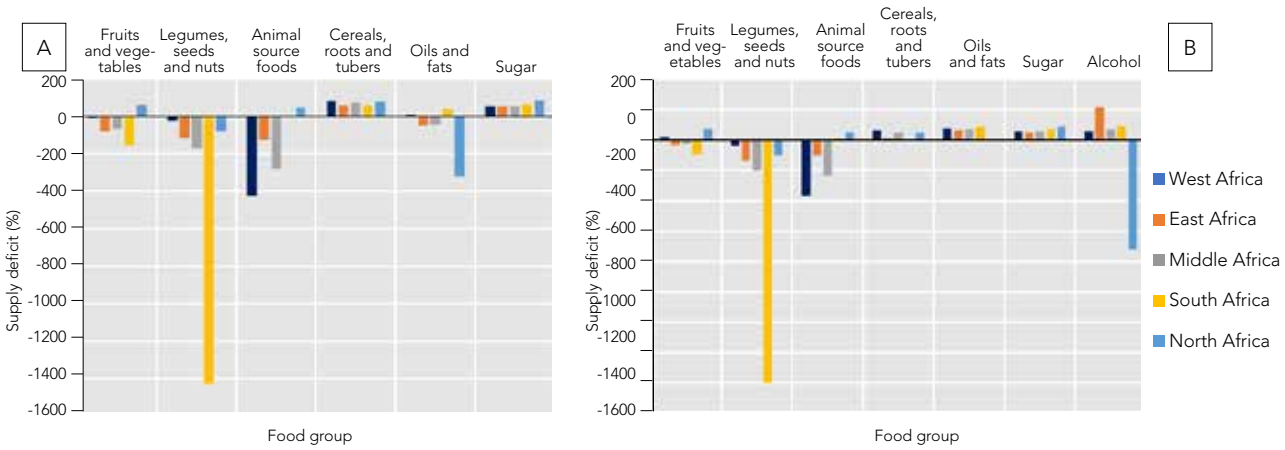

Figure 6: Projected food supply deficits in Africa compared to EAT-Lancet (A) and African food-based (B) dietary recommendations by 2100.

Source: Authors, data from FAO Food Balance Sheets.

Food Supply Deficit in Africa

Figures 4, 5, and 6 illustrate past, current, and future African food supply deficits compared to food intake recommendations in the EAT-Lancet and African food-based dietary guidelines (AFBDGs). Figure 4 demonstrates that, on average, there has been an insufficient supply of fruits, vegetables, legumes, nuts, seeds, and animal-sourced foods in Africa. Furthermore, when compared to EAT-Lancet and AFBDGs recommendations, Figure 4 shows that legumes, seeds, and nuts are the most insufficiently supplied food group followed by animal-source foods. Compared to the EAT-Lancet diet alone, fats and oils are the third most insufficient food groups in African food supply, whereas, in comparison to the AFBDGs, there is an excess supply of fats and oils making fruits and vegetables the third most insufficient commodities. Contrarily, all regions have had an excess supply of starchy staples (cereals, roots, and tubers). There has been an excess supply of sugar in all regions except West Africa. Considering the AFBDGs, the supply of alcohol in all African regions except northern Africa exceeded the recommended intake levels. These observations corroborate earlier studies by Chen et al. (2022) who reported similar inadequate food supplies in their review on dietary changes for sustainable development. Overall, current African food supply insufficiency is projected beyond 2050 as Figures 5 and 6 illustrate.

Southern Africa was found to have the highest supply deficit of legumes, seeds, and nuts. The deficit is estimated to be about 777–876 percent less than the recommended intake levels. It is projected to increase by 1042 percent by 2050 and 1170 percent by 2100 indicating the need to boost legumes, seeds, and nuts supplies in southern Africa especially if the region aims to participate in a shift to plant protein consumption. Implementing plant-based protein consumption in southern Africa as a complement or alternative to animal-source proteins would thus first require implementing strategies to increase plant-based protein production and supply in the region.

Projected supply amounts indicate that with a supply deficit of -170 percent to -201 percent, Middle Africa would be second to southern Africa in legumes, seeds, and nuts insufficiency followed by eastern Africa (-113% to -145%), northern Africa (-81% to -172%) and western Africa (-24% to – 84%). Consequently, these regions could be the focus areas in attempts to increase alternative plant protein supplies in Africa. This supply insufficiency along with inherent antinutrients, unavoidable household-level processing losses, and food waste militate against efforts to ensure adequate food and protein intake among Africans.

Animal-sourced foods are the conventional sources of protein in all food baskets. They are essential in combating protein deficiency diseases in Africa and other world regions affected by protein malnutrition. Compared to the EAT-Lancet diet recommendations and considering the average food supply from 1961 to 2020, West Africa has the most significant animal-source food supply deficit. Its animal-sourced food supply is 314 percent less than the recommended

intake. Middle and eastern Africa are second and third in animal-source food supply deficiency (158% and 136% deficit respectively) while southern and northern African supplies are lower than recommended intakes by only 0.66 percent and 29 percent respectively. The projected supplies in 2050 and 2100 indicate that West, Middle, and East Africa will retain their current positions in animal-source food supply deficits while supplies in southern and northern Africa will slightly exceed the recommended intakes. A similar supply deficit trend was observed when compared to the AFBDGs. Despite being environmentally beneficial, the insufficient animal-source food supply and an insufficient plant-based protein supply could be attributable to the prevalence of protein deficiency in Africa.

Environmental-nutrition analysis

Environmental nutrition analysis provides insights into the complex interplay between food systems, nutrition, and the environment to guide policymakers and scientists in identifying sustainable solutions that promote environmental wellbeing and human health. Understanding this interplay is thus essential in transforming African food systems. Sections 4.1 and 4.2 of this chapter discuss the nutritional adequacy and environmental impact of Africa's food supply and consumption trends considering supplies from 1961 to 2020 and projected supplies by 2050 and 2100.

Nutrition Adequacy in Africa

Establishing African Food-Based Dietary Guidelines for Assessment

Over one hundred countries have published food-based dietary guidelines globally with only 11 of these from African countries (Ghana, Gabon, South Africa, Benin, Zambia, Ethiopia, Sierra Leone, Nigeria, Seychelles, Namibia, and Kenya) (FAO, 2023). Table 2 illustrates that all the AFBDGs except two (Kenya and Gabon) have published food guides. All the AFBDGs are aimed at individuals aged five years or older except in South Africa, which has pediatric FBDGs for individuals aged 0 to 7 years (Ainuson-Quampah, 2022; FAO, 2023).

Generally, the AFBDGs aim to promote healthy eating and address diet-based non-communicable diseases. Unlike other dietary guidelines, Sierra Leone's FBDG was designed to reflect the Sierra Leonean food basket to guide diet-related programs and policies.

Table 1: Quantitative food-based dietary guidelines in Africa

Food Group	Recommended Intake (g/capita/day)			
	Ethiopia	Ghana	Zambia	Africa***
Fruits and vegetables	150	-	-	378
Fruit	-	226	300	
Vegetables	-	227	230	
Legumes, seeds, and nuts	-	198	105	139
Legumes	100	-	-	
Nuts and seeds	15	-	-	
Animal-sourced foods	-	144	-	294
Meat and eggs	60	-	-	
Fish, insects, and meat	-	-	82.5	
Dairy	350	-	245	
Cereals, roots, and tubers	-	672	560	616
Oil and fats	17.5	6	14	12.5
Salt	<5	-	<5	<5
Sugar	30	-	-	30
Alcohol++	~31	-	-	31

++ *A maximum of 2 glasses is recommended originally. The equivalence of this recommendation in grams was estimated using beer as representative alcohol.*

*** *Average of available African quantitative FBDGs.*

Table 2: African food-based dietary guidelines that recommended a reduced intake of unhealthy foods.

Country	Sugar	Alcohol	Salt	Lipids	Ultra-processed foods	Food Guide
Ghana	Y	Y	Y	Y	Y	Y
Benin	Y	Y	Y	Y	NS	Y
Zambia	Y	Y	Y	Y	Y	Y
Kenya	Y	NS	Y	Y	NS	N/A
Namibia	Y	Y	Y	Y	NS	Y
South Africa	Y	NS	Y	Y	NS	Y
Ethiopia	Y	Y	Y	Y	NS	Y
Sierra Leone	Y	NS	Y	Y	NS	Y
Nigeria	Y	NS	Y	Y	NS	Y
Seychelles	Y	Y	Y	Y	NS	Y
Gabon	Y	Y	Y	Y	NS	N/A

Y: Yes; NS: Not Stated; N: Not Available

Although all the FBDGs encouraged the consumption of healthier and environmentally-friendly foods (fruits, vegetables, legumes, seeds, insects, and nuts), none were directly targeted at responding to the needs of sustainable food consumption and food systems transformations in Africa (Ainuson-Quampah, 2022; FAO, 2023). The FBDGs have varying food groupings which range between four and nine food groups. Namibia had only four food groups, while Ethiopia had nine food groups. For instance, some dietary guidelines grouped dairy, meat, and eggs as animal-sourced foods, while others kept them as separate food groups. These variations in groupings led to different numbers of food groups in the various FBDGs.

Only three guidelines (Zambia, Ethiopia, and Ghana) specified the quantity of each food group (Table 1) and the daily intake quantities of each food group varied across the countries. For instance, Ethiopia recommended 150 g/day of fruit and vegetable consumption, while Zambia recommended 530 g/day15. Ghana recommended only 144g/day of animal-source foods, while Ethiopia recommended 350 g/day of dairy and 60 g/day of meat and eggs (Shiratori et al., 2023). Cereals, roots, and tubers constitute the food groups with the highest recommended daily intake quantities (>500 g/day) in most FBDGs. However, they are absent in Ethiopia's FBDGs critical messages leaflet even though its food guide indicates that cereals, roots, and tubers constitute the largest share of the recommended daily food intake (FAO, 2023). This was followed by fruits and vegetables, except in Ethiopia where the second-largest intake recommendation (410 g/day) was for animal-sourced foods as described in their key messages leaflet.

Animal-sourced foods are recommended in all guidelines, with Kenya, Seychelles, Sierra Leone, and South Africa recommending dairy consumption. Although Kenya recommended insect consumption as an alternative protein source, there was no direct recommendation to reduce meat consumption in any of the guidelines. The consumption of legumes, nuts, and seeds was recommended in all FBDGs but with the intention of achieving variety and not necessarily as sustainable protein sources. As shown in Table 2, all the FBDGs recommended reducing the consumption of salt and sugar. Overall, no African-based dietary guidelines are directly aimed at responding to the increasing need for resilient food systems on the continent. As a reference for this chapter, the food groups of the three quantitative AFBDGs were aggregated into eight major food groups: fruits and vegetables; legumes, seeds, and nuts; animal-sourced foods; cereals, roots, and tubers; fats and oils; salt; sugar; and alcohol. The average quantities of these food groups were estimated and used to represent the reference AFBDGs. The recommended intakes of salt, sugar, and alcohol were not averaged but used as they stated in the respective guidelines.

Evaluating nutrient adequacy

Malnutrition remains a persistent and complex challenge across Africa affecting millions of individuals and hindering socio-economic development. Despite efforts to improve food security and nutritional outcomes, a significant portion of the population

in Africa continues to suffer from undernutrition, micronutrient deficiencies, and other diet-related health issues (FAO, UNICEF, WFP and WHO, 2023). Undernutrition, encompassing both stunting (chronic malnutrition), wasting (acute malnutrition), and being underweight, remains a serious concern in Africa. It was estimated that in 2022, approximately 282 million people in Africa were undernourished (FAO, UNICEF, WFP and WHO, 2023). The prevalence of undernutrition is exceptionally high among children under the age of five, pregnant women, and lactating mothers leading to severe consequences for their health and wellbeing.

The prevailing undernutrition issue in Africa is associated with micronutrient deficiencies in the region including essential vitamins and minerals such as Vitamin A, iron, folate, zinc, and vitamins B2 and B12, which pose significant public health challenges globally, including in Africa (Chaudhary & Krishna, 2019; Chen et al., 2022). More than 30 percent of the population worldwide that suffers from vitamin and mineral deficiencies resides in Africa (WHO, 2019). These deficiencies can impair physical and cognitive development, weaken the immune system, and increase the risk of chronic diseases contributing to the cycle of poverty and limiting human potential.

Food supply and availability drive consumption and dietary patterns. As seen in Figure 1, dietary patterns in many African countries often lack diversity and rely heavily on staple crops. While staples such as cereals, grains, roots, and tubers provide essential calories, they may not offer sufficient micronutrients leading to "hidden hunger" (Food and Agriculture Organization (FAO), 2013). Low dietary diversity and limited access to nutrient-rich foods such as fruits, vegetables, and animal-source foods further exacerbate nutrition inadequacy and hinder the achievement of a balanced diet. The current and projected food supplies illustrated in Figures 1, 2, and 3 therefore indicate that East Africa, West Africa, and South Africa could suffer micronutrient deficiencies beyond 2050 due to low animal-source foods, fruits, and vegetable consumption in these regions.

Addressing nutrition inadequacy in Africa requires a multi-faceted and holistic approach encompassing agricultural development, social safety nets, healthcare interventions, education, policy initiatives, and strengthening food value chains for enhanced supplies. Sustainable agricultural practices including improved access to diverse and nutritious foods, nutrition education, and targeted interventions for vulnerable groups are among the key strategies needed to combat nutrition inadequacy and pave the way for a healthier and more prosperous future for Africa. However, addressing Africa's nutrition inadequacy could eventually increase environmental damage to the region's food systems and hence needs to be addressed with caution.

Climate change/environmental impact

Assessment criteria for environmental impact

This chapter evaluates the environmental impact of the estimated total regional and sub-regional food production/supply and considers the four leading environmental indicators—global warming/GHGEs, land use, water use, and eutrophication potential in environmental impact assessment. The estimation is based on supplied food and other commodities (44 commodities) with data on the impact per kilogram of each selected commodity collected from the Our World in Data website and peer-reviewed publications on the Life Cycle Assessment (LCA) of food crop production(Crippa, 2021; Poore & Nemecek, 2018). This chapter uses this data to estimate the environmental impact associated with the mass per capita per day of the various commodities.

Evaluation

Figures 7 and 8 show the total impacts associated with the per capita daily food supply. The environmental impacts of the per capita daily African food supply vary significantly across the sub-regions. This variation is due to differences in the types and quantities of food supplied in each region. Despite evidence that animal-source foods are the highest contributors to environmental harm caused by food systems, there was little correlation between animal-source foods supply in Africa and GHGEs ($R2 = 0.3$) and land use ($R2 = 0.06$) associated with the daily per capita consumption. However, there was a moderate correlation ($R2 = 0.6$) with water scarcity and a higher correlation ($R2 = 0.7$) with eutrophication potential. The variation in the correlation between food supply and environmental impacts could be due to the different environmental impacts of different foods. The composition of animal-sourced foods varies across the sub-regions. Therefore, depending on the composition, a region could have more animal-sourced foods yet cause lower environmental harm than another region with a lower supply of these foods.

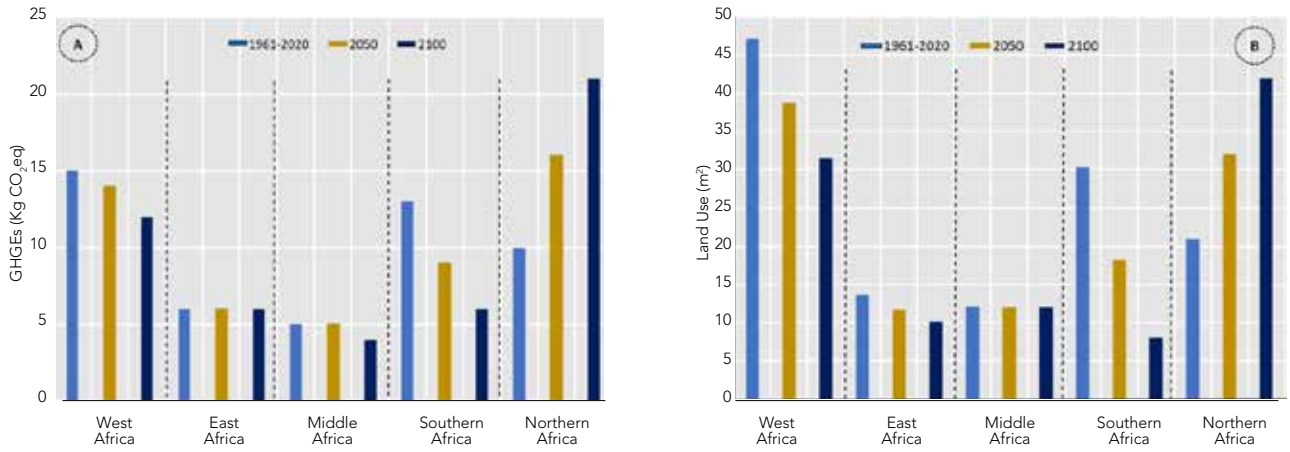

Figure 7: (A) Greenhouse gas emissions(GHGEs) (kg CO2eq) and (B) Land use(m2) associated with the current and future per capita daily food supply in Africa as estimated using 44 foods (the most supplied and others) from FAO Food Balance Sheets.

Source: Authors, data from FAO Food Balance Sheets.

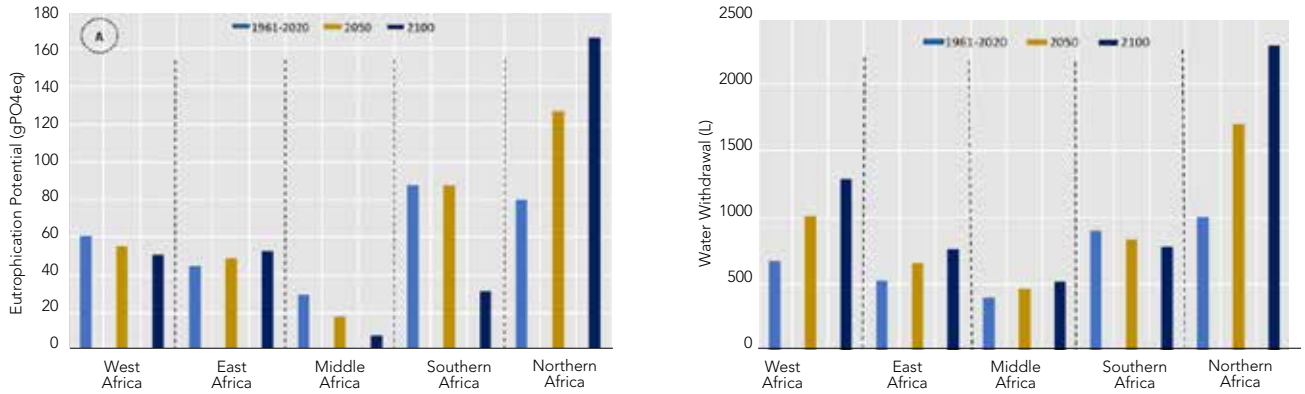

Figure 8: (A) Eutrophication potential (gPO4eq) and (B) water withdrawals (liters) associated with the current and future per capita daily food supply in Africa as estimated using 44 foods (the most supplied and others) from FAO Food Balance Sheets.

Source: Authors, data from FAO Food Balance Sheets.

There was very little correlation between the supply of cereals, roots, and tubers and GHGEs, land use, eutrophication, and water scarcity due to Africa's food supply. Thus, regions with higher supplies did not necessarily have higher environmental impacts than regions with lower supplies. Although the supply of cereals, roots, and tubers accounts for an enormous share (43 to 63%) of Africa's food basket, it only contributed 5 to 18 percent, 2 to 10 percent, 3 to 6 percent, and 25 to 35 percent to the GHGEs, land use, eutrophication potential, and water scarcity respectively from 1961 to 2020. As the share of starchy staples in the African food basket increases, their contribution to the estimated share of environmental impact also increases. Therefore, in regions like Middle Africa where the share of starchy staples is highest (approximately 63% estimated based on 1961 to 2020 figures), their share of the environmental impact is the highest except for water scarcity, which is highest in Western Africa.

As an exception, the starchy staple supply share in southern Africa (as predicted) declined from 44 percent in 2050 to 39 percent in 2100 yet its contribution to environmental impacts increased regardless. This observation further buttresses that the quantity and type of food commodities account for a food system's environmental impact. As such, variation in the environmental impacts of southern and Middle Africa's starchy staple supply could be attributed to variation in the regions' starchy staple supply compositions and quantities. Cassava, maize, sorghum, yam, wheat, sweet potato, millet, and rice

(in descending order of their supply quantities) are components of the starchy staples in Middle Africa. On the other hand, maize, wheat, potato, rice, sorghum, sweet potato, and millet (in descending order of their supply quantities) are significant components in southern Africa's starchy staples supply. Cassava and yam are absent in southern Africa's roots and tubers supply whereas, in Middle Africa, they are the first and fourth most significant contributors. Adding to the compositional supply variations, Middle Africa's starchy staple supply (g/capita/day) is nearly twice that of southern Africa's as shown in Figures 1, 2, and 3.

The dynamics discussed above could account for the trend of environmental impacts for Africa's sub-regions presented in Figures 7 and 8. North Africa will still have the highest total per capita daily food supply (1518 to 3495 g/capita/day) by 2050 and 2100 and will also have the largest dairy and red meat supply in Africa by 2050 and 2100. Consequently, the sub-region is predicted to account for the largest share of GHGEs, eutrophication potential, and water scarcity caused by Africa's food supply in 2050 and 2100 and land use by 2100. West Africa accounted for the most extensive land use from 1961 to 2020 and is expected to remain the same until 2050. The extensive land use could be due to the sub-region's large proportions of cereals, roots, and tubers, which increase land use (Abe-Inge, 2023). Middle Africa, which has the smallest per capita daily food supply, accounts for a minor portion of African food systems' environmental impact for all indicators and is projected to remain the same beyond 2050.

