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Nutrient Adequacy Analysis for Nutrition-Sensitive Agrifood Systems Under the Kampala CAADP Declaration

By John M. Ulimwengu, Léa Vicky Magne Domgho, Julia Collins, Mahamadou Tankari, and Moustapha Pene

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Editorial

Since its adoption by the African Union (AU) in 2003, the Comprehensive Africa Agriculture Development Programme (CAADP) has been Africa's primary policy framework for agricultural transformation, wealth creation, food security, economic growth, and prosperity. It guides the African Union Commission (AUC), the African Union Development Agency-New Partnership for Africa's Development (AUDA-NEPAD), Regional Economic Communities (RECs), and Member States in driving agricultural transformation toward a self-reliant and productive Africa.

The recently adopted **Kampala CAADP Declaration** on ***"Building Resilient and Sustainable Agrifood Systems in Africa"*** and the associated **CAADP Strategy and Action Plan (2026-2035)** will build on the success and deepen the progress achieved after two decades of CAADP implementation, during which Africa significantly improved in economic and agricultural growth, poverty reduction, nutrition outcomes, and agricultural trade expansion. The next 10-year cycle of CAADP implementation must further deepen its focus to incorporate lessons while responding to emerging issues to accelerate sustainable food system transformation within a context of climate change and multifaceted stressors and shocks.

The longevity and continued success of CAADP can be attributed to its credibility as a shared framework designed to guide Member States toward agricultural transformation and economic growth. Driven by the CAADP principles and values, with emphasis on African ownership and mutual accountability, alongside review and benchmarking, data and analytics have been central to CAADP's evidence-based planning and implementation approach. As Africa prepares for the implementation phase of the Kampala CAADP Declaration, which comes into force on January 1, 2026, evidence and robust data analysis will continue to remain indispensable to successful implementation on the ground. This is the rationale behind AKADEMIYA2063's ***Kampala Policy Brief Series***.

The purpose of the policy briefs is to serve as reference documents for policy analysts and planners across AU Member States as they prepare their programs in response to the Kampala CAADP Declaration. The policy briefs will provide a synthesis of a large body of research tackling topics of strategic relevance to Africa's development agenda in parallel with key issues to be addressed during the new phase of CAADP implementation to provide insights, analyze emerging ideas, review cross-cutting thematic areas, and propose policy recommendations that can be replicated for sustainable impact.

The evidence presented in the Kampala Policy Brief Series is derived from published research and data by AKADEMIYA2063's scientists and collaborators across Africa and outside the continent. These lessons are made accessible to policymakers, non-state actors, and other practitioners at continental, regional, and national levels, as well as development partners, to support the implementation of CAADP 2026-2035. In addition to packaging the lessons and insights into comprehensive yet accessible knowledge products, AKADEMIYA2063 is facilitating policy dialogue through webinars. During these sessions, the findings are presented to a broad range of stakeholders to guide programmatic interventions supporting the implementation of the Kampala CAADP Agenda.

Abstract

Achieving the food and nutrition security targets of the Kampala CAADP Declaration requires robust, context–specific evidence. Micronutrient deficiencies remain a critical but under–measured challenge in many African countries. This brief presents an approach to nutrient adequacy analysis based on household consumption data as a practical tool for identifying gaps in nutrient intake and supporting targeted nutrition interventions. The approach provides forward–looking, actionable insights for policymakers, planners, and other stakeholders. Analysis of nutrient adequacy gaps in 12 countries demonstrates that patterns differ not only across but within countries. The responsiveness of household nutrient demand to changes in incomes and food prices also differs by nutrient and country. These findings highlight the need for detailed data and evidence to guide context-specific interventions.

1. Introduction

Micronutrient deficiencies, also known as hidden hunger, are a major public health issue across the globe. These deficiencies can have irreversible impacts on overall health and cognitive development. Yet, they often go unnoticed as they may have fewer visible symptoms compared with other forms of undernutrition and are relatively difficult to measure. Despite limited reliable data, existing evidence suggests that Africa bears a disproportionate burden of hidden hunger. For example, Stevens et al. (2022) estimated that 62 percent of children under five and 80 percent of non-pregnant women of reproductive age experienced at least one micronutrient deficiency, the highest rates among world regions.

The third commitment of the Kampala CAADP Declaration on Building Resilient and Sustainable Agrifood Systems in Africa calls for the continent to ensure food and nutrition security, including by reducing stunting, wasting, and overweight by 25 percent by 2035. The CAADP agenda places a central emphasis on eradicating malnutrition in all its forms, including micronutrient deficiencies. To improve health and nutrition, agrifood systems must go beyond simply producing food—they must prioritize the nutritional quality of food that reaches consumers. This involves encouraging the cultivation and consumption of nutrient-dense and biofortified crops, integrating nutrition education and community outreach, strengthening social safety nets, and implementing policy actions, including school feeding programs, targeted subsidies, and regulatory tools to improve access to nutritious food and shape healthier food environments.

