

Agrifood Sector Growth, Poverty, and Diet Quality in Low-Income Countries

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Abstract

This study investigates the impact of productivity growth in the agrifood sector on poverty alleviation, dietary quality, and affordability across five low-income Sub-Saharan African countries. Using computable general equilibrium models, specifically IFPRI's RIAPA models, it assesses how productivity growth in primary agriculture, agro-processing, and food services influences household welfare and dietary outcomes. By linking these models with survey-based microsimulations, the study examines the distributive effects of productivity increases in agricultural value chains, shedding light on their effectiveness in poverty alleviation and diet improvement. The results show that while non-agricultural productivity growth is essential for reducing poverty and hunger, primary agriculture remains critical for enhancing diet quality and reducing the costs of a healthy diet. Subsector analysis indicates that no single value chain is most effective across all outcomes. Staples excel in poverty and hunger reduction, while horticulture and animal-source foods improve diet quality and lower costs.

Keywords: Productivity growth, Diet quality, Sub-Saharan Africa, Computable general equilibrium models

Jel Codes:

C68 Computable General Equilibrium Models

I32 Measurement and Analysis of Poverty

Q18 Agricultural Policy - Food Policy

1. Introduction

Agriculture plays an important role in kickstarting structural change and contributing to growth and development in low-income countries. However, the decisions that policymakers in the agrifood system must contend with are becoming increasingly complex, going beyond traditional considerations such as how to raise productivity and improve smallholder farmers' livelihoods, to having an explicit mandate to supply healthy and affordable diets derived from a diverse range of foods produced in a sustainable manner. While reducing the overall cost of a healthy diet is certainly necessary, it is not sufficient for improved diet quality given consumers' unique dietary preferences. In other words, whether a healthy diet is affordable is not necessarily a guarantee that consumers will choose that diet. Beyond the cost of the overall diet, policymakers should therefore also consider the implications of their policies on prices of healthy – and often under-consumed – food items relative to (say) staple foods that tend to be overconsumed, such that their policies can bring about relative price changes that will nudge consumers towards healthier diets.

The study examines implications of productivity growth in the agrifood system for poverty and diet quality and affordability in the context of structural change in five low-income countries, in Sub-Saharan Africa, namely Ethiopia, Ghana, Malawi, Nigeria, and Tanzania. We use single-country computable general equilibrium models – specifically IFPRI's Rural Investment and Policy Analysis (RIAPA) models – which have a detailed specification and capture the complex interconnections across different components of the agrifood system and the rest of the economy. The agrifood system comprises an on-farm component (i.e., primary agriculture) and several off-farm components, including agroprocessing sectors, food trade and transport sectors, restaurants and hotels, and agricultural inputs. Whereas primary agriculture accounts for an average of 25 percent of GDP across the five countries, the broader agrifood system accounts for an average of 39 percent of GDP, with the off-farm component typically becoming relatively larger as economies develop. The models further link to survey-based microsimulation models in which the distributional and welfare implications are assessed at household-level.

The objective of the study is three-fold. First, in the context of structural change, which is associated with an increasing share of GDP generated in the off-farm components of the agrifood system as urbanizing consumers shift demand towards more processed foods accessed via markets or restaurants, we test whether productivity growth in primary agriculture, agroprocessing, or food

services has the greatest impact on poverty reduction or diet quality. This has implications for where in the agrifood system policymakers should prioritize their investments. Second, within primary agriculture, we examine which subsectors or value chains are most effective at reducing poverty or improving diet quality given the unique impacts these subsectors have on (rural) income distribution and relative food prices. This too has implications for prioritization of agricultural policies and investments. Third, we focus on cost and affordability of healthy diets, and assess how in each of the above scenarios diet costs decline, what that means for diet affordability, and whether the same aggregate or subsectors that drive cheaper healthy diets also drive improved diet quality. This will help us assess whether affordability of a healthy diet is sufficient to drive diet quality improvements, or whether policymakers should simultaneously also focus on relative costs of healthy diet components and food consumption preferences of consumers.

The remaining parts of this article are outlined as follows: Section 2 examines agricultural sector dynamics in sub-Saharan Africa, mainly across the 5 countries of study. Section 3 presents the model and data. Sections 4 and 5 discuss scenario development and analyze the results, respectively. Finally, Section 6 wraps up the article, pointing out potential areas for future research.