Comparative environmental-nutrition trade-off

Figure 9 presents the trade-off regarding damage to land use and GHGEs against the relative proportion of projected food supply. It shows that regions such as North Africa will produce approximately 75

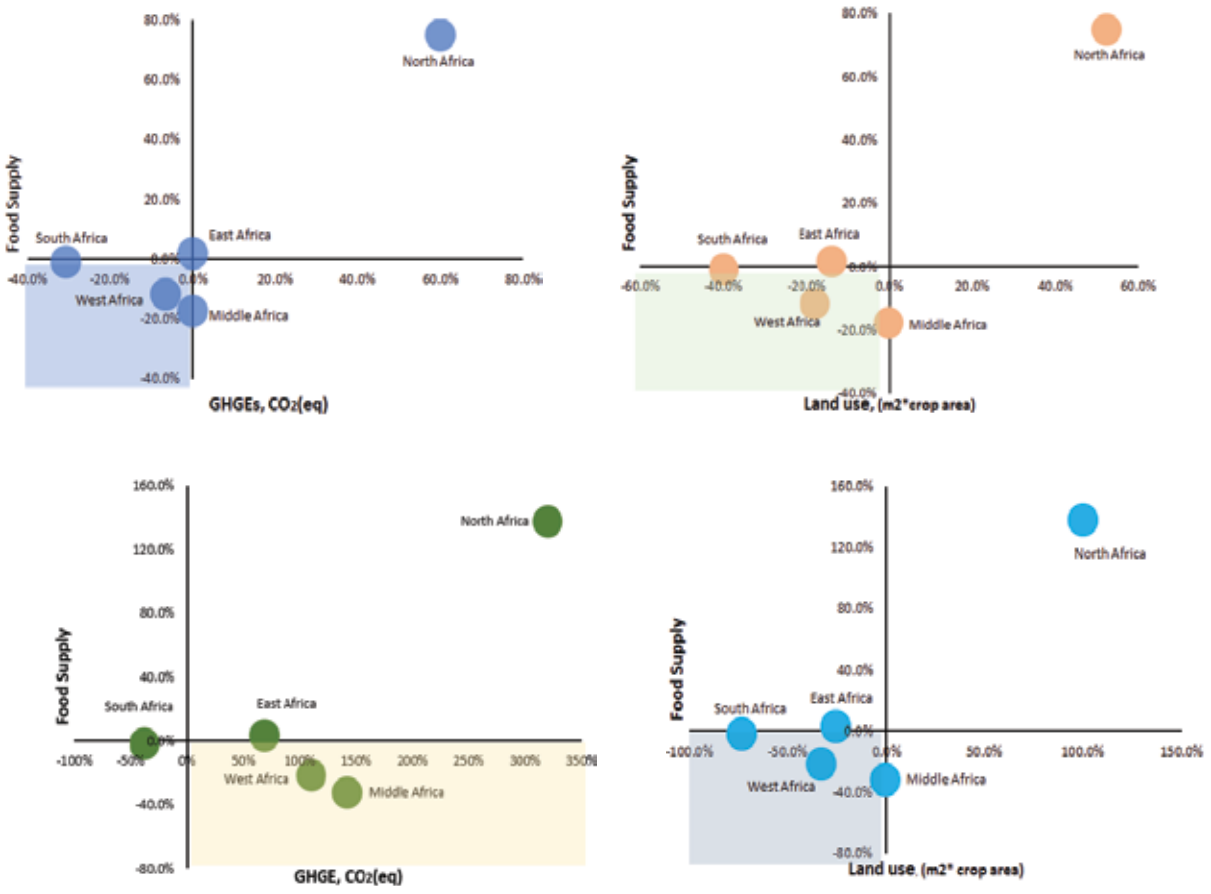

Figure 9: Environmental nutrition trade-off of food supply against (a) GHGEs, 2050, (b) GHGEs 2100, (c) land use, 2050, and (d) land use, 2100

percent and 138 percent more animal-sourced foods by 2050 and 2100 respectively compared to the present average. However, this is associated with a corresponding 60 percent and 320 percent increase respectively in GHGEs in the set timeframes. Additionally, this is associated with a 52 percent and 100 percent increase in land use in 2050 and 2100 respectively. In Figures 9(c) and 9(d), it is observed that sub-regions such as West, East, South, and Middle Africa have lower projected animal-source food supply with lower land use. However, conflicting observations are made for the estimated GHGEs in the West, Middle, and East African sub-regions in 2050 and 2100.

In 2050, it is observed that there are no significant changes in GHGEs but by 2100, these sub-regions will have projected GHGEs of between 69 percent and 142 percent up from the baseline year. This observed increase can be attributed to the projected increase in the supply of other commodities such as cereals, legumes, and fruits and vegetables. Questions about the potential benefits of addressing malnutrition through food supply must be considered alongside the unintended hidden detrimental effects on the environment.

Setting priorities for food systems transformation: the case of Senegal

Food systems transformations are required for food and nutrition security as well as a protected environment. Simultaneously achieving these goals requires a complex process to ensure minimal trade-offs from implemented transformation strategies. In this section, we use the Vitamin A nutrition map of Senegal as a case study to demonstrate how an environmental nutrition trade-off scenario could be applied to ascertain potential food system transformation pathways that maximize nutritional quality but minimize environmental impacts.

Figure 10 shows the prevalence of Vitamin A deficiency in Senegal with an estimated deficiency of more than 80 percent of the region. This data contributes further evidence to previous reports that Vitamin A deficiency is a significant public health concern in more than half of Africa (World Health Organization, No Date). Vitamin A deficiency is a form of malnutrition resulting from insufficient Vitamin A intake, an essential nutrient for various bodily functions essential for vision, immune system function, and growth and development especially in children. There are two

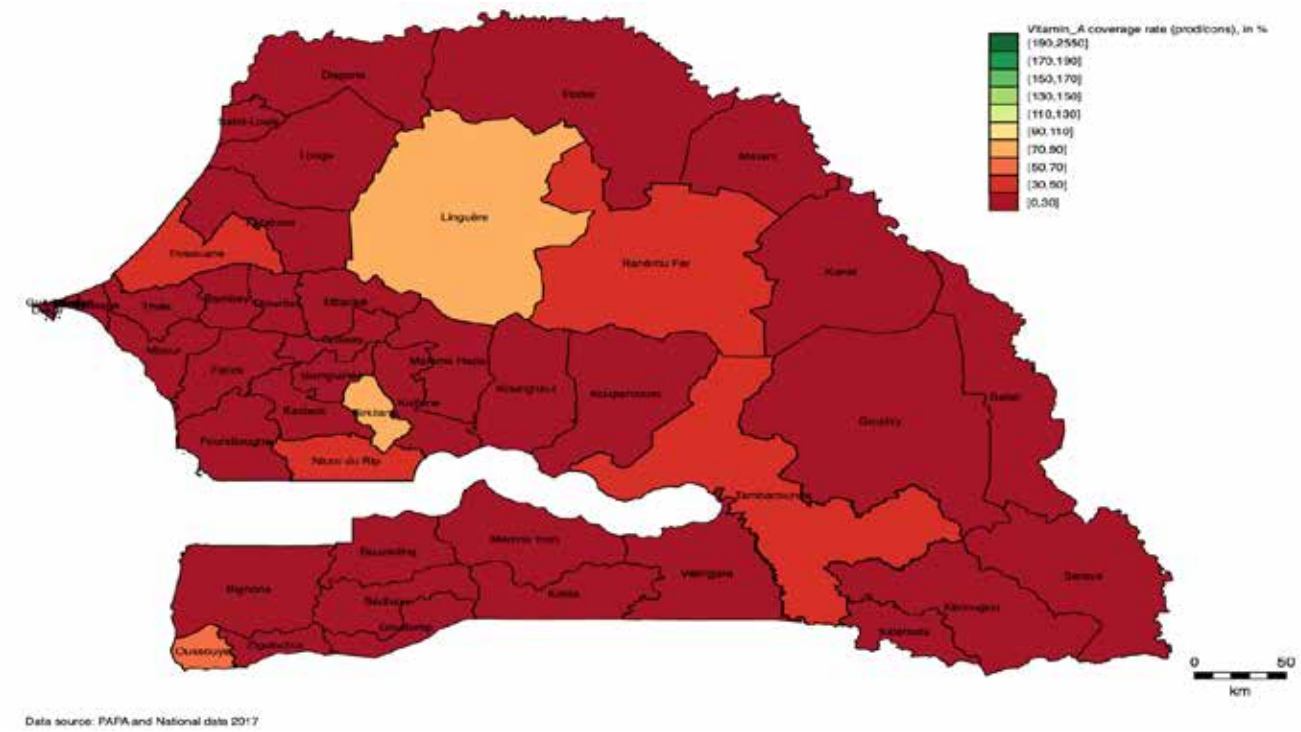

Figure 10: Vitamin A deficiency in Senegal (adapted from Wim et al. 46). The red color indicates the highest deficiency.

primary forms of Vitamin A: preformed Vitamin A (retinoids), which are readily bioavailable and found in animal products, and provitamin A carotenoids found in plant-based foods (Carazo et al., 2021). Thus, whole milk and whole milk products, fish, liver, eggs, fruits, and vegetables are the essential food-based sources of Vitamin A. Whole milk, whole milk products, meat (liver especially), and meat products are the most significant contributors of preformed vitamin A followed by eggs, egg products, fish, and fish products.

Starchy staples such as rice, maize, roots, and tubers have also emerged as plant-based sources of Vitamin A due to recent biofortification programs targeting them as the most consumed foods in Africa, especially in the Vitamin A deficient zones. However, cereals, roots, and tubers undergo extensive household processing involving heat and exposure to the atmosphere, in most cases leading to losses of the heat-sensitive provitamin A components (Eyinla et al., 2019). This situation implies that tackling the Vitamin A deficiency in Senegal through its currently most consumed staples (cereals, roots, and tubers, as shown in Table 3) may subsequently lead to inadequate solutions.

Therefore, adequately addressing food, nutrient, and environmental security in Senegal and Africa as a whole, calls for priorities to boost animal-sourced food supply to meet the required daily intakes proposed in sustainable food-based dietary guidelines (EAT-Lancet diet and AFBDGs as presented in Table 1). Secondly, despite the potential associated political complexity, the supply of cereals, roots, and tubers could be regulated to minimize the potential increased consumption of refined cereals and starchy foods, which are unsustainable considering their association with increased risks of obesity, diabetes, and cardiovascular diseases (Fadnes et al., 2022a, 2022b; Lal et al., 2021). Cereals, roots, and tubers processed at the household level could require higher water use than minimally processed foods such as fruits and vegetables. Most fruits and vegetables are only minimally processed before consumption, hence retaining higher quantities of their nutrients. Although current supplies show lower fruit and vegetable supply rates compared to starchy staples, fruit and vegetables present an opportunity for increased nutrient intake considering starchy staples undergo excessive processing prior to ingestion leading to large losses of their nutrient contents (Aragón et al., 2018; Eyinla et al., 2019; Gallego-Castillo et al., 2021; Kwofie et al., 2019; Taleon et al., 2019; Taleon et al., 2021). As such, biofortifying fruits and vegetables with provitamin A could be an environmentally sustainable and healthier approach to solving vitamin A deficiency in Senegal (Fig. 10), and subsequently in Africa, through more effective dietary approaches. This strategy could augment the nutrient losses incurred in existing biofortified and non-biofortified starchy staples during household processing as revealed in previous studies (Aragón et al., 2018; Eyinla et al., 2019; Gallego-Castillo et al., 2021; Kwofie et al., 2019; Taleon et al., 2019; Taleon et al., 2021). It will also encourage a shift from the starchy staple-heavy food supply to a diverse food supply. Biofortification could also be carried out on starchy staples such as sweet potato and other food crops that often can be consumed after minimal processing or after single-step processing methods such as boiling, which has been reported to retain at least 60 percent of nutrients (Alamu et al., 2015; Wu et al., 2008). This approach could increase the intake of other micronutrients, augment the nutritional losses incurred due to processing of readily-accessible and affordable starchy staples and create an opportunity to benefit from the lower environmental harm associated

Table 3: The per capita supply (g/day) of foods commonly listed in food-based dietary guidelines in Senegal

Period	Fruits and vegetables	Legumes, seeds, and nuts	Animal-source foods	Cereals, roots, and tubers	Oils and fats	Sugar	Alcohol
AfPC	169	36	193	556	32	45	11
2050	426	29	144	551	61	41	1
2100	642	23	103	548	86	38	-7
AFBDGs	378	139	294	616	13	30	31
EAT Lancet	500	125	334	282	52	31	0

AfPC = Average supply from 1961 – 2020; AFBDGs = Averaged African Food-based dietary guidelines

with the consumption of fruits and vegetables (Poore & Nemecek, 2018; Willett et al., 2019). African-based policies addressing micronutrient deficiencies while protecting the environment could therefore consider transformation guidelines in line with this approach in addition to increasing the supply of nutrient-dense foods such as animal-sourced foods and sustainable diets such as legumes, seeds, and nuts.

Conclusion

The findings of this chapter indicate that starchy staple foods dominate the food supply of all African sub-regions. On the other hand, the supply of fruits, vegetables, legumes, seeds, and nuts is generally insufficient to support existing and emerging dietary guidelines in Africa and proposed global sustainable diets. Also, the availability of nutrient-dense animal-source foods, which are often associated with cardiovascular diseases, cancer, and high environmental harm and are consequently discouraged in proposed sustainable and healthy diets, is significantly below the maximum recommended intake in the diet EAT-Lancet and AFBDGs in western, Middle, and eastern Africa. These supplies are estimated to shrink further in western and Middle Africa, remain approximately constant in eastern and southern Africa and increase in northern Africa. Despite varying supplies between sub-regions, the average animal-source food supply in grams per capita per day in Africa is lower than the recommended intakes in public health and sustainability-oriented food-based dietary guidelines (Willett et al., 2019). Therefore, considering the nutrient-dense nature of animal-source foods and prevailing malnutrition in Africa, a nutritionally adequate and environmentally friendly food systems transformation in Africa requires careful consideration of increasing animal-source food supplies.

Furthermore, the food types and quantities assessed determined the environmental impact contributions of each sub-region's food system. Overall, northern Africa, which had the highest food supply per capita per day, had the highest environmental impact per capita per day, consequently contributing enormously to the environmental impact associated with Africa's food supply. With the smallest per capita daily food supply, Middle Africa contributed the least. Adopting the EAT-Lancet diet in its current form in Africa as a sustainable food consumption guideline could be challenging due to the associated increased cost and the existing wide gap between food availability and recommended intakes. Also, its full adoption has been revealed to cause insufficient intakes of protein, folate, selenium, zinc and iron (Young, 2022); hence its adoption could increase food costs and aggravate Africa's prevailing puzzling undernutrition problem. African food policymakers should therefore consider developing sustainable dietary guidelines incorporating micronutrients into environmentally friendlier food crops that do not require extensive household-level processing before consumption. Sustainable food production guidelines are also required for increased food productivity in regions such as Middle Africa and East Africa, which generally have lower food supplies, and for increased production of deficient sustainable commodities on the continent (as pointed out in Figures 4, 5 and 6).

Besides the primary conclusions drawn from this chapter, the following additional strategies can be considered in increasing food supply and ensuring adequate nutrition and environmental sustainability in Africa:

- Promote climate-smart agriculture: climate-smart agriculture is an approach that aims to increase agricultural productivity, adapt, and build resilience to climate change, and reduce GHGEs. This can include agroforestry, conservation agriculture, and improved water management (Lipper et al., 2014).
- Diversify agricultural production: diversification of agricultural production can enhance dietary diversity, which is essential for nutrition, while also increasing resilience to environmental shocks and stresses. This can include promoting a variety of crops and integrating crops, livestock, and fisheries (Remans et al., 2011).
- Improve access to markets: access to markets can enable farmers to sell a greater diversity of products, improve their income, and access a wider variety of nutritious foods. This can be facilitated through improvements in transport infrastructure, information systems, and value chain development(Food and Agriculture Organization (FAO), 2017).
- Enhance nutrient efficiency: improving the efficiency of nutrient use in agriculture can help to reduce environmental impacts while maintaining

or improving crop yields. This can include strategies such as precision agriculture, integrated soil fertility management, and organic farming (Zhang et al., 2013).

- Strengthen institutional capacity and policy frameworks: effective governance and policy frameworks balance environmental and nutritional objectives can include support for agricultural research and development, extension services, and policy measures to promote sustainable and nutritious food production and consumption.
- Increase investment in infrastructure: developing infrastructure such as irrigation systems, roads, and electricity can enable more sustainable and productive agricultural systems, improve access to markets, and facilitate the storage and processing of food thereby reducing post-harvest losses and enhancing the availability of nutritious foods.
- Promote sustainable diets: education and awareness-raising about the environmental impact of food choices can help promote healthy and environmentally sustainable diets. This can be facilitated through nutrition education, food labeling, and public awareness campaigns (FAO and Biodiversity, 2012).

Although this chapter highlights the salient trade-offs to consider in transforming African food systems, country-specific analyses are required to further understand the details of the sub-regionalized analysis articulated here. This would also be important to identify specific countries for urgent focus in transforming African systems. In addition, since this chapter focused mainly on food supply, further analysis incorporating food waste is required to fully comprehend the environmental-nutrition trade-offs in Africa for more appropriate transformation strategies.

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9 Innovations and Knowledge for Food System Empowerment

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Key Messages

1. Innovation should be viewed holistically due to the level of interaction and dependency among the multiple food systems components and players.
2. An enabling policy and institution environment is critical to promote and incentivize the development and adoption of innovations to achieve food and nutrition security, sustainability, inclusiveness, and resilience.
3. Transforming African food systems will require that smallholders and other value chain actors have access to technologies that go beyond productivity growth and include improved nutrition, sustainability, and livelihoods.

Introduction

Innovations and knowledge provide the best opportunity to address the challenges facing food systems by enhancing food security and nutrition, building resilience against climate change, increasing efficiency and productivity, and linking producers with markets through information systems.

Innovations that are key to the transformation of food systems include higher-yielding and nutrition-enhancing seeds (biofortification) and better farm practices such as precision agriculture, fertilizer micro-dosing, and more efficient irrigation to improve productivity at farm level. Beyond the farm gate, industries can leverage innovations to produce healthier foods and snacks for example through fortification, and marketers can use e-commerce technologies to link producers with consumers.

The creation and implementation of such innovations and knowledge generation, dissemination and management must be integrated into whole value chains or even whole food systems and should involve all actors including input providers, smallholder producers, traders or marketers, consumers, and government extension agencies, among others.

To accelerate innovations and knowledge dissemination, governments and partners should promote a policy and institutional environment that encourages: access to technology and knowledge for vulnerable and marginalized groups; innovations and knowledge for multiple wins such as productivity, nutrition, climate adaption and mitigation, and inclusion; knowledge dissemination to move innovations to actual on-ground impact; and south-south cooperation for learning and exchange. A systems approach to innovations and knowledge is necessary to strengthen institution and stakeholder networks and to adopt participatory approaches that involve users to ensure they are adaptable and relevant to local conditions.

This chapter focuses on the significance of innovations and knowledge in transforming and empowering food systems. It begins by elucidating key challenges that hinder the transformation of African food systems. The chapter then explores the transformative roles of different types of innovations followed by a discussion of the critical role of knowledge creation and dissemination for African smallholders. The chapter also outlines pathways to foster innovations and knowledge-driven approaches, particularly through an enabling policy and institutional environment.

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Challenges Facing Food Systems in Africa

African food systems face numerous challenges that have weakened food and nutrition security on the continent. A significant proportion of the population is exposed to the triple burden of malnutrition: hunger, hidden hunger, and overweight/obesity. According to FAO, approximately 282 million people in Africa (nearly 20% of the population) are suffering from hunger or lack of adequate dietary energy. Around 63 million (30%) of children under the age of five years are stunted, about 12 percent of adults are obese, and 5 percent of children under five are overweight (FAO, 2023). The food security situation is exacerbated by emerging challenges including climate change, conflict, and other shocks such as the COVID-19 pandemic and the crisis in Ukraine.

In addition to conflict, sporadic weather conditions have been the main drivers of increasing food insecurity in Africa in the past decade. The FSIN (2019) report estimated that in 2018, climate shocks and related natural disasters pushed more than 23 million people in Africa into acute food insecurity. The continent is experiencing climate change-induced food insecurity, population displacement, and stress on water resources with smallholder farmers and small-scale entrepreneurs and their families, who rely on rainfed agriculture for their livelihoods, as the most vulnerable to these impacts (Mutengwa et al., 2023).

The impact of climate change in Africa is evident. The continent is experiencing higher temperatures, more variable precipitation patterns, and more frequent extreme weather events (World Meteorological Organization, 2020). Cyclone Freddy devastated most of southern Africa in early 2023 and was one of the strongest and longest cyclones on record[5]. It was also one of the most devastating and deadliest, killing more than 500 people mainly in Mozambique and Malawi. Cyclone Idai which made landfall in Mozambique in 2019, killed an estimated 1,000 people. During the same period, southern Africa suffered extensive drought while the Greater Horn of Africa shifted from very dry conditions in 2018 and most of 2019 to floods and landslides in late 2019. The Sahel and surrounding areas experienced flooding from May to October 2019.

The recent series of shocks has elevated these challenges to unprecedented heights. The long-lasting impact of the COVID-19 pandemic, particularly its detrimental effects on economic growth, and the crisis in Ukraine have worsened the status of food security in Africa (Wudil et al., 2022). Runaway inflation has caused the prices of fertilizers and other inputs to skyrocket therefore inflicting damage on agricultural productivity. The long-standing challenge of pest infestations has exacerbated these challenges. For example, the locust infestation that affected East Africa in 2019/20 posted a destructive impact on food security and livelihoods (International Federation of Red Cross and Red Crescent Societies, 2022).

African food systems are already affected by persistent low productivity. From 1990 to 2015, land productivity in Africa increased from USD 190 to USD 335 with an annual growth rate of 2.2 percent (Table 1). This is lower than the annual population growth of 2.5 percent observed during the same period. In comparison, land productivity in Asia grew at more than 3 percent per year despite a lower population growth rate of 1.2 percent per year. Lower land productivity coupled with slower growth in total factor productivity (TFP) indicates that agricultural growth in Africa primarily stemmed from expanding land use rather than from technological advancements driving land productivity growth.

5 https://public.wmo.int/en/media/news/tropical-cyclone-freddy-may-set-new-record

Table 9.1. Land, Labor, and Total Factor Productivity

Region	Land Productivity/USD				Total Factor Productivity Growth/%		
	1990	2000	2010	2015	1991-2000	2001-2010	2011-2015
Sub-Saharan Africa	190	239	319	335	1.5	1.0	0.4
Latin America and the Caribbean	255	336	468	526	1.3	2.3	1.9
Asia and the Pacific	646	909	1219	1355	1.7	1.7	1.5
Middle East and North Africa	1073	1344	1596	1738	1.3	1.5	1.2

Source: International Food Policy Research Institute (IFPRI), 2020.

It is projected that by the year 2050, climate change will lead to an alarming decline of crop yields by 8 percent with large regional variation (Knox et al., 2012). Evidence shows that although there may be a slight increase in rainfed maize and rice yields, climate change is expected to reduce wheat, soybean, sorghum, and irrigated rice yields by 5 to 20 percent in eastern Africa if sufficient adaptation cannot be achieved (Waithaka et al., 2013). Similar analyses for western and southern Africa reveal varying impacts at subregional, country, and even sub-country levels for different crops (Hachigonta et al., 2013; Jalloh et al., 2013).

However, the challenges discussed also provide an opportunity to leverage innovations and knowledge to fast-track the transformation of food systems. In the context of food systems, innovation is defined as the "process whereby individuals or organizations bring new or existing products, processes, or ways of organization into use for the first time in a specific context to increase effectiveness, competitiveness, resilience to shocks, or environmental sustainability and thereby contribute to food security and nutrition, economic development, or sustainable natural resource management" (FAO, 2018).

