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Africa Agriculture Trade Monitor
2024

Edited by Sunday Odjo, Fousseini Traoré, and Chahir Zaki

AKADEMIYA 2063

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
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ACRONYMS AND ABBREVIATIONS

AATM	Africa Agriculture Trade Monitor
AfCFTA	African Continental Free Trade Area
AIDI	Africa Infrastructure Development Index
AMU	Arab Maghreb Union
CEN-SAD	Community of Sahel-Saharan States
CEMAC	Economic and Monetary Community of Central Africa
CEPII	Centre d'Études Prospectives et d'Informations Internationales
CET	Common External Tariff
CILSS	Comité permanent Inter-États de Lutte contre la Sécheresse dans le Sahel
COMESA	Common Market for Eastern and Southern Africa
DRC	Democratic Republic of the Congo
EAC	East African Community
ECCAS	Economic Community of Central African States
ECOSHAM	ECOWAS Scheme for Harmonization of Standards
ECOWAS	Economic Community of West African States
ETLS	ECOWAS Trade Liberalization Scheme
EU	European Union
ICT	Information and communications technology
FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign direct investment
FLW	Food loss and waste
FVVCs	Fruit and vegetable value chains
GDP	Gross domestic product
GHG	Greenhouse gas
GVCs	Global value chains
HHI	Herfindahl-Hirschman Index
HS	Harmonized System
IGAD	Intergovernmental Authority on Development
ITC	International Trade Centre
LPI	Logistics Performance Index
MRIO	Multi-Region Input-Output Table

NTM	Nontariff measure
RCA	Revealed comparative advantage
REC	Regional economic community
RTI	Regional trade introversion index
SADC	Southern African Development Community
SPS	Sanitary and phytosanitary
SSPs	Shared Socioeconomic Pathways
SWD	Specific water demand
TBT	Technical barriers to trade
THC	Technical Harmonization Committee for Agricultural and Food Products
UNECA	United Nations Economic Commission for Africa
VWT	Virtual water trade
WSS	Water supply and sanitation
WTO	World Trade Organization

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FOREWORD

Climate change is one of the most pressing global concerns of our time. Despite differences in climate change projections, there is consensus that tropical and semi-tropical production areas that are currently less resilient will suffer the most. While trade contributes to climate change through production and transportation of goods, it is also affected by shifts in comparative advantages that result from climate change. However, trade can play an important role in reducing carbon emissions and adapting to climate change through the shift of production to areas with cleaner production techniques and through increased access to environmental goods and services that help reduce emissions. Trade can also serve as a mechanism for adapting to natural disasters, by moving food and medicines from surplus areas to places suffering shortages. Thus, to better understand the complex relationships between trade, climate change, and food security, this report examines the recent performance of African agricultural trade.

Given its geography, Africa is disproportionately affected by climate change while contributing only minimally to global greenhouse gas emissions. However, it is crucial for African countries to adopt sustainable production practices and trade policies. These will ensure the continent can continue to trade in the future, as world demand for clean and healthy products grows. In that respect, African countries have been developing mitigation and adaptation plans known as Nationally Determined Contributions as part of global efforts to reduce emissions and adapt to climate change under the 2021 Paris Agreement implementation framework.

As discussed in the report, trade affects all dimensions of food security, including food availability, access, utilization, and stability. Hence, appropriate policies are needed to ensure trade can play its role as a strategy to adapt to climate change. Rising per capita income, urbanization, and changing lifestyles are driving growing demand for processed products in Africa, and most countries in Africa are net importers of carbon emissions, which together indicate the continent's increasing responsibility for climate change. In particular, demand for fruits and vegetables is among the fastest growing in urban markets. While production of these products in Africa is challenged by rising temperatures and water stress, their processing and export are limited by tariff escalation and the capacity to comply with stringent regulations and standards in rich destination countries.

The report demonstrates that trade can potentially mitigate the environmental impacts of economic activities. For example, trade helps to move production from water-scarce countries to water-abundant ones. However, trade facilitation is needed to fully achieve that function, as virtual water trade in Africa currently occurs primarily between countries belonging to the same regional economic community.

Trade is part of the solution to climate change as well as to achieving the goals of food security and sustainable development in Africa. This report provides a timely review of Africa's contribution and exposure to climate change, laying out steps to ensure countries can leverage trade to guarantee food security, achieve greater competitiveness in world and regional markets, and transition to low-carbon growth paths.

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EXECUTIVE SUMMARY

The 2024 AATM investigates critical issues related to African agricultural trade. As in previous editions of the report, we have developed a database that corrects discrepancies in trade flow values, as reported by importing and exporting countries, as the basis for analyzing Africa's international, domestic, and regional economic community (REC) trade. Given the pressing need to address climate change and curb greenhouse gas emissions, this year's AATM takes an in-depth look at the relationship between climate change, water use, and emissions and African agricultural trade.

Trade in both agricultural outputs and inputs, and related policy instruments, can affect all dimensions of food security, which include availability, access, utilization, and stability. This complex relationship is investigated in Chapter 1, which considers how trade policy instruments (especially tariffs, nontariff measures, and deep trade agreements) can improve food security in Africa. Special attention is paid to fertilizer, given that almost 90 percent of fertilizer used in sub-Saharan Africa is imported. Because of this dependence on imports, recent increases and volatility in fertilizer prices and supply disruptions from key producing countries have posed a major challenge for African countries, especially for small farmers in these countries.

African agricultural exports have been increasing, but Africa's share in traded global carbon emissions is smaller than its share in agricultural trade. A comprehensive analysis of African trade in agricultural products and their embodied carbon emissions is provided in Chapter 2, with the aim of deepening the understanding of Africa's contribution to the global carbon footprint of agricultural trade. Africa enjoyed the third fastest growth in agricultural exports (after the Americas and Asia) and the second fastest growth in imports (after Asia) between 2018 and 2022. At the product level, Africa plays a large role in world markets for some of its most traded product categories, including cotton, cocoa, coffee and tea, and tobacco on the exports side and cereals, sugar and sugar confectionery, and fats and oils on the imports side. Yet, its share in traded global emissions is smaller than its share in trade. Africa's textile and wearing apparel sector, where it has one of its largest manufacturing capacities, is among the most emissions-intensive of Africa's export sectors; however, these exports are sold largely within Africa. Carbon emissions embedded in Africa's agricultural imports largely originate in Asia, especially the textile and wearing apparel sector. However, the textile sector faces serious challenges to transitioning to sustainable technologies and practices, as it does in other world regions.

At the intra-African level, most of the RECs are more introverted than extroverted. A detailed analysis of intra-African trade provided in Chapter 3 shows that, in value terms, most RECs trade more within their regions than with the rest of Africa, reflecting the importance of intra-REC free trade agreements in facilitating intraregional trade.

Virtual water trade can reduce the impact of localized water scarcity within Africa. Analysis of the water content embedded in trade flows of agricultural products (virtual water), presented in Chapter 3, helps us assess the contribution of intra-African trade to addressing water stress and scarcity in African countries and to more efficient water use. At the product level, millet and mace have the largest impact on water use among the examined crops, followed by guavas, mangoes, and beans. From a policy perspective, facilitating virtual water exports is a key strategy for reducing both water scarcity and the impacts of differential water availability within the continent. Both national and regional policies are needed to support infrastructure investments to improve irrigation systems and water management practices.

For fruit and vegetable value chains (FVVCs), Africa's specialization lies mainly in the upstream sector. Chapter 4 analyzes FVVCs and highlights challenges and opportunities for increased fruit and vegetable trade and for upgrading within the value chain. Over the past 20 years, African exports of fruits, especially, and vegetables have been consistently dominated by unprocessed goods. At the same time, imports are dominated by unprocessed fruit and processed vegetables, suggesting that Africa is in an upstream position along these FVVCs. At the global level, African countries are entirely absent from the list of top 10 countries that export and import fruits and vegetables, at every level of processing. At the intra-African level, fruit trade is primarily in unprocessed products, whereas nearly 60 percent of intra-African vegetable trade is in processed products. In addition, Africa has rather marginal exports of fruits and vegetables with a revealed comparative advantage and for which global demand is high. Yet, there is potential that can be developed in the long term for some fruits (such as apples, citrus fruits, bananas, peaches, strawberries) and their semi-processed and processed products, some of the main tropical fruits (such as mangoes, guavas, and pineapples), vegetables (including potatoes, tomatoes, onions, shallots, broccoli, cauliflower, and carrots), and mixed and frozen vegetable preparations. However, this potential can be developed only if all the impediments facing FVVCs are tackled, especially nontariff measures and tariff escalation by Africa's main trade partners, as well as poor connectivity between African countries.

African countries are highly exposed to climate change, which will affect their comparative advantage. Chapter 5 examines the extent to which African countries are exposed to climate change relative to other regions of the world. The chapter shows that Africa's comparative advantage in agriculture will be severely affected by climate change, including rising temperatures, the increased frequency of extreme events (particularly droughts), plant pests and diseases, and reduced labor productivity. These impacts are likely to increase Africa's vulnerability on several fronts, especially the agriculture sector, forced migration, and food insecurity. Climate change can also affect African countries' specialization as a result of the sensitivity of agricultural products to changes in temperature and water availability. The chapter identifies four groups of products: those at very high risk (leguminous vegetables, edible nuts, and oilseeds); high risk (vegetables and some fruits, such as apples and bananas); moderate risk (mainly cereals and some oilseeds, such as soya beans and sunflower seeds); and low risk (mainly barley and colza seeds). Notably, most agricultural products traded or consumed in Africa appear to be at risk.

The Economic Community of West African States (ECOWAS) has succeeded in its regional integration, but still faces political and economic challenges. Chapter 6 assesses agricultural trade flows and policies in the ECOWAS area, along with the main challenges facing this region, which include tariffs, nontariff measures, logistics performance, and currency diversity. Integration in West Africa dates back to the age of African empires and kingdoms, and the REC, which emerged following the colonial period, has now been operating for almost 50 years. ECOWAS is considered among the most advanced RECs in Africa in terms of achieving integration, with major successes related to the free movement of people, internal liberalization of tariffs within the REC, and its high level of introversion (meaning ECOWAS countries tend to trade more within the REC than outside it). Yet, several challenges hamper its effectiveness, especially nontariff measures, corruption, excessive bureaucracy, and the low quality of its infrastructure, while political tensions between some member states (especially Mali, Burkina Faso, and Niger) make the REC's future uncertain.

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Overview and Recent Challenges

Sunday Odjo, Fousseini Traoré, Chahir Zaki, and Charlotte Hebebrand

Background and Overview

The Africa Agriculture Trade Monitor (AATM) is an annual flagship publication of the International Food Policy Research Institute (IFPRI) and AKADEMIYA2063. This seventh edition provides an overview of short- and long-term trends and drivers behind Africa's global trade, intra-African trade, and trade within Africa's regional economic communities (RECs), with a focus on the nexus of trade and climate change. The six chapters of this 2024 AATM report are as follows.

This first chapter offers an overview of the food security concerns in African countries in the wake of the global crisis related to the COVID-19 pandemic, the Russia–Ukraine war, and the global resurgence of protectionist policies. It examines trade through a food security lens, including availability, utilization, accessibility, and stability of food supplies, as well as the effects of tariffs, nontariff measures (NTMs), and deep trade agreements on food security in Africa. Special attention is paid to fertilizers, given the importance of these inputs for agricultural productivity and food security. As a result of Africa's heavy dependence on fertilizer imports, farmers, and particularly smallholders, were severely challenged in the recent crisis when spikes in international fertilizer prices were compounded by high rates of domestic inflation.

Chapter 2 looks at Africa's participation in world agricultural trade in terms of gross value and carbon emissions. Increases in trade and contributions to global trade value are first analyzed by comparing Africa with other world regions. The chapter then examines Africa's most traded products and degree of trade partner diversification, as well as identifying the world's largest players in global agricultural markets. Second, the chapter explores the continent's contributions to the global carbon footprint through trade in agricultural products, again comparing Africa with other regions. The origins and destinations of carbon emissions embodied in Africa's imports and exports are examined, contrasting emissions from agriculture with those generated in other sectors, including the fishing, textiles and apparel, mining and quarrying, and food and beverages sectors. The chapter highlights the importance of transitioning to sustainable production technologies and practices in Africa and of importing from suppliers that use cleaner production technologies.

Intra-African agricultural trade and its virtual water content are examined in Chapter 3. The chapter begins with a review of trade in value terms, focusing on trends and patterns within and among regional economic communities (RECs), and then examines the patterns of virtual water trade between African subregions for a dozen export products. An econometric analysis explores the determinants of virtual water trade among African countries, including the impact of water productivity and water and land endowments, along with other factors, on trade at the continental level, among RECs, and for specific commodities. This analysis supports a call for greater intra-African trade to alleviate the impacts of water scarcity.

Chapter 4 provides a detailed analysis of Africa's participation in fruit and vegetable value chains (FVVCs) and discusses challenges and opportunities within these value chains, including the potential impact of the African Continental Free Trade Area (AfCFTA). The chapter begins by examining the importance of the fruit and vegetable sector for Africa, as well as the risks inherent in this sector, with special attention to smallholders. It then identifies the main trends in exports and imports of fruits and vegetables, differentiating among unprocessed, semi-processed, and processed products. The chapter offers an analysis of the challenges affecting Africa's participation in FVVCs, including the region's capacity to increase its downstream presence in these value chains. It concludes with some policy recommendations focused on opportunities for improved intra-African integration in FVVCs.

Chapter 5 examines the impact of climate change on trade with a focus on how climate change will likely affect Africa's comparative advantages and regional integration. The chapter starts with an examination of Africa's high level of exposure to climate change. It then reviews the literature on shifts in Africa's comparative advantages caused by climate change and the associated impacts on trade flows. In addition, the sensitivity of individual unprocessed agricultural products to changes in temperature and water stress are investigated, identifying products at different levels of risk, ranging from very high to very low. Drawing on these findings, the chapter points to the importance of trade policy for mitigating these risks and adapting to climate change.

Agricultural trade integration in the Economic Community of West African States (ECOWAS) is the focus of Chapter 6 in this year's report. The chapter begins with a historical review of early regional integration initiatives in Africa and the main steps in the construction of ECOWAS. It then assesses intraregional trade costs, covering tariffs, NTMs, and logistics performance, with a special focus on currency diversity as an impediment to trade within the REC; it also assesses intraregional trade flows, including informal cross-border trade. The chapter then reviews key achievements and main challenges to greater ECOWAS integration, including the risk posed to the REC by the recent withdrawal of Mali, Burkina Faso, and Niger. It also calls for the monitoring and mainstreaming of substantial informal cross-border trade data in official statistics.

Trade and Food Security

How does trade contribute to food security?

The contribution of trade to food security has been much debated. According to the proponents of protectionism, some degree of trade restriction is necessary to promote local production and attain food self-sufficiency, which should yield food security. At the other end of the spectrum, proponents of trade liberalization consider trade paramount for food security, as it allows people to access affordable and more diverse food, thus improving food security and diets. Recent crises—such as the Russia–Ukraine war and the resurgence of noncooperative trade policies in key countries—have intensified the debate, and more countries are now calling for food self-sufficiency or food sovereignty. In this section, we shed light on both sides of this debate by considering the relationship of trade to each of the four dimensions of food security: availability, accessibility, stability, and utilization.

The first channel through which trade impacts food security is availability. The objective of opening a country to trade is to increase the quantity of food available to consumers, either complementing or replacing local production. Trade contributes to both the intensive and extensive margins of availability, that is, it both increases the quantity of products that are readily available and introduces new varieties. In addition, in a context marked by climate change and shifting comparative advantages, supply disruptions can be expected in many areas of the world. Trade can be critical for mitigating the impacts and maintaining the supply of food products under climate change, especially in Africa, where the impacts are expected to be significant (Gouel 2022; Gouel and Laborde 2021). However, the opponents of trade liberalization often argue that the contribution of trade to food availability is ambiguous and the strategy risky, given that dependence on world markets transmits global price shocks to local markets and creates market volatility. In addition, some global markets are highly concentrated around a few exporting countries, and when a crisis occurs, these countries turn to restrictive noncooperative (beggar-thy-neighbor) trade policies, with negative impacts in net importing countries (Laborde, Matchaya, and Traoré 2023).

The second channel is food accessibility, including both physical and economic accessibility. For trade to enhance physical access to food requires low transaction costs and good infrastructure for storing and moving food from food surplus to deficit areas. In terms of economic accessibility, trade is expected to ease access to cheaper food through production based on countries' comparative advantages and exploitation of arbitrage opportunities. In addition, by exporting products in which they have a comparative advantage, countries can generate sufficient income through export earnings to purchase more nutritious food for their own population. The logic here mirrors the options at the individual level: self-sufficiency in food production versus relying on one's comparative advantage and selling to the market to get the income needed to purchase more and higher quality food.

Stability is a key component of food security. Risk averse consumers seek stable supply and prices as an essential component of welfare, but there are divergent views on how to achieve this. On the one hand, domestic production may be more volatile than world production, given that domestic production is imperfectly correlated with external shocks and is affected by other domestic factors. In that context, trade can reduce the volatility of domestic food markets and stabilize prices. This stabilization mechanism can be at play even at the regional level, when regional aggregate production is less volatile than domestic production (Badiane, Odjo, and Jemaneh 2014); in this case, supply diversification can increase stability. On the other hand, when the external markets are more volatile than domestic production, domestic markets can become more volatile when open to trade. In that context, a set of policy instruments are available to governments, but these tools should be used with care as they can exacerbate the volatility of both domestic and world markets. For example, in a period of high and volatile prices, removing import duties—a frequent policy response—will increase demand and compound tensions in domestic and world markets.

Finally, trade can contribute to better food utilization. As mentioned, trade can improve the availability and access to more nutritious food, and the literature suggests it can improve the quality of diets by increasing dietary diversity and nutrient adequacy (Ruel 2003). However, trade can negatively impact nutritional outcomes if it increases the consumption of foods rich in fat, sugar, and other elements associated with increased risk of noncommunicable diseases (Shankar 2017). Thus, the net contribution of trade to food utilization is ambiguous, and complementary policies are needed to improve nutritional outcomes.

Is there a role for trade policy?

With this background on the channels through which trade affects food security, this section explores the trade policies that can affect food security. We focus on three main tools: tariffs, NTMs, and trade agreements.

When importing countries impose a tariff, all four dimensions of food security can be affected. First, tariffs lead to higher domestic prices (tariff pass-through) and thus to a reduction in the consumer surplus, which affects both accessibility and utilization of imported goods (Aboushady and Zaki 2023; Barlow et al. 2020). Second, tariffs can reduce incentives to import, thus reducing the availability of these products. However, the net effect on availability will be less than the decrease in imports, since tariffs can be expected to boost local production. Because Africa is net importer of agricultural goods, the high agricultural tariffs in African countries (15 percent on average) at the global level, and even between some countries within the same RECs, risk negative impacts on food security. This is especially true of tariffs on imported inputs. For example, Tanzania implemented a 10 percent tariff on imported edible oils as a means to protect domestic production and reduce dependence on imports; however, because the country also levied a high tax on inputs needed for domestic production of edible oils, as well as because of poor transport infrastructure, the protectionist tariff did not improve food security or the competitiveness of Tanzanian producers (Mgeni 2018).

The effect of NTMs, which include export bans, sanitary and phytosanitary (SPS) standards, and technical barriers to trade (TBT), is rather heterogenous (Hepburn et al. 2021). First, export bans imposed by exporting countries (to ensure domestic supply) will negatively affect food security in importing countries, as both food accessibility and availability can be expected to decrease. Export bans also lead to higher world food prices (Gillson and Busch 2014) and an increase in price volatility in the country imposing them (Martin et al. 2024). Second, the effect of SPS and technical barriers to trade depends on countries' compliance. If exporting countries comply with the standards set by importing countries, trade increases and consumers have access to imported goods. When exporting countries do not comply, goods cannot cross borders, and food accessibility and availability are reduced. Bouët and Laborde (2016) examine the impact of different NTMs (such as import quotas, export taxes, export subsidies and export restrictions) and show that, while some measures increase self-sufficiency, they can also behave as beggar-thy-neighbor noncooperative policies, which negatively affect food security in importing countries. In addition, NTMs are highly protectionist. For instance, Cadot and Gourdon (2014) show that SPS regulations on imports of rice led to an increase in prices of 42 percent in Kenya and 30 percent in Uganda.

Trade agreements (both regional and multilateral) can affect food security. However, few studies have examined the impact of the depth of trade agreements on food security. The literature distinguishes between the horizontal and the vertical depth of trade agreements. Horizontal depth refers to the inclusion of provisions that go beyond tariff removal; vertical depth refers to the enforceability and precision of such provisions. The deeper the agreement, the more likely it can promote food security as it can include provisions related to NTMs, services, innovation, and other areas beyond tariffs. For instance, innovation-related provisions can promote technological transfer in soil, seeds, and production techniques, which increase production capacities and improve food security. Provisions related to NTMs can support mutual recognition or harmonization of standards and thus increase trade in agricultural products. In terms of regional trade, Raimondi et al. (2023) argue that global value chain integration is the main channel through which regional trade agreements (RTAs) can affect trade policy and thus food security. They show that, compared with countries with weaker participation in global value chains, countries characterized by stronger global value chains have lower tariffs with partners outside RTAs as well as lower NTMs with partners both inside and outside those agreements.

At the multilateral level, the World Trade Organization (WTO) can have a crucial impact on food security, as it can help to guarantee that members do not restrict trade in food unnecessarily (WTO 2023). In addition, through its various committees and agreements (especially the Agreement on Agriculture, the Agreement on Trade Facilitation, the Agreement on Technical Barriers to Trade, and the Agreement on Sanitary and Phytosanitary Measures), the WTO can provide the basis for trade negotiations relevant to food security in a multilateral setting. However, some studies show that the multilateral system has not increased trade in food. For instance, Mujahid and Kalkuhl (2015) argue that, despite the positive impact of the WTO and RTAs on trade among participant countries, trade in food is not affected by WTO membership. In contrast, RTAs have led to increased food trade among their participants.

Trade in fertilizers and food security

A focus on the links between food security and trade must consider trade of and access to agricultural inputs. The great majority of phosphate and potash fertilizers are produced in a few major producing regions that have phosphate and potash resources. While nitrogen can be produced anywhere, major producers tend to be in regions with access to relatively low-priced natural gas (or coal). As a result, a large share of fertilizers applied around the world are imported from a limited number of major producing regions.

Fertilizers provide essential nutrients to crops and play an important role in increasing agricultural productivity and, by extension, food security. Nitrogen, phosphate, and potash are essential macronutrients provided by fertilizers, but soils also need secondary nutrients (calcium, magnesium, and sulfur) as well as eight micronutrients that are also provided by chemical fertilizers. Nutrients can also be provided by organic fertilizers, including manure and plant residues, and via biological nitrogen fixation (through legumes). However, mineral fertilizers play a crucial role, since they offer higher levels and known quantities of needed nutrients in a form more readily available to plants. Nitrogen fertilizers alone have been estimated to account for half of global agricultural production.

Sub-Saharan Africa had an average fertilizer application rate of 22 kilograms per hectare in 2018, compared to the average global application rate of 139 kilograms. Low fertilizer application rates help to explain the much lower crop yields (estimated to be 30 percent of global averages) in sub-Saharan Africa compared with other regions, as well as the fact that increases in agricultural production in the region are largely achieved through cropland expansion rather than productivity gains.

Increasing fertilizer application would provide an important boost to agricultural productivity in sub-Saharan Africa and promote food security on the continent. African countries continue to be dependent on fertilizer imports, particularly nitrogen and potash, from outside of Africa. Although African nitrogen production capacity has increased substantially in recent years (notably in Nigeria), most of this new production is exported outside of Africa. African countries thus remain vulnerable to fertilizer price shocks and supply disruptions, such as those witnessed following the Russian invasion of Ukraine, which led to an estimated 25 percent decline in African fertilizer use in 2022 (AU 2024). The fact that sub-Saharan Africa accounts for 3 to 4 percent of global fertilizer consumption makes it especially vulnerable to shocks, as suppliers may bypass Africa to export to larger markets during periods of high prices. High transportation costs, regulatory bottlenecks to intra-African trade, and a lack of financing available to fertilizer value chain players also hinder the movement of fertilizers across borders and last-mile delivery in Africa.

The importance of increasing intra-African fertilizer trade is recognized in the Nairobi Declaration, which was signed by African heads of state at the May 2024 Africa Fertilizer and Soil Health Summit (AU 2024). The Declaration calls for leveraging the AfCFTA to double intra-Africa fertilizer trade by 2034; harmonizing national and regional policies and regulatory frameworks to ensure coherence and promote regional and continental trade; and strengthening public–private partnerships to enhance investments in the fertilizer value chain.

Likewise, the 10-year African Fertilizer and Soil Health Action Plan released at the Summit, which sets a goal of tripling of fertilizer use to 54 kilograms per hectare by 2034, calls for the promotion of regional and continental trade; greater facilitation of farmers' access to local, national, and international input and output markets; and new incentives for the private sector to invest in African food systems as well as increased government investments in transportation and communications infrastructure to lower the costs of food trade among African countries.

Data and Methodology

The AATM report relies heavily on trade statistics to monitor trade in agriculture. As high-quality statistics are essential for developing good policy recommendations, and the continent's official data on agricultural trade are often inaccurate and include little information on pervasive informal cross-border trade, the construction of a high-quality trade database was essential for the preparation of the AATM. Here we present the statistical approach we have adopted to ensure rigorous analysis.

As in the previous editions, the 2024 release of the AATM is based on an original dataset constructed to provide better statistics on global and African trade. This analytical database employs the United Nations' commodity trade statistics (UN Comtrade Database). Raw trade data are processed to provide an accurate estimate of formal cross-border trade in Africa (no estimate of informal trade is included in this 2024 edition of the AATM dataset). However, informal trade is considered in the chapter devoted to ECOWAS (Chapter 6).

In the first step, the data are harmonized and cleaned. Trade flows of less than US$1,000 at the product and bilateral levels are discarded, since they are associated with significant noise in quantity estimates. Because countries report in different Harmonized System (HS) nomenclatures, all data are converted to the HS 2012.

In the second step, we reconstruct unique trade flows in the presence of discrepancies in mirror trade flows, that is, the import and export declarations of the same trade transaction. Rather than averaging the two declarations, a series of checks aimed at identifying the most reliable declaration is conducted. First, export and import unit values for each trade flow (trade value divided by the corresponding trade quantity) are computed; outliers are identified, and their associated trade flows discarded. An observation is considered an outlier if the absolute deviation is greater than three times the mean absolute deviation (the average distance between each data point and the mean). This gives us a sense of the variability in the dataset. The remaining trade flows are selected based first on the importer's declaration—these are generally more reliable because collection of customs duties requires that imports be monitored carefully. When an importer's declaration is not available or was previously discarded, the exporter's declaration is used.

Finally, the trade flows are all expressed in CIF (cost-insurance-freight) value. When the exporter's FOB (free-on-board) declaration has been used, a CIF/FOB correction is applied. The estimates of the CIF/FOB ratios used to make this correction are obtained using a gravity equation including distance, contiguity, common official language, and colonial relationship as explanatory variables. When estimating the gravity equation, trade values are weighted by quantities using the gap between the reported mirror quantities to give more importance to trade flows similarly reported by both partners. From the gravity equations, estimates at the HS 2-digit level of the CIF/FOB ratio are derived and applied to export declarations.

The annual AATM aims to provide a thorough analysis of Africa's trade in agriculture. Over the years, the AATM database has gained in accuracy and the length of time covered. As highlighted in preceding editions of this report, the measurement and integration of informal trade data in the AATM database remains a challenge that must be addressed to obtain a complete picture of intra-African trade flows. Here a recent initiative led by the United Nations Economic Commission for Africa (UNECA), the African Union, and Afreximbank is worth mentioning. The initiative has developed a methodology for collecting harmonized data on informal cross-border trade flows. Its next phase will launch a set of pilot studies before extending the methodology to the whole continent. In coming years, the data collected under this initiative could enrich the AATM database.

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2

Africa in World Agricultural Trade: Recent Trends and Carbon Footprint

Sunday Odjo, Abdrahmane Berthe, and Mouhamadou Hady Diallo

Introduction

Agriculture, deeply embedded within the cultural and economic fabric of African societies, is a linchpin for the continent's socioeconomic advancement. With its diverse array of climatic conditions, Africa hosts a spectrum of agricultural practices, ranging from traditional subsistence farming to modern commercial enterprises. However, alongside agriculture's pivotal role in livelihoods and economic growth, the sector poses a challenge as a significant contributor to greenhouse gas (GHG) emissions. Against this backdrop, a nuanced understanding of the intricate relationship among agricultural activities, emissions, and international trade emerges as crucial for balancing sustainable development within Africa and global climate change mitigation efforts.

In an era marked by the urgent imperative to address climate change and curb GHG emissions, the role of agriculture has come under intense scrutiny (Smith et al. 2014). The global agriculture sector, intricately interwoven with international trade, underscores the multifaceted environmental complexities inherent in agricultural production and distribution. Climate change significantly impacts global agrifood trade dynamics, influencing production patterns, market accessibility, and economic resilience (Bozzola, Lamonaca, and Santeramo 2023; Gouel and Laborde 2021; Lamonaca, Bozzola, and Santeramo 2024). These effects are compounded by climate-induced shifts in crop yields, water availability, and temperature regimes, altering both supply and demand dynamics across international markets. Notably, agricultural goods traded across borders "carry" the emissions generated during their production and transportation. This notion of emissions embodied in exports and imports has garnered increasing attention in contemporary literature (Davis and Caldeira 2010). Recent studies emphasize the significant interlinkages between climate change and emissions embedded in trade within the agrifood sector. For example, Santeramo, Ferrari, and Toteti (2024) explore the intricate balance required to achieve climate change and environmental goals without resorting to protectionist measures, emphasizing the complexities of international trade policies in mitigating emissions. Li et al. (2023) highlight that despite efficiency gains along global supply chains, changes in global food consumption patterns have contributed to increased GHG emissions, underscoring the need for sustainable trade practices to mitigate environmental impacts.

Estimating the carbon footprint associated with international agricultural trade poses considerable methodological challenges, primarily due to the complex nature of supply chains and the role of trade in intermediate goods (Peters et al. 2011). Intermediate goods, integral to the agricultural trade network, traverse the globe, creating environmental impacts that are tricky to quantify and allocate. Global value chains (GVCs) are pivotal in shaping these methodological challenges, influencing the flow of inputs and outputs across borders, and contributing to emissions embedded in traded goods (UNCTAD 2013). GVCs also dictate the geographic distribution of production stages and emissions profiles throughout the supply chain, from production to consumption (Gereffi, Humphrey, and Sturgeon 2005).

In addition, Africa's agricultural landscape is characterized by a mosaic of production technologies and practices that vary significantly across regions and countries. These disparities encompass differences in farming techniques, land use patterns, energy efficiency, and emissions intensity. Consequently, the carbon footprint of traded agricultural products is deeply influenced by these regional nuances (Dasgupta et al. 2002).

Our research endeavors to unravel the complexities inherent in international agricultural trade, with a specific lens on the African context. Africa's role within the global agricultural trade network not only shapes its own development trajectory but also has profound implications for global environmental sustainability. The primary objective is to provide a comprehensive understanding of Africa's contribution to the global carbon footprint within the realm of agricultural trade.

The remainder of the chapter is organized as follows. The following section analyzes Africa's involvement in global agricultural trade in value terms, exploring the continent's performance and relationships with other world regions through analysis of trade flows. The next section looks at the carbon content and emissions transfers associated with these same trade flows. The final section summarizes the main findings and concludes.

Overview of Africa's Agricultural Trade: Emerging Trends and Patterns

This section focuses on Africa's agricultural trade performance relative to other world regions. Recent trade trends and patterns are investigated through the calculation of growth rates and regional contributions and the identification of major traded products, primary trade partners, and main players in world agricultural markets.

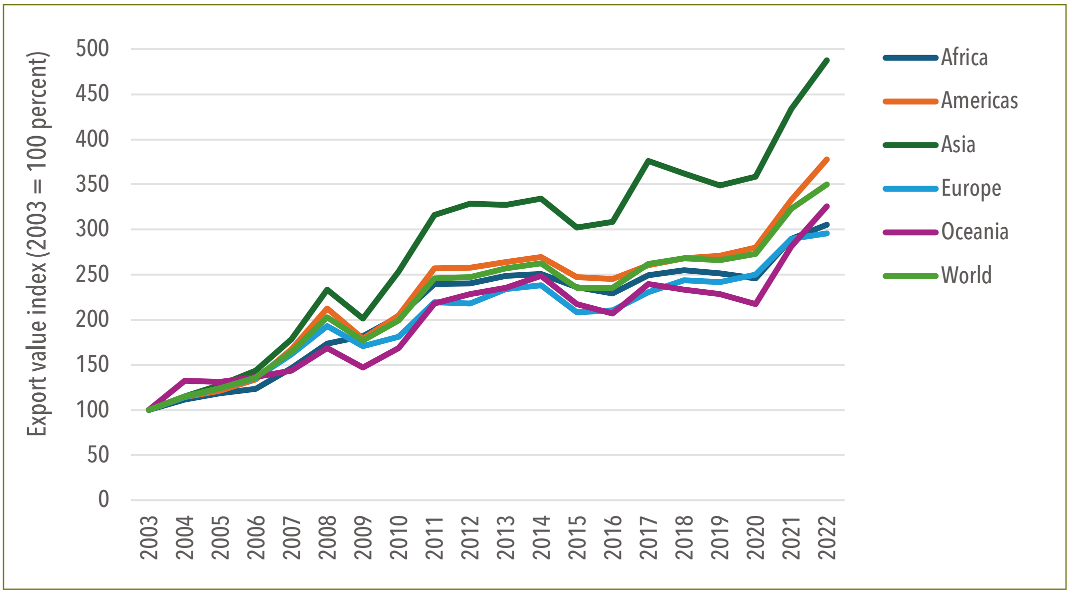
Recent growth trends

Globally, agricultural exports have been on the rise, although they vary considerably across different regions of the world. Taking 2003 as the base year, consistent growth in agricultural exports is observed until 2022 (Figure 2.1). However, this progression is often marked by peaks followed by declines, highlighting the fragility of economies in the face of external shocks. The years 2008 and 2009 particularly illustrate the contraction in world trade in response to factors such as the global financial crisis.

Despite experiencing steady growth, Africa lags behind the Americas and Asia in agricultural export growth.[1] Asia emerges as the region with the fastest growth in agricultural export value over recent decades. Africa ranks third, showing a consistent upward trajectory but one that is less pronounced than that of the Americas. Notably, export value increased threefold in Africa between 2003 and 2022, compared to nearly fivefold in Asia.

1 Growth is computed as the annual percentage change in the US dollar value of agricultural exports.

Figure 2.1 Trends in agricultural export value, by world region, 2003–2022

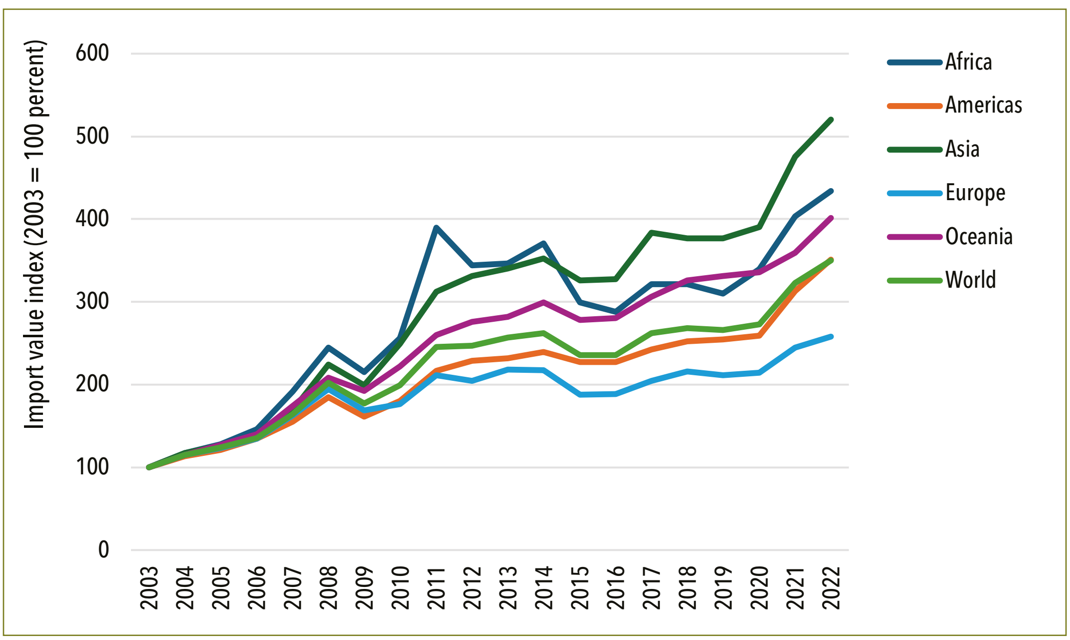


Source: Authors' calculations based on the AATM 2024 database.

Note: (1) Agricultural export value includes intracontinental export flows. (2) The export value index is determined as the ratio of the current value of exports to their value in 2003 and is expressed as a percentage.

Africa recorded the second fastest agricultural import growth after Asia (Figure 2.2). Following a collapse in 2015, Africa's agricultural import value has followed an upward trajectory since 2017, increasing in 2022 to more than four times its level in 2003. The decline in global trade in 2015 is common to all world regions and can be attributed to economic sanctions imposed by the European Union (EU) and the United States on Russia, including bans on food imports.

Figure 2.2 Trends in agricultural import value, by world region, 2003–2022



Source: Authors' calculations based on the AATM 2024 database.
Note: (1) Agricultural import value includes intracontinental import flows. (2) The import value index is determined as the ratio of the current value of imports to their value in 2013 and is expressed as a percentage.

Table 2.1 explores the balance of agricultural trade—that is, the difference between agricultural exports and imports. Africa, like Asia, has run a deficit over the years. In contrast, the Americas and Oceania have sustained a surplus, and Europe has evolved from a deficit to a surplus. As a share of continental gross domestic product (GDP), Africa's deficit is larger than that of Asia (around 1.1 percent and 0.8 percent, respectively), and the surplus is larger for Oceania than for the Americas (around 2.8 percent and 0.7 percent, respectively). Africa's deficit increased over the past two decades, but the increase was much slower in recent years. The deficit growth slowed from 32.9 percent in the 2008–2012 period to 13.5 percent in 2018–2022. Asia has witnessed a similar trend of deceleration in deficit growth, while Oceania and the Americas have seen a deceleration in surplus growth. Europe has achieved a remarkable trend reversal, progressing from fast deficit reduction to a slightly slower surplus expansion.

Table 2.1 Size and growth of agricultural trade balance, 2008–2022

Region	Annual value (US$ billions)		Percentage of GDP (%)		Annual growth rate (%) of deficit or surplus	
	2008-2012	2018-2022	2008-2012	2018-2022	2008-2012	2018-2022
Africa	−23.8	−27.8	−1.14	−1.06	32.9	13.5
Americas	168.4	207.3	0.76	0.70	12.5	7.9
Asia	−150.6	−268.1	−0.71	−0.79	18.2	7.7
Europe	−30.7	38.4	−0.15	0.17	−18.2	14.4
Oceania	36.7	50.2	2.63	2.84	12.0	8.6

Source: Authors' calculations based on the AATM 2024 database for trade data and the World Bank's World Development Indicators for GDP data.

Table 2.2 shows the regional patterns and trends in world agricultural trade in recent years (2018–2022). Africa recorded significant growth in agricultural trade, with export growth rates of 4 percent and import growth rates of 7 percent. Despite this progress, Africa's participation in the global market remains relatively modest, at only 4 percent of global exports and 6 percent of global imports. The Americas and Europe dominate the export market (31 percent and 41 percent, respectively), while Asia and Europe lead the import market (35 percent and 39 percent, respectively). While Africa and Oceania have comparable shares of global agricultural exports, Oceania represents a much lower share of imports. Export growth is remarkably faster in Oceania, while its import growth is slower compared with growth trends in Africa. Growth in exports from Africa is mainly driven by products originating in the North Africa and Southern Africa subregions, which have grown at around 6 percent.[2] Similarly, dynamics in Africa's global imports are led by imports destined to East and North Africa, which grew at 13 percent and 5 percent, respectively.

2 Table A2.1 in the appendix to this chapter lists the countries in each of Africa's subregions. The country grouping by continental region and geographical subregion used in this chapter follows the United Nations' country classification: https://unstats.un.org/unsd/methodology/m49/

Table 2.2 Breakdown of world agricultural trade, 2018–2022

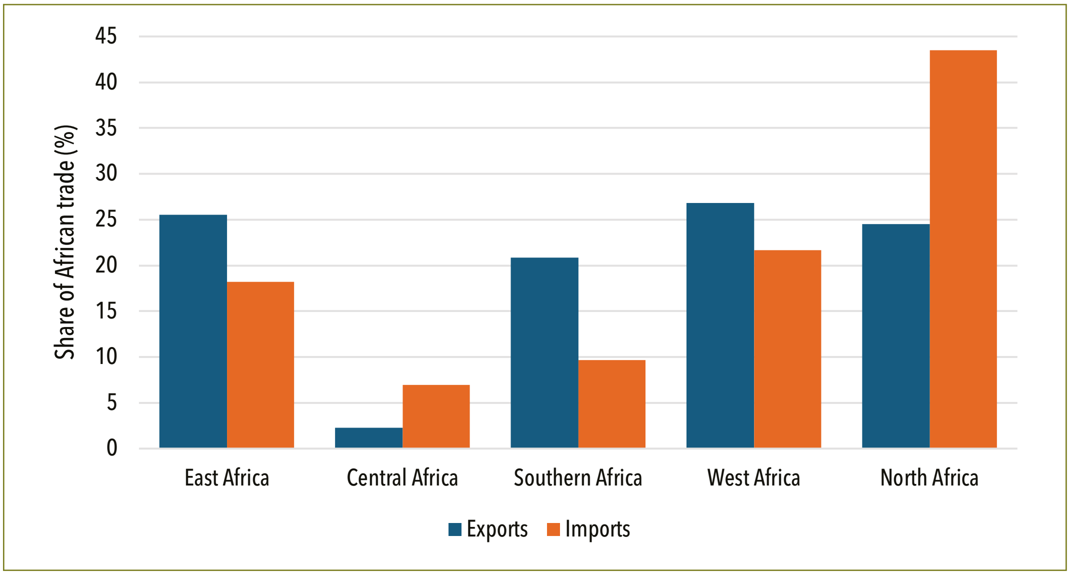
Region/subregion	Share of global exports (%)	Export growth rate (%)	Share of global imports (%)	Import growth rate (%)
Africa	4.0	4.3	5.6	6.5
East Africa	1.0	4.9	1.0	13.3
Central Africa	0.1	4.1	0.4	9.3
Southern Africa	0.8	5.7	0.5	3.5
West Africa	1.1	2.0	1.2	6.7
North Africa	1.0	6.0	2.4	4.5
Americas	30.6	7.9	19.1	7.9
Asia	19.7	5.7	35.2	6.6
Europe	41.3	5.3	38.7	4.9
Oceania	4.4	7.1	1.3	5.6
World	100	6.2	100	6.2

Source: Authors' calculations based on the AATM 2024 database.
Note: Growth rates are the average of annual changes over the period 2018–2022.

A quasi-balanced distribution of exports exists in four out of five African subregions (20–27 percent each), but the export share of Central Africa is 10 times smaller than that of the other subregions (Figure 2.3a). However, a noticeable difference arises in imports, with North Africa leading at 43 percent, trailed by West and East Africa (22 percent and 18 percent, respectively). As mentioned, North Africa imports more agricultural products than the rest of the continent. Several factors may explain this phenomenon. First, North Africa is in close geographic proximity to key regions, including Europe and the Middle East/Asia, which together contribute more than 60 percent of global agricultural trade. Second, North Africa has the continent's largest economy, with a regional GDP of US$985.4 billion in 2022. It is dominated by Egypt ($476.7 billion), followed by Algeria ($225.6 billion) and Morocco ($130.9 billion). West Africa has the second largest economy, with a regional GDP of $768.3 billion, led by Nigeria ($472.6 billion), Ghana ($74.3 billion), and Côte d'Ivoire ($70.2 billion).[3]

3 Regional GDP values are calculated from country GDP in current US dollars obtained from the World Development Indicators database and using the UN country classification summarized in Table A2.1 in the appendix to this chapter.

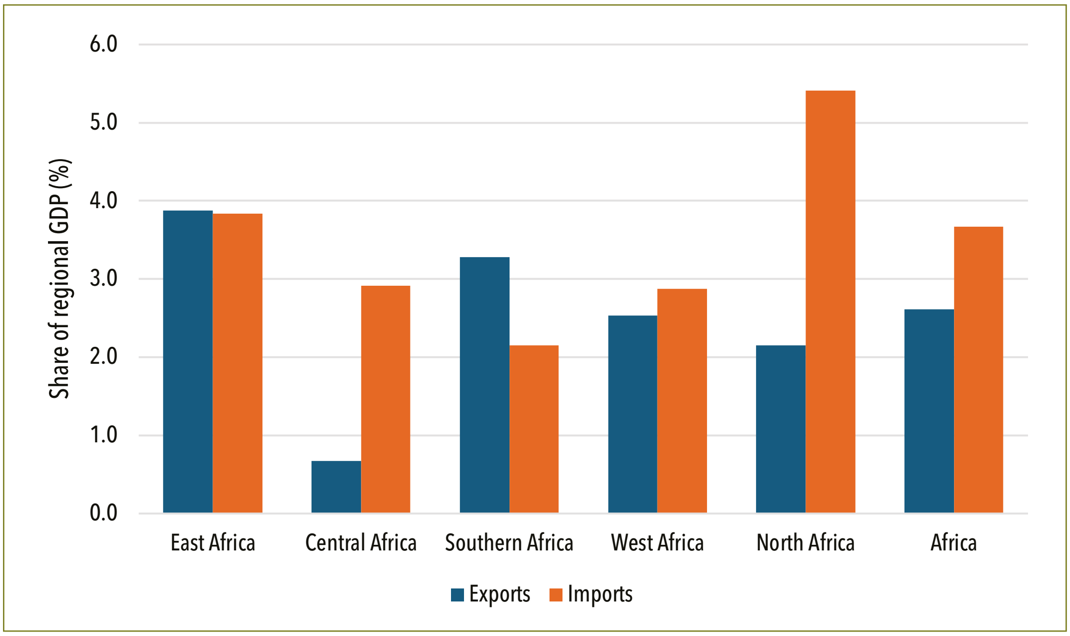
Figure 2.3a Regional breakdown of Africa's agricultural trade, 2018–2022



Source: Authors' calculations based on the AATM 2024 database.

Figure 2.3b analyzes the agricultural performance of Africa's subregions in world markets through the lens of the trade-to-GDP ratio. Exports as a share of GDP are largest in East Africa and smallest in Central Africa, at 3.9 percent and 0.7 percent, respectively. In that respect, Southern Africa is more export oriented than West and North Africa. Conversely, North Africa records the largest imports-to-GDP ratio (5.4 percent) and Southern Africa the lowest (2.1 percent). With imports-to-GDP ratios of 2.9 percent, Central and West Africa are less dependent on imports than East Africa, where the ratio is 3.8 percent.

Figure 2.3b Agricultural trade as a share of GDP, 2018–2022



Source: Authors' calculations based on the AATM 2024 database.

To refine this picture, the next subsection investigates which product categories and countries contribute most to Africa's recent trends in world agricultural markets.

Leading African products and traders in world markets

The top 10 product categories exported by Africa represent nearly 80 percent of the region's total agricultural exports (Table 2.3). Edible fruits and nuts make up the largest share of African agricultural exports, with a market share of more than 20 percent. This category is followed closely by cocoa and its preparations, contributing 15 percent, and coffee, tea, mate, and spices, and spices, contributing 8 percent. The latter two categories, combined with cotton, are the top three African exports, with a high market share in global agricultural trade. More precisely, cotton accounts for only 3 percent of African agricultural exports, while Africa represents up to 12 percent of the world cotton export market. Moreover, these products are highly competitive, as indicated by their high revealed comparative advantage (RCA) index, especially cocoa and cotton.[4] It is noteworthy that two product categories are found to be noncompetitive in world markets, with a RCA of less than1: animal or vegetable fats and oils; and beverages, spirits, and vinegar. These categories have emerged among the top 10 exports because they are largely destined for intra-African markets.

Most of Africa's top exports have recorded a rapid growth rate in recent years, except for cocoa and preparations, tobacco and substitutes, and sugars and sugar confectionery, which have contracted. Oilseeds and oleaginous fruits, and cotton in particular, are not only competitive exports but are also expanding at double-digit growth rates. Africa's exports of cocoa and preparations contracted by 2 percent annually between 2018 and 2022. However, cocoa is the most competitive African export, and the continent still accounts for 20 percent of the world market. This situation underscores the challenges facing Africa's major export products, including price volatility. For instance, between 2016 and 2023, the global monthly price of cocoa surged to its peak in October 2023, reaching approximately US$3,692 per metric ton. Over that period, it fluctuated within the range of approximately $1,900–2,700 per metric ton.[5] Meanwhile, over time, the decline in exports of products with a high comparative advantage like cocoa might result in decreased market share. However, expansion of the export of products with no comparative advantage might indicate opportunities for their diversification and enhanced competitiveness.

4 The revealed comparative advantage index for a product is calculated, following Balassa (1965), as the ratio of a product category's share in Africa's agricultural exports to the same category's share in world agricultural exports, using the formula $RCA_{kt} = \frac{\sum_j X_{jkt}}{\sum_j \sum_k X_{jkt}} / \frac{\sum_i X_{ikt}}{\sum_i \sum_k X_{ikt}}$, where j is an African country, i is every country across the world, and X_{ikt} and X_{jkt} are country i and $j's$ exports of an agricultural product category k in period t. RCA_{kt} values are then averaged over the period 2018–2022. A value greater (smaller) than 1 indicates that Africa has a (no) comparative advantage for exporting products in category k.
5 https://www.statista.com/statistics/498496/global-cocoa-price/

Table 2.3 Africa's leading agricultural export commodities, 2018–2022

Commodity	Export share (%)	Revealed comparative advantage index	Africa's share in world exports (%)	Export growth rate (%)
Fruits and nuts, edible	21.3	2.4	9.6	4.3
Cocoa and cocoa preparations	15.1	4.9	19.7	−2.3
Coffee, tea, mate, and spices	8.4	2.6	10.3	6.1
Vegetables and certain roots and tubers	7.7	1.7	6.6	6.5
Oilseeds and oleaginous fruits	7.3	1.0	3.9	14.6
Tobacco and manufactured tobacco substitutes	5.0	1.7	6.6	−3.1
Animal or vegetable fats and oils	5.0	0.7	2.6	16.7
Sugars and sugar confectionery	3.6	1.2	4.8	0.0
Cotton	3.4	3.1	12.2	12.6
Beverages, spirits, and vinegar	3.1	0.4	1.5	4.8
Total	79.9			

Source: Authors' calculations based on the AATM 2024 database.

Note: Growth rates are the average of annual changes over the period 2018–2022.

Africa's major imports consist largely of products for which the continent has no RCA, except for sugars and sugar confectionery and tobacco and manufactured tobacco substitutes (Table 2.4). The top 10 most imported product categories represent 81 percent of Africa's total agricultural imports. Cereals, animal or vegetable fats and oils, and sugars and sugar confectionery together account for 50 percent. This highlights the challenges Africa faces in satisfying the region's rapidly growing domestic demand (due to rising income, demography, and urbanization) with limited local production capacity. Africa remains a major partner in world markets, capturing 20 percent of cereal imports and 14 percent of sugar and sugar confectionery imports. Oilseeds and oleaginous fruits, which account for 4 percent of Africa's agricultural imports bill, have a very rapid growth rate of nearly 18 percent. This indicates the region's increasing dependence on world markets for this product. It is also noteworthy that animal or vegetable fats and oils and beverages, spirits, and vinegar are found among both top import and export product categories.

Table 2.4 Africa's major agricultural import commodities, 2018–2022

Commodity	Import share (%)	Revealed comparative advantage index	Africa's share in global imports (%)	Import growth rate (%)
Cereals	31.5	0.3	20.1	7.6
Animal or vegetable fats and oils	11.9	0.7	8.8	11.0
Sugars and sugar confectionery	7.7	1.2	14.4	3.4
Dairy produce, eggs, and honey	5.9	0.2	5.6	5.6
Meat and edible meat offal	4.9	0.1	3.2	1.7
Preparations of cereals, flour, starch, or milk	4.2	0.3	4.7	6.3
Miscellaneous edible preparations	3.9	0.4	4.2	7.3
Tobacco and manufactured tobacco substitutes	3.8	1.7	7.2	5.3
Beverages, spirits, and vinegar	3.7	0.4	2.6	7.2
Oilseeds and oleaginous fruits	3.5	1.0	2.7	17.7
Total	80.9			

Source: Authors' calculations based on the AATM 2024 database.

Note: Growth rates are the average of annual changes over the period 2018–2022.

Table 2.5a presents the top exporting subregion for each major export product category. West Africa alone supplies 87 percent of African exports of cocoa and cocoa preparations, which corresponds to 17 percent of global exports in this product category. Similarly, West Africa is the primary source of the continent's exports of cotton as well as other oilseeds and oleaginous fruits, with 8 percent and 1 percent of world market shares, respectively. East Africa stands out as Africa's leading exporter in two product categories: coffee, tea, mate, and spices (9 percent of global exports); and tobacco and manufactured tobacco substitutes (1 percent). North Africa is the major origin of African exports in the category of vegetables and roots and tubers, supplying 4 percent of global exports. Southern Africa is the primary source of African exports in the categories of sugars and sugar confectionery and edible fruits and nuts, at 2 percent and 1 percent, respectively, of the corresponding global markets.

Table 2.5a Major African exporters of the most exported products, by subregion, 2018–2022

Product	Top exporting subregion	Share of African exports (%)	Share of global exports (%)
Fruits and nuts, edible	Southern Africa	37.4	3.6
Cocoa and cocoa preparations	West Africa	87.0	17.1
Coffee, tea, mate, and spices	East Africa	90.0	9.2
Vegetables and certain roots and tubers	North Africa	63.1	4.2
Oilseeds and oleaginous fruits	West Africa	34.1	1.3
Tobacco and manufactured tobacco substitutes	East Africa	79.1	5.3
Animal or vegetable fats and oils	North Africa	44.2	1.2
Sugars and sugar confectionery	Southern Africa	38.8	1.9
Cotton	West Africa	65.7	8.0
Beverages, spirits, and vinegar	Southern Africa	77.4	1.2

Source: Authors' calculations based on the AATM 2024 database.

Table 2.5b provides a more precise picture with the leading exporting country for each major exported product category. With 55 percent of African exports of cocoa and cocoa preparations, Côte d'Ivoire alone secures 11 percent of the global market for this product category. South Africa, Kenya, and Benin each holds at least 3 percent of the global market of a major export category. West Africa emerges as the leading exporting subregion for oilseeds and oleaginous fruits, with 1 percent of the world market, while Sudan, in East Africa, is the leading exporting country, capturing almost 1 percent of the market.

Table 2.5b Major African exporters of the most exported products, by country, 2018–2022

Product	Top exporting country	Share of African exports (%)	Share of global exports (%)
Fruits and nuts, edible	South Africa	36.7	3.5
Cocoa and cocoa preparations	Côte d'Ivoire	54.8	10.8
Coffee, tea, mate, and spices	Kenya	29.7	3.0
Vegetables and certain roots and tubers	Morocco	34.6	2.3
Oilseeds and oleaginous fruits	Sudan	19.7	0.8
Tobacco and manufactured tobacco substitutes	Zimbabwe	33.2	2.2
Animal or vegetable fats and oils	Tunisia	25.1	0.7
Sugars and sugar confectionery	South Africa	21.8	1.1
Cotton	Benin	24.3	3.0
Beverages, spirits, and vinegar	South Africa	70.6	1.1

Source: Authors' calculations based on the AATM 2024 database.

Tables 2.6a and 2.6b investigate the leading African players in import markets. North Africa stands out as the largest player in 6 of the 10 most imported product categories identified. For instance, the subregion accounts for 50 percent of cereal imports at the continental level and 10 percent at the global level. West Africa is the leading destination of Africa's imports of food preparations, while Southern Africa is the largest destination of the continent's imports of beverages, spirits, and vinegar. At the country level, Egypt is the largest importer of cereals, fats and oils, meat and offal, and oilseeds and oleaginous fruits (Table 2.6b). Algeria, Nigeria, South Africa, and Libya also emerge as primary destinations for products among Africa's most imported product categories. These insights illustrate the strong dependence of some African countries on imports of essential agricultural products, hence their exposure and vulnerability to global supply chain disruptions, like those faced during the COVID-19 pandemic and the Russian–Ukraine war (Badiane et al. 2022; Bouët, Odjo, and Zaki 2020, 2022).

Table 2.6a Largest African importers of the most imported products, by subregion, 2018–2020

Product	Top importing subregion	Share of African imports (%)	Share of global imports (%)
Cereals	North Africa	50.0	10.0
Animal or vegetable fats and oils	East Africa	36.8	3.2
Sugars and sugar confectionery	North Africa	38.6	5.6
Dairy produce, eggs, and honey	North Africa	53.8	3.0
Meat and edible meat offal	North Africa	39.0	1.3
Preparations of cereals, flour, starch, or milk	West Africa	38.5	1.8
Miscellaneous edible preparations	West Africa	32.6	1.4
Tobacco and manufactured tobacco substitutes	North Africa	43.9	3.1
Beverages, spirits, and vinegar	Southern Africa	29.5	0.8
Oilseeds and oleaginous fruits	North Africa	83.1	2.2

Source: Authors' calculations based on the AATM 2024 database.

Table 2.6b Largest African importers of the most imported products, by country, 2018–2020

Product	Top importing country	Share of African imports (%)	Share of global imports (%)
Cereals	Egypt	24.7	5.0
Animal or vegetable fats and oils	Egypt	11.9	1.0
Sugars and sugar confectionery	Algeria	10.6	1.5
Dairy produce, eggs, and honey	Algeria	25.6	1.4
Meat and edible meat offal	Egypt	30.9	1.0
Preparations of cereals, flour, starch, or milk	Nigeria	11.4	0.5
Miscellaneous edible preparations	South Africa	10.1	0.4
Tobacco and manufactured tobacco substitutes	Libya	14.3	1.0
Beverages, spirits, and vinegar	South Africa	18.5	0.5
Oilseeds and oleaginous fruits	Egypt	50.6	1.4

Source: Authors' calculations based on the AATM 2024 database.

The preceding analysis illustrates the patterns of specialization of African subregions and countries with respect to the major leading export and import products. It indicates that Africa plays a crucial role in supplying as well as importing certain agricultural products, despite a tiny overall share of global agricultural trade. It also shows the diversity of RCAs in various agricultural products among African subregions and countries.

Africa's major trade partners

Tables 2.7 and 2.8 explore Africa's primary partners in agricultural trade. For each major export product category, Table 2.7 identifies the destination that receives the largest share of Africa's exports in that category. In general, the shares of such top destinations are not more than 25 percent, except for China, whose share represents 37 percent of Africa's exports of oilseeds and oleaginous fruits. This reflects the relative diversification of the destinations of African agricultural exports. A minimum of 11 but not more than 21 countries outside Africa are destinations of at least 1 percent of the continent's exports in the different product categories. Low values of the Herfindahl-Hirschman Index (HHI)[6] confirm the relative diversity of the destinations of Africa's exports in the product categories under consideration. A more detailed analysis at the Harmonized System (HS) 6-digit level of product definition might reveal higher HHI values—that is, a more concentrated export market structure for certain specific products. Africa's export market for oilseeds and oleaginous fruits is the least diversified, with an HHI value of 0.153, while that of beverages, spirits, and vinegar, with an HHI value of 0.028, is the most diversified. A diversified export market is important to reduce an exporter's dependence on and vulnerability to policy changes or external shocks affecting its trade partners that could result in more stringent export barriers.

6 The Herfindahl-Hirschman Index of export (import) market diversification measures the dispersion of export (import) value across all destinations (origins). For each product category , we calculate the index of Africa's export (import) market diversification using the formula $HHI_k = \sum_{i=1}^{N_k} s_{ik}^2$, where i is an export destination (import origin) of product category k , N_k is the number of destinations (origins), and s_{ik} is the share of destination (origin) i in Africa's global exports (imports) of k on average over the period 2018–2022. If Africa exports to (imports from) a very few partners, the index will be close to 1. Conversely, if Africa trades with a huge number of partners with small market shares, the index will be close to $1/N_k$, with N_k ranging from 111 to 173 destinations (origins) for the different product categories under analysis. Hence, HHI_k varies between $1/N_k$ (high market diversification) and 1 (high market concentration).

Table 2.7 Top destinations of African agricultural exports, 2018–2022

Product	Top export destination		Number of non-African destinations with market share > 1%	HHI of Africa's export market diversification
	Country	Market share (%)		
Fruits and nuts, edible	Viet Nam	10.0	17	0.049
Cocoa and cocoa preparations	Netherlands	25.3	17	0.097
Coffee, tea, mate, and spices	United States	13.3	21	0.046
Vegetables and certain roots and tubers	France	15.1	14	0.054
Oilseeds and oleaginous fruits	China	36.9	18	0.153
Tobacco and manufactured tobacco substitutes	China	19.6	15	0.053
Animal or vegetable fats and oils	Spain	9.7	15	0.029
Sugars and sugar confectionery	South Africa	12.8	13	0.031
Cotton	Viet Nam	19.7	11	0.091
Beverages, spirits, and vinegar	United Kingdom	8.3	14	0.028

Source: Authors' calculations based on the AATM 2024 database.
Note: HHI = Herfindahl-Hirschman Index.

Table 2.8 reveals the same diversification in sources of Africa's imports of agricultural products, with 9 to 19 countries supplying at least 1 percent of the continent's imports of a product in the different product categories. This is reflected in the low HHI values of Africa's import market diversification. Africa's import market for sugars and sugar confectionery is the least diversified, with an HHI value of 0.228. With more than 30 percent of Africa's import market, Brazil emerges as the top source of sugars and sugar confectionery as well as meat and edible meat offal. In contrast, the import market of miscellaneous edible preparations is the most diversified, with an HHI value of 0.047. South Africa is the largest supplier of Africa's imports, with a market share of only 10.6 percent. The United States is the top origin of oilseeds and oleaginous fruits. Other primary partners individually supply between 11 percent and 30 percent of Africa's market.

Comparing HHI values in Tables 2.7 and 2.8 for the product categories that Africa both exports and imports, it appears that Africa's import markets for such products are less diversified than the corresponding export markets. Such products are in the categories of oilseeds and oleaginous fruits; tobacco and manufactured tobacco substitutes; animal or vegetable fats and oils; sugars and sugar confectionery; and beverages, spirits, and vinegar. To illustrate, for sugars and sugar confectionery, the HHI of the diversification of the continent's import market (0.228) is seven times larger than that of its export market (0.031). Diversifying import sources is crucial for food security and for mitigating supply disruptions that could arise in some source countries.

Table 2.8 Top origins of African agricultural imports, 2018–2022

Product	Top import origin		Number of non-African origins with market share > 1%	HHI of Africa's import market diversification
	Country	Market share (%)		
Cereals	Russia	16.8	19	0.076
Animal or vegetable fats and oils	Indonesia	26.0	15	0.145
Sugars and sugar confectionery	Brazil	42.9	9	0.228
Dairy produce, eggs, honey	New Zealand	18.9	19	0.070
Meat and edible meat offal	Brazil	30.9	16	0.142
Preparations of cereals, flour, starch, or milk	France	11.1	17	0.053
Miscellaneous edible preparations	South Africa	10.6	16	0.047
Tobacco and manufactured tobacco substitutes	UAE	29.4	12	0.110
Beverages, spirits, and vinegar	South Africa	17.0	15	0.066
Oilseeds and oleaginous fruits	United States	39.4	13	0.181

Source: Authors' calculations based on the AATM 2024 database.

Note: HHI = Herfindahl-Hirschman Index; UAE = United Arab Emirates.

Major intra-African trade players

The most traded products between African countries pertain to the same categories as the leading products in Africa's global trade, with two exceptions. Cotton is an important product category in Africa's global trade but not in intra-African trade. Conversely, preparations of cereals, flour, starch, or milk are more important in intracontinental trade than in Africa's global trade. Tables 2.9 and 2.10 inform on the degree of diversification of intra-African export destination and import sources for these top traded product categories. The primary destinations of these products generally account for less than 25 percent of intracontinental exports, except for Egypt, which is the destination of 32 percent of intracontinental exports in the category of coffee, tea, mate, and spices (Table 2.9). At least 15 countries are destinations for 1 percent or more of intra-African exports in the different product categories. This is an indication of high diversification of the intracontinental destination of agricultural exports, as also revealed by low HHI values. The destination for products in the category of coffee, tea, mate, and spices is the least diversified, with an HHI value of 0.138, compared with the destination for miscellaneous edible preparations, which is the most diversified (an HHI value of 0.035).

Table 2.9 Top destinations of intra-African agricultural exports, 2018–2022

Product	Top intra-African export destination		Number of intra-African destinations with market share > 1%	HHI of intra-African export destination diversification
	Country	Market share (%)		
Animal or vegetable fats and oils	Zimbabwe	11.3	25	0.049
Sugars and sugar confectionery	South Africa	22.9	22	0.089
Beverages, spirits, and vinegar	Botswana	12.2	22	0.062
Cereals	Zimbabwe	16.8	15	0.091
Miscellaneous edible preparations	Mozambique	7.1	30	0.035
Tobacco and manufactured tobacco substitutes	Egypt	8.3	25	0.040
Vegetables and certain roots and tubers	Somalia	23.7	23	0.084
Coffee, tea, mate, and spices	Egypt	31.5	17	0.138
Preparations of cereals, flour, starch or milk	Botswana	8.6	29	0.037
Fruits and nuts, edible	Morocco	17.8	22	0.078

Source: Authors' calculations based on the AATM 2024 database.
Note: HHI = Herfindahl-Hirschman Index.