2. Agricultural dynamics and diets in sub-Saharan Africa

Sub-Saharan Africa observed strong economic growth in the decade preceding the COVID-19 pandemic, despite variations in pace and nature. Countries in this region faced challenges from global commodity price fluctuations and the pandemic, which hindered economic growth. Various factors, including COVID-19 policies, the Russia-Ukraine war, and macroeconomic instability, contributed to sluggish growth (World Bank, 2023). However, despite these difficulties, the agricultural sector proved to be a key element in economic resilience during times of crisis.

In Sub-Saharan Africa, agriculture holds considerable importance in the social, economic, and cultural fabric of developing countries worldwide. The sector contributes approximately 23% of the total gross domestic product (GDP) on average and employs over 50% of the labor force (OECD, 2016). Despite its vital role in the region's economy, productivity remains a concern. Many countries in the region encounter similar challenges within their agricultural sectors. More than 60 percent of the sub-Saharan African population consists of smallholder farmers, and

agriculture contributes about 23 percent to the region's GDP (Goedde et al., 2019). Throughout the region, the prevalence of small farm sizes inhibits productivity growth and limits the sector's potential, resulting in lower levels of labor productivity globally. This stagnation can be attributed to various factors, including small farm sizes, the region's production structure, limited adoption of modern technology, inadequate rural infrastructure, and widespread land informality.

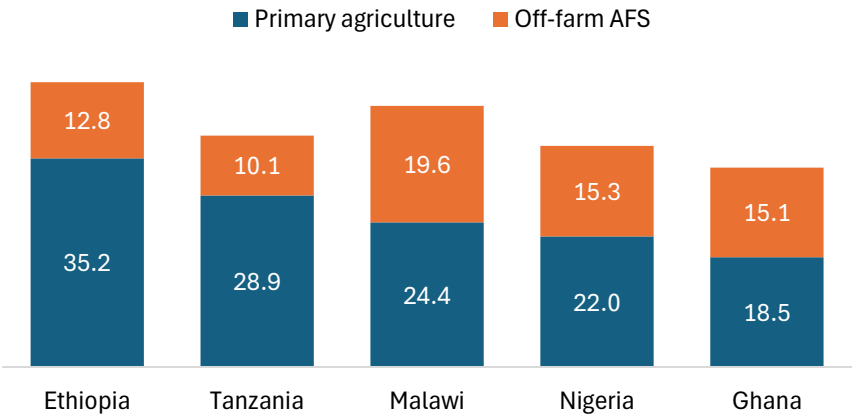
These dynamics in agriculture directly impact dietary patterns and nutrition outcomes in the region. Over 80% of the world's three billion people unable to afford a healthy diet reside in Sub-Saharan Africa (FAO, 2023). Poor infrastructure and limited resources compounded with conflict, HIV, and poor access to health services are factors that contribute to the staggering levels of malnutrition and food insecurity on the continent (Fanzo, 2012). The predominance of smallholder farming often results in limited diversification of crops, with a heavy reliance on staple foods such as maize, cassava, and rice. While these staples provide essential calories, they may lack the necessary diversity to ensure balanced nutrition. Furthermore, the challenges in agricultural productivity can lead to food insecurity and limited access to nutritious foods, particularly for vulnerable populations. A growing literature agrees that affordability of a healthy diet remains a pressing concern in Africa, underlining the need for comprehensive policies and interventions. The direct financial support alone are insufficient to fully align actual dietary intakes with healthy dietary recommendations (Bai & Masters, 2024; Black et al., 2013; Spronk et al., 2014). Therefore, it is important to guide research efforts aimed at helping to adapt agrifood systems in such a way that they, in turn, contribute to reducing disparities such as poverty, improving diets, and eliminating hunger.