According to Wiggins et al. (2021), there are two schools of thought on innovations and knowledge and their adoption. The first one, by scientists and economists, contends that the gap exists in creating awareness among players and removing barriers to the adoption of technologies. The second school of thought by sociologists and anthropologists views technical ideas from research as just one of the sources of innovation. Some innovations emanate from formal research by public and private entities, while others originate from informal systems across the food systems. This view advocates for the systems approach to innovations in the agricultural space. It argues that innovations are more than biological or digital technologies and modern machinery. It is a process that cuts across social, organizational, and institutional spheres and transcends changes in all value chain nodes and support services.

Similarly, the 2021 UNFSS Scientific Group advocates for a systems approach to innovations. Such an approach strengthens institutions' and stakeholders' networks to better respond to the needs of actors (Von Braun et al., 2021). Innovation, therefore, should be viewed holistically due to the level of interaction and dependency among the multiple types and players.

For example, advanced technologies will not be applied effectively without corresponding changes in human behavior or system-level changes. Changes in human behavior are more important but also most difficult to achieve given factors such as diversity, trust, and preferences (National Academies of Sciences, Engineering, and Medicine, 2020). Thus, innovations in technology, policy, and institution become critical for African food systems transformation due to their contribution to promoting synergies between different dimensions of food systems (Fan et al., 2021).

Opportunities for Empowering African Food Systems through Innovations and Knowledge

The benefits of innovations and knowledge lie in the potential to increase efficiency and reduce losses and waste thus increasing value and returns across the value chain. "Innovations let us do more and better with less". Despite the gigantic both economic and human losses it has caused, the COVID-19 pandemic has triggered an acceleration of innovations especially with the increased need to remotely support services such as input distribution, business operations, and emergency responses. If scaled out, especially through knowledge dissemination, these innovations can transform how food is produced, transported, processed, and marketed. Africa should build on this momentum to sustain a food systems transformation on the continent. Some of the technological, policy and institutional innovations are reviewed below.

Innovating Multiple Win Technologies

The transformation of African food systems requires multiple-win solutions to cope with such resource-sensitive, climate-threatened, and smallholder-based food systems. Technological innovations bring novel opportunities for making progress on different food system objectives across the value chain to cost-effectively leverage synergies. For example, at the production level, innovations can include higher-yielding seeds, better farm practices, or more efficient irrigation to improve productivity while beyond the farm, industries can produce healthier foods and snacks (Figure 1). Marketers can adopt e-commerce to open new markets and reduce physical movements when linking with consumers. As illustrated, these technologies are supported and thrive within an environment of policy and institutional innovations.

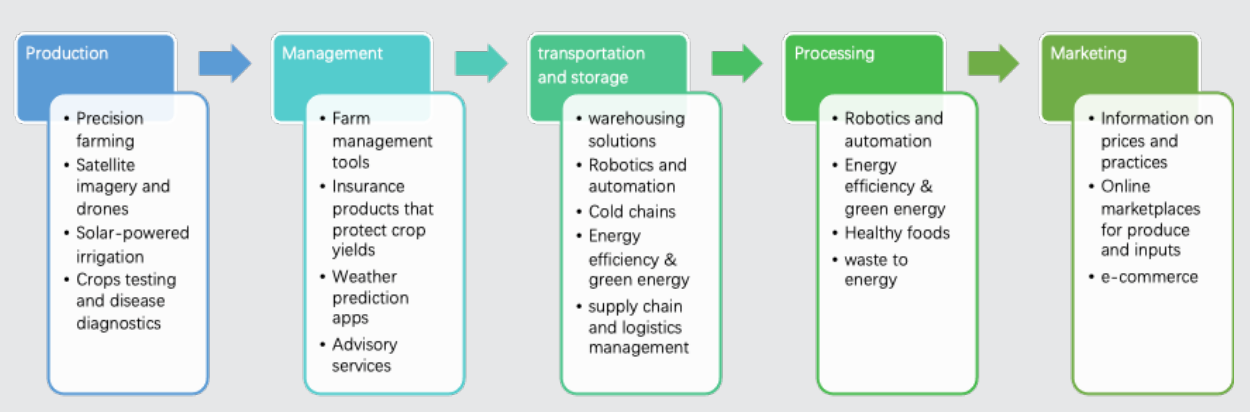

Figure 9.1: Examples of Innovations and knowledge across the food value chain

Source: Adapted from Briter Bridges and WFP (2022)

Africa has seen a steep increase in the number of agricultural technologies driven not only by their potential to increase the efficiency and sustainability of food systems but also commercial viability (Technical Centre for Agriculture and Rural Cooperation (CTA) (2019). An estimated 400 agricultural technology and digital agriculture companies were operating in Africa in 2021 (CTA, 2019; Briter Bridges and WFP, 2022). The most active agricultural technological solutions startups are concentrated in East Africa, especially in Kenya. For example, in the past decade, startups headquartered in Kenya received over 85 percent of funding in East Africa, excluding Tanzania. Also, only about 20 percent of the innovations account for more than 80 percent of farmers who are accessed (CTA, 2019). In East Africa, technologies dealing with market data and linkages, off-grid and smart irrigation, supply chain management, and marketplaces for fertilizers have attracted the most funding in recent years.

In past decades, many research organizations including national institutes, bilateral collaborative organizations, and CGIAR centers were devoted to high-yield varieties for the continent. Taking rice for example, by 2020, such efforts resulted in about 570 rice varieties in 10 major rice-producing countries in sub-Saharan Africa (Futakuchi et al., 2021). Research has confirmed that using upland indica materials from Asia to further improve existing varieties has great prospects (Saito et al., 2018; Vandamme et al., 2018).

In addition to improving yield, climate change is another key driver of crop breeding development. Stress-tolerant varieties are crucial in adapting to climate-related challenges (Nagargade et al., 2017). Evidence shows that without adopting stress-tolerant maize varieties, the prevalence of food insecurity in rural Nigeria would have been 6 percent higher during the investigation period (Abdoulaye et al., 2018). Utilizing stress-tolerant varieties showed significant contributions to Africa's food security and smallholders' welfare. For example, drought-tolerant maize developed by the International Maize and Wheat Improvement Center (CIMMYT) provides added grain worth over USD 160–200 million each year in drought-affected areas of sub-Saharan Africa. Under moderate drought conditions, such varieties could achieve at least one ton per hectare more yield, with a 20–30 percent increase, compared with previous varieties. During the extension program, 60 hybrids and 57 open-pollinated varieties were made available to smallholders in Africa benefiting 40 million people in 13 African countries (CIMMYT, n.d.).

Biofortification is a promising technique for addressing malnutrition challenges. Despite lack of comprehensive and up-to-date data on micronutrient deficiency, current research widely acknowledges the need for serious attention to the challenge of micronutrient deficiency facing the continent (WHO, 2015; Engidaw et al., 2023). By enriching locally produced crops' bioavailable micronutrients, biofortification provides a readily accessible solution (Bouis and Saltzman, 2017). In the past decade, some biofortified varieties have been released and commercialized in Africa (Ekpa et al., 2018). Evidence shows that in most cases, biofortification made greater impacts on addressing Vitamin A and zinc deficiencies than other measures such as dietary diversity, fortification, and supplementation (Galani et al., 2022). The importance of biofortification could be more significant in the context of climate change. Both short- and long-term temperature increases are related to decreased children's dietary diversity

in Africa (Niles et al., 2021), which would increase the risk of micronutrient deficiency. The current development of the biofortification technique is facing several challenges including limited acceptance, low yield potential, and quality assurance (Goredema-Matongera et al., 2021). Further innovations in biofortification technology could focus on addressing such challenges to achieve more significant impacts.

Micro-dosing of fertilizer has shown its prospects for enhancing food system resilience under the shocks of fertilizer supply and prices such as the recent crisis. Escalating fertilizer prices could be a major driver of exacerbated food insecurity and rural poverty in Africa during the Ukraine crisis (Arndt et al., 2023). Evidence suggests that fertilizer micro-dosing is an effective measure to increase crop yield, nutrient use efficiency, and farmers' profitability (Blessing et al., 2017). A wide-scale assessment in Zimbabwe consistently demonstrated that grain yield could increase by 30 to 50 percent with micro-dosing in different conditions of soil, farmer management, and climate (Twomlow et al., 2011). Micro-dosing of fertilizer provides an affordable opportunity for smallholder farmers to increase output under soaring fertilizer prices.

Precision agriculture provides an emerging opportunity for a cost-effective and resource-efficient food system in Africa. Precision agriculture refers to an integrated strategy composed of a basket of technological innovations to support management decisions for achieving efficient resource use and other goals such as productivity and sustainability. Evidence shows that precision agriculture is an effective solution to improve resource management, increase yield stability, and enhance climate adaptability (Mintert et al., 2016; Yost et al., 2017). Despite the original implementation of precision agriculture in intensified large farms, significant potentials were also identified for smallholder farmers and the continent. Satellite technology provides an affordable solution. It could be utilized for yield estimation, fertilizer management, and addressing cadastral problems (Mizik, 2023). The progress of precision agriculture in Africa covers various fields including plant and animal protection, crop monitoring, water management, yield and fertility mapping, and yield enhancement. Wireless sensors and numerical models were implemented in Burkina Faso and Malawi to optimize irrigation systems and remote sensing was used to monitor the cultivation of Arabica coffee. Digital soil fertility maps were used to plan the cultivation of common beans in Tanzania (Onyango et al., 2021).

Synthetic biotechnology is recognized as an effective instrument for addressing the trade-off between sustainability and productivity in traditional food production (Roell & Zurbriggen, 2020). As an interdisciplinary domain, synthetic biotechnology enables researchers to create new biomolecular components and pathways to achieve desired functionalities usually metaphorically referred to as cell factory (Khalil, 2010). Recent research advancements demonstrated that synthetic biotechnology is highly suitable for leveraging the continent's food systems. Some progress has been made in plant nitrogen fixation (Goold et al., 2018). Such innovations could directly benefit African food systems since it reduces the need for fertilizer, which is import-dependent and price-sensitive in some African countries (Balma et al., 2022).

However, the spread of innovations, particularly technological ones, is faced by various challenges notably the digital divide and external infrastructure and economic factors as discussed in this chapter.

Digital technologies such as smartphones and associated applications have increasingly become the main avenue for dissemination of agricultural information and services. Such services include advisory, market information, credit services, and farm and logistics management, among others. Although the number of farmers reached by digital tools has increased substantially in the recent past, estimated at 33 million in 2019, most sub-Saharan smallholder farmers (more than 85%) are still unreached (Technical Centre for Agriculture and Rural Cooperation (CTA), 2019). Only about a quarter of the population in Africa has access to the internet while less than a third of the population has access to broadband connectivity. This makes it difficult, especially for farmers, to access and use digital technologies. In addition to the connectivity problem, many smallholder farmers lack the digital literacy and skills required to use digital technologies or cannot afford the necessary devices. The implication of this is that most small-scale farmers cannot access the information, knowledge, and services that they require to improve their farming practices. This status entrenches existing biases against smallholder farmers and keeps them in a subsistence trap.

Second, external factors beyond the technical aspects of innovations affect the actualization of the possible benefits. Factors external to innovation such as infrastructure – roads and telecommunications – affect the cost and efficiency of operations and transactions and therefore returns to value chain players (Wiggins

et al., 2021). Country-specific economic factors such as the taxation structure and inflation affect the prices of products and services and therefore affordability. For example, high taxes on digital tools and services limit access to information from online sources that have increasingly become key agricultural information media. Market failure has persistently affected the African agricultural space. Therefore, the sector fails to attract investment because of missing markets for inputs, and expensive or inaccessible financial and insurance markets. The implication is that even though modern inputs such as agrochemicals and fertilizers may be available locally, farmers get poor returns for their investment in innovations and are vulnerable to many risks including bad weather, pests and diseases, and unpredictable prices when selling their produce (Wiggins et al, 2021). This in turn negatively affects their future decisions to adopt the innovations or practices.

Innovating Policy and Institutions

An enabling policy and institutional environment is critical to promote and incentivize the transformation to achieve food and nutrition security, sustainability, inclusiveness, and resilience. Africa's food systems are engaging in many critical policy and institutional agendas. Innovations in policy and institutions must be conducted to address the challenges faced. For instance, gender inequality persists in many countries. Men have a more dominant presence in the rice trade network compared to women and the evolving rice value chains worsening the situation through unequal gender-based division of labor (Walther et al., 2019). Youth empowerment is another urgent issue to be addressed. The current agricultural support plan in African countries does not provide sufficient assistance for youth participation in the economy. As a result, the continent's youth are pessimistic about the capability of agriculture to improve their living standards (Geza et al., 2021).

Land tenure recognition is a major field of institutional innovation in Africa. It could achieve substantial benefits on productivity and farmers' income (Lawry et al., 2017). Ensuring women's land rights is particularly critical for food systems transformation. Evidence shows that women's land rights are closely related to women's bargaining power and decision-making on consumption, human capital investment, and intergenerational transfers. Although more specific research that focuses on women's land rights as a factor is needed, research in Africa suggests that women's land rights are related to technology adoption and natural resources management (Meinzen-Dick et al., 2019). Much progress has already been made on the continent. Rwanda started its Land Tenure Regularization program in 2004. Investigation showed that participants of the program were twice as likely as non-participants to invest in soil conservation. Notably, female beneficiaries showed the most significant effects in terms of becoming more likely to take such long-term investments (Ali et al., 2014). Malawi includes land tenure security in its intervention area of the National Agricultural Investment Plan specifically emphasizing women and youth empowerment. Priority for women, youth, and vulnerable groups in the land register was considered in its governmental practice (Ministry of Agriculture, Irrigation and Water Development, 2018).

Nevertheless, it is essential to acknowledge that there are multiple drivers for land registration (Boone, 2019). Although land consolidation is regarded as a significant contributor to increased crop yield (World Bank, 2018), more efforts are needed to ensure land registration to benefit the inclusiveness of the continent's food systems. Disturbing research findings from Malawi suggest that land reforms implemented prior to 2015 have no significant effects on improving productivity and income for female-headed households (Mendola and Simtowe, 2015). As previously mentioned, more research that specifically focuses on the effect of women's land rights on poverty, productivity, and access to credit and other crucial resources is needed (Meinzen-Dick et al., 2019).

Africa's smallholder-driven food systems require a supportive institutional environment to help modernize its value chains. Governments could support the private sector to advance its business for the purpose of improving value chains. Rwanda enabled the public-private partnership (PPP) scheme to leverage its private sector. The public-private partnership law was enacted in 2016 to establish a framework for inclusive and sustainable investment. In 2019, the Leveraging Private Sector Strategy (LPSS) was issued to support private investment in food systems. The LPSS aimed to contribute to various goals such as sustainable job creation, trade deficit reduction, and income improvement through establishing a friendly environment for private investment and enhancing the links between farmers and agricultural produce off-takers (Republic of Rwanda, 2019).

Institutions can also enhance both vertical and horizontal coordination within the food value chain. They can facilitate efficiency-building competition

among various farming models such as cooperatives and family farms to promote productivity. Additionally, institutions can work towards improving synchronization between farms and markets ensuring efficient and timely flow of products. Moreover, collaboration between urban and rural policymakers is essential. By supporting the movement of agricultural products into cities, policymakers can tap into the opportunities arising from urbanization. This collaboration can enable the integration of smallholders, traders, and other stakeholders into urban markets ensuring their participation in the entire food value chain.

In addition, African governments should institutionalize their efforts to promote inclusive value chains. For example, gender mainstreaming is incorporated into Rwanda's LPSS as mandatory guidelines. Youth employment is a critical action track for inclusive value chains. Institutions should provide an enabling environment for young people. Schemes such as professional skill training, labor market information and analysis services, provincial dialogues, and young entrepreneur funds could be adopted.

Strategic grain reserves are crucial in ensuring food security during crises especially for poor consumers (Fraser et al., 2015). Policy innovations could be adopted to optimize reserve mechanisms for leveraging its impact and integrating the efforts of enhancing smallholder farmers' profitability. A recent evaluation shows that a slight adjustment in reserve policy could benefit the most vulnerable group. In Malawi, the national strategic grain reserve usually starts its replenishment in July, the start of its fiscal year. This timing might further push up the rising maize price. Due to the shift of the start of the fiscal year from July to April, it is now possible to start the replenishment earlier to prop up the maize price at the year's lowest point. Through stabilizing prices, such a shift could benefit the poorest farmers to improve profitability and food security (Malabo Montpellier Panel, 2021).

Regional collaboration in grain reserves should be seriously considered in Africa. Each country only has limited capability to cope with food security emergencies. Many shocks, such as extreme weather and natural disasters could cause a nationwide food production and distribution crisis. Regional collaboration in grain reserves could promote better resilience. The ASEAN Plus Three Emergency Rice Reserve (APTERR) is a representative arrangement for regional food security collaboration. APTERR is a formal scheme established by the Association of Southeast Asian Nations (ASEAN), along with China, Japan, and South Korea, based on long-standing dialogue on food security among those countries. Before its establishment, a temporary pilot project was carried out between those countries. Such a framework of collaboration consisting of long-term dialogue, piloting, and final institutionalization, provides a meaningful reference for other regions. APTERR received positive comments in recent evaluations suggesting the broad prospects of regional food security collaboration (Kim, 2021).

As mentioned earlier, achieving adequate food supply is not the only objective for African food systems transformation. Policies should consider health instead of solely targeting increasing food supply. Many innovations have been developed and progress has been made in Africa on this agenda. For example, Ghana integrated dietary-related factors into its national non-communicable disease (NCD) policy. The country declared limitations to salt, fat, trans fat, and added sugar in processed food and food served in restaurants. Some legislative actions were taken to regulate the accuracy of the nutritional content declarations (Malabo Montpellier Panel, 2021). Malawi made progress on school feeding programs and nutritional education with advocacy in the country to improve food diversity in its school feeding package. It also planned various forms of nutritional education such as localized cooking demonstrations, village-level nutrition fairs, and national-level nutrition campaigns. Such actions were included as one of the 16 intervention areas in Malawi's National Agricultural Investment Plan (Ministry of Agriculture, Irrigation and Water Development, 2018).

Digitalization-enabling policies are essential for the continent to seize the opportunities of the next generation. As previously indicated, digital technology could create many new opportunities for the continent's food systems. However, it faces multiple obstacles, such as limited accessibility and suitable tools when scaling up for smallholders (Kudama et al., 2021). Regulation is the first field that innovations in policy should focus on. On the one hand, policies should encourage innovative application of digital technology in food systems and lift inappropriate restrictions. On the other hand, some regulatory policy is needed to address emerging issues related to digitalization such as privacy infringement and violation of digital property rights. Some significant progress at the regional level was achieved, such

as the Convention on Cybersecurity and Personal Data Protection of the African Union and the East African Community's Framework for Cyber Laws. More innovations are needed at the national level (Malabo Montpellier Panel. 2019).

Digital infrastructure remains one of the major barriers to digitalization in Africa and is thus another field that needs effective enabling policies. (Kudama et al., 2021). Connecting the last mile in rural areas requires massive efforts thus policies should be designed to encourage innovations in cost-effective solutions to provide information services. To achieve this, the participation of the private sector should be fully encouraged. Experiences from China's digitalization illustrated the private sector's crucial role in driving digitalization (Ito, 2019). Specifically, grassroot workshops and startups significantly contributed to providing affordable and diverse cell phones and other digital devices at the beginning of China's digital era. Although such contribution could not directly be utilized for industrial needs, it played a vital role in disseminating knowledge and cultivating the acceptance of digital technologies.

Limited access to financing services is a critical barrier to the adoption of many promising technologies in Africa (Onyango et al., 2021; Mudziwapasi et al., 2022). Policy innovations are needed to establish an inclusive finance system for vulnerable groups such as smallholders, women, and youth. Policies should encourage credits for low-risk productivity-enhancing investments, such as irrigation devices, and consider providing credit guarantees. An innovative financing practice in Morocco shows the effectiveness of such a scheme. Tamwil El Fellah (TEF), an innovative financing institution, provides collateral-free credits to smallholders and receives a risk coverage of 60 percent from the Government (Ramirez and Hernandez, 2016). By 2016, the second year of the TEF's achievement of break-even, 67,000 smallholders had received loans to invest in irrigation, farm equipment, and other productivity improvements. Nearly all (98%) of the loan has been repaid successfully. Such practice has been regarded as an instructive reference for other countries to promote innovative finance (Malabo Montpellier Panel, 2021).

Informal saving groups are critical for vulnerable groups to access credit for social and economic development and ensure food security. They have also significantly contributed to skill development and knowledge dissemination, especially for women (Lukwa et al., 2022). Policies should engage in such a scheme to coordinate it with other actors to enhance credit service and expand its functionalities. The City of Windhoek in Namibia cooperated with local saving groups and established a scheme to provide housing solutions. The Shack Dwellers Federation of Namibia was founded in 1998 to provide housing savings for the rural and urban poor. By 2022, it had around 956 saving groups, covered about 29,718 members, and built over 7,000 brick houses. Its functionalities also expanded to a broad scope of poor empowerment (The Shack Dwellers Federation of Namibia, 2022). During the establishment of this scheme, many related policy innovations, such as modified minimal housing land size and optional and self-installed water and sewerage services, were incorporated into the scheme to improve the affordability of housing (International Institute for Environment and Development, 2006). Such examples illustrated the importance and prospects of policy innovations in enabling inclusive credit services.

Last but not least, institutional accountability must be strengthened to ensure food security and enable necessary remedies and assistance in African countries. Such efforts should be based on effective governance mechanisms that use data to enhance monitoring. For example, the Africa Agriculture Transformation Scorecard provides accountability by tracking the progress of commitments made through the Malabo Declaration to improve livelihoods by transforming food systems. In addition, ensuring the justiciability or judicialization of the right to adequate food and nutrients is an essential part of food security accountability. Experiences from other developing countries such as India, could be useful in developing such legal mechanisms (Durojaye and Chilemba, 2018).

Creating and Disseminating Knowledge to Empower Food Systems

Knowledge is critical in the creation and implementation of such innovations. Davis and Sulaiman (2016) illustrated a system approach for knowledge flows and actor linkages in food systems innovation (Figure 9.2). It emphasized the direct linkage between value chain actors and actors in the innovation system. Appropriate solutions are based on the accurate identification of the gap between current status and best practice. Technologies must be adapted to local conditions to achieve effective extension and dissemination. Hence, for smallholder-based food systems in Africa, creating and disseminating knowledge for smallholders is a pivotal component in food systems transformation.