Intra-African import sources are less diversified than export destinations (Table 2.10). Compared with destination countries, fewer source countries account for at least 1 percent of intra-African imports of the most traded product categories. For instance, 17 such source countries exist for animal or vegetable fats and oils (Table 2.10) compared with 25 destination countries (Table 2.9). In addition, a significant share of intracontinental trade is shipped from the leading exporter of every product category. South Africa, the primary exporter of several product categories, accounts for 56 percent of supplies of beverages, spirits, and vinegar and for 48 percent of cereals. The lower degree of diversification of intra-African import sources compared with export destinations is reflected in the higher HHI values in Table 2.10 compared with those in Table 2.9. The intra-African import sources for animal or vegetable fats and oils and for tobacco and manufactured tobacco substitutes are the most diversified, with HHI values of 0.105 and 0.107, respectively, while import sources for beverages, spirits, and vinegar is the least diversified, with an HHI value of 0.327.

Table 2.10 Major sources of intra-African agricultural imports, 2018–2022

Product	Top intra-African import source		Number of intra-African sources with market share >1%	HHI of intra-African import source diversification
	Country	Market share (%)		
Animal or vegetable fats and oils	South Africa	23.0	17	0.105
Sugars and sugar confectionery	Eswatini	24.3	14	0.124
Beverages, spirits, and vinegar	South Africa	55.7	14	0.327
Cereals	South Africa	47.6	10	0.290
Miscellaneous edible preparations	South Africa	38.1	10	0.203
Tobacco and manufactured tobacco substitutes	South Africa	15.5	12	0.107
Vegetables and certain roots and tubers	Ethiopia	32.2	11	0.179
Coffee, tea, mate, and spices	Kenya	40.3	16	0.202
Preparations of cereals, flour, starch or milk	South Africa	38.6	15	0.186
Fruits and nuts, edible	South Africa	39.3	13	0.193

Source: Authors' calculations based on the AATM 2024 database.
Note: HHI = Herfindahl-Hirschman Index.

Africa and the world's top exporters

For each of Africa's most exported product categories, Table 2.11 identifies the country that accounts for the largest share of world exports on average (2018–2022). The United States is the world's top exporter of cotton and of edible fruits and nuts. Its share of global cotton exports (36 percent) is three times larger than Africa's (12 percent). However, Africa's participation in the world export market for fruit and nuts (9.6 percent) is comparable to that of the United States (9.5 percent). Brazil is the leading exporter worldwide in three export product categories, including oilseeds and oleaginous fruits, for which Brazil's market share (32 percent) is a remarkable eight times larger than Africa's (4 percent); and Brazil's contribution to global exports of sugars and sugar confectionery is almost five times larger than Africa's. Nevertheless, Africa's performance in the global export market of coffee, tea, mate, and spices (10 percent) is roughly comparable to Brazil's (12 percent). The other leading exporters worldwide are Germany[7] for cocoa and cocoa preparations exports, Mexico for vegetable and certain tuber exports, Poland for tobacco, Indonesia for fats and oils, and France for beverages, spirits, and vinegar. Compared with Africa, these countries individually capture a larger share of the global exports market, except for Germany.

7 It is worth noting that Germany does not produce cocoa beans, but its cocoa processing industry is well known, with several chocolate brands that source cocoa beans globally to produce dark chocolate.

Table 2.11 Africa compared with the world's leading exporters, 2018–2022

Product	World's top exporter		Africa's share of global exports (%)
	Country	Share of global exports (%)	
Fruits and nuts, edible	United States	9.5	9.6
Cocoa and cocoa preparations	Germany	11.5	19.7
Coffee, tea, mate, and spices	Brazil	11.7	10.3
Vegetables and certain roots and tubers	Mexico	11.4	6.6
Oilseeds and oleaginous fruits	Brazil	32.0	3.9
Tobacco and manufactured tobacco substitutes	Poland	9.4	6.6
Animal or vegetable fats and oils	Indonesia	21.2	2.6
Sugars and sugar confectionery	Brazil	19.3	4.8
Cotton	United States	36.2	12.2
Beverages, spirits, and vinegar	France	16.0	1.5

Source: Authors' calculations based on the AATM 2024 database.

This section reviewed Africa's participation in world agricultural trade in recent years. While it might be deemed low in terms of trade values and shares of global trade, it is remarkable in its growth trends and the diversification of its trade partners, which are spread across all continents. This presence in international trade entails some environmental costs. Most notably, trade is associated with GHG emissions through production, processing, and transportation activities. The next section explores the trends and patterns in Africa's agricultural trade-related carbon footprint.

Carbon Emissions Content of Africa's Agricultural Trade

This section begins by analyzing the trends in GHG emissions transfers from and to Africa via the continent's participation in international trade of agricultural products. It compares Africa with other world regions with respect to their involvement in GHG emissions trade, taking into account their demographic and economic size differences. The section then investigates the main partners of Africa's GHG emissions trade, comparing emissions originating in agriculture and other sectors of the economy.

Data on the GHG emissions embodied in trade flows are obtained from the Eora Global Supply Chain Database (Lenzen et al. 2012, 2013).[8] The database consists of a multiregion input–output table (MRIO) model that provides a time series of high-resolution IO tables with matching environmental and social satellite accounts. It is based on data drawn from a wide range of national and international sources. It documents the intersectoral transfers among 15,909 sectors across 190 countries over the period 1990 to 2022, including data on countries' total GHG footprints and details on countries (and sectors) in which that footprint originates.

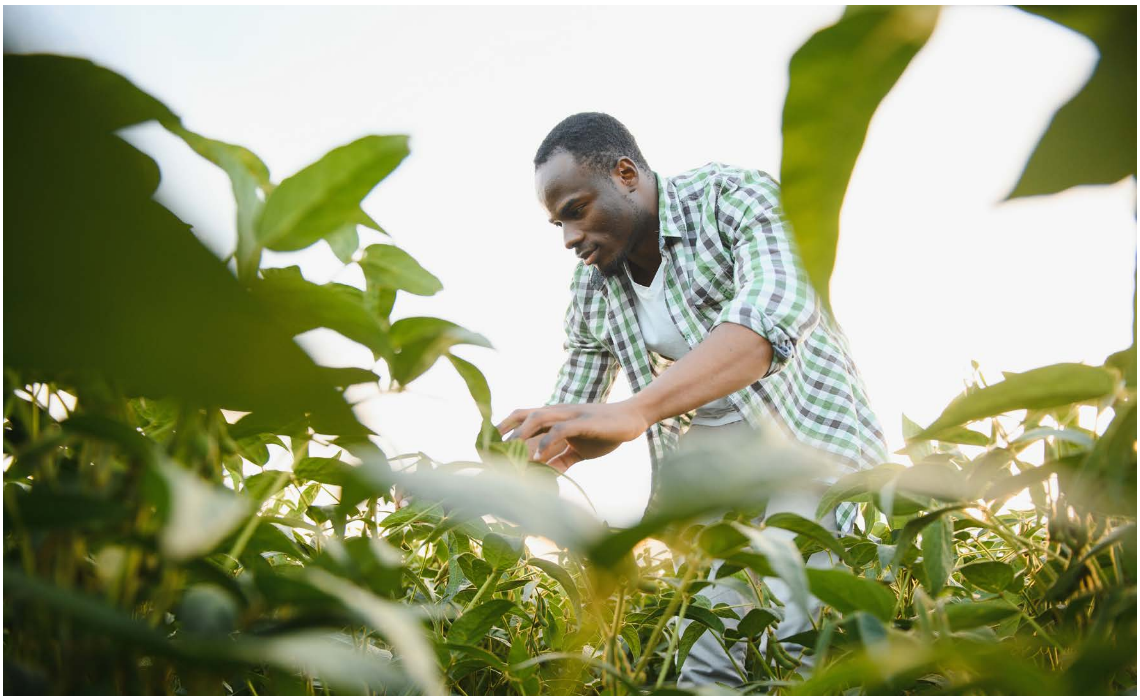
Using a simplified 26-sector structure, the current analysis differentiates the first six sectors—with agriculture covering all crop production, livestock, forestry, and hunting activities—and aggregates the remaining 20 sectors into a "rest of the economy" sector.[9] The data available

8 See https://www.worldmrio.com/footprints/carbon/
9 The full Eora Global Supply Chain Database is available only with paid licenses. Free access to the database is granted to a simplified version with a 26-sector structure, as in Table A2.2 in the appendix to this chapter

for the sectoral analysis of GHG emissions trade are limited to the period 1990–2016. All types of GHGs are combined and expressed in carbon dioxide (CO_2) equivalent terms. Despite these limitations, the analysis provides useful insights into the carbon footprint implications of Africa's participation in global agricultural trade.

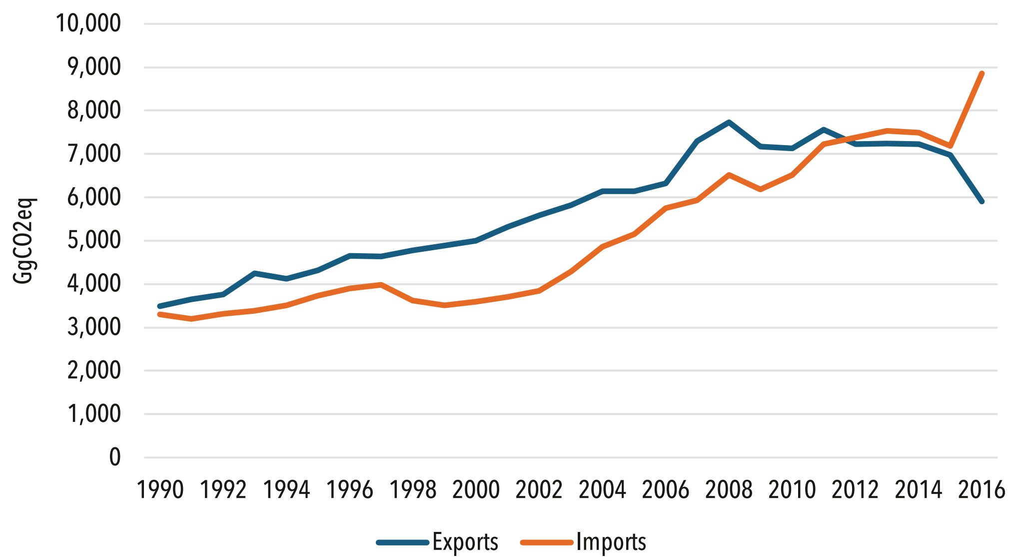
Africa's role in global GHG emissions embodied in agricultural trade

Africa's contribution to global carbon emissions associated with agricultural trade has steadily expanded since the 1990s. Figure 2.4 reveals an upward trajectory in carbon emissions embedded in Africa's exports of agricultural goods, commencing at 3,490 gigagrams of CO_2 equivalent ($GgCO_2eq$) in 1990, peaking at 7,731 $GgCO_2eq$ in 2008, and decreasing to 5,910 $GgCO_2eq$ in 2016. The emissions embodied in imports of agricultural goods into Africa increased continuously while remaining below the level of emissions embedded in exports until 2012, when Africa became a net importer of agricultural GHG emissions. This trend underscores the escalating environmental impact associated with Africa's agricultural imports. The carbon emissions embodied in Africa's agricultural trade began to increase faster in imports compared with exports in the early 2000s: emissions embedded in imports increased at an annual rate of 9.3 percent in the 2002–2006 period, compared with 3.6 percent for exports (Table 2.12). A decade later, these growth rates fell to 4.6 percent and −4.6 percent, respectively. The decrease in growth of emissions embodied in Africa's agricultural exports reflects the trend in emissions embedded in global agricultural trade, which decelerated from 6.3 percent in 2002–2006 to 0.6 percent in 2012–2016. In addition, these trends echoed the slowdown of agricultural export growth in current US dollar value terms between 2012 and 2016, particularly in 2015 and 2016, when African exports contracted by 5.8 percent and 3 percent, respectively, and global exports decreased by 10 percent in 2015 and grew by only 0.08 percent in 2016.[10] More detailed data on GHG emissions associated with individual agricultural export products would allow us to investigate the extent to which the decline in emissions in 2012–2016 is due to changes in export product composition, in addition to changes in export size.



10 Growth in agricultural export values at global and African levels are calculated from the AATM 2024 database.

Figure 2.4 Evolution of GHG emissions embedded in Africa's agricultural trade, 1990–2016 ($GgCO_2eq$)



Source: Authors' calculations based on Eora Global Supply Chain Database (Lenzen et al. 2012, 2013).

Note: $GgCO_2eq$ = gigagrams carbon dioxide equivalent.

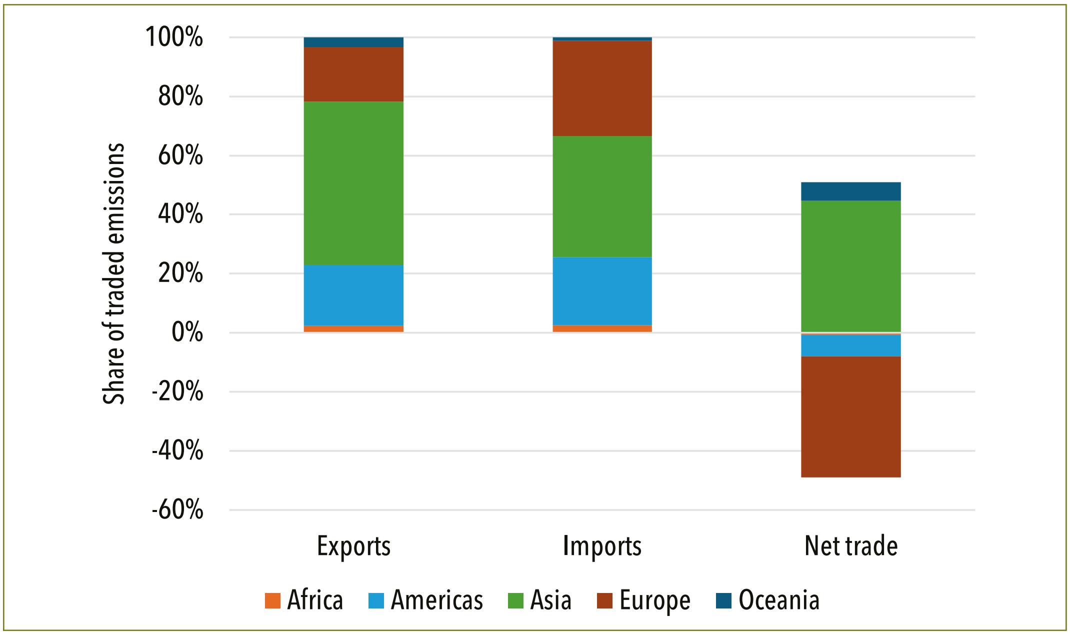
Table 2.12 Annual growth in GHG emissions embodied in African and world agricultural trade, 1992–2016

Period	African agricultural trade		Global agricultural trade (%)
	Exports (%)	Imports (%)	
1992–1996	5.1	4.0	5.2
2002–2006	3.6	9.3	6.3
2012–2016	−4.6	4.6	0.6

Source: Authors' calculations based on Eora Global Supply Chain Database (Lenzen et al. 2012, 2013).

Figure 2.5 explores the relative importance of Africa's participation in global carbon emissions through agricultural trade. It shows that Africa is responsible for only a tiny share of global emissions embodied in agricultural trade: 2.3 percent and 2.5 percent in exports and imports, respectively. These contributions to GHG emissions are much lower than the continent's shares in global agricultural exports and imports in gross value terms, as observed in Table 2.2, which are 4.0 percent and 5.6 percent, respectively. Asia contributes the largest shares of carbon emissions incorporated in world agricultural exports (55 percent) and imports (41 percent). The Americas contribute more than Europe on the exports side, while the reverse holds on the imports side. Overall, while Asia and Oceania are net exporters of carbon emissions, Europe, the Americas, and Africa are net importers, although Africa's net import of carbon emissions is so small it is hardly visible in Figure 2.5.

Figure 2.5 Regional breakdown of GHG emissions embodied in global agricultural trade, 2012–2016



Source: Authors' calculations based on Eora Global Supply Chain Database (Lenzen et al. 2012, 2013).

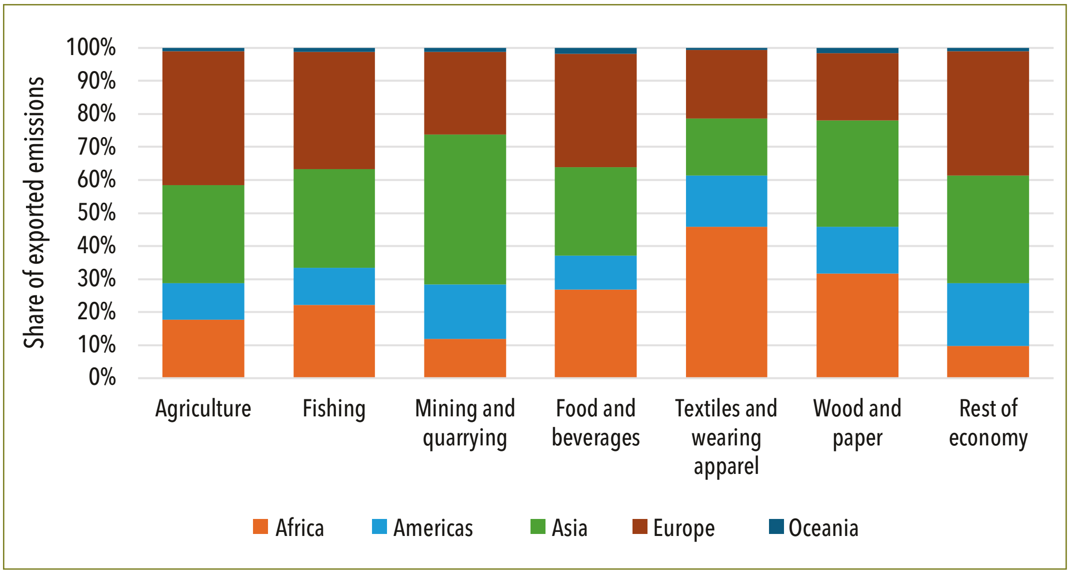
In sum, Africa's contribution to GHG emissions through trade in agricultural commodities is low, in line with its share in global agricultural trade in gross value terms. In an attempt to understand these trends, the next section explores the destination and source regions of GHG emissions embedded in Africa's trade, comparing emissions originating in agriculture and other sectors of the economy. As noted above, agriculture is an aggregate sector in the simplified version of the Eora dataset used for the analysis (Lenzen et al. 2012, 2013). Agriculture comprises crop production, livestock, forestry, and hunting. It is unfortunately not possible to decompose total GHG emissions associated with African agricultural trade into the respective contributions of specific agricultural activities or products. Similarly, it is not possible to break down GHG emissions embedded in trade into specific shares of emissions generated during the production and transportation of traded commodities. Moreover, the dataset is not appropriate for exploring a decomposition of total carbon emissions embodied in trade by type of input used and type of GHG emitted.[11]

Major destinations and sources of GHG emissions embodied in Africa's agricultural trade

Figure 2.6 summarizes the breakdown of GHG emissions embodied in Africa's sectoral exports into destination regions. Europe is the top destination for emissions originating in Africa's agriculture and fishing export sectors: it received 40 percent and 35 percent of Africa's GHG emissions exports from these sectors, respectively, in the 2012–2016 period. In contrast, most of the emissions embedded in exports from the mining and quarrying sector are destined to Asia. It is noteworthy that emissions associated with African exports from the textiles and wearing apparel sector are primarily retained within Africa. In general, the Americas are the fourth largest destination, after Asia, Europe, and Africa.

11 In-depth research to explore those breakdowns needs to be conducted using the full Eora database, which is accessible with a paid license.

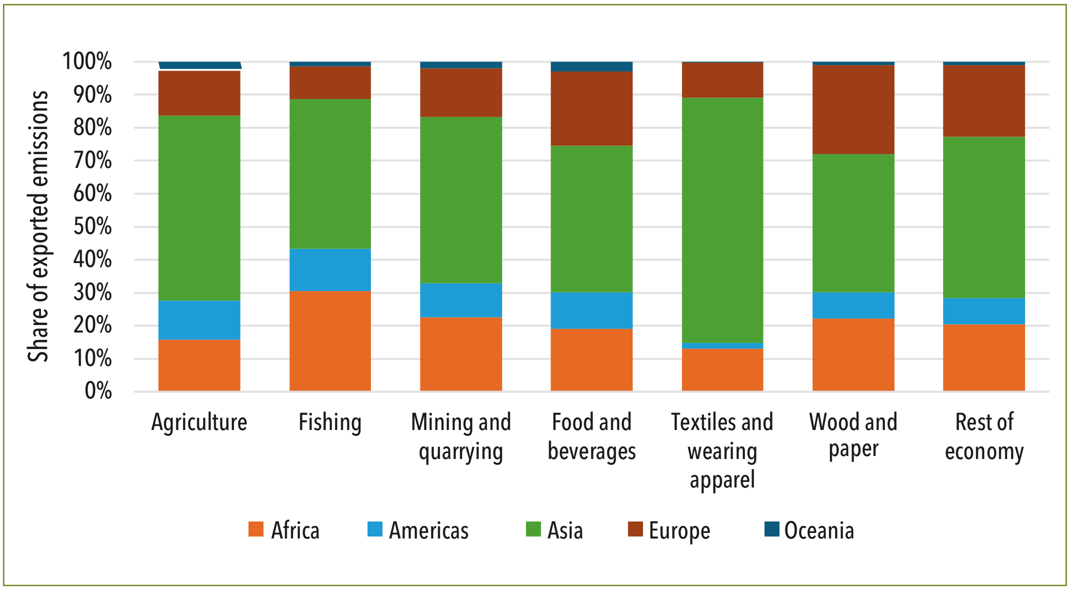
Figure 2.6 Destinations of GHG emissions embedded in Africa's exports, by source sector, 2012–2016



Source: Authors' calculations based on Eora Global Supply Chain Database (Lenzen et al. 2012, 2013).

Figure 2.7 presents the origins of GHG emissions embedded in Africa's sectoral imports, with Asia appearing as the primary origin irrespective of the emitting sector. Up to 56 percent of the GHG emissions content of African agricultural imports originated in Asia in 2012–2016, on average. However, Asia's contribution to GHG emissions in African imports of textile and wearing apparel was much larger, reaching 74 percent.

Figure 2.7 Origins of GHG emissions embedded in Africa's imports, by source sector, 2012–2016



Source: Authors' calculations based on Eora Global Supply Chain Database (Lenzen et al. 2012, 2013).

Table 2.13 identifies the country destinations of emissions embedded in Africa's agricultural exports. The top 20 countries are destinations of 70 percent of GHG emissions exported from Africa's agriculture sector. Germany, the United Kingdom, and the United States together received nearly one-quarter of those emissions. Four African countries are among the top 20 destinations: Botswana, Namibia, Angola, and Zambia combined received 8 percent of those emissions.

Table 2.13 Top destinations of GHG emissions embodied in Africa's agricultural exports, 2012–2016

Destination	Share (%)	Destination	Share (%)
Germany	8.57	Spain	2.48
United Kingdom	8.04	India	2.31
United States	7.83	Namibia	1.91
Japan	4.7	Angola	1.81
France	4.52	Switzerland	1.75
Kazakhstan	4.38	United Arab Emirates	1.61
China	3.93	Zambia	1.59
China, Hong Kong	3.24	Saudi Arabia	1.38
Netherlands	3.03	Belgium	1.29
Botswana	2.66	**Top 20 total**	**69.6**
Italy	2.59		

Source: Authors' calculations based on Eora Global Supply Chain Database (Lenzen et al. 2012, 2013).

The top 20 countries listed in Table 2.14 are the origin of nearly 90 percent of GHG emissions embodied in Africa's agricultural imports. The top three—India, China, and South Africa—are the source of up to 55 percent of GHG emissions imported to Africa with agricultural products. South Africa and Kenya are the only two African countries in this top 20.

Table 2.14 Major origins of GHG emissions embodied in Africa's agricultural imports, 2012–2016

Origin	Share (%)	Origin	Share (%)
India	23.92	Turkey	1.98
China	17.85	Kenya	1.85
South Africa	13.95	Thailand	1.37
United States	4.31	Spain	1.29
Iran	3.40	Italy	1.19
Argentina	2.81	Germany	1.18
France	2.61	Netherlands	1.15
Indonesia	2.28	Canada	0.86
Brazil	2.15	Malaysia	0.85
Viet Nam	2.12	**Top 20 total**	**89.20**
Australia	2.07		

Source: Authors' calculations based on Eora Global Supply Chain Database (Lenzen et al. 2012, 2013).

In short, the preceding sections explored trends and patterns in Africa's agricultural trade in terms of both gross value and GHG emissions. From being a net exporter of agricultural GHG emissions, the continent became a net importer in the 2012–2016 period, partly due to a slowdown of its agricultural exports in gross value terms. In-depth research is needed to investigate the extent to which this trend reversal is associated with changes in the composition of the continent's agricultural exports. Europe is the top destination for GHG emissions from Africa's agricultural and fishing exports, and Asia receives most of the emissions exported from the continent's mining and quarrying sector, while the continent retains most of the emissions embedded in its exports of textiles and apparel products. On the import side, Asia is the primary source of emissions embodied in African agricultural imports, and more significantly in the continent's textiles and apparel imports.

Conclusions

Africa's participation in global agricultural trade in recent years is the focus of this chapter. The continent's agricultural trade is analyzed in terms of both value and GHG emissions. As a result of a consistent upward growth trend, Africa has the third fastest growth in agricultural exports after the Americas and Asia and the second fastest growth in imports after Asia. However, its share of global agricultural trade remains low, as does its contribution to GHG emissions through agricultural trade. The North and Southern Africa subregions drive the continent's export growth, while import growth is led by the East and North Africa subregions. Growth in the continent's agricultural trade deficit decelerated over the recent decade, as in other world regions.

While Africa accounts for a small share of global agricultural trade as a whole, it is a big player in the world markets of some of its most traded product categories, such as cotton, cocoa, coffee and tea, and tobacco on the exports side and cereals, sugars and sugar confectionery, and fats and oils on the imports side. The analysis of major trading subregions and countries reveal differences in comparative advantages, patterns of export specialization and import dependency, and vulnerability to world market disruptions, such as those resulting from the COVID-19 pandemic and the Russia–Ukraine war. However, the analysis also reveals a relatively higher diversification of the continent's export destinations compared with import sources in the world markets of its most traded commodity groups.

Africa generally sustains a significant growth rate in its most exported product categories, except for cocoa and cocoa preparations in recent years. However, it faces strong competition, whereby the world's leading exporters generally reap a larger share of the global export market compared to Africa. This explains why growth performance in its most exported products does not translate into a significant increase in world market share.

The trends in GHG emissions embodied in Africa's agricultural trade reflect the sustained growth performance of exports and imports in gross value terms, turning the continent into a net importer of agricultural GHG emissions a decade ago. While Africa's contribution to global GHG emissions via agricultural trade appears small compared with that of other world regions, it faces the common challenge of transitioning to sustainable technologies and practices.

Europe receives the largest portion of GHG emissions exported from Africa's agriculture and fishing sectors, while Asia is the primary destination of emissions embodied in the continent's exports from the mining and quarrying sector. Emissions embodied in exports from the textile and wearing apparel sector, where Africa has one of its largest manufacturing capacities, are largely retained within the continent. Emissions embedded in Africa's agricultural imports mostly originate in Asia across all emitting sectors, but more notably in textiles and wearing apparel.

Overall, the findings from this chapter raise the importance of developing a strategy for import product and partner diversification to reduce the scale of carbon emissions imported with agricultural products. The strategy should also seek to diversify intracontinental import sources. Currently, intra-African imports mostly originate in only a few countries, with South Africa contributing significant shares of the continental supply of many product categories. Among the factors that limit imports from other intracontinental sources are poor trade infrastructure; trade-restricting, behind-the-border policies; and high external customs duties imposed on trade between regional economic communities.

A critical issue that warrants further exploration is the impact of nontariff measures (NTMs) on intra-African agricultural trade. NTMs are numerous and varied across the continent, playing a crucial role in shaping trade dynamics and market access. The prevalence of NTMs may reflect higher demand for safe food in a context of rising income and changing diets. NTMs intended to protect human health (sanitary and phytosanitary measures) account for 52 percent of all NTMs (UNCTAD 2012). Most NTMs are adopted with the objective of correcting market inefficiencies. Thus, NTMs can be trade catalysts or trade barriers. Santeramo and Lamonaca (2019) reviewed an extensive literature on the trade effects of NTMs and found that both the trade-barrier and trade-catalyst natures of NTMs have been empirically identified, but their trade-barrier nature prevails. Recent studies highlight that reductions in NTMs can significantly enhance intra-African trade under initiatives such as the African Continental Free Trade Area (AfCFTA) (Beckman, Johnson, and Ivanic 2024; Bouët, Laborde, and Traoré 2022). Since NTMs are expected to play a corrective role in the marketplace, raising the financial and technical capacities of African exporters to comply with NTMs might be more appropriate than reducing or dismantling them. By leveraging initiatives like AfCFTA and focusing on sustainable practices, Africa can enhance its economic resilience and contribute positively to global climate efforts.

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Appendix 2.1

Table A2.1 List of countries by African subregion

East Africa	Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, South Sudan, Tanzania, Uganda, Zambia, Zimbabwe
Central Africa	Angola, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Sao Tome and Principe
Southern Africa	Botswana, Eswatini, Lesotho, Namibia, South Africa
West Africa	Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo
North Africa	Egypt, Libya, Morocco, Sudan, Tunisia, Western Sahara

Source: United Nations country classification, https://unstats.un.org/unsd/methodology/m49/

Table A2.2 Eora 26-sector structure

#	Description	#	Description
1	Agriculture	14	Construction
2	Fishing	15	Maintenance and repair
3	Mining and quarrying	16	Wholesale trade
4	Food and beverages	17	Retail trade
5	Textiles and wearing apparel	18	Hotels and restaurants
6	Wood and paper	19	Transport
7	Petroleum, chemical, and non-metallic mineral products	20	Post and telecommunication
8	Metal products	21	Financial intermediation and business activities
9	Electrical and machinery	22	Public administration
10	Transport equipment	23	Education, health, and other services
11	Other manufacturing	24	Private households
12	Recycling	25	Others
13	Electricity, gas, and water	26	Re-export and re-import

Source: Eora Global Supply Chain Database (Lenzen et al. 2012, 2013).

3

Intra-African Trade in Virtual Water: Trends and Drivers

Greenwell Matchaya, Sunday Odjo, and Julia Collins

Introduction

Increasing intra-African trade is expected to have a wide range of benefits, including contributing to increased economic growth, employment, and food security. The African Continental Free Trade Area (AfCFTA), launched in 2021, will have potentially significant impacts on economic output and incomes when fully implemented. A recent study suggests that AfCFTA implementation will drive substantial employment growth, generating more than 7 million new jobs in manufacturing, public services, trade, and other services (World Bank 2020). Bouët, Laborde, and Traoré (2022) estimate that an ambitious implementation of the AfCFTA, which eliminates tariffs and significantly reduces nontariff measures, would increase Africa's gross domestic product (GDP) by 0.2 percent compared to baseline trends in the absence of the AfCFTA by 2035. Increased intra-African trade in agriculture could also contribute significantly to improving food security and nutrition, including by increasing dietary diversity, promoting food price stability, and boosting the availability of key micronutrients (Bonuedi, Kamasa, and Opeku 2020; Makochekanwa and Matchaya 2019; Odjo and Badiane 2018; Olivetti et al. 2023).

A further potential benefit of increased intra-African trade is its contribution to environmental sustainability and efficient use of scarce natural resources. The impacts of trade on the environment are complex. Although trade expends resources and contributes to greenhouse gas emissions, it could also contribute to sustainable resource use if it allows countries to specialize in production patterns according to their resource endowments and comparative advantage (Odjo, Traoré, and Zaki 2023). In the context of climate variability and water scarcity, trade could potentially help to minimize the negative impacts by moving commodities from areas with high water availability to water-scarce areas (Matchaya, Garcia, and Traoré 2023).

This chapter reviews overall trends in intra-African agricultural trade and, to assess the contribution of this trade to sustainability, takes a close look at its potential to address issues of water scarcity and contribute to efficient use of water resources. The chapter examines intra-African agricultural trade in virtual water—that is, the water content embedded in trade flows of agricultural products. Trade is most commonly measured in value terms, but the monetary value of a product does not always reflect the resources used to produce it. Trade flows expressed as virtual water trade (VWT) reflect both the specific water requirements of different crops and the varying crop yields obtained in different countries. Examining intra-African trade in virtual water terms and identifying the impact of countries' resource endowments and water productivity levels on VWT helps us to assess the contribution of intra-African trade to addressing water stress and scarcity in African countries and contributing to more efficient water use.

Water is a key resource for food security in Africa. Water availability is a significant constraint to agricultural productivity. Distribution of Africa's water resources is highly unequal (Xie et al. 2014), with ample water resources in some areas (for example, Central Africa) and pronounced water scarcity in others (notably North Africa). Intra-African agricultural trade in virtual water could thus be a means to allow countries with greater water scarcity or less productive use of water to import virtual water content from countries with greater water endowments or greater water productivity, rather than exhausting their own limited resources.

The chapter is organized as follows. The next section reviews intra-African agricultural trade in value terms, assessing overall trends over time and across regional economic communities (RECs) and countries. The third section examines trade trends in terms of virtual water content and explores the relationship between trade in value and trade in water content for selected crops. The fourth section carries out an econometric analysis to explore the determinants of VWT

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among African countries. Specifically, the analysis examines the impact of water productivity and water and land endowments as well as other factors on VWT at the continental level and among RECs and for specific commodity groups. The final section concludes.

Trends in the Value of African Agricultural Trade

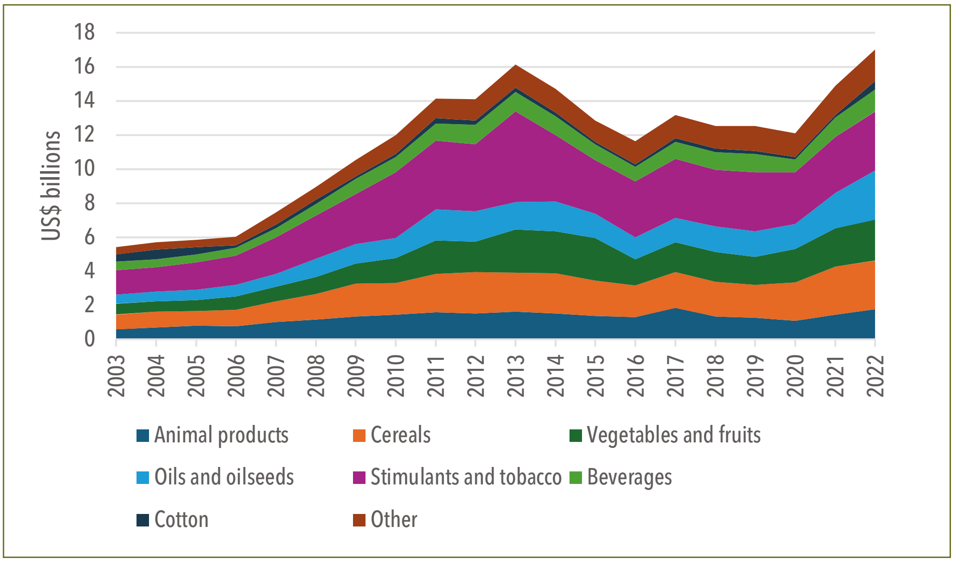
This section reviews current and recent patterns in intra-African agricultural trade measured in value terms as a backdrop to the subsequent examination of trade in virtual water terms. It should be noted that the trade data included in this chapter—both in terms of value and in terms of virtual water—include only formal trade. While there are no comprehensive continentwide data on informal trade in Africa, this trade is thought to constitute a significant share of cross-border flows, particularly for agricultural products (Bouët, Cissé, and Traoré 2020). A recent United Nations Economic Commission for Africa study estimates that Africa's informal trade represents 7 to 16 percent of formal trade at the continental level, and between 30 and 72 percent of formal trade between bordering countries (Gaarder, Luke, and Sommer 2021). Analyses of the content of informal trade suggest that perishable products are especially likely to be traded informally (Bensassi, Jarreau, and Mitaritonna 2019; Siu 2019) and that livestock products and cereals constitute a high share of informal trade (Afrika and Ajumbo 2012). Given the large share of informal trade in cross-border trade in agricultural products, all trade flows in the chapter should be considered substantial underestimates of actual intra-African agricultural trade.

Intra-African agricultural trade trends by product category

Figure 3.1 shows intra-African agricultural trade values during the 2003 to 2022 period, disaggregated by product category. The total value of intra-African agricultural trade rose sharply in the decade from 2003 to 2013, more than tripling from US$5.4 billion to $16.1 billion.[1] The value of trade then declined, before finally surpassing the 2013 value in 2022, when it reached $17.0 billion. This peak in the early 2010s followed by declining and later rising values reflects changes in global food prices (FAO 2024; Olivetti et al. 2023).

1 All figures in this chapter are in US dollars.

Figure 3.1 Intra-African agricultural exports by product category, 2003–2022 (current US$ billions)



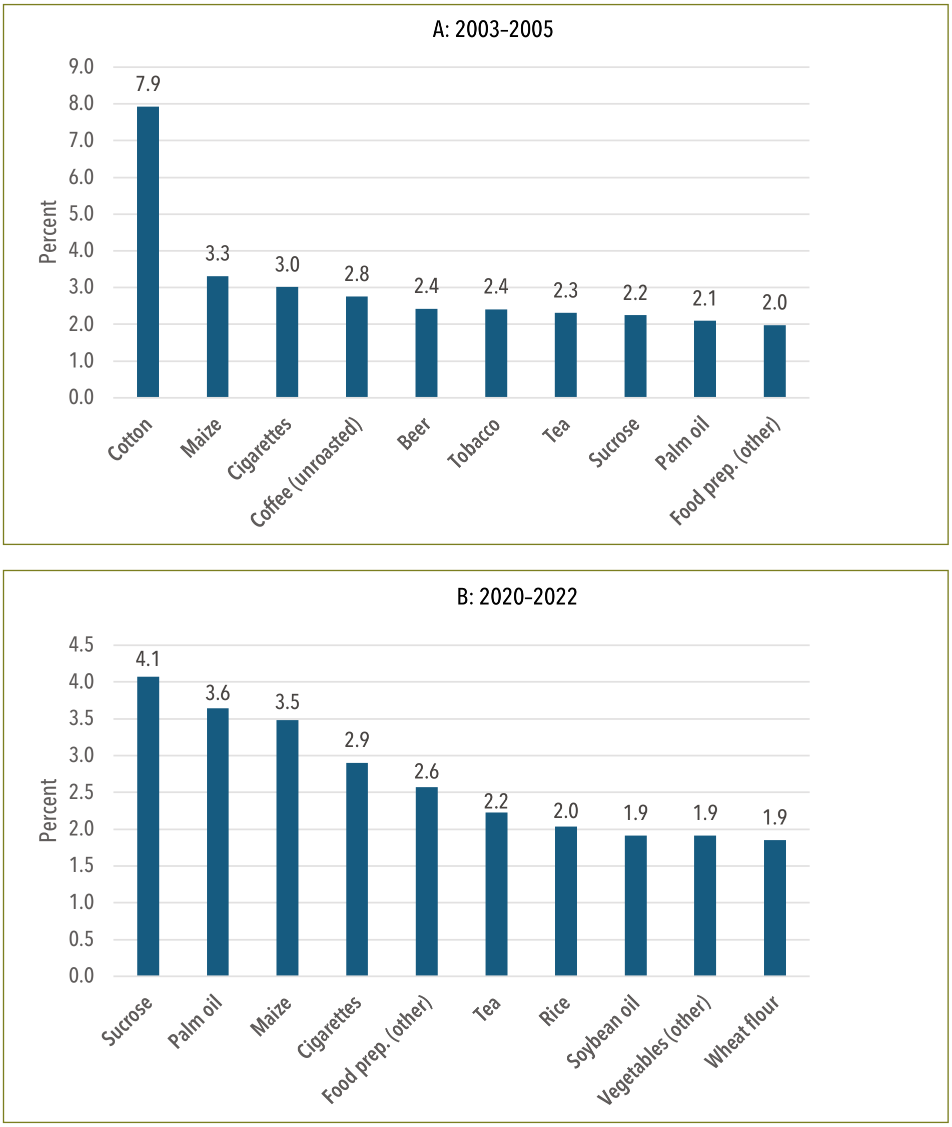
Source: 2024 AATM database.
Note: Product categories are aggregations of Harmonized System 2-digit level (HS2) categories, as detailed in Appendix 3.1.

The composition of intra-African agricultural trade in terms of product groups has shown moderate changes over time. Stimulants and tobacco—which comprises important cash crops including coffee, tea, sugar, and tobacco—is consistently the largest category, with an average share over the entire period of 27.1 percent of intra-African agricultural exports. However, its share has begun to decline in the last few years, reaching its lowest point in 2022 at 20.3 percent. Cotton has also shown declining importance in intra-African trade. Its share declined from 8.3 percent of intra-African exports on average during the 2003–2005 period to less than 3 percent of exports in all subsequent years. Along with the share, the overall value of intra-African cotton exports fell by around 3 percent per year between 2003 and 2022. These trends reflect the declining importance of cotton in Africa's global trade: as the continent's cotton production faces challenges, including low productivity and water stress, exacerbated by recent droughts, cotton subsidies in developed countries, and increasing international cotton price volatility, its global cotton exports have also declined significantly, and Africa has become a net importer of cotton (Sall, Odjo, and Zaki 2023). In contrast, the export shares of most food product categories remained the same or rose over the period. The share of oils and oilseeds rose moderately over the period, reaching its highest point of 16.9 percent of agricultural trade in 2022. The share of vegetables and fruits also rose slightly, while the shares of cereals and of animal products remained fairly stable over the period.

Figure 3.2 shows the top intra-African agricultural export products in the 2003–2005 and 2020–2022 periods at the more detailed HS6 product level. The figures show that intra-African trade has become slightly less concentrated over time. In 2003–2005, the top 10 products represented 30.5 percent of total intra-African exports, but by 2020–2022, their combined share had fallen to 26.6 percent. While the composition of top products has remained broadly similar over time, its evolution reflects the changes in categories discussed above. For example, cotton has decreased substantially in importance: it was no longer among the top 10 traded products in 2020–2022 (at 13th) despite ranking first and well above the other products in 2003–2005. Palm oil increased significantly in importance, rising from the ninth most traded product in 2003–2005 to second place in 2020–2022, and soybean oil entered the top 10 group of products in the latter period.

There were several changes in relative importance of products within the category, including stimulants and tobacco. Sucrose, or table sugar, rose from 8th position in 2003–2005 to first in 2020–2022, while unroasted coffee declined in importance and disappeared from the top 10, declining from the 4th to the 17th most traded product. Intra-African exports of unprocessed tobacco decreased significantly between the two periods, dropping from the 6th most traded product to the 44th, but cigarettes maintained a position among the top products, rising from the 4th to the 3rd most traded product. Among other products, the trade share of beer decreased significantly between the two periods, while rice, other vegetables, and wheat flour increased their shares and entered the top 10 in the second period.

Figure 3.2 Top intra-African agricultural exports at HS6 level, 2003–2005 and 2020–2022, share in total value of intra-African agricultural exports (%)



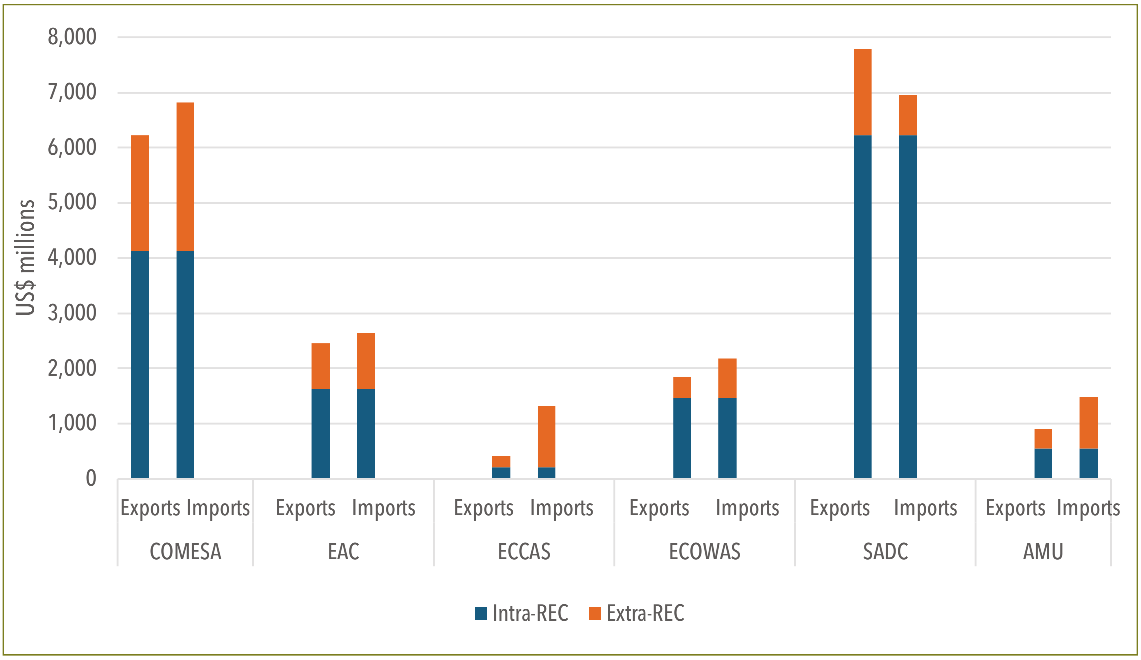
Source: 2024 AATM dataset.
Note: Shortened product names are listed in the figure. Harmonized System at the 6-digit level (HS6) codes and full product names are provided in Appendix 3.2.

Trade trends among regional economic communities and countries

We next examine patterns in the value of trade between regions and countries. Figure 3.3 shows trade between and within major RECs during the 2020–2022 period. The Southern African Development Community (SADC) is the largest player in intra-African trade in both exports and imports, followed by the Common Market for Eastern and Southern Africa (COMESA). SADC has a substantial intra-African agricultural trade surplus, with exports to other African RECs exceeding imports from other RECs by $834 million. This surplus corresponds to more than 10 percent of the value of SADC's total intra-African exports. Every other REC shows intra-African trade deficits, ranging from around 7 percent of the value of exports in the East African Community (EAC) to more than 200 percent of exports in the Economic Community of Central African States (ECCAS).

In addition to being the only REC where intra-African agricultural imports are more than double the exports, ECCAS stands out as the REC in which intra-REC trade accounts for the smallest share of its total intra-African agricultural trade. Member states of COMESA, EAC, the Economic Community of West African States (ECOWAS), and SADC trade with countries within their RECs at far greater levels than with countries outside their RECs. This is especially the case for SADC, where nearly 80 percent of intra-African exports and nearly 90 percent of intra-African imports are directed to or sourced from within the REC. In the Arab Maghreb Union (AMU), intra-REC exports exceed extra-REC exports, but countries import more from non-AMU countries than from countries within the REC. In ECCAS, extra-REC exports are slightly higher than intra-REC exports, while extra-REC imports are more than five times higher than imports from within the REC. Unlike the other RECs shown in the figure, AMU and ECCAS do not have functioning intra-REC free trade agreements: in AMU, political issues between member countries have impeded progress in regional integration; and in both AMU and ECCAS, tariff and nontariff barriers to intra-REC trade remain high (Baghdadi, Karray, and Zaki 2021; Efogo, Kane, and Ndoricimpa 2022). Their smaller shares of intra-REC trade may reflect the importance of free trade areas in facilitating intraregional trade (see also Aboushady, Ramzy, and Zaki 2023).

Figure 3.3 Intra-African agricultural trade values by REC, 2020–2022 average (current US$ millions)



Source: 2024 AATM database.
Note: AMU = Arab Maghreb Union; COMESA = Common Market for Eastern and Southern Africa; EAC = East African Community; ECCAS = Economic Community of Central African States; ECOWAS = Economic Community of West African States; REC = regional economic community; SADC = Southern African Development Community.

Table 3.1 lists the countries with the largest intra-African trade values, and Table 3.2 presents the countries with the largest intra-African agricultural trade surpluses and deficits during the 2020–2022 period—that is, countries with the highest and lowest net agricultural exports to the rest of the continent. The role of SADC in REC-level trends reflects the dominance of South Africa, which accounts for nearly a third of intra-African agricultural exports as well as 8.3 percent of imports. Unsurprisingly, South Africa also has the largest agricultural trade surplus with the rest of the continent. Three other SADC countries (Tanzania, Zambia, and Eswatini) are also among the top exporters and have sizable trade surpluses, while several others in the REC (Botswana, the Democratic Republic of the Congo [DRC], Lesotho, Mozambique, Namibia, and Zimbabwe) are top importers with large trade deficits. Outside of SADC, Egypt, Kenya, and Morocco, like South Africa, are top exporters as well as top importers. In Kenya and Egypt, exports exceed imports significantly. As shown in Table 3.2, for most of the countries with the largest trade surpluses, the surplus represents a small or moderate share of overall GDP; for example, Eswatini's agricultural trade surplus with Africa is equal to about 2 percent of its GDP, with smaller shares for all other countries listed. In contrast, several countries have significant deficits in terms of GDP, notably Lesotho with a deficit equivalent to 15.6 percent of GDP. Agricultural trade deficits in Botswana and Somalia reach 4.0 and 4.5 percent of GDP, respectively.

Table 3.1 Top 10 intra-African agricultural exporters and importers, 2020–2022 average

Top exporters			Top importers		
Country	**Export share (percent)**	**Export value (US$ millions)**	**Country**	**Import share (percent)**	**Import value (US$ millions)**
South Africa	30.2	4,424.8	South Africa	8.3	1,218.7
Egypt	8.8	1,292.5	Botswana	6.1	890.8
Kenya	7.1	1,041.4	Kenya	5.9	866.5
Tanzania	4.6	668.3	Zimbabwe	5.7	832.1
Zambia	3.8	561.1	Namibia	4.8	703.9
Ethiopia	3.4	504.2	Egypt	4.3	630.4
Côte d'Ivoire	3.3	484.1	Mozambique	4.3	626.9
Uganda	3.2	462.7	DRC	3.7	549.6
Eswatini	3.1	453.6	Morocco	3.7	536.7
Morocco	2.8	407.0	Lesotho	3.1	450.8
Top 10 Total	70.2	10,299.8	Top 10 total	49.8	7,306.4

Source: 2024 AATM database.
Note: DRC = Democratic Republic of the Congo.

Table 3.2 Top 10 intra-African agricultural trade surplus and deficit countries, 2020–2022 average

Country	Net exports (US$ millions)	Surplus as share of GDP (percent)	Country	Net exports (US$ millions)	Deficit as share of GDP (percent)
South Africa	3,206.1	0.8	Botswana	−720.7	4.0
Egypt	662.1	0.2	Zimbabwe	−524.0	2.0
Tanzania	429.8	0.6	DRC	−508.9	0.9
Côte d'Ivoire	285.8	0.4	Somalia	−439.7	4.5
Tunisia	219.8	0.5	Namibia	−424.6	3.5
Zambia	187.2	0.8	Libya	−401.8	0.9
Kenya	174.9	0.2	Lesotho	−345.8	15.6
Ethiopia	137.1	0.1	Mozambique	−343.2	2.1
Togo	105.0	1.3	Mali	−272.6	1.5
Eswatini	104.8	2.3	South Sudan	−184.9	

Source: 2024 AATM database; data on GDP from World Bank (2024).
Note: DRC = Democratic Republic of the Congo.

Because the production of agricultural products requires water, trade in agricultural products can be viewed as an exchange of virtual water resources between nations. In the next section, we investigate the patterns in virtual water exchange associated with the above-described intra-African agricultural trade flows.

Intra-African Virtual Water Trade

Virtual water trade (VWT) refers to the amount of water used to produce goods that are then traded internationally. Annual intra-African agricultural trade volumes are transformed from tons to VWT in m^3 per transaction, following the methodology in Chapagain and colleagues (2006) and Matchaya, Garcia, and Traoré (2023). To compute the water equivalent aggregated across all transactions, we multiply the specific water demand (SWD) of a commodity by the volume of the crop traded (CT_{ij}) from the i^{th} exporter to the j^{th} importer:

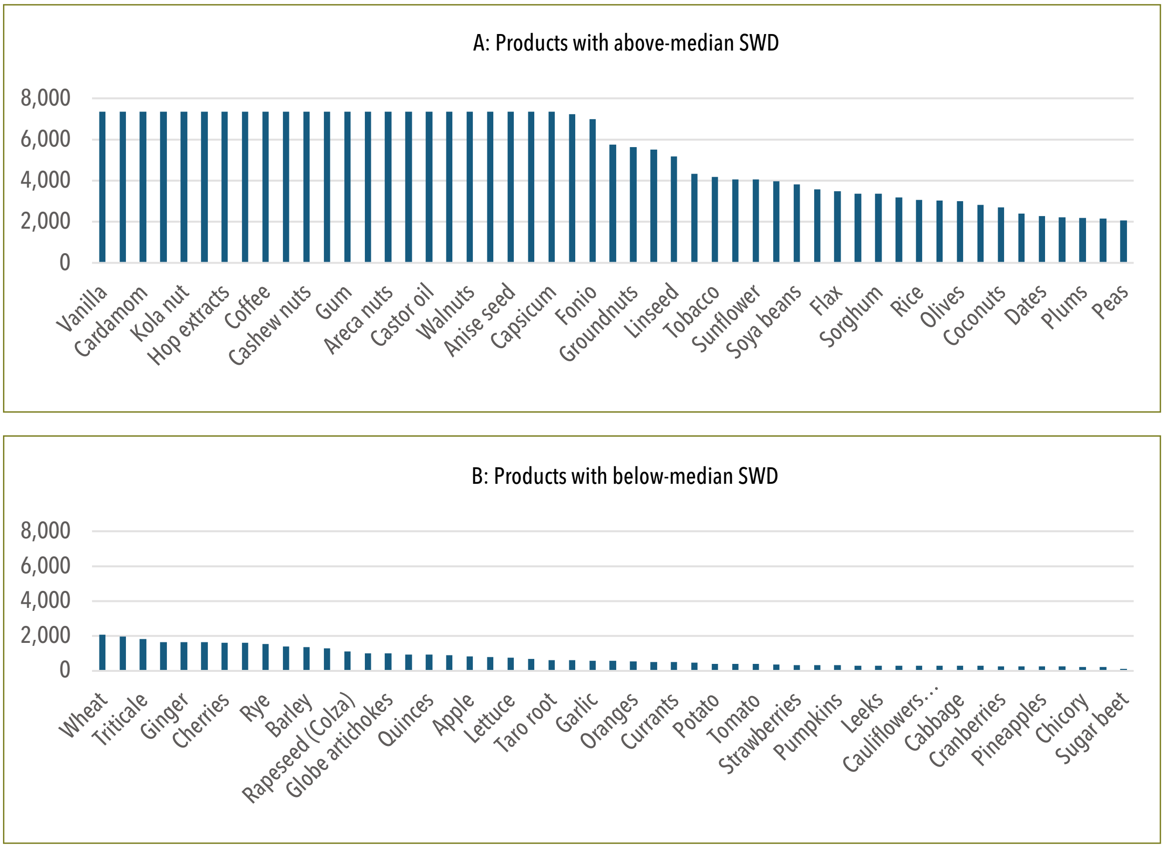
$$VWT_{ij} = CT_{ij} \cdot SWD \qquad (1)$$

where VWT_{ij} is the water equivalent aggregated across all transactions, CT is in tons, and SWD (cubic meters per ton) is the commodity's water requirement (cubic meters per ha) divided by the crop yield (tons per ha). The total VWT is the sum of all virtual water for all crops traded from the i^{th} exporter to the j^{th} importer. This approach is consistent with the methodology used by Tamea and colleagues (2014). The crops' water requirements are documented in Hoekstra and Hung (2002), SWDs are available in Mekonnen and Hoekstra (2010), and the yields are taken from FAO (2023). Many factors, including technological advances, affect crop yields. Hence, the current average yield for each crop in each country is used to compute the weighted average SWD where crop water requirement data are available. In a few cases where SWD are absent from Mekonnen and Hoekstra (2010), we use the older crop water requirements from Hoekstra and Hung (2002), as there are no databases with recent data for crop water requirements across countries. Although these data are old, the use of current productivity parameters to calculate SWD ensures that the SWD estimates are not distant from reality.

The results of the SWD calculations are presented in Figure 3.4, which illustrates the large variability in water demand among crops traded within the continent.[2] SWD ranges between less than 100 m^3 per ton and more than 7,000 m^3 per ton. Vegetables are among the least water-intensive crops, while the most water-intensive are perennial crops.

2 See also Chapter 5, this volume, which uses these estimations of SWD to assess which traded products are the most affected by climate change.

Figure 3.4 Specific water demand by crop (cubic meters per ton)

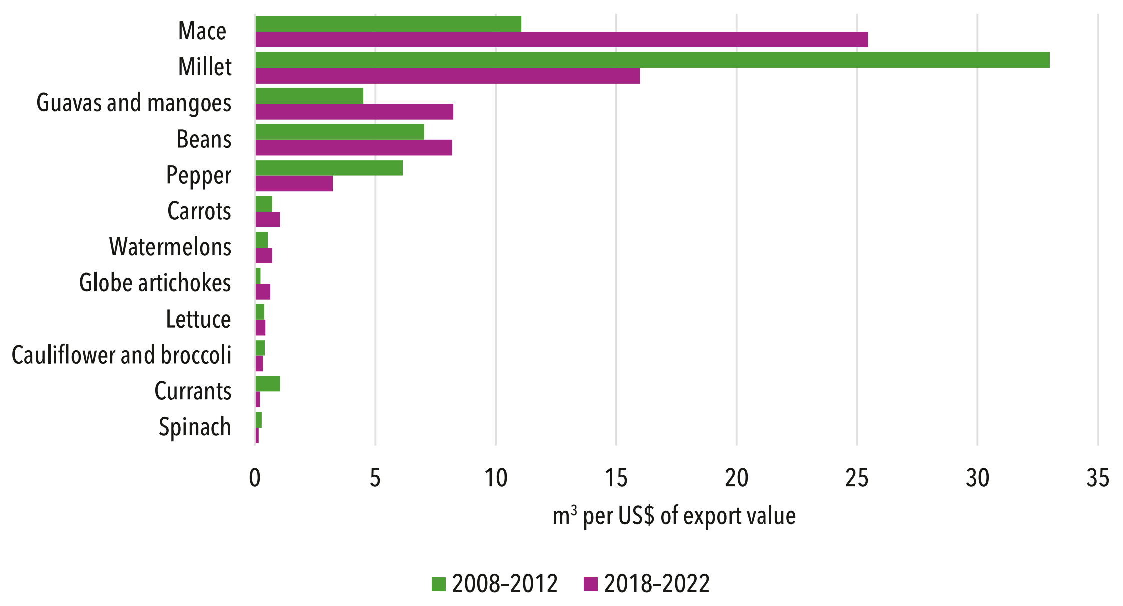


Source: Authors' calculations.
Note: SWD = specific water demand.

The remainder of this section examines the patterns of virtual water transfers among Africa's regions and countries through trade in a dozen selected crops. The selected crops are those for which trade quantity data and necessary conversion parameters are available to enable estimation of the water hidden in every bilateral intra-African trade flow. Processed food products are not included in the analysis due to a lack of data on their water requirements. We start with a comparison of the volumes of virtual water associated with intra-continental export of individual crops, and then explore the leading virtual water trading regions and countries for every selected crop.

Figure 3.5 presents the volumes of virtual water traded across the continent per US dollar of export value for the different crops. Of the crops under analysis, mace and millet are the largest virtual water movers across Africa, while spinach and currants are the lowest. For every one dollar of mace export revenue, 25 m^3 of hidden water are moved, on average, from one place to another within the continent in recent years (an average over 2018–2022). The corresponding number for millet is 16 m^3, but only 0.16 and 0.21 m^3 for spinach and currants, respectively. In other words, for the same economic benefit, intra-African trade in mace and millet entails a higher water footprint than trade in other selected crops. It is worth noting that the volume of intra-African VWT per US dollar of export value decreased between 2008–2012 and 2018–2022 for some crops, including most notably millet and pepper. For instance, the volume of virtual water exported with every US dollar of millet exports decreased from an average of 33 m³ in 2008–2012 to 16 m³ in 2018–2022. Conversely, the volume increased for other crops, including mace (from 11 to 25 m³) and beans (from 7 to 8 m³). Next, we examine the main routes of virtual water flows in relation with intra-African trade in each crop.

Figure 3.5 Ratio of intra-African virtual water trade to the corresponding export value, for selected crops, 2008–2022 average (cubic meters per US dollar)



Source: Authors' calculations from AATM database.

The role of different countries and regions in VWT could potentially be influenced by the availability of water resources. Table 3.3 categorizes African countries by the degree of water stress—that is, the ratio of water demand to renewable water supply. Many African countries have high water stress, including those in North Africa, Sahelian countries, some East African countries, and those around the Kalahari and Namibian deserts, as well as South Africa, which also faces considerable physical water scarcity. At the regional level, North Africa has the highest share of countries with high levels of water stress, followed by Southern Africa and East Africa. Most Central African countries have abundant water resources, and nearly all are classified in the low water stress category.

Table 3.3 Country grouping by degree of water stress

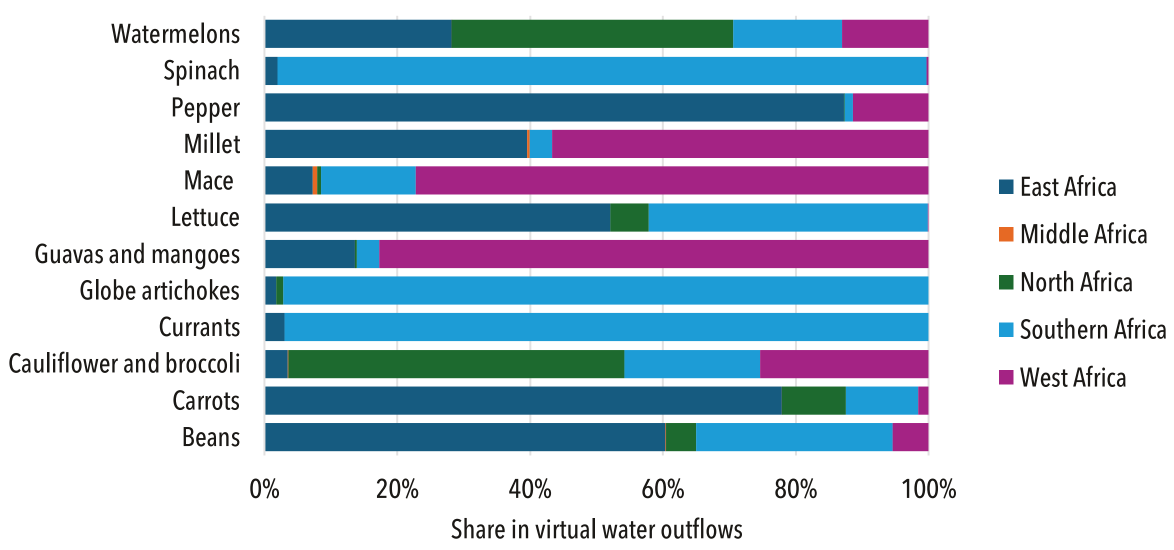
Low water stress (<10 percent)		Low-medium (10–20 percent) and medium (20–40 percent) water stress	High (40–80 percent) and extremely high (>80 percent) water stress
Benin	Guinea-Bissau	**Low-medium**	**High**
Burundi	Kenya	Angola	Algeria
Cameroon	Liberia	Burkina Faso	Djibouti
Central African Republic	Madagascar	Somalia	Eritrea
Chad	Malawi	South Sudan	Morocco
Côte d'Ivoire	Mali	Sudan	Niger
DRC	Mozambique	Tanzania	
Equatorial Guinea	Nigeria	**Medium**	**Extremely high**
Eswatini	Republic of the Congo	Lesotho	Botswana
Ethiopia	Rwanda	Mauritania	Egypt
Gabon	Sierra Leone	Senegal	Libya
Gambia	Togo	Zimbabwe	Namibia
Ghana	Uganda		South Africa
Guinea	Zambia		Tunisia

Source: Authors' computations from World Resources Institute (2023) data.
Note: Water stress measures the ratio of water demand to renewable water supply. Water stress categories are those used by the World Resources Institute and are based on thresholds defined in previous literature (see Gassert et al. 2014 and Kuzma et al. 2023 for more details). DRC = Democratic Republic of the Congo.

Although the data appear to categorize many of the countries as less water stressed, within-country realities can vary. For example, Kenya falls within the low water stress category at the national level but has counties with high levels of local water stress (WRI 2023).

Figure 3.6 and Table 3.4 break down the volume of intra-African VWT related to each crop into leading source regions and countries for the 2018–2022 period. A broad pattern of specialization exists among Africa's regions with respect to their contributions to the hidden water outflows associated with each crop's trade. East Africa is the leading source of intra-African virtual water transfers related to trade in pepper, carrots, and beans. Madagascar, Ethiopia, and Tanzania emerge as the leading sources of hidden water trade in these three crops, respectively. Southern Africa, and particularly South Africa, is the dominant exporter of water embedded in intracontinental trade in spinach, globe artichokes, and currants, which are among the crops with the lowest volumes of hidden water trade per US dollar of export value. West Africa dominates the export of virtual water in intra-African trade of guavas and mangoes, mace, and millet, the crops with the largest volumes of virtual water transfer per US dollar of export value (Figure 3.5). North Africa contributes the largest shares of hidden water associated with the trade of watermelons and of cauliflower and broccoli across the continent. No significant transfer of virtual water originates in Central Africa to the rest of the continent, despite the region's abundant water resources. This recalls the relatively small share of ECCAS in intra-African trade in value terms (Figure 3.3). Trade in lettuce is associated with hidden water outflows from East and Southern Africa. In short, West Africa tends to specialize in crops that move the largest volumes of virtual water per unit of export value, while the reverse applies to Southern Africa. This may be related to the relatively high water stress of several Southern African countries (Table 3.3). However, further investigation with a larger set of crops is needed to confirm these patterns.