Understanding the sources of agricultural potential and addressing the challenges hindering real expansion is essential. This expansion should not only alleviate poverty but also enhance other aspects of development and reduce dependence on specific commodities, crucial for improving dietary quality and food security. According to UN-COMTRADE (2022), Sub-Saharan Africa imports \$15 billion worth of basic food crops (grains, edible oils, and sugar), mainly from Asia and South America. Goedde et al. (2019) conducted an analysis of potential productivity in the region and found that nine countries account for 60 percent of the total potential, with Ethiopia, Nigeria, and Tanzania comprising half of that figure. This indicates a highly concentrated potential, where a few countries stand to benefit the most. According to Chamberlin et al. (2014), there are

an estimated 80 million hectares of potentially available cropland that can be profitably farmed in Sub-Saharan Africa. Similarly, the benefits of this expansion potential would primarily accrue to countries such as Angola, Madagascar, Mozambique, Tanzania, and Zambia (Goedde et al., 2019).

This research presents a case study focused on five sub-Saharan African countries. The study considers the three largest potential contributors to agricultural growth: Ethiopia, Nigeria, and Tanzania, as well as Ghana and Malawi, which are highly agrarian economies with significant potential for expanding cultivable hectares. Given the unique characteristics of each of these economies, it is important to mention specific relevant traits of their different economic structures and agricultural food systems (AFS).

Figure 1: Shares of agricultural and off-farm AFS in total GDP (%)

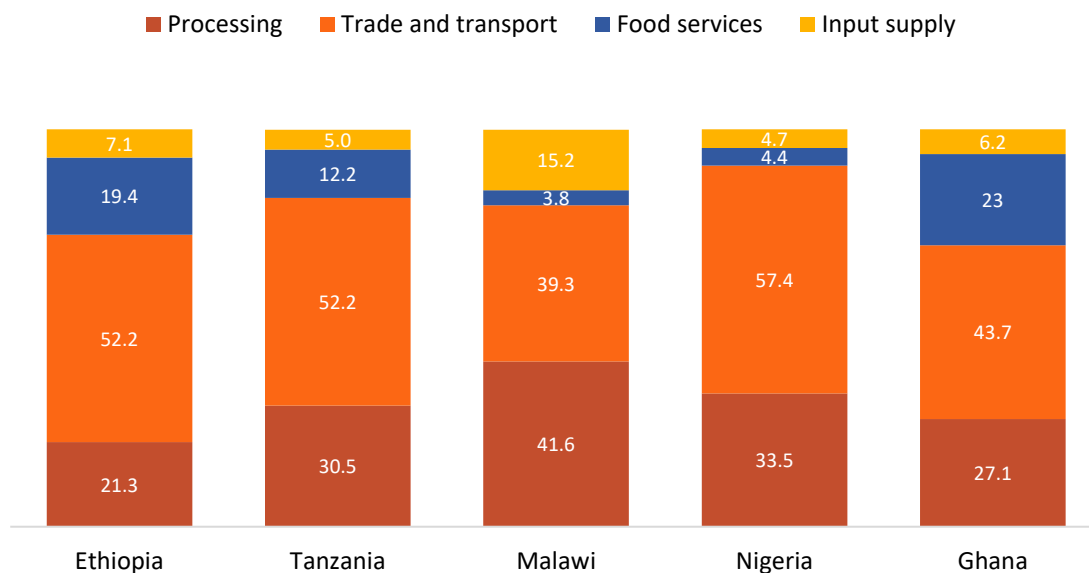


Source: IFPRI’s Agrifood System Database (Thurlow et al. 2023) and the 2019 Social Accounting Matrix for selected SAA countries

The AFS in the selected countries exhibit both commonalities and significant differences. As we can see in figure 1, Countries like Ethiopia, Tanzania, and Malawi are characterized by being highly agrarian, which is reflected in a high contribution of primary agriculture to GDP. In Nigeria and Ghana, which are lower-middle-income countries (LMICs), we observe a lesser reliance on agriculture, with the non-agricultural sector contributing over 15% to GDP. This shift suggests a growing role of the off-farm AFS when countries develop.

A more detailed analysis of the non-agricultural component in these countries, considering four non-agricultural components of AFS in Figure 2, shows that agroprocessing, as well as agrifood trade and transport components, are the main contributors to the total off-farm AFS GDP. This underscores the significance of connectivity via roads and marketing channels in the AFS across all countries. Only Malawi sees agroprocessing as its primary AFS contributor, though marginally. In contrast, while food services play a minor role in most countries, they are notably significant in Ethiopia and Ghana.