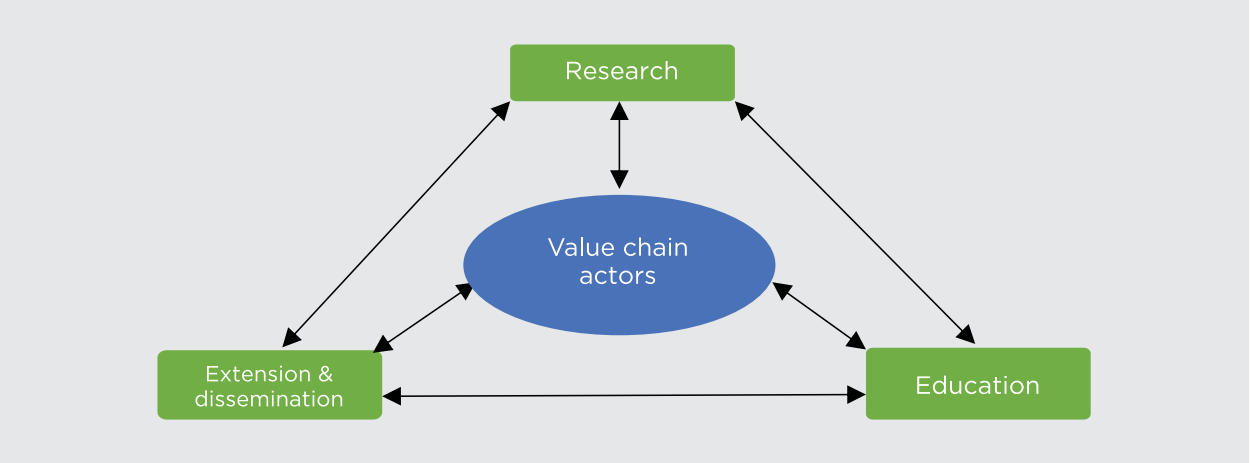

Figure 9.2. Knowledge Flows in Food Systems Innovation
Source: Adapted from Davis and Sulaiman, 2016

Precisely identifying current gaps is the foundation of food systems transformation. Knowledge is integrated as practical protocols and tools to achieve such identification. SeedSAT is a tool used for this purpose in Africa. It is used to analyze a country's seed system to identify the reason for deficiencies and inefficiencies and help to determine the improvement priorities. It leverages information and knowledge from existing resources and adds extra expertise. In addition, a clear evaluation of the current status could be necessary for making improvements. Researchers in Kenya developed a protocol to generate data on methane emissions from livestock systems. The method is used for reporting Kenya's baseline GHG emissions to make the country eligible for international climate finance.

The extension of innovations requires widespread efforts to exchange expertise. Knowledge dissemination is critical for leveraging the effect of innovative technologies. In Ghana, combined with improved seeds, well-trained and equipped extension agents helped rice farmers increase the yield by 345 kilograms per hectare on average compared to non-beneficiary farmers in the 2019 harvest season (Zoogah and Nakuja, 2020). In addition to the national technology extension project, the private sector should play an essential role in providing technological and advisory services. Evidence from Burkina Faso demonstrates that the private sector could achieve higher levels of farmer satisfaction compared with public extension services (Sylla et al., 2019). Diverse business modes and services tailored to smallholders' conditions enable the private sector to extend innovations more efficiently and disseminate more applicable knowledge to smallholders.

Knowledge management is a critical part of the extension process to ensure equal and ample opportunities for knowledge sharing. Well-developed knowledge management is particularly important for African food systems since it must appropriately integrate indigenous and exogenous knowledge. This requires significant efforts since normally exogenous knowledge is shared in a wider context (Tandi Lwoga, 2011). An expert panel identified five critical capacity areas for improving knowledge management in the rural context (Lamm et al., 2017). Such measures enable multiple opportunities for a better knowledge management practice (Table 2).

During the extension of technologies and other innovations, knowledge must be created to assess status and find out barriers. For example, a survey in South Africa showed that the adoption of climate smart agriculture by smallholder farmers is still limited. Through econometric analysis, it identified a set of key factors in the adoption of climate smart practices. Based on its findings, several critical measures such as strengthening contact and raising awareness were proposed to promote the adoption rate (Abegunde et al., 2019). In addition to case-specific studies, efforts on conceptual and methodological research for understanding the adoption of innovations should be increased. A recent review demonstrated the importance of such knowledge in analyzing technology acceptance. It shows that many critical factors need to be investigated. Also, protocols and methodologies for such investigation still need to be developed (Thomas et al., 2023).

Table 9.2. Capacity Areas and Corresponding Objectives

Capacity Area	Objective
Providing an effective platform for enhanced learning and information exchange through face-to-face opportunities	Ensuring efficiency and effectiveness
Providing opportunities for networking through shared information and resources	Expanding the scope of influence
Making activities, products, best practices, and success stories accessible to stakeholders in a format they can use	Making knowledge practical, especially for smallholder farmers
Having a culture that supports sharing among all levels	Maximizing knowledge potentials
Providing documentation of knowledge through a centralized platform	Enabling large-scale implementation

Source: Capacity areas are obtained from Lamm et al., 2017

It is necessary to evaluate the complete impact of food systems transformation. This process typically requires comprehensive actions including surveillance, survey, and model analysis. Regular public disclosure of evaluation results helps the public and academic community to adjust their research, development, and adoption of innovations in a timely manner. Many entities working on innovation extension, such as Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA), regularly disclose their detailed projects, the number of beneficiaries, and measurable economic impacts. These tangible numbers play a crucial role in promoting public and political engagement in innovations. In addition, implementing interdisciplinary models creates the opportunity to simulate the impact for informing decisions. In 2013, a global general equilibrium model helped the European Union (EU) to decide its biofuel policy. It showed that biofuel mandates would impact GHG emissions more significantly than previously considered (Van Noorden, 2013). Such simulative findings could contribute to policymaking and help reduce the risk of decision failures.

Innovation adoption does not follow the commonly referred top-down linear path where ideas and technologies are developed by scientists and researchers and disseminated by extension agents. Rather, players depend on a multiplicity of sources of information and evaluate and test them rigorously against their priorities, conditions, and resources (Wiggins et al., 2021). The transmission of innovations and knowledge is dependent on formal extension systems but also on informal channels such as social networks among farmers. Wiggins et al. (2021) advocate for participatory approaches to innovation, one which users of innovations are involved through collaborative platforms and processes. This calls for a close linkage between the creation and dissemination of knowledge and the transformative practices in food systems establishing the interface between science and society.

The China Agricultural University established a scheme to provide localized science-society interaction hubs named Science and Technology Backyard (STB) (Jiao et al., 2019). It provides on-site science and technology services for smallholders and helps promote urban-rural integration on agricultural value chains. By 2023, there were 1,048 STBs nationwide covering 31 provinces or equivalent administrative regions and involving more than 200 types of agricultural products. The STB scheme is also extended to other countries including African countries (China Agricultural University, 2023). A recent analysis illustrated several key experiences from the STB scheme that could benefit Africa including scientist-farmer engagement for localized innovations, effective knowledge dissemination for smallholders, and the establishment of an open platform for multiple resources and actors (Jiao et al., 2020).

Pathways Forward for Innovation and Knowledge

Innovations and knowledge are crucial for transforming African food systems to address challenges such as poverty, hunger, and malnutrition. It is clear that transforming African food systems must ensure that smallholders and other value chain actors have access to technologies that go beyond simply productivity growth and include improved nutrition, sustainability, and livelihoods. Table 3 summarizes various technological, policy and institutional innovations that are critical to food systems transformation in Africa.

Table 9.3. Empowering African Food Systems Transformation

Transformation tracks	Challenges and barriers	Innovative technology solutions	Policy and institutional foundations	Backing knowledge
Ensure access to safe and nutritious food for all	• Limited productivity • Limited resources and inputs • Dietary micronutrient deficiency • Inadequate social protection	• High-yield varieties • Fertilizer micro-dosing • Biofortification • Sustainable intensification	• Secure land tenure • Institutional accountability for food security • Productive safety	• Diagnosing current farming practices • Assessing potential solutions • Evaluating the impacts of innovative practices
Shift to healthy and sustainable consumption patterns	• Insufficient accessibility • Lack of diet and nutrition knowledge of consumers • Lack of incentivizing policy	• Nutrition enhancement technology • Synthetic biotechnology • Processing technology that preserving nutrient value • Appropriate cooking	• Nutrition-driven agricultural policy • Health targeting dietary incentive • Labeling regulation • Regulations on ultra-processed foods • Tax on unhealthy food	• Surveilling and diagnosing current nutrition and health status • Understanding consumer's behavior • Developing intervention strategy
Boost nature-positive production	• The urgent need for improving productivity • Inadequate natural resources management • Loss of biodiversity • Deforestation	• Perennial varieties • Conservation tillage • Crop rotation • Land leveling • Precision agriculture • Straw management • Agroforestry	• Increasing investment in breeding and farming techniques • Increase environmental compensation	• Developing breeding and farming techniques • Assessing environmental impacts • Quantifying the environmental cost
Advance equitable livelihoods	• Lack of services to smallholders • Gender inequality • Lack of youth empowerment	• Digital information services • Inclusive infrastructure, such as solar powered pumps and other devices • Gender-sensitive mechanization • Household livelihood diversification • Technologies for value chain advancements, such as improved processing and packaging	• Ensuring women land rights • Encouraging private extension services • Establishing knowledge exchange networks • Creating science-society interface • Promoting inclusive food value chains • Government-backed innovative finance • Leveraging informal saving groups	• Extending technologies and innovative practices • Providing rural advisory services • Identifying adoption barriers • Understanding farmers' innovation acceptance • Ensuring inclusive knowledge management

Transformation tracks	Challenges and barriers	Innovative technology solutions	Policy and institutional foundations	Backing knowledge
Build resilience to vulnerabilities, shocks, and stress	• Lack of infrastructure • Lack of insurance and social protection • Import-dependent and price-sensitive inputs • Imperfect food reserve system	• Innovative civil engineering technology • Fertilizer micro-dosing • Climate resilient crop and animal varieties	• Increasing investment in infrastructure • Innovative public private partnership • Increase insurance and social protection coverage • Regional reserve collaborations	• Risk identification and early warning • Modeled simulation of impacts • Responding policy assessment

Note: Transformation tracks are adapted from the United Nations, 2021.

Develop and Promote Multiple win Technologies

Multiple win technologies are crucial for addressing challenges facing African food systems. Technologies focused solely on yield adopted in the early Green Revolution had limited effectiveness in addressing challenges such as climate change, natural resource degradation, and micronutrient deficiencies (Pingali, 2012). Multiple win technologies should hence be prioritized for their potential to address different challenges simultaneously (Table 4). Emerging crop varieties are not only higher yielding, but also stress tolerant, more resource efficient, and richer in nutrition. Micro-dosing of fertilizer enhances yield with improved input efficiency and benefits Africa's smallholders. Precision agriculture improves resource utilization efficiency and shows significant potential in serving smallholders and enhancing the resilience of African food systems. Synthetic biotechnology shows broad prospects in increasing yield, protecting the environment, and enhancing the efficiency of resource and input utilization (Wang et al., 2022).

Technology affirmative action for vulnerable and marginalized groups

The majority of primary agricultural producers in Africa are small-scale farmers in rural areas. These farmers are faced with poor access to information and technology and the capacity to utilize it. They risk being left behind in the innovation cycle.

Rather than reinforcing existing biases, the transition towards modern food systems must be equitable and inclusive ensuring that the benefits are widely distributed and accessible to all. Governments, development partners, the private sector, and civil society have a responsibility to ensure that innovations, more so technological ones, are accessible and affordable for all. This can be achieved through policy frameworks that maximize the benefits to all while minimizing harm to the vulnerable.

Adopt a Systems Approach to Innovation

The innovation domain of African food systems is occupied by various key stakeholders such as governments, development organizations, civil society, farmers and farmer organizations, research and academic institutions, and private sector companies. The pace of innovation diffusion and technological change is hinged on the synergetic synchronicity of all players to leverage and build on their individual capacities and presence.

A multidimensional and pluri-disciplinary approach is needed to manage interdependencies between key parts of the food system while emphasizing the importance of incorporating political, economic, and ecological dimensions.

Table 9.4. Critical Contributions of Multiple Win Technologies

Challenges	Crop breeding (including biofortification)	Fertilizer micro-dosing	Precision agriculture	Synthetic biotechnology
Limited productivity	√	√	-	√
Malnutrition	√	-	-	√
Climate mitigation/ adaptation	√	-	√	√
Resources depletion	√	√/○	√	√
Smallholders inclusion	√/○	√	√/○	-

Note: Information summarized from this chapter, where "√" denotes critical contribution, "○" denotes the need for further efforts or research to address significant obstacles or potential negative impacts, and "-" denotes other cases.

Enhance Knowledge Dissemination

The previous discussion illustrates that innovations have broad prospects for supporting smallholders to cope with barriers in food systems transformation. The critical role of knowledge in the extension and adoption of innovations in food systems poses an urgent need for knowledge dissemination for smallholder farmers. Promising measures include training programs, information services, on-site R&D services, enhancing grassroot learning organizations, and establishing interface hubs for academia, extension service providers, and local societies.

Promote South-South Cooperation

Given that they face similar challenges, developing countries could achieve broad prospects through experience and knowledge sharing. South-south cooperation is thus critical for enhancing Africa's innovations in food systems. Major pathways include germplasm resource sharing, education cooperation, technology transfer, and establishing joint laboratories.

There are significant prospects for cooperation in breeding R&D between Africa and China. For example, such cooperation could leverage Africa's climate adaptation and mitigation through the extension of novel varieties. Water-Saving and Drought-Resistant Rice (WDR) in China revealed that some varieties could save over 40 percent of water usage and reduce methane emission by about 97 percent if in aerobic cultivations, compared with flooding-cultivated common rice varieties (Xia et al., 2022). In addition, crop-breeding cooperation could particularly empower smallholder farmers in Africa. A study from China suggests that perennial crops could achieve similar yields compared with annual crops while having lower costs and acceptable milling and cooking quality (Huang et al., 2018). Such technology could achieve significant environmental benefits as well. Evidence shows that such benefits include increasing soil organic carbon accumulation, nitrogen accumulation, and water capacity (Zhang et al., 2022).

Food policy also plays a critical role in south-south cooperation for transforming food systems. Policy cooperation could directly share experiences between policymakers, lift trade distortions, and promote concerted actions on major agendas such as climate change. Developing countries, especially African countries, should establish south-south food policy networks to leverage knowledge dissemination and food systems transformation. For example, evidence from China shows that support policies on healthy and sustainable food could achieve multiple outcomes including increasing dietary quality for the entire population, reducing food systems emissions, and receiving long-term national income returns (Academy of Global Food Economics and Policy (AGFEP), 2022). International experience could also contribute to Africa's emerging dietary transition. A healthy and sustainable diet can help maintain negative environmental impacts at a lower level while ensuring the necessary nutrients for good health. Such diets could be achieved through appropriate policies including comprehensive intervention, taxation and subsidies, and policy on trade and foreign direct investment (AGFEP, 2023).

Conclusion

Innovations and knowledge in African food systems should be designated to enable all actors including input providers, smallholders, traders, processors, and consumers. Technological, political, and institutional innovations are all needed and must be integrated through the whole food system. Innovating multiple-win technology is the key to creating novel opportunities for food systems transformation in Africa. Political and institutional innovations form the foundation of smallholder empowerment and food value chain advancement in Africa. The creation and dissemination of knowledge to trigger African food systems transformation must be directly linked to value chain actors. Indigenous and exogenous knowledge should both be considered essential components of African food systems and science-society interface hubs could provide critical value for creating and disseminating knowledge for actors.

This chapter proposes four key recommendations for leveraging the innovation and knowledge systems to empower African food systems. First, technology affirmative action for vulnerable and marginalized groups should be developed and implemented. Second, all stakeholders in African food systems should promote systematic innovations for multiple wins such as productivity, nutrition, climate adaption and mitigation, and the inclusion of smallholders, women, youth, and other disadvantaged groups. Third, African countries should enhance knowledge dissemination to move innovations to actual on-ground impact especially for smallholders. Finally, the continent should seize the opportunity to promote south-south cooperation in food systems innovation and knowledge dissemination.

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10 Innovative Financing for Food Systems

Amath Pathé Sene[1] and Hedwig Siewertsen[2]

Key Messages

1. Food systems in Africa are heavily underinvested: African governments invest less than 10 percent of their budgets in the agricultural sector and in most countries, less than 5 percent of the total credit portfolio volumes is invested agricultural sector.
2. Food systems thinking opens opportunities for Africa to deploy public and private investments to transform how food is produced, processed, and consumed to make Africa's population and natural resources increasingly resilient to shocks and crises.
3. Repurposing of existing agricultural subsidies and private capital flows to address the climate, nutrition and debt crises in Africa provides a major boost in financing sustainable food systems.
4. The three interrelated crises in Africa (food and nutrition, over indebtedness, and climate and biodiversity) lead to large scale mobilization of new public and private capital that can, if deployed in a blended manner, derive a sustainable food system transformation.

Introduction

African countries are facing increasingly complex and interrelated challenges due to the confluence of three crises at regional and global level: food and nutrition, debt, and environmental and climate crisis. The compounded effects of these crises, exacerbated by the war in Ukraine, have brought food systems in the region close to a breaking point undermining progress of the past decade and many countries' efforts to achieve the Sustainable Development Goals (SDGs) and the Paris Climate Agreement targets by 2030. To address the crises mentioned, a radical reform of public and private investments in food systems is needed especially in Africa where finance for agrifood systems is strikingly low.

At the global level, there is enough liquidity to finance the food system transformation. Global public subsidies for agriculture and fisheries are estimated at around USD 670 billion per year although most of this is supporting harmful practices (World Bank, 2023). In addition, an estimated USD 630 billion of private capital per year is available for investment in food systems (Elwin et al, 2023). Partly repurposing these flows to address the climate, nutrition and debt crises in Africa could provide a major boost in financing sustainable food systems.

This chapter outlines how food systems thinking opens opportunities for Africa to deploy public and private investments to transform the way food is produced, processed, and consumed to increase the resilience of Africa's population and natural resources.

The first insight is that current public and private financial instruments are not leading to more sustainable food systems but rather towards deteriorating environmental and nutritional outcomes.

The second insight is that the current combination of food, climate, and debt crises in Africa calls for radical innovations in the way food systems are being financed and supported.

The third and final insight is that if the public and private resources that seek to address the crises are deployed in a blended and food systems-oriented manner, the common good of a healthy population and planet can be realized together with a financial return.

Current instruments for food systems finance are not reaching desired outcomes

In food systems thinking, the externalities of food production, processing, and consumption, which include health and environmental impacts, are equally important aspects when evaluating return on investments.

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Several aspects of the financial instruments currently deployed in Africa are broken:

1. Food system actors, mostly smallholder farmers and SMEs, are not being reached by current financial instruments thereby limiting their growth and contribution to sustainable food systems.
2. The financial sector does not sufficiently consider the costs and risks of climate change and biodiversity loss in investment decisions.
3. Patient public funding for food systems is decreasing and (global) subsidies and taxes are contributing to the degradation of natural resources thereby harming people, planet, and economies.

African food systems actors lack access to financial services

Food systems in Africa are predominantly made up of smallholder farmers and informal small businesses. While they form the backbone of the continent's food system, these entities often pose higher risks and offer lower returns on investment compared to larger, more formal businesses. This dissuades potential investors particularly when agriculture is mainly rainfed under a changing climate.

Other factors that discourage commercial banks and investors from doing business with small-scale farming and business operators include (FAO, 2021; World Bank, 2021, Dalberg, 2018):

1. The higher risk and cost of serving these food systems actors. Lending to agricultural SMEs is 4-5% less profitable than lending to other sectors (Dalberg, 2018).
2. Lack of structured, well-functioning markets for small-scale food systems actors, especially those who deal with staple crops, which limits their access to value chain financing.
3. High (opportunity) cost of capital due to excessive government borrowing. Treasury bills are a less risky and more profitable investment opportunity.
4. Low bankability of SMEs due to limited record-keeping, credit history, market access, management skills, and governance.
5. Lack of the requisite collateral combined with strict regulatory and prudential norms set by central banks.
6. High transaction costs for agricultural loans due to the remoteness of clients in rural areas and the number of small loans involved.
7. Women's access to financing is even more limited due to lack of assets especially land, lower levels of education, and constraining cultural norms.

Blended finance facilities that unlock private capital through public capital facilities have helped to address some of the constraints related to the unfavourable risk return ratio of agricultural finance. An example is the Agri Business Capital Fund (ABC Fund, 2019) - a blended investment fund established by IFAD targeting agricultural SMEs, cooperatives, and rural financial institutions. The Fund has built a USD 30 million portfolio partly invested in agricultural SMEs and cooperatives on one hand and rural financial institutions on the other. The fund is capitalized by public and private investors through share classes that have different risk return profiles. Another example is the Ghana Incentive-Based Risk-Sharing Scheme for Agricultural Lending (GIRSAL, 2019), a scheme of Bank of Ghana and AfDB that de-risks Ghanaian commercial bank agricultural loans.

GIRSAL Ltd. is a non-bank financial institution whose goal is to de-risk agricultural financing by financial institutions by issuing agricultural credit guarantee instruments and accompanying measures that enhance the capacity and appetite to provide credit to the agricultural and agribusiness sectors. GIRSAL was capitalized with GHS 200 million from the Bank of Ghana and USD 13.6 million from the Ministry of Finance through funding support from the AfDB but operates at arm's length of Government. GIRSAL has four operational pillars: a credit guarantee scheme for agricultural loans; a bank rating system; a knowledge portal; and a technical assistance facility. It is the combination of these elements that makes the GIRSAL model attractive to financial institutions. Since 2019, 28 financial institutions have signed agreements with GIRSAL for the guarantee facility. Sixteen of them have cumulatively disbursed USD 72 million worth of loans with GIRSAL guaranteeing over 100 agribusinesses mainly in the crops and input sector. Loan losses to date are less than 0.5 percent.

Blended finance initiatives in Africa's agriculture and food sector remain limited due to constraints such as high transaction costs to establish and manage (small) funds, lack of technical capacity to assess the risks and returns and manage complex application procedures, and inadequate or complex regulatory frameworks (Convergence et al., 2022; IFAD, 2020; Moyo, 2019).

Digitalization and loan securitization have been identified as possible solutions that can be deployed by the financial sector to address the lack of economies of scale and cost of lending to small enterprises and farmers.

Digital solutions deployed by financial institutions offer the possibility of reducing the cost and risk of agricultural lending. This is because the flow of information and cash is more efficient through digital channels and, furthermore, because digital access to information on borrowers and their activities reduces the risk of financing future defaulters. Other opportunities are digitization of the loan application and approval processes, which reduces the cost of lending. There are already good cases of digital lenders in the agricultural sector such as Apollo Agriculture in Kenya, which is already reaching 170,000 farmers with input loans and the increasing level of automation of rural financial cooperatives, which makes them more attractive service points for farmers and rural SMEs. However, the scaling of digital solutions also face challenges most notably high customer education and acquisition ("Tech 'N Touch") due to a lack of digital literacy in rural areas combined with low purchasing power and highly fragmented agricultural markets.