Micronutrient deficiencies result from complex factors that can vary significantly across population groups and regions, as well as within communities and households. For instance, studies have shown that deficiencies are more prevalent in populations with limited access to diverse diets and those affected by poverty and food insecurity (Pedreschi et al. 2024; Dhillon et al. 2022). Disparities in deficiencies have been documented between urban and rural

areas, and even within households, due to varying dietary patterns and access to health services. However, detailed and up-to-date data on micronutrient deficiencies remain scarce in many African countries and are often limited to a few nutrients or specific population groups. To better plan and target effective nutrition-enhancing interventions, policymakers and nutrition stakeholders need more comprehensive and geographically disaggregated data, a need emphasized by recent population-based studies and international nutrition policy reviews (Coomson et al. 2025; Williams et al. 2020).

This brief presents evidence on areas at risk for micronutrient deficiencies by assessing the adequacy of micronutrient consumption at a geographically disaggregated level. The analysis is intended to help decision-makers understand patterns of micronutrient adequacy in detail, enabling more effective planning and targeting of interventions to improve diet quality and combat hidden hunger. It also offers insights into how household micronutrient intake responds to changes in income and food prices—information that can help anticipate the nutritional impact of economic shocks and inform the design of policies to mitigate them.

2. Approach

The assessment of household micronutrient gaps usually relies on both analysis of consumption survey data and biological measures obtained through blood tests. Both types of measures are important and complementary. Biological measures provide a time-specific picture of deficiency at the time of the test, while assessments of micronutrient intake as measured through surveys predict ongoing and future deficiencies by measuring nutrient flows. Adequacy measures based on consumption patterns are less costly to collect and provide actionable insights to inform policy, as policymakers may have greater influence on consumption than on biologically measured micronutrient levels, which are shaped by multiple factors beyond diet.

The analysis presented in this brief uses household consumption survey data to assess adequacy for energy (kilocalories), protein, and eleven micronutrients: calcium, folate, iron, zinc, Vitamin A, Vitamin B6, Vitamin B12, Vitamin C, niacin, riboflavin, and thiamin.[1] We first obtained quantities of food products consumed by each household from household survey data and calculated the nutrient content of foods consumed using food composition tables from the given country or neighboring countries.[2] We calculate nutrient requirements for each household using recommended daily nutrient intakes defined by WHO/FAO (2005), taking household composition into account, and compare households' nutrient intakes with requirements to obtain nutrient adequacy ratios. We then calculate average nutrient adequacy for districts or regions of a country, as well as for rural and urban households and male-headed and female-headed households.[3]

This analysis helps assess how patterns of consumption adequacy differ across nutrients, regions, and household types. However, it is also important to understand how nutrient adequacy reacts to changes. In a second stage of analysis, we therefore estimate elasticities of demand for nutrients with respect to incomes and food prices, which capture the responsiveness of demand for different

1 The data for Senegal were collected through the Projet d'Appui aux Politiques Agricoles (PAPA), while data for all other countries are from the Living Standards Measurement Study-Integrated Agriculture Survey (LSMS-ISA).
2 The Western Africa FCT for 2019 developed by the Food and Agriculture Organization of the United Nations (Vincent et al. 2020) was used for West African Countries; the Central and Eastern Uganda FCT developed by HarvestPlus in 2012 was used for Uganda (Hotz et al. 2012); the Tanzania FCT developed in 2008 was used for Tanzania (Lukmanji et al. 2008); the Malawian FCT developed by the Government of Malawi in 2019 was used for Malawi (MAFOODS 2019).
3 Adult Male Equivalent (AME) factors from FAO (2001) were used to adjust nutrient requirements according to household composition. Nutrient adequacy ratios for each household were truncated at 100 percent before calculating averages by region and by household category, in order to avoid households that exceed nutrient requirements masking nutrient gaps among other households. See Ulimwengu et al. (2023) for further details.

nutrients to changes in income and in prices of various food products.[4] We can then estimate how a shock that affects household incomes or food prices would affect nutrient adequacy, as well as assess the expected impacts of interventions such as income transfers and food price subsidies.

3. Nutrient Adequacy Levels Across Countries and Subnational Areas

Average nutrient adequacy levels in 12 African countries are presented in Table 1. Nearly all of the selected countries show relatively high adequacy levels for energy and protein, but results for micronutrients are more mixed. Calcium, Vitamin B12, and riboflavin appear to present the most challenges, with several countries showing adequacy levels below 50 percent, indicating that households are, on average, meeting less than half of their requirements through their diets.

Table 1. Average consumption adequacy of energy, protein, and micronutrients, 12 countries