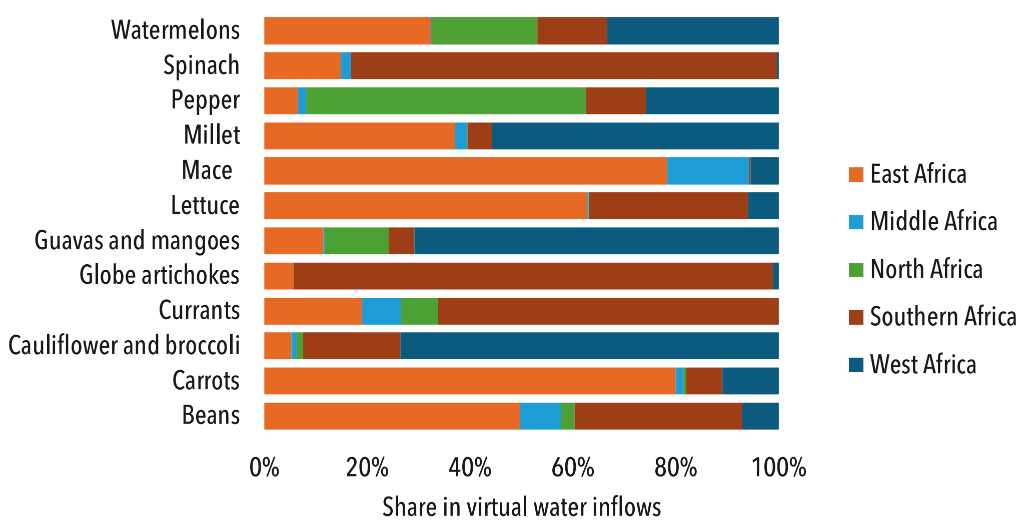
Figure 3.6 Regional breakdown of intra-African virtual water outflows, by selected crop, 2018–2022 average



Source: Authors' calculations from AATM database.

Figure 3.7 presents the breakdown of the volume of intra-African virtual water transfers associated with each crop's trade by destination regions for the 2018–2022 period. East Africa is the main destination of water transfers embedded in carrots, mace, and lettuce traded across Africa, and the region is also the primary source of virtual water exported through carrots and lettuce across Africa (as shown in Figure 3.6). Hence, the water-stressed region of East Africa dominates intracontinental inflows and outflows of the virtual water traded through carrots and lettuce, which are among the least water-intensive crops (see Figure 3.4). The same trend is observed in Southern Africa. Southern Africa is the leading destination of virtual water transfers related to globe artichokes, currants, and spinach, which predominantly originate in the same region (Figure 3.6). Hence, trade in virtual water embodied in these three crops mostly occurs within the region. For instance, Table 3.4 indicates that South Africa is the primary source of virtual water flows through exports of currants, and Lesotho is their primary destination. Similarly, the virtual water transfers associated with the trade of guavas, mangoes, and millet predominantly occur within West Africa, which also receives the bulk of water embodied in traded quantities of cauliflower and broccoli. North Africa receives the largest share of water embodied in traded pepper and retains part of embedded water flows in intracontinental trade of watermelons. In short, Figure 3.7 reveals that VWT between African countries generally occurs through intraregional flows, that is, originating and ending in the same region. This pattern is similar to that presented in Figure 3.3, which shows higher levels of intra-REC agricultural trade than extra-REC trade in value terms.

Figure 3.7 Regional breakdown of intra-African virtual water inflows, by selected crop, 2018–2022 average



Source: Authors' calculations from AATM database.

Table 3.4 Leading intra-African exporter and importer of virtual water, by selected crop, 2018–2022 average

Crop	Top exporter	Share in crop virtual water export (%)	Top importer	Share in crop virtual water import (%)
Beans	Tanzania	22.8	South Africa	25.8
Carrots	Ethiopia	55.3	Somalia	53.4
Cauliflower and broccoli	Morocco	48.1	Mauritania	46.3
Currants	South Africa	96.7	Lesotho	27.1
Globe artichokes	South Africa	97.1	Botswana	93.0
Guavas and mangoes	Côte d'Ivoire	66.9	Ghana	33.9
Lettuce	South Africa	42.0	Djibouti	34.4
Mace	Nigeria	77.2	Uganda	72.3
Millet	Tanzania	32.8	Kenya	31.7
Pepper	Madagascar	57.0	Sudan	25.3
Spinach	South Africa	97.5	Lesotho	31.5
Watermelons	Morocco	21.2	Mauritania	21.2

Source: Authors' calculations from AATM database.
Note: "Share in crop virtual water export/import" refers to the share of the country's export/import of the crop in total intra-African trade of the crop in virtual water terms.

This examination of trade in virtual water terms demonstrates that VWT patterns differ across commodities as well as regions and countries. However, further analysis is necessary to identify the determinants of these patterns. A key benefit of looking at trade through the lens of water content is the possibility of assessing whether and to what extent countries' water endowments influence their exports and imports of virtual water, and thus whether trade in virtual water helps to increase water use efficiency. In the next section, we examine this question by investigating the determinants of trade in virtual water.

Econometric Analysis of the Determinants of Bilateral Trade in Virtual Water

As demonstrated in the previous section, patterns in intra-African trade in virtual water differ across countries and commodities. A study of the trade in agriculture commodities and the VWT that flows from it should provide insights into whether factor endowments explain trade or whether other determinants matter. The Heckscher-Ohlin (Leamer 1995) and Rybczynski (1955) theorems, which relate trade to the factors used to produce traded products, imply that international trade can save water globally or regionally if a water-intensive commodity is traded from an area of high water abundance to an area with water scarcity. According to Hoekstra (2010), global use of water in agriculture could be reduced by 5 percent through international VWT. Dalin et al. (2012) find that the VWT associated with international food trade increases global water use efficiency and contributes to water resource savings. A nation can preserve its domestic water resources by importing a water-intensive product instead of producing it domestically.

Export of agricultural products entails expending national water resources, whereas import of agricultural products saves national water resources (Chapagain et al. 2006). Water-abundant countries could profit from their abundance of water resources by producing water-intensive products for export. VWT between nations and even continents could thus be used as an instrument to improve regional water use efficiency and to achieve water security in water-scarce regions of the world (Shi, Liu, and Pinter 2014). Despite the potential of the virtual water concept to help societies achieve some level of water security through trade, empirical research in this area in Africa is limited.

Focusing on Brazil, da Silva et al. (2016) find that the nature and magnitude of virtual water movements depend on the specific crops studied. Fracasso (2014) suggests that bilateral VWT is determined by economic variables as well as by water endowments and the level of pressure on water resources. However, Feng and colleagues (2014) report the opposite, finding that water-scarce areas in northern China export water-intensive products to water-abundant southern China. Similar observations in China have been explained by three possibilities, including low costs for water use, differing climate conditions and water management practices, and economic and other government policies (Feng et al. 2014; Guan and Hubacek 2007; Islam and Susskind 2013; Zhuo, Mekonnen, and Hoekstra 2016). In SADC, Matchaya, Garcia, and Traoré (2023) find that VWT in cereals varies with distance, as well as with water endowments.

This section weighs in on this debate by analyzing bilateral VWT (exports and imports), considering economic variables and sociocultural and geographical factors, in addition to water-related aspects of agricultural production. It uses a large database of more than 75,000 observations of trade transactions for African countries, which was not available to many previous studies.

Materials and methods

Data sources

The analysis uses data drawn from the AATM database for annual trade transactions involving more than 100 unprocessed agricultural commodities (listed in Appendix 3.3) for the 55 African Union member states for the 2003–2022 period. Data on processed products are not included in this analysis due to challenges in calculating their virtual water content. The production database of the Food and Agriculture Organization (FAO) of the United Nations provides data on crop production, hectares planted, and arable land and yields, and the FAO publishes statistics on crop water requirements (FAO 2023). GDP, population, proportion of the population with access to water, and exchange rate data are obtained from the World Development Indicators (World Bank 2024). Data for the dummy variables related to common borders, membership in regional groupings, language, and distance between commercial capitals are taken from the database of the Centre d'Études Prospectives et d'Informations Internationales (CEPII),[3] while data on water stress by country are from the World Resources Institute.[4] Data on conflicts are taken from the database by Davies et al. (2024), data on international water treaties are from the Oregon State University website,[5] and variables for AfCFTA ratification are derived from information available at Tralac.[6]

Virtual water trade

The VWT variable is the key variable for the analysis. Annual traded volumes are transformed from tons to VWT in cubic meters per transaction, as described in the preceding section, following the methodology in Chapagain and colleagues (2006) and Matchaya, Garcia, and Traoré (2023).

A trade matrix is constructed on export values between pairs of countries for each of the 55 African countries for all of the more than 100 commodities considered. The commodities are also grouped into four main categories (cereals, fruits, nuts, and vegetables) to permit further group-level analysis. This is important because analysis at the individual specific commodity level would encounter problems of insufficient data for some years. The matrix of the quantities of VWT thus consists of 55 countries, each with 100 commodities recorded over 20 years, and more than 110,000 observations, which reduce to 75,000 once other data quality checks are applied. Our focus is on the total VWT between each pair of countries; hence, both bilateral exports from and imports to each country are considered in line with Matchaya, Garcia, and Traoré (2023). This differs from Lenzen et al. (2013), who focus on virtual water imports only. Finally, all the continuous variables are converted into natural logarithms for ease of interpretation and to lessen the influence of heteroscedasticity in the analysis.

Gravity model specification

The classical gravity model is widely used in estimation of international trade (Anderson and Van Wincoop 2003; Bensassi, Jarreau, and Mitaritonna 2019; Head and Mayer 2014; Kamin 2022; Melitz and Toubal 2014; as well as Matchaya, Garcia, and Traoré 2023), but its application in understanding the flow of virtual water among nations has been limited (Dang et al. 2015; Matchaya, Garcia, and Traoré 2023; Tamea et al. 2014). We adopt the formulation in Matchaya, Garcia, and Traoré (2023) to model the bilateral trade process (as detailed in the technical note in Appendix 3.4). The dependent variable is bilateral VWT. We examine the impact on VWT of variables associated with water and other natural resource availability in the exporting and importing country, including the ratio of water productivity of the exporter and importer, the ratio of freshwater withdrawals of the exporter and importer, the ratio of the degree of water stress of the exporter and importer, and the ratio of exporter's and importer's available farmland. We also include variables that represent the ease or difficulty of trade and other economic factors explaining trade flows, including the distance between trading partners, the ratio of the exporter's and importer's GDP per capita, the exchange rate between the exporter and importer, and variables capturing whether exporters are landlocked, as well as the existence of a common border, language, or colonizer between the trading partners. We also include language similarity, as this is found to influence trade (Melitz and Toubal 2014); existence of

3 www.cepii.fr/CEPII/en/bdd_modele/bdd_modele.asp
4 www.wri.org/insights/highest-water-stressed-countries
5 https://transboundarywaters.ceoas.oregonstate.edu/international-freshwater-treaties-database
6 www.tralac.org/documents/resources/booklets/5388-the-afcfta-a-tralac-guide-11th-ed-may-2024/file.html

present and/or past conflict within the trade dyad, as wars can influence the amount and pace of trade (Kamin 2022); and common membership in a REC, as well as common membership in water treaties/transboundary water agreements in the form of river basin organizations, as these are also key for trade, since lack of cooperation on water use could limit production and tradable surpluses (Gbandi 2024).[7]

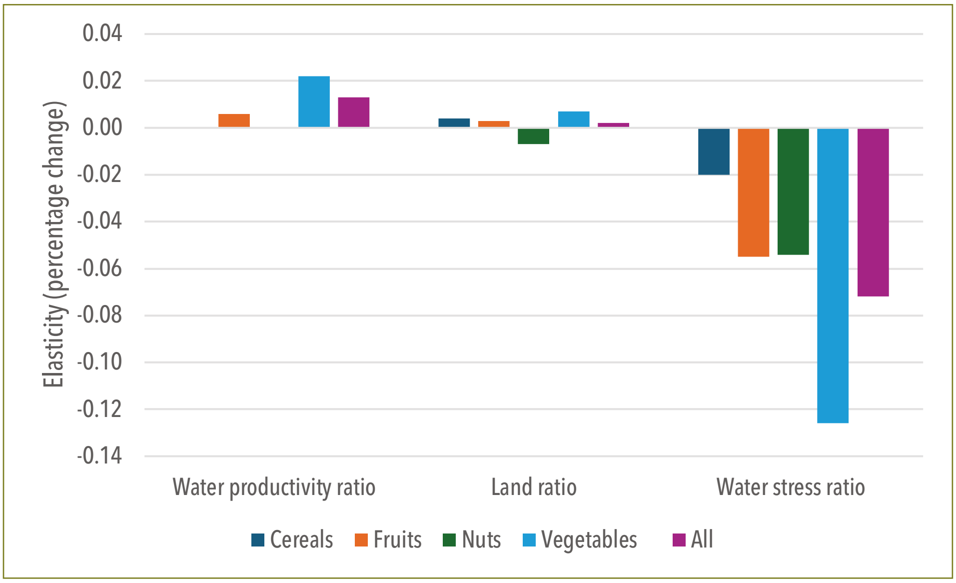
Results

Appendix 3.5 and Appendix 3.6 present the regression results, and Figures 4.8 and 4.9 summarize results for variables of interest. Many of the results are significant and are in line with previous studies (Kamin 2022; Matchaya, Garcia, and Traoré 2023; Melitz and Toubal 2014; Tamea et al. 2014), suggesting that the models have the capacity to identify important drivers of VWT. The discussion of the regressions focuses on the different RECs and different commodity groups to tease out the heterogeneous effects of water stress and endowments on these different groups. This is important because policy prescriptions are likely to vary across RECs and commodity groups, depending on the specific drivers of trade in each region and commodity category. Where the focus is on REC trade (Appendix 3.6), the analysis focuses on intra-REC trade only.

Figure 3.8 and Appendix 3.5 to this chapter show the effects of water endowments on VWT across all key commodity groups. Studying the effects across different commodity groups is useful because demand for agricultural commodities may be heterogenous, and their response to various factors may also differ. Studying them separately can offer insights that pooled regression may hide. The signs and statistical significance of the coefficients for the variables of interest (water stress variables) are consistent across all commodity-based regression estimates. A central focus of this study is to gain insight into which factors affect VWT. Variables directly related to water and land are of particular interest. The coefficient on the degree of water stress for the exporter and the degree of water stress for the importer evaluated as a ratio is negative, as well as statistically significant at both the 5 and 1 percent levels across all commodity groups (Figure 3.8). The negative and significant coefficients on exporters' and importers' degree of water stress suggests that countries with low water endowments import more virtual water, whereas those with high water endowments tend to export more. Water therefore is a limiting factor in international trade, and trade can be used to ameliorate the effects of water stress in a country.

7 Water cooperation is relatively well established in Africa, particularly in Africa south of the Sahara, with functioning agreements covering most major river basins (UN and UNESCO 2021). Such transboundary water agreements facilitate the management of shared water bodies by multiple countries.

Figure 3.8 Impacts of natural resource-related variables on virtual water trade by commodity



Source: Authors' construction from regression results.

Note: Only results significant at the 1 or 5 percent levels are shown. All variables are constructed as logarithms of the ratio of exporter and importer values. The values shown by the bars represent elasticities of virtual water trade (that is, the percentage change in virtual water trade expected to result from a 1 percent increase in the value of the variable). Results for freshwater withdrawals are significant at the 1 percent level but are omitted due to low magnitudes.

Across the commodity categories, it is clear that water availability affects production of cereals, nuts, fruits, and vegetables, and thus trade, differently. For example, a 1 percent increase in the ratio of the water stress index between the exporter and the importer is associated with reduction in VWT of −0.13 percent for vegetables, −0.05 percent for nuts, −0.06 percent for fruits, and −0.02 percent for cereals. For all the commodities, a 1 percent increase in the ratio of water stress leads to a -0.07 percent reduction in VWT through those commodities, at the continental level. Thus, there are differences in trade sensitivities across commodity groups following an increase in water stress, with vegetables most affected, followed by nuts and fruits. The variation in impacts of water stress on trade depending on the commodity, with the largest impacts on trade in vegetables, can be explained by the different water sensitivities of these crops, which affect their production (FAO 2012). Our results recall da Silva et al. (2016), who also identify differential impacts of drivers of VWT depending on the commodity concerned.

Other measures of water availability—including freshwater withdrawals and water use productivity—also support the important role of water endowments in VWT. Generally, an increase in the ratio of freshwater withdrawals between exporters and importers (implying more withdrawals by the exporter) is associated with an increase in trade across all the commodity types. This result implies that an increase in water withdrawals among importers is associated with a reduction in virtual water imports, likely because the resultant production reduces the need for virtual water imports. Again, where the ratio in water productivity between exporter and importer is high, implying that exporters have higher withdrawals, VWT generally increases. A 1 percent increase in the ratio of water productivity for exporters and importers is associated with a 0.01 percent increase in all VWT. The effect varies by crop type, such that a 1 percent increase in the ratio of water productivity leads to a 0.02 percent trade increase for vegetables and a 0.01 percent increase for fruits. Similarly, an increase in the exporter–importer ratio of land allocated to agriculture generally positively drives VWT. These results are significant at the 5 and 1 percent levels, implying that land endowments are also important for trade dynamics across the different commodity groups.

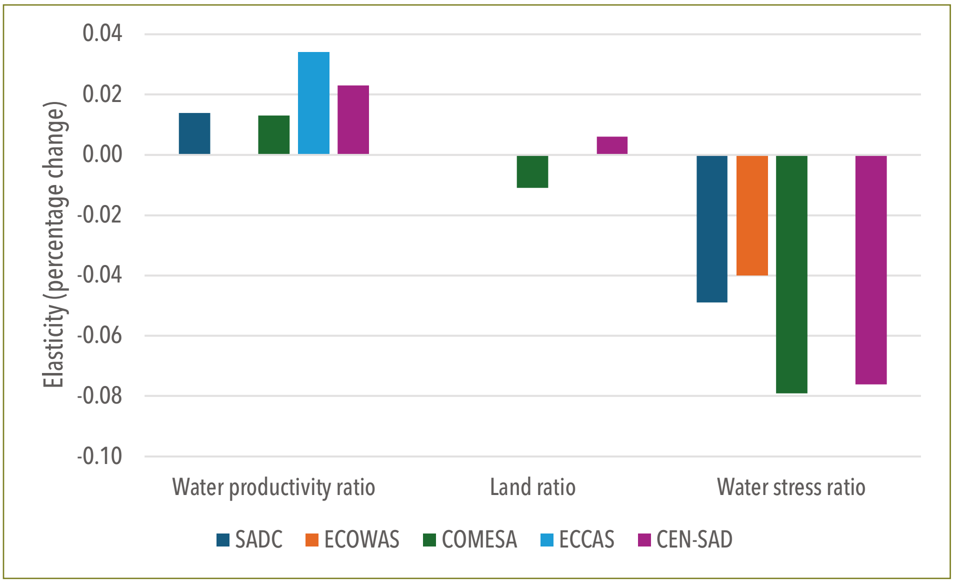
Thus, virtual flows of water through the trade in crops are affected by the amount of arable land and availability of water. That is, it appears as if arable land and water endowments, if all else is the same, provide the ability to produce for export, that is, specialization and agricultural trade, as trade theory suggests. This implies that irrigation expansion could bring about increases in marketable surpluses that can be exported from countries where arable land and water are available to countries where water and land are scarce (see Matchaya, Garcia, and Traoré 2023).

As discussed previously, other key variables that explain bilateral trade include the distance between the bilateral partners and their purchasing and production power. The logarithm of distance is negative and significant at the 5 and 1 percent levels across all commodity groups (except for cereals), underscoring the importance of transport and storage infrastructure as well as other trade facilitation factors that undermine the smooth and timely flow of commodities. Countries that are contiguous tend to trade more in virtual water, underscoring the importance of not only distance but also other cultural similarities. Although the common official languages do not appear to systematically positively influence trade in virtual water, likely because these areas are spread far apart and may not trade despite similar languages, trade is influenced more positively by local native languages. Countries with a common colonizer appear to trade more because transaction costs of trade are lower. Across the continent, being landlocked encourages intra-African trade. Countries that belong to the same REC trade more because trade restrictions are generally lower for members. Similarly, common membership to the AfCFTA is associated with more bilateral trade, but as this agreement is not yet fully operational, this result should be interpreted with caution, and more studies are needed once it is fully operational. Underscoring the importance of water in trade, common membership in water treaties is also associated with more bilateral trade, likely because such treaties simplify water use within basins, which leads to marketable surpluses. It is interesting to note that wars appear to have a mixed effect on commodity trade within Africa, likely because while wars undermine production and market access in some places, conflicts may increase the need for trade in search of resources to finance the war (Cali 2015).

An increase in the exporter–importer income ratio is associated with increased VWT. The logarithm of the exchange rate between the exporter and the importer is generally positive, implying that countries tend to export more when their currencies are relatively weaker and import more with stronger currencies. This finding also implies that under certain conditions, a depreciation improves the exporter's competitiveness.

Figure 3.9 and Appendix 3.6 show the effects of water endowments on VWT within six RECs. Studying trade by region is important because some policies are region specific, and the findings can have applications at that level of administration. Water endowments also vary across regions, with some RECs experiencing more significant water stress than others. Among the RECs analyzed here, the Community of Sahel-Saharan States (CEN-SAD) has the largest share of countries with high water stress, followed by SADC and COMESA; ECOWAS and ECCAS countries have the least water stress (see Table 3.3). It is important to understand how intra-REC VWT varies across regions in relation to water endowments. The signs and statistical significance of the coefficients for the variables of interest (water stress, water withdrawals, and water productivity variables) are mostly consistent across all REC-based regression estimates. The coefficients on the ratio of the degree of water stress for the exporter and importer are negative and statistically significant at the 5 and 1 percent levels across all the RECs, except for the Intergovernmental Authority on Development (IGAD) and ECCAS, where the coefficient on the degree of water stress was either not estimable due to low within-REC variation for this variable or was not significant. The negative and significant coefficients on the ratio of the degree of water stress suggest that countries with low water endowments import more virtual water, whereas those with high water endowments tend to export more virtual water; and, in fact, trade is negatively affected by water scarcity.

Figure 3.9 Impacts of natural resource-related variables on virtual water trade by REC



Source: Authors' construction from regression results.
Note: Only results significant at the 1 or 5 percent levels are shown. All variables are constructed as logarithms of the ratio of exporter and importer values. The values shown by the bars represent elasticities of virtual water trade (that is, the percentage change in virtual water trade expected to result from a 1 percent increase in the value of the variable). Results for freshwater withdrawals are significant at the 1 percent level but are omitted due to low magnitudes. CEN-SAD = Community of Sahel-Saharan States; COMESA = Common Market for Eastern and Southern Africa; ECCAS = Economic Community of Central African States; ECOWAS = Economic Community of West African States; REC = regional economic community; SADC = Southern African Development Community.

Across the RECs, it is clear that water availability affects trade in SADC, ECOWAS, COMESA, IGAD, ECCAS, and CEN-SAD differently. For example, a 1 percent increase in the ratio of water stress index is associated with a 0.08 percent reduction in virtual water exports in CEN-SAD, 0.07 percent in IGAD, 0.08 percent in COMESA, 0.04 percent in ECOWAS, and 0.05 percent in SADC. In IGAD, the coefficients are not statistically significant. Thus, there are differences in trade sensitivities across REC groups following an increase in water stress, with CEN-SAD, COMESA, and SADC most affected. The higher sensitivity of these RECs to additional water stress may be related to the already high levels of water stress among many North, East, and Southern African countries (see Table 3.3).

Water is therefore a limiting factor again in intraregional trade, and trade can be used to ameliorate the effects of water stress in a region. The variation in the effects across RECs also suggests that there are unexploited opportunities to reduce the impacts of water scarcity within regional blocs through trade between blocs.

Similarly, land endowments are important for trade dynamics across the different RECs. Other measures of water availability, including freshwater withdrawals and water use productivity, also support the important role of water endowments in VWT. Generally, an increase in freshwater withdrawals among importers is associated with a reduction in virtual water imports across all RECs, likely because the resultant production reduces the need for virtual water imports. A 1 percent increase in the ratio of water productivity for exporters and importers is associated with notable percentage increases in VWT as follows: SADC, 0.01 percent; COMESA, 0.01 percent; ECCAS, 0.03 percent; and CEN-SAD, 0.02 percent. The same factors, including common membership to water treaties, contiguity, native languages, land lockedness, common AfCFTA membership, and common colonizers, are all important in determining VWT at the REC level as well.

The magnitude of the statistically significant elasticities is often around 0.01 percent or greater, except for water withdrawals. These elasticities are comparable to other studies on impacts of virtual water on agriculture trade and, given the scale of current trade flows, imply economically significant impacts. Therefore, these results are significant from both a statistical and a policy perspective.

Conclusions

This chapter reviewed intra-African agricultural trade trends in terms of value and virtual water and analyzed the determinants of VWT. The analysis of trade trends by value shows that the level of trade has begun to increase again after stagnating throughout the mid-2010s. The commodity composition of trade has changed moderately over time, with a sizable but declining share of cash crops such as stimulants, tobacco, and cotton, and increasing shares of oilseeds and oils, vegetables, and fruits. Most RECs trade more within their regions than with the rest of Africa, reflecting the importance of intra-REC free trade agreements in facilitating intraregional trade.

An analysis of the relationship between trade in value terms and trade in virtual water terms for selected crops shows that some products are characterized by much higher water use per dollar of exports than others. Millet and mace have the highest impact on water use of the examined crops, followed by guavas and mangoes and beans. West Africa tends to specialize in crops that move the largest volumes of virtual water per unit of export value, while the reverse holds true of Southern Africa. As was observed for trade in value terms, most VWT is intraregional, with trade originating and ending in the same region.

This chapter has explored the factors that characterize agricultural VWT associated with intra-African trade in unprocessed commodities, as in Matchaya, Garcia, and Traoré (2023). The principal research question was whether such agricultural trade reflects relative water availabilities in member states or whether other factors drive agricultural trade, such that VWT flows in the opposite direction, from water-scarce countries to water-abundant countries.

The results on water stress and endowment variables support the argument that management of water resources through intraregional trade can reduce the mismatch in water availability and water scarcity (see also Matchaya, Garcia, and Traoré 2023). Both the availability of arable farmland and water availability as well as water stress in the exporting country affect export of virtual water in a manner that indicates that high water endowments encourage trade flows to areas of low water endowments. High water stress discourages exports, while low water stress encourages exports, and high water stress encourages imports of virtual water. These results are consistent for most commodity groups and RECs studied. Given the poor quality of water infrastructure in many parts of Africa, facilitating virtual water exports is a key strategy for reducing the impacts of differential water availability within the continent. Country- and regional-level policies and strategies that support irrigation systems and/or improvement in water management practices for crop production could have the desired effect in terms of moving water from where it is relatively abundant to where it is scarce. This finding therefore can be very useful for climate change adaptation.

The significance of the coefficient on distance, a proxy for transportation costs, suggests that efforts to reduce the cost of transport, storage, and related marketing costs could improve commodity trade and the flow of virtual water within and across RECs. The commodity- and REC-level results suggest that distance matters particularly in SADC and ECCAS and for vegetable trade, perhaps owing to vegetables' perishability; thus, trade facilitation would be beneficial for commodity trade and especially for vegetable trade in those areas, likely because vegetables are more perishable than the other crops.

Thus, there is a clear role for trade policy in each REC to reduce the impacts of water insecurity through trade. Countries that are water stressed can lessen the effects of the scarcity through imports of water-intensive commodities. This knowledge can be very beneficial in guiding anticipatory action in preparation for water-related crises. For example, where dry spells are predicted for a region with some precision, the affected areas can consider switching to producing more low water–intensive crops and prepare to import more water-intensive commodities.

Further, understanding the potential impact of an impending water crisis, or indeed macroeconomic instability, can inform the targeting of safety nets and reduce the impact of such crises on poverty and livelihoods. Given that many African countries experience high levels of water scarcity, it would be beneficial in the long term for countries to make efforts to reduce water stress, for example through water conservation measures or improved water use efficiency. Reduced water stress would in turn lessen the influence of water stress on bilateral trade. Regional integration as well as transboundary water cooperation are also very important in encouraging bilateral trade in Africa, and it is important that these both be encouraged or strengthened.

On a broad level, the chapter's findings call for further efforts to facilitate intra-African trade in order to increase the contribution of trade to alleviating the impacts of water scarcity. Constraints to intra-African trade include the poor quality of transport and market infrastructure, inefficient and lengthy border procedures, harassment and corruption, and other tariff and nontariff barriers, all of which increase the cost of trade; lack of knowledge about trade regulations and limited compliance capacity; and lack of transparency about product quality, which lowers consumers' confidence in local products. Addressing these issues would help to strengthen the positive contribution of intra-African trade to enhancing the efficient use of natural resources.

It should be noted that the commodity coverage of this chapter's examination of the virtual water content of trade is limited by data availability. Developing methodologies to accurately estimate the virtual water content of processed products is an important area for future research. In addition, comprehensive data on informal trade are essential to provide a more complete picture of intra-African trade. Despite this limitation, the chapter provides initial evidence on the role of water endowments in driving intra-African trade, and the potential for trade to address issues of water scarcity on the continent.

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Appendix 3.1

Table A3.1 Composition of commodity groups

Commodity group	HS2 code	HS2 description
Animal products	01	Animals, live
	02	Meat and edible meat offal
	04	Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included
	05	Animal originated products, not elsewhere specified or included
	16	Meat, fish, or crustaceans, mollusks, or other aquatic invertebrates, preparations thereof
	41	Raw hides and skins (other than fur skins) and leather
	43	Fur skins and artificial fur, manufactures thereof
	50	Silk
	51	Wool; fine or coarse animal hair; horsehair yarn and woven fabric
Cereals	10	Cereals
	11	Products of the milling industry: malt, starches, inulin, wheat gluten
	19	Preparations of cereals, flour, starch or milk; pastrycooks' products
Vegetables and fruits	07	Vegetables and certain roots and tubers, edible
	08	Fruit and nuts, edible; peel of citrus fruit or melons
	14	Vegetable plaiting materials: vegetable products not elsewhere specified or included
	20	Preparations of vegetables, fruit, nuts, or other parts of plants
Oil and oilseeds	12	Oilseeds and oleaginous fruits; miscellaneous grains, seeds, and fruit; industrial or medicinal plants; straw and fodder
	15	Animal or vegetable fats and oils and their cleavage products; prepared animal fats; animal or vegetable waxes
	33	Essential oils and resinoids; perfumery, cosmetic, or toilet preparations
Stimulants and tobacco	09	Coffee, tea, maté, and spices
	17	Sugars and sugar confectionery
	18	Cocoa and cocoa preparations
	24	Tobacco and manufactured tobacco substitutes
Beverages	22	Beverages, spirits, and vinegar
Cotton	52	Cotton

Commodity group	HS2 code	HS2 description
Other	06	Trees and other plants, live; bulbs, roots, and the like; cut flowers and ornamental foliage
	13	Lac; gums, resins, and other vegetable saps and extracts
	21	Miscellaneous edible preparations
	23	Food industries, residues and wastes thereof; prepared animal fodder
	29	Organic chemicals
	35	Albuminoidal substances; modified starches; glues; enzymes
	38	Chemical products n.e.c.
	53	Vegetable textile fibers; paper yarn and woven fabrics of paper yarn

Note: n.e.c. = not elsewhere classified.

Appendix 3.2

Table A3.2 HS6 codes and full HS6 product descriptions for top intra-African products

HS6 code	Long name	Short name
70999	Vegetables, edible, n.e.c. in Chapter 7, fresh or chilled	Vegetables (other)
090111	Coffee, not roasted or decaffeinated	Coffee (unroasted)
090240	Tea, black; (fermented) and partly fermented tea, in immediate packings of a content exceeding 3 kg	Tea
100590	Cereals; maize (corn), other than seed	Maize
100630	Cereals: rice, semi-milled or wholly milled, whether or not polished or glazed	Rice
110100	Wheat or meslin flour	Wheat flour
150710	Vegetable oils: soya-bean oil and its fractions, crude, whether or not degummed, not chemically modified	Soybean oil
151190	Vegetable oils: palm oil and its fractions, other than crude, whether or not refined, but not chemically modified	Palm oil
170199	Sugars: sucrose, chemically pure, in solid form, not containing added flavoring or coloring matter	Sucrose
210690	Food preparations; n.e.c. in item no. 2106.10	Food prep. (other)
220300	Beer, made from malt	Beer
240110	Tobacco (not stemmed or stripped)	Tobacco
240220	Cigarettes, containing tobacco	Cigarettes
520100	Cotton, not carded or combed	Cotton

Note: n.e.c. = not elsewhere classified.

Appendix 3.3

Table A3.3 List of unprocessed agricultural commodities considered in the gravity analysis

Commodity	HS6 code	Commodity	HS6 code	Commodity	HS6 code	Commodity	HS6 code
Potato	070110	Pistachios	080251	Capsicum	090421	Groundnuts	120241
Potato	070190	Pistachios	080252	Vanilla	090510	Groundnuts	120242
Tomato	070200	Macadamia	080261	Cinnamon	090611	Linseed	120400
Garlic	070320	Macadamia	080262	Cinnamon	090619	Rapeseed (colza)	120510
Leeks	070390	Kola nut	080270	Cloves	090710	Rapeseed (colza)	120590
Cauliflowers and broccoli	070410	Areca nuts	080280	Mace	090811	Sunflower	120600
Cabbage	070490	Plantains	080310	Mace	090821	Palm nuts	120710
Cabbage	070511	Bananas	080390	Carda-moms	090831	Cotton	120721
Lettuce	070519	Dates	080410	Anise seed	090921	Cotton	120729
Chicory	070521	Figs	080420	Cumin	090931	Castor oil	120730
Chicory	070529	Pineapples	080430	Anise seed	090961	*Sesamum*	120740
Carrots	070610	Avocados,	080440	Ginger	091011	Mustard	120750
Sugar beet	070690	Guavas and mangoes	080450	Wheat	100111	Safflower	120760
Cucumber	070700	Oranges	080510	Wheat	100119	Poppy	120791
Peas	070810	Citrus, other	080520	Wheat	100191	Sugar beet	120910
Beans	070820	Grapefruits	080540	Wheat	100199	Rye	120925
Asparagus	070920	Citrus, other	080550	Rye	100210	Veg., other	120991
Aubergines	070930	Citrus, other	080590	Rye	100290	Hop cones	121010
Capsicum	070960	Grapefruits	080610	Barley	100310	Poppy	121140
Spinach	070970	Watermelons	080711	Barley	100390	Sugar beet	121291
Globe artichokes	070991	Watermelons	080719	Oats	100410	Locus bean	121292
Olives	070992	Pawpaws	080720	Oats	100490	Sugar cane	121293
Pumpkins	070993	Apples	080810	Maize	100510	Chicory	121294

Commodity	HS6 code	Commodity	HS6 code	Commodity	HS6 code	Commodity	HS6 code
Cassava	071410	Pears	080830	Maize	100590	Cereals, other	121300
Potato, sweet	071420	Quinces	080840	Rice	100610	Gum	130120
Yams	071430	Apricots	080910	Rice	100620	Gum	130190
Taro root	071440	Cherries	080921	Rice	100630	Hop extracts	130213
Yautia	071450	Cherries	080929	Rice	100640	Veg., other	140190
Cassava	071490	Peaches	080930	Sorghum	100710	Cocoa	180100
Coconuts	080111	Plums	080940	Sorghum	100790	Cocoa	180200
Coconuts	080112	Strawberries	081010	Wheat	100810	Tobacco	240110
Coconuts	080119	Raspberries	081020	Millet	100821	Cotton	520100
Cashew nuts	080131	Currants	081030	Millet	100829	Cotton	520210
Cashew nuts	080132	Cranberries	081040	Canary	100830	Cotton	520291
Almonds	080211	Kiwifruit	081050	Fonio	100840	Cotton	520299
Almonds	080212	Coffee	090111	Triticale	100860	Flax	530110
Hazelnuts	080221	Coffee	090112	Cereals, other	100890	Flax	530121
Hazelnuts	080222	Tea	090210	Soya beans	120110		
Walnuts	080231	Tea	090220	Soya beans	120190		
Walnuts	080232	Pepper	090411	Ground-nuts	120230		

Appendix 3.4

Technical Note

In its basic formulation, the gravity model considers the sizes of trading partners and the distances between them as important (Fracasso 2014; Head and Mayer 2014). We adopt the formulation in Matchaya, Garcia, and Traoré (2023) to model the bilateral trade process. Thus, in Equation (2), size and distance assume a multiplicative form:

$$VWT_{ij} = G \cdot S_i^{\beta} \cdot S_j^{\alpha} \cdot \Phi_{ij}^{\gamma} \qquad (2)$$

where VWT_{ij} represents bilateral trade transactions between the i^{th} exporting country to the j^{th} importing country. Bilateral trade between exporter and importer are specified as VWT flows. G is the gravitational constant. S refers to the size of the economy, measured as total real GDP in per capita terms, or S_i and S_j in the exporting and importing country, respectively.

We introduce a further modification to the gravity model by including income per capita rather than absolute incomes, in line with Reina et al. (2024) as well as Khayat (2019), among others. This deviates from Matchaya, Garcia, and Traoré (2023) and is justified on the basis that per capita income may matter more for trade than just absolute incomes. The variables that represent the ease or difficulty with which the i^{th} exporting country accesses the market of the j^{th} importing country and other economic factors explaining trade flows are included in Φ_{ij}. This includes distance, common border or language, and other economic or policy variables affecting export supply or import demand. There are also variables that account for water treaties, the African Continental Free Trade Agreement, conflict, common native languages, and common regional economic community memberships. These variables are identified from literature cited previously as useful in bilateral trade determination (see Anderson and Van Wincoop 2003; Benassi, Jarreau, and Mitaritonna 2019; Head and Mayer 2014; Kamin 2022; Matchaya, Garcia, and Traoré 2023; Melitz and Toubal 2014).

The total volume of bilateral trade in the commodities between the i^{th} exporting country and the j^{th} importing country is converted into VWT_{ij}. The continuous variables are converted into natural logarithms and the variables tested for stationarity. The base model is expressed as Equation (3) for each bilateral VWT pairing over time t:

$$\begin{aligned} \ln VWT_{ijt} = {} & \ln G + \gamma \ln Dist_{ij} + \beta \ln GDPPc_{ijt} + \gamma_1 \ln Watp_{ijt} + \gamma_2 \ln AFL_{ijt} + \gamma_3 \ln ER_{ijt} + \\ & \gamma_4 Contiguity_{ij} + \gamma_5 Common\_Language_{ij} + \gamma_6 Common\_Colonizer_{ij} + \gamma_7 Landlocked_{ij} + \\ & \gamma_8 \ln WAI_{ijt} + \gamma_9 \ln WaS_{ij} + \gamma_{10} WaTT_{ijt} + \\ & \gamma_{11} AfCFTA_{ij} + \gamma_{12} War_{ijt} + \gamma_{13} SREC_{ijt} + \gamma_{14} NativLang_{ij} + \delta_t + \varepsilon_{ijt} \end{aligned} \qquad (3)$$

where each variable is defined as listed in Table A3.4. In this model, δt represents years dummies that control for unobservables that evolve over time but are constant across entities (see Hanck et al. 2024). We run a classical gravity model because we are interested in identifying the effects of variables that change by exporter and importer and that are not time variant (this is why we do not include bilateral fixed effects that control for the endogeneity of trade agreements). Finally, it is also possible that some of our estimates may be biased downward because we do not control for intranational trade flows.

Table A3.4 Variable names and units

Variable	Description	Unit
VWT_{ijt}	Cubic meters of water traded	Cubic meters
$Dist_{ij}$	Distance between trading partners' cities	Km
$GDPPc_{iit}$	Ratio of real income per capita exporter for exporter and importer	
$Watp_{ijt}$	Ratio of water productivity for exporter and importer	
AFL_{ijt}	Ratio of available farmland for exporter and importer	
ER_{ijt}	Exchange rate between exporter and importer	Local currency to $
$Contiguity_{ij}$	Whether countries share a border = 1	Dummy variable
$Common\_Language_{ij}$	Whether pair share official language = 1	Dummy variable
$Common\_Colonizer_{ij}$	Whether pair was colonized by same country = 1	Dummy variable
$Landlocked_{ij}$	Whether pair is landlocked = 1	Dummy variable
WAI_{ijt}	Ratio of fresh water withdrawals by exporter and importer	Cubic meters
WaS_{ij}	Ratio of water stress index for exporter and importer	
$WaTT_{ijt}$	1 for common water treaty	Dummy variable
$AfCFTA_{ij}$	1 if common AfCFTA ratification	Dummy variable
War_{ijt}	1 if both countries are/were at war	Dummy variable
$SREC_{ijt}$	1 if shared REC	Dummy variable
$NativLang_{ij}$	1 for similar native language	Dummy variable
δt	Years dummies	Dummy variables

Estimating Equation (3) by ordinary least squares (OLS) assumes that the functional form of the model is known, and that the distribution of errors follows an OLS-compatible form, which might not hold. Log-linearization can introduce an endogeneity bias in the presence of heteroskedasticity in the nonlinear, original form (Santos and Tenreyro 2010). Other factors within years and across countries may affect trade decisions (e.g., multilateral trade resistance terms idiosyncratic to country and time), which produced biased OLS estimates in the absence of sufficient control. Thus, Equation (3) is estimated by the Poisson pseudo maximum likelihood (PPML) method with years dummies to control for time unobservables (Head and Mayer 2014). Our results are produced following both the OLS and the PPML technique, but we present the PPML results because OLS results may exhibit inherent bias, as discussed previously.

Appendix 3.5

Table A3.5 Effect of water endowments on intra-Africa virtual water trade by key commodity groups

	PPML cereals	**PPML fruits**	**PPML nuts**	**PPML vegetables**	**All trade**
Log distance between countries	−0.004 (0.00)	−0.017** (0.01)	−0.013** (0.00)	−0.030*** (0.01)	−0.005** (0.00)
Log ratio exporter/ importer real GDP	0.000 (0.00)	0.016*** (0.00)	0.013*** (0.00)	0.020*** (0.00)	0.021*** (0.00)
Log ratio of exporter/ importer water productivity	0.002 (0.00)	0.006*** (0.00)	0.001 (0.00)	0.022*** (0.00)	0.013*** (0.00)
Log ratio exporter/ importer agricultural land	0.004** (0.00)	0.003** (0.00)	−0.007*** (0.00)	0.007*** (0.00)	0.002*** (0.00)
Log exporter/importer exchange rate	0.002* (0.00)	0.004*** (0.00)	0.007*** (0.00)	0.012*** (0.00)	0.008*** (0.00)
Log ratio exporter/ importer freshwater withdrawals	0.000*** (0.00)	0.000*** (0.00)	−0.000 (0.00)	0.000*** (0.00)	0.000*** (0.00)
Log ratio exporter/ importer degree of water stress	−0.020*** (0.00)	−0.055*** (0.00)	−0.054*** (0.01)	−0.126*** (0.01)	−0.072*** (0.00)
1 for contiguity	0.050*** (0.01)	0.094*** (0.01)	0.013 (0.01)	0.014 (0.01)	0.027*** (0.00)
1 for common official language	−0.019** (0.01)	0.008 (0.01)	−0.007 (0.01)	−0.029*** (0.01)	−0.019*** (0.00)
1 for native language similarity	0.030*** (0.01)	0.012 (0.01)	0.023** (0.01)	−0.003 (0.01)	0.042*** (0.00)
1 for common colonizer, post-1945	0.029*** (0.01)	0.016* (0.01)	0.026*** (0.01)	0.031*** (0.01)	0.034*** (0.00)
1 if landlocked	−0.003 (0.01)	−0.012 (0.01)	0.025*** (0.01)	−0.013 (0.01)	0.030*** (0.00)
1 for shared regional economic community	0.018*** (0.00)	0.021*** (0.00)	0.035*** (0.00)	0.022*** (0.01)	0.013*** (0.00)
1 for being member of the same water treaty	0.039*** (0.01)	0.003 (0.01)	0.043*** (0.01)	0.060*** (0.01)	0.052*** (0.00)
1 for ratification of AfCFTA	0.013* (0.01)	0.065*** (0.01)	0.045*** (0.01)	0.041*** (0.01)	0.034*** (0.00)
1 if both countries were/ are at war	−0.014* (0.01)	0.000 (0.01)	0.042*** (0.01)	−0.010 (0.01)	0.003 (0.00)
Constant	2.457*** (0.03)	2.130*** (0.05)	2.443*** (0.03)	2.515*** (0.06)	2.386*** (0.02)
Years dummies	Yes	Yes	Yes	Yes	Yes
N	11,702.0	16,117.0	6,316.0	8,239.0	60,799.0
R-squared	0.10	0.12	0.14	0.24	0.16

Note: AfCFTA = African Continental Free Trade Area; PPML = Poisson pseudo maximum likelihood.
* p < .10; ** p < .05; *** p < .01. Standard errors are in the parentheses.

Appendix 3.6

Table A3.6 Effect of water endowments on intraregional virtual water trade by key regional economic community (PPML estimates)

	SADC	ECOWAS	COMESA	IGAD	ECCAS	CENSAD
Log distance between countries	−0.015** (0.01)	0.003 (0.00)	−0.002 (0.00)	−0.108 (0.08)	−0.016* (0.01)	−0.021*** (0.00)
Log ratio exporter/ importer real GDP	0.032*** (0.00)	−0.022*** (0.01)	0.019*** (0.00)	−0.050 (0.06)	0.060*** (0.01)	0.010** (0.00)
Log ratio exporter/ importer water productivity	0.014*** (0.00)	0.004 (0.00)	0.013*** (0.00)	−0.036 (0.05)	0.034** (0.01)	0.023*** (0.00)
Log ratio exporter/ importer agricultural land	0.000 (0.00)	−0.006* (0.00)	−0.011*** (0.00)	0.019 (0.15)	−0.007 (0.00)	0.006*** (0.00)
Log exporter/ importer exchange rate	0.004*** (0.00)	0.006*** (0.00)	0.002 (0.00)	0.010 (0.01)	−0.033*** (0.01)	0.011*** (0.00)
Log ratio exporter/ importer freshwater withdrawals	0.000* (0.00)	0.000*** (0.00)	0.000*** (0.00)	−0.000 (0.00)	0.000*** (0.00)	0.000*** (0.00)
Ratio exporter/ importer degree of water stress	−0.049*** (0.01)	−0.040*** (0.01)	−0.079*** (0.01)	−0.068 (0.24)		−0.076*** (0.00)
1 for contiguity	0.056*** (0.01)	0.025** (0.01)	0.021** (0.01)	−0.055 (0.09)	−0.008 (0.05)	−0.001 (0.01)
1 for common official language	−0.018** (0.01)	−0.041 (0.03)	-0.014 (0.01)	0.298 (0.19)	−0.044 (0.05)	0.030*** (0.01)
1 for native language similarity	0.010 (0.01)	0.050*** (0.01)	0.074*** (0.01)		−0.012 (0.03)	0.041*** (0.01)
1 for common colonizer post-1945	0.061*** (0.01)	0.040 (0.03)	0.018** (0.01)	0.014 (0.07)	0.076 (0.04)	−0.028*** (0.01)
1 if landlocked	−0.014* (0.01)	0.072*** (0.01)	0.125*** (0.01)	0.272** (0.10)	−0.045* (0.02)	0.069*** (0.01)
1 for common water treaty	−0.005 (0.01)	0.047*** (0.01)	0.008 (0.01)	−0.040 (0.06)	0.121*** (0.02)	0.076*** (0.01)
1 for common AfCFTA ratification	0.024*** (0.01)	0.056*** (0.01)	0.035*** (0.01)	0.047** (0.02)	0.028 (0.02)	0.033*** (0.01)
1 if both countries are/were at war	−0.023*** (0.00)	0.114*** (0.02)	0.007 (0.01)		0.059 (0.04)	
Constant	2.511*** (0.04)	2.269*** (0.04)	2.352*** (0.04)	2.795*** (0.54)	2.371*** (0.05)	2.523*** (0.03)
Years dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	21,529.0	9,578.0	10,897.0	1,949.0	1,414.0	16,032.0
R-squared	0.12	0.10	0.16	0.20	0.14	0.16

Note: AfCFTA = African Continental Free Trade Area; CEN-SAD = Community of Sahel-Saharan States; COMESA = Common Market for Eastern and Southern Africa; ECCAS = Economic Community of Central African States; ECOWAS = Economic Community of West African States; IGAD = Intergovernmental Authority on Development; PPML = Poisson pseudo maximum likelihood; SADC = Southern African Development Community. * $p < .10$; ** $p < .05$; *** $p < .01$. Standard errors are in the parentheses.

4

Fruit and Vegetable Value Chains in Africa

Nora Aboushady, Lukas Kornher, and Chahir Zaki

Introduction

The patterns of Africa's participation in fruit and vegetable value chains (FVVCs) clearly reflect the continent's colonial past. The restructuring of African exports around a few commodities to serve European markets during the colonial period largely undermined the farming of local food crops, including indigenous fruits and vegetables. Postcolonial governments focused on cash crops as the main source of foreign exchange earnings, reinforcing the status quo. However, the mid-1980s witnessed a major shift in global demand away from traditional cash crops and toward high-value products, including fruits and vegetables. This shift was an opportunity for developing countries, including those in Africa, to diversify their exports and reduce their vulnerability to global commodity price fluctuations. Participation in FVVCs can also have positive impacts on employment creation, income mobility, and poverty reduction. Yet, Africa's participation in FVVCs is undermined by a number of structural challenges, some of which are typical of FVVCs, and some related to long-standing issues facing African economies in general, and the agriculture sector in particular.

From a theoretical perspective, it is important to understand the determinants of FVVCs in Africa before analyzing trade data. Three main theoretical frameworks can be evoked: the factor content theory, gravity models, and global value chain determinants. First, the factor content theory argues that countries export products that use their relatively abundant factors of production. Thus, if fruits and vegetables are intensive in land and water, they will be exported by African countries that are abundant in these factors. Second, the gravity model predicts that bilateral trade flows are based on the economic sizes and distance between two countries, which is reflected in trade costs. Trade costs include transport and storage infrastructure, such as cold storage facilities, as well as trade policies and trade barriers, and are affected by common borders, historical colonial links, and common languages. Trade policies that increase trade costs include tariffs and nontariff measures. Thus, gravity considerations play an important role explaining African trade patterns, given that African countries generally trade with countries characterized by large markets (the United States and China) or with countries with which they had colonial links (France, Portugal, Italy, and the United Kingdom). Third, the literature examines the determinants of upgrading—that is, participating in the downstream nodes—in a global value chain. These are mainly the skills of the labor force, trade policy at the origin and the destination, and technology transfer (Gereffi 2019). Clearly, in Africa, the lack of research and development (and thus innovation) in the agriculture sector and the presence of high tariffs on processed agrifood products help to explain the specialization of most countries in unprocessed products in the early stages of the value chain.

Against this background, this chapter analyzes Africa's participation in FVVCs and discusses challenges and opportunities in this sector, including new prospects with the advent of the African Continental Free Trade Area (AfCFTA). The chapter is structured as follows. We begin with a brief overview of the importance of the fruit and vegetable sector for Africa and summarize the main findings on the benefits from participation in FVVCs, as well as the risks faced by African countries in this sector, with special attention to smallholders. The core of the chapter analyzes FVVCs at the global and African levels, including trends in exports and imports of fruits and vegetables, top exporters, and top export destinations. Throughout the analysis, we examine trade in fruits and vegetables at three levels of processing: unprocessed, semi-processed, and processed products.[1] We also compare two time periods[2] with a 10-year

1 There is no standard definition of the three levels of processing. Throughout this chapter, we define "unprocessed" fruits and vegetables as raw commodities, "processed" fruits and vegetables as products that are ready to consume, and "semi-processed" goods as goods that are neither raw nor ready to consume.

2 This methodology was used in previous editions of the AATM. In principle, the underlying logic is to choose a 5-year period of the most recent data and compare it with a 5-year period with a 10-year interval. This can help us track whether trade data reflect a longstanding pattern or whether there may have been disruptive changes during and after 2020.

interval: the first from 2008 to 2012, and the second from 2018 to 2022. Next, we highlight the different categories of fruits and vegetables that may present an opportunity for Africa, taking into account both supply and demand sides. Based on Africa's comparative advantage and global demand, we distinguish between the various processed, semi-processed, and unprocessed fruits and vegetables that Africa should develop and those it should not prioritize, both in the short and long term. The last part of the analysis focuses on the challenges affecting Africa's participation and upgrades in FVVCs. These range from production-specific issues to more general challenges related to poor infrastructure and restrictive trade policies. Finally, the chapter's conclusions provide some policy recommendations, focusing on opportunities for improved intra-African integration in FVVCs.

Why Do Fruit and Vegetable Value Chains Matter for Africa?

African countries' current production and trade of fruits and vegetables reflect the focus of colonial powers on a few export commodities in each colony, beginning in the early 19th century. In the colonial period, African agriculture had to shift from the production of traditional food crops to export crops—primarily fiber (such as cotton), vegetable oils (such as palm oil and peanut oil), sugar, rubber, cocoa, coffee, and tea (Bjornlund, Bjornlund, and Van Rooyen 2020). The colonial export-oriented policies had major impacts on Africa's rich food system and food security. Following independence, African governments continued to implement the same policies, focusing on exporting one or two cash crops, to maintain the flow of foreign currency needed to fund their industrialization policies.

Since the mid-1980s, international trade in fruits and vegetables has grown substantially, driven by rising incomes worldwide (Joosten et al. 2015) and by the rise of supermarkets in developing countries, which has further increased demand for high-quality food products (Swinnen, Colen, and Maertens 2013). The shift in global demand from traditional export crops to high-value products, including fruits and vegetables, has several implications for African countries. On the one hand, the shift creates new opportunities for African farmers to increase their participation in agrifood value chains. On the other, these developments entail potentially severe repercussions for smallholders, who constitute the majority of producers in Africa.

To better understand these opportunities and challenges, it is important to understand the structure and governance of FVVCs. Rising trade in fruits and vegetables between developing and developed countries has shaped these value chains around structures that have left most African producers "stuck" in upstream, typically low value-added segments of FVVCs. First, growing international trade in fruits and vegetables was accompanied by rising flows of foreign direct investment (FDI) toward developing countries, including Africa. These investments are typically controlled by a small number of multinational companies. Second, the organization and governance of FVVCs is controlled by these large exporting companies, which adopt either a vertical integration structure[3] or rely on contract farming with smallholders (Van den Broeck and Maertens 2016). Third, exports of fruits and vegetables to developed countries require tighter food quality and safety standards, especially as the level of processing increases. This concentration of actors along the value chain, together with stringent standards and regulations, may explain in part why African exporting countries are largely positioned in upstream segments of the value chain, that is, where fruit and vegetable exports are mostly unprocessed, as we demonstrate in the next sections of this chapter.

3 Vertical integration refers to a situation in which the whole supply chain is integrated and owned by one firm.

Nevertheless, participation and upgrade along FVVCs may have several positive implications for Africa. In addition to revenues from their traditional export crops, production of fruits and vegetables can help to diversify African countries' exports and reduce their vulnerability to global commodity price fluctuations. Moreover, compared with traditional cash crops, the value of fruits and vegetables per unit or per weight is higher (Swinnen, Colen, and Maertens 2013). As the demand for processed agrifood products grows, African countries can also benefit from upgrading along FVVCs to promote smallholder commercialization and rural development (Jenane, Ulimwengu, and Tadesse 2022). Ongoing shifts in global demand (especially in emerging markets) toward healthier diets including fruit and vegetable products present an opportunity for Africa to engage in processing activities along global and regional FVVCs.

The horticulture sector is typically intensive in low-skilled labor, meaning that participation in FVVCs has potential to increase incomes and reduce poverty, especially for African smallholders. A recent study (Mossie et al. 2021) found that participation in apple and mango value chains in Ethiopia's Upper Blue Nile Basin is associated with 17 percent and 18.5 percent higher household consumption expenditures, respectively. Maertens et al. (2012), in a study in Madagascar, found that vegetables produced under contract farming systems with exporting companies accounted for 47 percent of the household income of involved farmers; and in Senegal, found that participation in bean and tomato value chains had important implications for female empowerment within rural households, due to the female labor intensity of these sectors. Moreover, Van den Broeck and Maertens (2016) suggest that the shift from smallholder contract farming to vertically integrated estate farming affects the labor intensity of FVVCs, as more workers are needed for postharvest activities. Unlike in contract farming, women provide most of the labor in these export companies. Consequently, FVVCs can improve income and food security outcomes not only for smallholders working in contract farming, but also for women through wage employment. Moreover, participation in FVVCs can improve African countries' foreign exchange earnings and trade balance, thus increasing their capacity to import food, among other vital products. Van den Broeck et al. (2018) found that participation in FVVCs increased food security in Senegal through the country's capacity to import food.

Notwithstanding the positive outcomes of fruit and vegetable exports, Africa's participation in FVVCs is undermined by several issues. First, fruits and vegetables are seasonal, and their supply chain is characterized by high perishability and susceptibility to waste and loss. Loss can occur due to poor production and harvesting conditions, lack of adequate transportation or poor road conditions, improper packaging, and lack of appropriate storage and cooling. For example, losses in Kenyan production of mangoes are estimated to reach up to 60 percent, most of which occurs before or during harvesting (Ridolfi, Hoffmann, and Baral 2018). Given the agriculture sector's high labor intensity, important income fluctuations can result from yield variations, losses, and waste, which increase the vulnerability of African agricultural communities. In addition, seasonality and perishability are among the main obstacles preventing African firms engaged in processing activities from operating at full capacity year-round (Jenane, Ulimwengu, and Tadesse 2022).

Finally, climate change is a major cause of yield variations and among the main challenges facing African agriculture and participation in global value chains. Africa is particularly vulnerable to climate change–related drought shocks, flooding, and extreme weather, which can have severe repercussions on the livelihoods of small farmers. In their study of two districts in Ghana, Williams et al. (2018) found that exposure to climate variability and low capacity to adapt to climate change are among the main factors increasing livelihood vulnerability among smallholder horticultural farmers. Similarly, results from a survey conducted in the Limpopo province of South Africa (Randela 2018) suggest that temperature variability has had a negative and significant impact on avocado yields.

In sum, Africa's participation and upgrading along FVVCs entails several benefits and opportunities for different stakeholders, including African governments, investors, smallholders, and consumers. However, Africa's performance along the value chain is undermined by multiple factors, including the current governance structure of the value chains, in addition to other structural challenges, most notably, poor access to technology and know-how, inadequate infrastructure and logistics, restrictive trade policies (both in African countries and their main export destinations), stringent food safety and quality in destination countries, and intra-African sanitary and phytosanitary measures, among others. Following a thorough analysis of African trade and value chain participation and of potential in the fruit and vegetable sector, we offer a more detailed discussion of some of these challenges and limitations.

Overview of Africa's Fruit and Vegetable Value Chains

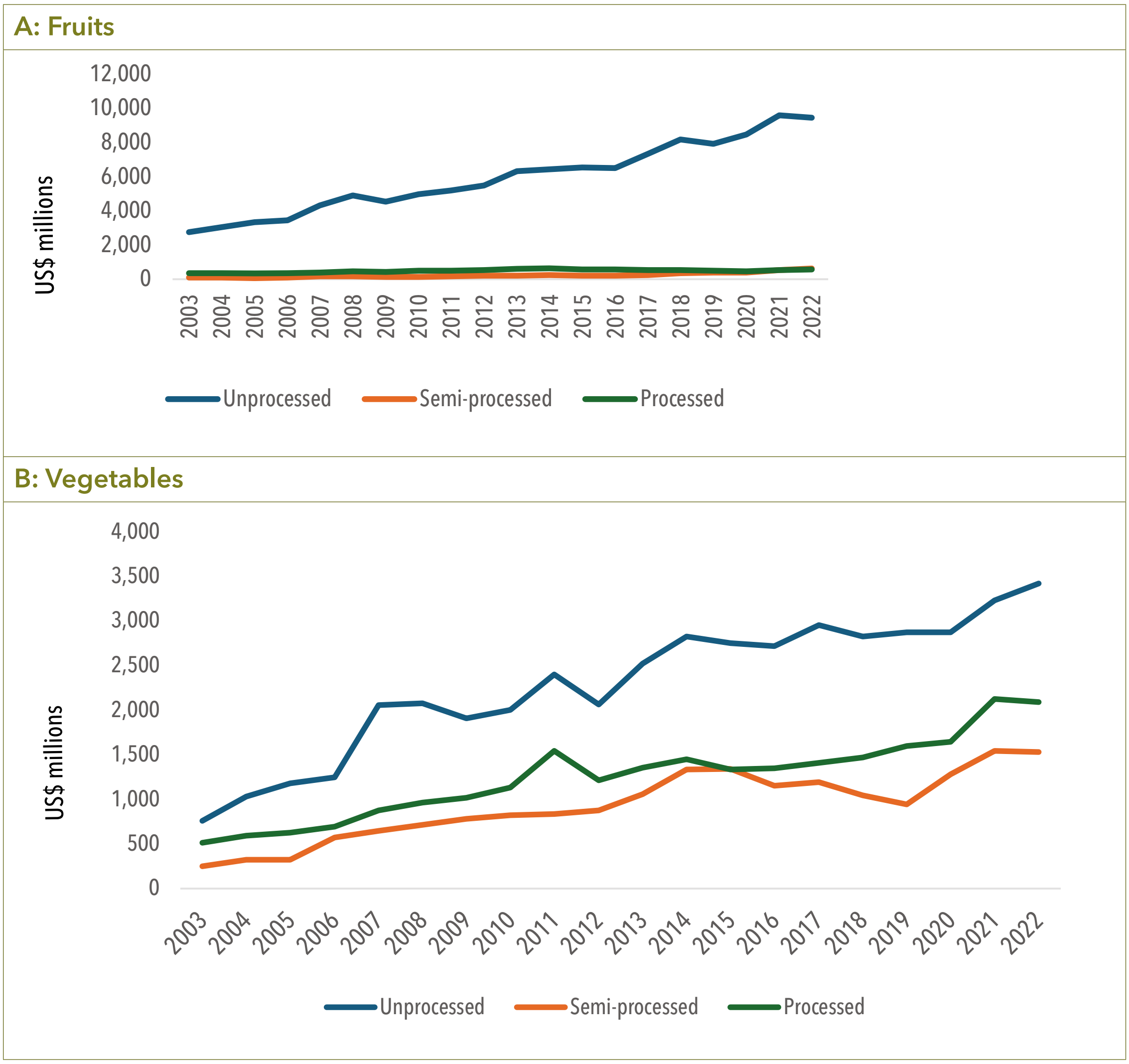
This section provides an in-depth analysis of global and African trade along FVVCs. We begin with an overview of African exports and imports of fruits and vegetables by level of processing and then look at the major exporters and importers at the global level. We then apply this analytical framework to Africa, investigating the major actors at the continental level and the main export destinations for African fruit and vegetable products. We also explore the evolution of intra-African trade in fruits and vegetables and identify the major intracontinental exporters and importers. Throughout this analysis, we look at two periods with a 10-year time interval (2008–2012 and 2018–2022) and at processed, semi-processed, and unprocessed fruits and vegetables in order to identify any changes in the main trade trends over this time period.

African trade in fruits and vegetables

Figure 4.1 depicts the evolution of African exports of fruits and vegetables, by level of processing, between 2003 and 2022.[4] Generally, Africa's exports of fruits and vegetables were dominated by unprocessed commodities over this 20-year period. Moreover, the value of unprocessed fruit exports exceeds that of unprocessed vegetables. In the case of fruit (Figure 4.1, panel A), the gap between the exports of unprocessed goods, on the one hand, and semi-processed and processed products, on the other, is substantial: exports of unprocessed goods increased from US$2.752 billion in 2003 to $9.433 billion in 2022.[5] Over the same period, the value of semi-processed fruit exports increased from $90.9 million to $627 million and that of processed fruit exports from $359.3 million to $581 million. For vegetables (Figure 4.1, panel B), the value of unprocessed exports also remained above the values of semi-processed and processed products. In 2003, exports of unprocessed vegetables amounted to $759 million, while those of semi-processed and processed vegetables were $250 million and $513 million, respectively. By 2022, exports of unprocessed vegetables reached $3.419 billion, while those of semi-processed and processed products were $1.527 billion and $2.088 billion, respectively.

4 See Appendix Table A4.1 for the full list of fruits and vegetables by level of processing.
5 Dollar values refer to US dollars throughout this chapter.

Figure 4.1 Exports of African countries by level of processing, US$ millions



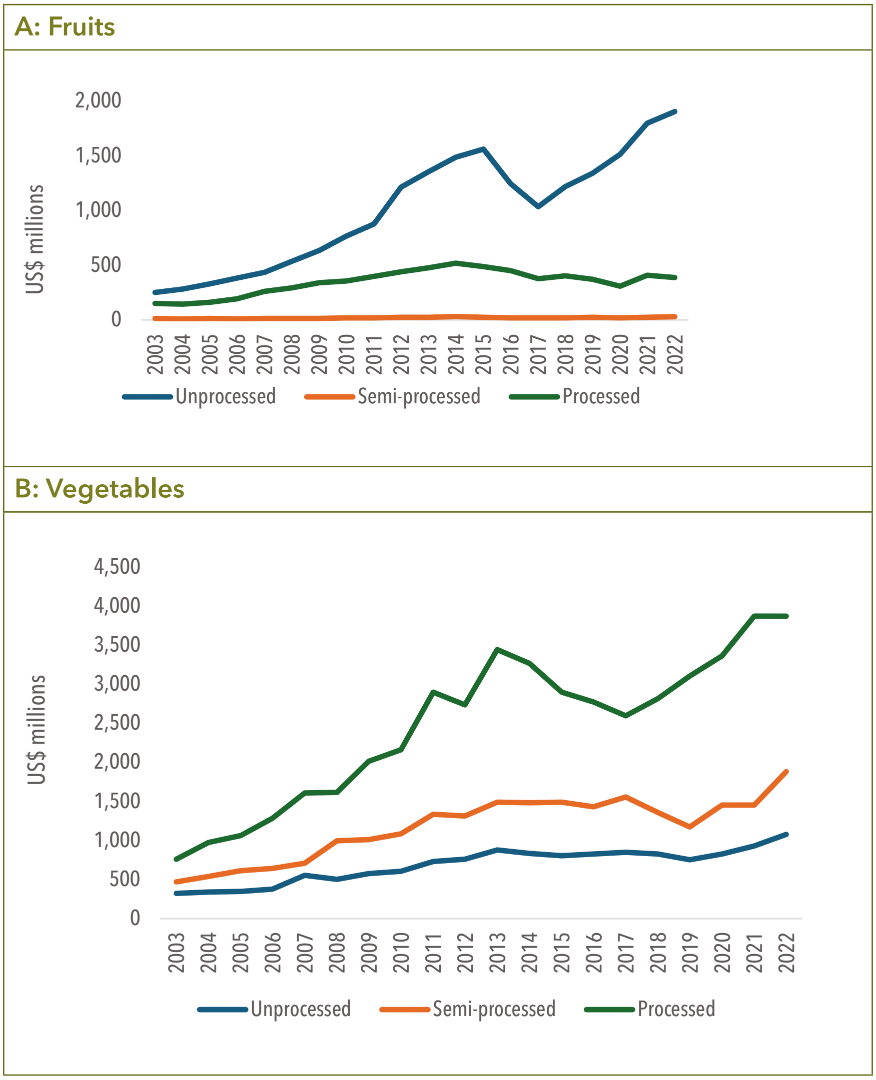
Source: Authors' elaboration using the 2024 AATM database.