Securitization offers the possibility of increasing the supply of capital towards the agricultural sector. Many rural financial institutions and non-bank financial institutions (leasing and factoring companies and most public development banks) lack the capital to increase their loan books. Securitization refers to repackaging portfolios of (agricultural) loans into securities or tradable capital market instruments for transfer to other investors enables lenders. It includes the sale of pools of loans, leases, or other receivables to institutional investors to generate new lending capacity, thus overcoming funding constraints to enable the continued provision of loans to its customers. This instrument is still small in Africa but merits further exploration.

The issue of low bankability of smaller food systems actors, including farmers, may require the most innovation. Current practices of training farmers and SMEs and providing investment advisory and matchmaking services lack scalability, which makes them expensive. The lack of standards to measure and compare the effectiveness and costs of the provision of the different so-called non-financial services leads to un-informed spending of official development assistance (ODA) on these types of activities. In 2022, the Initiative for Smallholder Finance (ISF, 2023), Argidius Foundation, and the Small Foundation conducted research on how grants can be deployed more effectively based on evidence gathered to enhance the finance-ability of agricultural SMEs.

Financial sector actors are not pricing externalities

There is growing recognition of the direct and pronounced impacts of the environmental and climate crisis on the financial sector. Central banks have acknowledged biodiversity loss as an important source of financial risk; studies have found that between 35 percent and 54 percent of assets held by financial institutions are highly or very highly dependent on ecosystem services (Miller, 2022). According to the World Bank (2021), the collapse of certain ecosystem services provided by nature could result in a decline in global GDP of USD 2.7 trillion annually by 2030. It is projected that sub-Saharan Africa will experience the highest relative contraction of real GDP (9.7% per year). Failure to adequately address environmental destruction and climate change has great potential to destabilize financial systems around the world.

The ripple effects of the environmental crisis extend to the insurance industry as well. Insurers are grappling with rising uncertainty, as some risks associated with environmental degradation and climate change are reaching levels where they are no longer insurable. This trend is predicted to amplify in the face of worsening climate change impacts posing significant challenges for food systems risk management (Munich Re, 2023). The introduction of the Corporate Sustainability Reporting Directive (CSRD) in Europe (European Union) demands the inclusion of biodiversity and ecosystem impacts in corporate sustainability reports creating pressure for companies to align their investment decisions with environmental sustainability (Eur-Lex, 2023).

There is need to develop national climate accounting standards and regulation to incorporate climate considerations into investment decision-making as part of a concerted move towards mandatory reporting of sustainability metrics, climate accounting, and climate-related financial risk disclosures. This will also increase transparency for capital markets and fundamentally embed climate considerations into the financial system architecture and onto corporate balance sheet accounting. This is an important consideration, especially for national finance ministers, given the implications that lack of transparency and uncertainty around rising climate costs on food systems will have on sovereign debt markets.

Spent for food systems prioritizes short term effects over long term outcome

International public funding, including ODA and investments from multilateral banks, is shifting from reaching the long-term SDGs towards solving immediate crises (hunger, migration, natural disasters, etc.). In recent years, the bulk of ODA has been directed to humanitarian crises such as famines or other food security emergencies leaving less resources available for the long-term transformation of food systems.

While emergency response is crucial as it alleviates immediate suffering and prevents loss of life (World Food Programme, WFP 2022), these crisis response funds can also be deployed to invest in sustainable transformation of food systems that will break perpetuate vulnerability (International Food Policy Research Institute, IFPRI 2023). There is urgent need for a balanced approach on the supply side, which allocates sufficient resources to long-term investments aimed at enhancing resilience, sustainability, and equity in food systems (FAO, 2021; High Level Panel of Experts on Food Security and Nutrition, 2022). Such an approach should prioritize capacity-building, infrastructure development, and sustainable farming practices alongside emergency food aid.

Multilateral bank-funded programs, which provide financing to countries in the forms of concessional sovereign loans are also important to finance long-term food systems outcomes. For instance, the Agricultural Growth Program in Ethiopia, financed through World Bank loans, has led to improvements in agricultural productivity. Similarly, Senegal's Agricultural Development and Rural Infrastructure Project (PADAER, for its acronym in French), which is funded through an IFAD loan, has significantly increased smallholder farmers' productivity and incomes. However, the high debt burden that many African countries are currently experiencing threatens the long-term sustainability of such initiatives (World Bank, 2020).

Some of the reported drawbacks of multilateral funding of African governments to invest in food systems are: i) donor aid levels have been dwindling in recent years (UNCTAD, 2021); ii) this financial aid is often tied to specific goals or projects limiting the flexibility of farmers and governments to allocate funds where they are most needed; and iii) dependency on donor contributions may affect the sustainability and reliability of such programs (AfDB, 2016).

These drawbacks call for the need to align multilateral (and bilateral) funded initiatives with national priorities and for country-led and integrated approaches for more impactful outcomes. Some African countries (Malawi, Ghana, and Rwanda among others) have recently developed national food systems-based investment plans using the pathways towards sustainable food systems developed following the 2021 UN Food Systems Summit (UNFSS). These plans contain a set of complementing integrated priority investments in food production and processing, health, and nutrition as well as investments that sustain the natural capital of the countries.

Richer (high-income) countries spend more on agricultural subsidies than poorer countries even when compared to total agricultural production. In some countries, part of these subsidies incentivize excessive fertilizer usage to the extent that it suppresses agricultural productivity, degrades soils and waterways, and damages people's health. While African agriculture needs fertilizers to improve crop productivity on its depleted soils, more than half of global agricultural production now occurs in regions where fertilizer is suppressing rather than increasing productivity. Inefficient subsidy usage is responsible for up to 17 percent of all nitrogen pollution in water in the past 30 years. This has large enough health impacts to reduce labor productivity by up to 3.5 percent (World Bank, 2023).

Similarly, agricultural subsidies provided by richer (high-income) countries are responsible for the loss of 2.2 million hectares of forest per year, equivalent to 14 percent of global deforestation. For instance, livestock subsidies in the United States (U.S.) drive deforestation in Brazil by increasing the demand for soybeans as feedstock. In turn, subsidy-driven deforestation causes the spread of vector-transmitted diseases including

3.8 million additional cases of malaria each year with an economic impact of up to USD 19 billion per year (World Bank, 2023). To curb that trend, there is a call for subsidy reforms related to more than just subsidy removal and consisting of a package of measures that mitigate the risks of reform, including political opposition and adverse impacts on vulnerable groups, while maximizing their contribution to sustainable development.

Funding from African governments has historically been a significant source of finance for investment in rural infrastructure, research and extension services, and subsidized inputs to boost agricultural productivity (World Bank, 2018). Twenty years ago, in 2003, African countries committed to increase funding for agriculture significantly by allocating 10 percent of their respective annual budgets to the sector's development under the CAADP framework. According to Oxfam International, most African governments (48 out of 54) reportedly spend an average of 3.8 percent of their budgets on agriculture with some spending as little as 1 percent.

When it comes to subsidizing agricultural inputs, a common criticism is that they tend to favour larger-scale farmers over smallholders even though the latter account for most of the agricultural production in many developing countries (FAO, 2018). To address this, one of the AfDB's policy recommendations is for governments to refocus their subsidy programs to target the most vulnerable segments of the population such as smallholder farmers (AfDB, 2020).

As some countries spend a large share of their agricultural budgets on subsidies that are not necessarily leading to increased productivity, it is important to also revisit inputs subsidy schemes to ensure that they lead to more sustainable financing mechanisms. As an alternative, public funds can be used to enhance the uptake of agricultural insurance (through premium subsidy), which will unlock agricultural finance from private sector suppliers because of the reduced risk of default due to climate-related shocks.

An example of successful leveraging of domestic budget allocations to agriculture is Rwanda's Girinka (one cow per poor family) program. Studies show that the Girinka program had a positive impact on social cohesion ("pass on the first born calf to your neighbour"), household income and production, and increased the value of crop production among beneficiaries possibly due to an increased supply of organic fertilizers (Nilson et al., 2018). This illustrates how political will can ensure effective, targeted funding for smallholder agriculture (AU, 2018).

Ethiopia has also used domestic budgeting to finance food systems and mitigate food security notably through the Productive Safety Net Program, which is aimed at ensuring food security among vulnerable populations (Devereux et al., 2017). The program's positive outcomes underscore the need for safety nets to protect the most vulnerable populations.

An important recommendation of the AfDB Group, especially considering the intensification of the environmental crisis, is to use subsidies to promote sustainable, climate-smart farming practices. Similarly, the World Resources Institute (WRI) suggests principles for redirecting agricultural subsidies towards a sustainable food future. These include phasing out subsidies that encourage overuse of inputs or expansion of cropland or pastureland into natural ecosystems (Searchinger et al., 2019).

In its "Food Systems in Africa: Rethinking the Role of Markets", the World Bank advocates for the removal of distortive subsidies and taxes that discourage private sector participation and innovation and recommends investing in public goods such as roads, electricity, water, and storage facilities to foster market development and integration in African food systems (World Bank, 2021).

Tax collection revenue from international agrifood companies has remained low on the side of African governments. The Tax Justice Network estimates that low-income countries lose USD 36 billion per year because of tax avoidance and evasion by private firms. The agrifood sector is a major source of fiscal leakage with tax exemptions regularly attached to agri-export corridors and leading agribusinesses engaging in large-scale tax avoidance.

On the regulatory front, numerous policies are in place across Africa to encourage investment and financing in the agriculture and food sector. Their efficacy varies significantly as it is often hampered by i) gaps between policy formulation and implementation (Akoto et al., 2018) and ii) lack of an enabling environment for investment where issues such as insecure land tenure and weak contract enforcement often pose significant barriers for financial sector actors (World Bank, 2018). Other regulatory barriers to the growth of agricultural finance identified by a recent study by Aceli (2022) include items like loan loss provisioning, collateral valuation, and risk weighting of guarantee fund, which

reduce the effectiveness of de-risking instruments such as guarantee funds and alternative collaterals.

Summary

The main actors in the African food system are small and informal and lack access to finance due to the high risks and costs of serving them. Solutions such as blended finance, digitalization, and securitization of portfolios are gaining traction on the continent as tools to mitigate some of the costs and risks.

The financial sector, including insurers and regulators, should start to make climate change and biodiversity loss-related risks part of their investment decisions, which might decrease their appetite to invest in food systems. Alternative sources of targeted capital are needed to make up for the financing gap.

While food systems transformation requires long-term public capital, this is decreasingly available. However, agricultural subsidy reforms in richer (high-income) countries and enhanced tax collection by African governments might become new sources of funding.

Multiple crises in Africa call for innovations in food systems finance

Food and nutrition crisis

In the aftermath of the COVID-19 pandemic, the intensifying conflict between Ukraine and Russia has sparked a severe global food crisis. Both countries are major exporters of food commodities and fertilizers that are crucial for agriculture globally. Their conflict disrupts these trade flows, causing food prices to surge (OECD, 2023). Many African countries depend heavily on these imports to feed their population and supply their agricultural sectors. The skyrocketing costs have made these imports prohibitively expensive leading to food shortages and increased food insecurity (WFP, 2023; USAID, 2023). According to the Global Report on Food Crisis 2022, in 2021, of the close to 193 million people in the world experiencing acute food insecurity (a 24 percent increase from 2020), over 60 percent were in Africa: 45.56 million in Central and Southern Africa; 43.6 million in East Africa; and 30.4 million in West Africa and the Sahel (GRFC, 2022).

The food crisis goes together with the nutrition crisis: rural areas and fragile regions of the continent continue to grapple with undernourishment and tend to be affected more severely by the rising prices of food and agricultural inputs. A fifth of the African population (or 278 million people) is undernourished, and 55 million children in Africa under the age of five years are stunted due to severe malnutrition (Oxfam International 2023).

At the same time, the rapid pace of urbanization in Africa has precipitated a unique and challenging dichotomy in the nutrition landscape between the rural poor and the trend of growing obesity predominantly among the urban middle class. According to WHO, one in five adults and one in ten children and teenagers in ten high-burden African countries are projected to become obese by December 2023 (WHO Africa, 2022). The increased availability and relative affordability of unhealthy food options in cities has led to changes in dietary habits with urban dwellers favouring less nutritious options over healthier alternatives (WHO, 2022; Ng et al., 2014).

These food and nutrition crises call for financial innovations such as true pricing of food, which considers the costs of externalities (damage to health and natural capital) in the cost of food. Healthy options such as local fruit and vegetables would become relatively cheaper compared to food containing sugar and saturated fat or food that is fossil fuel-intensive because of transport and processing. Taxation can reduce their attractiveness and allow for relatively lower cost of healthy and nutritious food.

Debt crisis limits public food systems actors' investments in the common goods.

The strain on government fiscal resources, compounded by the existing debt crisis in many African countries, makes it challenging to mitigate the effects of the food crisis due to the limited financial capacities. This further exacerbates already persistent and worsening food and nutrition security problems (IMF, 2023).

Unsustainable debt levels are a major risk. Debt levels across Africa were on the rise even before the COVID-19 pandemic, as countries were forced to borrow more to keep up with financial needs (ONE.org). The combined effects of the pandemic, the Russia-Ukraine conflict, and soaring inflation around the world only made the situation worse. Africa's debt is now at its highest level in over a decade: 21 countries on the continent are in or at high risk of debt distress. As of 2021, African countries owed USD 644.9 billion to external creditors and will pay USD 68.9 billion in debt service in 2023 (ONE.org, 2023). While African countries' combined debt is equivalent to 24

percent of their combined GDP in 2021, the external debt levels of some countries like Angola, Cabo Verde, Djibouti, Mauritius, Mozambique, Rwanda, Seychelles, Sudan, Tunisia, and Zambia had reached more than 75 percent of GDP (Akeredolu, 2023).

Not only has indebtedness in the region reached critical levels, but the composition of African debt has also changed significantly over the past decade. Previously, African countries owed most of their debt to official creditors – high-income countries and multilateral lenders such as the World Bank and IMF, which tend to practice much lower interest rates. Now, China and private creditors make up a sizeable proportion of debt stocks. More than 40 percent of African debt is owed to private creditors, 32.5 percent to multilateral creditors, and 26.6 percent to bilateral creditors, mainly China (over USD 73 billion of Africa's debt in 2020) (ONE.org, 2023). While private creditors have reportedly charged African countries between 7 percent and 10 percent in interest against the less than 1 percent on loans to the US and the UK (Gbadamosi, 2023), China is said to have applied a 2.7 percent interest rate on loans to the region in 2021 (Akeredolu, 2023). It is also important to note that when 12 African countries – including Ghana and Zambia[3] – were reclassified from low-income (LICs) to low-middle-income countries (LMICs), they were no longer eligible for soft loans and grants forcing them to resort to high interest loans, often in US dollars, to fund state services.

This change in the composition of Africa's debt raises two major challenges: first, a greater portion of this debt is non-concessional, meaning higher interest payments, which, when combined with rising risk premiums and currency depreciation, has resulted in substantial increases in debt service payments. One estimate puts this increase at as high as 120 percent in the past decade (Gbadamosi, 2023). The second challenge stems from the growing complexity of dealing with various creditors. "African countries looking to discuss easing the debt burden face the uphill task of coordinating creditors with varying interests and willingness to cooperate" (Akeredolu, 2023). To make matters worse, recent emergency initiatives to help poorer countries manage their debt payments have ended up costing them more. For instance, under the G20 Debt Service Suspension Initiative, Zambia obtained USD 700 million in debt relief, yet the depreciating kwacha led to a USD 1.7 billion-increase in the country's debt burden (Gbadamosi, 2023). Effective debt restructuring is key to free up significant fiscal space in African countries (UN's SDG Stimulus Plan) and allow their governments to regain access to credit.

Unsustainable debt levels of African governments severely restrict their fiscal space undermining the public sector's ability to drive the transformation of food systems. The impact of over-indebtedness on agriculture and food systems is, in fact, multifaceted. First, it limits the resources available for investments in agricultural research and development (R&D), which are essential for improving productivity and sustainability, as well as much-needed infrastructure such as roads, markets, and irrigation facilities that supports the food system (IFPRI 2021, AfDB 2021). Secondly, it constrains the public sector's ability to provide financial incentives and essential services such as extension services to farmers, thereby limiting their capacity to adapt to more efficient and sustainable agricultural practices (FAO, 2022). Finally, it can impede the ability of governments to implement social protection programs that enhance food security particularly for the most vulnerable populations (UNDP, 2022).

In the midst of this debt crisis, ODA to African countries has been on the decline as mentioned earlier; in 2022, it fell by 7.4 percent in real terms compared to 2021 (OECD 2022). This reduction directly impacts the availability of concessional funding (OECD, 2022), which is more manageable for recipient countries (World Bank, 2019) due to the lower interest rates and longer repayment periods. With the decrease in ODA, countries will undoubtedly find it harder to finance essential investments in agricultural productivity, climate resilience, food security and nutrition thus resulting in a slowdown in the transformation towards more sustainable, resilient, and equitable food systems and progress towards the SDGs (UNDP, 2021). The current scenario underscores the need for innovative financing mechanisms and diversified funding sources to fill the gap left by declining ODA.

Environmental and climate crisis affect Africa's human and natural capital.

Africa faces serious environmental challenges including land and soil degradation, water scarcity, deforestation, biodiversity loss, and extreme vulnerability to climate change (UNEP, 2022). The escalating environmental crisis is having devastating impacts on African farmers who experience the effects

3 Zambia has been reclassified as a LIC for the 2023 year by the World Bank.

of climate change in their daily lives. Many have already suffered losses of hard-earned assets, entire crops, and livestock herds. This has led to disruptions in agrifood value chains and further inflation of food prices because of increases in the frequency, intensity, and duration of droughts and floods, record-high temperatures, desertification, rainfall variability, locust infestations, water scarcity, and soil erosion.

Agricultural production is expected to drop by at least 20 percent in Africa by 2050 (Global Adaptation Centre, 2023) reducing food availability and farmers' incomes and intensifying competition over diminishing natural capital. This in turn affects entire food systems and fuels conflict, instability, and migration, especially of rural youth. With African youth (population under 30 years of age) representing 70 percent of the continent's population and an estimated 440 million young people expected to enter the region's labour market by 2030 (IFAD,2022), investing in engaging youth, especially young women, in food systems development must be a top priority in strategies to drive the transition to sustainable, inclusive food systems across the continent.

Underpinned by biologically diverse ecosystems, nature is critical to human survival, health, wellbeing, and economic prosperity. Half of the global GDP of USD 44 trillion is generated in sectors such as construction, agriculture, and energy that highly or moderately depend on nature and its services. Two-thirds of food crops rely, at least in part, on animal pollination. This natural capital, along with produced capital, human capital, and non-renewable natural resources makes up countries' wealth and generates income that drives economic growth and progress towards achieving the SDGs. Prevention of biodiversity loss is therefore crucial in building sustainable food systems. Apart from climate change, the key drivers of biodiversity loss are mostly related to food systems. These include (IFC, 2022):

- Land-use change: is the biggest single source of pressure on biodiversity worldwide, leading to habitat loss, fragmentation, and degradation. It includes ecosystem conversion from agriculture, unsustainable forest management, urbanization, industrial developments, and transport networks.
- Overexploitation and unsustainable use of nature: overexploitation and destructive harvesting practices are a critical threat to the world's biodiversity and ecosystems. Unsustainable water use for agriculture puts further pressure on biodiversity and the health of ecosystems.
- Pollution: this is a growing threat to biodiversity in terrestrial, inland water, coastal, and marine ecosystems. It includes air pollution, greenhouse gas emissions, untreated urban and rural waste, plastic pollution, pollution from nutrients (such as nitrogen and phosphorous), and other pollutants from industries, mining, and agricultural activities.
- Invasive species: the spread of invasive alien species continues to be a major threat to all types of species and ecosystems. Invasive species introduced intentionally as part of project design or unintentionally through unrelated project activities can have a negative impact on native ecosystems.

African countries will benefit from innovative financial solutions supporting the transition to nature-smart production practices and deployment of nature-based climate solutions. Biodiversity finance, defined as finance that contributes or intends to contribute to activities that conserve, restore, or avoid a negative footprint on biodiversity and ecosystem services, has emerged as a fast-growing area in green finance. Investors, financial institutions, and bond issuers globally have demonstrated an increased interest in financing the transition to nature-smart economic activity, which was further reinforced by the introduction of the environment, social, and governance (ESG) principles. However, there is still a lack of guidance in the market on criteria for projects eligible for this kind of financing.

Summary

The food and nutrition crisis diverts long-term investments in sustainable food systems that are adapted to climate change towards short-term food aid and humanitarian interventions. At the same time, the debt crisis reduces the capacity of African governments to intervene. To avoid a food systems break, radical changes in the way food systems are financed are needed.

Moving funding from harmful practices and products such as levying carbon, sugar, and fat taxes and reducing agricultural and fossil subsidies towards funding investments in climate adaptation, mitigation, and biodiversity are the building blocks for developing innovative financing mechanisms.

Innovative public and private food system financing that benefit the public common good

The three interrelated crises described above (food and nutrition, over indebtedness, and climate and biodiversity) lead to large scale mobilization of new public and private capital that can, if deployed in a blended manner, derive a sustainable food system transformation. Marrying short term economic growth and job creation with investments in long-term public goods such as a healthy planet and population, requires more deployment of blended finance in Africa. African governments should strategically use their resources and other international and local public capital (including philanthropic funds) for food and nutrition security, debt relief, climate adaptation and mitigation, and biodiversity to mobilize private investments into food systems transformation.

Blended finance, combined with Africa's leapfrogging to digital solutions in the financing landscape, will enable Africans, including those living in remote rural areas, to get connected to basic financial services and food systems services such as extension, market information, and logistics, which will contribute to the sustainable transformation of food systems in Africa.

Innovative financing opportunities using food and nutrition crisis funds.

WFP's experience in buying and distributing food in 80 countries across the world to respond to food crises provides important insights in the main problems facing food systems. These are:

- The "last mile" problem: most of the hungry poor are geographically, economically, socially, and politically isolated and thus hard to reach. Even when nutritious food is available, it is often too expensive to access.
- The "bad year" or "lean season" problem: when crops fail, or during the lean months between harvests, poor families in both urban and rural areas lack the resources to meet their food needs and are forced to adopt detrimental strategies including eating less and eating less nutritious food to cope.
- The "good year" problem: even a plentiful harvest can have its downsides. Inadequate capacity to store, market, and transport food surpluses causes food prices and quality to drop causing farmers to miss out on putting their produce for sale at a premium when demand is highest. As a result, food is wasted and spoiled, and market volatility is sharpened.

These three problems tend to disproportionately affect women partly because they have more limited access to assets and services and may be excluded from decision-making processes.

In response, food aid is increasingly being used to invest in food systems making rural communities more resilient and building their capacity to absorb, adapt, and transform. Examples of such innovations in food aid programs include: local or regional sourcing of food distributed in food aid programs (for example, the WFP patient procurement platform); home-grown school meal programs in which local farmers produce the food served in schools; the creation and rehabilitation of infrastructure in exchange for food or cash-based assistance; strengthening public food reserves; and supporting smallholder farmers through the facilitation of credit, capacity development, and access to markets.