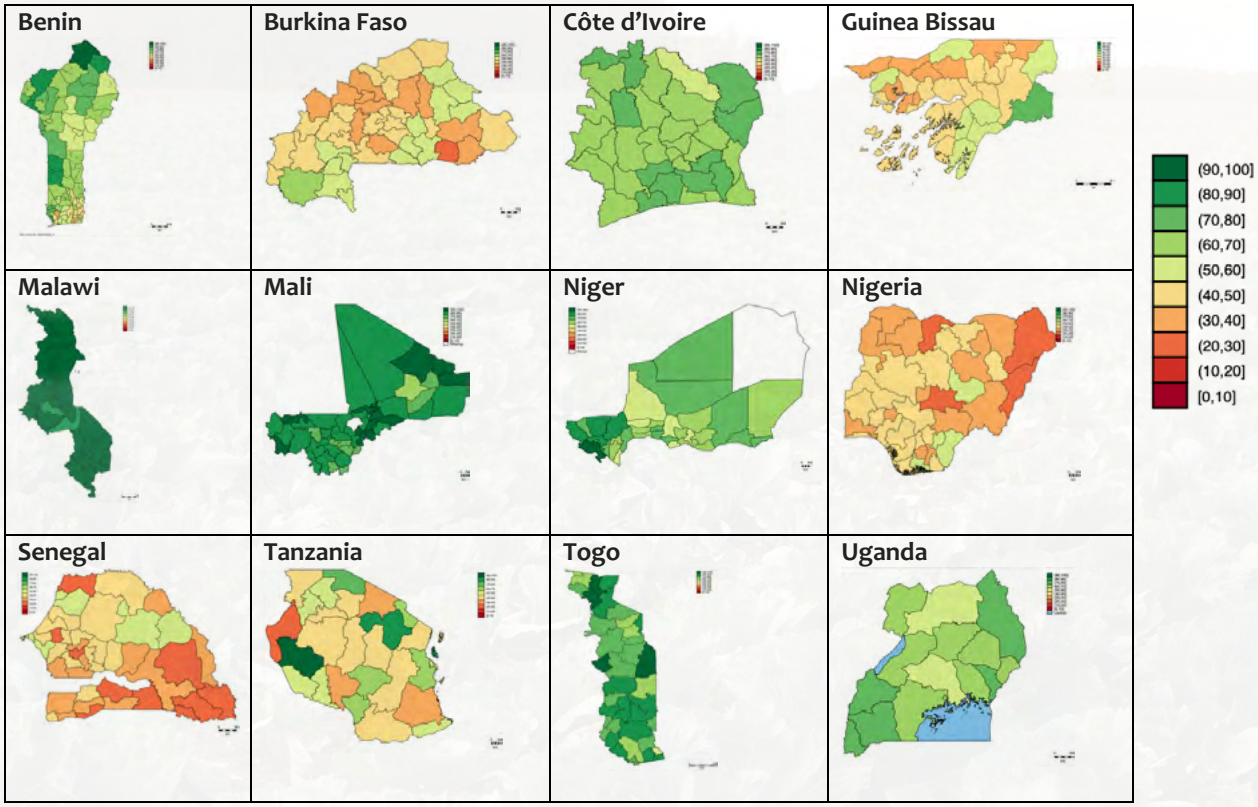
	BEN	BFA	CIV	GNB	MWI	MLI	NER	NGA	SNE	TZA	TGO	UGA
Energy	82.5	77.7	81.2	87.1	87.6	96.0	93.9	82.2	86.5	86.0	71.9	83.2
Protein	93.2	93.4	93.6	95.7	96.7	98.7	97.9	92.3	94.3	93.2	92.9	88.3
Calcium	59.7	45.4	67.9	44.9	94.4	83.7	69.7	41.6	47.0	51.5	80.9	65.9
Zinc	65.4	70.7	64.6	69.9	89.9	75.6	92.9	75.0	59.2	74.8	70.1	74.9
Iron	69.0	71.0	64.9	64.1	98.7	77.3	95.7	73.3	64.4	67.9	66.5	69.5
Folate	83.2	81.2	64.0	58.3	85.3	83.1	96.7	92.8	67.5	81.6	79.4	96.9
Vitamin B12	87.4	72.2	71.1	72.2	34.9	70.0	38.5	73.4	80.0	54.8	94.7	62.5
Vitamin A	82.4	51.6	88.7	84.7	56.3	65.7	74.7	98.8	89.1	72.0	86.0	87.0
Vitamin B6	79.3	74.9	78.8	70.5	91.6	81.1	93.9	87.2	66.4	87.3	80.4	95.9
Vitamin C	89.8	51.3	89.5	77.9	91.3	73.6	66.9	90.4	75.6	86.2	87.0	98.3
Riboflavin	54.1	48.8	60.2	49.5	58.4	61.9	83.4	48.3	59.7	76.8	55.0	82.9
Thiamin	78.6	74.7	65.8	69.1	93.3	78.2	93.0	89.1	68.5	93.9	69.6	90.7
Niacin	73.9	72.5	86.8	81.0	70.8	82.2	84.7	75.7	91.2	82.4	73.6	84.7

Source: Ulimwengu et al. 2023.
Note: BEN=Benin; BFA=Burkina Faso; GNB=Guinea Bissau; MWL=Malawi; MLI=Mali; NER=Niger; NGA=Nigeria; SNE=Senegal; TZA=Tanzania; TGO=Togo; UGA= Uganda. Dark green cells indicate adequacy levels of 75.0% or higher; light green indicates levels of 50.0% to 74.9%; red indicates levels below 50.0%.

4 We use a Quadratic Almost Ideal Demand System model to derive elasticities of demand for nutrients with respect to income and to prices of different food groups. See Ulimwengu et al. (2023) for further details.

Figures 1–3 show subnational adequacy patterns for selected nutrients. The results demonstrate the extent to which adequacy differs both across and within countries, highlighting the need to go beyond national-level figures to assess nutrient gaps at a more disaggregated level. Figure 1 presents results for calcium. As shown in Table 1, households in several countries are far from meeting their calcium needs through their diets, particularly in Senegal, Nigeria, Burkina Faso, and Guinea-Bissau. Most countries show significant regional variation in calcium adequacy. Malawi is an exception, with generally high calcium adequacy in most districts, reflecting high levels of consumption of calcium-rich green vegetables and smoked fish (Ulimwengu et al. 2023).