Figure 4.2 depicts import flows. Africa's unprocessed fruit imports (Figure 4.2, panel A) were on an upward trend over the past 20 years, interrupted by a sharp drop in 2016 and 2017.[6] However, imports of processed and semi-processed fruits increased much less. In 2022, imports of unprocessed fruits reached $1.904 billion, while the value of semi-processed fruit imports was only $28.6 million (up from $10.5 million in 2003), and that of processed fruit imports was $385 million (up from $150 million in 2003). The picture for vegetable imports is quite different. The value of processed vegetable imports has always exceeded the values of unprocessed and semi-processed vegetables, and the gap widened over the 20-year period. In 2022, imports of

6 The drop in 2017 may have been caused by adverse weather conditions in the world's main fruit-growing regions in 2016 and 2017, which disrupted global production of all major tropical fruits. Mango, papaya, and avocado production were affected by drought in parts of South America and Asia, while pineapple cultivation suffered from flooding in Central and South America. Moreover, tropical storms in the Caribbean in September and October 2017 affected fruit production in small island states (Altendorf 2017). Among the major challenges facing tropical fruit production is that these fruits are mostly grown by smallholders with little access to weather-resilient production systems. Aside from climate shocks, the drop in imports may also have been caused by changes in Egyptian imports. Data on top African importers show that Egypt was on average the top importer of unprocessed fruits in both periods and was likely to be among the top importers in 2016 and 2017 (this period is not covered). However, in 2016, Egypt raised tariffs on 53 lines of food and agricultural products, including fresh and processed fruits considered "luxury" products (USDA Foreign Agricultural Service 2016), and also devaluated its exchange rate, with impacts on imports.

processed vegetables reached $3.871 billion (up from $759 million in 2003). At the same time, semi-processed and unprocessed vegetable imports amounted to $1.881 billion and $1.077 billion, respectively.

Figure 4.2 Imports of African countries by level of processing, US$ millions



Source: Authors' elaboration using the 2024 AATM dataset.

In sum, except for vegetable imports, Africa's participation in FVVCs is marked by a concentration of trade flows in unprocessed goods. The predominance of unprocessed exports may reflect the global shift in consumer preferences driven by an increasing awareness of the nutritional benefits of fresh fruit and vegetable consumption (especially tropical produce). In developed countries and also a number of developing countries, demand for fresh, high-quality fruits and vegetables is increasing. In the particular case of tropical fruit, the unit price is also typically higher for fresh than for processed items, which increases profit margins from unprocessed exports (Altendorf 2017).

At the same time, the relatively modest value of semi-processed and processed fruit and vegetable exports may also reflect the multiple challenges facing African countries in upgrading along FVVCs, including the lack of processing capacities and necessary logistics (such as storage and transport) and the difficulty in meeting international standards for processed fruits and vegetables, or the escalation of tariffs in export destinations (Fukase and Martin 2018). A more detailed discussion of these challenges follows later in this chapter.

Finally, the structure of imports may be largely attributed to several factors, including rising incomes, urbanization, and shifts in consumer preferences in Africa. On the one hand, imports of unprocessed fruits may reflect increasing awareness of the benefits of fresh fruit consumption or the growing demand for tropical (mostly imported) varieties, especially in the largest African economies. On the other hand, the predominance of processed vegetable imports could reflect shifts in consumer preferences toward new varieties that are not domestically available, in addition to increasing income and urbanization, which drive up demand for vegetable preparations. Finally, the structure of trade flows may also reflect the lack of domestic vegetable processing capacities.

In the following section, we identify the world's major exporters and importers of fruits and vegetables by level of processing in order to investigate, first, whether African countries feature among top exporters or top importing markets, and second, how the top exporters and importers have changed over time.

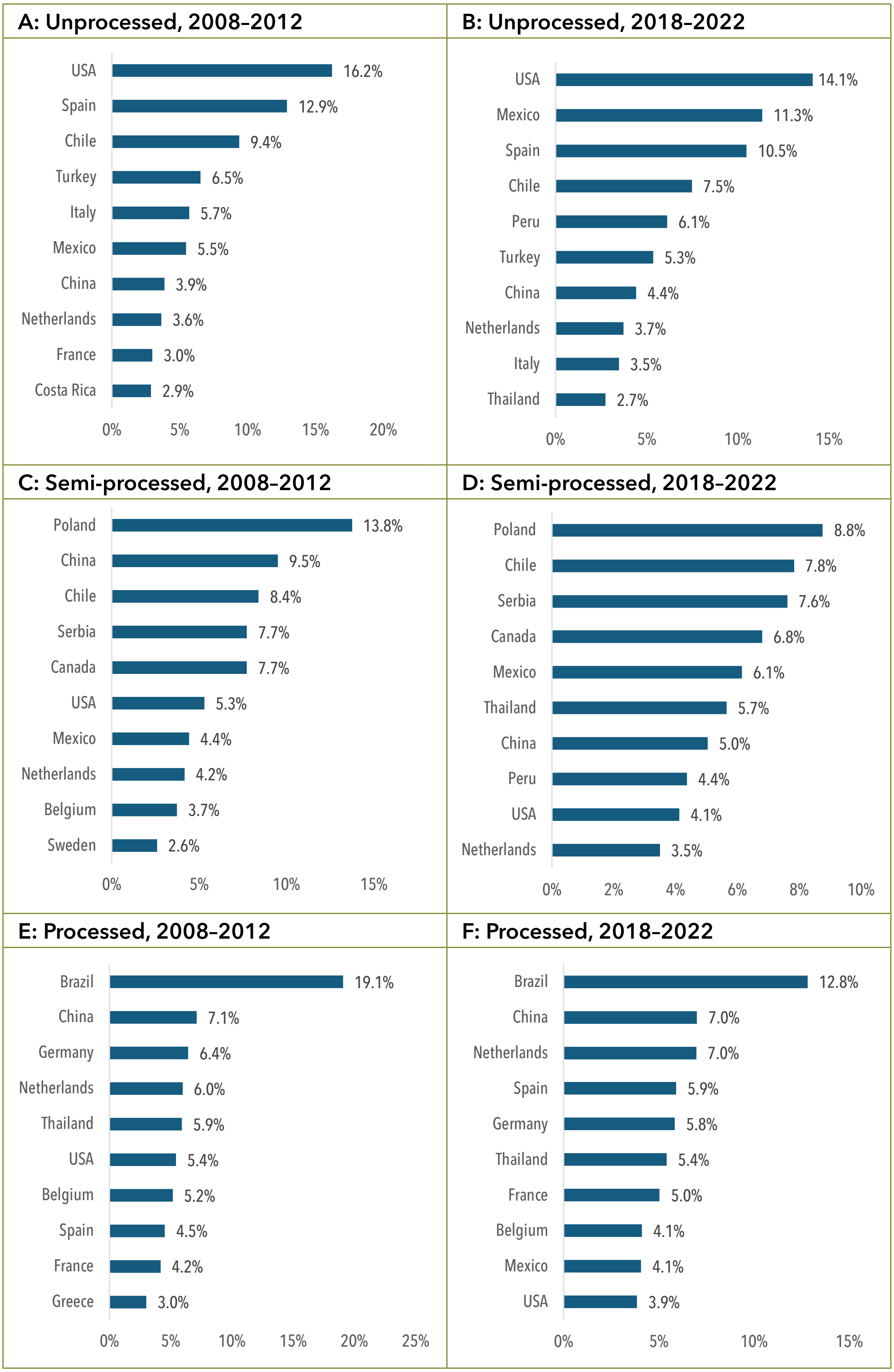
World's top exporters and importers

Figures 4.3 and 4.4 rank the top exporters of fruits and vegetables for two periods (2008–2012 and 2018–2022) and by level of processing. The figures suggest three key findings, including, above all, the absence of African countries among the top 10 exporters. Second, the group of top exporters has changed very little over time. Exports are largely dominated by Europe, the United States, and Canada, in addition to China and several Asian and Latin American countries (such as Brazil, Mexico, and Thailand). Third, the world's exports of fruits and vegetables tend to be highly concentrated in a small number of countries, especially for unprocessed exports. For example, the top three exporters of unprocessed fruits (Figure 4.3, panel B) together constituted more than 35 percent of the world's exports. For unprocessed vegetables (Figure 4.4, panel B), this share is as high as 47.3 percent.

The presence of China among the top 10 exporters can be traced back to the country's efforts to raise its profile in the global market for agricultural commodities, as part of the agricultural reforms including (but not limited to) the liberalization of agricultural input and output markets in the 1990s and improvements in irrigation and agricultural technology (Guo 2020). Since the 2000s, Chinese exports of fruits and vegetables have been growing rapidly and marked by an increasing diversification of export markets (Mu and Jin 2020). Moreover, China's agriculture sector relies increasingly on intelligent agricultural production, networked agricultural operations, digital technology, big data, and artificial intelligence (Lyu 2020). In Brazil, the agribusiness sector represents 21 percent of the country's GDP (Barros 2020; Mu and Jin 2020). The important role of Brazilian agricultural exports dates to colonial times. Since the 1980s, however, Brazil's agribusiness sector has increased its focus on goods for which there is global demand, such as processed fruits, including orange juice and sugar.

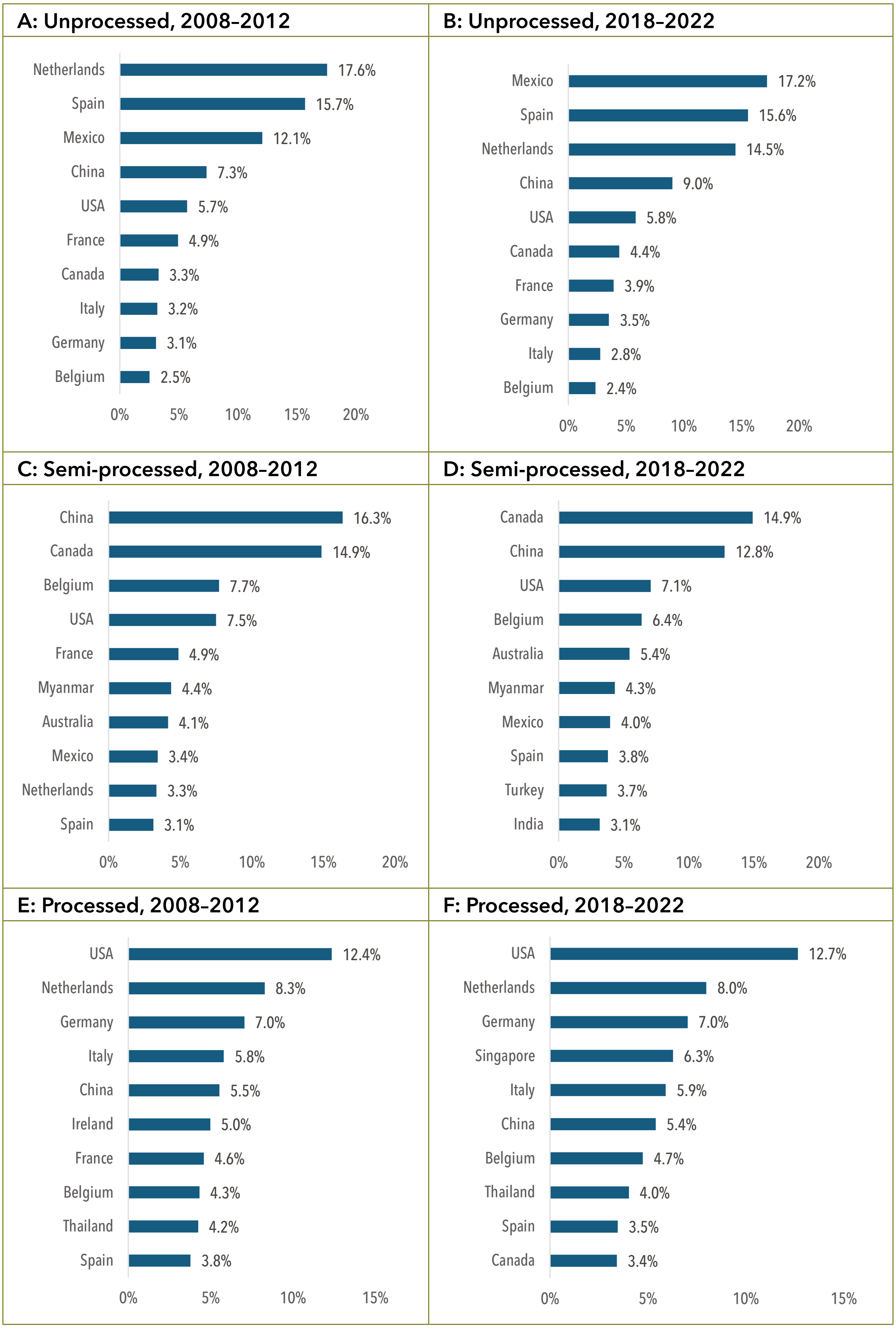
Figures 4.5 and 4.6 show the top 10 importers of fruits and vegetables by level of processing. As we found for the world's top exporters of fruits and vegetables, African countries also are not among the top 10 importers. The United States and Germany often occupy the top two spots, and most of the other top importers are developed countries. Imports of fruits and vegetables are also concentrated among the top 10 (and sometimes, the top 3). For example, the top 10 countries accounted for more than 60 percent of the world's imports of unprocessed and processed fruits (Figure 4.5, panels B and F). In the case of semi-processed fruits (Figure 4.5, panel D), the top 10 importers accounted for as much as 70 percent of the world's imports. For unprocessed vegetables (Figure 4.6, panel B), the United States and Germany together accounted for 32.5 percent of the world's imports, and in the case of processed vegetables (Figure 4.6, panel F), the top three importers accounted for 39.1 percent of the world's imports. China is also a prominent importer of fruits and vegetables at all levels of processing, a trend that reflects increasing incomes, especially in urban areas, and a growing domestic demand to try "novelty products" such as tropical fruits (Altendorf 2017).

Figure 4.3 Top 10 world exporters of fruits, share of world exports, by level of processing



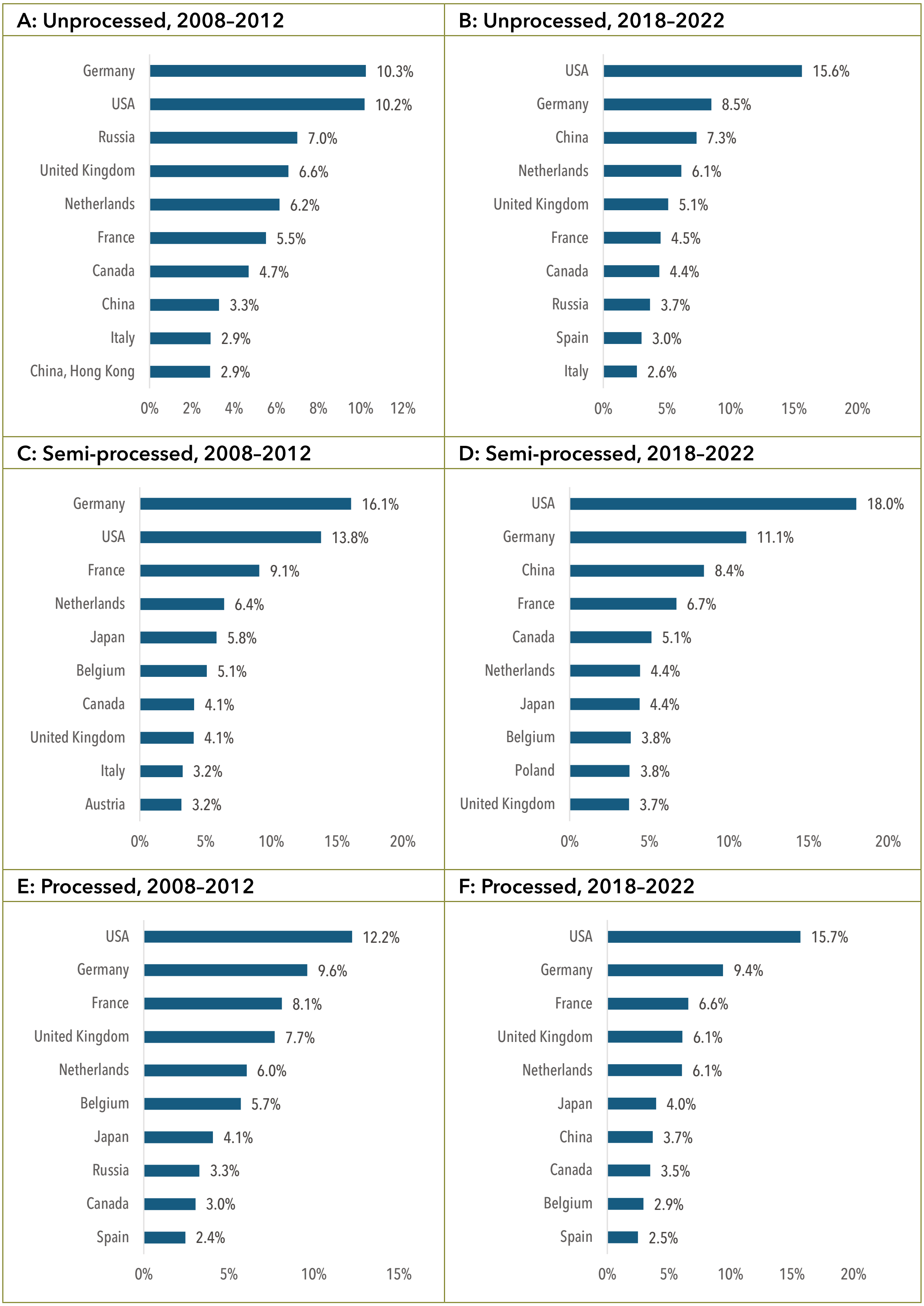
Source: Authors' elaboration using the 2024 AATM database.

Figure 4.4 Top 10 world exporters of vegetables, share of world exports, by level of processing



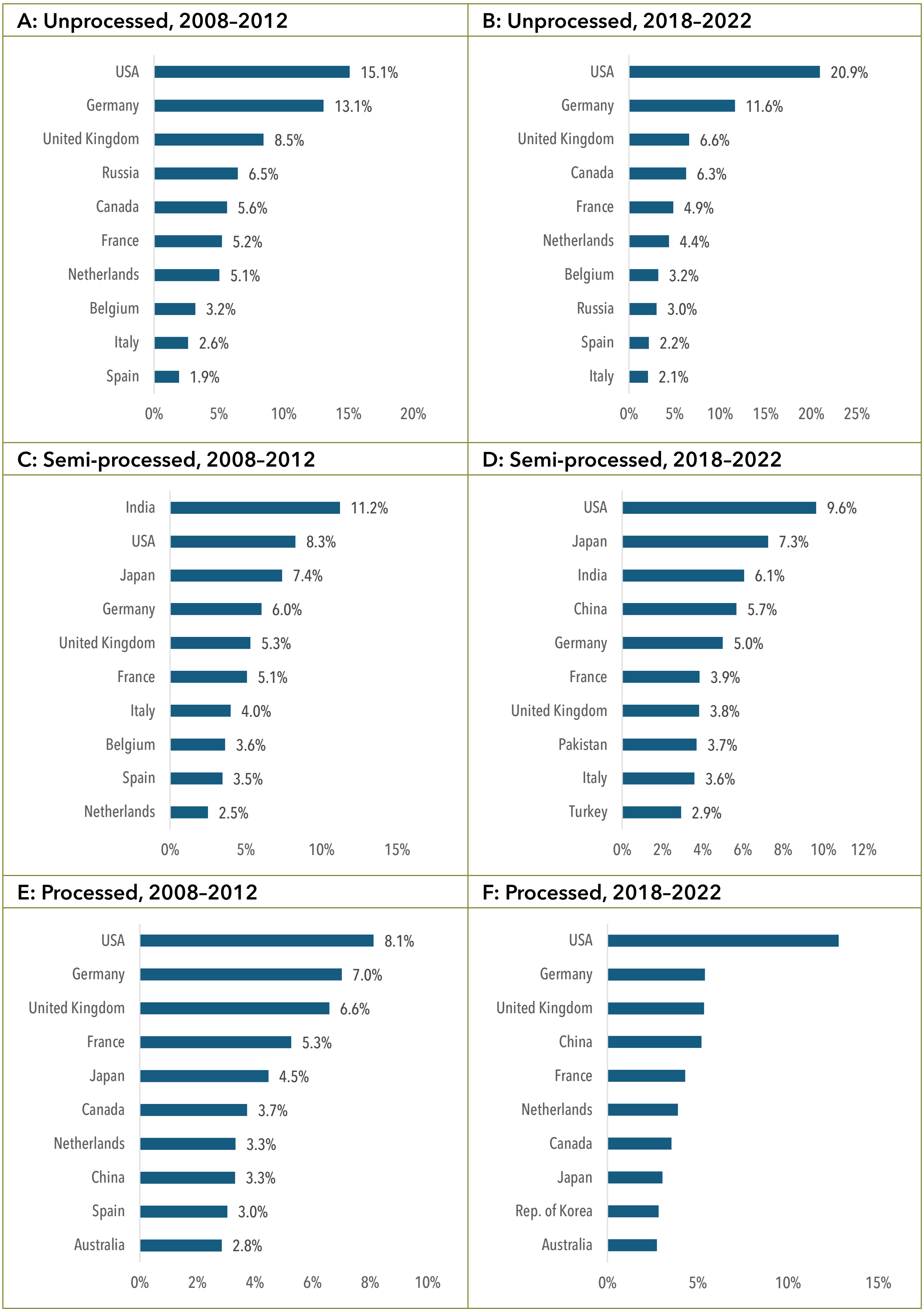
Source: Authors' elaboration using the 2024 AATM database.

Figure 4.5 Top 10 world importers of fruits, share of world imports, by level of processing



Source: Authors' elaboration using the 2024 AATM database.

Figure 4.6 Top 10 world importers of vegetables, share of world imports, by level of processing



Source: Authors' elaboration using the 2024 AATM database.

In the next section, we look at the top exporters and importers of fruits and vegetables among African countries.

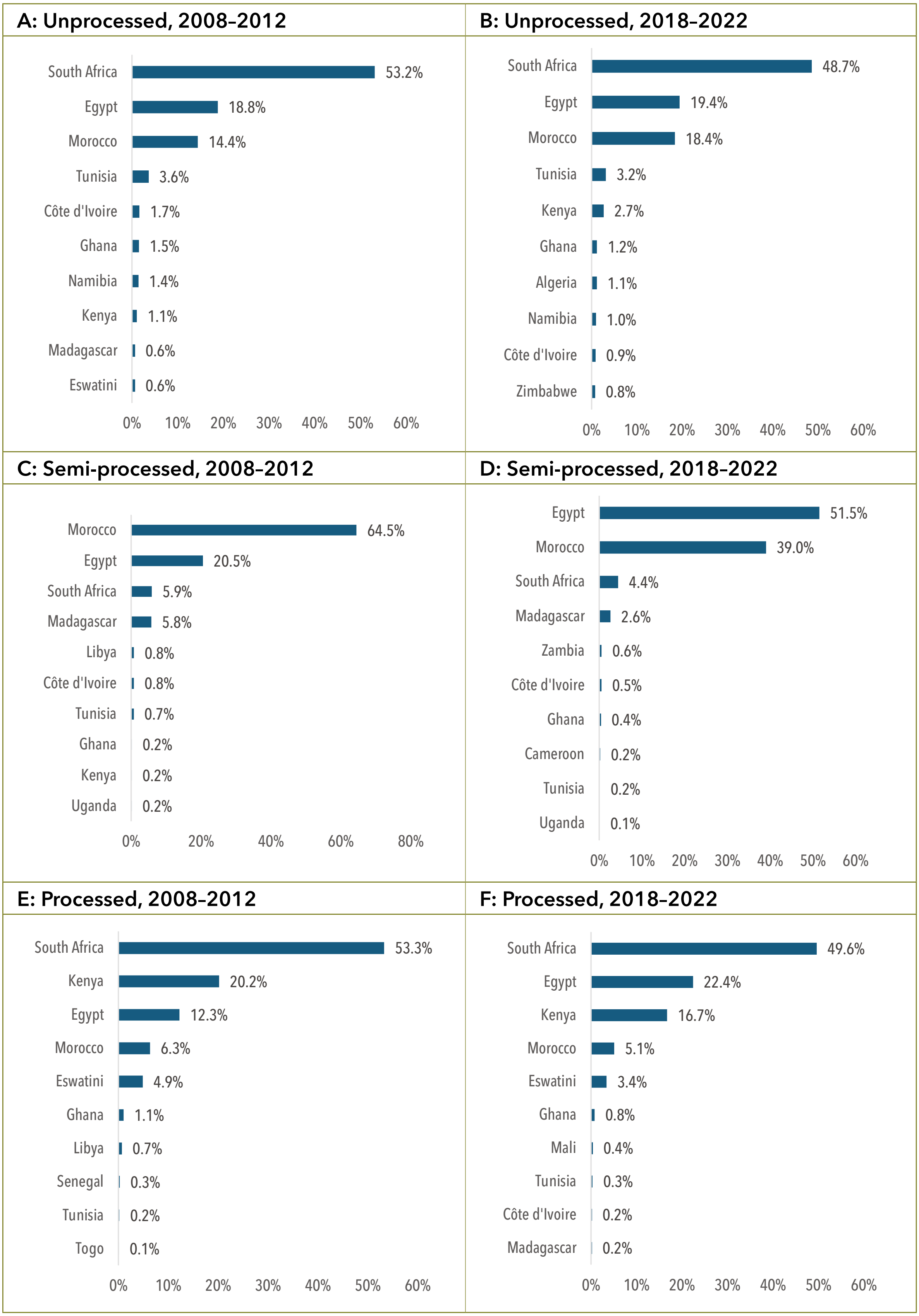
Top African exporters and importers

Since Africa is not among the world's top participants in FVVCs, this section provides a separate analysis of the top-performing African countries, regardless of their share in global trade in these categories. Figure 4.7 shows the top 10 African exporters of fruit by level of processing for both periods (2008–2012 and 2018–2022). Overall, the data suggest a concentration of top African exporters in a limited number of countries.

For exports of unprocessed fruits (Figure 4.7, panels A and B), South Africa is by far the largest exporter, accounting for about half of the continent's exports, followed by Egypt and Morocco. Grapes and citrus fruits are among these countries' top exports. South Africa upgraded citrus fruit exports by planting high-quality varieties and responding to rising international standards (Chisoro and Roberts 2024). In the case of Egypt, the production of fruit (especially citrus and grapes) exceeds domestic consumption and is among the main sources of agricultural export revenues (Kassim et al. 2018). Similarly, Morocco is one of the main exporters of oranges and grapes, especially to the European Union (EU) (Santeramo and Lamonaca 2023). In the case of semi-processed fruit exports (Figure 4.7, panels C and D), the composition of the top 10 exporters is similar, but the ranking is different, with Morocco and Egypt together constituting more than 90 percent of these exports during the second period. Finally, South Africa exports nearly half of the continent's processed fruits (Figure 4.7, panels E and F), followed by Egypt (22.4 percent) and Kenya (16.7 percent). South Africa and Kenya, for example, account for 85 percent of Africa's exports of pineapple juice concentrate, while South Africa also accounts for more than half of the continent's orange juice exports, followed by Egypt (Schreinemachers et al. 2022).

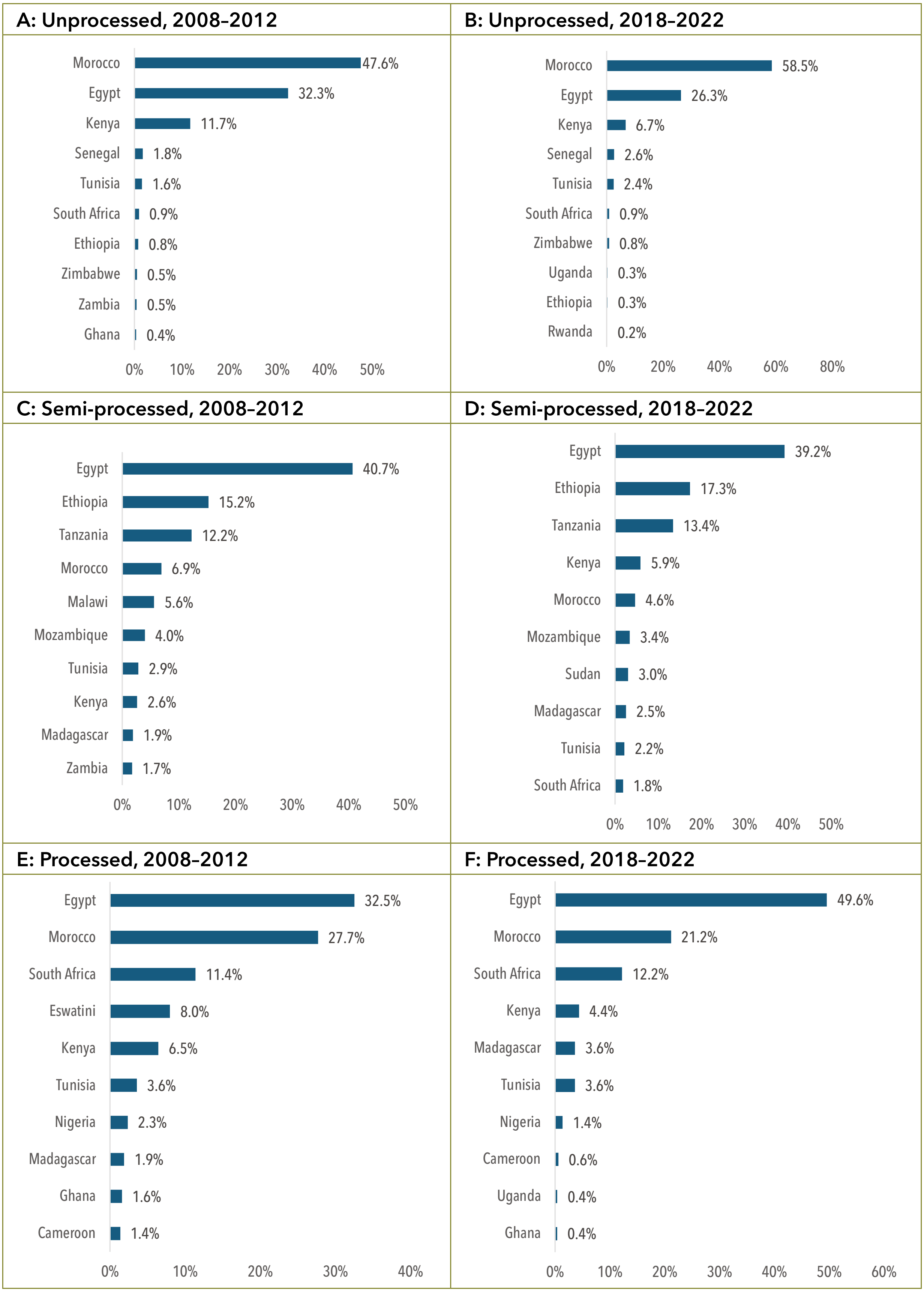
Figure 4.8 depicts the top 10 African exporters of vegetables by level of processing. Similar to our findings on fruit, exports of vegetables remain concentrated in two to three exporters whose shares are substantially higher than the rest. For unprocessed vegetable exports (Figure 4.8, panels A and B), the composition and ranking remained largely unchanged in both periods, with Morocco being the top exporter and accounting for 58.5 percent during the second period. Together, Morocco, Egypt, and Kenya export more than 90 percent of the continent's total exports of unprocessed vegetables. For example, Morocco and Egypt are the top exporters of fresh tomatoes (Schreinemachers et al. 2022). For semi-processed vegetables (Figure 4.8, panels C and D), Egypt is the top exporter, with a share of about 40 percent during both periods, followed by Ethiopia and Tanzania. Finally, for processed vegetables (Figure 4.8, panels E and F), Egypt is also the top exporter, accounting for 49.6 percent of total exports during the second period. Other top exporters include Morocco and South Africa.

Figure 4.7 Top 10 African exporters of fruits, share of African exports, by level of processing



Source: Authors' own elaboration using the 2024 AATM database.

Figure 4.8 Top 10 African exporters of vegetables, share of African exports, by level of processing

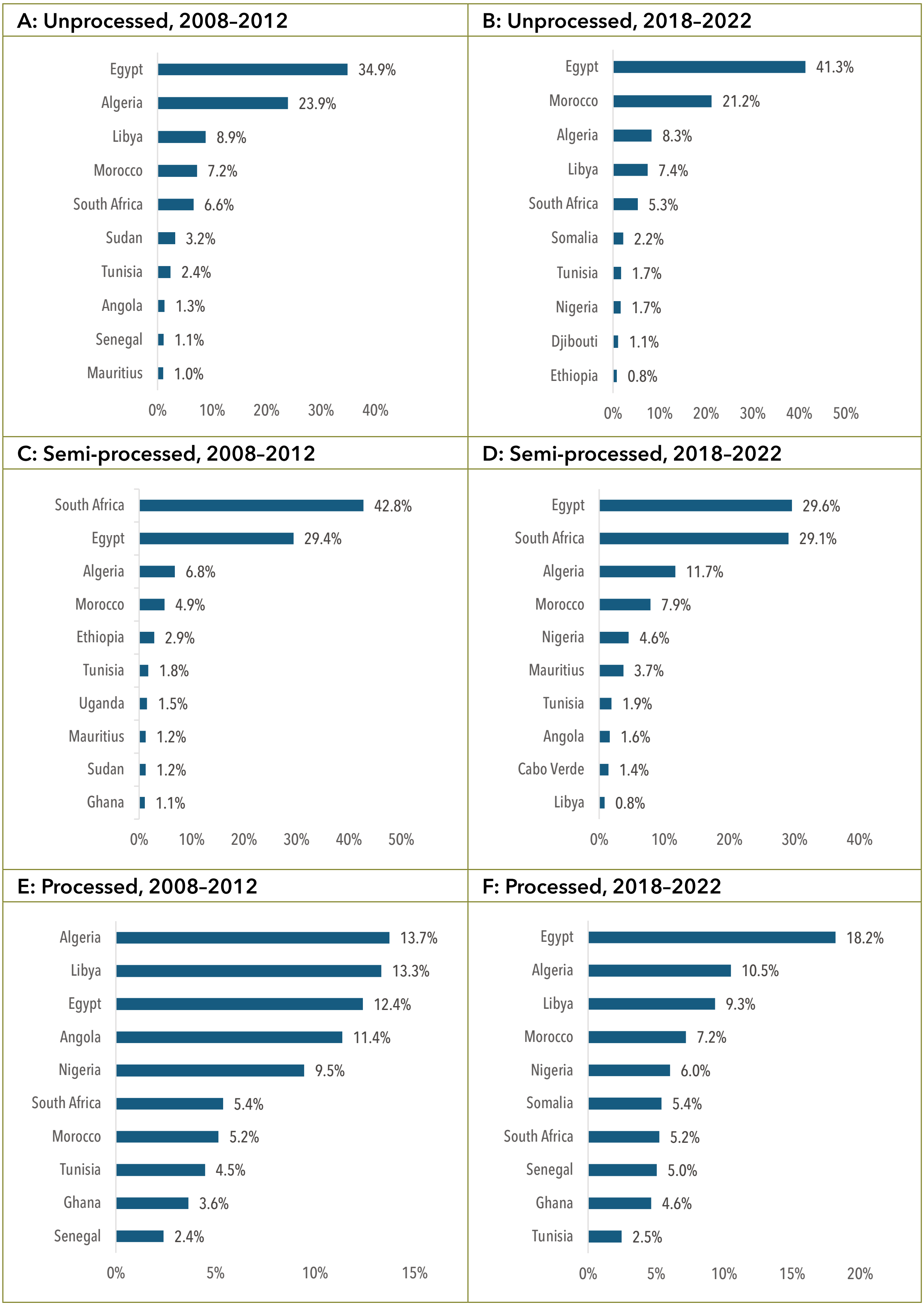


Source: Authors' elaboration using the 2024 AATM database.

In the case of fruit imports (Figure 4.9), North African countries (such as Egypt and Morocco) are also among the top-ranked countries. For unprocessed fruits (Figure 4.9, panels A and B), Egypt, Algeria, Libya, and Morocco constitute 78.2 percent of African imports for the 2018–2022 period. For semi-processed fruit imports (Figure 4.9, panels C and D), South Africa was the top importer, with a share of 42.8 percent during the first period, followed by Egypt (29.9 percent). During the second period, Egypt and South Africa had comparable shares (about 29 percent), followed by Algeria and Morocco. The list of top importers of processed fruits (Figure 4.9, panels E and F) also reveals a strong presence of North African countries, with Egypt, Algeria, and Libya among the top importers in both periods. Together, the top 10 importers constitute 73.9 percent of the total African imports within this category for the second period.

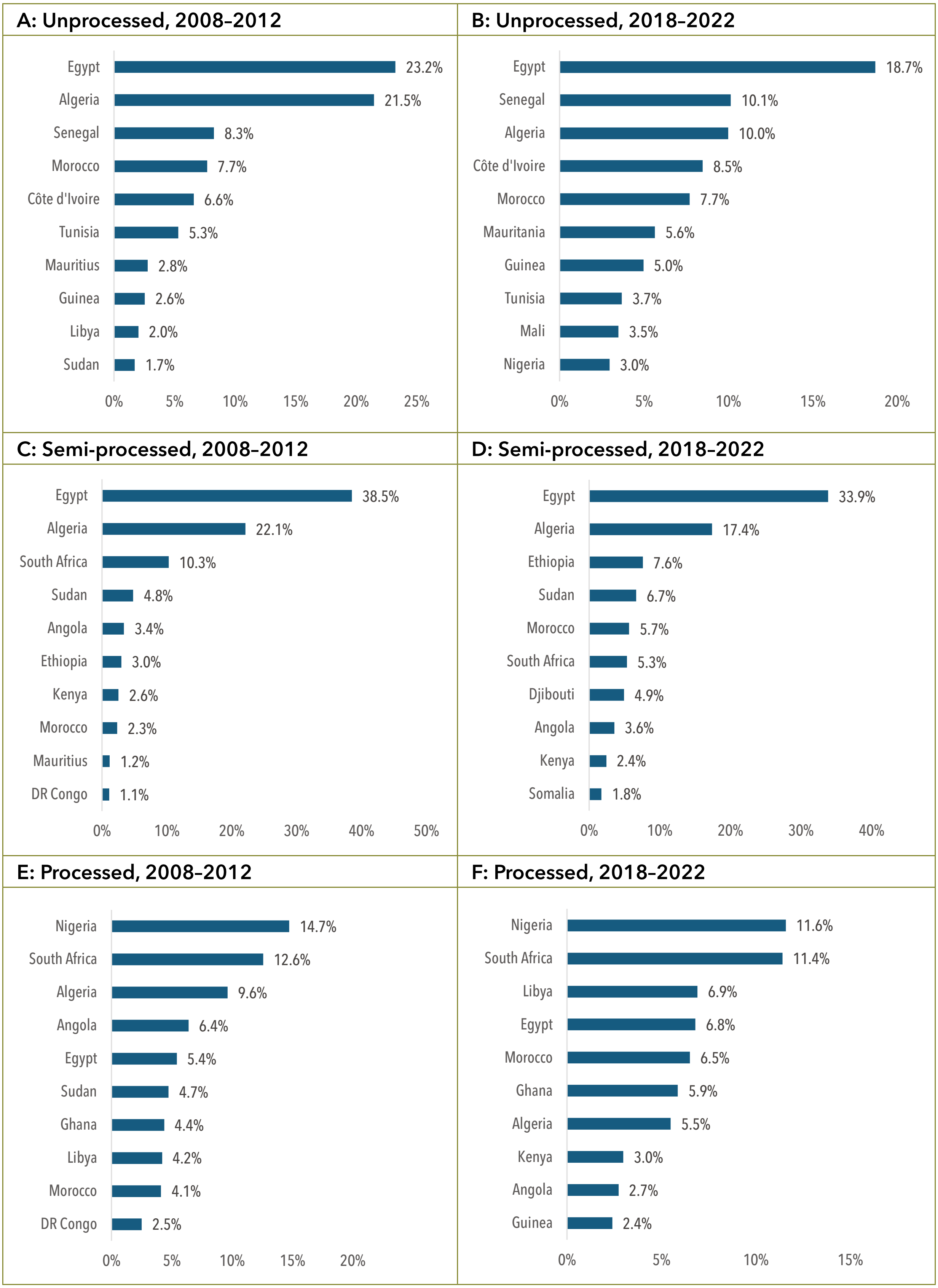
Finally, Figure 4.10 shows the top 10 African importers of vegetables by level of processing. These countries are mostly in North and West Africa. The data for unprocessed vegetables (Figure 4.10, panels A and B) suggest a more balanced share of each country in total African imports within this category. Whereas, in the first period, North African countries like Egypt and Algeria dominated these imports, data for the second period suggest a lower concentration of imports among the top 10 countries. Egypt was still the top importer, followed by Senegal and Algeria. The imports of semi-processed vegetables (Figure 4.10, panels C and D) reflect a strong presence of North and East African countries. Egypt ranks first, with 33.9 percent of total African imports within this category, followed by Algeria (17.4 percent). Finally, the imports of processed vegetables (Figure 4.10, panels E and F) reveal a relatively more balanced geographic distribution, with East African countries like Kenya and Southwestern countries like Angola among the top 10 exporters. Unlike unprocessed and semi-processed imports, processed vegetable imports are dominated by Nigeria and South Africa, followed by North African countries, such as Libya, Egypt, and Morocco.

Figure 4.9 Top 10 African importers of fruits, share of African imports, by level of processing



Source: Authors' elaboration using the 2024 AATM database.

Figure 4.10 Top 10 African importers of vegetables, share of African imports, by level of processing



Source: Authors' elaboration using the 2024 AATM database.

Our analysis of the main African exporters and importers of fruits and vegetables highlights several interesting findings: on the one hand, North African countries (primarily Egypt and Morocco) play a major role in exports of fruits and vegetables, along with South Africa (in the fruit sector). The concentration of exports in the top 10 countries can be as high as 90 percent. On the other hand, imports of fruits and vegetables are more balanced. While North African countries and South Africa have a major presence, some countries in West Africa (Guinea, Nigeria, and Senegal) and in East Africa (Ethiopia and Kenya) are also among the top 10 importers.

These findings have important implications for value chains. The concentration of fruit and vegetable exports in a relatively small number of countries—together with the predominance of unprocessed exports depicted in Figure 4.1—could be attributed to several factors. First, endowments play an important role, as trade in agriculture is primarily driven by factor endowments (land, climate conditions, and thus the ability to produce and export). Clearly, this explains why these countries have a high comparative advantage in agriculture exports.

Second, income is one of the major determinants of the status of African participation in global value chains (GVCs). Our findings suggest that the income levels of the African exporters are the highest in the continent. South Africa, which has a heavy presence in FVVCs, has the highest GDP in the continent, followed by Egypt (which is also among the top African performers in agricultural GVCs). Income levels were also found to correlate with a higher per capita demand for fruit and vegetable products (Mensah et al. 2021), without these trade flows being necessarily related to other processing activities along GVCs (such as in the case of Algeria and Nigeria). This may explain why economies that are larger in terms of GDP per capita, such as South Africa, Egypt, Algeria, and Nigeria, are also among the top importers of vegetables across different levels of processing, although Africa as a whole has the lowest per capita production and consumption of fruits and vegetables in the world (Schreinemachers et al. 2022).

Third, it is also important to note that a sufficient and predictable domestic demand for fruits and vegetables is essential for the development of competitive value chains in the first place. These, once developed, could realize economies of scale and later compete internationally. Integration in the global economy also contributes to technology transfers and efficiency gains. For example, countries engaged in FVVCs have higher levels of input and irrigation technology use, which are of particular importance for these value chains (Baumüller et al. 2020). South Africa, for example, has invested in planting high-quality varieties to meet rising international standards. Countries that export and import fruits and vegetables across different stages of processing are also more likely to be engaged in FVVCs, due to endowments in specific crops (such as pineapple in South Africa and oranges and tomatoes in South Africa, Egypt, and Morocco). Thanks to the availability of necessary capital and technology, these countries have better fruit and vegetable processing capacities and are therefore engaged in different processing stages along the value chain. However, for most African countries, innovation among agrifood processing firms is generally low, due to low investments in research and development and limited access to technology (Jenane, Ulimwengu, and Tadesse 2022). Most African countries also rely on small-scale fruit and vegetable production. Given the high perishability of most fruit and vegetable produce and the absence of processing capacities and reliable market outlets for smallholders, domestic and intraregional trade is usually more realistic than international trade (Schreinemachers et al. 2022).

Fourth, infrastructure is a significant challenge for Africa's fruit and vegetable trade and for upgrading along value chains due to long distances between producers and consumers coupled with poor road conditions and a lack of refrigerated transportation. Top exporters in Africa, however, have more suitable logistics, transport, and storage conditions than other African countries.

Finally, it is important to note that trade policy plays a limited role, as will be shown later in this chapter. On the one hand, the top exporting countries perform better than other African countries due to their endowments and comparative advantage rather than their trade policies. On the other hand, other African countries benefit from preferential access to export markets—through the African Growth and Opportunity Act,[7] the Generalized System of Preferences, or the Everything but Arms[8] initiative—yet are not strong exporters, as they face several nontariff measures that reduce their competitiveness.

Destination of African fruit and vegetable exports by level of processing

In this section, we explore the main destination markets for African exports of fruits and vegetables for the two time periods. Figure 4.11 shows the top 10 destinations for African fruit exports. Regardless of the level of processing, the top 10 importers are mostly European countries, the United States, and Canada. The imports of African unprocessed and semi-processed fruits for both periods of the analysis (Figure 4.11, panels A–D) are concentrated in Europe and the United States and, to a lesser extent, Japan. Other countries, including China and Russia, are also among the top importers. For processed fruit exports (Figure 4.11, panels E and F), the second period shows a diversification of top importing countries, with four African countries among the top importers.

The top 10 destinations for Africa's vegetable exports are shown in Figure 4.12. While the top importers of African unprocessed vegetables (Figure 4.12, panels A and B) are predominantly European countries, those of semi-processed and processed vegetables (Figure 4.12, panels C–F) are more diversified and include Arab, African, and Asian countries. Thus, as the level of processing increases and food safety and quality standards become more stringent, the top destinations are more diversified and reflect a stronger presence of Asian and Arab countries as the main importers.

Overall, we find that African countries are positioned upstream along FVVCs (that is, more toward the origin of the value chain). The growth of exports of unprocessed fruits and vegetables is significantly greater than exports of semi-processed and processed products. Moreover, Africa's top importers of unprocessed fruits and vegetables are predominantly Europe and the United States, suggesting an upstream position of African countries in the value chain, with their specialization in raw, unprocessed commodities, which are later processed in developed countries and may even be re-exported to Africa for domestic consumption.

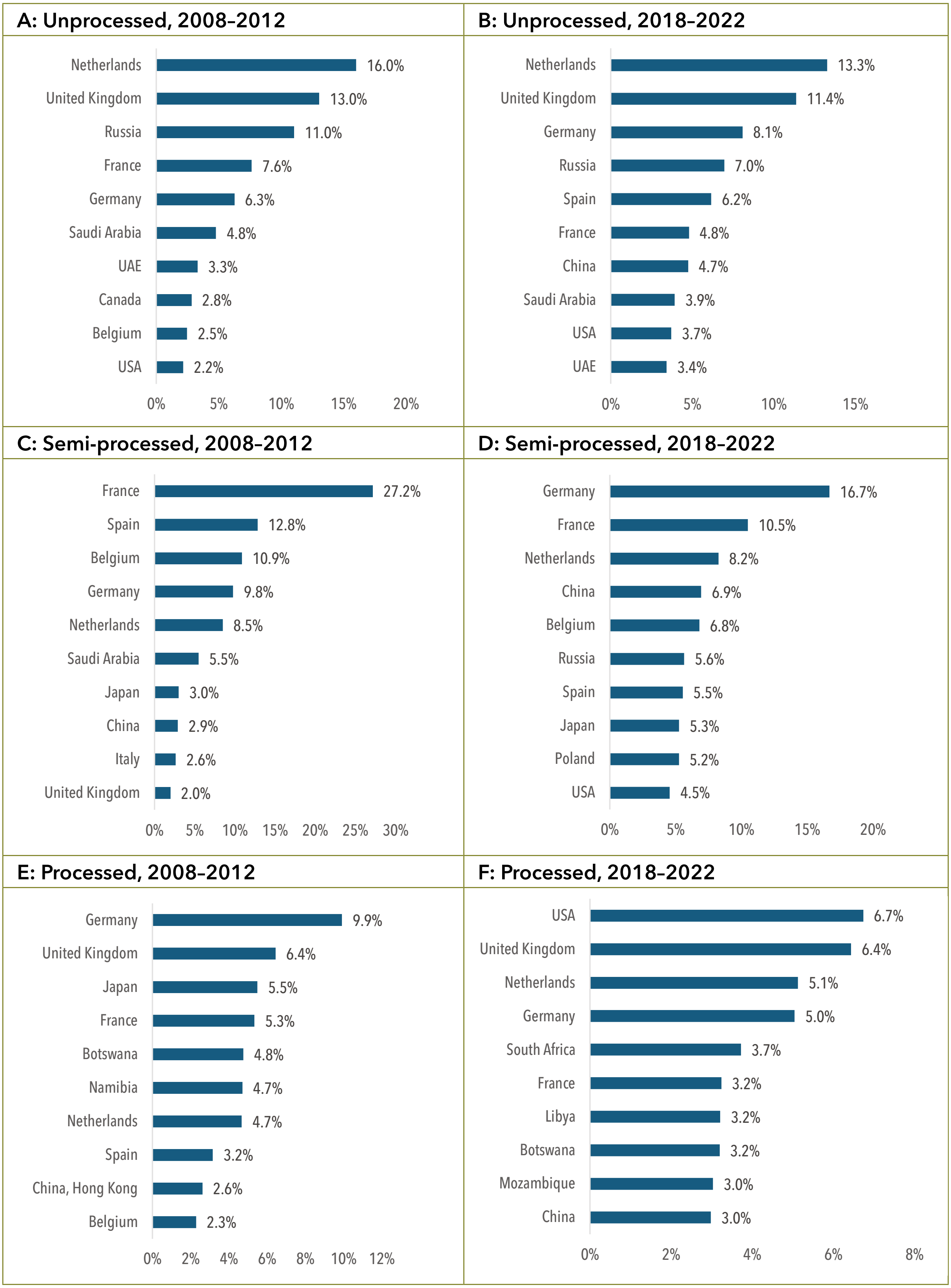
As was mentioned, gravity considerations play an important role in explaining these trade patterns, given that African countries trade generally with countries characterized by large markets (the United States and China) or with countries with which they had colonial links (France, Portugal, Italy, and the United Kingdom). In fact, these trade patterns are largely in line with the historical role European countries played as the main destination for African exports of (especially unprocessed) fruits and vegetables. Despite the relative maturity and high degree of competition in European markets, these are likely to remain attractive to Africa's fruit and vegetable exports due to increased interest in plant-based diets and healthy foods, in addition

7 The African Growth and Opportunity Act provides eligible sub-Saharan African countries with duty-free access to the US market for several products, in addition to other products that are eligible for duty-free access under the Generalized System of Preferences program. This scheme is extended until 2025.
8 The Everything but Arms scheme removes tariffs and quotas for all imports of goods (except arms and ammunition) coming into the European Union from least developed countries, mainly African ones.

to their relative profitability (COLEACP 2020). At the same time, trade with other regions has been growing rapidly, especially at the higher levels of processing. Between 2002 and 2017, Africa's exports of fruits and vegetables (processed and unprocessed) to East Asia grew at an average rate of 9.6 percent per year, compared with only 1.1 percent for exports to the EU (COLEACP 2020). For the 2018–2022 period, Asian and Arab countries are also among the top destinations for Africa's semi-processed and processed fruit and vegetable exports. This reflects the ability of African countries to cater to markets with less stringent standards and sanitary restrictions and highlights the potential for developing vegetable processing industries and serving geographically close markets in the Middle East or rapidly growing markets in Asia. Despite this potential to upgrade along FVVCs, it is important to note that tariff escalation contributes to the concentration of African exports in unprocessed products. Tariff escalation refers to situations in which lower tariffs are imposed on unprocessed products and higher tariffs on processed ones, which is common in Africa's main export destinations, including China, the EU, and the United States (Antimiani, Di Maio, and Rampa 2011).

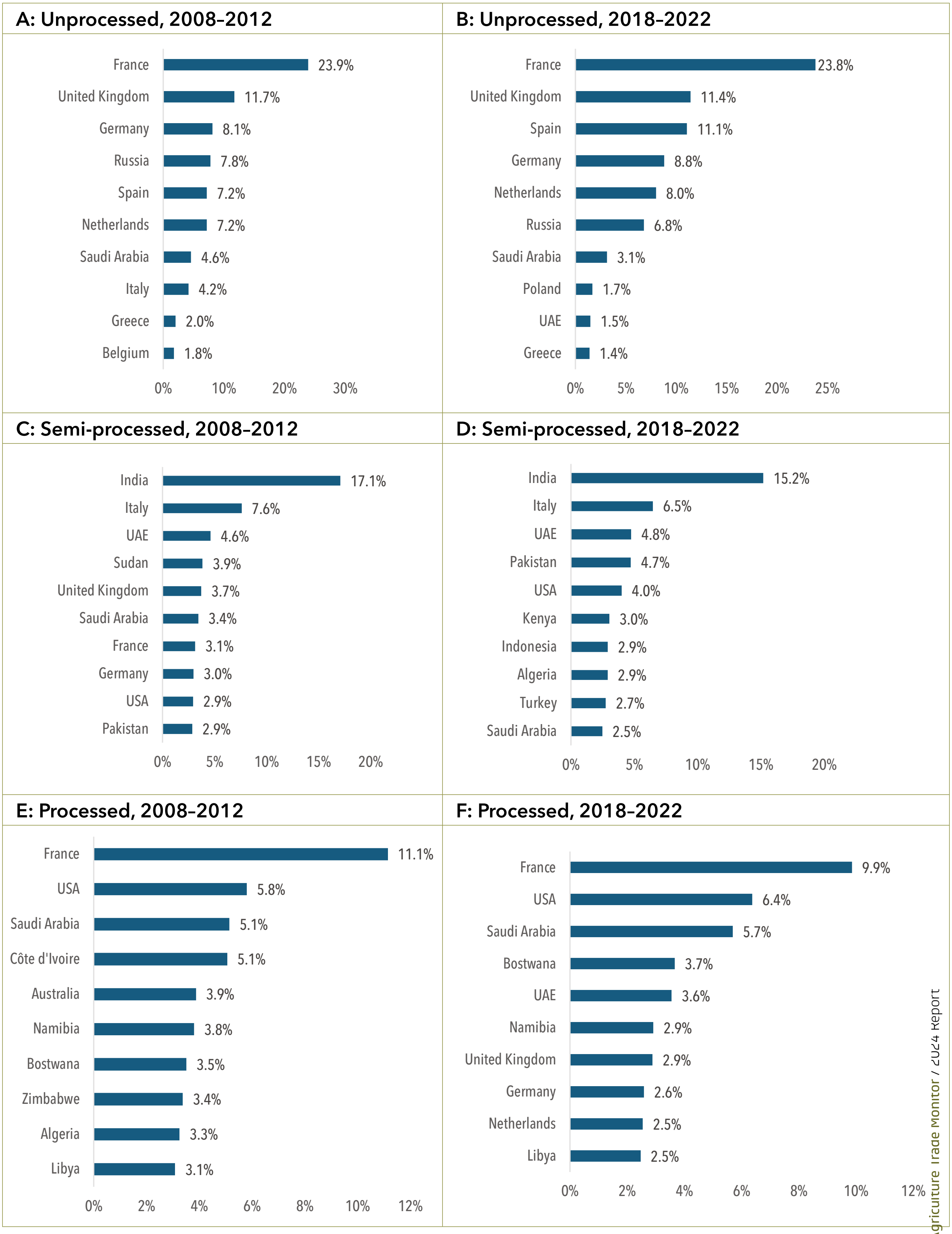
Our initial analysis also suggests the presence of regional value chains, with some African countries among the top importers of Africa's processed and semi-processed fruits and vegetables, which we discuss in the next section.

Figure 4.11 Top 10 importers of African exports of fruits, share of African exports, by level of processing



Source: Authors' own elaboration using the AATM 2024 database.

Figure 4.12 Top 10 importers of African exports of vegetables, share of African exports, by level of processing



Source: Authors' own elaboration using the AATM 2024 database.

Intra-African fruit and vegetable value chains

In this section, we examine intra-African trade patterns and compare the observations with the findings on global trade above in order to better understand the challenges facing intra-African trade in fruits and vegetables.

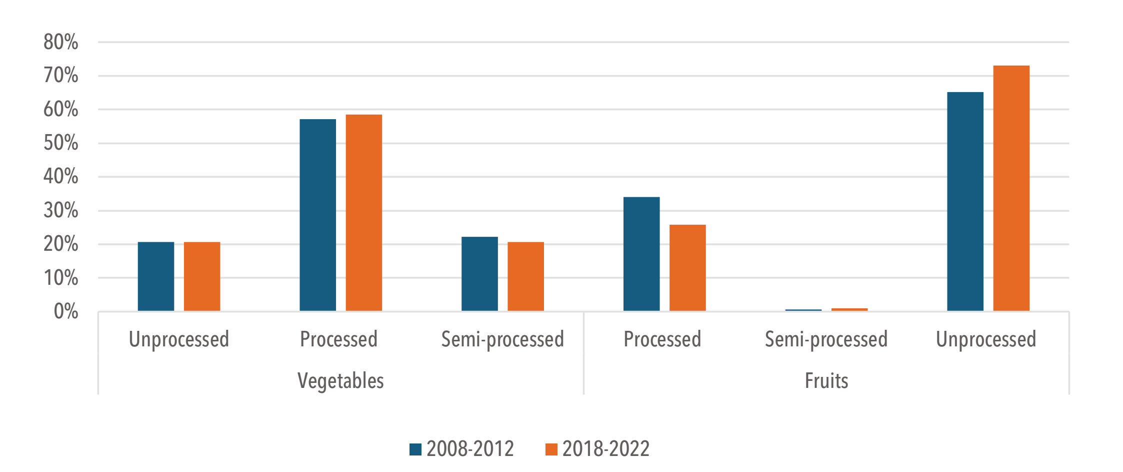
Trade by level of processing

Total intra-African fruit and vegetable trade amounted to $2.36 billion in 2022, of which $1.55 billion was trade in vegetable products and $812 million was trade in fruit products. This is an increase of $750 million, almost 50 percent, since 2012. Of total African exports of fruits and vegetables, intra-African trade accounts for only about 6 percent of trade in fruits and 17 percent of trade in vegetables. About 21 percent of fruit imports and about 11 percent of vegetable imports are sourced from another African country.[9] However, intra-African trade statistics are likely underestimating the total level of intra-African trade due to the high level of informal trade (Bouët, Cissé, and Traoré 2020). Over the 2018–2020 period, overall, about 40 percent of intra-African fruit and vegetable trade was in the form of unprocessed commodities, 50 percent in processed products, and about 10 percent in semi-processed products. This has not changed substantially over the past 20 years, with only a few variations in individual years.

There are a few differences between intra-African trade in fruit and vegetable products (Figure 4.13). Among fruit products, there is virtually no trade in semi-processed products, while about 20 percent of intra-African vegetable trade is in semi-processed products. Furthermore, intra-African fruit trade is primarily unprocessed, and the share of unprocessed fruits even increased between the 2008–2012 and 2018–2022 periods. Conversely, about 60 percent of intra-African vegetable trade is in processed products (about the same in both periods). This is both a consequence of the definition of semi-processed products, which are fewer in number than unprocessed and fully processed products, and the fact that regional FVVCs in Africa are very limited. For instance, Odjo and Diallo (2022) discuss Africa's role in GVCs and show, despite an increasing trend, limited African participation. As a result, FVVC products are either fully processed or unprocessed. They argue that this is caused by small, narrow manufacturing sectors that require additional cross-border foreign direct investment. Limited cross-border infrastructure and complex trade regimes, including rules of origin regulations, also contribute to limited participation in regional value chains (Kornher and von Braun 2020). The implementation of the AfCFTA in coming years offers an opportunity to address these policy constraints and improve intra-African trade.

9 To approximate the share, we use the total intra-African exports (imports) of the top 10 intra-African exporters (importers) and the total African exports (imports) presented in Figures 4.1 and 4.2.

Figure 4.13 Share of intra-African FVVC trade, by level of processing

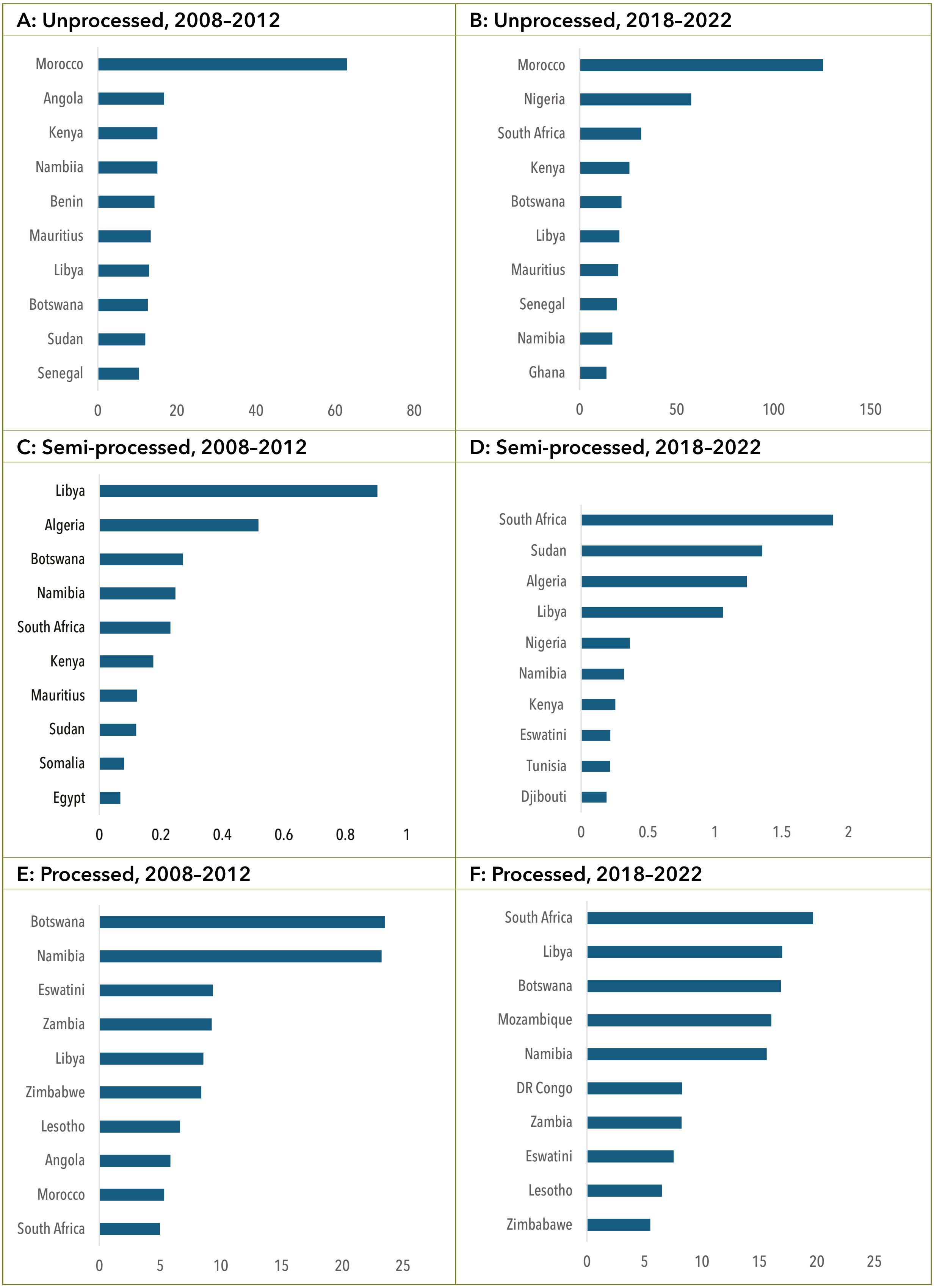


Source: Authors' elaboration using the 2024 AATM database.