Figure 2: Shares of off-farm components in total off-farm AFS GDP (%)



Source: IFPRI's Agrifood System Database (Thurlow et al. 2023) and the 2019 Social Accounting Matrix for selected SAA countries

Overall, the growth in Sub-Saharan African countries has entailed structural changes in the economy and agricultural and food systems. There has been a trend towards structural transformation in these systems, with a greater emphasis on non-agricultural components such as food processing and agricultural trade (Thurlow et al., 2023). Although the importance of agriculture in terms of employment has decreased, it remains a significant part of the economies and livelihoods of rural populations in Sub-Saharan Africa.

3. Model simulations and data

IFPRI's RIAPA models are used to analyze productivity growth in agricultural value chains across five case study countries. At the core of RIAPA is a recursive-dynamic Computable General Equilibrium (CGE) model with standard flexible behavioral equations, including nested production functions, imperfect substitution across traded and domestic commodities, and linear expenditure systems of consumer demand. Consumers and producers maximize utility and profits, respectively, and factor and product market prices adjust endogenously to establish market equilibrium. In the recursive-dynamic component of the model, population and labor supply growth rates are set exogenously based on historical trends, while capital stock accumulation is determined endogenously by linking to previous period current investment flows. All the country RIAPA models are calibrated to IFPRI's Nexus Social Accounting Matrices (SAMs) with 2019 base years, while the simulation period for the productivity growth scenarios runs from 2020 to 2025.

For the first set of simulations, we adjust total factor productivity (TFP) for three aggregate sectors that form part of the agrifood system, namely primary agriculture, agroprocessing, and food services. Primary agriculture is made up of approximately 36 subsectors that form part of typical Nexus SAM, the agroprocessing sector includes 16 subsectors that process primary agricultural goods, and the food services sector comprises food-related trade and transport sectors as well as restaurant services. An important feature of the simulations is that we impose a uniform TFP growth rate to each subsector within a broader aggregate group such that the additional GDP generated from that scenario is exactly one-quarter of a percent above the baseline GDP by 2025. Therefore, the goal is not to identify growth sources, evaluate growth potential, or determine costs associated with the modeled productivity gains; instead, by normalizing the marginal GDP effect the scenarios are directly comparable in that we can interpret the poverty and diet quality outcomes per unit of growth generated in that scenario.

In the second set of simulations, we focus on agricultural subsectors. For these scenarios we group the 36 subsectors in six aggregate value chains, namely: cereals; root crops; horticulture (fruits and vegetables); animal source foods (including milk, dairy, and eggs); pulses, oilseeds, and nuts; and lastly export and other (mostly) nonfood crops. Once again, we set TFP growth rates within each of these value chain groupings such that the marginal increase in GDP is one quarter of percent

over the baseline GDP by 2025. A caveat is that smaller value chains need to expand more rapidly than larger ones, which may have implications for relative food prices and hence poverty or diet outcomes, but the advantage is once again that these results can be interpreted per unit of GDP generated due to the exogenous productivity increase within each value chain.

RIAPA models link to survey-based microsimulation where indicators such as poverty, hunger, or diet deprivation are measured. Households sampled in consumption and expenditure surveys are mapped to the household groups in the RIAPA model and simulated consumption changes in the model are applied consumption expenditures of the survey households. We estimate poverty headcount rates and gaps following (Foster et al. 1984). The hunger rate is the share of the population that falls below a minimum calorie requirement threshold (FAO et al. 2022), with calories either imputed from survey expenditures or observed in the survey data. Lastly, the diet measure is a deprivation measure called the Reference Diet Deprivation (ReDD) index (Pauw et al. 2023). ReDD is a composite measure of the incidence, breadth, and depth of food consumption shortfalls within and across six major food groups. Although to date the default has been to use the EAT-Lancet healthy reference diet (Willet et al. 2019) as basis for computing ReDD, this study pilots the use of the Healthy Diet Basket (HDB) (Herforth et al. 2022). While still adhering to principles of healthy eating, the calorie intake guidelines by food group in the HDB are arguably closer to revealed diet preferences for consumers in low-income countries; for example, it includes relatively more staples from calories and fewer from oilseeds and legumes. As such, ReDD estimates based on HDB are slightly lower than those based on the EAT-Lancet diet. In general, a lower ReDD value is indicative of less diet deprivation (i.e., smaller consumption gaps and/or fewer food group deprivation).