Another instrument used in times of food crises is debt-for-food-security swaps, which is a response to both the food and nutrition and debt crisis. A debt-for-food swap is the foregoing of repayment of public debt by a creditor (donor government), under condition that the borrower invests the money in food security programs. The benefits for the creditor are that the swap is an opportunity to increase ODA without using new resources while ensuring that the resources freed-up are used to finance programs under SDG 2 (zero hunger). For debtors, the swap means an immediate reduction in foreign currency denominated debt creating fiscal space to reprioritize the use of scarce foreign exchange resources and an opportunity to increase or sustain domestic spending on SDG 2 in a multi-stakeholder environment.

Apart from innovative usage of food aid expenditures, countries can strategically use taxes on unhealthy food items such as sugary drinks or highly processed foods for the transition to sustainable food systems and agriculture. Such taxes can serve a dual purpose: they discourage the consumption of unhealthy food products thereby contributing to improved public health and generate revenue that can be used to fund initiatives that promote food security and nutrition such as school meal programs (Thow et al., 2010). For these taxes to be effective, they must consider tax rate, price elasticity, substitution effects, corporate lobby efforts and their impact on income and the cost of living. (World Health Organization, 2017).

South Africa was the first African country to impose a tax of approximately 10 percent on the sugar in sweetened soft drinks to curb rising obesity and related diseases including diabetes and hypertension. The tax was effective—South Africans are consuming fewer sugary drinks since the tax was introduced in 2018 but powerful multinational food and beverage companies are inhibiting neighboring countries from following suit, which exhibits the tensions between economic and health considerations. Although seven countries—Botswana, Namibia, Zambia, Uganda, Kenya, Rwanda, and Tanzania already tax soft drinks, none target the sugar content or do so for health reasons. This despite non-communicable diseases (NDCs) accounting for one-third of deaths in some African countries like Uganda. There is "limited recognition" of the link between sugary drinks and NCDs. (https://www.tandfonline.com/doi/full/10.1080/16549716.2021.1892307#)

Innovative blended financing opportunities from debt crisis relief

The unsustainable debt levels of many African governments are creating the need to decrease these countries' dependency on food and fertilizer imports to diversify and localize their food systems. The steps to reduce dependency include increasing local and regional trade using local currencies, investing in local production of crop nutrients and seeds, and mobilizing local capital for food systems investments. Debt relief instruments (refinancing or foregoing of debt) can be used to direct investments into making food systems more sustainable.

The African Continental Free Trade Area (AfCFTA) is an unprecedented agreement among 54 African nations, which provides an exceptional opportunity to revolutionize food systems across the continent. By fostering the development of an integrated market, the agreement can significantly decrease dependence on food imports. It can also augment regional trade, which can bring down food prices and pave the way for the de-dollarization of African trade, an essential step for economic sovereignty (AfCFTA, 2021; UNECA, 2021), and for the emergence of new financial instruments such as local currency hedging and regional trading and procurement platforms (ATEX) that are being developed by Afreximbank. With the reduced trade barriers that AfCFTA provides, African countries can attract more foreign direct investment (FDI) into their agricultural and financial sectors. Such investments can further bolster food systems through the transfer of technology, knowledge, and innovative farming and financing practices (UNCTAD, 2020).

In refinancing debt through issuance of bonds, these can be linked to sustainability outcomes in so-called green, social, sustainability and sustainability linked (GSSS) bonds, which align financial returns with sustainable development outcomes. The bonds come with different names or labels with green bonds as the most popular type and their proceeds generally destined to financing projects that generate positive environmental impacts such as investments in renewable energy, green buildings, clean transportation, or climate change adaptation.

According to the World Bank (WB 2018), potential drawbacks to green bonds include: (i) savings for issuers (governments) are for the most part almost insignificant despite the identified greenium and the final costs will still be strictly tied to creditworthiness as measured by credit rating agencies; (ii) the combination of promises to bond buyers and fiscal austerity may have unintended consequences such as having to cut down on other budget items; and (iii) linking bond proceeds to specific public expenditures (that is, ring-fencing) can lead to more expensive funding, or even underfunding. Lastly, the financial engineering and involvement of several actors can be costly. In Belize, the cost of the debt for climate swap disclosed was USD 10 million, while some estimated it up to USD 85 million, which is a sizable amount for such a deal and economy.

The issuance of bonds could prove to be a particularly interesting option for raising funds for the agriculture sector due to the long-term nature of bond investing. Furthermore, the global GSSS bond market has been experiencing very rapid growth reaching close to 700 billion Euros in annual issuances in 2021 (OECD 2022, 13).

African countries and AfDB have begun issuing bonds: Nigeria issued the first African sovereign green bond in 2017 allocating part of the funds to agriculture (Climate Bonds Initiative, 2017). Another example is Ethiopia's diaspora bond initiative, which has funded various developmental projects including agricultural ones. The World Bank approved its first sustainability-linked bond providing USD 100 million to support Rwanda in increasing access to finance and supporting businesses' recovery and resilience in the post-pandemic period.

Upscaling debt swaps is seen to invest not only in climate and nature (as in the case of the Seychelles and Belize and the recently closed blue swap in Gabon), but also more generally in sustainable development without adding to the debt burden of developing countries. Recent estimates suggest that, in the short-run, climate and nature-linked debt instruments alone could provide up to USD 105 billion of debt relief and help mobilise USD 329 billion in new borrowing (Patel 2022).

Funds generated by debt swap operations, especially those that are bilateral, are often disbursed using grants. The use of funds that would upscale the impact of the debt swap could be optimized through: (i) a switch from grants to financial instruments (loans, equity or guarantees) to generate a return that could be invested in additional development projects; and (ii) leveraging grants to de-risk private sector investments–in other words, create blended finance instruments.

Innovative financing opportunities from climate and biodiversity crisis investments

Climate adaptation, mitigation, and biodiversity funds represent a fundamental source of resources for transformative change in food systems. This is particularly the case considering escalating climate change impacts and the accelerating loss of biodiversity and natural capital (water and soil). Deploying these funds in targeted investments can help build resilience in food systems ensuring they can weather the adverse effects of climate change and halt biodiversity decline.

The United Nations Framework Convention on Climate Change's (UNFCCC's) Green Climate Fund (GCF) portfolio overview and details shows that financing earmarked for climate change purposes is being used to support the adoption of agroecological practices, biodiversity conservation, the development of climate-resilient crop varieties and animal breeds (FAO, 2022; IPCC, 2021), renewable energy sources to power food systems value chains, and to support farmers with access to climate-smart techniques and technologies including crop insurance. (FAO, 2020; IFAD, 2021; UNDP, 2020).

Under the Paris Agreement, developed countries pledged to mobilize US$100 billion annually in climate finance to aid developing nations. However, this commitment has not been fully realized with dire consequences for the capacity of developing countries to create climate-resilient food systems. The shortfall in climate finance is a pressing issue particularly given agriculture's dual role as a significant contributor to and a potential solution for climate change (UNFCCC, 2023).

As in the rest of the world, the agricultural sector in Africa has historically received a disproportionately low level of financing: only 1.7 percent of total global climate finance is allocated to smallholder farmers. As for the funding needed, data submitted by 51 African countries indicates that together, between 2020 and 2030, these countries will need around USD 2.8 trillion to implement their Nationally Determined Contributions (NDCs) or approximately USD 250 billion per year. Current funding levels do not even come close.

In 2020, total domestic and international annual climate finance flows in Africa for the year were only USD 30 billion or about 12 percent of the amount needed. Climate Policy Initiative (CPI) calculates the mitigation needs for the agriculture, forestry, and land use sectors for the African countries at USD 108.1 billion and adaptation at USD 49 billion for the 2020-2030 period. This funding gap therefore constitutes yet another daunting challenge for the transition to sustainable, resilient, and inclusive food systems in Africa.

Contributions by international development aid agencies offer substantial funding for climate-smart food systems. Noteworthy are AfDB's USD 25.71 million Africa Climate Change Fund (ACCF); the UNFCCC's USD 10.3 billion GCF; and the joint World Bank-International Finance Cooperation (IFC) USD 8 billion Climate Investment Funds (CIF) (AfDB, 2020; GCF, 2020; CIF, 2019). Combined with the Global Environment Facility (GEF) and the Africa Adaptation Acceleration Program, these climate and environment funds have significant potential to contribute to improved climate resilience and reduced emissions in the food systems of various African countries while safeguarding natural capital.

However, like other types of blended finance, issues of access and absorptive capacity and transaction cost persist especially among smaller nations and marginalized communities.

Carbon taxes that allow governments to embed external costs of unsustainable practices are an alternative source of funding for climate adaptation and the African NDCs. World Bank April 2022 reports indicate that there are 37 carbon tax initiatives in

different countries around the world, although the number is likely to increase as more countries seek direct carbon pricing as a response to the challenge of climate change. Kenya's National Treasury has issued a Draft National Green Fiscal Incentives Policy Framework, which includes a proposal for the Government to explore the viability and design of a carbon tax.

Costa Rica's Program for Ecosystem services (PES) is an interesting example of how pricing of harmful products can be invested in sustainable food systems. In this case, carbon tax is used to pay for ecosystem services.

Since 1997, Costa Rica's Payments for Ecosystems Services (PES) program has returned forest cover to over 50 percent of the country's land area from a low of just 20 percent in the 1980s.

Fuel tax, also referred to as the Ecotax, is the main source of funding for the Environmental Services Payments Program. This special tax on the consumption of any crude-oil derivates passed as part of the new Forest Law in 1996 and caused major policy debate involving the National Constitutional Court because fiscal policy in Costa Rica (as in most other countries) opposes the earmarking of any tax or levy for specific purposes. In passing this controversial fiscal measure as part of the Forest Law, Costa Rica has visibly succeeded in placing forests high on the list of national priorities.

Environmental Service Certificates constitute another novel financing instrument to mobilize private investments. These certificates are issued for voluntary contributions by the private sector and the funds are used to finance payments for environmental services. Buyers of the certificates normally define to which forest areas the funds must the applied. In addition, FONAFIFO (the National Fund for Forestry Financing) obtains payments for the protection of water resources through agreements with hydro-electric companies.

The international community also invests in the Environmental Services Payment Program. For example, the World Bank and GEF have provided a credit line of USD 32.6 million and a grant of USD 8 million respectively to help finance the program.

Carbon tax might become an alternative income stream to complement the voluntary carbon market (VCM) where carbon offset credits are traded. This market has suffered decreasing prices recently due to transparency and integrity issues, the voluntary nature of the market (both supply and demand), and high transaction costs related to identification, validation, and verification of the avoided GHG emissions generated through the projects.

Finally, private sector capital represents a rapidly growing source of climate finance. Investment and equity funds, commercial financial institutions, corporations, and private citizens are increasingly investing in adaptation and mitigation-related activities (TBI, 2021). This trend reflects the growing recognition of the financial and strategic value of climate-resilient food systems (Buchner et al., 2020). However, there is need to further incentivize private sector investment and ensure that it aligns with national and international climate and development goals (UNEP, 2018).

Conclusion

As different sections of this chapter have argued, food systems thinking opens opportunities for Africa to deploy public and private investments to transform how food is produced, processed, and consumed so that Africa's population and natural resources become increasingly resilient to shocks and crises.

The sections have explored possible policies, products, and practices that support the availability of much-needed investments in sustainable food systems. Governments, private sector, financial institutions, and international aid organizations have distinct roles to play. In summary, the recommendations from this chapter are:

For African Governments

1. Tax harmful products and practices to mobilize funds for food system investments. For example, the use of carbon tax on fossil fuel to pay for ecosystem services or the use of sugar and fat tax to provide nutritious school meals.
2. In restructuring government debts, negotiate improved terms based on global ecosystem services delivered by the country.
3. Regulate voluntary carbon markets to ensure that benefits are shared in an equitable manner and benefit the people who are delivering the ecosystem services.

4. Use (food systems-related) public budgets to unlock private investments by deploying simple, low-cost blended instruments like GIRSAL (guarantee funds, interest rebates, first loss facilities, etc.).
5. Develop definitions and monitoring and reporting frameworks for climate and green financial instruments and review central bank regulations to be more food systems friendly.
6. Streamline investments in sustainable food systems, consider setting up one coordinating focal point in the public sector to help ensure transparency, integrity, information and knowledge-sharing, and avoids duplication and creates additionality among different investments in food systems.
7. Public policy will be crucial in fostering new innovative financing solutions or incentivizing private domestic investors to adopt and allocate finance in new ways that promote food systems transformation.
8. Invest in financial and digital literacy to enhance the participation of all people including rural women and youth in food systems.

Private sector (large and small)

9. Ensure registration and pay taxes due in the countries where turnover and profits are realized so that the government has the necessary resources to invest in common public goods such as infrastructure, R&D and ecosystem services.
10. Invest in greening your business processes and products thereby reducing your GHG emissions and other externalities in your supply chain.
11. Be prepared for changing regulations regarding sustainability reporting and reduced appetite of insurance companies to provide insurance for activities that are harmful for the natural environment or suffer from the effects of climate change.
12. Take advantage of advances in innovative finance for food system transformations to improve business practices, particularly in bookkeeping and financial and sustainability reporting, to become eligible for new types of financing instruments.
13. Invest in local sourcing and supply chains thereby reducing GHG emissions and becoming more resilient to (global) shocks that might disrupt infrastructure and logistics.

International aid agencies (including philanthropic capital)

14. Activate a shift in mindset and funding from short-term crisis response to interventions that strengthen food security in the long term. Examples are investments in extension services, agricultural R&D, digital information services, and small-scale irrigation that make food production and farmers more resilient to shocks and crises.
15. Use grant funds as much as possible to unlock additional private sector capital through simple, well understood blended finance instruments such as first loss facilities, interest rebates, and guarantees.
16. Use (food aid) subsidies to promote sustainable, climate smart farming practices and to target the most vulnerable populations with means of production sourced from and through the local private sector.
17. Repurpose existing agricultural support measures in the global north to finance climate commitments and investments in sustainable food system transformation in low-income countries.

Financial sector (investors and banks)

18. Invest in blended instruments and seek collaboration with public sector investors. Lack of awareness and regulatory frameworks and high transaction costs are slowing down the deployment of blended instruments and the development of capital markets. Deploying ODA to accelerate the uptake of blended innovative instruments through awareness creation and financial literacy would be highly catalytic.
19. Deploy the funds available to address the food, nutrition, climate, and biodiversity crises in an innovative manner that helps reduce the debt burden of African countries while making food systems more sustainable. The financial sector should support such innovations that include debt swaps and securitization of loan portfolios to reduce the cost of funding and free up liquidity for investment in food systems.

Nigeria - Access Bank's Green Bond Initiative

Access Bank, in partnership with the Nigerian Securities and Exchange Commission and the Lagos State Government, successfully raised a total of NGN 15 billion (USD 41 million) in Africa's first certified corporate green bond in March 2019. The bond, which had a 15.5 percent coupon and a five-year tenor, was oversubscribed demonstrating strong confidence in the initiative (Access Bank Plc, 2019). Proceeds from the bond issuance are allocated to projects with environmental benefits that are aligned with the Bank's five-year strategic initiative. The key target areas are renewable energy, clean transportation, energy efficiency, water management, and sustainable agriculture. The success of Access Bank's green bond initiative extends beyond raising capital for environmental projects as it demonstrated the viability of green bonds as a mechanism for financing sustainable initiatives in Africa. Moreover, it raised awareness of climate change and sustainability issues in Nigeria's financial sector and the broader public, prompting other financial institutions to consider similar initiatives (Climate Bonds Initiative, 2019). Access Bank's Green Bond initiative is a clear testament to the role that financial institutions can play in driving sustainable development while contributing to the global fight against climate change. The success of this initiative offers valuable lessons for other African banks and countries, indicating that green bonds could be a feasible and impactful avenue for financing sustainable development in the region.

West and Central Africa - IGREENFIN: An inclusive green financing initiative to revolutionize financing for climate resilient, low emission smallholder agriculture

IFAD has recently launched IGREENFIN, a new initiative in West and Central Africa (WCA), to capitalize on these opportunities: the inclusive Green Financing Initiative: Greening Agricultural Banks and the Financial Sector to Foster Climate Resilient and Low Emission Smallholder Agriculture in the Great Green Wall (GGW) countries financed by GCF for its first phase of USD 250 million with the aim of greening the financial sector and tackling one of the main constraints on the transition to climate-resilient, low-emission agriculture by increasing smallholder farmers' access to much-needed financing and technical assistance. The IGREENFIN model is made up of three pillars: i) increased access to highly concessional green financing for smallholder agriculture with loans at zero percent interest; ii) technical assistance and capacity-building on green financing and green business development to agricultural banks on the supply side as well as to farmers on the demand side; iii) regional support program for more effective information sharing, knowledge management and coordination among projects.

Kenya - Equity Bank's Green Energy Financing

Equity Bank, one of Africa's leading financial institutions, has made significant strides in green lending through its innovative Green Energy Financing initiative. Launched in partnership with the German Development Bank (KfW) and GCF, the Green Energy Financing initiative was designed to provide affordable and accessible green lending options to Kenyan farmers. The initiative is one of the first in Africa to offer zero-interest loans to farmers for the adoption of renewable energy technologies and environmentally friendly farming practices (GCF, 2019). Through the initiative, farmers can access loans to invest in sustainable farming technologies such as solar-powered irrigation systems, bio-digesters, and energy-efficient stoves. The loans, which come with a flexible repayment period and no interest, are meant to encourage more farmers to adopt green technologies thereby promoting sustainable farming while also contributing to the mitigation of climate change (Equity Bank, 2022). From the time of its inception to the end of 2021, more than 600,000 smallholder farmers had benefitted from the initiative through the zero-interest loans. In addition, the initiative has led to the reduction of approximately two million tons of carbon dioxide emissions because of the increased use of renewable energy technologies in agriculture (GCF, 2021).

Innovative financing for sustainable food systems transformation in Africa

The main actors in the African food system are small and informal and lack access to finance due to high risks and the costs of serving them. They are the most vulnerable to climate change and poverty and hardest hit by the multiple crises affecting the region. The food and nutrition crisis diverts long-term investments in sustainable food systems that are adapted to climate change towards short-term food aid and humanitarian interventions while the growing debt crisis reduces the capacity of African governments to intervene. Radical changes in how food systems are financed are needed to prevent food systems from breaking. Moving funding from harmful practices and products (levying carbon and unhealthy food taxes and reducing agricultural and fossil subsidies) towards funding investments in climate adaptation, mitigation, and biodiversity are the building blocks for developing innovative financing mechanisms.

Food systems transformation requires long-term public capital, which is decreasingly available. However, agricultural subsidy reforms in richer countries and enhanced tax collection by African governments could represent new sources of funding. Solutions such as blended finance and securitization of portfolios to mitigate some of the costs and risks are gaining traction on the continent. Other options are deploying the funds available to address the food, nutrition, climate, and biodiversity crises in an innovative manner that helps reduce the debt burden of African countries while making food systems more sustainable. Such innovations include debt swaps, taxes on harmful products and practices, and green or sustainability-linked bonds whose proceeds are invested in building sustainable, resilient, and inclusive food systems.

There are also signs of growing involvement and interest on the part of the financial sector; for example, insurers and regulators are starting to make climate change and biodiversity loss-related risks part of their investment decisions and looking for opportunities to invest in portfolios of sustainability-linked assets. It is also true that the high risks associated with small-scale farming and agribusiness under a changing climate might decrease these actors' appetite to invest in food systems. Alternative sources of targeted capital are thus needed to make up for the financing gap and the fulfilment of countries' commitments on financing for climate adaptation, mitigation, and biodiversity funds is essential to fill this gap. For countries in Africa to fully take advantage of these sources of financing, capacity-building, technical assistance, and resources must also be provided.

Lack of awareness, regulatory frameworks, and high transaction costs are barriers to developing these instruments and investment markets faster. Deploying ODA to accelerate the uptake of these innovative instruments would be highly catalytic, as would supporting the development of digital tools to tackle these barriers.

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11 Conclusion

John M Ulimwengu[1]

With its vast arable lands and youthful population, Africa holds the potential to not only ensure food security for its people but also play a crucial role in the global food system. However, the continent is still grappling with myriad challenges from climate change and infrastructural gaps to inadequate policies, which require proactive and innovative solutions.

In this report, experts have delved deep into the intricacies of African food systems highlighting both the opportunities for transformation and the challenges that lie ahead. The report's in-depth assessment and stocktaking analysis of African food systems provides valuable insights into both the challenges and opportunities facing the region. Africa's rich agricultural potential combined with its diverse cultures, youthful population, and emerging technologies offers a hopeful outlook for food-secure Africa. To capitalize on these opportunities and pave the way for a robust and sustainable food system, the following recommendations are put forward.

Infrastructure development, from rural roads to storage facilities, can significantly reduce post-harvest losses and improve market access ensuring that farmers get better returns and consumers receive fresher produce. Fast-tracking the operationalization of AfCFTA will be a game-changer; by removing trade barriers, harmonizing standards, and facilitating intra-Africa trade, AfCFTA has the potential to trigger successful food systems transformation. When fully implemented, the AfCFTA is expected to increase intra-African trade by 53 percent, and Africa's trade with the rest of the world by 15 percent.

Food systems transformation requires long-term public capital and traditional financing models should be complemented with innovative solutions such as agri-business bonds and green financing to drive investments into the agricultural sector and food systems at large. There is a need for cutting-edge financial strategies and models that can drive African food systems into a sustainable future. This report calls for a strong commitment to research and development in agro-tech, sustainable farming practices, and other innovative solutions that can propel Africa to the forefront of global food production. All stakeholders in African food systems should promote systematic innovations for multiple wins such as productivity, nutrition, climate adaption and mitigation, and the inclusion of smallholders, women, youth, and other disadvantaged groups. Establishing platforms for knowledge sharing would allow African countries to learn from each other's successes and challenges, accelerating transformation across the continent.

The adoption of digital tools, from mobile banking to precision agriculture, holds the promise to increase efficiency, reduce costs, and connect stakeholders throughout all food systems components. However, inadequate physical infrastructure, limited access to ICT, lack of relevant information, asymmetric benefits, absence of appropriate legislative and regulatory infrastructure, financial constraints, and data privacy issues are often highlighted as key concerns for the expanded digitization of food systems.

Striking a balance between productivity and sustainability is crucial; successful transformation of African food systems will require a critical focus on improving nutrition while ensuring that current environmental impacts are not exacerbated. Governments must develop and implement policies that incentivize sustainable and productive practices. For example, initiatives that promote sustainable agricultural practices and biofortification of crops can ensure both environmental health and nutritional adequacy.

Africa's youthful population is its most significant asset. The potential to harness this demographic dividend is exciting but, without the necessary investments, a large and unproductive workforce could place an enormous burden on African food systems. Empowering the youth through education, skills training, and entrepreneurship opportunities in the agri-food sector will trigger innovative solutions and energetic leadership for the future.