Destinations by level of processing

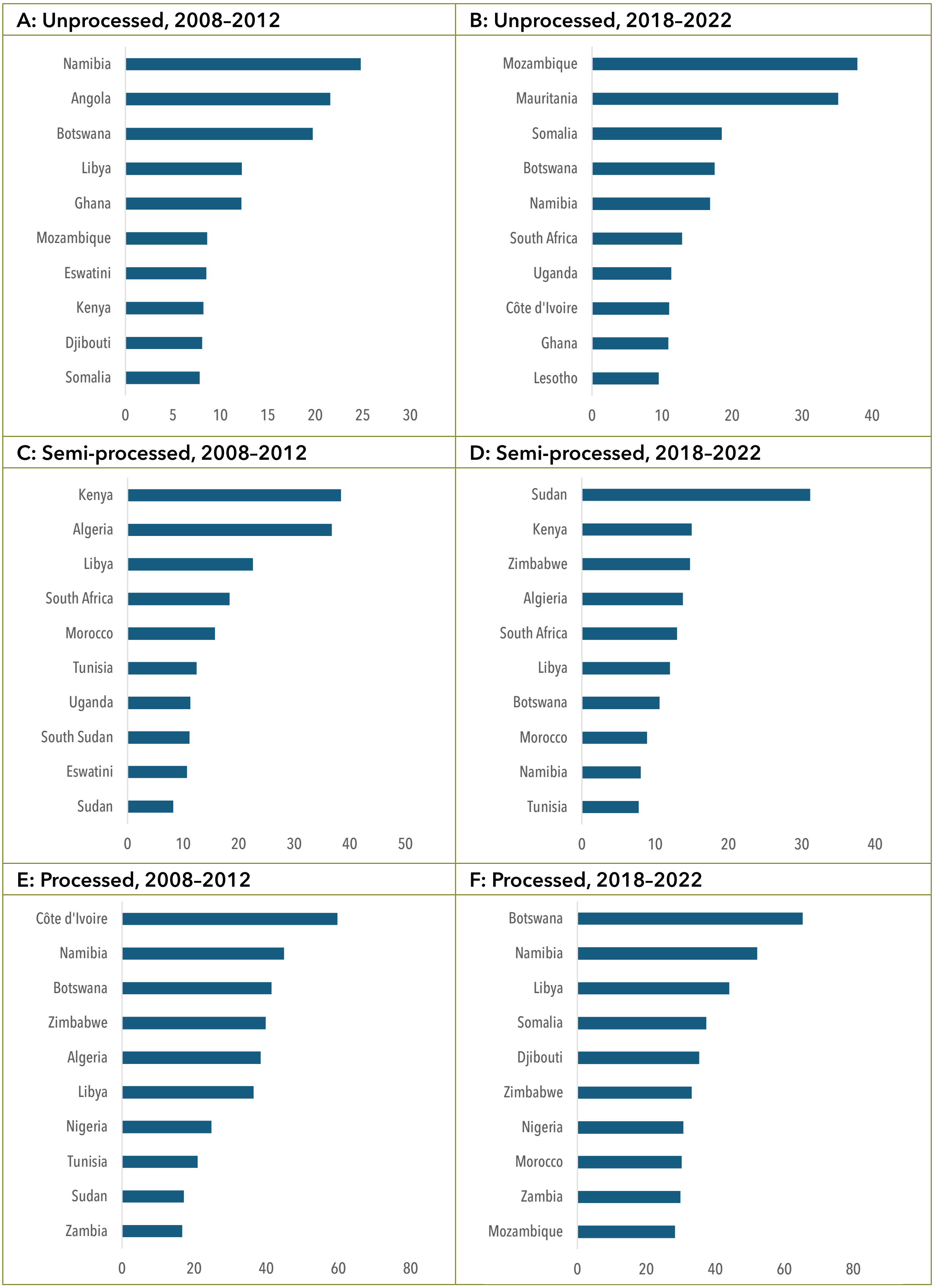
The top 10 intra-African fruit and vegetable trade destinations are shown in Figures 4.14 and 4.15. Botswana, Kenya, and Mozambique are the main destinations of intra-African vegetable trade for processed, semi-processed, and unprocessed products. Several countries appear in the top 10 list for two levels of processing: Mozambique, Morocco, South Africa, Somalia, Libya, Botswana, and Namibia (Figure 4.15). Three of these countries—South Africa, Libya, and Namibia—are also in the top 10 of intra-African fruit destinations (Figure 4.14). These findings differ from those in the previous section on top African importers (both intra- and extra-African trade). Many of the top African exporters from North Africa are less relevant for intra-African trade. This hints at better trade integration of these countries within the Mediterranean region than with sub-Saharan African countries. Generally, all African regions, except Central Africa, are frequently ranked among the top 10 destinations. While the size and purchasing power of the import market may explain why several of the wealthier African economies are among the top fruit and vegetable import markets (for example, Morocco, Nigeria, and South Africa), it is remarkable that several small countries—Eswatini, Lesotho, and Djibouti—are also ranked among the top 10 intra-African import destinations. The low level of fruit and vegetable imports overall signifies demand-side constraints among African importers, evident from the low levels of per capita fruit and vegetable consumption across the continent. There is no clear clustering of top importers of unprocessed and semi-processed fruit and vegetable products, which again supports the supposition that regional FVVCs are not well developed. Therefore, enabling and promoting African regional FVVCs should be a priority in the AfCFTA implementation process.

Figure 4.14 Top 10 intra-African importers of fruits, by level of processing (US$ million per year)



Source: Authors' elaboration using the 2024 AATM database.
Note: Figures present official (formal) intra-African trade only.

Figure 4.15 Top 10 intra-African importers of vegetables, by level of processing (US$ million per year)



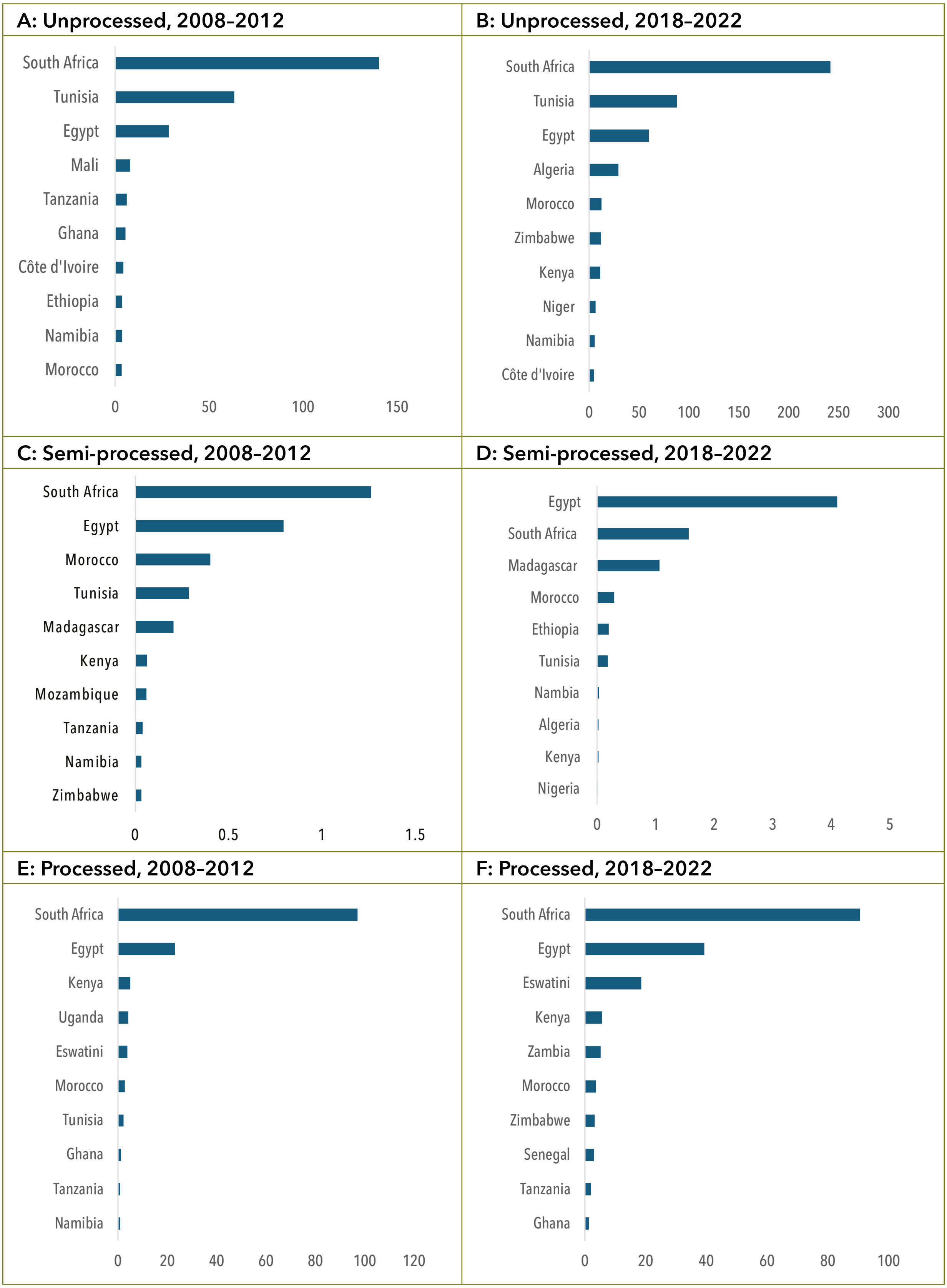
Source: Authors' elaboration using the 2024 AATM database.
Note: Figures present official (formal) intra-African trade only.

Intra-African top exporters

The group of top 10 intra-African exporting countries is quite different and much more concentrated than the top 10 intra-Africa import destinations (Figures 4.16 and 4.17). For instance, Egypt and South Africa are among the top three intra-African exporters of fruits and vegetables at all levels of processing. It is not surprising to see these countries in the lead for intra-African fruit trade, as we have seen they are among the top African exporters (Figures 4.7 and 4.8). Hence, the top African fruit and vegetable exporters also lead in intra-African fruit and vegetable trade. In fact, these countries are global fruit exporters, specifically of citrus fruits, and therefore have developed internationally competitive FVVCs (Seleka and Obi 2018). At the same time, many other African countries lack the production capacity, such as irrigation and inputs, and value chain requirements, such as cold storage transport and facilities, to produce and trade fruit and vegetable products at large scale (Baumüller et al. 2021).

Regarding the top 10 import destinations, no Central African country is ranked among the top intra-African exporters. In a few instances, West African countries are among the top 10, namely Ghana, Burkina Faso, and Niger for vegetable exports and Ghana, Nigeria, Niger, Senegal, and Côte d'Ivoire for both fruits and vegetables. On the other hand, North, East, and Southern African countries are frequently among the top importers, indicating that FVVC trade in the Southern Africa Development Community (SADC) and East African Community (EAC) have reached an advanced stage (COLEACP 2020). The development of this regional trade may have several causes: better infrastructure and improved market access of smallholders; more efficient and liberal trade policy frameworks in SADC and EAC; and comparative advantages in terms of geography as well as land and labor productivity. The first two will be directly addressed if the AfCFTA is successfully implemented. Generally, the concentration of intra-African exports is less pronounced than it was 20 years ago. Among the most traded vegetable products within Africa are food preparations and sauces as well as onions, beans, and tomatoes. The top intra-African-traded fruit products are dates, apples, and fruit juices.

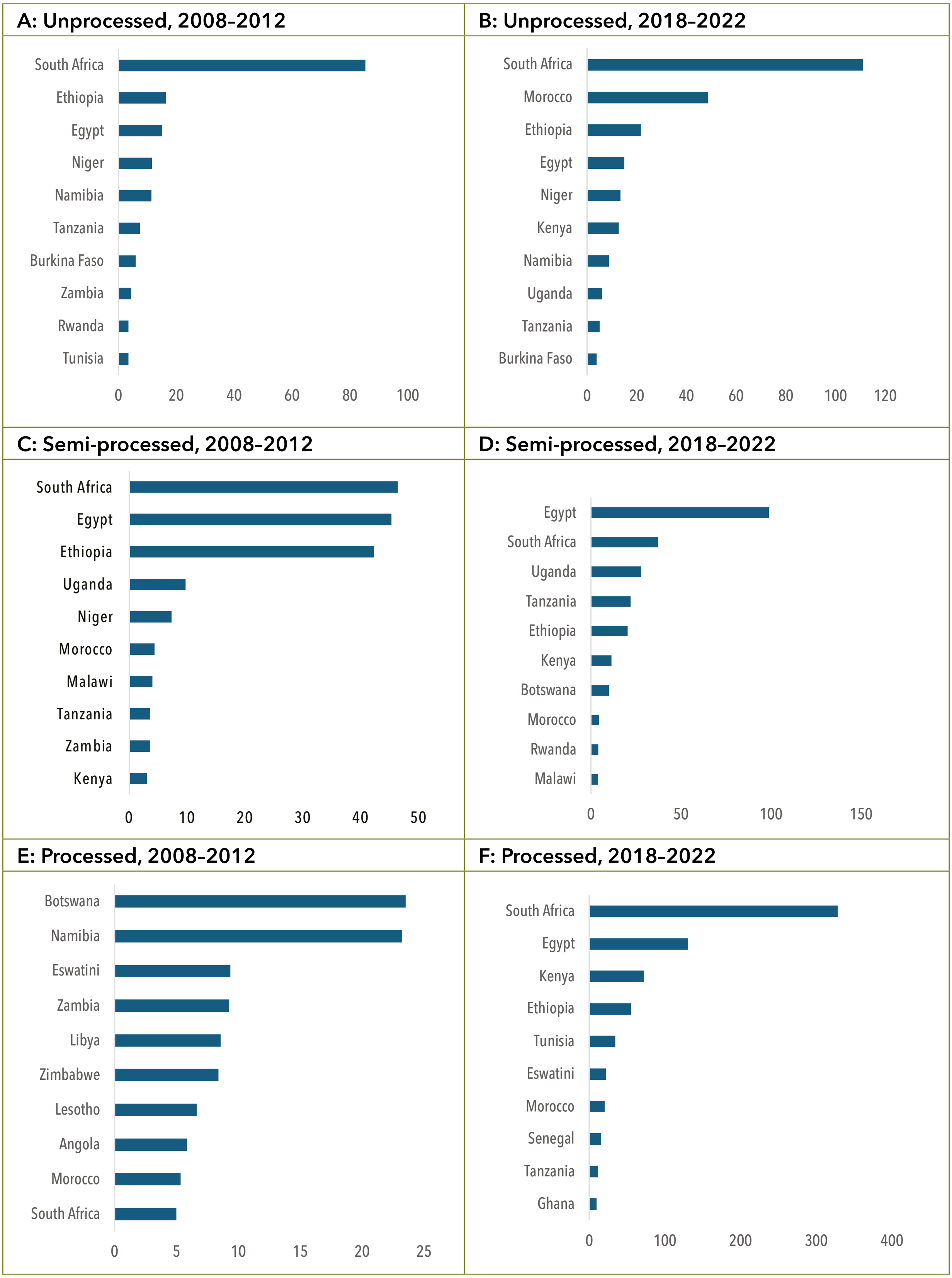
Figure 4.16 Top 10 intra-African fruit exporters, by level of processing (US$ million per year)



Source: Authors' elaboration using the 2024 AATM database.

Note: Figures present official intra-African trade only.

Figure 4.17 Top 10 intra-African vegetable exporters, by level of processing (US$ million per year)



Source: Authors' elaboration using the 2024 AATM database.
Note: Figures present official intra-African trade only.

Does Africa Meet World Demand?

In this section, we compare African supply to global demand for processed, semi-processed, and unprocessed fruits and vegetables in order to highlight those products for which there is potential for Africa to expand exports. We begin the analysis by categorizing all fruits and vegetables according to Africa's revealed comparative advantage (RCA)[10] and global demand, as measured by world imports.[11] This yields four categories: (1) All fruits and vegetables for which Africa has an RCA and global demand is high. This category constitutes a true opportunity for Africa, and countries should focus on these products and promote their export. (2) All fruits and vegetables for which Africa does not have an RCA, but global demand is high. This category has potential for development, should the available endowments permit. (3) All fruits and vegetables for which Africa has an RCA, but global demand is low. Products in this category could be beneficial to African countries in the short term, but if demand remains the same, have no potential for long-term growth. (4) All fruits and vegetables for which Africa does not have an RCA and global demand is low. Clearly, this category does not have potential for increasing African exports, as neither the supply nor demand sides favor African countries.

Figure 4.18 shows the share of products categorized under each of these four groups in total African fruit and vegetable exports. One of the main findings is that, in both time periods, African countries did not export any processed or unprocessed fruits or vegetables for which they have an RCA and that enjoy high global demand. A modest share of semi-processed products (2 percent of all exported fruit and vegetables in the first period and 1 percent in the second period) satisfies both conditions. Fruits and vegetables for which Africa has an RCA, but for which global demand is low, also represent a relatively minor share in total exports of these goods. This share does not exceed 3 percent for any of the three levels of processing in either time period. While this category of exports may be useful in the short term, focusing on these products in the long term is not recommended, given the low global demand.

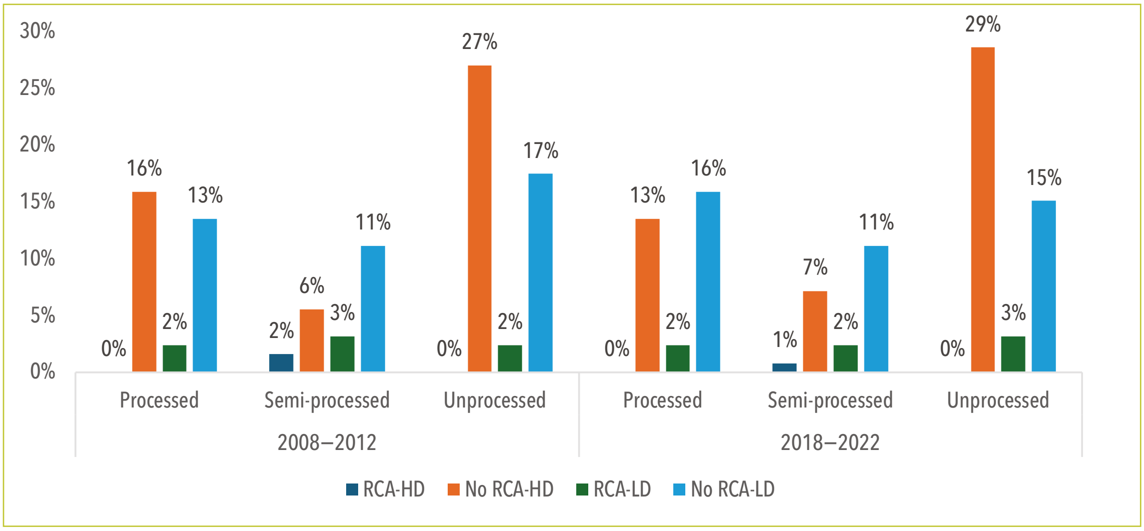
A considerable share of fruits and vegetables exported by Africa do not have an RCA and face low global demand, meaning they should not be prioritized given the weak potential on the supply as well as on the demand side. Product shares in this category range from 11 percent for semi-processed products to 15 percent and 16 percent for unprocessed and processed products, respectively.

Fruits and vegetables for which global demand is high but African countries do not have an RCA constitute a large share of all exported products. For both periods, this category represented 49 percent of all fruit and vegetable products, with a major share of unprocessed products (27 percent during the first period and 29 percent during the second period). This category of products has potential benefits for African countries, as they could be developed in the long term. However, two important factors may limit this potential: first, the ability of African countries to use their resources and endowments to develop these products and increase their exports; and second (and more importantly), the availability of water and suitable climate conditions to grow these crops. As mentioned, Africa is among the regions most exposed to extreme weather fluctuations, with severe consequences for agriculture, especially for smallholders. Water availability can also be problematic, as several African countries are characterized by either a high level of water stress (North Africa) or a low level of water productivity (sub-Saharan Africa). This affects products that are water intensive, such as oilseeds, nuts, rice, and oats.

10 The RCA index is measured using the Balassa index. A country is said to have a RCA in a given product i when its ratio of exports of product i to its total exports of all goods (products) exceeds the same ratio for the world as a whole.
11 High (low) demand refers to products whose world imports are greater (lower) than the median world imports over the period of analysis.

In addition, the impact of climate change on agricultural markets may lead to a 0.26 percent reduction in total global GDP, with several African countries severely affected, according to Costinot et al. (2016). Similarly, Mahofa (2022) argues that, by the 2050s, climate change will affect production and thus increase African countries' cereal imports. In the same vein, Gouel and Laborde (2021) show that export shares for maize, wheat, and rice will decrease for Africa by 2080 due to declining yields. Chapter 5 of this report presents a thorough discussion on the impact of climate change on African comparative advantage.

Figure 4.18 Product classification by category



Source: Authors' elaboration using the 2024 AATM database.
Note: (1) RCA-HD refers to products for which Africa has a comparative advantage and with high global demand. No RCA-HD refers to products for which African countries do not have a comparative advantage but with high global demand. RCA-LD refers to products for which African countries have a comparative advantage but with low global demand. No RCA-LD refers to products for which African countries do not have a comparative advantage for Africa and with low global demand. (2) High (low) demand refers to products whose world imports are greater (less) than the median world imports over the period of analysis. With (without) RCA refers to products whose revealed comparative advantage index is greater (less) than 1.

Table 4.1 provides a more detailed classification of fruit and vegetable exports using these four categories. This detailed presentation can help to identify specific products for African countries to focus on in the long term. As mentioned, African countries do not have any processed or unprocessed fruit and vegetable exports for which their supply is competitive and global demand is high. Among semi-processed products, both mushrooms and truffles and specific bean species were the two product categories for which Africa had a comparative advantage and global demand was high during the 2008–2012 period.[12] During the 2018–2022 period, only semi-processed mushrooms and truffles were in this category.

Some other products may be beneficial to export in the short term but should not be promoted in the long term, given relatively low global demand. These include specific processed roots and tubers (including arrowroot and Jerusalem artichokes, tapioca preparations) and some bean preparations, adzuki beans, and legumes (semi-processed) and unshelled hazelnuts, dried prunes, and dried apples (unprocessed).

12 See Table A4.2 in Appendix 4.1 for the first period (2008–2012).

Another category of interest are products for which Africa could potentially build a comparative advantage in the long term to benefit from the high global demand. For processed fruits and vegetables, this category includes, among others, preserved vegetables, fruits, and nuts; preserved tomatoes; mixed frozen vegetable preparations; frozen potatoes; preserved olives; preserved sweet corn; fruit jams, purees, and pastes; preserved pineapples; orange juice; and some sauces (including tomato sauce and ketchup). Top African exporters of these products, such as Egypt and South Africa for orange juice and Egypt and Morocco for tomato products, could work on overcoming the challenges (related to resources or food safety, for example) to increase their share in the global market. The same applies to processed vegetables, for which the market is expanding both worldwide and in Africa with increasing urbanization and preference for easy-to-prepare meals. For semi-processed fruit and vegetables, potential products include frozen cooked or uncooked vegetables, dried mixtures of vegetables, dried peas, some types of dried beans (including kidney beans), dried lentils, berries (including frozen strawberries), and some types of frozen fruit and nuts. Finally, for unprocessed exports, this category includes numerous fruits (such as apples, oranges, mandarins, grapefruit, grapes, peaches, plums, strawberries, almonds, and shelled hazelnuts), some of the major tropical fruits (pineapples, mangoes, and guavas), and vegetables (such as potatoes, tomatoes, onions and shallots, garlic, broccoli and cauliflower, lettuce, carrots, cucumbers, and mushrooms). As mentioned, tropical fruits are typically more profitable in their fresh than processed state. Despite the multiple challenges facing the agriculture sector in Africa, some countries may seize this opportunity and work on scaling up their exports in this category.

It is important to note that while we have assessed the potential evolution of supply and demand for fruits and vegetables in Africa in order to identify which sectors can generate higher benefits, the indicators we used do not account for other important factors, including the comparative advantage of competitors or possible changes in endowments or external conditions (such as climate change).

Table 4.1 Classification of fruits and vegetables by processing stage, supply and demand approach, 2018–2022

	A: Processed fruits and vegetables	
	High demand	Low demand
With RCA	0	3
	No products	Vegetable roots and tubers, arrowroot Food preparations, tapioca and substitutes Vegetable preparations, beans
No RCA	17	20
	Vegetable roots and tubers; manioc (cassava) Vegetable prep., vegetables, fruit, nuts, and edible parts of plants Vegetable prep., tomatoes, whole or in pieces Vegetable prep., tomatoes, other than whole or in pieces Vegetable prep., potatoes Vegetable prep., vegetables and mixtures of vegetables, excluding potatoes Vegetable prep., potatoes, not frozen Vegetable prep., olives, not frozen Vegetable prep., sweet corn, not frozen Jams, jellies, marmalades, purees and pastes (excluding homogenized) n.e.s. in heading no. 2007 Fruit, pineapples, prepared or preserved Juice; orange, frozen, unfermented Juice; orange, not frozen, unfermented Juices; mixtures, unfermented Sauces; tomato ketchup and other tomato sauces Sauces and preparations; mixed condiments and mixed seasonings Food preparations; n.e.s.	Vegetable roots and tubers; sweet potatoes Vegetable prep., cucumbers and gherkins Vegetable prep., mushrooms Vegetable prep., homogenized vegetables, not frozen Vegetable prep., peas, not frozen Vegetable prep., beans, not frozen Vegetable prep., asparagus, not frozen Fruit, nuts, fruit peel, and other parts of plants; preserved by sugar Jams, fruit jellies, marmalades, fruit or nut puree (homogenized) Jams, jellies, marmalades, purees and pastes (excluding homogenized) Fruit, citrus, prepared or preserved Fruit, pears, prepared or preserved Fruit, apricots, prepared or preserved Fruit, cherries, prepared or preserved Fruit, peaches, prepared or preserved Fruit, strawberries, prepared or preserved Palm hearts, prepared or preserved Juice, tomato, unfermented Sauces; soya Mustard flour and meal; prepared mustard

B: Semi-processed fruits and vegetables		
	High demand	**Low demand**
With RCA	1	3
	Vegetables, leguminous; chickpeas (garbanzos), dried	Vegetables, leguminous; small red (adzuki) beans, shelled, dried Vegetables, leguminous; n.e.s., dried, shelled. Fruit, edible; fruit and nuts n.e.s. in heading no. 0812, provisionally preserved but unsuitable in that state for immediate consumption
No RCA	9	14
	Vegetables, frozen, n.e.s. in Chapter 7 Vegetables, mixtures of vegetables n.e.s. in heading no. 0712, whole, cut, sliced, broken, or in powder but not further prepared, dried Vegetables, leguminous; peas, dried Vegetables, leguminous; beans, dried, shelled Vegetables, leguminous; kidney beans, dried, shelled Vegetables, leguminous; lentils, shelled, dried Fruit, edible; strawberries, frozen Fruit, edible; raspberries and other berries, whether containing added sugar or other sweetening matter Fruit, edible; fruit and nuts n.e.s. in heading no. 0811, frozen	Vegetables, potatoes, frozen Vegetables, leguminous; peas, frozen Vegetables, leguminous; beans, frozen Vegetables, leguminous (other than peas or beans), frozen Vegetables; spinach, frozen Vegetables; sweet corn, frozen Vegetable mixtures, frozen Vegetables, olives, provisionally preserved but unsuitable in that state for immediate consumption Vegetables, cucumbers, and gherkins, provisionally preserved but unsuitable in that state for immediate consumption Vegetables and mixed vegetables; n.e.s. in heading no. 0711, provisionally preserved but unsuitable in that state for immediate consumption Vegetables, onions, not further prepared, dried Vegetables, leguminous; broad beans, dried, shelled Vegetables, leguminous; n.e.s. in heading no. 0713, shelled, dried Fruit, edible; cherries, provisionally preserved but unsuitable in that state for immediate consumption

	C: Unprocessed fruits and vegetables	
	High demand	Low demand
With RCA	0	4
	No products	Nuts, edible; hazelnuts or filberts (*Corylus* spp.), fresh or dried, in shell Fruit, edible; citrus fruit n.e.s. in heading no. 0805, fresh or dried Fruit, edible; prunes, dried Fruit, edible; apples, dried
No RCA	36	19
	Vegetables; potatoes (other than seed), fresh or chilled Vegetables; tomatoes, fresh or chilled Vegetables, alliaceous; onions and shallots, fresh or chilled Vegetables, alliaceous; garlic, fresh or chilled Vegetables, brassica; cauliflowers, headed broccoli, fresh or chilled Vegetables, brassica; edible, n.e.s. in heading no. 0704, fresh or chilled Vegetables; lettuce (other than cabbage lettuce), fresh or chilled Vegetables, root; carrots and turnips, fresh or chilled Vegetables; cucumbers and gherkins, fresh or chilled Vegetables, leguminous; beans, shelled or not, fresh or chilled Vegetables; asparagus, fresh or chilled Vegetables; mushrooms, fresh or chilled Vegetables; fruits of the genus *Capsicum* or *Pimento* Nuts, edible; almonds, fresh or dried, in shell Nuts, edible; almonds, fresh or dried, shelled Nuts, edible; hazelnuts or filberts (*Corylus* spp.), fresh or dried, shelled Nuts, edible; walnuts, fresh or dried, in shell Nuts, edible; walnuts, fresh or dried, shelled Nuts, edible; n.e.s. in heading no. 0801 and 0802, fresh or dried, whether or not shelled or peeled Fruit, edible; dates, fresh or dried	Vegetables, seed potatoes, fresh or chilled Vegetables, alliaceous; leeks and other kinds n.e.s., fresh or chilled Vegetables, brassica; brussels sprouts, fresh or chilled Vegetables, cabbage (head) lettuce (*Lactuca sativa*), fresh or chilled Vegetables, Witloff chicory, fresh or chilled Vegetables, chicory (other than witloof chicory), fresh or chilled Vegetables, root; salad beetroot, salsify, celeric, fresh or chilled Vegetables, leguminous; peas, shelled or unshelled, fresh or chilled Vegetables, leguminous (other than peas and beans), fresh or chilled Vegetables; aubergines (eggplants), fresh or chilled Vegetables; celery (other than celeriac), fresh or chilled Vegetables; spinach, New Zealand and orache spinach, fresh or chilled Fruit, edible; figs, fresh or dried Fruit, edible; papaws (papayas), fresh Fruit, edible; apricots, fresh Fruit, edible; black, white, or red currants and gooseberries, fresh Fruit, edible; apricots, dried Nuts, edible; mixtures of nuts or dried fruits of Chapter 8 Peel of citrus fruit or melons (including watermelons), fresh, frozen, dried, or provisionally preserved in brine, sulfur water, and other preservative solutions

	High demand	Low demand
No RCA	Fruit, edible; pineapples, fresh or dried Fruit, edible; avocados, fresh or dried Fruit, edible; guavas, mangoes, and mangosteens, fresh or dried Fruit, edible; oranges, fresh or dried Fruit, edible; mandarins (including tangerines and satsumas), clementines, wilkings, and similar citrus hybrids, fresh or dried Fruit, edible; grapefruit, fresh or dried Fruit, edible; grapes, fresh Fruit, edible; grapes, dried Fruit, edible; apples, fresh Fruit, edible; peaches including nectarines, fresh Fruit, edible; plums and sloes, fresh Fruit, edible; strawberries, fresh Fruit, edible; raspberries, blackberries, mulberries, and loganberries, fresh Fruit, edible; cranberries, bilberries, and other fruits of the genus *Vaccinium*, fresh Fruit, edible; fruit n.e.s. in heading no. 0801 to 0810, fresh Fruit, edible; fruit n.e.s. in heading no. 0812, dried	

Source: Authors' own elaboration using the 2024 AATM database.
Note: (1) High (low) demand refers to products whose world imports are greater (less) than median world imports over the period of analysis; (2) With/without RCA refers to products whose revealed comparative advantage index is greater (less) than 1. n.e.s. = not elsewhere specified. Numbers above each block indicate the number of products.

Challenges of Fruit and Vegetable Value Chains

The description of past and current fruit and vegetable trade patterns of African countries and the market demand analysis clearly show the limited capacity of African countries to engage in global and regional value chains. The reasons for this are multifaceted and include sectoral, institutional, and structural issues. In this section, we discuss the challenges in detail, looking at production processes, post-production processes, and trade policy.

Production processes

Africa's agricultural sector is not performing at its full potential due to a variety of interrelated factors, including the lack of adoption and investment in production-enhancing technologies and inadequate institutional frameworks (Baumüller et al. 2020). As a result, African fruit and vegetable yields are far below yields in other regions (FAOSTAT 2024), which limits Africa's capacity to produce sufficient fruits and vegetables to meet consumption needs. A simulation using the International Food Policy Research Institute (IFPRI)'s IMPACT model shows that many countries around the world will need to increase fruit and vegetable production to achieve the World Health Organization's dietary recommendations, even if waste is reduced to zero (Mason-D'Croz et al. 2019). There are specific challenges to increasing FVVC productivity and production, which we discuss below.

Seeds, seed systems, and seed varieties

Access to seeds of high-quality improved varieties that are adapted to local agroecologies, pest risk, and farmer preferences is a key element to increasing fruit and vegetable yields in Africa. Current limitations reflect the lack of selection and breeding studies for fruits and vegetables that are suited for the region, and particularly for traditional African vegetables (Dinssa et al. 2016). Very few seed companies operate in Africa, and even fewer have invested in research and development to create locally adapted varieties. Instead, most of these seed companies have based their businesses on trading and distributing seeds (Afari-Sefa et al. 2012). Despite the arrival of multiple international seed corporations, there is still very little breeding of vegetables or other crops for the local market in sub-Saharan Africa (Access to Seeds Foundation 2019).

Inputs

The low adoption of agricultural inputs to increase soil fertility and of pesticides to control pests is another contributor to poor fruit and vegetable yields in Africa. Given the low levels of fertilizer use prevalent in Africa compared with other regions (Kirui, Kornher, and Bekchanov 2023), agricultural production is very responsive to increasing chemical fertilization (Kornher and von Braun 2024). For example, Rosegrant et al. (2014) show that the yield increases that could be achieved through nitrogen-efficient technologies in Africa are higher than in other regions. This is important for fruits and vegetables because they deplete soil nitrogen more than other products, and therefore low fertilization contributes to ongoing soil degradation in Africa (Elrys et al. 2020). Regarding pesticide use, African farmers applied the lowest levels in terms of cropland area, population, and the value of their agricultural production between 1990 and 2020 (FAO 2022). Among all pesticides, herbicides, fungicides, bactericides, and insecticides have relatively equal shares. Most of the pesticides applied in Africa are imported from outside Africa, with only about 10 percent of the pesticide trade occurring within Africa.

The constraints to enhanced fertilizer and pesticide availability in Africa are similar to those limiting adapted seeds: Fertilizer and pesticide production is limited in Africa. However, unlike adapted seeds, fertilizers and pesticides are less context-specific. Therefore, decisions about fertilizer and chemical input use at the farm are subject to country factors, suggesting the importance of national policies and institutions for increased chemical input availability and use (Sheahan and Barrett 2017).

Irrigation

FVVCs largely depend on frequent water applications in many parts of the world. Water is required in different stages of FVVCs, including growing, processing (produce washing, packhouse wash down, sanitation), and distribution (wash down). Many fruit and vegetable crops, such as tomatoes and cucumbers, have high water content, and their yields and quality deteriorate under water stress. Therefore, a secure and reliable water supply is important to ensure productivity and quality. In Africa, however, crop cultivation is primarily rainfed, and only about 5 percent of agricultural land is irrigated (FAOSTAT 2024). With progressing climate change and uncertain precipitation, fruit and vegetable yields, particularly in semi-arid areas, will be under stress, and the expansion of irrigated cropland will be essential to mitigate climate change effects on yields (Hess and Sutcliff 2018). For instance, North African countries, which have substantially more crop area under irrigation, have higher fruit and vegetable yields than countries in sub-Saharan Africa and export vegetable products to the European Union (ZEF and ICRIER 2021). This suggests that irrigation is essential to lift fruit and vegetable farming from the subsistence to commercial level.

Irrigation expansion can be achieved through large-scale irrigation schemes that employ water diversion and dams, as well as through the adoption of small-scale irrigation systems in the form of local pumps with substantial impact. For example, the Bwanje Valley Irrigation Scheme in Malawi increases the agricultural incomes of participating farmers by 65 percent and their caloric intake by 10 percent (Nkhata 2014). For small-scale irrigation, studies have shown that the adoption of simple irrigation technologies in Burkina Faso contributed to an increase in national vegetable production of between 60,000 and 160,000 tons within nine years. Households in Tigray, Ethiopia, that use irrigation earn double the income of households that do not have access to irrigation, with overall income gains of around $150 per household per year (Malabo Montpellier Panel 2018).

IMPACT model simulations run by IFPRI show that under current conditions, sub-Saharan Africa will require net imports of 36 million tons of vegetables in 2050. In contrast, if irrigation is expanded, the region could become a net vegetable exporter.[13] Besides the macroeconomic effects of irrigation through yield increase, the adoption of irrigation technologies is also found to have strong microeconomic effects. For instance, smallholder households that adopt irrigation can increase crop diversity and expand fruit and vegetable production. Smallholders, who frequently practice irrigation, grow more vegetables, fruit, and other micronutrient-rich crops, particularly during the dry season. This increases the consumption of nutritious foods and offers additional income opportunities when selling these products in the market (Ringler et al. 2022).

Postharvest losses

Food loss and waste (FLW) is a major challenge to sustainable food systems and is estimated to reach about 20 percent of total production quantities in Africa, which is substantially higher than the global average (FAO 2024). Postharvest losses are caused by high perishability. For

13 This is because vegetable products are of high value and profits outweigh investment costs, even under high internal rates of return. Within sub-Saharan Africa, East and Central Africa will remain net importers, but at much lower rates than before, and West and Southern Africa become net exporters. In this scenario, West Africa could turn into a net exporter of up to 17 million tons of vegetables (Xie et al. 2018).

instance, reported losses for FVVC products vary between 0 and 80 percent but are related to several other factors, such as weather and production and transportation mode (Santacoloma et al. 2021). In low- and middle-income countries, and Africa specifically, most FLW occurs in the field and postharvest and not during consumption. Causes include inadequate production methods, the incidence of diseases, poor on-farm storage after harvesting and before marketing, excessive temperatures and humidity during storage and handling, weather conditions, the type of packaging, and time delays and handling during transportation, such as delays caused by road harassment (Bouët, Sall, and Traoré 2023). Many of these factors are more relevant in Africa than in other regions, where storage facilities are better equipped, management is more professional, and infrastructure and energy are available to manage temperatures during transport and storage.

Fruit and vegetable products are highly perishable, so losses are higher than for cereal and legume crops (Houngbo 2019). Houngbo (2019) estimates that FLW for fruits and vegetables in sub-Saharan Africa could be up to 50 percent. Specifically, they reach 55 percent for fruits and about 45 percent for vegetables (Santacoloma et al. 2021). These estimates are in line with a systematic literature analysis by Kitinoja and Kader (2015), who found that reported FWL globally is between 30 and 40 percent, with little change since 1970.

Postharvest losses result in monetary losses at the production, processing, and wholesale level. In addition, perishability also leads to substantial quality deterioration in fruits and vegetables, which also contributes to monetary losses. Estimates suggest that monetary losses from both quality deterioration and losses range from 4.8 to 81 percent for tomatoes, amaranth leaves, okra, oranges, and mangoes that suffer damage, spoilage, or decay at the farm level; between 5.4 and 90 percent at the wholesale level; and between 7 and 79 percent at the retail level (Santacoloma et al. 2021). These losses, also high compared with those of other food crops, are a disincentive to the production and marketing of fruit and vegetable products in Africa.

Post-production processes: Market access and infrastructure

Constraints to agricultural production are only one element that hinders growth of FVVCs. Fruits and vegetables are produced worldwide, but not all producers and traders have equal access to markets because value chains are seldom organized efficiently. For instance, many small farmers cultivate different species and produce in small quantities, which makes formal vertical market linkages less likely. Small producers often sell through middlemen, and most of their transactions are informal and do not fulfill food safety or quality control (grading) requirements. However, in fruit and vegetable supply chains, we must distinguish between value chains intended for export and those intended for domestic markets.

Market access and value chain participation

Agriculture in Africa remains largely at the subsistence level, although market participation has increased in recent years (Carletto, Paul, and Guelfi 2017). Formal and informal links to local and global value chains are important to encourage producers to allocate resources toward fruit and vegetable cultivation and invest in production technologies. Traditionally, vegetables are mainly grown for subsistence, often at a small scale in kitchen gardens close to the homestead (Issahaku et al. 2023), and therefore move along traditional value chains. However, many tropical fruit products are produced for international export, and the creation and expansion of GVCs has increased vertical market linkages for these products.

There are several causes for the limited market participation of African vegetable farmers. First, transaction costs of trading with smallholder farmers, many of them located in remote areas, are high. This is because vegetable farmers are seldom organized into producer groups and lack vertical linkages. Second, poor transport infrastructure increases the trade costs for many smallholder producers. The distance from farms to buyers as well as output markets without adequate storage infrastructure further increase trade costs for fruit and vegetable products. Third, domestic agrifood supply chains in Africa are characterized by both small and medium food-processing enterprises and substantial wholesale trade in open wet markets (Reardon, Bellemare, and Zilberman 2020). These are transitional domestic supply chains, without contractual market linkages between actors and without common quality standards, which hinders integration of FVVCs. In comparison, modern supply chains have accepted food standards and quality grades and are well integrated.

Infrastructure

Infrastructure quality is highly relevant for fruit and vegetable marketing, as these perishable products are particularly prone to damage during transportation. However, road and storage infrastructure in Africa is poor compared with other regions. Long transportation times related to poor road infrastructure and road blockages and trade bureaucracy are associated with high losses during transport of fruit and vegetables, though losses differ between products and value chains (Santacoloma et al. 2021). One particular culprit is the lack of frozen storage, which can reduce loss and damage, for many FVVCs in Africa.

Numerous studies show that improved rural infrastructure increases agricultural output and/or revenue by lowering market transaction costs and increasing access to both input and output markets. Thus, improved infrastructure lowers the cost of inputs and increases the income farmers receive from their products but also enables smallholders in low- and middle-income countries to profit from more nonfarm opportunities (van Berkum 2021). Given the importance of transport and storage infrastructure for fruit and vegetable trading, improved infrastructure is clearly critical for development of FVVCs. For instance, Barrett et al. (2022) argue that the selection of areas for fruit and vegetable production in exporting countries is largely explained by infrastructure factors, such as road infrastructure and electricity.

Demand constraints

Fruits and vegetables are the most consumed nonstaple food crop in Africa. The EAT-Lancet Commission recommends consuming at least 240 to 300 grams of vegetables per capita per day. Low demand for fruits and vegetables is largely associated with relatively high prices. For instance, the relatively high prices for fruits and vegetable products, compared with other foods, in Africa and elsewhere contributes to low demand (Headey and Alderman 2019). In turn, limited demand in Africa for local fruit and vegetable products reduces the size of local markets and does not create incentives for local producers and value chains to increase production. However, when compared to other food products, the demand for fruits and vegetables in low- and middle-income countries is price- and income-elastic. Thus, even slight price adjustments for these goods can have a significant impact on demand. For instance, some studies indicate that a 10 percent increase in the cost of fruits and vegetables could result in an 8 to 10.5 percent decrease in consumption (Magrini, Balié, and Morales-Opazo 2017). Similarly, a small increase in income can lead to substantial increases in fruit and vegetable consumption.

Trade policy and certification requirements

Trade policy challenges

Trade policy issues are eminently relevant to Africa's FVVCs. Intra-African trade liberalization and international market access could create incentives to expand fruit and vegetable production and improve allocative efficiency. Currently, tariff escalation in high-income export markets promotes trade in raw products and hinders trade of processed fruit and vegetable products that could lead to increased value addition in Africa (van Berkum 2009). Nontariff measures (NTMs) and associated trade bureaucracy increase trade costs and may be used by importing countries to protect local producers. The trade costs associated with NTMs are exacerbated by the limited institutional export capacity, such as port efficiency, of African producers (Kornher, Sakyi, and Tannor 2024). In addition, ad hoc border closures, such as the situation between Uganda and Rwanda where the border has been closed for three years, disrupt trade flows and create uncertainty for traders.

Globally, tariffs on agricultural products have been reduced substantially as a consequence of international trade liberalization, including World Trade Organization (WTO) reforms and the increasing number of regional and preferential trade agreements. Several African countries are granted market access to export markets under unilateral preferential trade agreements, such as the Everything but Arms agreement, and multilateral regional trade agreements, like the African Growth and Opportunity Act agreement with the United States and the Economic Partnership Agreements with the EU (Kornher and von Braun 2020). For the remaining trade partners, FVVCs are subject to tariff escalation, with tariffs on processed produce generally higher than on the raw commodities, which limits Africa's participation in value added from agricultural trade (Fusacchia, Balié, and Salvatici 2022). In addition, the EU's entry price system restricts fruit and vegetable imports from North Africa if prices fall below a set price threshold (Santeramo et al. 2023). In intra-African trade, FVVC trade within regional economic communities (RECs) benefits from reduced or suspended tariffs, but preferential access is not commonly expanded to countries outside an individual REC. However, these REC agreements will be subject to changes with the upcoming AfCFTA.

Apart from tariffs, agricultural trade in general, and fruit and vegetable trade in particular, are subject to significant nontariff trade costs, primarily related to sanitary and phytosanitary standards (SPS). SPS is necessary due to the food safety issues and health risks associated with perishable products and is motivated by the precautionary principle in high-income importing countries, especially the EU (Otsuki, Wilson, and Sewadeh 2001). Between 1995 and 2000, nearly 270 SPS measures were imposed on imports of fresh fruit and vegetables worldwide (UNCTAD Trains). Often these standards and required certification deviate from the joint FAO/WHO Codex Alimentarius Commission for food safety, which sets the international standards promoted by the WTO Agreement on Sanitary and Phytosanitary Standards. For instance, the EU's pesticide maximum residue levels are stricter than international standards in sectors where EU producers compete with African exporters (Kareem, Martínez-Zarzoso, and Brümmer 2018). Exporters must navigate numerous requirements and regulations, including soil quality checks and certification standards compliance, which increase operational costs. At the same time, agricultural exporters must comply with the quality standards of the private sector, such as the Global G.A.P.[14] Ensuring quality control and adherence to standards remains a challenge. Substandard farming inputs and poor awareness among farmers regarding approved chemicals and farming practices result in the use of banned or inappropriate inputs, which leads to rejected produce and compromises both local food safety and export potential.

14 www.globalgap.org

Intra-African SPS regulations

In the intra-African context, SPS and quality regulations are less strict, yet differences exist among and within RECs, posing challenges to harmonization and smooth cross-border trade in FVVC products within and between regions. Additionally, differences in other regional trade policies, such as food standards, grading systems, and border procedures, further complicate intraregional trade in fruit and vegetable products. The lack of uniformity in these policies creates barriers and inefficiencies in trade flows, hindering the sector's growth potential. These costs increase when countries are members of overlapping RECs that apply different standards.

Some RECs, such as the Economic Community of West African States (ECOWAS), have advanced quality infrastructure—institutional and physical systems to ensure products are safe and of high quality—that supports the continental quality infrastructure. Within ECOWAS, regional quality infrastructure has been established to ensure compliance and safety of products, particularly in the fruit and vegetable sector. Under the auspices of the ECOWAS Scheme for Harmonization of Standards (ECOSHAM), more than 90 standards have been harmonized, covering various areas including agricultural and food products. ECOSHAM certification ensures broad acceptance of products in all ECOWAS member states, thereby facilitating access to other markets in ECOWAS. The ECOWAS SPS guide outlines comprehensive procedures for phytosanitary inspection, focusing on plants, plant products, and regulated articles in international traffic.

In 2013, the EAC Partner States adopted the EAC SPS Protocol, with the primary aim of enforcing SPS measures and standards as well as promoting both intra- and interregional trade. As of 2021, all partner states had ratified the protocol, clearing the way for implementation and domestication of various SPS instruments (EAC 2024). To lay the groundwork for effective implementation and enforcement of the protocol, several key instruments were developed and adopted, including SPS measures and procedures for fish and fisheries, phytosanitary measures and procedures for plants, and food and feed safety measures. Additionally, a draft SPS bill that provides a legal framework for the enforcement of EAC SPS measures and instruments was adopted by the Sectoral Council on Agriculture and Food Security and is currently awaiting enactment by the East African Legislative Assembly. Moreover, harmonized SPS regulations and standard operating procedures necessary to facilitate the implementation of the SPS bill have been developed.

The SADC Protocol on Trade (SADC Protocol) emphasizes the harmonization of SPS measures for agricultural and livestock production based on international standards, guidelines, and recommendations, with provisions for consultations to achieve agreement on the recognition of equivalent SPS measures (Article 16). This protocol also offers a framework for collaboration and cooperation on SPS issues, focused on facilitating the protection of human, animal, or plant life or health, enhancing the implementation of the WTO Agreement on the Application of SPS Measures, building technical capacity, providing a regional forum for addressing SPS matters, and resolving trade-related SPS issues (Annex VIII). The SADC SPS Coordination Committee—tasked with addressing regional SPS issues, promoting transparency, and strengthening cooperation between national regulatory agencies responsible for SPS measures—plays a pivotal role. National Committees on SPS Measures are also established in each member state, responsible for their WTO SPS National Notification Authorities and Enquiry Points, with representatives appointed to serve on the SADC SPS Coordinating Committee. The SADC Protocol includes provisions such as Article 11 on Control, Inspection, and Approval Procedures, which improve on the WTO SPS Agreement by facilitating the acceptance of equivalent procedures and reviewing inspection, testing, certification, and approval systems to enhance access to traded products (CFTA 2017).

The Economic Community of Central African States (ECCAS) coordinates SPS activities in Central Africa through regional programs that support member states, with the assistance of technical and financial partners such as the Food and Agriculture Organization of the United Nations (FAO). While 9 of the 11 ECCAS member states are also members of the WTO and also implement the WTO SPS Agreement, the ECCAS SPS program is still in its early stages. Achievements include the development of a joint phytosanitary regulation project, capacity-building activities, establishment of National SPS Committees and Focal Points, launch of a regional pesticide registration system, establishment of an interstate Committee on Pesticides in Africa in Central Africa, operationalization of a Regional Animal Health Centre, adoption of coordinated approaches in monitoring cross-border diseases and zoonoses, implementation of regional programs on health safety during disease outbreaks and for vector-borne diseases, and operationalization of the Regional Food Safety Program in Central Africa (CFTA 2017).

Conclusions

This chapter has analyzed Africa's participation in FVVCs, highlighting challenges and opportunities for increased fruit and vegetable trade and upgrading along these value chains. One of our main findings is that, over the past 20 years, African exports of fruits and vegetables have been consistently dominated by unprocessed goods. This is more pronounced for exported fruits than for vegetables. At the same time, imports are dominated by unprocessed fruits and processed vegetables. This means that Africa is in an upstream position along FVVCs. While this may be profitable in the case of tropical fruit exports, African countries may be still missing opportunities to secure a place in the expanding market for processed fruit and vegetable products.

As far as the global market is concerned, African countries are entirely absent from the list of the top 10 fruit and vegetable exporting and importing countries, regardless of the level of processing. Exports are largely dominated by Europe, the United States, and Canada and, to a lesser extent, China and a few Asian and Latin American developing countries.

Our analysis of African trade in fruits and vegetables suggests a strong presence of North African countries (primarily Egypt and Morocco), in addition to South Africa, as the top exporters and importers. These countries may be engaged in FVVCs due to resource endowments, suitable agricultural and export upgrade policies, and better processing capacities, logistics, and transport and storage conditions compared with other African countries. At the global level, Europe and the United States are the main importers of African unprocessed fruits and vegetables. As the level of processing increases, top importers are more diversified, with a larger presence of Asian and Arab countries as importers. This suggests the ability of African countries to meet demand for processed products in countries with less stringent standards and sanitary restrictions. At the intra-African level, fruit trade is primarily unprocessed, whereas nearly 60 percent of intra-African vegetable trade is in processed products, reflecting the growing urbanization and demand for easy-to-prepare meals. Egypt and South Africa are among the top fruit and vegetable intra-African exporters for all levels of processing, and some SADC and EAC countries are among the top intracontinental exporters.

We combine data on global demand and African supply to single out specific fruit and vegetable products that Africa should focus on developing and exporting in the long term. Our findings suggest that Africa's exports of fruits and vegetables with an RCA and for which global demand is high are quite minimal. However, the structure of African exports reflects a strong presence of fruits and vegetables that could be expanded in the long term. These include a rich variety of fruits and their semi-processed and processed products (such as apples, citrus fruits, bananas, peaches, strawberries), some of the main tropical fruits (such as mangoes, guavas, and pineapples), vegetables (including potatoes, tomatoes, onions, shallots, broccoli, cauliflower, and carrots), and mixed and frozen vegetable preparations.

The potential to increase exports of these fruits and vegetables and their products will depend on several factors, including access to good quality seeds and adequate pest control. More important, many of these fruit and vegetable crops have a high water content (such as tomatoes), and the potential to further increase production and exports will depend on a reliable water supply. In Africa, however, crop cultivation is primarily rainfed, and climate change and water stress can be expected to undermine attempts to expand these crops.

Current trade policies are also among the main obstacles facing African trade and participation in FVVCs. At the extra-Africa level, tariff escalation on the part of Africa's main trade partners fosters the concentration of exports in unprocessed commodities. In addition, the inability of African producers to meet stringent SPS regulations undermines Africa's participation in higher value-added segments of FVVCs and limits exports of processed fruits and vegetables to a number of African and Asian developing countries.

At the intra-Africa level, prolonged border closures, high trade costs, poor quality control and adherence to standards, lack of sectoral organization, and uneven access to digital technologies are among the main obstacles to the fruit and vegetable trade. These challenges hinder market growth and sustainability in the sector, impacting economic development and regional integration efforts within RECs. Efforts to address these challenges include harmonizing SPS policies and regulations within RECs like ECOWAS, EAC, COMESA, SADC, AMU, IGAD, and CEN-SAD, along with initiatives to improve quality infrastructure and streamline trade processes. Indeed, the harmonization of SPS regulations and mutual recognition of food standards will also be crucial to facilitate export growth in the sector. At the continental level, the African Organization for Standardization (ARSO) plays a crucial role in harmonizing standards, including those related to agricultural and food products. The Technical Harmonization Committee for Agricultural and Food Products (THC) has developed 294 harmonized standards, demonstrating a commitment to the quality of traded products (Diop 2020).

African trade integration through the AfCFTA opens a window of opportunity to correct market failures that limit intra-African trade potential in the fruit and vegetable sector. Trade integration efforts should focus on increasing market access and export opportunities within Africa, even outside existing RECs.

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Appendix 4.1

Table A4.1 Product list by level of processing

Processed	
071410	Vegetable roots and tubers; manioc (cassava), with high starch or inulin content, whether or not sliced or in the form of pellets, fresh or dried
071420	Vegetable roots and tubers; sweet potatoes, with high starch or inulin content, whether or not sliced or in the form of pellets, fresh or dried
071490	Vegetable roots and tubers; arrowroot, salep, Jerusalem artichokes, and similar roots and tubers, high starch or inulin content, whether or not sliced or in the form of pellets, fresh or dried; sago pith
190300	Food preparations; tapioca and substitutes thereof, prepared from starch in the form of flakes, grains, pearls, siftings, or similar
200110	Vegetable preparations; cucumbers and gherkins, prepared or preserved by vinegar or acetic acid
200120	Vegetable preparations; onions, prepared or preserved by vinegar or acetic acid
200190	Vegetable preparations; vegetables, fruit, nuts, and other edible parts of plants, prepared or preserved by vinegar or acetic acid (excluding cucumbers, gherkins, and onions)
200210	Vegetable preparations; tomatoes, whole or in pieces, prepared or preserved otherwise than by vinegar or acetic acid
200290	Vegetable preparations; tomatoes (other than whole or in pieces), prepared or preserved otherwise than by vinegar or acetic acid
200310	Vegetable preparations; mushrooms, prepared or preserved otherwise than by vinegar or acetic acid
200320	Vegetable preparations; truffles, prepared or preserved otherwise than by vinegar or acetic acid
200410	Vegetable preparations; potatoes, prepared or preserved otherwise than by vinegar or acetic acid, frozen
200490	Vegetable preparations; vegetables and mixtures of vegetables (excluding potatoes), prepared or preserved otherwise than by vinegar or acetic acid, frozen
200510	Vegetable preparations; homogenized vegetables, prepared or preserved otherwise than by vinegar or acetic acid, not frozen
200520	Vegetable preparations; potatoes, prepared or preserved otherwise than by vinegar or acetic acid, not frozen
200530	Vegetable preparations; sauerkraut
200540	Vegetable preparations; peas (*Pisum sativum*), prepared or preserved otherwise than by vinegar or acetic acid, not frozen
200551	Vegetable preparations; beans, shelled, prepared, or preserved otherwise than by vinegar or acetic acid, not frozen
200559	Vegetable preparations; beans (not shelled), prepared or preserved otherwise than by vinegar or acetic acid, not frozen
200560	Vegetable preparations; asparagus, prepared or preserved otherwise than by vinegar or acetic acid, not frozen
200570	Vegetable preparations; olives, prepared or preserved otherwise than by vinegar or acetic acid, not frozen

200580	Vegetable preparations; sweet corn (*Zea mays* var. *saccharata*), prepared or preserved otherwise than by vinegar or acetic acid, not frozen
200590	Vegetable preparations; vegetables and mixtures of vegetables n.e.s. in heading no. 2005, prepared or preserved otherwise than by vinegar or acetic acid, not frozen
200600	Fruit, nuts, fruit peel, and other parts of plants; preserved by sugar (drained, glace or crystallized)
200710	Jams, fruit jellies, marmalades, fruit or nut puree, and fruit or nut pastes; homogenized, cooked preparations, whether or not containing added sugar or other sweetening matter
200791	Jams, jellies, marmalades, purees and pastes; of citrus fruit, cooked preparations (excluding homogenized), whether or not containing added sugar or other sweetening matter
200799	Jams, fruit jellies, marmalades, purees and pastes; of fruit or nuts n.e.s. in heading no. 2007, cooked preparations (excluding homogenized), whether or not containing added sugar or other sweetening matter
200820	Fruit; pineapples, prepared or preserved in ways n.e.s. in heading no. 2007, whether or not containing added sugar, other sweetening matter, or spirit
200830	Fruit; citrus, prepared or preserved in ways n.e.s. in heading no. 2007, whether or not containing added sugar, other sweetening matter, or spirit
200840	Fruit; pears, prepared or preserved in ways n.e.s. in heading no. 2007, whether or not containing added sugar, other sweetening matter, or spirit
200850	Fruit; apricots, prepared or preserved in ways n.e.s. in heading no. 2007, whether or not containing added sugar, other sweetening matter, or spirit
200860	Fruit; cherries, prepared or preserved in ways n.e.s. in heading no. 2007, whether or not containing added sugar, other sweetening matter, or spirit
200870	Fruit; peaches, prepared or preserved in ways n.e.s. in heading no. 2007, whether or not containing added sugar, other sweetening matter, or spirit
200880	Fruit; strawberries, prepared or preserved in ways n.e.s. in heading no. 2007, whether or not containing added sugar, other sweetening matter, or spirit
200891	Palm hearts; prepared or preserved, whether or not containing added sugar, other sweetening matter, or spirit
200892	Fruit; mixtures, prepared or preserved, whether or not containing added sugar, other sweetening matter, or spirit
200911	Juice; orange, frozen, unfermented, not containing added spirit, whether or not containing added sugar or other sweetening matter
200919	Juice; orange, not frozen, unfermented, not containing added spirit, whether or not containing added sugar or other sweetening matter
200920	Juice; grapefruit, unfermented, not containing added spirit, whether or not containing added sugar or other sweetening matter
200930	Juice; of single citrus fruit (excluding orange or grapefruit), unfermented, not containing added spirit, whether or not containing added sugar or other sweetening matter
200940	Juice; pineapple, unfermented, not containing added spirit, whether or not containing added sugar or other sweetening matter
200950	Juice; tomato, unfermented, not containing added spirit, whether or not containing added sugar or other sweetening matter

200960	Juice; grape (including grape must), unfermented, not containing added spirit, whether or not containing added sugar or other sweetening matter
200970	Juice; apple, unfermented, not containing added spirit, whether or not containing added sugar or other sweetening matter
200980	Juice; of any single fruit or vegetable n.e.s. in heading no. 2009, unfermented, not containing added spirit, whether or not containing added sugar or other sweetening matter
200990	Juices; mixtures, unfermented, not containing added spirit, whether or not containing added sugar or other sweetening matter
210310	Sauces; soya
210320	Sauces; tomato ketchup and other tomato sauces
210330	Mustard flour and meal and prepared mustard
210390	Sauces and preparations therefor; mixed condiments and mixed seasonings
210690	Food preparations; n.e.s. in item no. 2106.10
Semi-processed	
071010	Vegetables; potatoes, uncooked or cooked by steaming or boiling in water, frozen
071021	Vegetables, leguminous; peas (*Pisum sativum*), shelled or unshelled, uncooked or cooked by steaming or boiling in water, frozen
071022	Vegetables, leguminous; beans (*Vigna* spp., *Phaseolus* spp.), shelled or unshelled, uncooked or cooked by steaming or boiling in water, frozen
071029	Vegetables, leguminous (other than peas or beans), shelled or unshelled, uncooked or cooked by steaming or boiling in water, frozen
071030	Vegetables; spinach, New Zealand spinach and orache spinach (garden spinach), uncooked or cooked by steaming or boiling in water, frozen
071040	Vegetables; sweet corn, uncooked or cooked by steaming or boiling in water, frozen
071080	Vegetables; uncooked or cooked by steaming or boiling in water, frozen, n.e.s. in Chapter 7
071090	Vegetable mixtures; uncooked or cooked by steaming or boiling in water, frozen
071110	Vegetables; onions, provisionally preserved by sulfur dioxide gas but unsuitable in that state for immediate consumption
071120	Vegetables; olives, provisionally preserved but unsuitable in that state for immediate consumption
071130	Vegetables; capers, provisionally preserved but unsuitable in that state for immediate consumption
071140	Vegetables; cucumbers and gherkins, provisionally preserved but unsuitable in that state for immediate consumption
071190	Vegetables and mixed vegetables; n.e.s. in heading no. 0711, provisionally preserved but unsuitable in that state for immediate consumption
071210	Vegetables; potatoes, whether or not cut or sliced but not further prepared, dried
071220	Vegetables; onions, whole, cut, sliced, broken, or in powder but not further prepared, dried
071230	Vegetables; mushrooms and truffles, whole, cut, sliced, broken, or in powder but not further prepared, dried

071290	Vegetables; mixtures of vegetables n.e.s. in heading no. 0712, whole, cut, sliced, broken, or in powder but not further prepared, dried
071310	Vegetables, leguminous; peas (*Pisum sativum*), shelled, whether or not skinned or split, dried
071320	Vegetables, leguminous; chickpeas (garbanzos), shelled, whether or not skinned or split, dried
071331	Vegetables, leguminous; beans (*Vigna mungo* L. Hepper or *Vigna radiata* L. Wilczek), dried, shelled, whether or not skinned or split
071332	Vegetables, leguminous; small red (adzuki) beans (*Phaseolus* or *Vigna angularis*), shelled, dried, whether or not skinned or split
071333	Vegetables, leguminous; kidney beans, including white pea beans (*Phaseolus vulgaris*), dried, shelled, whether or not skinned or split
071339	Vegetables, leguminous; n.e.s. in item no. 0713.30, dried, shelled, whether or not skinned or split
071340	Vegetables, leguminous; lentils, shelled, whether or not skinned or split, dried
071350	Vegetables, leguminous; broad beans (*Vicia faba* var. *major*) and horse beans (*Vicia faba* var. *equina* and *Vicia faba* var. *minor*), dried, shelled, whether or not skinned or split
071390	Vegetables, leguminous; n.e.s. in heading no. 0713, shelled, whether or not skinned or split, dried
081110	Fruit, edible; strawberries, uncooked or cooked by steaming or boiling in water, frozen, whether or not containing added sugar or other sweetening matter
081120	Fruit, edible; raspberries, blackberries, mulberries, loganberries, black, white, or red currants and gooseberries, uncooked or cooked, whether or not containing added sugar or other sweetening matter
081190	Fruit, edible; fruit and nuts n.e.s. in heading no. 0811, uncooked or cooked, frozen, whether or not containing added sugar or other sweetening matter
081210	Fruit, edible; cherries, provisionally preserved, but unsuitable in that state for immediate consumption
081220	Fruit, edible; strawberries, provisionally preserved but unsuitable in that state for immediate consumption
081290	Fruit, edible; fruit and nuts n.e.s. in heading no. 0812, provisionally preserved but unsuitable in that state for immediate consumption
Unprocessed	
070110	Vegetables; seed potatoes, fresh or chilled
070190	Vegetables; potatoes (other than seed), fresh or chilled
070200	Vegetables; tomatoes, fresh or chilled
070310	Vegetables, alliaceous; onions and shallots, fresh or chilled
070320	Vegetables, alliaceous; garlic, fresh or chilled
070390	Vegetables, alliaceous; leeks and other kinds n.e.s. in heading no. 0703, fresh or chilled
070410	Vegetables, brassica; cauliflowers and headed broccoli, fresh or chilled
070420	Vegetables, brassica; brussels sprouts, fresh or chilled
070490	Vegetables, brassica; edible, n.e.s. in heading no. 0704, fresh or chilled
070511	Vegetables; cabbage (head) lettuce (*Lactuca sativa*), fresh or chilled
070519	Vegetables; lettuce (*Lactuca sativa*) (other than cabbage lettuce), fresh or chilled

070521	Vegetables; Witloff chicory (*Cichorium intybus* var. *foliosum*), fresh or chilled
070529	Vegetables; chicory (*Cichorium* spp.) (other than Witloof chicory), fresh or chilled
070610	Vegetables, root; carrots and turnips, fresh or chilled
070690	Vegetables, root; salad beetroot, salsify, celeric, radishes and similar edible roots, fresh or chilled
070700	Vegetables; cucumbers and gherkins, fresh or chilled
070810	Vegetables, leguminous; peas (*Pisum sativum*), shelled or unshelled, fresh or chilled
070820	Vegetables, leguminous; beans (*Vigna* spp., *Phaseolus* spp.), shelled or unshelled, fresh or chilled
070890	Vegetables, leguminous (other than peas and beans), shelled or unshelled, fresh or chilled
070910	Vegetables; globe artichokes, fresh or chilled
070920	Vegetables; asparagus, fresh or chilled
070930	Vegetables; aubergines (eggplants), fresh or chilled
070940	Vegetables; celery (other than celeriac), fresh or chilled
070951	Vegetables; mushrooms, fresh or chilled
070952	Vegetables; truffles, fresh or chilled
070960	Vegetables; fruits of the genus *capsicum* or *pimenta*
070970	Vegetables; spinach, New Zealand spinach and orache spinach (garden spinach), fresh or chilled
070990	Vegetables; edible, n.e.s. in Chapter 7, fresh or chilled
080110	Nuts, edible; coconuts, fresh or dried, whether or not shelled or peeled
080120	Nuts, edible; Brazil nuts, fresh or dried, whether or not shelled or peeled
080130	Nuts, edible; cashew nuts, fresh or dried, whether or not shelled or peeled
080211	Nuts, edible; almonds, fresh or dried, in shell
080212	Nuts, edible; almonds, fresh or dried, shelled
080221	Nuts, edible; hazelnuts or filberts (*Corylus* spp.), fresh or dried, in shell
080222	Nuts, edible; hazelnuts or filberts (*Corylus* spp.), fresh or dried, shelled
080231	Nuts, edible; walnuts, fresh or dried, in shell
080232	Nuts, edible; walnuts, fresh or dried, shelled
080240	Nuts, edible; chestnuts (*Castanea* spp.), fresh or dried, whether or not shelled or peeled
080250	Nuts, edible; pistachios, fresh or dried, whether or not shelled or peeled
080290	Nuts, edible; n.e.s. in heading no. 0801 and 0802, fresh or dried, whether or not shelled or peeled
080300	Fruit, edible; bananas (including plantains), fresh or dried
080410	Fruit, edible; dates, fresh or dried
080420	Fruit, edible; figs, fresh or dried
080430	Fruit, edible; pineapples, fresh or dried
080440	Fruit, edible; avocados, fresh or dried
080450	Fruit, edible; guavas, mangoes, and mangosteens, fresh or dried
080510	Fruit, edible; oranges, fresh or dried

080520	Fruit, edible; mandarins (including tangerines and satsumas), clementines, wilkings, and similar citrus hybrids, fresh or dried
080530	Fruit, edible; lemons (*Citrus limon, Citrus limonum*), limes (*Citrus aurantifolia*)
080540	Fruit, edible; grapefruit, fresh or dried
080590	Fruit, edible; citrus fruit n.e.s. in heading no. 0805, fresh or dried
080610	Fruit, edible; grapes, fresh
080620	Fruit, edible; grapes, dried
080710	Fruit, edible; melons (including watermelons), fresh
080720	Fruit, edible; papaws (papayas), fresh
080810	Fruit, edible; apples, fresh
080820	Fruit, edible; pears and quinces, fresh
080910	Fruit, edible; apricots, fresh
080920	Fruit, edible; cherries, fresh
080930	Fruit, edible; peaches including nectarines, fresh
080940	Fruit, edible; plums and sloes, fresh
081010	Fruit, edible; strawberries, fresh
081020	Fruit, edible; raspberries, blackberries, mulberries, and loganberries, fresh
081030	Fruit, edible; black, white, or red currants and gooseberries, fresh
081040	Fruit, edible; cranberries, bilberries, and other fruits of the genus vaccinium, fresh
081090	Fruit, edible; fruits n.e.s. in heading no. 0801 to 0810, fresh
081310	Fruit, edible; apricots, dried
081320	Fruit, edible; prunes, dried
081330	Fruit, edible; apples, dried
081340	Fruit, edible; fruit n.e.s. in heading no. 0812, dried
081350	Nuts, edible; mixtures of nuts or dried fruits of Chapter 8
081400	Peel; of citrus fruit or melons (including watermelons), fresh, frozen, dried, or provisionally preserved in brine, in sulfur water and other preservative solutions

Source: Authors' own elaboration using the 2024 AATM database.
Note: The first column includes the HS6 code and the second column the product label.