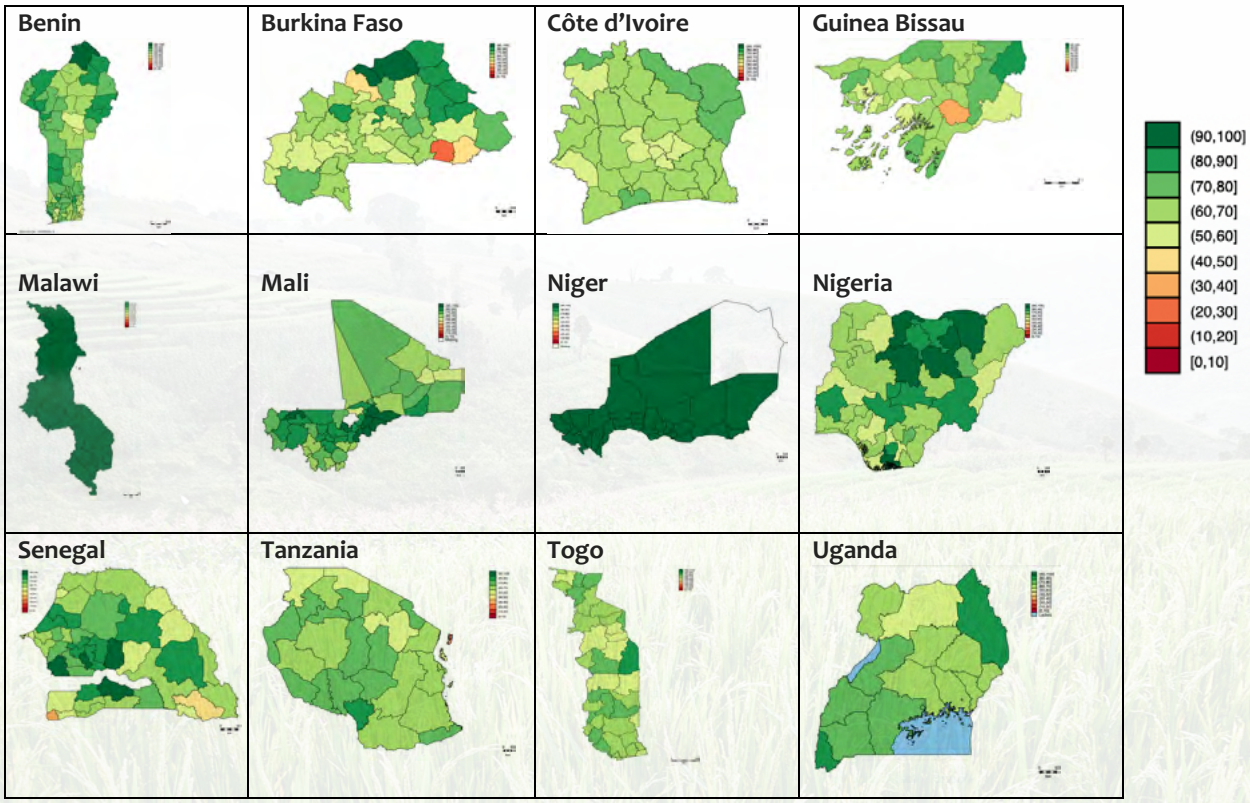
Figure 1. Calcium consumption adequacy in 12 African countries



Source: Ulimwengu et al. 2023

Figure 2 shows the adequacy of iron consumption. Most countries have relatively high levels of iron adequacy, particularly Malawi and Niger, with adequacy above 90 percent in all areas. Adequacy levels are more variable in the other countries. Burkina Faso, Guinea-Bissau, and Senegal each have pockets of more severe iron adequacy gaps as well as regions with relatively high adequacy.