4. Results and discussion

At the broader sectoral level, our results show that raising productivity in the primary agricultural sector is most effective at improving diet quality, but it is less effective at reducing poverty. In fact, in four of the five countries, productivity growth in either agroprocessing or food services is most effective at reducing poverty or hunger. While outcomes differ by country, productivity growth in food service sectors is generally more effective at reducing poverty, while agroprocessing is more effective at alleviating hunger. This suggests that trade and transportation networks are increasingly important for sub-Saharan African countries, and that improvements in these networks can potentially be effective in reducing poverty. However, productivity growth in the agroprocessing sector should not be overlooked, as it significantly reduces hunger. Moreover, in countries like Tanzania and Ghana, agroprocessing is also the most important contributor to poverty reduction.

The productivity growth scenarios at subsector level reveal more heterogeneity across countries, influenced by economic structure and consumption patterns. Panel 1 further below reports the ranking of value chains in terms of poverty, hunger, diet deprivation, and diet cost, with one (1) being the most effective measure and six (6) the least effective.

To gain an overall perspective, we tallied how often a value chain ranked in the top three for its contribution to development outcomes in the five studied countries. Table 1 ranks these value chains using this weighting scheme, with the first column showing the most frequent among the top three and the second column displaying the second most frequent. Specifically, the pulses and oilseeds value chain ranks first in poverty reduction, followed by the roots. The cereals value chain is the most effective in hunger reduction. Lastly, the horticulture and pulses and oilseeds value chains are most beneficial for improving the cost and quality of diet, respectively.

Table 1: Value Chain rankings in selected countries

	<i>Most frequently</i>	<i>Second-most frequently</i>
Poverty	Pulses & oilseeds	Roots
Hunger	Cereals	Pulses & oilseeds
Diets	Pulses & oilseeds	Horticulture
Diet cost	Horticulture	Animal-source foods

5. Conclusion

In summary, our findings highlight the significance of productivity growth in both on-farm and off-farm components of the agrifood system for addressing poverty and hunger. While productivity improvements in the primary agricultural sector remain crucial for enhancing diet quality and reducing the cost of a healthy diet, the off-farm components are gaining importance as more people seek processed foods and access food through markets. Consequently, these off-farm components may play a more prominent role in ensuring diet quality and affordability in the future.

Moreover, our results underscore that no single value chain within the agrifood system is uniformly effective in achieving all development outcomes. Staples are pivotal for reducing poverty and hunger, while horticulture and animal-source foods are instrumental in enhancing diet quality and lowering dietary costs. Additionally, pulses and oilseeds contribute significantly to poverty reduction and diet quality improvement.

However, it's important to note that while affordability is crucial for acquiring a healthy diet, it may not always accurately reflect the quality of the diet. Therefore, a holistic approach considering various aspects of productivity and accessibility within the agrifood system is essential for achieving comprehensive improvements in nutrition and food security.

Panel 1: Ranking of value chains across five countries

	Poverty reduction						Hunger reduction					
	cere	root	hort	Asfs	puls	coth	cere	root	hort	asfs	puls	coth
Ethiopia	5	1	2	6	3	4	3	1	2	6	4	5
Ghana	4	5	3	6	2	1	3	4	5	6	2	1
Malawi	3	2	4	6	1	5	1	1	5	6	1	4
Nigeria	4	3	5	1	2	6	3	5	6	2	1	4
Tanzania	1	2	4	6	3	5	1	2	5	6	3	4
	Diet deprivation (ReDD)						Diet cost decline					
	cere	root	hort	Asfs	puls	coth	cere	root	hort	asfs	puls	coth
Ethiopia	3	6	1	2	4	5	4	2	1	5	3	6
Ghana	3	6	1	5	2	4	3	4	1	5	2	6
Malawi	4	6	1	2	3	5	3	6	2	4	1	5
Nigeria	4	6	1	2	3	5	4	6	3	2	1	5
Tanzania	2	5	1	3	4	6	1	3	4	5	2	6

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