Table A4.2 Classification of fruits and vegetables: Supply and demand approach.

Products	2008-2012			2018-2022		
Processed		**High demand**	**Low demand**		**High demand**	**Low demand**
	With RCA	**0**	**3**	With RCA	**0**	**3**
		No products	071420;200559;200891		No products	071490;190300;200559
	No RCA	**20**	**17**	No RCA	**17**	**20**
		071410;200190;200210;200290; 200310;200410;200490;200520; 200570;200580;200799;200820;200830 ;200870;200911;200919; 200990;210320;210390;210690	071490;190300;200110;200510; 200540;200551;200560;200600; 200710;200791;200840;200850; 200860;200880;200950;210310; 210330		071410;200190;200210;200290; 200410;200490;200520;200570; 200580;200799;200820;200911; 200919;200990;210320;210390; 210690	071420;200110;200310;200510; 200540;200551;200560;200600; 200710;200791;200830;200840; 200850;200860;200870;200880; 200891;200950;210310;210330
Semi-processed		**High demand**	**Low demand**		**High demand**	**Low demand**
	With RCA	**2**	**4**	With RCA	**1**	**3**
		071320;071331	071332;071350;071390;081290		071320	071332;071339;081290
	No RCA	**7**	**14**	No RCA	**9**	**14**
		071080;071290;071310;071333; 071340;081120;081190	071010;071021;071022;071029;071030; 071040;071090;071120;071140;071190; 071220;071339; 081110;081210		071080;071290;071310;071331;071333; 071340;081110;081120; 081190	071010;071021;071022;071029; 071030;071040;071090;071120; 071140;071190;071220;071350; 071390;081210
Unprocessed		**High demand**	**Low demand**		**High demand**	**Low demand**
	With RCA	**0**	**3**	With RCA	**0**	**4**
		No products	080211;080590;081400			080221;080590;081320;081330
	No RCA	**34**	**22**	No RCA	**36**	**19**
		070110;070190;070200;070310; 070320;70410;070490;070511;070519; 070610;070700;070820;070920;070951 ;070960;080212;080222;080232;08041 0;080430;080440; 080450;080510;080520;080540; 080610;080620;080810;080930; 080940;081010;081020;081040; 081090	070390;070420;070521;070529; 070690;070810;070890;070930; 070940;070970;080221;080231; 080290;080420;080720; 080910;081030;081310;081320; 081330;081340;081350		070190;070200;070310;070320; 070410;070490;070519;070610; 070700;070820;070920;070951; 070960;080211;080212;080222; 080231;080232;080290;080410; 080430;080440;080450; 080510;080520;080540;080610; 080620;080810;080930; 080940;081010;081020;081040; 081090;081340	070110;070390;070420;070511; 070521;070529;070690;070810; 070890;070930;070940;070970; 080420;080720;080910;081030; 081310;081350;081400

Note: High (low) demand refers to products whose world imports are greater (lower) than the median world imports over the period of analysis. With (without) RCA refers to products whose revealed comparative advantage index is greater (lower) than one. Numbers above each block indicate the number of products.

5

Impact of Climate Change on Trade in Africa

Pierre Mamboundou, Fousseini Traoré, and Chahir Zaki

Introduction

The literature on the complex relationship between trade and climate change is rich. While trade can affect climate change through dirty production techniques or carbon emissions due to transport (Brenton and Chemutai 2021), climate change can affect trade through its effect on agricultural productivity (Ben Zaied and Cheikh 2015; Chandio et al. 2020), production, and thus countries' specialization (Gouel and Laborde 2021), primarily due to high temperatures and water stress (Hamududu and Ngoma 2020). As Africa is a net importer of agricultural products, the consequence is that climate change will likely affect food security in the medium and long term.

Against this background, the objective of this chapter is twofold. First, we examine the extent to which African countries are exposed to climate change relative to other regions of the world. Second, we show how Africa's comparative advantages can be altered with rising temperatures and water stress. Our main findings show that climate change effects in Africa are more pronounced than in other regions, reflected in the increase in extreme weather events associated with rising temperatures and greater variability in precipitation. These developments are likely to increase the number of food insecure people. Furthermore, we identify how climate change can affect African countries' specialization based on products' sensitivity to changes in temperature and their dependence on water. We show that several crops (such as leguminous vegetables, edible nuts and coconuts, groundnuts, oilseeds, and oleaginous fruits) will be affected by climate change. Other crops' production may be less affected, but their future expansion may be limited by climate change–related factors.

The remainder of the chapter is organized as follows. The following section examines Africa's exposure to climate change. We then analyze the continent's shifting comparative advantages caused by climate change and the associated impacts on trade flows, and we also identify which agricultural products are most sensitive to climate change. The final section offers conclusions.

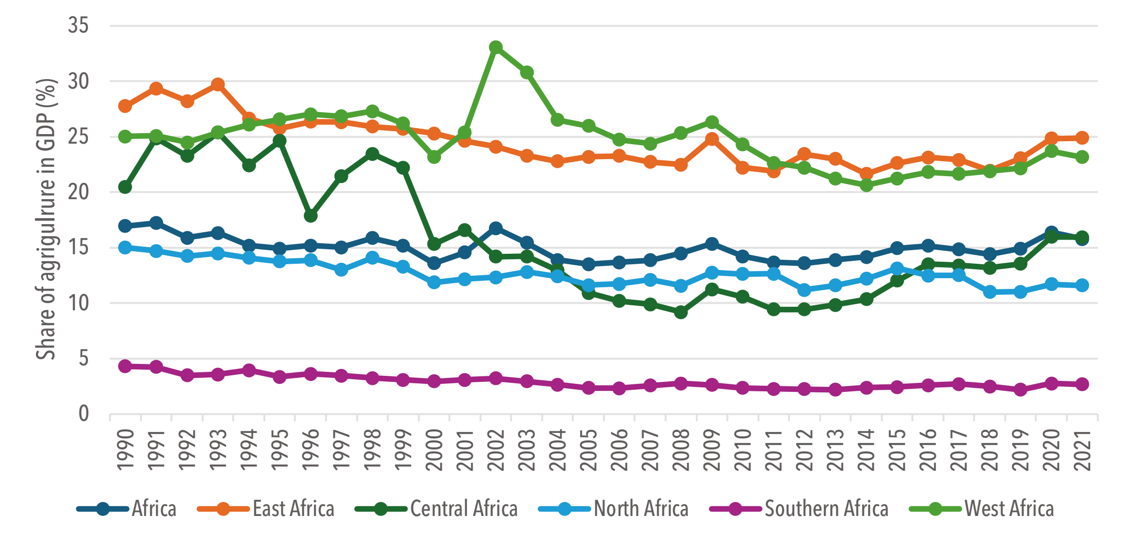
Africa's Exposure to Climate Change

This section presents an overview of the effects of climate change and the consequences for African countries' agriculture sectors and the overall food system. It examines the structure and place occupied by the agriculture sector in the continent's economy to better understand the challenges imposed by climate change. The section concludes that intraregional trade could play a role in mitigating the effects of climate change on agriculture in Africa.

The share and structure of agriculture in African countries' economies

On average over the period 1990 to 2021, agriculture contributed nearly 15 percent of Africa's GDP. However, this figure masks the varied contributions of individual regions (Figure 5.1). For example, agriculture contributes more than 25 percent of GDP in West and East Africa, 16 percent in Central Africa, and 13 percent in North Africa. Southern Africa has the lowest contribution, at around 3 percent (FAOSTAT 2023). Over the same period, the share of the agriculture sector in GDP in Africa fell by 1.15 percentage points, with the most significant declines in Central and North Africa (4.51 and 3.40 percentage points less, respectively). The concurrent rise in per capita income reflects the macroeconomic consequence of Engel's law (that is, the share of food expenditure in total consumption declines as income rises). At the same time, rapid urbanization has reduced both the land available for cultivation and the number of people employed in agriculture (Andrade et al. 2022; Djurfeldt 2015). In addition, the urbanization process makes employment in the agriculture sector less attractive than in other sectors (Christiaensen and Todo 2013; Ørtenblad, Birch-Thomsen, and Msese 2019), leading to a rural exodus. Cumulatively, these factors have an overall negative impact on agricultural production and rural development, although the economic structure of certain countries can counterbalance this dynamic.

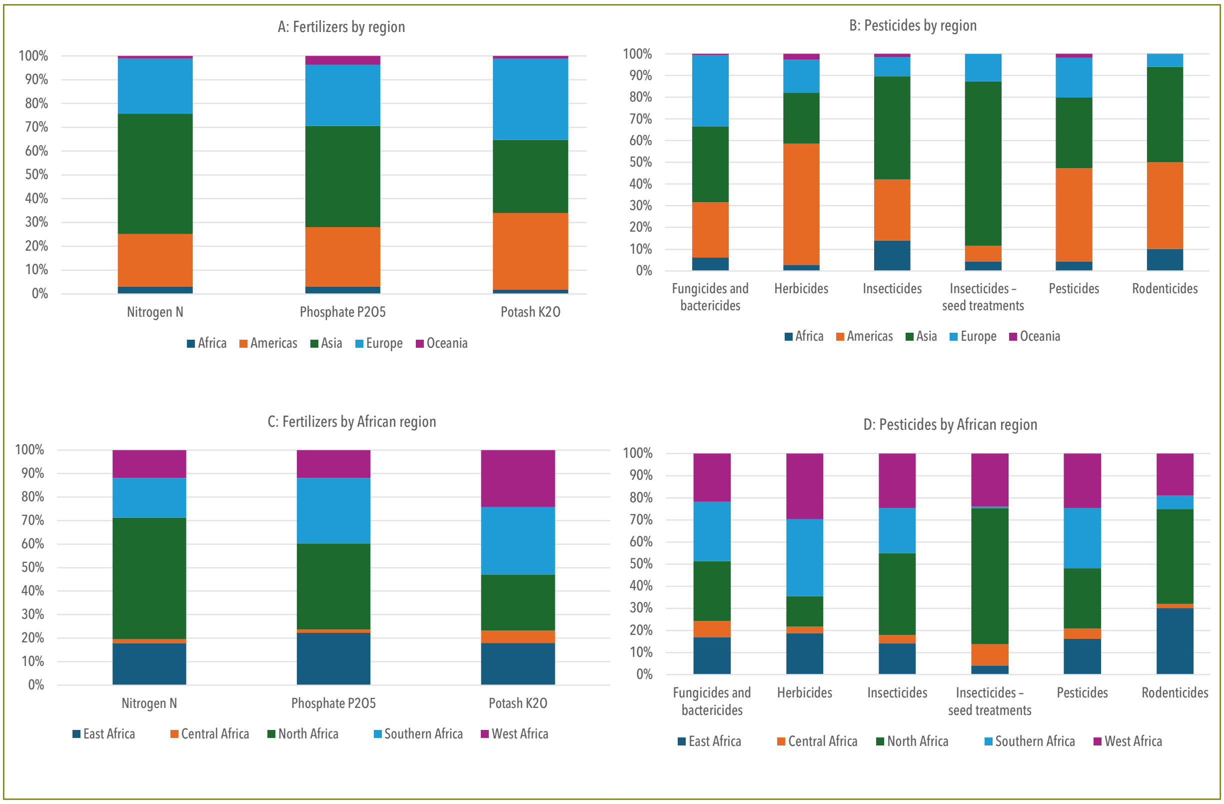
Figure 5.1 Share of agriculture sector in GDP by region in Africa



Source: Authors' calculation from the FAOSTAT database, accessed in 2023.

Both extensive and intensive agriculture are practiced across Africa, although the former predominates (Abe-Inge et al. 2023; Asafu-Adjaye 2014; Jayne and Sanchez 2021). Extensive agriculture requires large areas of land for sufficient production and is primarily rainfed. This type of agriculture can contribute to deforestation, thus accelerating climate change (Zingore et al. 2015) and increasing the sector's vulnerability to climatic conditions (Asafu-Adjaye 2014; WMO 2020, 2022). At the continental level, the dominance of extensive agriculture results from poor control of available water caused by insufficient irrigation infrastructure, the lack of farm mechanization, and the resulting reliance on a large, mostly unskilled workforce on the one hand and the low use of soil fertilization on the other (Asafu-Adjaye 2014; Bjornlund et al. 2020). In fact, Svendsen, Ewing, and Msangi (2009); Rosegrant, Ringler, and De Jong (2009); and OECD and FAO (2016) note that less than 10 percent of agricultural land in sub-Saharan Africa is irrigated. The dependence on rainfall of the other 90 percent explains why agriculture remains a seasonal activity in most regions of the continent. Furthermore, over the period 1990 to 2021, the use of chemical fertilizers such as nitrogen, phosphate, and potash in African agricultural production comprised less than 5 percent of all global use (Figure 5.2). Likewise, the use of other chemical inputs (herbicides, insecticides, fungicides, and so on) in African agriculture represented less than 10 percent of all global use.

Figure 5.2 Use of fertilizers and pesticides in agriculture by world region and African region

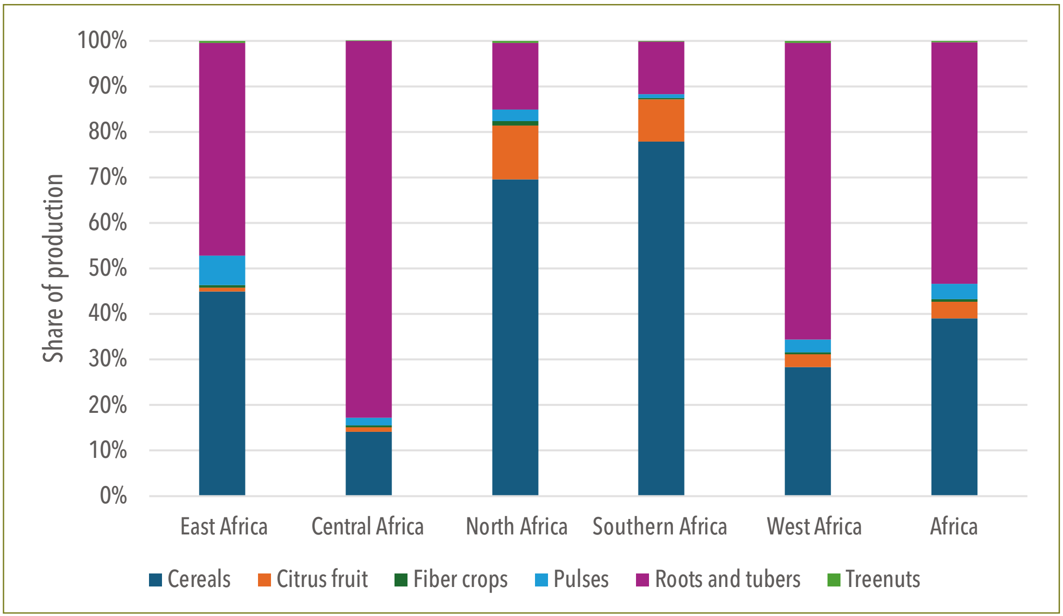


Source: Authors' calculations from the FAOSTAT database, accessed 2024.

On the continent, North, Southern, and West Africa use the most agricultural inputs, in terms of both pesticides and fertilizers. But overall, Africa's low use contributes to lower yields per hectare of crops than in other parts of the world. For example, over the period 1990 to 2021, cereal yields in Africa were 3.0 times lower than those recorded in the Americas, 2.5 times lower than in Asia and Europe, and 1.3 times lower than in Oceania. Yields of roots and tubers were one-half less in Africa than in the Americas, Asia, and Europe (FAOSTAT 2023).

Africa's overall low use of inputs and its relatively low yields have contributed to the persistence of undiversified agricultural systems, dominated by roots and tubers and cereals, which represent more than 80 percent of the continent's agricultural production (FAOSTAT 2023). The production of roots and tubers is dominant in Central, West, and East Africa (Figure 5.3). Conversely, cereal is mainly cultivated in Southern and North Africa, although cereals comprise nearly 45 percent of all crops in East Africa. The low yields and weak diversification of agricultural production by economic communities in Africa suggest that they are incapable of providing sufficient agricultural products to meet domestic needs, precluding them from contributing effectively to the goal of self-sufficiency in agricultural products.

Figure 5.3 Average share of major crops in production (tons) by region in Africa, 1961–2022



Source: Authors' calculations from the FAOSTAT database, accessed 2023.

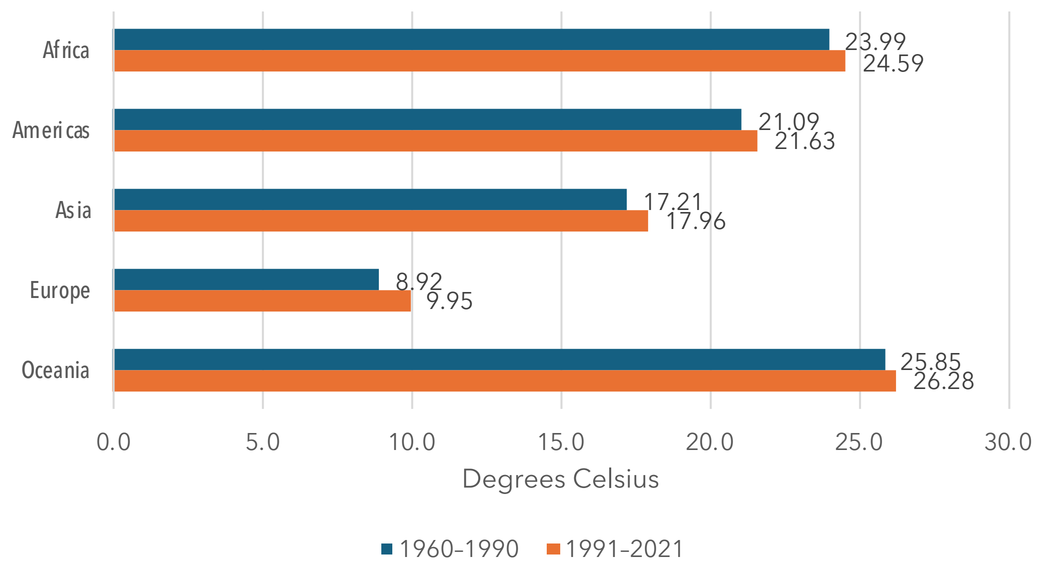
Low yield and low crop diversification can also be explained by the type of farms in Africa. African agriculture is mainly based on small family farms that grow food primarily for subsistence (Christiaensen and Demery 2018). In addition, these small farms are generally led by farmers with low levels of education and management skills, who do not use modern production tools (such as tractors and irrigation systems) due to their low income, and who face difficulty in accessing the financing necessary to innovate in their practices and improve their production (Christiaensen and Demery 2018; Mathinya et al. 2022). In addition, as subsistence farmers' socioeconomic conditions are generally difficult, their farms mainly produce agricultural goods intended for own consumption rather than for sale. These farms may also prioritize reduction of their costs by not hiring skilled workers (potentially more expensive) and by investing less in production infrastructure. Such choices contribute to reducing their productivity and slowing their diversification (Mwangi and Kariuki 2015).

Although agriculture is one of the main contributors to GDP in several African regions, where it accounts for more than 20 percent of GDP, the sector's contribution to wealth creation is declining, explained in part by farmers' lack of control over water, the low use of inputs, and the low productivity of agricultural capital (both human and physical). The same is true for agricultural employment, which is also decreasing. While the predominance of small farms limits employment opportunities, the development of medium and large farms, which favors more use of machines compared with labor, also contributes to reducing employment opportunities. Compounding the situation, climate change and rapid population growth are reducing the land available for agriculture (Jayne, Yeboah, and Henry 2017). The attractiveness of non-agriculture sectors, where incomes are generally higher, combined with urbanization have made agricultural employment less appealing, to the benefit of the industrial and service sectors that revolve around agriculture (Jayne et al. 2022). Faced with this already worrisome situation, vulnerability to climate change creates an uncertain future for the performance of the agriculture sector in Africa.

Climate change in Africa

The increase in extreme natural phenomena such as heavy rains, floods, droughts, and heat waves is evidence of the effects of climate change in Africa (IPCC 2023; WMO 2022). These events, the result of increased greenhouse gas (GHG) emissions globally, particularly affect Africa, although Africa emits 7 times less GHGs than Europe and 15 times less than North America (IPCC 2023). Increasing GHG emissions are disrupting ecosystems worldwide, as illustrated by rising temperatures and ocean levels, acidification of oceans, and even reduced available arable land (due to desert advancement and declines in soil fertility and yields) (IPCC 2023). Over the period 1990 to 2021, all continents experienced a temperature rise of an average 0.3 degrees Celsius (°C) per decade (Figure 5.4) (WMO 2020, 2022). Africa is the second hottest continent after Oceania and ranks third in temperature variation (+0.62°C versus +0.98°C in Europa, +0.74°C in Asia, +0.53°C in America, and +0.40°C in Oceania).

Figure 5.4 Average temperature (°C) in 1960–1990 and 1991–2021, by world region



Source: Authors' calculation from the University of East Anglia (UEA) database, accessed 2024.

Similarly, sea levels are rising along the tropical coasts of the South Atlantic and Indian Oceans at a rate higher than the global average (IPCC 2023; WMO 2022). At the same time, in 2022, the Horn of Africa recorded the most severe drought in 40 years, caused by a sharp drop in rainfall, while higher than normal rainfall was recorded in the Sahel, the Rift Valley, the central Nile catchment and northeast Africa, the Kalahari Basin, and the lower Congo River (UN 2022; WMO 2020, 2022). These events have led to significant negative consequences for natural resources and infrastructure on one hand, and for the labor productivity and well-being of populations on the other (IPCC 2023; WMO 2022).

Natural resources have been affected by climate change via a reduction in water resources and crop areas and by the disappearance of some species (AGRA 2020; Berrang-Ford, Pearce, and Ford 2015; Hultgren et al. 2022; IPCC 2023). For example, in 2020, above-average rainfall in Zambia destroyed more than 700 hectares of crops in Namwala district alone (a southern province of the country). The same year in Niger, nearly 10,000 hectares of crops were submerged under water.

In addition, grazing land for animals was reduced. Climate change–related extreme events also contribute to the destruction of infrastructure (roads, bridges) essential for the smooth running of economic and social activities (IPCC 2023; von Braun et al. 2023). The collapse of the Corniche Monument in the Republic of Congo and the Palar Bridge in Cameroon (Maroua), as well as the destruction of infrastructure in Algeria, Madagascar, Mauritius, and Morocco, are perfect illustrations. The increased public spending linked to the construction, maintenance, and repair of these buildings reduces the resources that can be allocated to other development objectives (IPCC 2023).

Another effect of climate change, although less studied, is on labor productivity (De Lima et al. 2021; Haqiqi et al. 2020). On this point, sub-Saharan Africa is particularly vulnerable. Indeed, with heat stress, the ability to carry out outdoor activities such as agricultural and livestock work will be reduced. As a result, the amount of agricultural labor could fall, leading to a drop in labor productivity in this labor-intensive sector (Matsumoto, Tachiiri, and Su 2021). Likewise, animals used for agricultural work can be affected by heat stress, which can promote animal weight loss and reduce their fertility, negatively affecting their productivity in the medium to long term (Thornton et al. 2022). In a region where the agriculture sector is mainly traditional, and where agricultural employment represents 58 percent of jobs in West and Central Africa, 22 percent in North Africa and the Middle East, and 19 percent in Southern Africa, this situation will have a direct negative impact on food availability and access to food. This perspective, combined with rising food prices and the proliferation of infectious diseases, will lead to significant welfare losses, characterized by an increase in displacement of populations and cases of malnutrition (FAO 2017; FAO and WFP 2020; Kinda and Badolo 2019; von Braun et al. 2023). For instance, more than 1 million Somalis were displaced within the country because of the 2022 drought, the decline in their means of subsistence, and the famine that ensued. In Ethiopia, more than 500,000 internally displaced people were recorded in 2022 because of drought (IPCC 2023). These situations lead to an increase in the vulnerability of populations in general and of poor populations in particular (von Braun et al. 2023).

Climate change in Africa is reflected in the increase in both frequency and intensity of extreme weather phenomena and the acceleration of the disruption of ecosystems due to rising temperatures and greater rainfall variability. Climate change lowers the productivity of production factors (reducing the quality and quantity of production, due to new plant and animal diseases), reduces livestock yields, and increases the arduousness of agricultural activity (Ceci et al. 2021; Singh et al. 2023), directly impacting the resources needed to ensure livelihoods. The result is an increased vulnerability of populations more exposed to food insecurity and/or poor nutrition.

Climate change and agriculture in Africa

Climate change is a complex phenomenon that can constitute a threat to agricultural practices in certain areas but can be an opportunity in other areas in Africa (Jarvis, Lane, and Hijmans 2008; Jarvis et al. 2012; Loum and Fogarassy 2015; Pereira 2017). On a continent where agricultural activity is dominated by extensive agriculture, soil degradation (through a decline in organic matter), irregular precipitation, rising temperatures, scarce water resources, and even the increased frequency of extreme climatic events all have negative impacts on agricultural development (Chandio et al. 2020; Craparo et al. 2015; IPCC 2014, 2023). Through the reduction in area dedicated to agricultural activities, the proliferation of new plant diseases, and the drop in yields of several crops, climate change has already contributed to a decline in the production of many agricultural goods and in the sector's contribution to GDP, as seen above (Bongase 2017; Hossain et al. 2021; Killeen and Harper 2016; Rowhani et al.

2011). Certain studies estimate that 40 to 80 percent of cultivated areas are degraded, which represents losses of 30 to 60 kilograms of nutrients per hectare per year and damage of several billion dollars (IPCC 2023; Kala, Kurukulasuriya, and Mendelsohn 2012).

Arid and semi-arid zones such as the Sahel are more affected by climate change, as only 3 to 30 percent of land in these zones is not yet degraded (AGNES 2020). For instance, increased soil degradation and temperatures and reduced rainfall have led to a drop in agricultural production of 3 percent per year since 1990 in the Sahel (Doukkali, Tharcisse, and Tudal 2018). In Senegal specifically, erosion and salinization have degraded more than 60 percent of arable land (AGNES 2020). Nigeria records losses of 30 million tons of topsoil per year, while Ethiopia loses almost 1 billion tons of topsoil per year (AGNES 2020). In Tanzania, increased intraseasonal rainfall variability—which corresponds to the length of the break between two rain cycles in a year—has reduced maize, sorghum, and rice yields by 4.2 percent, 7.2 percent, and 7.6 percent, respectively (Rowhani et al. 2011). On a continental scale, Rowhani et al. (2011) forecast a drop in agricultural yields of 8 percent by 2050, with a reduction of 17 percent for wheat, 15 percent for sorghum, 10 percent for millet, and 5 percent for corn. This dynamic could lead to the loss of more than one-half of the cultivated agricultural area in Africa by 2050 (IFAD 2021).

This trend will have two effects: (1) it will induce a drop in people's income, increasing their financial precariousness (Adhikari, Nejadhashemi, and Woznicki 2015; Baarsch et al. 2020; IFAD 2021); and (2) it will reduce food security in terms of food availability, access to food, and the nutritional quality of food (Ebi and Ziska 2018; FAO, IFAD, UNICEF, and WHO 2020; Mihret Dessie and Shumetie Ademe 2017; Teressa 2021). Indeed, most African populations are dependent on agricultural activities, which employ up to almost 60 percent of the workforce in certain regions (OECD and FAO 2021; Tongwane and Moeletsi 2018). Therefore, the irregularity of production due to climate change will reduce the quantities sold and consequently the income generated from agricultural activities (IPCC 2007; OECD and FAO 2021). In addition, the associated scarcity in the supply of agricultural and food products could have a consequence for their prices (Haggar and Schepp 2011; Herrero et al. 2010; Stuch, Alcamo, and Schaldach 2021). Likewise, rising temperatures and irregular rainfall have a negative impact on the nutrient supply of certain foods because they prevent the proper development of plants (Bhadra et al. 2022). A decline in the nutritional quality of agricultural products will be noticed. The combination of these different effects will increase food poverty and insecurity.

The overall negative effects of climate change on agriculture can be nuanced. In some regions, climate change may improve climate conditions and consequently the yield of some crops such as coffee, wheat, and maize (Affoh et al. 2022; Ovalle-Rivera et al. 2015). In such cases, farmers may increase their production and may benefit from an increase in prices if production has fallen substantially in other areas.

The ambiguous effects of climate change on agriculture, characterized by negative effects in some areas of the continent and positive effects in others, raises the priority of intraregional or intracontinental trade as a mitigation option. Indeed, if the volatility of domestic production is greater than the regional or continental trend in an economic community affected by a shock, an increase in intraregional and intracontinental trade should help stabilize the supply (availability) of agricultural products and consequently their prices (Badiane, Odjo, and Jemaneh 2014; Koester 1986; Kpodar and Imam 2016). To test this, we extend the previous work of Badiane, Odjo, and Jemaneh (2014) and build and analyze a production instability index. The index is based on the coefficient of variation of the quantities produced of an agricultural product in a country's production series, adjusted by the coefficient of determination of the linear trend model adapted to the series:

$$TCV_i = CV_i * \sqrt{1 - R_i^2} \qquad (1)$$

where CV_i is the coefficient of variation in the series of a country's production quantities of the commodity of interest; R_i^2 is the adjusted coefficient of determination of the linear trend model fitted to the series; and TCV_i is the trend-corrected coefficient of variation in country production quantities.

We obtained a trend-corrected coefficient of variation for each country. Next, we derive the regional production instability index by taking a pseudo weighted average of the national index values obtained previously for countries of the same region:

$$TCV_{reg}^2 = \sum_{i}^{n} s_i^2 \cdot TCV_i^2 + 2\sum_{i<}^{n}\sum_{j}^{n} s_i \cdot s_j \cdot r_{ij} \cdot TCV_i \cdot TCV_j \qquad (2)$$

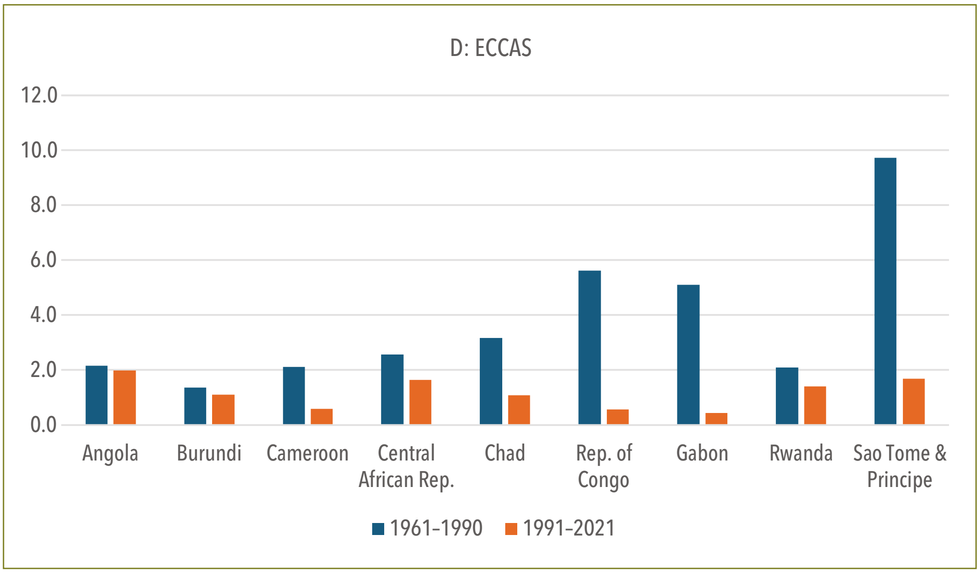
where *n* is the number of member countries in the regional grouping of interest; $S_i[S_j]$ is the share of a country in the region's overall production of the commodity under analysis; and r_{ij} is the coefficient of correlation between the series of production quantities in countries *i* and *j*.

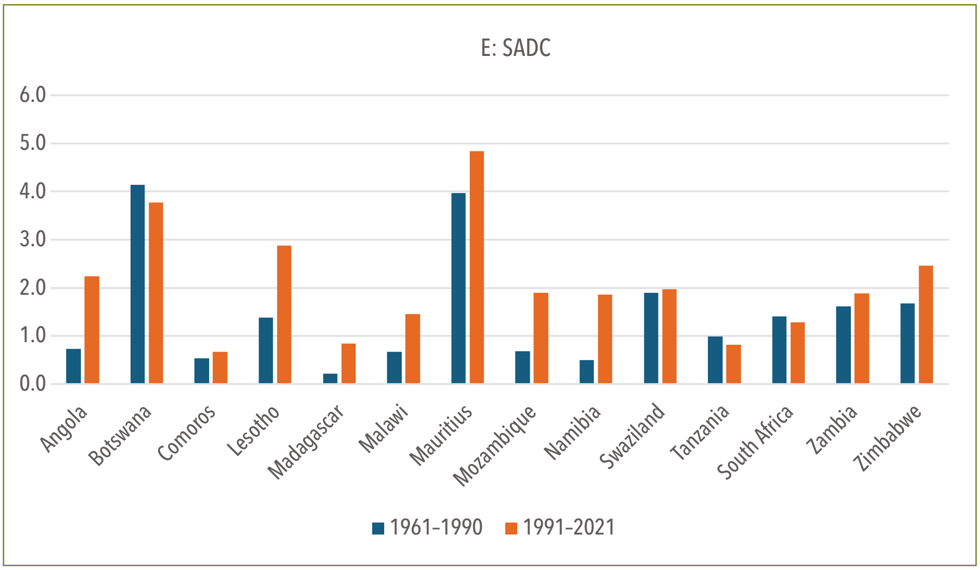
Finally, we normalized the measure of production instability at the country level by dividing it by the measure of instability at the regional level:

$$Normalized\ TCV_i = {TCV_i}/{\sqrt{TCV_{reg}^2}} \qquad (3)$$

As an illustration, we applied the index to data for the dominant crops on the continent, namely roots and tubers and cereals. We selected the period 1961 to 2021, for which data are available. Practically, we divided the period into two subperiods to see how national volatility evolves compared with regional volatility under the effect of climate change. Thus, as Figure 5.5 shows, cereal production instability in Libya and Mauritania in the Arab Maghreb Union (AMU)—with a normalized index higher than 1.0—was higher than the regional dynamics over the period 1961 to 1990, and lower from 1991 to 2021. In the Common Market for Eastern and Southern Africa (COMESA), instability deteriorated in Djibouti between the two periods, while in Egypt and the Comoros, it remained below the regional average. In this regional economic community (REC), Madagascar is the only country where cereal production instability improved between the two subperiods. In the Economic Community of Central African States (ECCAS), the normalized index of all member countries was higher than the regional average over the period 1961 to 1990. Over the second subperiod, instability fell significantly below the regional average in Cameroon, Republic of Congo, and Gabon. In the Economic Community of West African States (ECOWAS), cereal production instability increased between the two subperiods in most countries, except for a few coastal countries, including Benin, Guinea, Guinea Bissau, Nigeria, and Togo, where it remained below the regional average. Finally, in the Southern African Development Community (SADC), only the Comoros, Madagascar, and Tanzania had indexes below the regional average.

Figure 5.5 Cereal production instability by REC, 1961–2021, normalized coefficient of variation





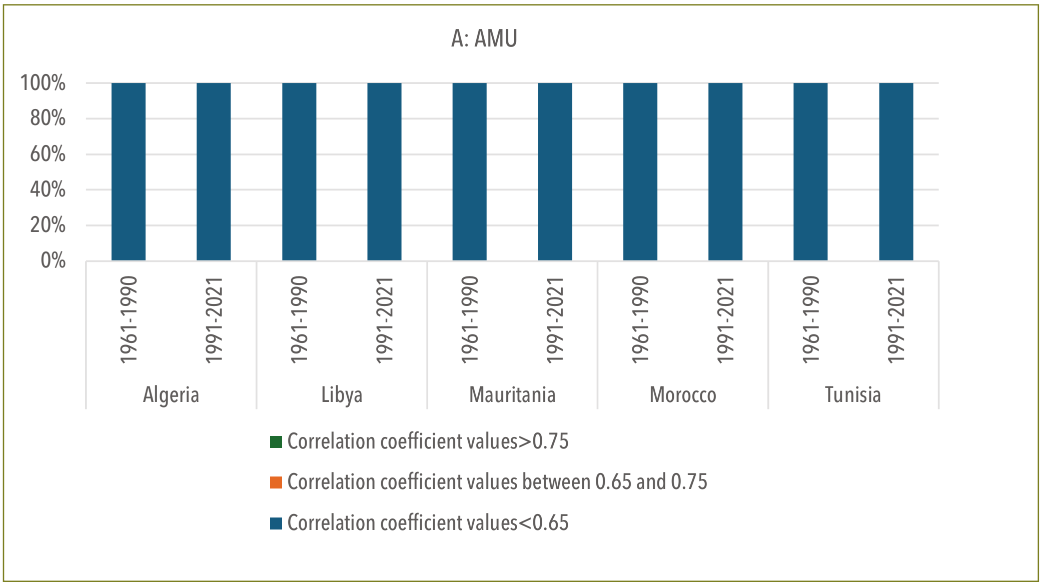
Source: Authors' calculations from the FAOSTAT database.

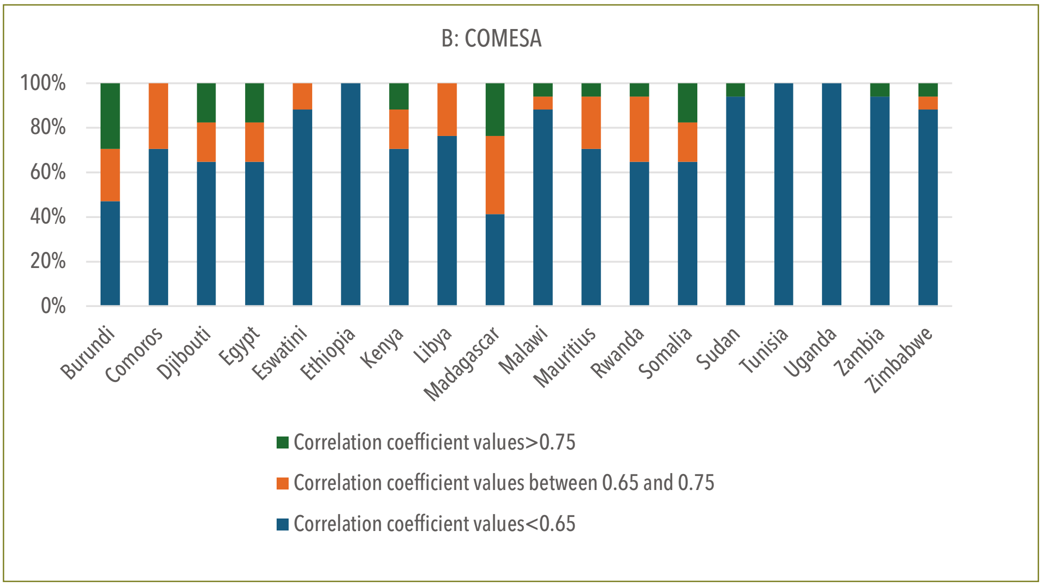
Analysis of the volatility of cereal production by REC shows that the national index in most countries is greater than 1, which reflects a national volatility higher than the regional trend. To analyze the distribution of fluctuations in cereal production, obtained by calculating for each product the values of the Pearson correlation coefficient between a country's production quantities and those of each of its neighbors in the REC, we defined three thresholds:

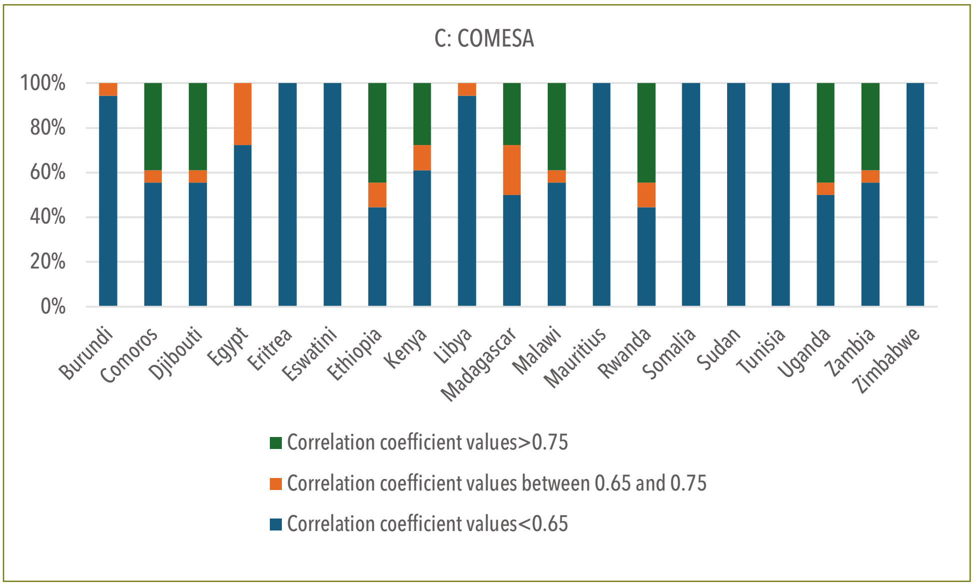
- When the correlation coefficient is less than 0.65, a country's production is weakly correlated.
- When the correlation coefficient is 0.65 to 0.75, a country's production is moderately correlated (Badiane, Odjo, and Jemaneh 2014).
- When the correlation coefficient is greater than 0.75, a country's production appears to be strongly correlated.

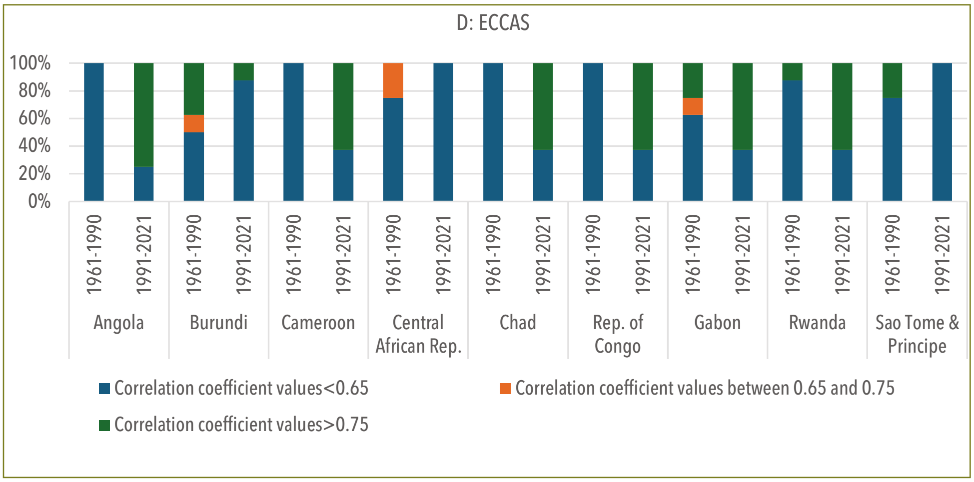
Based on these calculations, within the RECs, most countries have weakly correlated production fluctuations (Figure 5.6).

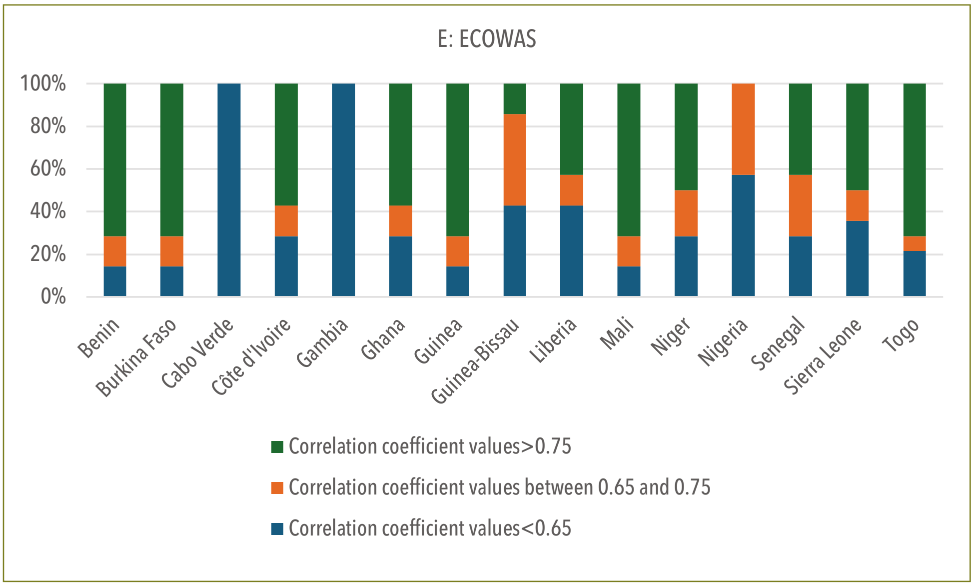
Figure 5.6 Distribution of correlation coefficients between each country's production of cereal and that of its neighbors






C: COMESA
100%
80%
60%
40%
20%
0%
Burundi
Comoros
Djibouti
Egypt
Eritrea
Eswatini
Ethiopia
Kenya
Libya
Madagascar
Malawi
Mauritius
Rwanda
Somalia
Sudan
Tunisia
Uganda
Zambia
Zimbabwe
Correlation coefficient values>0.75
Correlation coefficient values between 0.65 and 0.75
Correlation coefficient values<0.65


D: ECCAS
100%
80%
60%
40%
20%
0%
1961-1990
1991-2021
Angola
Burundi
Cameroon
Central African Rep.
Chad
Rep. of Congo
Gabon
Rwanda
Sao Tome & Principe
Correlation coefficient values<0.65
Correlation coefficient values between 0.65 and 0.75
Correlation coefficient values>0.75


E: ECOWAS
100%
80%
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Benin
Burkina Faso
Cabo Verde
Côte d'Ivoire
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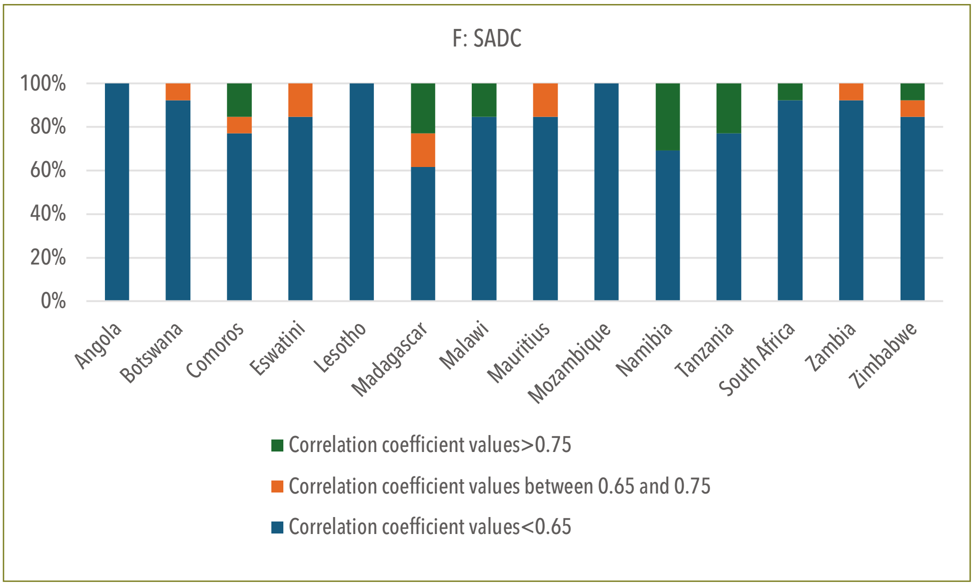
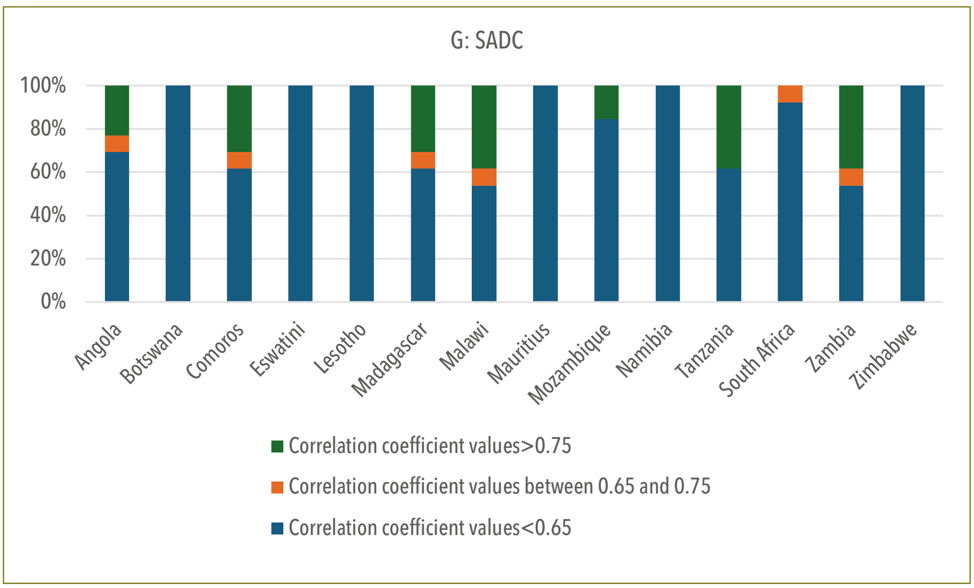
Guinea
Guinea-Bissau
Liberia
Mali
Niger
Nigeria
Senegal
Sierra Leone
Togo
Correlation coefficient values>0.75
Correlation coefficient values between 0.65 and 0.75
Correlation coefficient values<0.65



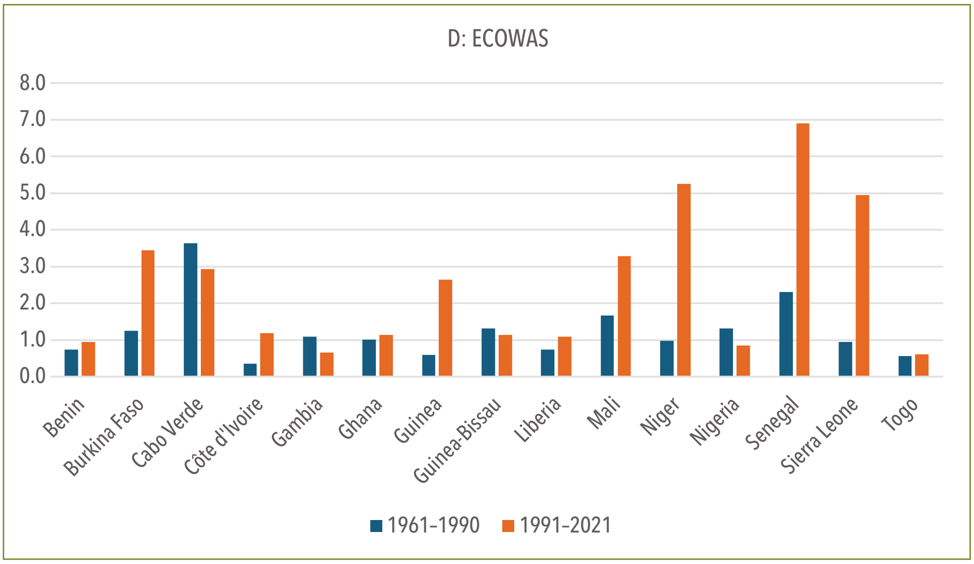


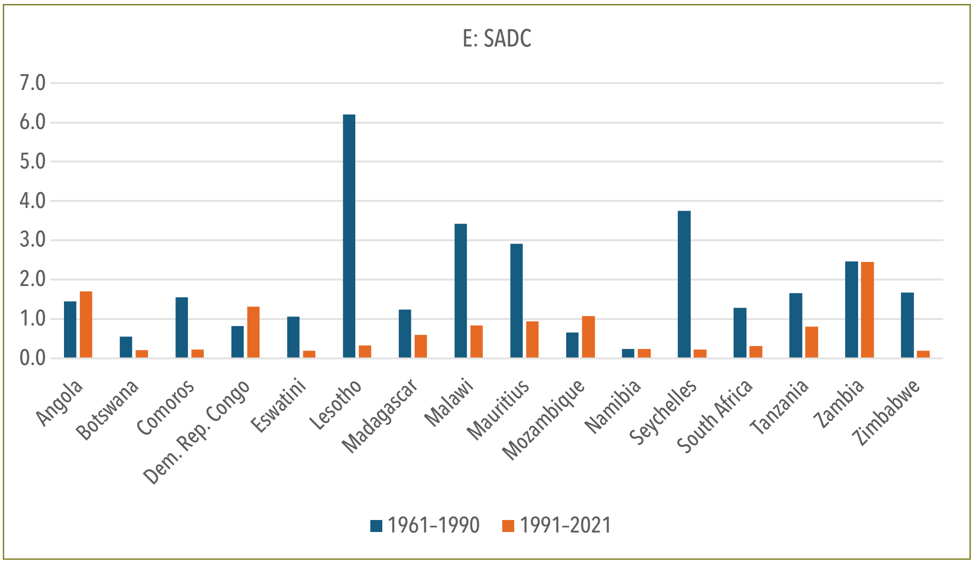
Source: Authors' elaboration.

Thus, the development of cereal trade at both the regional and continental level can stabilize product availability. That is, development of intraregional and/or intracontinental trade can alleviate shortages and stabilize prices.

A similar analysis for roots and tubers reveals a trend different from that of cereals. Apart from ECOWAS, in which the level of the national index compared with the regional trend improved between the two subperiods, the other RECs experienced the opposite (Figure 5.7).

Figure 5.7 Roots and tubers production instability by REC, 1961–2021 normalized coefficient of variation

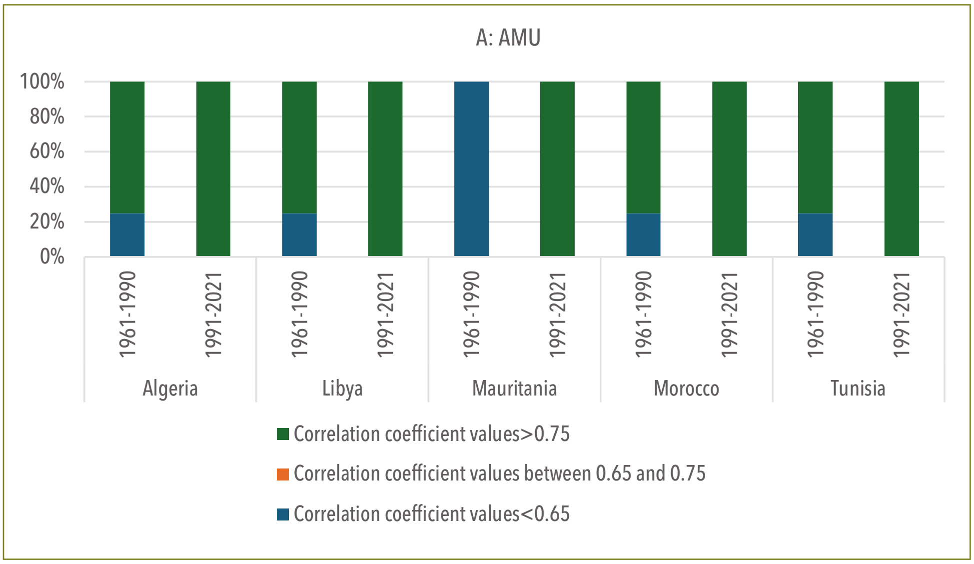


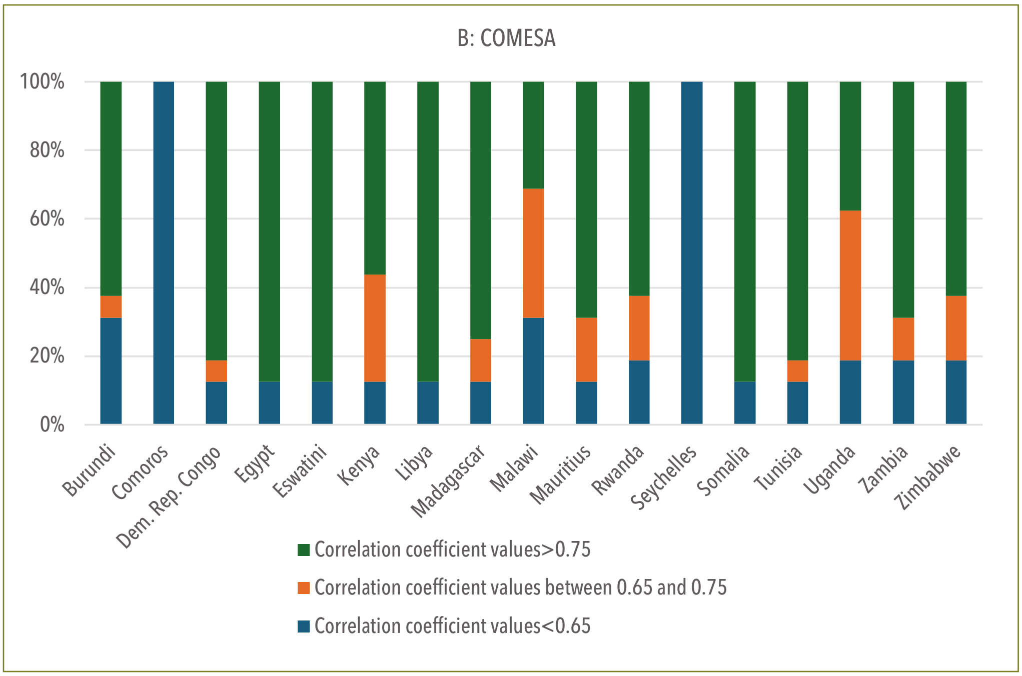


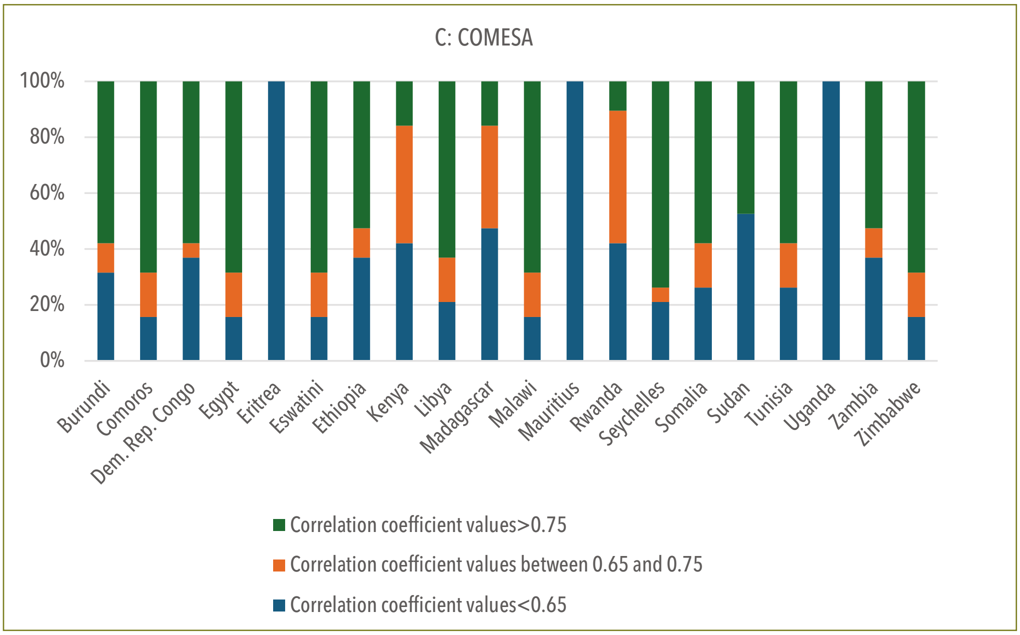
Source: Authors' calculation from the FAOSTAT database.

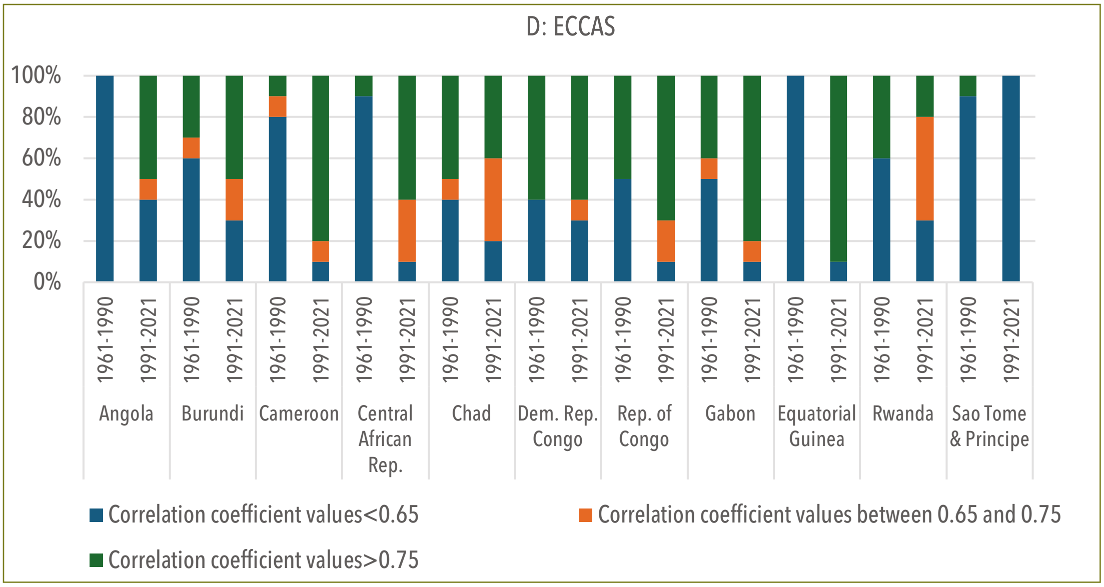
In addition, the production fluctuations in roots and tubers are mainly strongly correlated within RECs for both subperiods (Figure 5.8).