In conclusion, the transformation of African food systems is not only a matter of urgency but also an incredible opportunity to uplift millions from poverty, improve nutrition, and drive economic inclusive and sustainable growth. AASR23 clearly shows that the journey ahead will require collective effort, innovative thinking, and sustained commitment. The rewards—a prosperous, food-secure, and sustainable Africa—are well worth the endeavor.

1 Senior Research Fellow, International Food Policy Research Institute

Data

Technical Notes

The following conventions are used in the Tables:
0 or 0.0 = nil or negligible
.. or () data not available or missing.

Sources of data as follows:

- Population, total (millions)
  Source: World Development Indicators, World Bank
- Population Growth (annual %)
  Source: World Development Indicators, World Bank
- Rural Population (% of Total Population)
  Source: World Development Indicators, World Bank
- Urban Population (% of Total Population)
  Source: World Development Indicators, World Bank
- Crop Production Index (2014-2016 = 100)
  Source: World Development Indicators, World Bank
- Fertilizer consumption (kilograms per hectare of arable land)
  Source: World Development Indicators, World Bank
- Food Production Index (2014-2016 = 100)
  Source: World Development Indicators, World Bank
- GDP growth (annual %)
  Source: World Development Indicators, World Bank
- Global Food Security Index Ranking
  Source: https://impact.economist.com/sustainability/project/food-security-index

Population, Total (in Millions)

Country Name	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Angola	26.1	27.1	28.1	29.2	30.2	31.3	32.4	33.4	34.5	35.6
Benin	10.3	10.6	10.9	11.3	11.6	11.9	12.3	12.6	13.0	13.4
Botswana	2.2	2.3	2.3	2.4	2.4	2.5	2.5	2.5	2.6	2.6
Burkina Faso	17.6	18.2	18.7	19.3	19.8	20.4	21.0	21.5	22.1	22.7
Burundi	10.1	10.5	10.7	10.9	11.2	11.5	11.9	12.2	12.6	12.9
Cabo Verde	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cameroon	21.6	22.3	23.0	23.7	24.4	25.1	25.8	26.5	27.2	27.9
Central African Republic	4.8	4.8	4.8	4.9	5.0	5.1	5.2	5.3	5.5	5.6
Chad	13.2	13.7	14.1	14.6	15.1	15.6	16.1	16.6	17.2	17.7
Comoros	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8
Congo, Dem. Rep.	73.5	76.0	78.7	81.4	84.3	87.1	89.9	92.9	95.9	99.0
Congo, Rep.	4.8	4.9	5.1	5.2	5.3	5.4	5.6	5.7	5.8	6.0
Cote d'Ivoire	22.5	23.0	23.6	24.2	24.8	25.5	26.1	26.8	27.5	28.2
Equatorial Guinea	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.6	1.6	1.7
Eritrea	3.3	3.3	3.3	3.4	3.4	3.4	3.5	3.6	3.6	3.7
Eswatini	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2
Ethiopia	97.1	99.7	102.5	105.3	108.2	111.1	114.1	117.2	120.3	123.4
Gabon	1.9	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.3	2.4
Gambia, The	2.1	2.2	2.3	2.3	2.4	2.4	2.5	2.6	2.6	2.7
Ghana	27.5	28.2	28.9	29.6	30.2	30.9	31.5	32.2	32.8	33.5
Guinea	11.1	11.3	11.6	11.9	12.2	12.6	12.9	13.2	13.5	13.9
Guinea-Bissau	1.7	1.7	1.8	1.8	1.9	1.9	2.0	2.0	2.1	2.1
Kenya	44.8	45.8	46.9	47.9	48.9	50.0	51.0	52.0	53.0	54.0
Lesotho	2.1	2.1	2.1	2.1	2.2	2.2	2.2	2.3	2.3	2.3
Liberia	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3
Madagascar	23.6	24.2	24.9	25.5	26.2	26.8	27.5	28.2	28.9	29.6
Malawi	16.0	16.5	16.9	17.4	17.9	18.4	18.9	19.4	19.9	20.4
Mali	17.0	17.6	18.1	18.7	19.3	19.9	20.6	21.2	21.9	22.6
Mauritania	3.7	3.8	3.9	4.1	4.2	4.3	4.4	4.5	4.6	4.7
Mauritius	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Mozambique	25.3	26.0	26.8	27.7	28.6	29.4	30.3	31.2	32.1	33.0
Namibia	2.2	2.2	2.3	2.3	2.4	2.4	2.4	2.5	2.5	2.6
Niger	18.7	19.4	20.1	20.9	21.7	22.6	23.4	24.3	25.3	26.2
Nigeria	174.7	179.4	184.0	188.7	193.5	198.4	203.3	208.3	213.4	218.5
Rwanda	11.1	11.4	11.6	11.9	12.2	12.5	12.8	13.1	13.5	13.8
Sao Tome and Principe	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Senegal	13.6	14.0	14.4	14.8	15.2	15.6	16.0	16.4	16.9	17.3
Seychelles	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Sierra Leone	7.0	7.1	7.3	7.5	7.7	7.9	8.0	8.2	8.4	8.6
Somalia	12.9	13.3	13.8	14.3	14.9	15.4	16.0	16.5	17.1	17.6
South Africa	53.9	54.7	55.9	56.4	56.6	57.3	58.1	58.8	59.4	59.9
South Sudan	11.1	11.2	11.2	11.1	10.7	10.4	10.4	10.6	10.7	10.9
Sudan	36.0	37.0	38.2	39.4	40.7	42.0	43.2	44.4	45.7	46.9
Tanzania	49.3	50.8	52.5	54.4	56.3	58.1	59.9	61.7	63.6	65.5
Togo	7.1	7.3	7.5	7.7	7.9	8.0	8.2	8.4	8.6	8.8
Uganda	35.3	36.3	37.5	38.7	40.1	41.5	42.9	44.4	45.9	47.2
Zambia	15.2	15.7	16.2	16.8	17.3	17.8	18.4	18.9	19.5	20.0
Zimbabwe	13.6	13.9	14.2	14.5	14.8	15.1	15.4	15.7	16.0	16.3

Data from database: World Development Indicators
Last Updated: 07/25/2023

Population Growth (annual %)

Country Name	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Angola	3.7	3.7	3.6	3.6	3.6	3.5	3.4	3.3	3.2	3.1
Benin	2.9	2.9	3.0	2.9	2.9	2.9	2.9	2.8	2.8	2.7
Botswana	1.9	1.9	2.0	2.0	2.1	2.0	2.0	1.9	1.6	1.6
Burkina Faso	3.0	3.0	3.0	2.9	2.9	2.8	2.7	2.7	2.7	2.6
Burundi	3.6	3.3	2.2	1.6	2.3	3.0	3.3	2.9	2.7	2.7
Cabo Verde	1.1	1.1	1.1	1.1	1.2	1.1	1.0	1.0	0.9	0.9
Cameroon	2.8	3.0	3.1	3.0	2.8	2.8	2.8	2.7	2.6	2.6
Central African Republic	0.6	-0.1	0.4	1.7	1.9	1.9	2.2	2.5	2.1	2.2
Chad	3.6	3.6	3.2	3.1	3.3	3.4	3.3	3.2	3.2	3.1
Comoros	2.1	2.2	2.2	2.2	2.0	1.9	1.9	1.9	1.9	1.8
Congo, Dem. Rep.	3.4	3.4	3.4	3.5	3.4	3.3	3.2	3.2	3.2	3.2
Congo, Rep.	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.3	2.3	2.3
Cote d'Ivoire	2.1	2.3	2.6	2.6	2.6	2.6	2.5	2.5	2.5	2.5
Equatorial Guinea	4.1	4.0	3.9	3.8	3.6	3.5	3.3	2.7	2.4	2.4
Eritrea	1.3	0.8	0.5	0.8	0.9	1.4	1.5	1.6	1.8	1.7
Eswatini	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.9	1.0	0.8
Ethiopia	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.6	2.5
Gabon	3.5	3.3	3.1	2.8	2.6	2.4	2.3	2.2	2.1	2.0
Gambia, The	3.1	3.0	2.9	2.8	2.7	2.6	2.6	2.6	2.5	2.5
Ghana	2.5	2.4	2.4	2.3	2.2	2.1	2.1	2.1	2.0	1.9
Guinea	2.4	2.5	2.5	2.6	2.6	2.5	2.5	2.5	2.4	2.4
Guinea-Bissau	2.7	2.6	2.6	2.5	2.4	2.4	2.3	2.3	2.2	2.2
Kenya	2.4	2.3	2.2	2.2	2.2	2.0	2.0	2.0	1.9	1.9
Lesotho	0.9	1.0	1.1	1.2	1.2	1.3	1.3	1.3	1.2	1.1
Liberia	2.2	2.1	2.0	2.0	1.9	1.9	1.9	2.0	2.1	2.1
Madagascar	2.7	2.6	2.6	2.6	2.6	2.6	2.5	2.5	2.4	2.4
Malawi	2.8	2.8	2.8	2.7	2.7	2.7	2.7	2.7	2.6	2.6
Mali	2.9	3.2	3.1	3.2	3.2	3.2	3.1	3.1	3.2	3.1
Mauritania	2.9	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Mauritius	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	-0.3
Mozambique	3.1	3.1	3.0	3.1	3.1	2.9	2.9	2.9	2.8	2.7
Namibia	1.7	1.7	1.8	1.8	1.8	1.7	1.7	1.7	1.6	1.4
Niger	3.8	3.8	3.8	3.9	3.8	3.8	3.8	3.7	3.7	3.7
Nigeria	2.7	2.6	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4
Rwanda	2.4	2.4	2.4	2.4	2.5	2.4	2.4	2.4	2.4	2.3
Sao Tome and Principe	2.0	1.9	1.8	1.7	1.6	1.6	1.5	1.9	2.0	1.9
Senegal	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.6	2.6
Seychelles	1.8	1.6	2.2	1.3	1.2	1.0	0.9	0.9	0.8	0.8
Sierra Leone	2.6	2.5	2.4	2.4	2.4	2.4	2.3	2.3	2.2	2.2
Somalia	3.3	3.5	3.4	3.8	3.9	3.6	3.6	3.4	3.1	3.1
South Africa	1.4	1.6	2.1	1.0	0.4	1.2	1.3	1.2	1.0	0.8
South Sudan	3.7	1.0	-0.2	-1.2	-3.8	-2.5	0.5	1.5	1.3	1.5
Sudan	2.3	2.8	3.1	3.1	3.3	3.2	2.9	2.8	2.7	2.6
Tanzania	3.0	3.1	3.3	3.5	3.4	3.2	3.0	3.0	3.0	3.0
Togo	2.6	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4	2.3
Uganda	2.9	3.0	3.1	3.3	3.5	3.4	3.4	3.3	3.2	3.0
Zambia	3.3	3.2	3.2	3.1	3.1	3.1	3.0	2.9	2.8	2.8
Zimbabwe	2.2	2.2	2.1	2.1	2.0	2.0	2.0	2.0	2.0	2.0

Data from database: World Development Indicators
Last Updated: 07/25/2023

Rural Population (% of total population)

Country Name	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Angola	38.0	37.3	36.6	35.9	35.2	34.5	33.8	33.2	32.5	31.9
Benin	55.4	54.8	54.3	53.8	53.2	52.7	52.1	51.6	51.0	50.5
Botswana	34.4	33.6	32.8	32.1	31.3	30.6	29.8	29.1	28.4	27.8
Burkina Faso	73.7	73.1	72.5	71.9	71.3	70.6	70.0	69.4	68.8	68.1
Burundi	88.5	88.2	87.9	87.6	87.3	87.0	86.6	86.3	85.9	85.6
Cabo Verde	36.7	36.2	35.7	35.2	34.7	34.3	33.8	33.3	32.9	32.5
Cameroon	46.6	46.0	45.4	44.8	44.2	43.6	43.0	42.4	41.9	41.3
Central African Republic	60.3	60.0	59.7	59.4	59.0	58.6	58.2	57.8	57.4	56.9
Chad	77.8	77.6	77.5	77.3	77.1	76.9	76.7	76.5	76.2	75.9
Comoros	71.8	71.7	71.5	71.4	71.2	71.0	70.8	70.6	70.4	70.1
Congo, Dem. Rep.	58.4	57.8	57.3	56.7	56.1	55.5	55.0	54.4	53.8	53.2
Congo, Rep.	35.4	34.9	34.5	34.0	33.5	33.1	32.6	32.2	31.7	31.3
Cote d'Ivoire	51.4	51.0	50.6	50.1	49.7	49.2	48.8	48.3	47.8	47.3
Equatorial Guinea	30.5	29.9	29.4	28.9	28.4	27.9	27.4	26.9	26.4	26.0
Eritrea	63.0	62.4	61.8	61.2	60.5	59.9	59.3	58.7	58.0	57.4
Eswatini	77.0	76.9	76.7	76.5	76.4	76.2	76.0	75.8	75.6	75.4
Ethiopia	81.4	81.0	80.6	80.1	79.7	79.2	78.8	78.3	77.8	77.3
Gabon	12.8	12.3	11.9	11.4	11.0	10.6	10.3	9.9	9.6	9.3
Gambia, The	42.2	41.5	40.8	40.1	39.4	38.7	38.1	37.4	36.8	36.1
Ghana	47.3	46.6	45.9	45.3	44.6	43.9	43.3	42.7	42.0	41.4
Guinea	65.5	65.2	64.9	64.5	64.2	63.9	63.5	63.1	62.7	62.3
Guinea-Bissau	58.7	58.3	57.9	57.5	57.1	56.6	56.2	55.8	55.4	55.0
Kenya	75.2	74.8	74.3	73.9	73.4	73.0	72.5	72.0	71.5	71.0
Lesotho	73.9	73.5	73.1	72.7	72.3	71.8	71.4	71.0	70.5	70.1
Liberia	51.0	50.6	50.2	49.7	49.3	48.8	48.4	47.9	47.4	46.9
Madagascar	66.1	65.5	64.8	64.1	63.5	62.8	62.1	61.5	60.8	60.1
Malawi	84.0	83.9	83.7	83.5	83.3	83.1	82.8	82.6	82.3	82.0
Mali	61.6	60.8	60.0	59.2	58.4	57.6	56.9	56.1	55.3	54.6
Mauritania	50.7	49.8	48.9	48.0	47.2	46.3	45.5	44.7	43.9	43.1
Mauritius	58.8	58.9	59.0	59.1	59.2	59.2	59.2	59.2	59.2	59.2
Mozambique	66.6	66.1	65.6	65.1	64.5	64.0	63.5	62.9	62.4	61.8
Namibia	55.2	54.2	53.1	52.0	51.0	50.0	49.0	48.0	47.0	46.0
Niger	83.8	83.8	83.8	83.7	83.7	83.6	83.5	83.4	83.2	83.1
Nigeria	53.9	53.0	52.2	51.3	50.5	49.7	48.8	48.0	47.3	46.5
Rwanda	83.1	83.0	83.0	82.9	82.9	82.8	82.7	82.6	82.4	82.3
Sao Tome and Principe	31.8	30.8	29.8	28.9	28.0	27.2	26.4	25.6	24.9	24.2
Senegal	55.0	54.6	54.1	53.7	53.3	52.8	52.3	51.9	51.4	50.9
Seychelles	45.5	45.0	44.6	44.2	43.7	43.3	42.9	42.5	42.0	41.6
Sierra Leone	60.0	59.6	59.2	58.8	58.4	57.9	57.5	57.1	56.6	56.2
Somalia	57.9	57.3	56.8	56.2	55.6	55.0	54.4	53.9	53.3	52.7
South Africa	36.2	35.7	35.2	34.7	34.2	33.6	33.1	32.6	32.2	31.7
South Sudan	81.6	81.4	81.1	80.9	80.7	80.4	80.1	79.8	79.5	79.2
Sudan	66.5	66.3	66.1	65.9	65.6	65.4	65.1	64.7	64.4	64.0
Tanzania	69.8	69.1	68.4	67.7	66.9	66.2	65.5	64.8	64.0	63.3
Togo	60.9	60.4	59.9	59.4	58.8	58.3	57.8	57.2	56.6	56.1
Uganda	79.0	78.5	77.9	77.4	76.8	76.2	75.6	75.0	74.4	73.8
Zambia	59.1	58.6	58.1	57.6	57.0	56.5	55.9	55.4	54.8	54.2
Zimbabwe	67.3	67.5	67.6	67.7	67.8	67.8	67.8	67.8	67.7	67.6

Data from database: World Development Indicators
Last Updated: 07/25/2023

Urban Population (% of total population)

Country Name	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Angola	62	63	63	64	65	66	66	67	67	68
Benin	45	45	46	46	47	47	48	48	49	50
Botswana	66	66	67	68	69	69	70	71	72	72
Burkina Faso	26	27	28	28	29	29	30	31	31	32
Burundi	11	12	12	12	13	13	13	14	14	14
Cabo Verde	63	64	64	65	65	66	66	67	67	68
Cameroon	53	54	55	55	56	56	57	58	58	59
Central African Republic	40	40	40	41	41	41	42	42	43	43
Chad	22	22	23	23	23	23	23	24	24	24
Comoros	28	28	28	29	29	29	29	29	30	30
Congo, Dem. Rep.	42	42	43	43	44	44	45	46	46	47
Congo, Rep.	65	65	66	66	66	67	67	68	68	69
Cote d'Ivoire	49	49	49	50	50	51	51	52	52	53
Equatorial Guinea	70	70	71	71	72	72	73	73	74	74
Eritrea	37	38	38	39	39	40	41	41	42	43
Eswatini	23	23	23	23	24	24	24	24	24	25
Ethiopia	19	19	19	20	20	21	21	22	22	23
Gabon	87	88	88	89	89	89	90	90	90	91
Gambia, The	58	59	59	60	61	61	62	63	63	64
Ghana	53	53	54	55	55	56	57	57	58	59
Guinea	35	35	35	35	36	36	37	37	37	38
Guinea-Bissau	41	42	42	43	43	43	44	44	45	45
Kenya	25	25	26	26	27	27	28	28	28	29
Lesotho	26	27	27	27	28	28	29	29	29	30
Liberia	49	49	50	50	51	51	52	52	53	53
Madagascar	34	35	35	36	37	37	38	39	39	40
Malawi	16	16	16	17	17	17	17	17	18	18
Mali	38	39	40	41	42	42	43	44	45	45
Mauritania	49	50	51	52	53	54	55	55	56	57
Mauritius	41	41	41	41	41	41	41	41	41	41
Mozambique	33	34	34	35	35	36	37	37	38	38
Namibia	45	46	47	48	49	50	51	52	53	54
Niger	16	16	16	16	16	16	17	17	17	17
Nigeria	46	47	48	49	50	50	51	52	53	54
Rwanda	17	17	17	17	17	17	17	17	18	18
Sao Tome and Principe	68	69	70	71	72	73	74	74	75	76
Senegal	45	45	46	46	47	47	48	48	49	49
Seychelles	55	55	55	56	56	57	57	58	58	58
Sierra Leone	40	40	41	41	42	42	42	43	43	44
Somalia	42	43	43	44	44	45	46	46	47	47
South Africa	64	64	65	65	66	66	67	67	68	68
South Sudan	18	19	19	19	19	20	20	20	21	21
Sudan	34	34	34	34	34	35	35	35	36	36
Tanzania	30	31	32	32	33	34	35	35	36	37
Togo	39	40	40	41	41	42	42	43	43	44
Uganda	21	22	22	23	23	24	24	25	26	26
Zambia	41	41	42	42	43	44	44	45	45	46
Zimbabwe	33	33	32	32	32	32	32	32	32	32

Data from database: World Development Indicators
Last Updated: 07/25/2023

Crop Production Index (2014-2016 = 100)

Country Name	2013	2014	2015	2016	2017	2018	2019	2020	2021
Angola	114	98	100	102	103	106	108	113	115
Benin	98	104	92	104	110	117	125	122	129
Botswana	77	93	104	103	102	135	116	178	147
Burkina Faso	92	100	98	102	96	108	116	123	113
Burundi	116	101	96	103	98	121	132	131	121
Cabo Verde	110	101	101	98	91	72	70	70	71
Cameroon	91	95	101	104	99	101	103	102	105
Central African Republic	105	100	98	102	106	109	110	113	114
Chad	99	101	92	107	98	103	110	106	102
Comoros	101	97	98	105	105	107	107	107	107
Congo, Dem. Rep.	93	99	100	101	106	109	111	116	121
Congo, Rep.	92	101	101	98	99	102	103	103	107
Cote d'Ivoire	86	94	105	101	111	117	122	126	126
Equatorial Guinea	96	98	103	100	102	103	103	103	102
Eritrea	100	101	99	100	101	100	100	100	100
Eswatini	101	102	100	98	102	105	105	104	103
Ethiopia	89	96	101	103	106	106	108	117	113
Gabon	96	99	100	101	102	103	104	104	105
Gambia, The	117	97	111	92	76	47	56	61	60
Ghana	95	99	100	101	108	113	116	119	118
Guinea	93	96	100	104	110	115	118	124	129
Guinea-Bissau	100	94	102	105	106	109	115	121	125
Kenya	100	102	98	100	97	109	109	126	119
Lesotho	110	114	103	83	149	131	86	87	117
Liberia	96	90	97	112	95	100	106	108	107
Madagascar	98	102	98	100	97	102	103	104	106
Malawi	90	106	99	95	112	115	125	129	134
Mali	90	89	97	114	115	125	129	126	126
Mauritania	94	109	96	95	112	121	105	116	140
Mauritius	99	103	100	97	96	82	87	71	73
Mozambique	110	103	96	101	114	138	145	136	142
Namibia	91	101	103	96	108	111	99	116	118
Niger	84	90	101	109	111	122	120	131	113
Nigeria	84	96	98	106	108	113	108	107	109
Rwanda	135	98	100	102	117	112	128	129	136
Sao Tome and Principe	112	107	89	105	110	107	105	104	104
Senegal	74	80	114	106	140	166	164	201	195
Seychelles	93	99	102	99	100	103	101	101	103
Sierra Leone	119	110	96	93	84	89	77	91	132
Somalia	109	101	106	93	100	105	102	101	100
South Africa	102	108	101	91	117	112	107	120	125
South Sudan	88	98	103	98	97	101	110	112	114
Sudan	92	107	85	108	103	132	125	126	123
Tanzania	96	100	104	96	97	104	105	106	105
Togo	90	103	97	100	104	109	110	110	111
Uganda	99	103	105	92	105	104	123	140	134
Zambia	96	103	91	106	129	118	110	126	134
Zimbabwe	110	110	96	94	107	136	104	125	129

Data from database: World Development Indicators
Last Updated: 07/25/2023

Fertilizer consumption (kilograms per hectare of arable land)