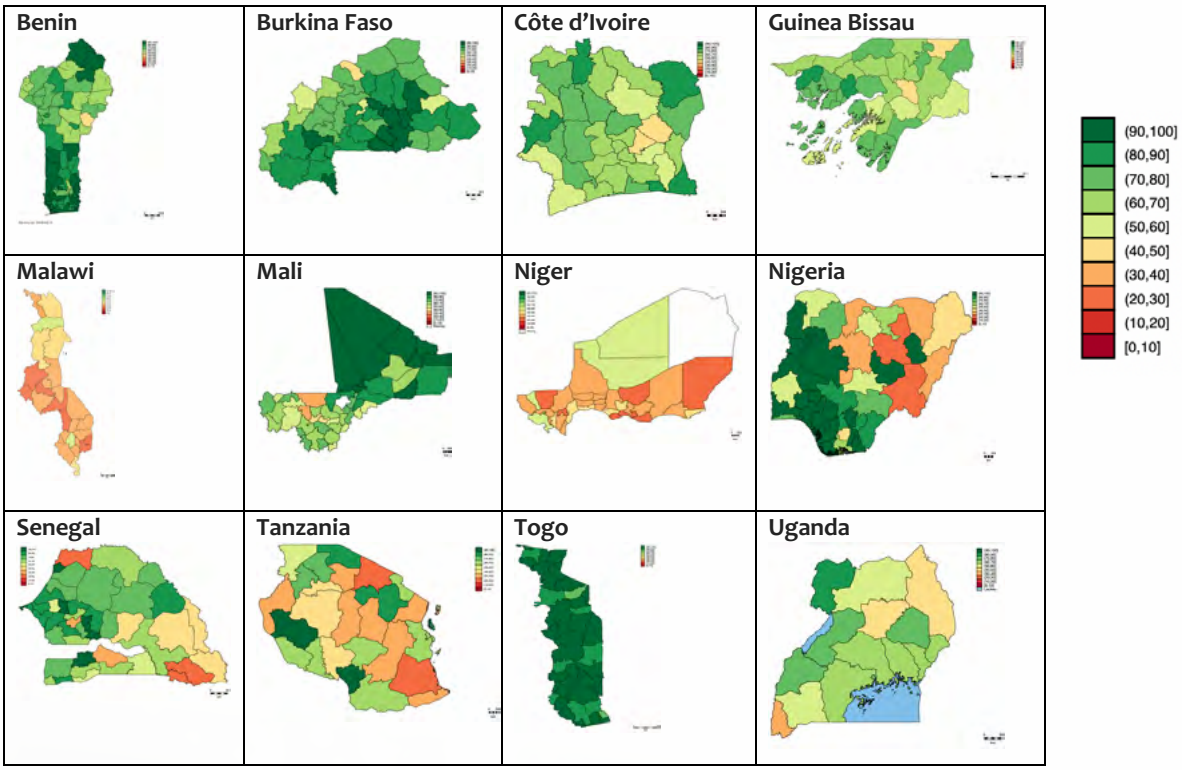
Figure 2. Iron consumption adequacy in 12 African countries



Source: Ulimwengu et al. 2023

As shown in Figure 3, Vitamin B12 consumption adequacy tends to be highly variable both across and within countries. Togo has relatively high adequacy nationwide, while households in most Malawi districts meet less than 50 percent of Vitamin B12 requirements from their diets. In Nigeria, Tanzania, and Senegal, some areas show over 90 percent adequacy, while others show 30 percent or lower adequacy.

Figure 3. Vitamin B12 consumption adequacy in 12 African countries



Source: Ulimwengu et al. (2023)

4. Priority Food Products for Promoting Nutrient Adequacy

The analysis can also identify the food products that make the largest contributions to households' nutrient intake, highlighting opportunities to address gaps by promoting key foods. For example, Table 2 compares the top five food products contributing to households' Vitamin B12 consumption in two neighboring departments of northern Senegal, Dagana (with an average Vitamin B12 adequacy level of 21.8 percent) and Saint-Louis (with an average adequacy level of 92.3 percent). Although the lists of top foods are similar, households in Dagana allocate a significantly smaller share of their food expenditures to Vitamin B12-rich products. Efforts to increase Vitamin B12 adequacy in Dagana could focus on increasing access to dried fish, a product very rich in Vitamin B12, with a budget share of only 0.21 percent.

Table 2. Top food products contributing to Vitamin B12 consumption in Dagana and Saint-Louis departments, Senegal

Top five food products consumed for Vitamin B12 (mcg) in Dagana, Senegal (Average Vitamin B12 adequacy: 21.8%)			
Food product	**Budget share (%)**	**Share of nutrient (%)**	**Nutrient content (mcg/100 gm)**
Dried fish	0.21	37.49	60
Meat (beef, mutton, goat)	4.49	24.86	2.2
Fresh fish	3.45	24.64	3.32
Powdered milk	2.11	7.7	1.8
Poultry	1.62	2.49	0.4
Top five food products consumed for Vitamin B12 (mcg) in Saint-Louis, Senegal (Average Vitamin B12 adequacy: 92.3%)			
Food product	**Budget share (%)**	**Share of nutrient (%)**	**Nutrient content (mcg/100 gm)**
Dried fish	1.20	56.31	60
Fresh fish	10.98	24.33	3.32
Meat (beef, mutton, goat)	7.92	10.38	2.2
Powdered milk	3.52	4.17	1.8
Poultry	6.65	1.83	0.4

Source: AKADEMIYA2063 Senegal FS-COR platform.

Table 3 shows the top sources of iron in two communes of Benin: N'Dali, a commune in central Benin with an average iron adequacy of 58.7 percent, and Karimama, a commune in northern Benin with a much higher iron adequacy of 96.0 percent. Although several food products appear on both lists, millet is among the top sources of iron in Karimama only; in N'Dali, the top source is maize grain, which is much less rich in iron. Promoting millet consumption could be an avenue to increase iron adequacy in N'Dali.

Table 3. Top food products contributing to iron consumption in N'Dali and Karimama communes, Benin

Top five food products consumed for iron (mg) in N'Dali, Benin (Average iron adequacy: 58.7%)			
Food product	**Budget share (%)**	**Share of nutrient (%)**	**Nutrient content (mcg/100 gm)**
Maize grain	9.30	27.28	1.87
Cowpea/Dry beans	4.68	17.19	6.57
Chili pepper	7.77	7.86	6.95
Dried Okra	0.79	5.66	6.40
Sorghum	1.01	4.7	5.20
Top five food products consumed for iron (mg) in Karimama, Benin (Average iron adequacy: 96.0%)			
Food product	**Budget share (%)**	**Share of nutrient (%)**	**Nutrient content (mcg/100 gm)**
Millet	5.69	19.86	10.30
Sorghum	6.25	17.28	5.20
Cowpea/Dry beans	5.69	13.13	6.57
Maize grain	6.36	11.35	1.87
Dried/fried fish	6.64	8.12	7.40

Source: AKADEMIYA2063 Benin FS-COR platform.