Figure 5.8 Distribution of correlation coefficients between each country's production of roots and tubers and that of its neighbors






C: COMESA
100%
80%
60%
40%
20%
0%
Burundi
Comoros
Dem. Rep. Congo
Egypt
Eritrea
Eswatini
Ethiopia
Kenya
Libya
Madagascar
Malawi
Mauritius
Rwanda
Seychelles
Somalia
Sudan
Tunisia
Uganda
Zambia
Zimbabwe
Correlation coefficient values>0.75
Correlation coefficient values between 0.65 and 0.75
Correlation coefficient values<0.65


D: ECCAS
100%
80%
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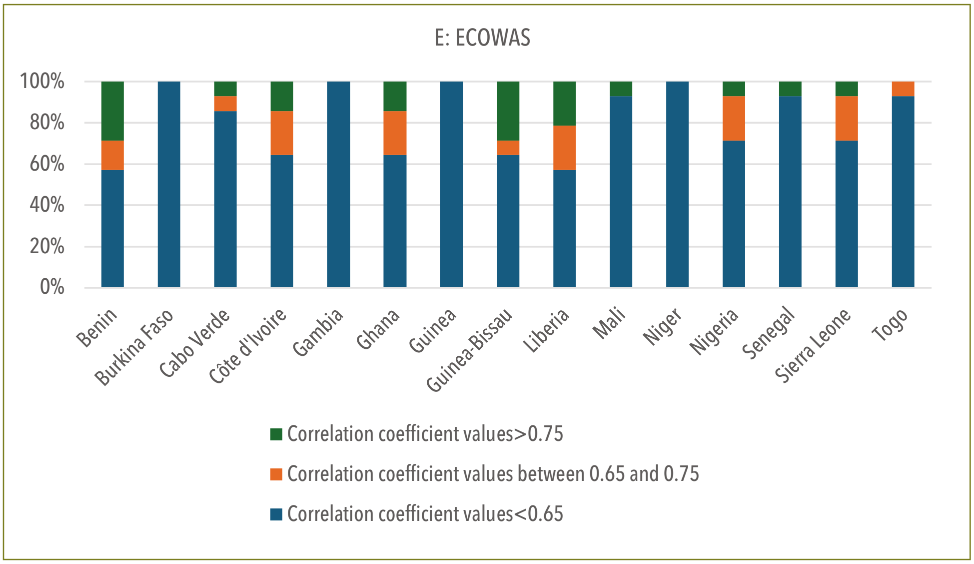
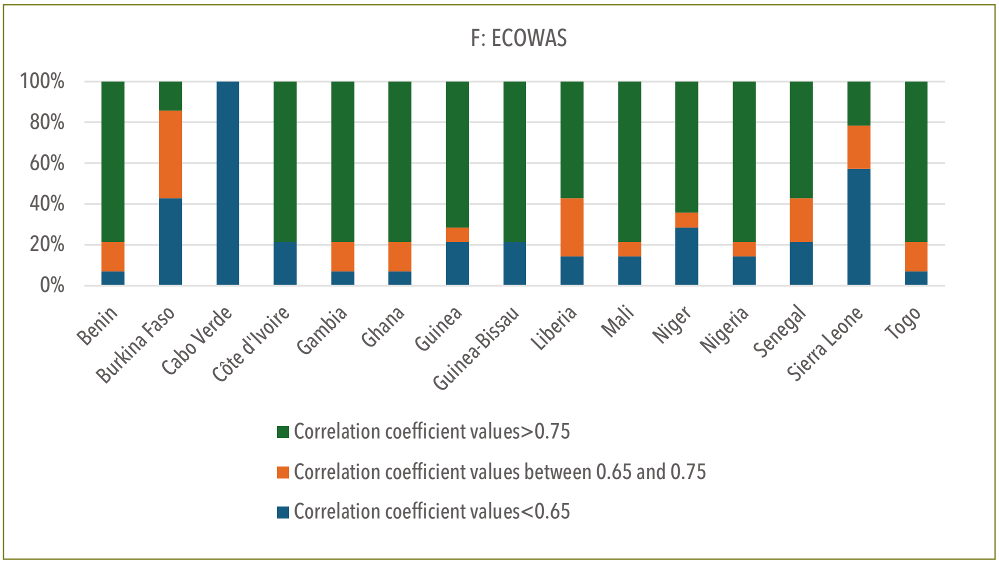
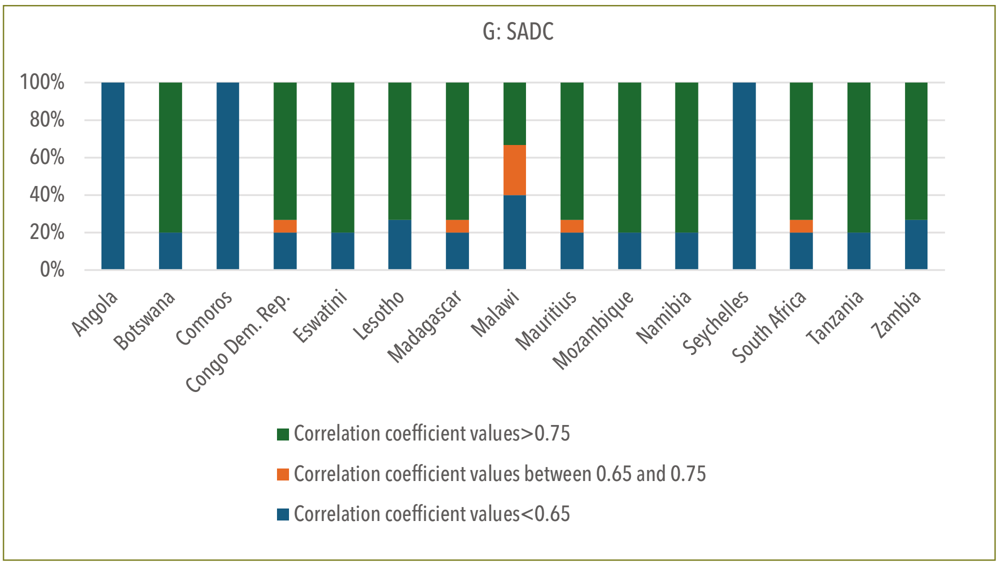
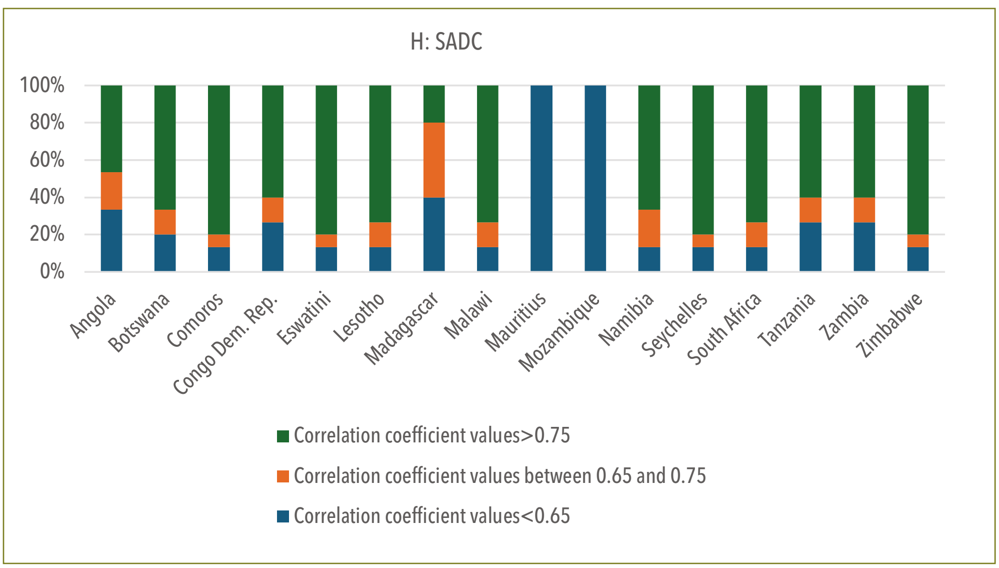
40%
20%
0%
1961-1990
1991-2021
Angola
Burundi
Cameroon
Central African Rep.
Chad
Dem. Rep. Congo
Rep. of Congo
Gabon
Equatorial Guinea
Rwanda
Sao Tome & Principe
Correlation coefficient values<0.65
Correlation coefficient values between 0.65 and 0.75
Correlation coefficient values>0.75


E: ECOWAS
100%
80%
60%
40%
20%
0%
Benin
Burkina Faso
Cabo Verde
Côte d'Ivoire
Gambia
Ghana
Guinea
Guinea-Bissau
Liberia
Mali
Niger
Nigeria
Senegal
Sierra Leone
Togo
Correlation coefficient values>0.75
Correlation coefficient values between 0.65 and 0.75
Correlation coefficient values<0.65







Source: Authors' calculation from the FAOSTAT database.

This unfavorable pattern in each REC means that an increase in intraregional or intracontinental trade would not fill national deficits. Thus, neither regional nor continental trade can stabilize supplies, nor can they mitigate price variations.

Climate Change and Trade in Africa: What Is the Evidence?

Shifting comparative advantages and trade flows

Climate change will significantly impact trade flows due to shifting comparative advantages associated with rising temperatures, variations in precipitation, and plant pests and diseases. As highlighted above, one of the main findings of the literature is that both within- and cross-country comparative advantages will be affected due to the heterogeneity of climate change impacts. Since the late 1990s, several studies have looked at the potential impact of climate change on trade flows, mainly using two methodological approaches: simulation and econometric models. We focus here on six studies that use these methods.

In a seminal study, Ringler et al. (2010) assess the impact of climate change on yields and trade flows of African countries by 2050 using a model disaggregated by agroecological zones (Gulf of Guinea, Sudano-Sahelian, Southern, Eastern, and Central). Given the heterogeneous impact on yields (positive versus negative changes), little change occurs in net cereal imports for sub-Saharan Africa. Indeed, increases in net cereal imports in some areas balance out decreases in other regions. Across agroecological zones, Eastern Africa will experience the largest increase in net cereal imports (+15 percent) due to large negative changes in maize yields, while the Soudano-Sahelian zone will experience a 6 percent decline in net cereal imports due mainly to positive changes in yields. No significant changes were found for the other zones.

In the wake of the work by Costinot, Donaldson, and Smith (2016), studies by Gouel (2022) and Gouel and Laborde (2021) look at the impact of climate change in agriculture and the role of trade in the adaptation process, respectively. While Gouel and Laborde (2021) focus on the role of trade and find that export shares for maize, wheat, and rice will decrease for Africa by 2080 due to declining yields, Gouel (2022) goes further and provides more details, using a model that includes seven individual African countries and the rest of sub-Saharan Africa as a group, and considers 35 products. The results show, on average, a negative impact of climate change for Africa by 2080. Net agricultural trade (net exports as a proportion of agricultural production) deteriorates in most countries (ranging from −67 percent for Egypt to −9 percent for Nigeria) except South Africa, Kenya, and Ethiopia, where it improves by 1.42 percent, 0.70 percent, and 4.85 percent, respectively. Table 5.1 presents the changes in exports and imports of crops by country/region. As previously noted, only Ethiopia, Kenya, and South Africa register a positive impact; the remaining parts of the continent see a fall in their exports and an increase in their imports.

Table 5.1 Climate change impact on exports and imports in Africa (change in %)

Country/region	Exports	Imports
Egypt	−34.20	5.27
Morocco	−97.24	11.29
Nigeria	−90.05	8.86
Senegal	−92.42	15.32
Ethiopia	112.49	9.79
Kenya	21.40	0.54
South Africa	4.46	0.12
Rest of Sub-Saharan Africa	−59.49	7.14

Source: Authors' computation based on Gouel (2022).

The third study based on a simulation model was conducted by UNU-UNECA (2017) and focused on ECOWAS. Four crop systems are considered in the trade module: paddy rice, cereals, vegetables and fruits, and oilseeds. The simulations run up to 2100 are based on different shared socioeconomic pathways (SSPs).[1] Depending on the SSP considered, total intraregional trade may stagnate (SSP3 for rice; SSP2 for fruits and vegetables; SSP4 for oilseeds) or decline (SSP3 and SSP4 for cereals; SSP4 for fruits and vegetables), with significant cross-country heterogeneity. Overall, no clear trend appears: specific countries are likely to become net food exporters in some years and net importers in others. Extra-ECOWAS imports of rice will either increase or stagnate depending on the country: the highest increases are in Côte d'Ivoire (806 percent in 2040), Ghana (710 percent in 2020), and Benin (643 percent in 2045).

In addition to simulation-based studies, two pieces of research rely on econometric (ex post) evaluations. The first study, by Barua and Valenzuela (2018), assesses the impact of high temperature and precipitation on agricultural exports of low- and middle-income countries from 1962 to 2014 on six product groups (grains, oilseeds, fruits and vegetables, tropical crops, livestock, and dairy and eggs). The results suggest that at the global level, a 1°C increase in temperature yields a 1.6 percent drop in agricultural exports. Curiously, no effect is found for precipitation. One can wonder if the absence of effect for precipitation is due to either an omitted nonlinear trend or the inclusion of the dispersion of the variable instead of its level. In Africa, a 1°C increase in temperature yields a 14 percent fall in agricultural exports, the highest impact found, and nine times the world average.

The second econometric study, by Jones and Olken (2010), also assesses the impact of high temperature and precipitation on exports of developing countries. The findings suggest that a 1°C increase reduces the growth of poor countries' exports by 2.4 percentage points. For the subsample of exports to the United States, dairy products and eggs (−12.35 percentage points) and cereals and preparations (−12.24 percentage points) are the most impacted agricultural products. Finally, here too, no significant impact of precipitation is found.

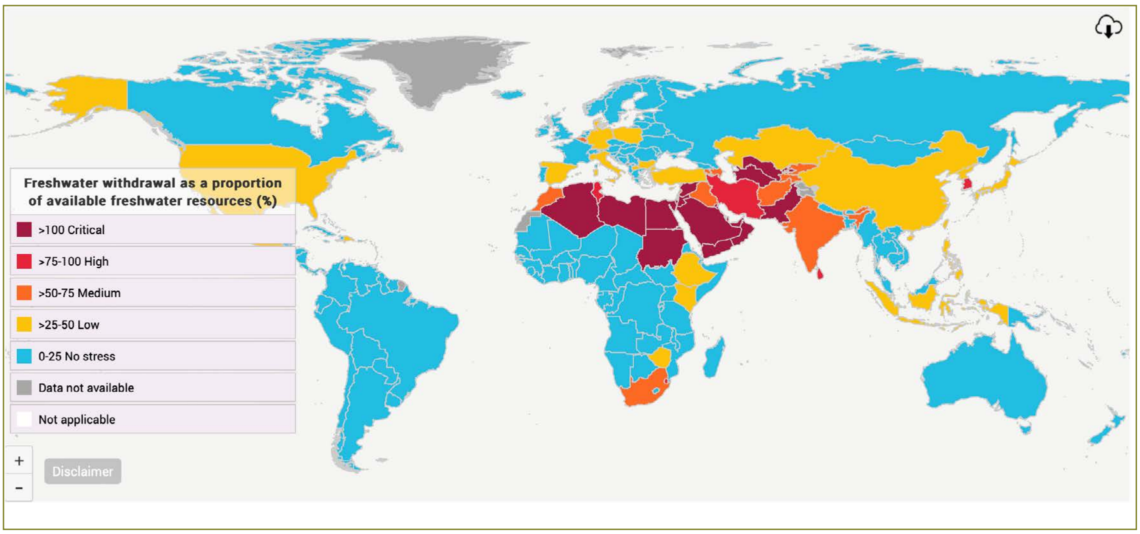
1 SSP1 refers to a world where state actors are dominant and strong institutions exist; in SSP2 the focus is on long-term priorities with a rigorous transition to sustainable development; SSP3 represents a case where nonstate actors are fully developed; SSP4 corresponds to a state of the world where nonstate actors are dominant and institutions and governance in the public sector are weak.

A typology of products' sensitivity to climate change and their comparative advantages

To assess the sensitivity of different agricultural products to climate, we rely on two main criteria: products' water content and their sensitivity to temperature. We also examine the link between these two variables and the comparative advantage of African countries in order to identify how the countries' comparative advantage might be affected by climate change.

To identify whether products are sensitive to water, we classify them into two categories: those for which the water content is greater than the median of the specific water demand[2] (high water sensitivity) and those for which it is below the median (low water sensitivity). Water content is defined as the specific water demand for each commodity group (in cubic meters per ton), a parameter used to compute the data analyzed in Chapter 3 of this report. This index is of particular importance, given that several African countries (especially in North Africa) are characterized by a high level of water stress (Figure 5.9). In addition, sub-Saharan Africa has a low level of water productivity (measured by GDP per cubic meter of total freshwater withdrawal) relative to other developing regions, such as Latin America and East Asia and the Pacific, and a low level of renewable freshwater resources per capita (Figure 5.10).

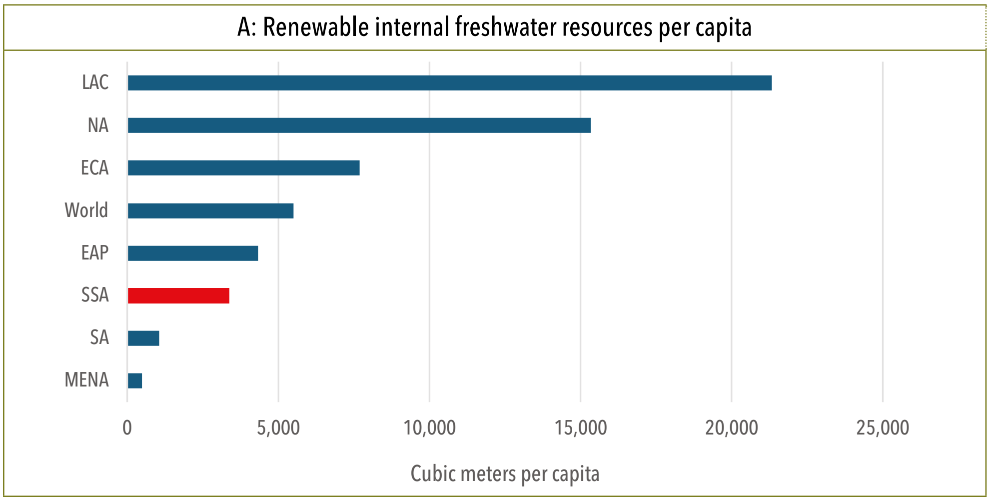
Figure 5.9 Global level of water stress, 2020

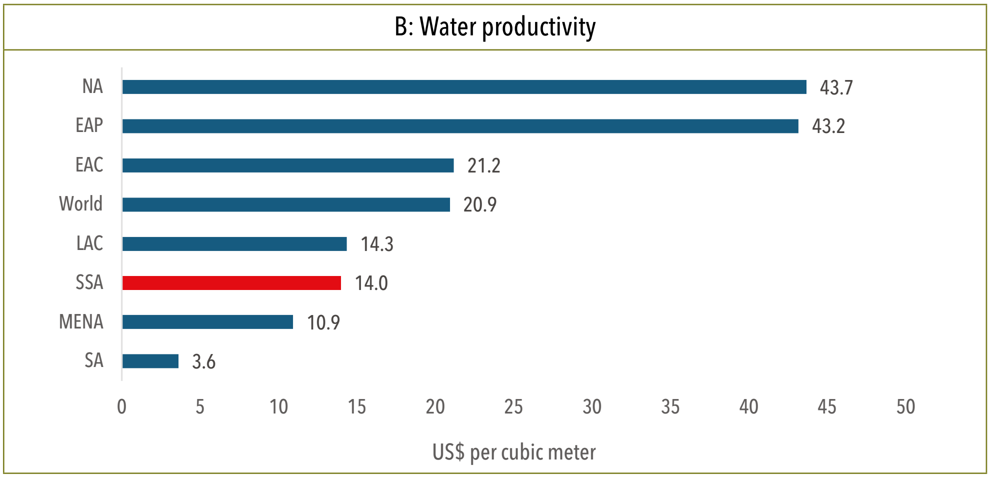


Source: FAO exported from UN Water: https://sdg6data.org/en/indicator/6.4.2
Note: Freshwater withdrawal as a proportion of available freshwater resources.

2 We also redid the calculation using as a threshold a higher percentile (90%) of water content instead of the median, with almost identical results.

Figure 5.10 Water indicators by global region, 2020





Source: World Development Indicators online dataset.
Note: A: Renewable internal freshwater is measured in cubic meters. B: Water productivity is measured at constant 2015 US$ GDP per cubic meter of total freshwater withdrawal. EAC = East Asia and Pacific; EAP = Europe and Central Asia; MENA = Middle East and North Africa; NA = North America; LAC = Latin America and Caribbean; SA = South Asia; SSA = Sub-Saharan Africa.

We use temperature data from the Food and Agriculture Organization of the United Nations (FAO) to estimate the elasticity of yield to temperature by running the following regression for each product:

$$\Delta Yield_{it} = \alpha_0 + \alpha_1 \Delta Temp_i + \delta_t + \eta_i + \varepsilon_{it} \qquad (4)$$

where the dependent variable $\Delta Yield$ is the change in yield for product *k* in country *i* and year *t*; $\Delta Temp$ is the change in temperature; and δ_t and η_i are year and country fixed effects, respectively.[3] These fixed effects help control for time and country unobservables to avoid spurious correlations. For instance, temperature is correlated with distance from the equator, and a large body of literature suggests that this is correlated with poor institutions (Olsson 2005),[4] which may explain low agricultural yield. ε_{it} is the error term. This regression is run

3 Our sample covers all African countries over the period 1961 to 2022. Because we have monthly change in temperature, we calculate an annual average for each country.
4 The literature shows that distance from the equator in degrees latitude is positively associated with institutional quality and economic development.

for each product separately to get its estimated elasticity (see the appendix to this chapter, Table A5.1). Later, we classify products into two categories: (1) when the elasticity is statistically significant (at 1 percent, 5 percent, and 10 percent), the product is defined as temperature sensitive; and (2) when the elasticity is not significant, the product is temperature insensitive. Note that while our calculations do not reflect trade elasticities, these elasticities measure the change in yield due to the change in temperature. Thus, if yields are affected, total output and therefore exports will be affected.

Finally, to calculate the comparative advantage of each country, we rely on the Contribution to Trade Balance (CTB) index (modified version of Stellian and Danna-Buitrago et al. 2022),[5] as follows:

$$CTB_{,k} = \frac{1}{Y}\left[X_k - M_{.,k} - w_k(X - M\ \ )\right] \qquad (5)$$

where $w_k = \frac{X_k + M_k}{X + M_t}$ refers to the share of *k* Harmonized System 4-digit (HS4) product[6] in Africa's trade with the rest of the world between 2012 and 2022; *Y* refers to Africa's GDP; and X and M are Africa's total exports and imports, respectively. This index is similar to the revealed comparative advantage index, with some differences. First, exports are replaced by the trade balance and the share of each product in the zone's trade to account for imports. Second, to reveal comparative advantages (disadvantages), the observed trade balance ($X_k - M_k$) must be greater (lower) than the theoretical balance ($w_k(X - M)$). Thus, positive (negative) values of CTB refer to a comparative advantage (disadvantage). Third, the index is normalized on the GDP (Y) of the country in question to account for the size of its economy.

Based on these three indexes, we classify African unprocessed products[7] into several groups (Table 5.2).

Table 5.2 Typology of agriculture products' sensitivity to climate change

	High water sensitivity		Low water sensitivity	
Advantage	**Temperature sensitivity**	**Temperature insensitivity**	**Temperature sensitivity**	**Temperature insensitivity**
Revealed comparative advantage	Very high risk	High risk	High risk	Low risk
No revealed comparative advantage	Moderate risk	Low risk	Moderate risk	Very low risk

Source: Authors' elaboration.
Note: (1) The comparative advantage of each country is measured by the Contribution to Trade Balance (CTB) index. If the index is positive (negative), the country has a comparative advantage (disadvantage). (2) Temperature sensitivity is measured by the elasticity of yields with respect to temperature. If it is statistically significant (insignificant), the product is defined as temperature sensitive (insensitive). (3) Water sensitivity is measured by the specific water demand. If the water content is greater (less) than the median, products are characterized by a high (low) water sensitivity.

5 Intra-Africa trade is excluded when computing the index. This index is calculated using the 2012 to 2022 average for trade flows at the HS4 level.
6 HS4 refers to the Harmonized System classification.
7 We include only unprocessed products for which we were able to find data on water and temperature sensitivity; thus, some products are not included in our analysis.

First, when an African country has a comparative advantage in a certain product that is sensitive to both water and temperature, we identify the latter as having a very high risk with respect to climate change. Second, when a country has a comparative advantage in a product that is sensitive to either water or temperature, the latter has a high risk, as the country may experience a decline in its comparative advantage when climate conditions deteriorate. Third, a moderate risk prevails if the product is sensitive to water and/or temperature, but the country has no comparative advantage: the potential development of this product in the medium term will be constrained by climate conditions. Finally, low risk characterizes a product that has a comparative advantage but is not sensitive to temperature or to water content, while a very low risk exists if that temperature- and water-insensitive product does not have a comparative advantage, as the country's specialization is not affected.

Potential impact of climate change on trade flows

Table 5.3 and Table 5.4 present the products corresponding to the typologies described above. It is important to note that, generally, the optimal temperature ranges differ not only between crops but also at different growth stages of the same crop. This is why it is crucial to understand the crop calendar of cool-weather crops, as they may require different levels of sunshine, rainfall, humidity, and warmth (Molua and Lambi 2007).

The first group of products associated with a ***very high risk*** includes products that are sensitive to both water and temperature and that have a comparative advantage. This includes leguminous vegetables (shelled or unshelled, fresh, or chilled, such as green beans, peas, broad beans and horse beans); edible nuts and coconuts (whether or not shelled or peeled); groundnuts (not roasted or otherwise cooked, whether or not shelled or broken) oilseeds; and oleaginous fruits. The second group includes products associated with a *high risk*. Products sensitive to heat but not to water include mainly vegetables (tomatoes, onions, carrots, cucumbers, and artichokes) and some fruits (apples, apricots, cherries, and bananas). This is because these products' optimum temperature ranges from 25 to 30°C. Generally, warm weather crops grow best at temperatures between 18 and 27°C. Products sensitive to water but not to heat include nuts (excluding coconuts, Brazil nuts, and cashew nuts, fresh or dried, whether or not shelled or peeled). Ramirez and Kallarackal (2015) show that the duration of flowering and fruiting of several species has increased by a few days and the cool hours have also grown shorter, leading to a decrease in the production of several species.

Moderate risk products include those that are sensitive to water and/or temperature but have no comparative advantage. Thus, with climate change, it is difficult to conceive that such products can be cultivated in Africa. They include rice, oats, grain sorghum, buckwheat, millet, and canary seeds; soya beans and oilseeds; and linseed and sunflower seeds, in addition to maize. This is in line with the results of Sun et al. (2019) and Gouel and Laborde (2021), who find that exports of maize (and wheat) will decline under climate change. Among the reasons why soybean belongs to the group of moderate risk products, Deryng et al. (2014) also show that this crop could improve globally through to the 2080s due to CO_2 fertilization effects.

Finally, *low risk* products include potatoes, cabbages, cauliflowers, lettuce, dates, figs, pineapples, avocados, guavas, mangoes, citrus fruits, and grapes. ***Very low risk*** products include rye, barley, rapeseed, and colza seeds.

Table 5.3 Temperature and water sensitivity for products with a comparative advantage

Sensitivity	High water sensitivity	Low water sensitivity
Temperature sensitive	• Leguminous vegetables; shelled or unshelled, fresh or chilled • Nuts, edible; coconuts, Brazil nuts, and cashew nuts; fresh or dried, whether or not shelled or peeled • Groundnuts; not roasted or otherwise cooked, whether or not shelled or broken • Oilseeds and oleaginous fruits, other, in HS Chapter 12; whether or not broken	• Tomatoes, fresh or chilled • Onions, shallots, garlic, leeks, and other alliaceous vegetables; fresh or chilled • Carrots, turnips, salad beetroot, salsify, celeriac, radishes, and similar edible roots; fresh or chilled • Cucumbers and gherkins; fresh or chilled • Vegetables; other, in HS Chapter 7; fresh or chilled • Manioc, arrowroot, salep, Jerusalem artichokes, sweet potatoes, and similar roots and tubers • Bananas, including plantains; fresh or dried • Apples, pears, and quinces; fresh • Apricots, cherries, peaches (including nectarines), plums, and sloes; fresh
Temperature insensitive	• Nuts (excluding coconuts, Brazil nuts, and cashew nuts); fresh or dried, whether or not shelled or peeled	• Potatoes; fresh or chilled • Cabbages, cauliflowers, kohlrabi, kale, and similar edible brassicas; fresh or chilled • Lettuce and chicory; fresh or chilled • Dates, figs, pineapples, avocados, guavas, mangoes, and mangosteens; fresh or dried • Citrus fruit; fresh or dried • Grapes; fresh or dried • Melons (including watermelons) and papaws (papayas); fresh • Fruit, fresh; other, in HS Chapter 8 • Locust beans, seaweeds and other algae, sugar beet, sugarcane; fresh, chilled, frozen, or dried

Source: Authors' elaboration.

Note: Red cells refer to products that have a very high risk (sensitive to both water and temperature and have a comparative advantage) or high risk (sensitive to either water or temperature and have a comparative advantage). Green cells refer to products that have a low risk (not sensitive to water or temperature and no comparative advantage).

Table 5.4 Temperature and water sensitivity for products without a comparative advantage

Sensitivity	High water sensitivity	Low water sensitivity
Temperature sensitive	• Rice	• Wheat and meslin • Maize (corn)
Temperature insensitive	• Oats • Grain sorghum • Buckwheat, millet, and canary seeds; other cereals • Soya beans, whether or not broken • Oilseeds; linseed, whether or not broken • Sunflower seeds, whether or not broken	• Rye • Barley • Rapeseed or colza seeds, whether or not broken • Seeds, fruit, and spores; of a kind used for sowing

Source: Authors' elaboration.
Note: Yellow cells refer to products that have a moderate risk (sensitive to water and/or temperature, but the country has no comparative advantage). Green cells refer to products that have a low risk (not sensitive to water or temperature and no comparative advantage).

Conclusions

The climate change–trade nexus has been much debated over the past decade. For Africa, the issue is paramount. This chapter showed that agriculture still represents a significant share of African economies, although the trend is declining as countries grow and their economies become more diversified. In addition, all of the most important indicators of climate change in Africa—such as temperature increases and sea level rise—are above global averages. Therefore, given the continent's degree of exposure and the size of the shocks it faces, significant impacts are expected from climate change–induced events in Africa.

Our findings support the conclusion that Africa's comparative advantage in agriculture will be highly affected by climate change, due to rising temperatures, the increased frequency of extreme events (in particular, droughts), plant pests and diseases, and reduced labor productivity. Although a certain degree of heterogeneity can be expected both within and between countries, the main message is that for most crops grown on the continent, climate change will reduce their yields. This in turn will lead to a fall in farm revenues, an increase in food imports, and a decrease in exports, and thus a widening trade deficit in agriculture and a deteriorating food security situation. Regional cereal trade can be expected to have some stabilizing effect that will mitigate these impacts. However, this is less the case for roots and tubers.

The above-mentioned negative outcomes are amplified by African countries' huge dependence on rainfed agriculture and by their low levels of input use. To paint a complete picture, we developed a typology of products' sensitivity to climate change (water and temperature) and their comparative advantage and proposed a risk profile for Africa's trade potential: the higher the sensitivity to climate change and the degree of comparative advantage, the higher the risk associated with climate change. Our typology highlighted four groups of products: those at very high risk (leguminous vegetables, edible nuts, and oilseeds); high risk (vegetables and some fruits, such as apples and bananas); moderate risk (mainly cereals and some oilseeds, such as soya beans and sunflower seeds); and low risk (mainly barley and colza seeds). Notably, most agricultural products traded or consumed in Africa appear to be at risk. Mitigating this risk and adapting to emerging climate conditions must be paramount, particularly in a global environment characterized by recurrent tensions and the resurgence of noncooperative trade policies such as export restrictions.

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Appendix 5.1

Table A5.1 Regressions results: Effects of variation of temperature on variation of yield for each agricultural product (based on equation 4)

Insensitive product	Coefficient	SE	t-stat		Insensitive product	Coefficient	SE	t-stat
Barley	0.00002	0.00005	0.47538		Tangerines, mandarins, clementines	0.00000	0.00001	0.05615
Rye	0.00094	0.00067	1.39445		Lemons and limes	−0.00001	0.00001	1.35805
Oats	−0.00012	0.00009	1.32548		Quinces	0.00000	0.00001	0.51549
Sorghum	0.00000	0.00005	0.01524		Cherries	−0.00004	0.00005	0.71717
Buckwheat	0.00004	0.00018	0.23211		Strawberries	0.00001	0.00001	0.52114
Fonio	−0.00019	0.00019	0.97685		Raspberries	−0.00001	0.00001	1.36139
Triticale	−0.00188	0.00152	1.24060		Other berries and fruits of the genus *Vaccinium,* n.e.c.	0.00000	0.00001	0.09767
Cereals, n.e.c.	−0.00009	0.00007	1.28635		Grapes	−0.00003	0.00003	1.22180
Potatoes	−0.00001	0.00001	1.41225		Watermelons	−0.00002	0.00003	0.64094
Taro	0.00003	0.00003	1.01460		Cantaloupes and other melons	0.00001	0.00001	1.64223
Edible roots and tubers with high starch or inulin content, n.e.c., fresh	0.00005	0.00004	1.34414		Figs	−0.00002	0.00002	1.14778
Sugarcane	−0.00004	0.00002	1.61066		Mangoes, guavas, and mangosteens	0.00000	0.00001	0.33467
Sugar beet	−0.00002	0.00002	1.06000		Pineapples	0.00000	0.00001	0.27879
Beans, dry	0.00002	0.00006	0.38448		Dates	0.00001	0.00001	0.63399
Broad beans and horse beans, dry	−0.00003	0.00008	0.36550		Cashew apple	0.00002	0.00001	1.37600
Peas, dry	−0.00034	0.00031	1.08430		Papayas	−0.00001	0.00000	1.58706
Chickpeas, dry	−0.00008	0.00040	0.19940		Other fruits, n.e.c.	0.00000	0.00000	0.47619

Insensitive product	Coefficient	SE	t-stat		Insensitive product	Coefficient	SE	t-stat
Cowpeas, dry	0.00020	0.00013	1.51353		Coffee, green	0.00035	0.00033	1.06812
Pigeon peas, dry	0.00014	0.00011	1.28222		Cocoa beans	0.00037	0.00044	0.84709
Bambara beans, dry	0.00005	0.00012	0.37838		Hop cones	0.00000	0.00007	0.03687
Other pulses, n.e.c.	−0.00187	0.00155	1.21070		Pepper (*Piper* spp.), raw	−0.00001	0.00007	0.21100
Chestnuts, in shell	0.00000	0.00000	1.16244		Chilies and peppers, dry (*Capsicum* spp., *Pimenta* spp.), raw	−0.00006	0.00005	1.20766
Almonds, in shell	−0.00008	0.00026	0.31013		Vanilla, raw	−0.00141	0.00099	1.42326
Walnuts, in shell	−0.00005	0.00020	0.26909		Cloves (whole stems), raw	0.00011	0.00117	0.09089
Kola nuts	0.00012	0.00010	1.18908		Nutmeg, mace, cardamoms, raw	0.00005	0.00020	0.22739
Hazelnuts, in shell	0.00003	0.00004	0.96338		Other stimulant, spice, and aromatic crops, n.e.c.	0.00011	0.00008	1.29939
Soya beans	0.00000	0.00006	0.04784		Pyrethrum, dried flowers	0.00044	0.00072	0.61172
Coconuts, in shell	−0.00006	0.00005	1.11538		Jute, raw or retted	−0.00001	0.00005	0.15296
Oil palm fruit	0.00003	0.00002	1.38571		Kenaf, and other textile bast fibers, raw or retted	−0.00019	0.00017	1.12262
Olives	−0.00017	0.00012	1.43246		Sisal, raw	0.00002	0.00024	0.07319
Karite nuts (sheanuts)	0.00003	0.00006	0.55822		Other fiber crops, raw, n.e.c.	−0.00011	0.00007	1.44324
Sunflower seed	−0.00015	0.00010	1.56128		Unmanufactured tobacco	0.00004	0.00004	0.85450
Rapeseed or colza seed	0.00004	0.00006	0.67782		Natural rubber in primary forms	−0.00003	0.00016	0.16188
Tung nuts	−0.00027	0.00021	1.26003		Raw milk of cattle	0.00004	0.00005	0.84222
Seed cotton, unginned	0.00008	0.00006	1.31424		Raw milk of sheep	0.00010	0.00054	0.18403
Linseed	−0.00020	0.00029	0.67395		Raw hides and skins of sheep or lambs	−0.00050	0.00094	0.53505

Insensitive product	Coefficient	SE	t-stat		Insensitive product	Coefficient	SE	t-stat
Other oilseeds, n.e.c.	0.00001	0.00005	0.21814		Raw milk of goats	0.00065	0.00040	1.59654
Cabbages	0.00000	0.00001	0.17456		Hen eggs in shell, fresh	−0.00006	0.00005	1.28778
Asparagus	0.00002	0.00002	1.15287		Eggs from other birds in shell, fresh, n.e.c.	0.00002	0.00003	0.50943
Lettuce and chicory	−0.00003	0.00002	1.31696		Raw milk of camel	−0.00012	0.00023	0.53768
Cauliflowers and broccoli	0.00000	0.00001	0.48107		Beeswax	−0.01328	0.00908	1.46178
Eggplants (aubergines)	0.00000	0.00001	0.42308		Roots and tubers, total	0.00116	0.00079	1.47623
Onions and shallots, dry (excluding dehydrated)	0.00000	0.00001	0.64583		Sugar crops, primary	0.00000	0.00000	0.29644
Leeks and other alliaceous vegetables	0.00001	0.00002	0.28515		Treenuts, total	−0.00022	0.00014	1.58222
String beans	0.00000	0.00001	0.28750		Vegetables, primary	0.00003	0.00002	1.52792
Okra	−0.00004	0.00003	1.62800		Fruit, primary	0.00000	0.00000	1.55853
Locust beans (carobs)	0.00004	0.00004	0.91063		Milk, total	−0.00015	0.00009	1.64035
Other vegetables, fresh, n.e.c.	−0.00001	0.00001	0.90406		Citrus fruit, total	0.00000	0.00001	0.68488
Oranges	0.00001	0.00000	1.32919		Fiber crops, fiber equivalent	0.00007	0.00013	0.51485

Sensitive product	Coefficient	SE	t-stat		Sensitive product	Coefficient	SE	t-stat
Wheat	−0.00012	0.00003	3.69136		Green garlic	−0.00002	0.00001	2.72216
Rice	−0.00006	0.00003	2.36293		Other beans, green	−0.00003	0.00001	4.77093
Maize (corn)	−0.02224	0.00669	3.32555		Peas, green	−0.00006	0.00002	3.40120
Millet	−0.00027	0.00007	3.80677		Broad beans and horse beans, green	−0.00002	0.00001	2.83721
Sweet potatoes	−0.00004	0.00001	3.80198		Carrots and turnips	−0.00002	0.00001	3.32731
Cassava, fresh	0.00001	0.00001	1.73267		Green corn (maize)	0.00002	0.00001	2.09052
Yams	0.00001	0.00001	1.77285		Bananas	−0.00001	0.00000	1.72273
Lentils, dry	0.00084	0.00028	2.93776		Plantains and cooking bananas	−0.00002	0.00001	1.73647
Vetches	0.00120	0.00046	2.60741		Pomelos and grapefruits	−0.00001	0.00000	1.85714
Lupins	0.00064	0.00029	2.22358		Other citrus fruit, n.e.c.	0.00002	0.00001	1.82418
Cashew nuts, in shell	−0.00109	0.00039	2.79558		Apples	−0.00001	0.00001	1.94678
Pistachios, in shell	−0.00452	0.00168	2.69742		Pears	−0.00005	0.00001	7.04965
Other nuts (excluding wild edible nuts and groundnuts), in shell, n.e.c.	0.00009	0.00003	2.71160		Apricots	−0.00007	0.00001	5.78226
Groundnuts, excluding shelled	−0.00013	0.00004	3.68732		Peaches and nectarines	−0.00011	0.00001	7.91971
Castor oilseeds	0.00025	0.00012	2.08223		Plums and sloes	−0.00003	0.00001	3.78917
Safflower seed	−0.00014	0.00008	1.78851		Other stone fruits	−0.00002	0.00001	1.91071
Sesame seed	0.00031	0.00010	2.99513		Avocados	0.00003	0.00001	2.27679
Melonseed	0.00046	0.00013	3.51003		Other tropical fruits, n.e.c.	0.00001	0.00000	1.86765
Artichokes	−0.00002	0.00001	1.98464		Tea leaves	0.00026	0.00008	3.21665
Spinach	−0.00001	0.00000	1.67955		Cinnamon and cinnamon-tree flowers, raw	−0.00220	0.00048	4.63179

Sensitive product	Coefficient	SE	t-stat		Sensitive product	Coefficient	SE	t-stat
Tomatoes	0.00001	0.00001	1.76110		Anise, badian, coriander, cumin, caraway, fennel and juniper berries, raw	−0.00008	0.00004	1.97500
Pumpkins, squash, and gourds	−0.00006	0.00002	2.52423		Ginger, raw	0.00012	0.00006	2.07179
Cucumbers and gherkins	−0.00003	0.00001	5.95819		Raw hides and skins of cattle	−0.00111	0.00024	4.57231
Chilies and peppers, green (Capsicum spp. and Pimenta spp.)	−0.00003	0.00001	2.57724		Raw hides and skins of goats or kids	−0.00285	0.00119	2.39004
Onions and shallots, green	0.00003	0.00002	1.94771		Cereals, primary	−0.02171	0.00655	3.31669
Eggs, primary	−0.00024	0.00005	4.61132		Pulses, total	0.00011	0.00005	2.03640
Oil crops, cake equivalent	−0.00012	0.00005	2.44511		Oil crops, oil equivalent	−0.00014	0.00007	1.90960

Source: Authors' elaboration using Stata.
Note: If the elasticity is statistically significant (at 1 percent, 5 percent, or 10 percent), the product is assumed to be sensitive. If not, it is insensitive. n.e.c = not elsewhere classified; SE = standard error.

6

Agricultural Trade Integration in ECOWAS

Antoine Bouët, Souleymane Sadio Diallo, and Fousseini Traoré

Introduction

The Economic Community of West African States (ECOWAS) is a regional economic community (REC) composed of 15 member states and an associate country.[1] Created in 1975 in Abuja, ECOWAS was established to pursue stability and regional integration in Africa and, over time, has expanded its mandate to include political dimensions. It is one of the largest RECs in Africa, covering a physical area of 5.1 million square kilometers with an estimated population of 424.3 million people as of 2022. The region's gross domestic product (GDP) in 2022 was estimated at US$758 billion, which represents a quarter of Africa's GDP (World Bank 2024). As the ECOWAS region pursues a process of structural transformation, the region's economy has shifted toward industry and services, and the share of agriculture in GDP in ECOWAS countries has been declining, as in many developing countries (Laborde et al. 2018). However, the agriculture sector still represents 26 percent of GDP[2] on average across the region, although with a high degree of heterogeneity: the share of agriculture in total GDP ranges from 5 percent in Cabo Verde to 60 percent in Sierra Leone. The REC is a heterogenous bloc that encompasses economic and demographic giants like Nigeria and small states like Cabo Verde and Gambia. It also includes landlocked countries (Mali, Burkina Faso, and Niger), members with access to the sea (Guinea-Bissau and Sierra Leone), and island states (Cabo Verde).

ECOWAS is often cited as a successful example of regional integration in Africa. Indeed, since its beginning, the integration process has moved forward continuously with key successes such as the free movement of people, which has been in effect since 1979. Among the eight RECs recognized by the African Union, ECOWAS ranks fifth for trade integration and first in terms of the free movement of people, according to the Regional Integration Index built by the United Nations' Economic Commission for Africa (UNECA). However, when it comes to movement of goods, results are mixed, and serious challenges remain despite the formal processes of liberalization adopted by member states. The frictions affecting the free movement of goods are problematic, particularly for agricultural products, given that, in an environment marked by global crisis (notably the pandemic of COVID-19 in 2020 and the ongoing Russia–Ukraine war), regional trade could mitigate the negative impacts and stabilize domestic markets. Furthermore, recent political tensions, marked by the intention of three member states (Mali, Burkina Faso, and Niger) to withdraw from the organization, raise questions about the REC's sustainability.

This chapter assesses the level of agricultural trade integration in the ECOWAS area, progress made, and the challenges ahead. In the next section, we provide the historical background, reviewing early regional integration initiatives in Africa and the main steps in the construction of ECOWAS. The following section assesses trade costs within ECOWAS, including tariffs, nontariff measures, and logistics performance, with a special focus on costs arising from currency diversity as an impediment to trade. We then examine intraregional trade flows, including informal cross-border trade, which represents the bulk of these flows. Before concluding, the chapter presents key achievements and main challenges to greater integration.

1 Current ECOWAS states are Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo, and Mauritania. After leaving ECOWAS in 2000 to join the Arab Maghreb Union (AMU), Mauritania rejoined in 2017 as an associate member. Mali, Burkina Faso, and Niger have recently decided to withdraw from ECOWAS.

2 If one considers the whole agrifood sector, including the processing and retail sectors, the share of GDP increases to 35 percent (OECD 2021).

Historical Background

Early regional integration initiatives in West Africa

West Africa has been a well-established, integrated region since the early 8th century and was home to the first known African empires, such as the Ghana empire and the Mali empire (also known as Mandé) in the 13th century, which included territory of several current West African countries. Both empires had strong trade relationships with their neighbors. They had large gold endowments and were at the crossroads of traders coming from both the north (Maghreb region) and south (Soudano region). In addition to gold, copper, and salt, agricultural products were highly traded in the region (Niane 1987). Trade was facilitated by the presence of homogenous ethnolinguistic groups established in several countries, which were later fragmented in the colonial period. These included the Mandingo group (present in Mali, Burkina Faso, Côte d'Ivoire, Guinea, Guinea-Bissau, and Gambia) and the Fulani group (present in Mali, Senegal, Burkina Faso, Guinea, Guinea-Bissau, Ghana, Benin, Niger, and Nigeria).

After the collapse of the empires, the colonial era saw the establishment of artificial subdivisions in the region. Following the Berlin Conference of 1885, the European powers divided up West Africa. In the francophone area, the Afrique occidentale française (AOF) bloc was created in 1895, composed of eight French colonies (Soudan Français, Mauritania, Senegal, Côte d'Ivoire, Niger, Guinea, Haute-Volta, and Dahomey).[3] In addition, there were Portuguese colonies (Cabo Verde and Guinea-Bissau); the territories of the British colonial empire (Nigeria, Ghana, Sierra Leone, and Gambia); Liberia, founded in 1822 by the United States to receive emancipated slaves; and Togo, a German colony.[4] This situation did not change until the independence years (mainly 1960). Then, some of the "fathers of independence" (Modibo Keita, Sekou Touré, Kwame Nkrumah, Félix Houphouët-Boigny, Leopold Sedar Senghor, and others), mindful of the balkanization of the region, took action to create greater unity by proposing that the countries seek independence in groups. Thus, in 1959, The Fédération du Mali was created, grouping Dahomey, Senegal, Soudan Français, and Haute-Volta, although Dahomey and Haute-Volta soon left to join a second bloc, the Conseil de l'Entente, formed by Côte d'Ivoire, Haute-Volta, Dahomey, Togo, and Niger. However, apart from Conseil de l'Entente, none of these entities lasted. In the same vein, in June 1959, seven francophone countries (Senegal, Mali, Côte d'Ivoire, Dahomey, Haute-Volta, Niger, and Mauritania) decided to create a customs union (Union douanière de l'Afrique de l'Ouest [UDAO]) with limited success, and which was transformed first into the Union douanière des États de l'Afrique de l'Ouest (UDEAO) in 1966 and, in 1972, into the Communauté économique de l'Afrique de l'Ouest (CEAO), which could be considered the precursor of ECOWAS. In addition, several specialized institutions in charge of specific sectors were created in parallel with the customs union. These included the Permanent Interstate Committee for Drought Control in the Sahel – CILSS[5] (created in 1973, and comprising Senegal, Mauritania, Guinea-Bissau, Guinea, Côte d'Ivoire, Mali, Burkina Faso, Benin, Togo, Niger, and Chad); the Senegal River Basin Development Organization – OMVS[6] (created in 1972 and comprising Senegal, Mali, Mauritania, Niger, and Guinea); and the Mano River Union (created in 1973 with Liberia and Sierra Leone, and joined by Guinea in 1980 and Côte d'Ivoire in 2008).

3 Soudan Français is now Mali; Haute-Volta is now Burkina Faso; and Dahomey is now Benin.
4 Liberia became independent in 1847. Following Germany's defeat in World War I, Togo was placed under the mandate of the League of Nations until 1946.
5 Comité Permanent Inter-États de Lutte contre la Sécheresse dans le Sahel
6 Organisation pour la mise en valeur du fleuve Senegal

Main steps in the construction of ECOWAS

After the failure of the early attempts to create regional economic blocs due to noncooperative policies on the part of member states, West African countries managed to create the first fully regional organization in 1975, composed of both French-speaking and English-speaking countries, with the aim of strengthening regional integration and maintaining peace and stability. ECOWAS was launched with the Lagos Treaty and included 16 countries in the region (Benin, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Haute-Volta, Liberia, Mali, Mauritania,[7] Niger, Nigeria, Senegal, Sierra Leone, and Togo). A major milestone was achieved shortly thereafter, with the launch of the ECOWAS Trade Liberalization Scheme (ETLS) in 1979 to foster regional trade. In response to the crisis that occurred in the early 1970s, the ETLS first covered agricultural and unprocessed products (for food security reasons) and handicrafts, before it was extended to industrial products in 1990. Agricultural products and handicrafts did not require proof of origin to benefit from the ETLS. However, the extension to industrial products required the definition and adoption of rules of origin for countries to benefit from the preferential tariffs.

In 1993, a revised treaty was signed in Cotonou, which reaffirmed the objectives of trade liberalization among member states and the establishment of a customs union via the adoption of a common external tariff (CET) and a common trade policy vis-à-vis third countries (article 3). Initially planned to be implemented gradually over a 10-year period (1990–2000), the establishment of the customs union experienced significant delays. Indeed, only in 2006 was the decision establishing the CET adopted, based on the West African Economic and Monetary Union (WAEMU/UEMOA)'s four tariff bands.[8] Due to pressures on some countries to protect a set of products deemed as sensitive, a fifth band was proposed in 2009 and adopted in 2013. The final CET structure, in place since 2015, is as follows: the first band covers essential goods with a tariff set to zero; the second band includes primary necessity goods and capital goods with a 5 percent tariff; the third band covers intermediate goods and inputs with a 10 percent tariff; the fourth band covers final consumption and finished goods with a 20 percent tariff; and the last band, with a 35 percent tariff, is for specific goods for economic development. Agricultural products fall mainly within the fourth band.

According to the revised treaty of 1993, the ECOWAS customs union now in force was to be a step toward the establishment of a common market and an economic and monetary union. Although the free movement of people is a reality, and ECOWAS has been a leader in this compared with other African RECs (UNECA and ECOWAS 2010), the establishment of the monetary union for all ECOWAS countries that was planned for 2010 has not yet occurred.

In terms of institutional evolution, ECOWAS was managed by a secretariat until 2007, when the secretariat was replaced by a commission consisting of seven commissioners with increased power. In 2013, a new extension was adopted to include eight additional commissioners, allowing for one representative per member state, although another reform, now effective, reverts to the previous institutional structure of seven commissioners. Currently, the ECOWAS Department of Economic Affairs and Agriculture, which includes the Directorate of Trade, the Directorate of the Customs Union and Taxation, and the Directorate of Agriculture and Rural Development, is the most relevant for agricultural trade. In addition to the Commission, the Conference of the Heads of States, the Council of Ministers, four institutions (the Parliament, the Economic and Social Council, the Court of Justice, and the Investment and Development Bank), and 15 specialized agencies are now operating in the community as the result of the integration process.

7 Mauritania later left the bloc, in 2000.
8 The WAEMU/UEMOA was created in 1994 and includes Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo.

These efforts made by member countries toward subregional integration should be reflected in the intra-ECOWAS trade costs. The following section examines these costs.

Intra-ECOWAS Trade Costs

Tariffs

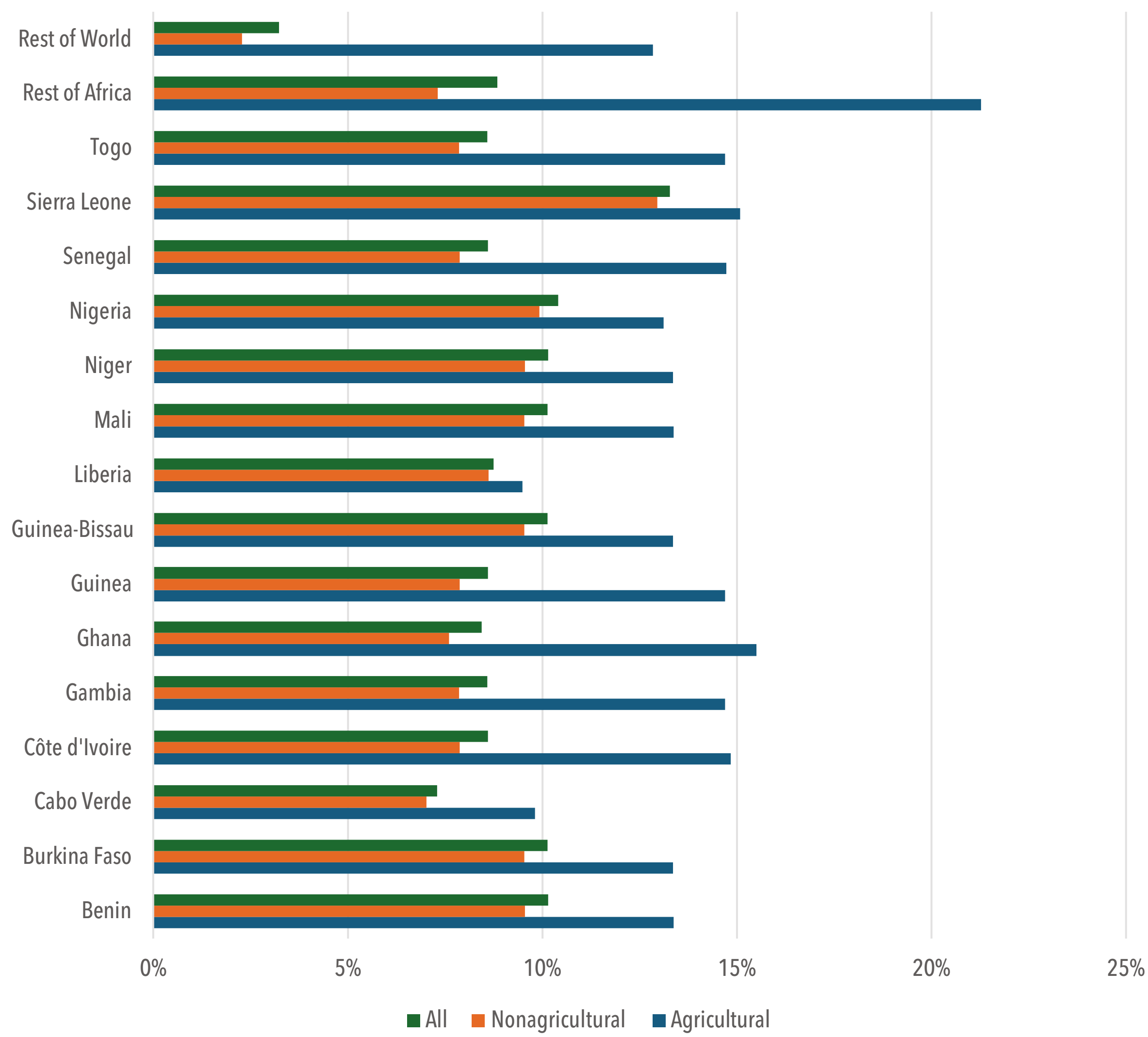
Data on tariffs implemented and faced by ECOWAS countries on agricultural trade flows come from CEPII's MacMAPs-HS6 database for 2019.[9] This database has the advantage of covering most tariff instruments and, above all, of taking into account all regional and preferential regimes for each country. It therefore offers, at the six-digit Harmonized System level (around 5,200 products), a bilateral measure of protection at a disaggregated level. It can be aggregated on all dimensions: instruments of protection by calculating ad valorem equivalents, countries notifying protection, partner countries penalized by this protection, and products.

We measure protectionism in relative terms: protection of agricultural products relative to protection of industrial products; protection vis-à-vis ECOWAS countries relative to protection vis-à-vis African non-ECOWAS countries; and protection vis-à-vis ECOWAS countries relative to protection vis-à-vis non-African countries. Indeed, trade costs must be measured in relative, not just absolute, terms: a 10 percent tariff must not be considered in isolation, but rather should be compared with tariffs penalizing imports of other products and those penalizing imports of the same product from other origins (Anderson and Van Wincoop 2003). This is related to "multilateral resistance," which is the concept that "all else equal, two countries will trade more with each other the more remote they are from the rest of the world" (Yotov and Larch 2016, 5). In the remainder of this section, we measure customs protection in absolute terms, but by giving levels of protection not just on a category of products or vis-à-vis a set of trading partners but also as a function of other categories of products or sets of partners. Comparing these levels of protection allows us to take multilateral resistance into account.

Figure 6.1 shows the average tariff imposed in 2019 by the 15 ECOWAS countries on all products, on agricultural products, and on nonagricultural products, from all sources of imports. Tariffs are aggregated according to the reference group methodology. The advantage of this methodology is that weights account for the potential magnitude of trade flows while reducing potential endogeneity bias (see Bouët et al. 2008). Endogeneity bias emerges when tariffs imposed by country s on product k coming from country r are weighted by imports by country s on product k coming from country r (in that case, with an increasing tariff, its weight decreases). With the reference group methodology, tariffs imposed by country s on product k coming from country r are weighted by imports by a reference group similar to country s[10] on product k coming from country r.

9 Centre d'Études Prospectives et d'Informations Internationales. We thank Houssein Guimbard for access to these data.
10 These reference groups are based on a clustering procedure that uses per capita GDP and trade openness.

Figure 6.1 Average import duties (%) imposed by ECOWAS, non-ECOWAS African countries, and non-African countries on imports from the rest of the world, 2019



Source: MacMaps-HS6 (2019) and authors' calculation.

Overall, African countries are more protectionist than the rest of the world taken globally, in all sectors as well as in agriculture and industry. However, it should be noted that the ratio of African protection to the rest of the world's protection is higher in industry than in agriculture.[11]

The overall level of trade protection in ECOWAS countries on average is close to the level in the rest of Africa, with some countries more open, such as Cabo Verde, Gambia, and Côte d'Ivoire, and some more closed, such as Sierra Leone and Nigeria.

11 It should be remembered that, in the MacMaps-HS6 database, any aggregation of importing or exporting countries or products is done using a methodology based on reference groups, which accounts for the size of the flows by minimizing potential endogeneity biases (see Bouët et al. 2008). However, the "nonagricultural" sector includes the industrial sector.

The agriculture sector is systematically more protected than the industrial sector: for example, in Côte d'Ivoire, industry is protected by an average tariff of 7.9 percent compared with 14.8 percent in agriculture. However, agriculture is significantly less protected in ECOWAS countries on average than in other African regions and countries. For illustration, the Senegalese agriculture sector is protected by an average tariff of 14.7 percent, compared with an average rate of 21.3 percent for agriculture in the rest of Africa.

Table 6.1 gives (1) the rate of protection on agricultural products imported by the zones in the column for goods whose origin is the countries in the rows; and (2) the rate of protection imposed by the countries in the rows on agricultural products imported from the zones in the columns. For example, as shown in the last column, Burkina Faso imposes an average customs duty of 13.4 percent on agricultural products from countries outside the African continent.

Table 6.1 Average level (%) of import duties on all agricultural imports, intra-ECOWAS imports, and extra-ECOWAS imports, 2019

Tariffs imposed by the region in column on imports from the country in row			Tariffs imposed by the country in row on imports from the region in column		
Country	**Rest of Africa**	**Rest of World**	**Country**	**Rest of Africa**	**Rest of World**
Benin	18.2%	5.3%	Benin	15.8%	13.4%
Burkina Faso	14.6%	8.3%	Burkina Faso	15.8%	13.4%
Cabo Verde	13.7%	2.8%	Cabo Verde	10.8%	9.8%
Côte d'Ivoire	16.1%	4.3%	Côte d'Ivoire	14.7%	15.2%
Gambia	17.7%	5.7%	Gambia	14.7%	15.2%
Ghana	12.9%	4.7%	Ghana	15.3%	16.0%
Guinea	13.1%	5.5%	Guinea	14.7%	15.2%
Guinea-Bissau	14.2%	6.1%	Guinea-Bissau	15.8%	13.4%
Liberia	4.9%	3.0%	Liberia	12.7%	9.2%
Mali	8.4%	3.9%	Mali	15.8%	13.4%
Niger	11.3%	8.8%	Niger	15.8%	13.4%
Nigeria	16.3%	9.8%	Nigeria	15.4%	13.2%
Senegal	21.6%	6.6%	Senegal	14.7%	15.2%
Sierra Leone	13.9%	7.1%	Sierra Leone	18.1%	14.2%
Togo	20.9%	8.5%	Togo	14.7%	15.2%
Rest of Africa	12.5%	11.5%	Rest of Africa	12.5%	22.0%
Rest of World	22.0%	13.0%	Rest of World	11.5%	13.0%

Source: MacMaps-HS6, CEPII database, http://www.cepii.fr/CEPII/fr/bdd_modele/bdd_modele_item.asp?id=12
Note: Columns 2 and 3 show the tariffs imposed by the region in column on imports from the country in row; so, for example, 18.2 percent is the average duty on imports faced by Benin's agricultural exports to the rest of Africa. Columns 5 and 6 show the tariffs imposed by the country in row on imports from the region in column; so, for example, 15.8 percent is the average duty on imports faced by the rest of Africa's agricultural exports to Benin.

Table 6.1 provides important insights that may explain the relative introversion of ECOWAS countries. As we will see later, in West Africa, agricultural trade is more introverted than extraverted: this means that the agricultural trade of ECOWAS countries is more oriented toward the interior of this community than toward the exterior—assuming that this relative introversion is properly measured. Customs duties imposed on products originating in the rest of Africa or in the rest of the world are relatively high, exceeding 10 percent for most extraregional intra-Africa flows, while duties on intra-ECOWAS trade are zero[12] because of the customs union. This encourages the introversion of ECOWAS agricultural trade.

At the product level, as noted, the ECOWAS common external tariff has five tariff bands: 0 percent, 5 percent, 10 percent, 20 percent, and 35 percent. From a food security point of view, important goods that are protected by high tariffs are wheat flour (20 percent), canned turkey and pork (35 percent), fresh pork (20 percent) and frozen pork (35 percent), potatoes (35 percent), peas (20 percent), beans (20 percent), sweet corn (20 percent),and onions and shallots (35 percent).

It should be noted that, when ECOWAS countries export outside the REC, the customs duties imposed by non-African countries are lower than those imposed by non-ECOWAS African countries. Therefore, these tariff structures give producers more incentive to export outside Africa than within Africa when exporting outside ECOWAS. This incentive should change with the establishment of the African Continental Free Trade Area (AfCFTA). However, trade flows depend not only on trading costs like tariffs but also on the productive capacities of exporting countries and the absorption capacity of importing countries; the productive and absorption capacities of West African countries also matter. For example, African countries do not yet have a strong cocoa processing industry like European countries, and their demand for chocolate is low. So even if there were no duties on intra-African trade, a significant part of the region's cocoa production would still go to the extra-African market.

Nontariff measures

As a result of the global trade liberalization movement characterized by the gradual removal of tariffs, nontariff measures (NTMs) have rapidly emerged as the main constraint on international trade. Environmental and health concerns are often invoked as the rationale for the application of NTMs, although they can ultimately prove to be a constraint on trade (Guedegbe 2016). NTMs can be categorized based on their scope and/or design (Sanjuàn Lopez et al. 2021). These measures include sanitary and phytosanitary measures (SPS), technical barriers to trade (TBT), pre-shipment inspections and other formalities, contingent trade protection measures, and intellectual property rights and rules of origin, among others.

It is difficult to find detailed data on the application of NTMs in Africa in general and in the ECOWAS region in particular. Table 6.2 shows the number and types of NTMs commonly applied in West Africa, as published by the World Trade Organization (WTO).

12 The MacMaps-HS6 database indicates positive tariffs on a few borders and a few products. We contacted the ECOWAS statistical services, which pointed out that this was not the case and that all customs duties on intra-ECOWAS trade are zero. Even if there are positive tariffs, their coverage is very small.

Table 6.2 Number of notified nontariff measures by category, 2022

	Sanitary and phytosanitary (SPS)	Anti-dumping (ADP)	Quantitative restrictions (QR)
Africa total	1,017	83	50
Africa average	32	17	13
Benin	6		
Burkina Faso	6		
Cabo Verde	4		
Côte d'Ivoire	19		15
Gambia	3		
Ghana	5	1	
Guinea	11		
Liberia	1		
Mali	21		20
Nigeria	29		
Senegal	7		
Togo	12		

Source: WTO, December 30, 2023. https://i-tip.wto.org/goods/Forms/MemberView.aspx?data=default
Note: No ECOWAS country has notified technical barriers to trade, according to the WTO database.

According to this data, apart from the anti-dumping measures applied by just one country (Ghana) and the quantitative restrictions applied by two others (Côte d'Ivoire and Mali), the NTMs declared by ECOWAS countries are limited to SPS measures (Table 6.2). The number of SPS measures declared in the ECOWAS zone varies from 1 in Liberia to 29 in Nigeria, showing that, taken individually, the West African countries are below the African continental average of 32 SPS measures. In addition to the lack of data for some ECOWAS member countries, the number of measures reported is insufficient to assess their impact on intraregional or third-country trade. Beyond the individual notifications in this table, ECOWAS has introduced various pest management, plant pest control, and SPS measures. The REC is working to strengthen member states' capability to adopt and implement science-based, coherent, and integrated plant pest control and SPS systems supportive of food security, shared prosperity, health, and trade for all Africans.[13]

Several studies have looked into the NTM issue and its implications for intracommunity trade in the ECOWAS region and on the African continent. These include, among others, Kalaba (2014), UNCTAD (2018), and Sanjuán López et al. (2021). According to Sanjuán López et al. (2021), the most critical impact of NTMs in intra-African trade is in sectors such as rice and sugar. They find not only that NTMs have a significant negative impact on intra-African trade in these products, but also that these products face a relatively high average number of NTMs.