Country Name	2013	2014	2015	2016	2017	2018	2019	2020
Angola	9.3	9.3	8.0	7.2	10.7	7.9	7.4	8.6
Benin	5.0	8.1	0.1	9.9	0.0	36.6	55.5	40.2
Botswana	80.5	57.8	66.0	46.9	33.2	58.2	51.3	51.3
Burkina Faso	15.5	15.9	16.3	21.8	18.2	17.6	9.5	17.2
Burundi	9.3	10.8	8.3	14.4	17.8	23.8	20.2	20.2
Cameroon	10.1	9.6	13.6	10.9	13.0	13.0	13.0	13.4
Central African Republic	0.1	0.0	0.3	0.2	0.2	0.2	0.2	0.2
Congo, Dem. Rep.	0.9	1.6	1.9	1.4	1.6	1.1	1.4	2.1
Congo, Rep.	2.9	1.9	4.1	2.2	2.3	2.4	4.3	9.9
Cote d'Ivoire	31.1	35.1	41.3	44.1	39.3	30.9	51.9	51.9
Eritrea	1.2	1.5	1.5	2.8	2.6	6.8	6.7	5.1
Ethiopia	18.3	25.4	28.1	33.8	34.5	36.2	36.2	36.2
Gabon	10.1	13.1	27.3	31.8	60.6	45.0	39.7	21.3
Gambia, The	0.4	0.5	0.5	0.7	0.4	8.0	4.2	0.8
Ghana	41.8	26.4	40.6	37.3	65.8	48.8	73.2	107.4
Guinea	2.9	1.0	0.9	0.8	8.5	6.9	6.9	6.9
Kenya	56.6	47.7	38.9	48.4	63.1	48.1	57.3	65.2
Madagascar	4.8	8.7	7.5	6.0	13.0	12.6	11.9	10.6
Malawi	28.8	39.8	42.7	24.5	35.6	35.9	32.6	32.6
Mali	14.6	21.0	27.5	33.9	24.8	24.8	24.7	37.2
Mauritius	248.1	313.3	183.8	273.3	257.6	187.1	194.7	150.5
Mozambique	5.9	7.5	4.6	4.6	5.1	6.7	6.7	11.2
Namibia	10.9	6.1	13.7	26.1	25.0	27.3	25.5	3.7
Niger	0.6	1.0	0.4	0.4	0.4	0.4	0.7	0.6
Nigeria	8.8	9.2	8.2	11.1	21.0	19.6	19.6	19.6
Rwanda	11.2	12.6	19.7	9.8	19.5	16.0	25.9	25.9
Senegal	12.4	11.7	16.2	21.6	34.6	16.9	21.6	25.3
Seychelles	341.7	337.1	816.7	521.7	646.0	515.7	845.1	542.5
South Africa	67.5	66.5	62.7	57.3	72.8	63.5	63.5	63.5
Sudan	2.6	4.2	4.5	9.4	8.3	8.1	7.1	7.1
Tanzania	12.4	9.7	9.6	13.3	12.6	16.3	16.0	16.4
Togo	11.7	1.8	3.3	13.7	5.8	15.4	2.7	2.7
Uganda	2.4	1.8	1.6	1.9	2.1	3.3	3.3	2.4
Zambia	49.0	50.5	55.9	64.0	72.1	52.5	67.6	79.8
Zimbabwe	25.6	25.8	19.7	32.6	36.6	33.2	33.2	33.2

Data from database: World Development Indicators
Last Updated: 07/25/2023

Food Production Index (2014-2016 = 100)

Country Name	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Angola	111	97	100	102	103	106	108	113	115	..
Benin	99	103	95	102	105	109	117	115	119	..
Botswana	115	100	105	95	93	96	101	101	106	..
Burkina Faso	95	99	99	102	95	112	121	124	116	..
Burundi	114	101	95	104	101	124	135	132	124	..
Cabo Verde	105	99	101	100	92	78	79	81	82	..
Cameroon	92	96	100	104	99	100	101	101	103	..
Central African Republic	102	100	99	101	105	107	107	109	111	..
Chad	95	98	97	105	109	115	118	121	123	..
Comoros	102	97	99	104	104	106	106	106	106	..
Congo, Dem. Rep.	93	99	100	101	106	108	110	115	120	..
Congo, Rep.	93	99	102	99	100	103	104	104	108	..
Cote d'Ivoire	86	95	104	101	112	115	117	120	122	..
Equatorial Guinea	95	97	103	100	102	102	103	103	102	..
Eritrea	101	100	99	101	103	104	104	104	105	..
Eswatini	102	102	100	98	102	104	104	103	105	..
Ethiopia	91	97	101	102	107	106	110	119	116	..
Gabon	97	99	100	101	102	103	104	104	105	..
Gambia, The	110	98	108	95	82	63	70	73	73	..
Ghana	95	99	100	101	108	113	116	118	118	..
Guinea	93	96	100	104	110	115	119	127	130	..
Guinea-Bissau	101	96	101	104	105	108	113	117	121	..
Kenya	103	103	106	91	87	96	109	114	110	..
Lesotho	106	107	101	93	114	107	89	91	100	..
Liberia	90	92	97	111	93	96	98	101	99	..
Madagascar	98	101	99	100	97	101	101	102	104	..
Malawi	86	103	99	98	117	124	131	135	142	..
Mali	91	89	98	113	113	124	128	137	126	..
Mauritania	95	98	100	101	103	107	104	106	112	..
Mauritius	100	103	100	97	98	89	94	80	83	..
Mozambique	106	103	97	100	115	134	135	136	140	..
Namibia	101	102	100	98	105	102	97	104	106	..
Niger	84	90	102	108	111	120	119	129	114	..
Nigeria	85	96	99	105	107	112	107	106	108	..
Rwanda	131	98	101	101	114	108	123	125	129	..
Sao Tome and Principe	111	106	89	104	111	107	106	104	104	..
Senegal	81	84	110	106	133	153	152	181	178	..
Seychelles	89	97	99	104	90	103	102	98	95	..
Sierra Leone	113	110	96	94	84	89	78	91	130	..
Somalia	110	101	102	97	98	98	101	101	99	..
South Africa	97	103	101	96	106	104	105	111	114	..
South Sudan	94	99	101	101	100	102	107	105	113	..
Sudan	95	103	92	105	102	118	115	116	114	..
Tanzania	93	99	103	98	99	108	108	112	114	..
Togo	93	102	99	100	103	106	109	111	112	..
Uganda	99	102	104	94	104	103	119	128	123	..
Zambia	100	106	93	102	125	118	113	123	129	..
Zimbabwe	112	97	101	102	107	109	106	110	132	..

Data from database: World Development Indicators
Last Updated: 07/25/2023

GDP Growth (Annual %)

Country Name	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Angola	5.0	4.8	0.9	-2.6	-0.1	-1.3	-0.7	-5.6	1.2	3.0
Benin	7.2	6.4	1.8	3.3	5.7	6.7	6.9	3.8	7.2	6.3
Botswana	11.1	5.7	-4.9	7.2	4.1	4.2	3.0	-8.7	11.9	5.8
Burkina Faso	5.8	4.3	3.9	6.0	6.2	6.6	5.7	1.9	6.9	1.5
Burundi	4.9	4.2	-3.9	-0.6	0.5	1.6	1.8	0.3	3.1	1.8
Cabo Verde	0.6	0.7	0.9	4.3	4.6	3.7	7.6	-19.3	6.8	17.7
Cameroon	5.0	5.7	5.7	4.5	3.5	4.0	3.5	0.3	3.6	3.5
Central African Republic	-36.4	0.1	4.3	4.8	4.5	3.8	3.1	0.9	0.9	0.0
Chad	5.7	6.9	2.8	-6.3	-3.0	2.4	3.2	-1.6	-1.2	2.2
Comoros	4.5	2.1	1.1	3.3	3.8	3.6	1.8	-0.2	2.1	2.4
Congo, Dem. Rep.	8.5	9.5	6.9	2.4	3.7	5.8	4.4	1.7	6.2	8.9
Congo, Rep.	-0.7	6.7	-3.6	-10.8	-4.4	-4.8	-0.1	-6.2	-2.2	1.5
Cote d'Ivoire	10.8	9.4	7.2	7.2	7.4	4.8	6.5	1.7	7.0	6.7
Equatorial Guinea	-4.1	0.4	-9.1	-8.8	-5.7	-6.2	-5.5	-4.2	-0.9	3.1
Eritrea	..	..	..	..	..	..	..	..	..	..
Eswatini	3.9	0.9	2.2	1.1	2.0	2.4	2.7	-1.6	7.9	3.9
Ethiopia	10.6	10.3	10.4	9.4	9.6	6.8	8.4	6.1	5.6	5.3
Gabon	5.6	4.3	3.9	2.1	0.5	0.8	3.9	-1.8	1.5	3.0
Gambia, The	2.9	-1.4	4.1	1.9	4.8	7.2	6.2	0.6	4.3	4.9
Ghana	7.3	2.9	2.1	3.4	8.1	6.2	6.5	0.5	5.4	3.2
Guinea	3.9	3.7	3.8	10.8	10.3	6.4	5.6	4.9	3.9	4.7
Guinea-Bissau	3.3	1.0	6.1	6.3	5.9	1.3	4.5	-2.4	3.8	3.5
Kenya	3.8	5.0	5.0	4.2	3.8	5.6	5.1	-0.3	7.6	4.8
Lesotho	1.8	1.7	3.1	3.6	-3.1	-1.5	-0.8	-5.6	1.6	0.6
Liberia	8.7	0.7	-0.0	-1.6	2.5	1.2	-2.5	-3.0	5.0	4.8
Madagascar	2.3	3.3	3.1	4.0	3.9	3.2	4.4	-7.1	5.7	3.8
Malawi	5.4	5.6	2.8	2.5	4.0	4.4	5.4	0.8	2.8	0.9
Mali	2.3	7.1	6.2	5.9	5.3	4.7	4.8	-1.2	3.1	3.7
Mauritania	4.2	4.3	5.4	1.3	6.3	4.8	5.3	-0.9	2.4	5.2
Mauritius	3.4	3.8	3.7	3.9	3.9	4.0	2.9	-14.6	3.4	8.7
Mozambique	7.0	7.4	6.7	3.8	3.7	3.4	2.3	-1.2	2.3	4.1
Namibia	5.6	6.1	4.3	0.0	-1.0	1.1	-0.8	-8.1	3.5	4.6
Niger	5.3	6.6	4.4	5.7	5.0	7.2	5.9	3.6	1.4	11.5
Nigeria	6.7	6.3	2.7	-1.6	0.8	1.9	2.2	-1.8	3.6	3.3
Rwanda	4.7	6.2	8.9	6.0	3.9	8.5	9.5	-3.4	10.9	8.2
Sao Tome and Principe	4.8	6.5	3.9	4.2	3.8	2.9	2.2	3.0	1.9	0.9
Senegal	2.4	6.2	6.4	6.4	7.4	6.2	4.6	1.3	6.5	4.2
Seychelles	1.3	4.1	4.2	5.1	2.8	3.7	4.9	-8.6	5.4	8.8
Sierra Leone	21.1	4.6	-20.5	6.3	3.8	3.5	5.3	-2.0	4.1	3.5
Somalia	..	7.8	15.0	8.5	2.3	7.5	7.5	2.5	4.0	4.8
South Africa	2.5	1.4	1.3	0.7	1.2	1.5	0.3	-6.3	4.9	2.0
South Sudan	13.1	3.4	-10.8	..	..	..	..	..	..	..
Sudan	2.0	4.7	1.9	3.5	0.7	-2.7	-2.2	-3.6	-1.9	-1.0
Tanzania	6.8	6.7	6.2	6.9	6.8	5.5	5.8	2.0	4.3	4.6
Togo	6.1	5.9	5.7	5.6	4.3	5.1	4.9	2.0	6.0	5.8
Uganda	3.6	5.1	5.2	4.8	3.1	6.3	6.4	3.0	3.5	4.7
Zambia	5.1	4.7	2.9	3.8	3.5	4.0	1.4	-2.8	4.6	4.7
Zimbabwe	3.2	1.5	2.0	0.9	4.1	5.0	-6.3	-7.8	8.5	3.4

Data from database: World Development Indicators
Last Updated: 07/25/2023

Trade (% of GDP)

Country Name	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Angola	87	79	63	53	52	66	58	55	62	..
Benin	59	65	57	59	61	62	64	45	48	51
Botswana	126	119	113	100	82	87	83	78	89	85
Burkina Faso	64	59	59	58	59	61	59	..	..	..
Burundi	47	43	23	23	22	27	29	27	29	28
Cabo Verde	86	91	94	95	100	106	103	78	77	95
Cameroon	50	51	46	41	39	41	43	34	37	40
Central African Republic	38	53	53	51	57	50	50	50	45	46
Chad	73	77	67	63	74	74	75	69	83	91
Comoros	39	39	38	37	40	43	42	34	42	48
Congo, Dem. Rep.	77	79	59	56	74	70	55	58	80	99
Congo, Rep.	93	104	123	131	113	120	127	99	96	112
Cote d'Ivoire	58	54	53	48	49	46	45	41	45	52
Equatorial Guinea	107	104	99	93	102	104	95	89	102	102
Eritrea	..	..	..	..	..	..	..	..	..	..
Eswatini	87	88	84	87	88	85	89	87	91	..
Ethiopia	41	41	40	35	31	31	29	24	24	27
Gabon	91	74	74	70	75	77	73	70	72	78
Gambia, The	45	58	53	46	53	63	53	48	42	35
Ghana	61	64	77	68	71	68	77	39	58	53
Guinea	80	77	72	112	101	89	78	115	106	107
Guinea-Bissau	44	52	60	58	61	56	55	44	..	..
Kenya	47	46	40	35	36	34	32	27	31	34
Lesotho	132	126	128	138	144	143	136	134	139	..
Liberia	..	..	..	..	..	..	..	..	..	..
Madagascar	56	62	61	61	65	68	63	49	54	71
Malawi	..	..	..	..	..	..	..	..	..	..
Mali	65	61	64	64	58	60	64	67	67	69
Mauritania	102	92	77	73	79	89	96	95	100	124
Mauritius	113	111	107	101	101	98	96	86	98	119
Mozambique	103	111	94	106	100	127	112	95	100	..
Namibia	98	103	97	94	81	82	83	77	82	94
Niger	46	46	45	36	40	38	38	36	38	39
Nigeria	31	31	21	21	26	33	34	16	23	..
Rwanda	43	44	45	49	54	56	58	55	55	60
Sao Tome and Principe	..	..	..	..	..	..	..	..	..	..
Senegal	61	58	58	54	58	62	64	60	69	81
Seychelles	196	213	193	194	216	209	197	179	236	233
Sierra Leone	87	83	66	76	74	57	56	52	58	..
Somalia	98	99	94	95	100	107	101	102	106	108
South Africa	59	59	57	56	54	55	54	51	56	65
South Sudan	51	65	66	..	..	..	..	..	..	..
Sudan	27	21	18	15	18	22	26	10	4	3
Tanzania	49	45	41	35	33	33	33	28	30	35
Togo	83	72	69	67	58	58	57	56	55	60
Uganda	43	36	38	31	37	37	39	37	42	34
Zambia	80	76	80	74	72	75	69	79	86	66
Zimbabwe	59	55	57	51	50	55	53	55	56	..

Data from database: World Development Indicators
Last Updated: 07/25/2023

2022 Global Food Security Index Ranking

FOOD SECURITY ENVIRONMENT				
Rank / 113			Score	Δ
59	▼8	South Africa	61.7	-3.2
82	▲1	Kenya	53.0	+0.4
83	▼2	Ghana	52.6	-1.6
85	▼1	Mali	51.9	-0.1
86	↔	Senegal	51.2	+0.4
87	▼9	Botswana	51.1	-3.6
88	▲14	Rwanda	50.6	+6.0
89	▼4	Burkina Faso	49.6	-2.2
90	▲3	Tanzania	49.1	+0.9
=91	▲5	Benin	48.1	+1.5
=91	▲8	Malawi	48.1	+2.8
93	▲1	Uganda	47.7	+0.7
94	▲5	Mozambique	47.3	+2.0
95	▼4	Côte d'Ivoire	46.5	-1.9
96	▼5	Cameroon	46.4	-2.0
97	▼9	Niger	46.3	-3.4
98	▼8	Togo	46.2	-2.3
99	▼2	Guinea	45.1	-1.3
100	▲7	Ethiopia	44.5	+1.8
101	▼3	Angola	43.7	-1.8
102	▼1	Zambia	43.5	-1.2
103	▲5	Chad	43.2	+0.8
104	▼1	Congo (Dem. Rep.)	43.0	-1.5
105	▲6	Sudan	42.8	+4.0
107	▼12	Nigeria	42.0	-4.8
=108	▲2	Burundi	40.6	+1.3
=108	▼3	Madagascar	40.6	-2.7
110	▼4	Sierra Leone	40.5	-2.4

1) AFFORDABILITY				
Rank / 113			Score	Δ
62	▼2	Botswana	69.0	-4.0
70	▲1	South Africa	63.4	-2.1
=75	↔	Ghana	59.9	-0.5
82	▼3	Senegal	57.9	+1.3
83	▼5	Côte d'Ivoire	54.2	-3.0
84	▼4	Mali	53.4	-1.5
88	▼3	Benin	50.5	-2.1
89	▼1	Cameroon	50.4	-0.3
90	▲10	Chad	50.1	+6.6
91	▼1	Burkina Faso	49.5	-0.6
92	▲19	Rwanda	48.4	+18.5
93	▼1	Uganda	48.3	-0.6
94	▲1	Congo (Dem. Rep.)	46.9	+0.6
96	↔	Tanzania	45.8	0
97	▼11	Togo	45.7	-6.0
98	↔	Niger	42.8	-1.4
99	▼5	Mozambique	42.6	-3.9
101	▼12	Kenya	41.7	-8.9
102	▼3	Madagascar	39.5	-4.4
103	▼1	Guinea	37.0	-3.7
104	▼1	Sierra Leone	36.6	-4.0
105	▼1	Angola	35.5	0
106	▲6	Sudan	35.2	+5.9
107	▲1	Malawi	33.6	+2.1
108	▲5	Ethiopia	32.9	+4.3
110	↔	Burundi	32.5	+2.2
112	▼3	Zambia	26.8	-4.5
113	▼8	Nigeria	25.0	-10.3

Scores are normalized 0-100, where 100=best conditions

'=' denotes tie in rank

Δ = change in score, 2022 compared with 2021

▲ = Rank improved ▼ = Rank deteriorated ↔ = No change in rank

Sorted by food security environment in 2022, best to worst

2) AVAILABILITY				
Rank / 113			Score	Δ
=52	▼16	South Africa	60.1	-3.9
58	▼4	Tanzania	58.7	-0.1
75	▲22	Benin	53.6	+8.2
=77	▲16	Malawi	52.9	+6.8
79	▲4	Kenya	52.5	+1.9
80	▼1	Ghana	52.4	-0.9
=81	▲1	Rwanda	51.8	+0.1
83	▲4	Togo	51.0	+1.3
86	▼17	Burkina Faso	48.8	-5.7
88	▲13	Mozambique	48.4	+5.0
90	▼5	Guinea	48.0	-0.9
91	▼16	Mali	48.7	-5.8
92	▲13	Sudan	48.2	+7.1
94	▼4	Senegal	47.8	-0.2
96	▼3	Zambia	46.7	+0.6
97	▲6	Ethiopia	44.7	+0.8
98	▲2	Angola	43.5	-1.1
99	▲5	Madagascar	43.0	-0.4
101	▼9	Côte d'Ivoire	42.1	-4.7
102	▼26	Niger	41.7	-12.7
103	▲5	Burundi	41.4	+2.3
104	▲6	Uganda	41.0	+4.4
105	↔	Congo (Dem. Rep.)	40.6	-0.5
106	▼22	Botswana	40.5	-9.7
107	▼8	Chad	40.0	-4.7
108	▼12	Nigeria	38.5	-6.3
110	▼3	Sierra Leone	35.5	-3.8
111	▼2	Cameroon	31.9	-5.6

3) QUALITY AND SAFETY				
Rank / 113			Score	Δ
58	▲12	Kenya	68.8	+10.1
60	▼9	South Africa	66.1	-6.3
69	▲2	Ethiopia	59.3	+0.9
74	▲2	Botswana	57.3	+0.2
75	▲6	Mali	56.8	+0.3
=76	▼4	Cameroon	56.5	-1.8
79	▲3	Nigeria	55.6	-0.4
84	▲4	Zambia	54.2	+1.0
=86	↔	Senegal	53.9	+0.6
=86	↔	Sudan	53.9	+0.6
88	▼5	Burkina Faso	52.8	-2.6
89	▲1	Burundi	52.4	+0.2
90	▲3	Malawi	52.0	+0.9
94	▼14	Ghana	50.5	-6.2
95	▲5	Rwanda	50.3	+1.0
96	▲2	Tanzania	50.2	+0.6
99	▲3	Benin	48.1	-0.1
100	▲3	Niger	47.0	+0.1
103	▲2	Uganda	45.1	-0.8
104	▲4	Chad	44.7	-0.1
105	▲1	Côte d'Ivoire	44.1	-0.9
106	▼11	Angola	43.9	-6.8
107	▼10	Congo (Dem. Rep.)	43.5	-6.5
108	▲1	Togo	42.3	-0.1
=109	▲1	Mozambique	41.8	+0.3
=109	▼3	Sierra Leone	41.8	-3.2
111	▲1	Guinea	39.8	-0.1
113	▼2	Madagascar	34.9	-5.9

4) SUSTAINABILITY AND ADAPTATION				
Rank / 113			Score	Δ
37	▲4	Malawi	58.2	+1.2
=42	▼4	Uganda	57.0	-0.2
=44	▼2	Guinea	56.9	+0.1
=44	▼8	South Africa	56.9	-0.6
48	▲26	Mozambique	56.5	+8.0
52	▼2	Niger	55.5	+0.9
54	▼3	Angola	54.6	+0.1
=57	▼4	Nigeria	53.7	-0.1
=64	▼2	Rwanda	52.7	+0.8
66	▼3	Kenya	52.6	+1.2
=69	▼11	Zambia	51.6	-0.8
73	▲3	Sierra Leone	49.8	+1.9
77	▲20	Mali	48.8	+8.0
=80	▼3	Cameroon	47.0	-0.4
82	▼3	Burkina Faso	46.4	+0.1
86	▼12	Togo	45.4	-3.5
88	↔	Ghana	45.1	+0.8
=89	▼3	Ethiopia	44.9	+0.2
=89	▼4	Madagascar	44.9	+0.1
=94	▼2	Senegal	43.5	0
96	▼1	Côte d'Ivoire	43.2	+1.2
98	▲5	Tanzania	41.7	+3.6
100	▼2	Congo (Dem. Rep.)	40.1	-0.1
101	▲2	Benin	38.9	+0.8
102	▼1	Burundi	38.6	-0.2
108	↔	Chad	35.9	-0.2
109	▲2	Sudan	35.7	+1.2
112	▲1	Botswana	32.9	+0.2