5. Demand Elasticities for Nutrients

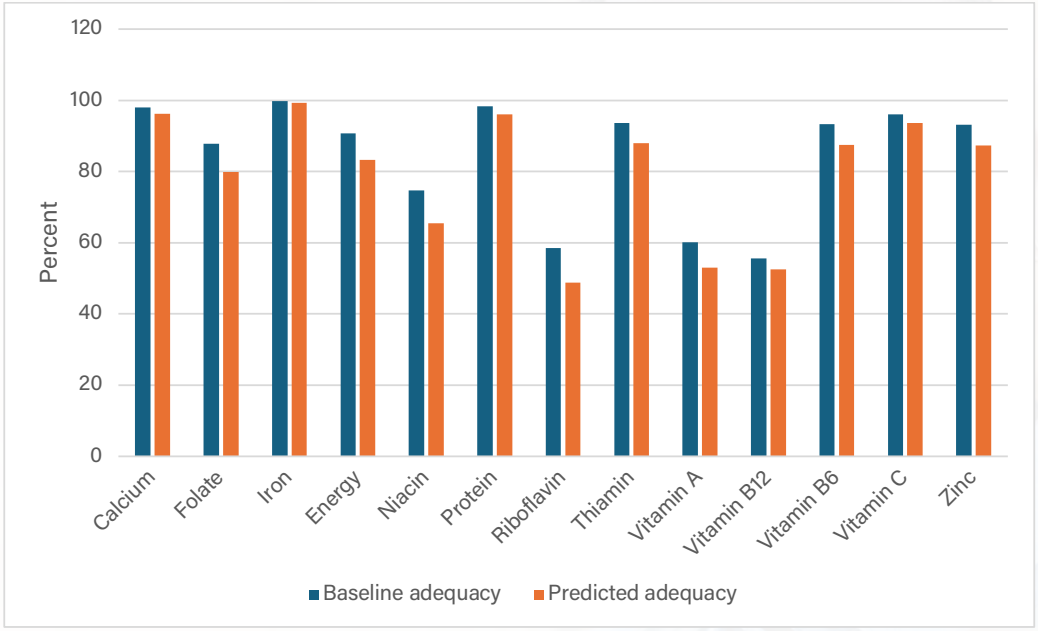
The analysis also estimates nutrient-demand elasticities with respect to income and food prices. Elasticities indicate how much households' nutrient demand responds to changes in incomes or food prices. They can therefore be used to anticipate the potential impacts of economic shocks or of policies and regulations that affect prices or incomes. Elasticities also provide a means to identify policy options and interventions to promote nutrient adequacy. In all countries, demand for all nutrients is expected to rise when incomes rise, but their relative responsiveness differs. Vitamin C and Vitamin B12 show the highest income elasticities in most countries. This suggests that a negative income shock could particularly affect adequacy in these micronutrients. Governments aiming to increase consumption of these vitamins could consider cash transfers or other income-boosting interventions.

Food price elasticities vary by nutrient, food group, and country, reflecting differences in dietary patterns. For example, in Senegal and Côte d'Ivoire, households' demand for and consumption of Vitamin A are particularly sensitive to oil prices, reflecting the importance of palm and other vegetable oils as sources of this micronutrient. Detailed elasticity results are available in Ulimwengu et al. (2023).

The Food System Crisis Observatory and Response (FS-COR) dashboards developed by AKADEMIYA2063 for selected countries present nutrient adequacy results and include a simulation tool. This tool uses estimated elasticities to assess the expected impacts of changes in income or food prices on nutrient adequacy.[5] Figure 4 shows baseline nutrient adequacies for Lilongwe City, Malawi, as well as predicted adequacies following a 20 percent decrease in income. Adequacy of all nutrients is expected to decrease, but sensitivity differs by nutrient: very little change is expected in calcium, iron, and protein adequacy, but larger changes are expected for several other nutrients, especially niacin and riboflavin.