In addition to the measures notified to the WTO, the results of surveys conducted by the International Trade Centre (ITC)[14] show that NTMs are diverse and omnipresent in intraregional trade in agricultural products (Guedegbe 2016). The findings of the surveys reveal that, for the ECOWAS countries covered, companies face NTMs in both origin and destination countries. In particular, the data show that 26 percent of restrictive NTMs are experienced in countries of

13 For more details, see https://ecowap.ecowas.int/ecowap-sector/2
14 The survey conducted in 2016 covered six ECOWAS countries: Benin, Burkina Faso, Côte d'Ivoire, Guinea, Mali, and Senegal. It was conducted among private companies operating in the agriculture and manufacturing sectors.

origin, while 30 percent are imposed in countries of destination. Moreover, 40 percent of the NTMs encountered by exporters of agricultural products in export markets are encountered in ECOWAS countries.

During negotiations for the AfCFTA, African countries, including those of ECOWAS, recognized the importance of NTMs. This recognition justified the adoption of an annex to the agreement specifically devoted to eliminating NTMs and to online reporting, monitoring, and removal mechanisms for NTMs.[15] This is particularly important because the work of Sanjuán Lopez et al. (2021) indicates that the application of technical and nontechnical NTMs has a systematic restrictive effect on agricultural trade. However, their results show that nontechnical measures have an even more significant impact on trade in agricultural products.

Logistics performance

Numerous studies have been devoted to investigating the links between logistics performance and trade around the world. These include work by Beké (2022) on ECOWAS; Takele and Buvik (2019) on Africa; Zaninović, Zaninović, and Skender (2021) in Europe; and Hausman, Lee, and Subramanian (2012) at the global level. The various assessments carried out in these studies show that logistics performance positively and significantly impacts a country's ability to trade with the rest of the world. The World Bank's Logistics Performance Index (LPI) is used to assess countries' performance, using a scale of 1 (low) to 5 (high) for the LPI and for each of its indicators. For the calculation methodology and a critique of the index, the interested reader can consult Chakrabartty (2020). The scores presented in Table 6.3 compare the logistics performance of ECOWAS with the African average and with other RECs.

Table 6.3 Logistics performance of ECOWAS compared with the African average and other regional economic communities

Region	Customs score	International shipments score	Logistics competence and quality score	Timeliness score	Tracking and tracing score
ECOWAS	2.30	2.58	2.49	2.64	2.49
SADC	2.42	2.71	2.66	2.93	2.65
COMESA	2.32	2.51	2.48	2.84	2.53
CEMAC	2.14	2.46	2.46	2.66	2.32
AMU	2.20	2.45	2.28	2.74	2.44
Africa	2.30	2.56	2.50	2.77	2.50

Source: Authors' calculation using the World Bank Logistics Performance Index database. https://lpi.worldbank.org/

The table shows that ECOWAS scores are well below the continental average on four out of five indicators of the LPI. Overall, ECOWAS performs worse than SADC and COMESA in this area, although it does better than CEMAC and AMU.[16] On the timeliness score, the subregion's score is below those of all the other RECs. On the other hand, despite being below the continental average, ECOWAS performs better than CEMAC on all components of logistics performance and scores better than AMU on customs, international consignments, logistics skills and quality, and tracking and tracing. The ECOWAS region's low scores can be explained by the performance of individual countries, as shown in Table 6.4. Most ECOWAS countries have relatively low scores, which pull down the average for the ECOWAS region.

15 https://www.tradebarriers.africa/
16 SADC = Southern African Development Community; COMESA = Common Market for Eastern and Southern Africa; CEMAC = Economic and Monetary Community of Central Africa; AMU = Arab Maghreb Union.

Table 6.4 Individual logistics performance for ECOWAS countries

Country	Customs score	International shipments score	Logistics competence and quality score	Timeliness score	Tracking and tracing score
ECOWAS	2.3	2.6	2.5	2.6	2.5
Benin	2.7	2.9	3.0	2.7	3.2
Burkina Faso	2.0	2.4	2.4	2.4	2.2
Côte d'Ivoire*	2.8	3.2	3.2	3.2	3.1
Gambia	1.8	2.6	2.3	2.6	2.4
Ghana	2.7	2.4	2.5	2.7	2.2
Guinea	2.4	2.2	2.7	2.5	2.7
Guinea-Bissau	2.7	2.9	2.9	2.4	2.3
Liberia	2.1	2.8	2.4	2.3	2.4
Mali	2.6	2.6	2.5	3.1	2.7
Niger*	2.1	2.3	2.2	2.7	2.5
Nigeria	2.4	2.5	2.3	3.1	2.7
Senegal*	2.2	2.4	2.1	2.5	2.1
Sierra Leone*	1.8	2.2	2.0	2.3	2.3
Togo	2.3	3.0	2.4	2.8	2.3

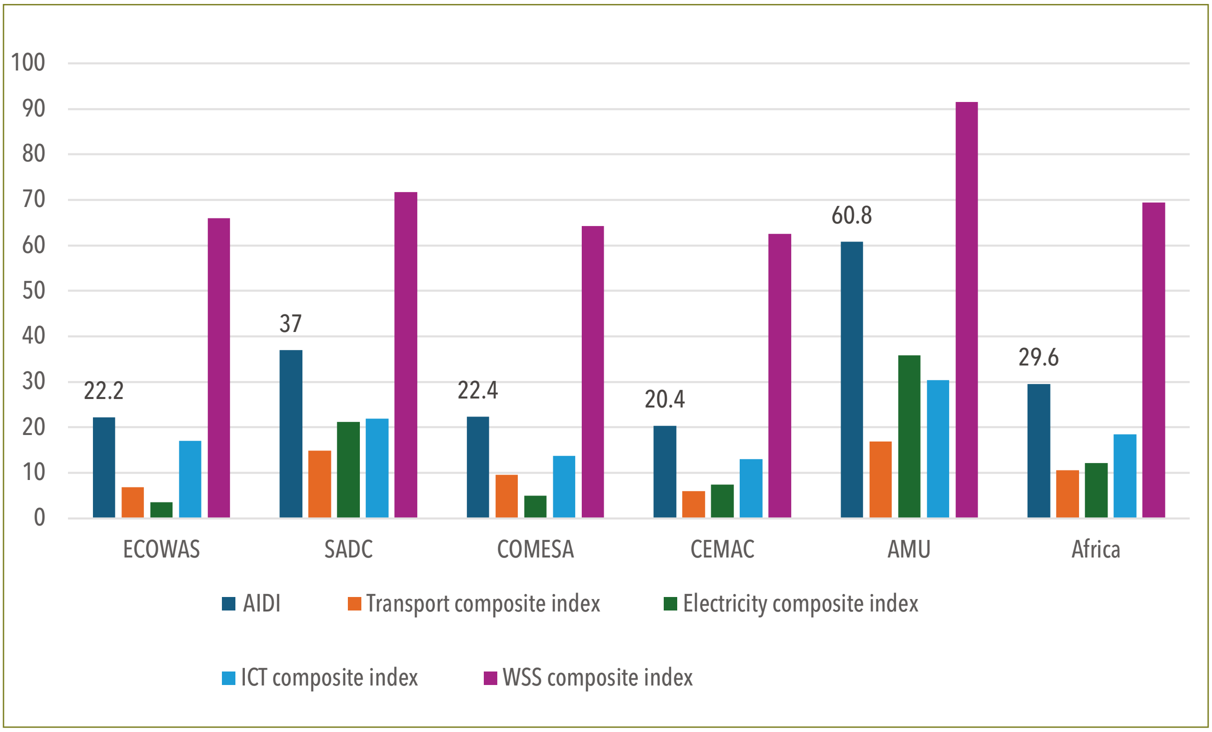
Source: Authors' calculation using the World Bank Logistics Performance Index database. https://lpi.worldbank.org/
Note: * In the absence of information for 2023, we have used 2018 data for these countries.

While some countries, such as Benin, Côte d'Ivoire, and, to a lesser extent, Nigeria, have performance scores above the subregional average, other countries score below the ECOWAS average. Burkina Faso, Gambia, and Sierra Leone have performance scores below the ECOWAS average for all indicators. This situation may act as a constraint on the development of intraregional trade, as well as trade with the rest of the world. Some countries face barriers to improved logistics performance that are beyond their control. This is the case, for example, with landlocked countries whose trade transits through third countries. For these countries, the level of logistical performance does not adequately reflect their efforts to facilitate trade because they depend in part on the transit systems of other countries.

Indeed, studies such as Gani (2017); Zaninović, Zaninović, and Skender (2021) in Europe; and Hausman, Lee, and Subramanian (2012) at the global level have shown that logistics performance is positively and significantly correlated with trade performance. These results are supported by the work of Beké (2022) in the specific case of ECOWAS. In particular, Beké shows that the direct costs of transport and logistics and the costs and delays associated with customs procedures are major obstacles to intraregional agricultural trade for ECOWAS.

Infrastructure performance is an essential element of logistics for trade facilitation. Figure 6.2 shows the Africa Infrastructure Development Index (AIDI) and its components for ECOWAS compared with the continental average and other RECs.

Figure 6.2 Infrastructure development indexes for ECOWAS compared with the African average and other regional economic communities



Source: Authors' calculation using data from the Africa Infrastructure Development Index (2022), https://infrastructureafrica.opendataforafrica.org/pbuerhd/africa-infrastructure-development-index-aidi-2022
Note: The value of the indexes varies from the less to the more efficient on a scale of 0 to 100. AIDI = Africa Infrastructure Development Index; ICT = information and communications technology; WSS= water supply and sanitation.

The AIDI has four components: the transport composite index, the electricity composite index, the information and communications technology (ICT) composite index, and the water supply and sanitation composite index. ECOWAS performs worse than the African average both on the overall composite index and all its component indexes. Similarly, ECOWAS performs less well than SADC on these indexes. The low level of infrastructure development is explained by the poor performance of transport, electricity, and, to some extent, ICT. Table 6.5 shows the individual performance of ECOWAS countries in terms of infrastructure development.

Table 6.5 Individual performance of ECOWAS countries in infrastructure development index

Country	Africa Infrastructure Development Index (AIDI)	Component			
		Transport composite index	Electricity composite index	ICT composite index	WSS composite index
Benin	17.4	5.2	0.4	15.3	53.3
Burkina Faso	20.3	10.9	2.1	13.9	62.8
Cabo Verde	49.8	25.5	15.6	27.6	90.7
Côte d'Ivoire	24.9	6.1	7.5	23.3	65.9
Gambia	30.3	7.6	2.4	21.9	75.6
Ghana	31.8	11.4	8.4	26.2	81.1
Guinea	18.8	4.7	2.6	14.9	69.3
Guinea-Bissau	15.3	5.2	1.6	14.1	49.3
Liberia	15.4	2.9	0.4	10.4	65.4
Mali	18.0	2.4	2.4	17.8	72.0
Niger	6.8	1.8	0.4	5.3	42.5
Nigeria	24.5	5.6	2.7	18.8	69.2
Senegal	31.3	3.6	4.8	20.2	77.9
Sierra Leone	12.7	4.1	0.9	12.1	57.9
Togo	15.2	5.9	1.7	12.6	57.0

Source: Authors' calculation using data from AIDI, https://infrastructureafrica.opendataforafrica.org/pbuerhd/africa-infrastructure-development-index-aidi-2022
Note: The value of the indexes varies from the less to the more efficient on a scale of 0 to 100. ICT = information and communications technology; WSS = water supply and sanitation.

The scores in Table 6.5 show that, in terms of the AIDI, only 6 of the 15 ECOWAS member countries are above the subregional average. These are Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Nigeria, and Senegal. Conversely, Niger and Sierra Leone have the lowest levels of infrastructure development. As far as the composite electricity index is concerned, where ECOWAS has the lowest level of development, only four countries are above the subregional average. These are Cabo Verde, Côte d'Ivoire, Ghana, and Senegal. In general, progress is more even across countries in the water supply and sanitation and ICT sectors. However, the significant progress achieved in the transport and electricity sectors in countries such as Cabo Verde is notable.

Many empirical studies have shown that infrastructure development has a positive and significant impact on trade. For example, Rahman et al. (2021) show that the development of transport infrastructure (roads, railways, seaports), ICT (mobile telephony), and electricity have a positive impact on trade, suggesting that ECOWAS needs to develop its infrastructure to facilitate trade.

Currency diversity and trade in West Africa

The ECOWAS zone, like ECCAS, is unusual among Africa's RECs in that it is composed of an eight-member economic and monetary union with a common currency and a group of seven other economies, each with its own currency and central bank. Table 6.6 lists the central banks, currencies, and exchange rate regimes of the 15 ECOWAS member states.

Table 6.6 Central banks, currencies, and exchange rate regimes in ECOWAS countries

Country	Issuing institute	Currency	Exchange rate regime
WAEMU countries: Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, Togo	Central Bank of States of West Africa (BCEAO)	Franc Communauté financière africaine (XOF)	Fixed exchange rate with the euro
Cabo Verde	Central Bank of Cabo Verde	Escudo (CVE)	Fixed exchange rate with the euro
Gambia	Central Bank of The Gambia	Dalasi (GMD)	Flexible exchange
Ghana	Bank of Ghana	Ghana Cedi (GHS)	Flexible exchange
Guinea	Central Bank of the Republic of Guinea	Guinean franc (GNF)	Flexible exchange
Liberia	Central Bank of Liberia	Liberian dollar (LRD)	Flexible exchange
Nigeria	Central Bank of Nigeria	Naira (NGN)	Flexible exchange
Sierra Leone	Bank of Sierra Leone	Leone (SLL)	Flexible exchange

Source: Laffiteau and Samaké-Konaté (2016).
Note: WAEMU = West African Economic and Monetary Union.

As the table shows, the ECOWAS zone thus has eight central banks, one of which is common to the eight WAEMU member states. Apart from the WAEMU's BCEAO and the Central Bank of Cabo Verde, which both have fixed exchange rates with the euro, the other central banks have flexible exchange rate regimes. Diop and Fall (2011) indicate that the fixed exchange rate regime is predominant within ECOWAS, reflecting the permanence of the fixed exchange rate regime in the WAEMU countries. However, they indicate that the weight of the fixed regime implemented (de facto) is slightly lower than that of the fixed regime declared (de jure), indicating that some countries are making adjustments of more or less significance to their exchange rates, despite their decision to keep them stable. An overview of exchange rate regimes published by the IMF in 2022 indicates that the environment is relatively complex. Table 6.7 shows that there is still considerable heterogeneity in the implementation of monetary policies and exchange rate regimes within ECOWAS countries.

Table 6.7 Exchange rate regimes and monetary policies in ECOWAS countries, 2022

Exchange rate arrangement	Exchange rate anchor		Monetary aggregate target	Inflation targeting framework
	US dollar	Euro		
Conventional peg		Cabo Verde WAEMU: Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, Togo		
Stabilized arrangement			Nigeria	
Crawl-like arrangement			Gambia, Guinea	Ghana
Other managed arrangement			Liberia, Sierra Leone	

Source: Authors' compilation from IMF 2022 data.
Note: WAEMU = West African Economic and Monetary Union.

While the WAEMU countries and Cabo Verde operate under a conventional fixed exchange rate regime anchored to the euro, the other ECOWAS countries operate under different regimes. Nigeria, which remains the subregion's leading economy, operates a stabilized exchange rate arrangement with a monetary aggregate targeting policy. Gambia, Guinea, Liberia, and Sierra Leone, like Nigeria, apply a monetary aggregate targeting policy with different variants of flexible exchange rate regimes. Ghana, on the other hand, targets a given inflation rate in its monetary policy.[17] The coexistence of these different exchange rate regimes and monetary policies within the ECOWAS zone makes the intraregional trade environment complex.

The multitude of currencies in the ECOWAS zone may act as a constraint on the development of intracommunity trade, although the issue does not appear to have been the subject of any specific study. On the upside, the adoption of a single currency could facilitate intracommunity trade. Indeed, a study by Mignamissi (2017) showed that the potential effect of the single currency on bilateral trade between ECOWAS countries, on the one hand, and ECCAS countries on the other, is positive and significant, but it differs by REC because of the different characteristics of the member countries. However, beyond the diversity of currencies, it is reasonable to think that the size of the economies could also play an important role in the capacity to drive trade. Within ECOWAS, Nigeria and Ghana potentially have greater capacity to drive intraregional trade than others, given their weight in the West African economy. Available data show that Nigeria and Ghana account for 62.7 percent and 9.5 percent, respectively, of total ECOWAS GDP, compared with 23.4 percent for the WAEMU countries as a whole. In contrast, countries such as Sierra Leone, Gambia, and Cabo Verde each account for less than 0.5 percent (World Bank 2024).

Many studies have been devoted to monetary issues in the ECOWAS region, most of which focus on the process of monetary integration with the creation of a single currency and its potential economic impact.[18] To our knowledge, these studies do not explicitly address the impact of currency diversity on trade in general or agricultural trade in particular.

Although Masson and Pottillo (2001) state that "monetary union is neither necessary nor sufficient to achieve other aspects of regional integration, in particular, intra-regional trade," authors such as Vinokurova et al. (2017) show that, after having made substantial progress in establishing a customs territory and common regulations, customs unions are faced with potential disruptions due to currency diversity and the lack of coordination of monetary policies.

In the particular context of ECOWAS, Abban and Ofori-Abebrese (2019) indicate that sovereign currencies in the ECOWAS subregion are barriers to trade due to the negative effect of exchange rate volatility, and they find that the countries using sovereign currencies have a greater negative effect on the level of trade in the subregion. Beké (2022) agrees. He points out that exchange rate stability and the absence of uncertainty and conversion costs conferred by a single currency have encouraged, for example, the significant creation of trade in agrifood goods in the WAEMU zone. This finding confirms the results of Taglioni (2002), who shows that in a multicountry and multicurrency context, exchange rate volatility has a strongly negative influence on trade. From his work, Taglioni deduced that exchange rate volatility is important, but it is less so within monetary unions, which supports the idea that use of a single currency within a given zone leads to a significant reduction in intrazone trade costs.

17 Ghana, Guinea, and Gambia are in a *crawl-like arrangement*. To be considered a crawl arrangement, the exchange rate must remain within a narrow margin of 2 percent of a statistically identified trend for six months or more (except for a specified number of outliers), and the exchange rate arrangement cannot be considered a true crawl exchange rate. A managed exchange rate regime is an exchange rate regime in which the exchange rate is neither entirely free (or floating) nor fixed. Rather, the value of the currency is kept in a range against another currency (or against a basket of currencies) by central bank intervention. For different definitions of the different regimes in Table 6.7, see Habermeier et al. (2009).

18 See Abban and Ofori-Abebrese (2019); Masson and Pattillo (2001); Adu, Litsios, and Baimbridge (2018); and Laffiteau and Samaké-Konté (2016), among others.

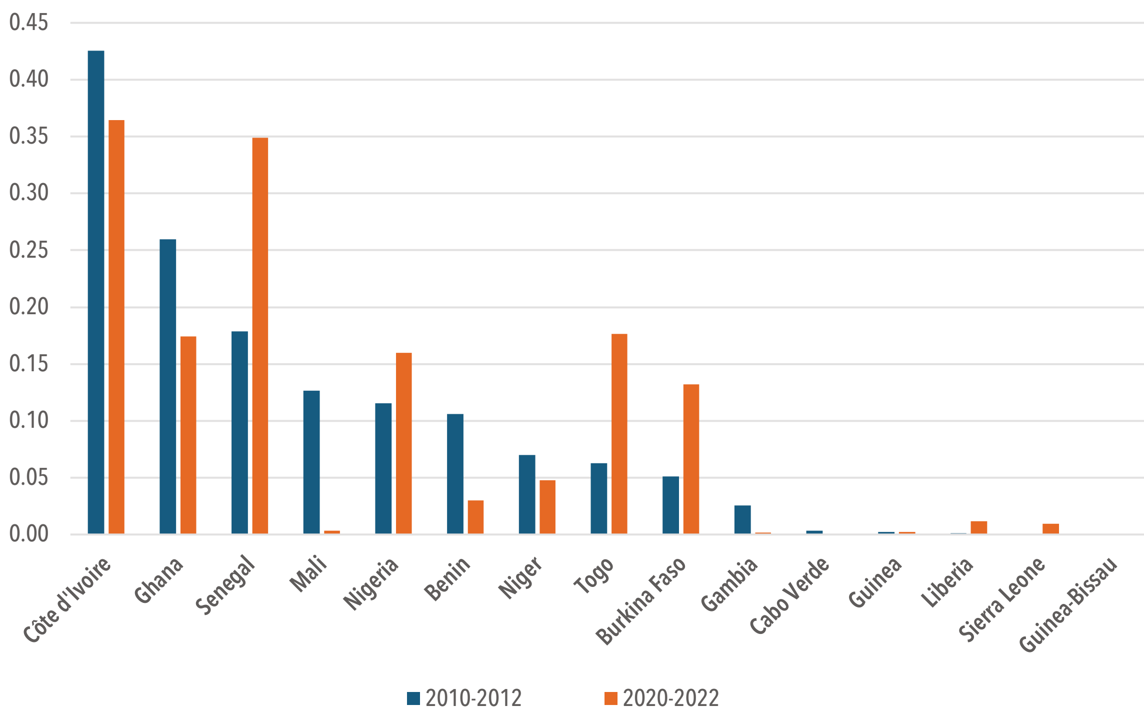
Intra-ECOWAS Trade Flows

This section looks at intra-ECOWAS agricultural trade. We first identify the region's most important exporters and importers and, for each country, the three most important partners and the three most important agricultural products on both the import and export sides. We then calculate indicators that measure the degree of regional integration, both simple ones such as the share of intraregional trade in total trade, and more sophisticated ones such as the regional trade introversion indicator.

Top exporters and importers

Figure 6.3 shows average intra-ECOWAS agricultural exports for the 15 member countries for the years 2020–2022 (to avoid a bias linked to an abnormal value for one year) and for 2010–2012, that is, 10 years earlier.

Figure 6.3 Intra-ECOWAS agricultural exports, 2010–2012 and 2020–2022, US$ billions



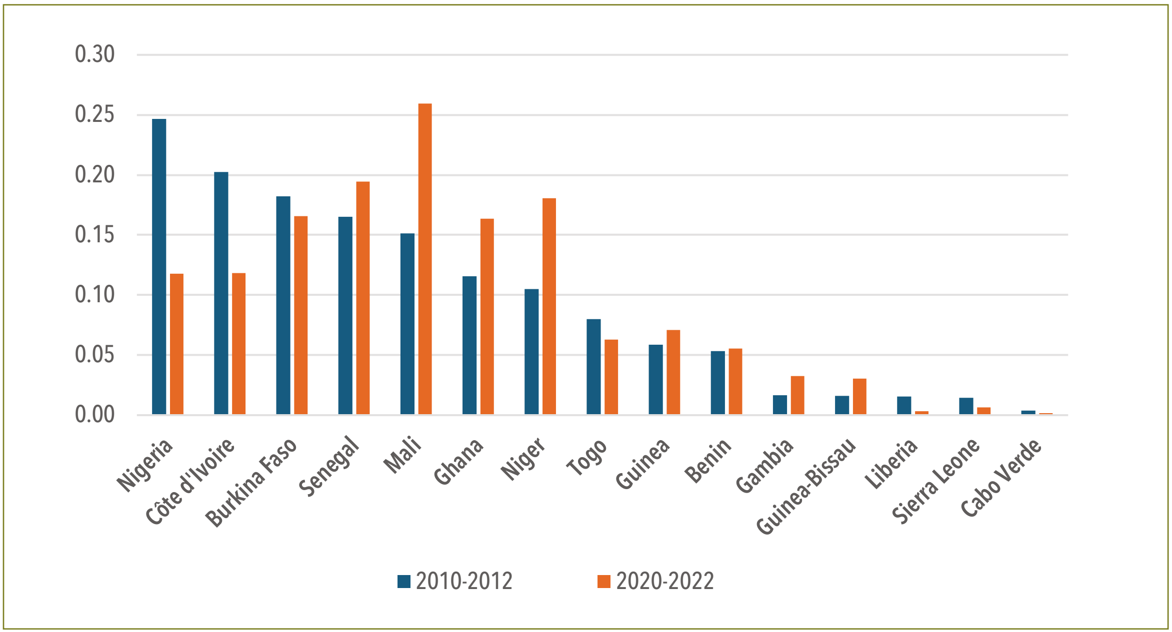
Source: 2024 AATM database and authors' calculations.

The two biggest exporters in the region are Côte d'Ivoire and Senegal. In 2020–2022, Togo and Ghana took third and fourth place. In 2010–2012, Mali was the region's fourth largest exporter, but this country saw its exports fall drastically, down 97.5 percent, over the intervening decade.[19] Sierra Leone, Liberia, Burkina Faso, and Nigeria saw their intraregional agricultural exports increase in those years: for the first two countries, the value of their intra-ECOWAS agricultural exports multiplied by 42 and 11, respectively, while those of Burkina Faso and Niger increased by 157 percent and 38.3 percent, respectively. All the other member countries recorded decreases in their intra-ECOWAS agricultural exports over the period, in particular Cabo Verde (−99.0 percent), Gambia (−94.3 percent), Niger (−32.0 percent), and Guinea (−1.8

19 This drastic fall could be due to the country's political instability, with coups d'état leading to trade and financial sanctions by ECOWAS and the closure of land borders in January 2022.

percent). Interestingly, the leading intraregional agricultural exporter in ECOWAS for 2020–2022 was Côte d'Ivoire, which is the third largest country in terms of GDP in the REC for those years (US$62.98 billion, compared with US$432.2 billion for Nigeria, the largest country in the region in terms of economic activity). Senegal is third in terms of intra-ECOWAS agricultural exports and fourth in terms of GDP; Ghana is fourth in exports and second in GDP. The three smallest countries in terms of intra-ECOWAS agricultural exports (Cabo Verde, Gambia, and Guinea-Bissau) are also the smallest in terms of GDP.

Figure 6.4 Intra-ECOWAS agricultural imports, 2010–2012 and 2020–2022, US$ billions



Source: 2024 AATM database and authors' calculations.

Figure 6.4 shows the intraregional agricultural imports of each country in the West African zone for 2020–2022 and 2010–2012. The region's largest importer of agricultural products in 2010–2012 was Nigeria, and in 2020–2022 it was Mali. The list of the largest intra-ECOWAS agricultural importers differs from the list of largest GDPs in 2020–2022, with no overlap between the top three positions in both rankings: Mali, Senegal, and Niger in descending order are the largest intra-ECOWAS agricultural importers; Nigeria, Ghana, and Côte d'Ivoire are the largest in terms of GDP. However, the last five intra-ECOWAS importers are also the five smallest in terms of GDP, although not in the same order: Cabo Verde, Liberia, Gambia, Guinea-Bissau, and Sierra Leone.

Nigeria saw its agricultural imports fall significantly between 2010–2012 and 2020–2022 (−52.4 percent in nominal terms). The largest increases in intra-ECOWAS agricultural imports over the period were recorded by Gambia (+95.9 percent, but this large increase in relative terms represents a small US dollar change: +US$1.6 million), Guinea-Bissau (+85.8 percent, or + US$1.6 million), and Niger (+72.4 percent; this large increase in relative terms represents a larger increase in US dollars than those of Gambia and Guinea-Bissau: +US$76 millions).

Top three partners

Tables 6.8 and 6.9 show the top three destinations for intraregional agricultural exports from each ECOWAS country, as well as the current value of these flows, averaged over 2010, 2011, and 2012 (Table 6.8) and over 2020, 2021, and 2022 (Table 6.9).

Table 6.8 Top 3 destinations of agricultural exports from ECOWAS countries, 2010–2012

Country	Partner 1	Value (US$ millions)	Partner 2	Value (US$ millions)	Partner 3	Value (US$ millions)
Benin	Nigeria	86.78	Niger	9.70	Côte d'Ivoire	2.99
Burkina Faso	Côte d'Ivoire	14.60	Ghana	13.17	Togo	6.41
Côte d'Ivoire	Burkina Faso	125.37	Mali	88.50	Senegal	81.77
Cabo Verde	Ghana	4.38	Nigeria	0.35	Guinea-Bissau	0.13
Ghana	Côte d'Ivoire	104.53	Nigeria	63.45	Togo	48.61
Guinea	Mali	1.72	Senegal	0.41	Gambia	0.11
Gambia	Nigeria	13.06	Senegal	8.84	Guinea	3.98
Guinea-Bissau	Gambia	0.10	Cabo Verde	0.05	Senegal	0.04
Liberia	Nigeria	1.04	Ghana	0.03	Gambia	0.02
Mali	Senegal	62.05	Côte d'Ivoire	41.93	Burkina Faso	10.66
Niger	Nigeria	48.61	Ghana	16.43	Côte d'Ivoire	1.95
Nigeria	Niger	44.62	Ghana	25.67	Côte d'Ivoire	18.27
Senegal	Mali	41.32	Guinea	37.62	Burkina Faso	20.48
Sierra Leone	Nigeria	0.24	Gambia	0.04	Ghana	0.03
Togo	Benin	25.89	Burkina Faso	11.78	Niger	7.33

Source: AATM database and authors' calculation.

Table 6.9 Top 3 destinations of agricultural exports for ECOWAS countries, 2020–2022

Country	Partner 1	Value (US$ millions)	Partner 2	Value (US$ millions)	Partner 3	Value (US$ millions)
Benin	Nigeria	10.35	Niger	9.40	Togo	3.03
Burkina Faso	Ghana	42.95	Côte d'Ivoire	34.85	Togo	20.46
Côte d'Ivoire	Mali	150.18	Burkina Faso	122.52	Ghana	118.58
Cabo Verde	Guinea-Bissau	0.03	Senegal	0.02	n.a.	n.a.
Ghana	Senegal	65.55	Côte d'Ivoire	47.03	Nigeria	29.77
Guinea	Senegal	2.03	Côte d'Ivoire	0.18	Gambia	0.18
Gambia	Guinea-Bissau	0.98	Mali	0.57	Senegal	0.42
Guinea-Bissau	Cabo Verde	0.07	n.a.	n.a.	n.a.	n.a.
Liberia	Côte d'Ivoire	26.54	Senegal	2.56	Togo	1.25
Mali	Côte d'Ivoire	5.42	Burkina Faso	0.69	Togo	0.29
Niger	Nigeria	28.59	Ghana	13.95	Côte d'Ivoire	4.36
Nigeria	Niger	56.13	Ghana	40.74	Senegal	16.75
Senegal	Mali	167.56	Guinea	53.10	Gambia	30.55
Sierra Leone	Senegal	8.95	Gambia	0.77	Benin	0.24
Togo	Niger	41.99	Benin	35.19	Ghana	26.30

Source: 2024 AATM database and authors' calculations.
Note: n.a. = not available.

According to the literature on gravity, international trade between two countries is greater the smaller the geographic distance between them and the higher their GDPs. This suggests that the top three destinations for each exporting country should be countries with a high GDP (the three highest GDPs in the region are recorded by Nigeria, Ghana, and Côte d'Ivoire) and a short distance away. This last criterion can be simplified by checking whether trade is greater between adjacent countries.[20] These conditions are easy to verify: in 36.6 percent of cases, Nigeria, Ghana, and Côte d'Ivoire are among the top three destinations for intraregional agricultural exports from ECOWAS countries. In 57 percent of cases, these are adjacent countries.[21] This is also interesting for the opposite reason, as 43 percent of cases are with nonadjacent countries, which is also significant. The economic activity of the importing country and geographic distance are therefore both significant factors in the intensity of agricultural trade within this REC. Of course, many other factors can also play a role, including the intensity of demand from countries outside the zone (and therefore their GDPs), the quality of transport and communication infrastructure, the presence of a common language, among others.

On the import side, Tables 6.10 and 6.11 show the top three origins of intra-ECOWAS agricultural imports for each country in the region. The gravity concept can also be applied here. In 53.3 percent of cases, Nigeria, Ghana, and Côte d'Ivoire (the high GDP countries) are among the top three origins of intra-ECOWAS agricultural imports: in 2020–2022, the top three intra-ECOWAS suppliers of agricultural products to Cabo Verde, Guinea-Bissau, Mali, and Nigeria are either Nigeria, Ghana, or Côte d'Ivoire, or Senegal (this is the fourth ECOWAS country in terms of GDP). In 47 percent of cases, the top three countries of origin are adjacent countries: for example, in 2020–2022, Senegal's top three intra-ECOWAS suppliers of agricultural products were Guinea, Mali, and Gambia.

Table 6.10 Top 3 origin countries of agricultural imports for ECOWAS countries, 2010–2012

Country	Partner 1	Value (US$ millions)	Partner 2	Value (US$ millions)	Partner 3	Value (US$ millions)
Benin	Togo	25.89	Côte d'Ivoire	9.44	Burkina Faso	5.06
Burkina Faso	Côte d'Ivoire	125.37	Senegal	20.48	Togo	11.78
Côte d'Ivoire	Ghana	104.53	Mali	41.93	Nigeria	18.27
Cabo Verde	Senegal	2.74	Ghana	0.72	Côte d'Ivoire	0.68
Ghana	Côte d'Ivoire	43.53	Nigeria	25.67	Niger	16.43
Guinea	Senegal	37.62	Côte d'Ivoire	10.86	Gambia	3.98
Gambia	Senegal	12.70	Côte d'Ivoire	2.68	Ghana	0.56
Guinea-Bissau	Senegal	13.04	Gambia	2.17	Nigeria	0.51
Liberia	Senegal	6.31	Côte d'Ivoire	3.61	Nigeria	2.31
Mali	Côte d'Ivoire	88.50	Senegal	41.32	Ghana	7.73
Niger	Nigeria	44.62	Côte d'Ivoire	19.77	Benin	9.70
Nigeria	Benin	86.78	Ghana	63.45	Niger	48.61
Senegal	Côte d'Ivoire	81.77	Mali	62.05	Gambia	8.84
Sierra Leone	Senegal	10.51	Mali	1.31	Nigeria	0.94
Togo	Ghana	48.61	Côte d'Ivoire	9.54	Nigeria	7.77

Source: AATM database and authors' calculations.

20 The relation between contiguity and trade must be cautiously interpreted, as even for adjacent countries, trade can be small due to low quality of road infrastructure and high levels of corruption.
21 Cabo Verde is not included in this computation because it is an island.

Table 6.11 Top 3 origin countries of agricultural imports for each ECOWAS country, 2020–2022

Country	Partner 1	Value (US$ millions)	Partner 2	Value (US$ millions)	Partner 3	Value (US$ millions)
Benin	Togo	35.19	Nigeria	5.93	Ghana	5.47
Burkina Faso	Côte d'Ivoire	122.52	Ghana	16.56	Togo	15.09
Côte d'Ivoire	Ghana	47.03	Burkina Faso	34.85	Senegal	26.71
Cabo Verde	Senegal	1.59	Côte d'Ivoire	0.14	Guinea-Bissau	0.07
Ghana	Côte d'Ivoire	118.58	Burkina Faso	42.95	Nigeria	40.74
Guinea	Senegal	53.10	Côte d'Ivoire	22.08	Nigeria	7.20
Gambia	Senegal	30.55	Nigeria	0.86	Sierra Leone	0.77
Guinea-Bissau	Senegal	26.39	Nigeria	2.76	Gambia	0.98
Liberia	Côte d'Ivoire	5.57	Senegal	0.76	Togo	0.27
Mali	Senegal	167.56	Côte d'Ivoire	150.18	Togo	18.18
Niger	Nigeria	56.13	Côte d'Ivoire	46.97	Togo	41.99
Nigeria	Côte d'Ivoire	31.76	Ghana	29.77	Niger	28.59
Senegal	Côte d'Ivoire	70.89	Ghana	65.55	Nigeria	16.75
Sierra Leone	Senegal	5.43	Côte d'Ivoire	0.85	Burkina Faso	0.31
Togo	Ghana	23.91	Burkina Faso	20.46	Nigeria	8.31

Source: 2024 AATM database and authors' calculations.

Top commodities traded

Table 6.12 shows the top three agricultural products exported, and the value of these flows, within ECOWAS by each of its members in 2010–2012 and 2020–2022. In 2020–2022, vegetable oils, generally in the form of palm oil, are among the most exported products. Animals and animal products were among the products most exported by ECOWAS countries in 2010–2012 but were not in 2020–2022. Processed products are regularly positioned among the three most exported products: soups and broths, ice cream and other dairy products, pasta, and vegetable oils. Finally, it is interesting to note that for small countries, the ranking of the three most exported products changes frequently; this is less true for large countries such as Côte d'Ivoire, Nigeria, and Senegal.

Table 6.12 Top 3 agricultural products exported by each ECOWAS country, 2010–2012 and 2020–2022, trade value in US$ millions in parentheses

	2010-2012			2020-2022		
Country	**Product 1**	**Product 2**	**Product 3**	**Product 1**	**Product 2**	**Product 3**
Benin	Fowl meat (76)	Millet rice (36)	Turkey meat (24)	Sugar cane (5)	Vegetable oil (5)	Cotton seeds (5)
Burkina Faso	Cigarettes (5)	Tomatoes (4)	Onions, shallots (3)	Cotton (35)	Oil seeds (22)	Cashew nuts (12)
Côte d'Ivoire	Palm oil (121)	Coffee (38)	Soups, broths (37)	Palm oil (65)	Coffee (58)	Tobacco (57)
Cabo Verde	Rice (4)	Rice (1)	Milk, cream (1)	Plants (0.06)	Wheat (0.03)	Cocoa (0.01)
Ghana	Sweet potatoes (141)	Coffee (39)	Pasta (16)	Palm oil (73)	Wheat (20)	Cocoa (17)
Guinea	Wheat (1)	Wheat (1)	Bran (1)	Bran (1)	Coffee (1)	Coffee (1)
Gambia	Cocoa beans (26)	Milk, cream (2)	Sucrose (2)	Pepper (0.4)	Sucrose (0.4)	Linseed oil (0.3)
Guinea-Bissau	Tomatoes (0.05)	Milk, cream (0.04)	Linseed oil (0.03)	Nuts (0.04)	Groundnuts (0.02)	Palm oil (0.01)
Liberia	Cocoa beans (1)	Cigars (0.1)	Black tea (0.1)	Palm oil (11)	Palm nuts (0.5)	Palm oil (0.4)
Mali	Cotton (24)	Cattle (19)	Buffalo (19)	Tomatoes (1)	Cereals (1)	Cotton (1)
Niger	Onions, shallots (12)	Kidney beans (8)	Bovine animals (8)	Onions, shallots (11)	Dates (9)	Palm oil (5)
Nigeria	Cigarettes (52)	Pasta (7)	Sauces (7)	Cigarettes (89)	Sucrose (22)	Soups, broths (11)
Senegal	Soups, broths (63)	Cigarettes (35)	Milk, cream (15)	Soups, broths (135)	Cigarettes (39)	Food prep. (39)
Sierra Leone	Milk, cream (0.3)	Liqueurs (0.1)	Cereal groats (0.04)	Palm oil (9)	Palm oil (0.8)	Linseed oil (0.6)
Togo	Waters (12)	Ice cream (5)	Beer (4)	Palm oil (53)	Wine (15)	Milk, cream (14)

Source: 2024 AATM database and authors' calculations.
Note: Labels of the HS6 products have been shortened for this table. Processed agricultural products like cigarettes are included.

Table 6.13 shows the top three agricultural products imported from within ECOWAS by each of its members in 2010–2012 and 2020–2022, with the value of these flows. As with intraregional exports, similar characteristics can be seen in the three agricultural products most imported by ECOWAS countries: vegetable oils, cigarettes, and to a lesser extent, cereals, are the most frequently cited products. While animals and animal products were among the top imports in 2010–2012, this was no longer the case in 2020–2022, at least for the three most imported products. Finally, processed products are regularly found in this ranking.

Table 6.13 Top 3 agricultural products imported by each ECOWAS country, 2010–2012 and 2020–2022, trade value in US$ millions in parentheses

	2010-2012			2020-2022		
Country	**Product 1**	**Product 2**	**Product 3**	**Product 1**	**Product 2**	**Product 3**
Benin	Cigarettes (4)	Waters (4)	Palm oil (4)	Palm oil (15)	Beer (5)	Undenatured ethyl alcohol (3)
Burkina Faso	Tobacco (21)	Tobacco (21)	Wheat, meslin flour (20)	Tobacco (56)	Coffee (20)	Palm oil (14)
Côte d'Ivoire	Sweet potatoes (281)	Cigarettes (19)	Cattle (12)	Cotton (87)	Cigarettes (21)	Palm oil (13)
Cabo Verde	Buffalos (12)	Millet rice (3)	Cigarettes (2)	Cigarettes (1)	Pasta (0.1)	Waters (0.1)
Ghana	Maize (corn) (1)	Cocoa beans (20)	Onions, shallots (12)	Palm oil (51)	Oil seeds (20)	Palm oil (17)
Guinea	Pasta (7)	Milk, cream (12)	Soups, broths (11)	Soups, broths (22)	Food prep. (14)	Cigarettes (14)
Gambia	Cigarettes (6)	Soups, broths (5)	Extracts coffee (3)	Soups, broths (14)	Food prep. (2)	Nonalcoholic beverages (2)
Guinea-Bissau	Groundnut oil (1)	Rice (4)	Soups, broths (3)	Soups, broths (8)	Cigarettes (3)	Nonalcoholic beverages (2)
Liberia	Milk, cream (1)	Cigarettes (7)	Oil-cake (4)	Rice (1)	Sauces (0.4)	Millet rice (0.3)
Mali	Millet rice (3)	Soups, broths (41)	Palm oil (27)	Soups, broths (61)	Rice (27)	Palm oil (26)
Niger	Vegetable oils (14)	Cigarettes (35)	Maize (corn) (11)	Cigarettes (52)	Palm oil (37)	Soups, broths (29)
Nigeria	Palm oil (8)	Fowl meat (76)	Millet rice (36)	Palm oil (18)	Cocoa (17)	Soups, broths (10)
Senegal	Turkey meat (24)	Palm oil (54)	Cotton (24)	Palm oil (83)	Coffee (23)	Sucrose (18)
Sierra Leone	Sheep (9)	Cigarettes (9)	Cotton (2)	Soups, broths (5)	Nonalcoholic beverages (0.4)	Wine (0.3)
Togo	Soups, broths (1)	Coffee (39)	Cigarettes (11)	Cotton (8)	Wheat or meslin flour (8)	Cigarettes (8)

Source: 2024 AATM database and authors' calculations.
Note: Labels of the HS6 products have been shortened for this table. Processed agricultural products like cigarettes are included.

Regional introversion of ECOWAS countries

Constructing indicators to measure the degree of trade integration in a region is useful, not only to see whether this integration is increasing over time, but also to compare the level of integration at a given point in time between different regions. It is tempting to use a simple indicator: the share of regional trade in total trade.

Using this indicator, we find that the share of intra-ECOWAS agricultural exports in total ECOWAS agricultural exports in 2010–2012 and 2020–2022 (again averaged over three years) was 8.1 percent and 8.0 percent, respectively, while for WAEMU, these shares for the same periods were 6.9 percent and 6.3 percent.[22] This illustrates the limitations of this trade indicator, given that one would expect it to show a higher degree of trade integration within WAEMU, but it indicates the opposite.

As mentioned earlier, WAEMU is an organization of eight West African countries that use the CFA franc as their common currency, with the aim of promoting economic integration among the group. WAEMU members are Benin, Burkina Faso, Guinea-Bissau, Côte d'Ivoire, Mali, Niger, Senegal, and Togo. Yet, since the WAEMU has established not only a free trade area and a customs union but also a common currency, it can be assumed that trade integration is stronger in the WAEMU than in ECOWAS. The existence of different currencies is seen by economists as an obstacle to international trade (Bergin and Lin 2012; Glick and Rose 2016). However, using the share of intraregional trade in total trade as our indicator, we might be tempted to conclude that agricultural trade integration is stronger in ECOWAS than in WAEMU, and that the degree of integration fell slightly between our two periods.

Thus, this indicator is biased, both for comparisons between countries at a given date and for a country over time. Trade shares depend not only on the degree of integration within the region, but also on factors such as geography, the competitiveness of the regional countries in world markets, and economic activity. For example, even if all the barriers to intraregional trade have been removed, a region will have a low indicator if the member countries are poor and therefore demand and import few products from each other. To give another example, if the competitiveness of the countries in the region falls significantly in relation to the rest of the world, the extraregional trade of the countries in the region will fall and so the ratio will rise, although this will not be the result of greater integration between the countries in the region.[23]

The construction of a coherent indicator to measure a region's degree of trade integration has given rise to an abundant literature. The best indicator is the one first presented by Iapadre and Luchetti (2010). Their regional trade introversion index (RTI) has a number of interesting properties; in particular, it is symmetrical, independent of the size of the region, and increases only if intraregional trade grows faster than extraregional trade. It also allows comparisons to be made between groups of countries at a given date, and a positive (negative) sign indicates that a region is more (less) introverted than extraverted.[24]

A computation of the RTI indexes for ECOWAS yields 0.71 for 2010–2012 and 0.77 for 2020–2022. For WAEMU, the same indexes are 0.89 and 0.88, respectively. By this measure, agricultural trade within both regions is more introverted than extraverted. WAEMU appears to be more integrated than ECOWAS in terms of agricultural trade. On the other hand, in

22 For a region R, the share of intraregional trade (SIT_R) is given by: $SIT_R = \frac{\sum_{s\in R}\sum_{s'\in R}(X_{s,s'} + X_{s',s})}{\sum_{r\in R}(X_{r,.} + X_{.,r})}$, where r, s: countries; R: region R (mainly RECs); $X_{r,.}$: Total exports of country r; $X_{.,r}$: Total imports of country r.

23 See Bouët, Cosnard, and Laborde (2017) for a review of literature and an application to the African case.

24 The regional trade introversion index (RTI_R) is based on a modified version of the intraregional intensity index ($MIRTI_R$) and the extraregional intensity index ($MERTI_R$). With notations defined in a previous footnote, the RTI_R is given by: $RTI_R = \frac{MIRTI_R - MERTI_R}{MIRTI_R + MERTI_R}$, where: $MIRTI_R = \frac{\sum_{s\in R}\sum_{s'\in R}(X_{s,s'} + X_{s',s}) / (\sum_{r\in R}(X_{r,.} + X_{.,r}))}{\sum_{s\in R}\sum_{s'\notin R}(X_{s,s'} + X_{s',s}) / (\sum_{r\notin R}(X_{r,.} + X_{.,r}))} = \frac{SIT_R}{\beta_R}$ and $MERTI_R = \frac{(1 - SIT_R)}{(1 - \beta_R)}$.

ECOWAS, agricultural trade integration increased between 2010–2012 and 2020–2022, whereas it decreased very slightly in the WAEMU over the same period.

In addition to this picture provided by the analysis of formal trade, examining informal and cross-border trade provides another perspective. It is well-known that formal measurement of trade in Africa is not done well and that informal trade is common, especially in the agriculture sector. The following section examines this component of intraregional trade.

Informal cross-border trade flows in ECOWAS

Informal trade, defined here as unregistered trade, is a major phenomenon in Africa and is flourishing in ECOWAS as in other African regions. There are many explanatory factors, and of these, two appear to play a key role in West Africa: on the one hand, the existence of numerous ethnic groups whose territory of economic activity extends into several ECOWAS countries and who have historically developed informal trading practices; on the other hand, the absence of customs duties on trade in local products. When border taxes were in place, they encouraged customs officials to exercise control over border crossings, including registering trade, often to demand the payment of bribes (Bouët, Glauber, and Pace 2018). Other drivers explain trade that avoids border controls, including NTMs, border harassment, and import or export bans.

Another factor explaining the importance of informal agricultural trade in West Africa, as in other African regions, is the extent of poverty. The lack of jobs pushes many people into the informal sector, and an important activity in this sector is agricultural cross-border trade, which allows individuals or informal businesses to cross the border with small quantities without being registered and to profit from cross-border differences in the price of the good transported. This type of activity is a key source of income for the families of informal traders, who have an average of eight dependents in West Africa, according to a World Bank survey. In addition, a significant proportion of informal cross-border traders are women, who experience inequitable treatment, such as sexual harassment and extortion of bribes (Karoff 2021).

With informal trade continuing at apparently significant levels, the accuracy of official trade statistics has been regularly questioned across the continent. In West Africa, an initiative to measure real agricultural trade has emerged from Burkina Faso and the CILSS. Collectors gather information on intraregional trade flows in 178 agricultural products[25] every day of the year from all the major marketplaces in the region and transmit it to focal points, who check the quality of the data (see Bouët et al. 2021a). This initiative, now called ECO-ICBT, has been running since 2010 and is coordinated between CILSS and professional agricultural organizations.

Table 6.14 shows intraregional trade for 2018 from exporting countries (in the rows) to importing countries (in the columns): for example, Burkina Faso exported US$6,711,000 worth of these 178 agricultural products to Benin. The same table shows Comtrade figures for total exports and imports of these 70 HS6 lines by these countries in 2018.

25 For the comparison conducted here, these 178 agricultural products have been transformed into 70 HS6 products. The CILSS database is richer than the United Nations Comtrade database. For example, the first database provides trade statistics on four types of niébé (cowpeas), these four products being classified under HS code 071335: vegetables, leguminous; cowpeas (Vigna unguiculata), shelled, whether or not skinned or split, dried.

Table 6.14 Regional trade of CILSS-monitored products, 2018, ECO-ICBT data and comparison with Comtrade data, US$ thousands

	Benin	Burkina Faso	Côte d'Ivoire	Ghana	Guinea	Mali	Mauritania	Niger	Nigeria	Senegal	Togo	Total ECO-ICBT	Total Comtrade	Ratio
Benin		1,672		345				1,080	8,795		665	12,557	0	n.a.
Burkina Faso	6,771		96,415	52,986		1,571		6,754	565	43	14,373	179,478	160	1,121.7
Côte d'Ivoire	62	7,410		213	105	5,505	14	132	4,187	2,807		20,435	295	69.3
Ghana		6,209						684	305		3,334	10,532	0	n.a.
Guinea									755			755	0	n.a.
Mali		357	61,526	322	21,976				118	46,676		130,975	37	3,539.9
Niger	571	1,113	313	23,499					14,485			39,981	7,813	5.1
Nigeria	1,561			596				36,617				38,774	5	7,754.8
Togo	2,080	2,455		13,066					27			17,628	0	n.a.
Total ECO-ICBT	11,045	19,216	158,254	91,027	22,081	7,076	14	45,267	29,237	49,526	18,372	451,115	8,310	54.3
Total Comtrade	5	334	39	7,932	0	0	0	0	0	0	0			
Ratio	2,209.0	57.5	4,057.8	11.5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.			

Source: Bouët et al. 2021a.

Note: Exporting countries are in rows, importing countries in columns. n.a. = not available.

The discrepancies between the two databases are very significant. For example, in 2018, Burkina Faso's imports of these 178 products from the nine ECOWAS countries indicated in the column amounted to more than US$19 million, whereas the Comtrade database indicates that these imports from the same bilateral relations on the 70 HS6 lines amounted to only US$334,000. The statistics given by CILSS are thus 57.5 times higher in this case, and on average, the trade flows indicated by CILSS are 54.3 times greater. The implications of these discrepancies is that the ECOWAS region is more integrated than the official trade data suggest.

Key Achievements and Challenges

Since its creation, ECOWAS has recorded substantial progress, despite important challenges. This progress covers all areas of integration, from the free movement of people to trade policies.

Free movement of people, formal tariffs, and customs union: Key achievements

Since the creation of ECOWAS in 1975, cooperation between member states in the fields of trade, customs, taxation, statistics, currency, and payments has been one of the REC's key objectives. The founding treaty of 1975, revised in 1993, has been supplemented by various additional texts that have shaped the organization's development and provided a framework for its integration practices. These include:

- Protocol A/P1/5/79 on the free movement of persons, the right of residence and establishment, adopted in Dakar on 25 May 1979
- Convention A/P4/5/82 of 29 May 1982 on the establishment of Interstate Road Transit for Goods (IRRT)
- Protocol A/P.1/1/03 of 31 January 2003 concerning the definition of the concept of products originating in ECOWAS member states
- Regulation C/REG.4/4/02 on the adoption of a certificate of origin for products originating in the Community
- Decision A/DEC.17/01/06 establishing the ECOWAS Common External Tariff (CET)

These texts have facilitated the application of measures to strengthen integration in the subregion. For example, in terms of the free movement of people, significant progress has been made. As a result, no visa is required anywhere for nationals of member states to travel within the ECOWAS zone. West African nationals now have the right to move freely and to settle wherever they wish within the REC, to carry out an economic activity or not. In addition, ECOWAS member states have implemented a common design for a regional passport, which is intended to facilitate the intraregional travel of member state citizens for periods of unlimited duration. The passport can be used within the subregion and is also recognized for international travel.

In terms of the free movement of goods, ECOWAS has made great progress with the entry into force of the CET in 2015. The implementation of the customs union has facilitated the movement of goods. However, it has encountered several practical difficulties. In 2018, the ECOWAS Regional Agency for Agriculture and Food (RAAF) commissioned an evaluation of the implementation of the CET (ARAA 2018), which found that ECOWAS member countries are applying several NTMs to protect their agriculture sectors. The assessments carried out as part of this evaluation revealed that the most protected sectors are not always strategic sectors (as in the case of the meat sector in Benin) and that strategic sectors are poorly protected: rice, sugar, milk powder, onions and shallots, tomato paste, and vegetable oils (except in Benin and Burkina Faso).

In addition, all ECOWAS member states have signed the AfCFTA, and, to our knowledge, only Benin and Liberia have not yet ratified the agreement. In addition, following Ghana, several ECOWAS countries[26] are candidates to be part of the second phase of the Guided Trade Initiative, which was set up to speed the implementation of the AfCFTA. This could reinforce the progress of integration in the ECOWAS zone and intensify intracommunity and intra-African trade by eliminating tariff and nontariff barriers.

Remaining challenges

The various aspects of regional integration presented above show that ECOWAS has made significant progress since its creation. These advances can be seen in the free movement of people, as well as in trade integration in general and agricultural trade in particular. Nevertheless, some challenges remain on the road to genuine trade integration in West Africa.

The first challenge is political. Four coups d'état have taken place in the region in just four years: in Mali in August 2020, in Guinea in September 2021, in Burkina Faso in January 2022, and in Niger in July 2023. In line with its fundamental principles (the promotion and consolidation of a democratic system of government in each member state is enshrined in the Abuja Declaration of Political Principles), ECOWAS has denounced these coups and called for the restoration of democracy in these countries. The regional organization sanctioned Mali, for example, by suspending its membership and closing its borders. In January 2024, Burkina Faso, Mali, and Niger announced that they were leaving ECOWAS with immediate effect, on the pretext that the organization was not helping them enough in their fight against terrorism. The trade effects of these announcements are impossible to estimate today, given that they are so recent and given a lack of current information on both the customs regime applied by these countries to products from the rest of ECOWAS and that applied by the rest of ECOWAS to products from these three countries. Undoubtedly, in addition to the consequences for democracy, these announcements create much uncertainty, which is bound to be damaging for traders and investors. Structural insecurity, which is related to political instability, also impacts trade routes and corridors.

The second challenge relates to monetary integration. ECOWAS is made up of 15 countries, 8 of which share a single currency (WAEMU)—the CFA franc—and 7 of which have their own currency.[27] The adoption of a single currency (see the discussion on the ECOWAS single currency in this chapter) would certainly have an accelerating effect on trade (Bergin and Lin 2012; Glick and Rose 2016); moreover, we have seen that today, agricultural trade introversion is higher among WAEMU countries than within ECOWAS.

The third challenge is the creation of a customs union in Africa. The transition from a free-trade area to a customs union is a difficult stage in regional integration, because while the barriers to intraregional trade will remain unchanged, those to imports from the rest of the world will be modified in ways that are difficult to predict. Bouët et al. (2024) show that many choices are possible: the economic and commercial implications will vary greatly from one African country to another, depending on the selected common external tariff and the objective defined by the negotiators, which could be maximizing GDP, or welfare, or intra-African trade. Moreover, discussions are likely to be long and difficult, since a tariff structure reflects collective preferences and economic characteristics specific to each country.

26 These include Côte d'Ivoire, Ghana, Nigeria, Senegal, and Togo.

27 Escudo for Cabo Verde, dalasi for Gambia, cedi for Ghana, Guinean franc for Guinea, Liberian dollar for Liberia, naira for Nigeria, and leone for Sierra Leone.

The fourth challenge facing the ECOWAS countries is the fight against corruption. It is well documented that police, gendarmerie, and customs officials often take bribes to facilitate intraregional trade flows, sometimes on a substantial scale. It has also been shown that these bribes have a significant negative effect on the intensity of intraregional trade in West Africa, favor smuggling, and exacerbate food insecurity (Bouët et al. 2021b; Bouët, Sall, and Traoré 2023).

The fifth challenge is statistical. The quality of intraregional trade data is low, even very low (Bouët et al. 2021a), particularly since the abolition of customs duties on intraregional trade, which is said to have reduced the incentive for customs officials to collect reliable information on cross-border transactions. Collecting reliable trade data is a key issue for public authorities in all countries, and particularly in West African countries. First, reliable data make it possible to estimate a country's trade balance accurately and is therefore a key tool for defining macroeconomic policies and evaluating competitiveness. Second, reliable customs data on agricultural products make it possible to determine what is going out of a country and what is coming in for each agricultural commodity, information which can be used to determine food balances and prevent malnutrition and famine. A priority in West Africa, where food security has been deteriorating since 2015, is to build up a reliable statistical system at the macroeconomic level in general, and at the customs level in particular. At the continental level, the recent initiative by the African Union, UNECA, and Afreximbank that aims at harmonizing the collection of informal trade data is a good step toward accurate statistics.

Of course, another challenge in the long term is the productive transformation of the region. Trade is about exchange of goods, meaning that if the objective is more intraregional trade, producing both more and more diverse products is needed.

Conclusions

West Africa has a long tradition of regional integration that goes back to the age when African empires and kingdoms dominated the area. The early tentative integration initiatives launched as countries achieved independence followed that tradition, although with limited success. In that context, ECOWAS is one of the institutions that emerged and remained active over the years. Functioning for almost 50 years, it is now one of the most advanced RECs in Africa. It has become a key institution in West Africa with 15 member states, whose relative success is attracting external partners such as Morocco. However, its future remains uncertain as political tensions between some member states and the REC organization are casting doubt as to its sustainability.

ECOWAS has registered successes, particularly in the free movement of people, which is now a reality. Regarding goods, the internal liberalization process started in the early 1980s, and the REC became a formal customs union in 2015. The resulting trade policy entails an overall level of protection of agriculture sectors that is higher than the protection afforded to the rest of the economy. However, the agriculture sector is less protected on average in ECOWAS than in other African RECs. While tariffs have been formally removed, NTMs and other trade costs remain an issue. The region suffers from the low quality of its infrastructure and its logistic performance. Indeed, in these areas, ECOWAS is below the continental averages in most cases.

Agricultural trade within the ECOWAS region is more introverted than extraverted. Past studies show that the degree of introversion has been stable over time and is the second highest among RECs in Africa (Odjo, Traore, and Zaki 2019). Within ECOWAS, WAEMU is more integrated and introverted compared with the rest of the group. Also, in accordance with the economic literature, regional trade flows within ECOWAS reflect the predictions of the gravity theory: trade between two countries is greater the smaller the geographic distance and the higher their GDPs. It is also worth noting that significant informal cross-border trade flows take place in the region, often unrecorded in official statistics, and make an important contribution to food security.

As we look forward, many challenges remain despite the (formal) success in agricultural trade liberalization. One of the main challenges remains red tape and bribes that erase the benefits of formal liberalization, threaten food security, and lower the quality of perishable products. In the same vein of reducing trade costs, the adoption of a common currency can facilitate trade, as currency diversity and volatility can impede trade. However, the implementation of the common currency agenda, which was supposed to be effective in 2020, has suffered significant delays. Another significant challenge is the region's political instability and its management (embargos, sanctions, and so on), which constitute a non-business-friendly climate and compromise regional integration. There is also a risk of disintegration or fragmentation in the region with the withdrawal of some countries from ECOWAS (Mali, Burkina Faso, and Niger), although it is not clear at this stage whether these withdrawals will be definitive or not. Finally, a good monitoring process for regional integration is necessary. The starting point for such a process is the availability of reliable trade data, including on informal trade, which is pervasive in the region and should be included in official statistics. Fortunately, recent initiatives launched by ECOWAS with other regional partners are trying to address this issue.

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SUMMARY AND CONCLUSIONS

The annual Africa Agriculture Trade Monitor (AATM) provides an analysis of global and regional trends in African agricultural trade flows and policies. By providing updated annual statistics and data on trade patterns, the AATM helps to monitor the evolution of African participation in world agricultural trade, as well as the progress made in enhancing intra-African trade. This 2024 AATM has a special focus on the trade and climate change nexus, including the impact of climate change on agricultural yields and thus on trade, and the relationship of trade with carbon emissions and water use. In addition, chapters provide analysis of Africa's fruit and vegetable value chains and the integration experience of the Economic Community of West African States (ECOWAS). The main findings and related policy implications of the report are discussed below.

Africa has seen an increase in food insecurity in the wake of recent global crises, including the COVID-19 pandemic, the Russia-Ukraine war, and the resurgence of protectionist policies in key agrifood-supplying countries. With this regional context as its background, the 2024 AATM begins with a chapter shedding light on the complex debate around trade and food security. Trade has complex impacts on food security, a multidimensional concept that encompasses availability, accessibility, utilization, and stability of the food supply. While the impact of trade on the availability of and access to food is clearly positive, the effects on the remaining two dimensions are ambiguous, though it is likely that positive impacts would outweigh negative ones when relevant policy interventions are put in place. However, these policy tools should be used carefully, as they can exacerbate negative outcomes and destabilize global markets. Given the dependence of African countries on fertilizer imports and the role of these in the agrifood supply, it is critical to consider the trade of inputs as well as agrifood products. Increasing intra-African trade in fertilizers is therefore important to reduce the productivity gap between the continent and the rest of the world, as the world market is highly concentrated, and supply disruptions are recurrent due to both geopolitical crises and trade restrictions in exporting countries.

The 2024 AATM analyzes the value chain for fruits and vegetables (Chapter 4), as these foods have potential to contribute to food security through healthy diets and can play an important role in the diversification of African exports. Rising incomes, changing consumption patterns (including demand for high-quality products), and rapid urbanization also call for a focus on the fruit and vegetable sector. The global data show that for fruits and vegetables, Africa remains specialized in the export of unprocessed goods, in the upstream sector of the value chain, and the import of unprocessed fruit and processed vegetables. In intra-African trade, the data show that trade in fruits is dominated by unprocessed products, but the opposite is true for vegetables. Africa's specialization in the upstream sector is largely due to higher tariffs and stringent regulations and standards in higher-income destination countries, an issue that must be addressed to increase the benefits from trade. The report also demonstrates that Africa produces relatively few fruit and vegetable products that have a revealed comparative advantage and benefit from high global demand, a key finding that requires attention. Tackling this problem is important to avoid poverty traps, given the evolution of food systems. In addition, improving the quality of infrastructure along the entire supply chain is critical to address major constraints in both the domestic and external markets.

This year's report highlights the complexity of the linkages between trade, climate change, and other environmental issues. We examine these connections by focusing on three important areas of the trade and climate change nexus: carbon emissions (Chapter 2), water resources (Chapter 3), and changing agricultural yields and comparative advantages (Chapter 5). First, trade mainly affects the environment through carbon emissions associated with the production and transportation of goods. Africa's contribution to the global carbon footprint of trade is limited, with its share of global emissions embedded in exported and imported agrifood products less than its respective shares in world agricultural trade. Due in part to a contraction in the level of agricultural exports from 2012 to 2016, Africa shifted from being a net exporter of emissions embedded in agricultural products to a net importer during that period. Although Europe is the main destination of emissions that originate from Africa's agriculture sector, emissions embedded in Africa's agricultural imports originate mainly from Asia. These emissions trends require strategies to reduce the continent's carbon footprint, especially through sustainable practices and cleaner technologies in other key contributing sectors such as textiles and apparel, as well as by diversifying away from import sources that use highly polluting technologies.

Second, trade can contribute positively to climate change mitigation and adaptation through the strategic use of countries' comparative advantages. For example, the environmental impact of economic activities can be mitigated when trade shifts production from environmentally resource-scarce countries to resource-abundant areas. The report focuses on water resources that are unequally distributed across the continent and within countries, finding that the trade of virtual water—that is, water embedded in traded products—between African countries mainly occurs within regional economic communities. Patterns of trade flows differ across commodities, with millet and mace having the highest impact on water use among the examined crops. Studying the virtual trade in water shows that countries' water endowments influence their exports and imports of virtual water. Trade in virtual water can thus help to increase the efficiency of water use and save water at the global level. From a policy perspective, facilitating the export of virtual water is a key strategy to reduce the impacts of differential water availability within the continent and address water scarcity. Both national and regional policies are needed to support infrastructure investments to improve irrigation systems and water management practices.

Third, changes in agricultural yields due to climate change can lead to shifts in comparative advantages between and within countries. Given the importance of agriculture in African economies and the farming practices that prevail in the sector (namely, extensive and rainfed agriculture), the continent is highly exposed to climate change compared to other regions in the world. The report finds that this heightened risk will expand Africa's agricultural trade deficit by reducing yields for most crops and threaten the food security of the continent's population. As temperatures continue rising and water stresses increase, most of the agricultural products produced and consumed in Africa are at risk of reduced yields. However, trade can play a role in adapting to and mitigating the impacts of climate change, both through international trade and, to some extent, regional trade, especially for cereals.

Challenges remain for regional trade in Africa, as illustrated by the experience of ECOWAS described in this report (Chapter 6). Although significant progress has been made on the free movement of people and the liberalization of internal tariffs within this regional economic community, challenges related to nontariff measures, corruption, overly rigid regulations along main trade corridors, and the low quality of infrastructure all contribute to overall trade costs that are above the Africa-wide average and among the highest in the world. Challenges that are not specific to ECOWAS should be tackled to strengthen regional integration in Africa as a risk-mitigation strategy in a global context marked by recurrent crises, lack of progress in multilateral discussions, and the resurgence of noncooperative trade policies. To this end, the African Continental Free Trade Area represents a timely opportunity to achieve progress, provided that its implementation is sufficiently broad and ambitious.

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