5 See AKADEMIYA2063's Kampala Policy Brief #10 for a description of the FS-COR platform.

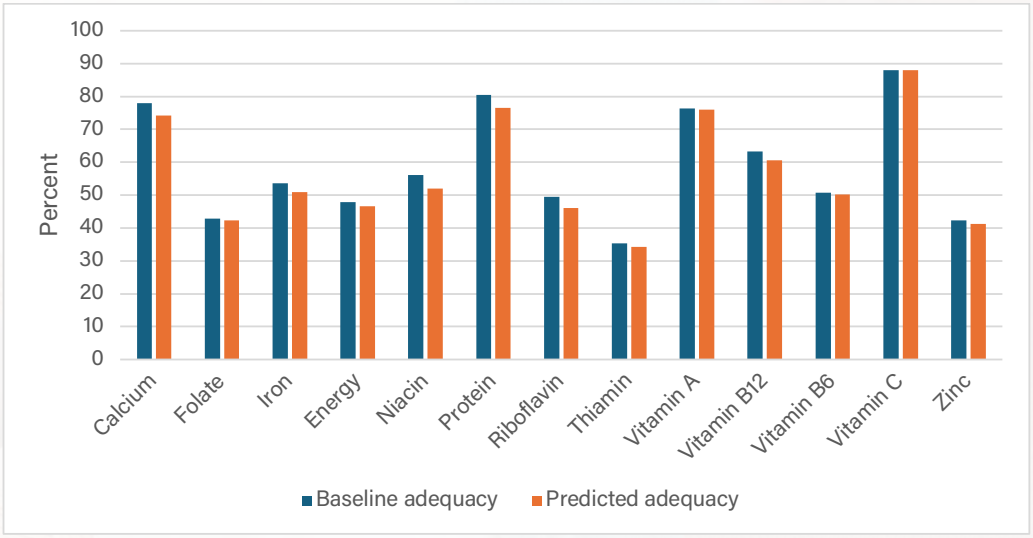
Figure 4. Baseline and predicted consumption adequacy following a 20 percent decrease in income, Lilongwe city, Malawi



Source: AKADEMIYA2063 Malawi FS-COR platform.

Figure 5 shows predicted consumption adequacies following a 50 percent increase in the price of the meat, poultry, and fish food group in Ghana's Western region. Adequacies of some nutrients, such as Vitamin A, Vitamin C, and zinc, are expected to show very little change, reflecting the fact that meat, poultry, and fish are not major sources of these nutrients for Ghanians. However, adequacies for several nutrients, including calcium, niacin, protein, and riboflavin, are more affected.

Figure 5. Baseline and predicted consumption adequacy following a 50 percent increase in prices of meat, poultry, and fish, Western region, Ghana



Source: AKADEMIYA2063 Ghana FS-COR platform

6. Conclusion

The results presented above demonstrate the importance of detailed subnational analyses of nutrient adequacy in order to capture the varying patterns of hidden hunger. Across the 12 countries reviewed, calcium, Vitamin B12, and riboflavin tend to show the largest adequacy gaps, but regions of very high and very low adequacy can coexist in the same country for the same nutrient. The uneven distribution of nutrient inadequacies suggests that spatially disaggregated interventions are essential to address hidden hunger. The analysis provides guidance for interventions to improve diet quality by identifying key foods that could be promoted to fill nutrient gaps in each area. Additionally, the simulation analysis demonstrates that price and income shocks can have strong effects on nutrient adequacy, with varying impacts by nutrient; governments need detailed, disaggregated information to craft responses to protect households from malnutrition.

Achieving the vision of "Sustainable and Resilient Agrifood Systems for a Healthy and Prosperous Africa" outlined in the CAADP Strategy and Action Plan 2026–2035 requires integrated, evidence-based interventions that go beyond increasing food production to ensure food and nutrition security for all Africans. Nutrient adequacy analysis offers a critical tool for operationalizing this vision, particularly under Strategic Objective 3: Ensuring Food and Nutrition Security. This approach enables decision-makers to assess, monitor, and target dietary interventions that align with CAADP's holistic, inclusive, and evidence-based development philosophy.

Unlike traditional food security metrics that often focus on caloric sufficiency, nutrient adequacy analysis provides a multidimensional understanding of dietary gaps. The analysis empowers governments and regional bodies to design interventions—such as food fortification, biofortified crop promotion, or nutrition-sensitive social protection programs—that are geographically and demographically tailored.

Moreover, the analysis supports the CAADP principle of mutual accountability and performance tracking. Through nutrient adequacy monitoring, countries can assess the nutritional impact of agrifood system reforms and policies over time, including how income shocks or changes in food prices affect dietary quality. This becomes particularly important under climate and economic stress, where vulnerable households may substitute nutrient-dense foods with cheaper, less nutritious alternatives. Estimating nutrient demand elasticities allows governments to forecast the effects of such shocks and design adaptive safety nets, a critical aspect of building agrifood system resilience (Strategic Objective 5).

Nutrient adequacy analysis also promotes inclusivity by identifying disparities in dietary intake between rural and urban households, or between male-headed and female-headed households. This information helps ensure that women, youth, and marginalized groups—central to CAADP's inclusive transformation vision—are not left behind. For instance, improving women's access to nutrient-rich foods can enhance household nutrition outcomes and community resilience.

Lastly, nutrient adequacy analysis reinforces the sustainability and efficiency of agrifood value chains. It enables planners to promote the cultivation and consumption of locally appropriate, nutrient-dense crops—such as iron-rich millet or vitamin A-rich sweet potatoes—thereby linking agricultural production more closely to nutritional outcomes. This alignment supports CAADP's push for agro-industrialization and local value addition by fostering demand for nutrient-rich commodities within African markets.

Importantly, nutrient adequacy analysis can be further enriched by integrating it with other dimensions of agrifood systems analysis. When data permits, aligning consumption adequacy with production, market access, and food trade data provides a more holistic view of nutrient flows within national and regional food systems. As demonstrated by Ulimwengu, Magne Domgho, and Collins (2023), high nutrient production does not always equate to adequate nutrient consumption,

underscoring the need to examine where nutrients are lost or diverted along the food chain. As with other areas of the Kampala Declaration, the availability of data on nutrient adequacy is key to supporting the generation of evidence to guide action toward effective implementation.

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ABOUT AKADEMIYA2063

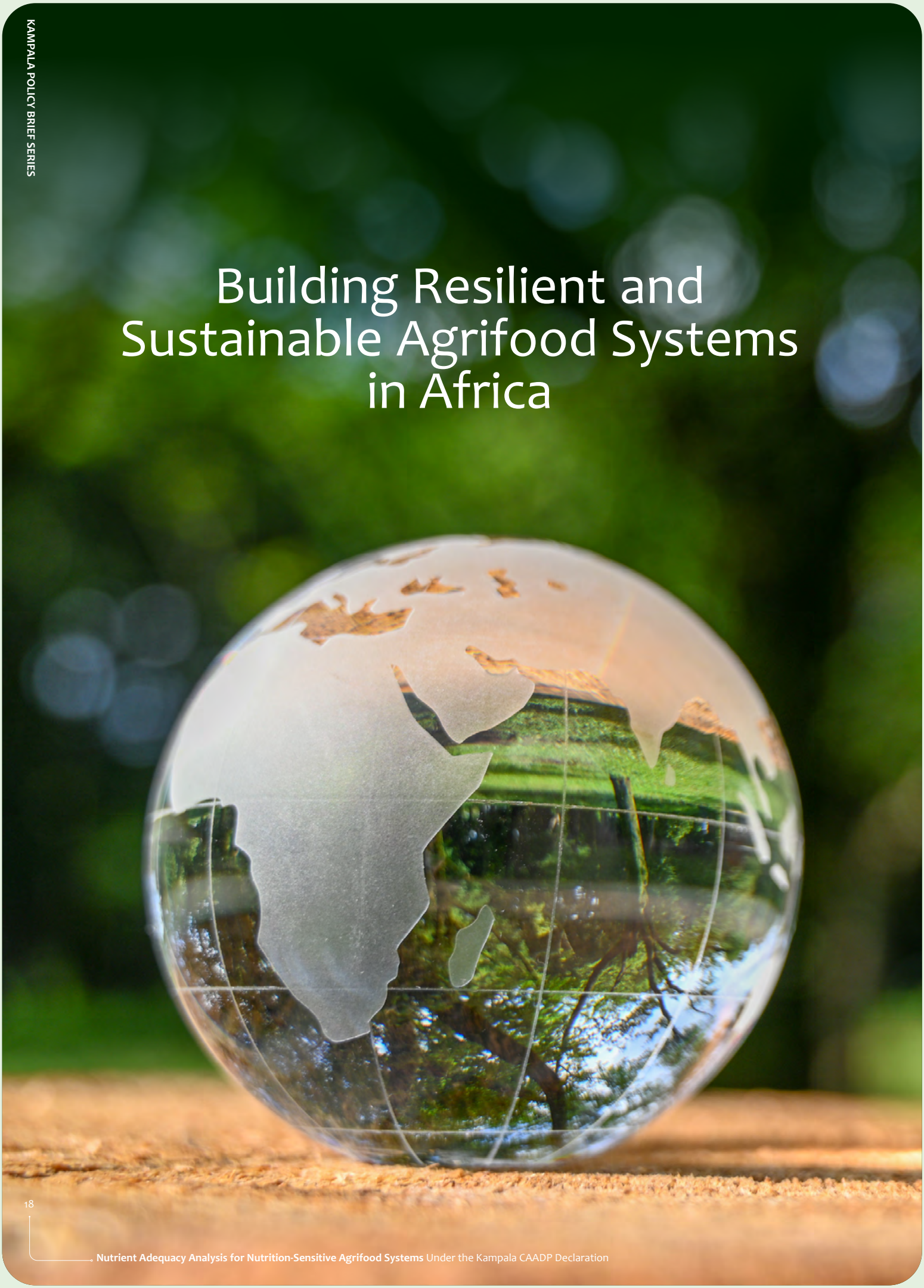
AKADEMIYA2063 is a pan-African non-profit research organization with headquarters in Kigali, Rwanda, and a regional office in Dakar, Senegal.

Inspired by the ambitions of Agenda 2063 and grounded in the recognition of the central importance of strong knowledge and evidence systems, the vision of AKADEMIYA2063 is an Africa with the expertise we need for the Africa we want. This expertise must be responsive to the continent's needs for data and analysis to ensure high-quality policy design and execution. Inclusive, evidence-informed policymaking is key to meeting the continent's development aspirations, creating wealth, and changing livelihoods for the better.

AKADEMIYA2063's overall mission is to create, across Africa and led from its headquarters in Rwanda, state-of-the-art technical capacities to support the efforts by the Member States of the African Union to achieve the key goals of the African Union's Agenda 2063 of transforming national economies to boost growth and prosperity.

Following from its vision and mission, the main goal of AKADEMIYA2063 is to help meet Africa's needs at the continental, regional and national levels in terms of data, analytics, and mutual learning for the effective implementation of Agenda 2063 and the realization of its outcomes by a critical mass of countries. AKADEMIYA2063 strives to meet its goals through programs organized under five strategic areas—policy intelligence, knowledge systems, data intelligence and governance—as well as partnerships and communication and outreach activities. For more information, visit www.akademiya2063.org.

Building Resilient and Sustainable Agrifood Systems in Africa



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