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For a world without hunger

A GROWING OPPORTUNITY FOR NUTRITION

How scaling up opportunity crops can reduce micronutrient gaps and contribute to resilient food systems

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Lead Authors: Caroline Joyce, PhD, MSc and Kendra Byrd, PhD, MSc
Simone Welte
Arno Bratz

Contributors: Inga Christina Kruse
Dr. Stefanie Griebel
Dr. Hendrik Hänke

External reviewers (in alphabetical order): Hans Biesalski, Professor Emeritus at Hohenheim University
Ty Beal, Global Alliance for Improved Nutrition (GAIN)
Gudrun Keding, Professor at Justus Liebig University Giessen
Bertha Mkandawire, AGRA
Diego Naziri, Natural Resources Institute
Lauren Pincus, Mercy Corps
Roland Schafleitner, World Vegetable Center

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Data sharing and availability: The raw data from the food composition tables can be found here: https://drive.google.com/file/d/1kXCBArJ0XFyoE158glGKmDH30shdHr07/view?usp=sharing

About this report

This report provides a quantitative and policy-oriented analysis of how scaling up the production and consumption of 20 opportunity crops prioritized by the Vision for Adapted Crops and Soils (VACS) initiative could help close micronutrient intake gaps in 41 countries facing hunger and undernutrition. Using national estimates of micronutrient intake inadequacies, crop nutrient composition data, crop production data, seasonal harvest calendars, and a review of nutrition, agriculture, biodiversity, and climate policies and strategies, the report demonstrates that opportunity crops offer a largely untapped pathway to address inadequate micronutrient intake, although limitations apply. The report recommends that policy makers and practitioners (1) invest in data, research, and innovation for opportunity crops; (2) scale location-appropriate opportunity crops to reduce micronutrient gaps; (3) promote nutrition-sensitive policies and trade environments; and (4) integrate underutilized crops in broader nutrition and food system strategies.

Intended audience and use

This report aims to provide evidence-based insight and recommendations to policymakers and activists who aim to promote sustainable and nutrition-sensitive food production and food system reforms; technical specialists who seek to design impactful nutrition-sensitive agriculture and food system programs; and Indigenous, farmer, and civil society groups who seek to promote indigenous or traditional crops. While the report does not cover the full global diversity of edible crops or all countries facing micronutrient gaps, it offers a model for promoting edible, climate-resilient crops in a nutrition-sensitive way.

EXECUTIVE SUMMARY

Micronutrient deficiencies, or "hidden hunger," affect more than half of all women and children worldwide (Stevens et al., 2022), particularly in the 41 countries classified by the Global Hunger Index as having serious or alarming hunger levels (Welthungerhilfe, Concern Worldwide, & IFHV, 2024). These deficiencies persist in part because healthy diets are unaffordable to 2.8 billion people globally (FAO et al., 2024). Climate change, soil degradation, and dependence on a narrow set of staples (e.g., maize, rice, and wheat) compound the problem by reducing yields, increasing the risk of crop failures, and degrading overall food system resilience and nutrient-density (van Dijk et al., 2021; Jägermeyr et al., 2021; Ruane et al., 2018; Myers et al., 2014). Rising atmospheric CO_2 levels further reduce the protein, iron, and zinc content of many staple crops, with declines of 5–15% observed in wheat, rice, peas, and soybeans (Myers et al., 2014; Bezner Kerr et al., 2022). These trends pose a critical threat to nutrition security in contexts where dietary diversity is low and populations rely heavily on staple foods for nutrient intake.

No single strategy can solve this challenge. Fortification, supplementation and biofortification play a critical role. Yet, large-scale fortification would leave an estimated 20.9 billion micronutrient gaps unmet (Friesen et al., 2025), and supplementation alone overlooks the broader benefits of diverse, minimally processed diets. Biofortification can help close specific nutrient gaps but is limited by agronomic tradeoffs and low consumer acceptability (Saltzman et al., 2013).

In response to these global nutrition challenges, "opportunity crops", a diverse set of nutrient-dense, often indigenous and underutilized crops, are gaining attention for their potential to enhance both dietary diversity and climate resilience (Glatzel et al., 2025; Chivenge et al., 2015). Despite growing interest, there is limited evidence on the extent to which these crops can close nutrient gaps across landscapes, markets, and diets.

This report provides the first quantitative, policy-oriented analysis of how scaling up production and consumption of 20 opportunity crops prioritized by the Vision for Adapted Crops and Soils (VACS) initiative could help close micronutrient intake gaps in the 41 countries facing the most severe levels of hunger and undernutrition (Welthungerhilfe et al., 2024). Using crop nutrient composition, production data, and national estimates of nutrient inadequacy, we assessed each crop's contribution to national micronutrient availability. We also examined seasonal harvest calendars to identify periods of likely micronutrient scarcity, and modeled country-specific scenarios in Burkina Faso, Malawi, and India to explore the impact of nutrition-sensitive production shifts. Finally, we analyzed the extent to which existing national nutrition, agriculture, biodiversity, and climate policies and strategies promote opportunity crops.

Due to gaps in yield data for many opportunity crops, we could not simulate land conversion scenarios, but we did demonstrate how production shifts would lead to nutrient shifts. For example, replacing 20% of rice production in India with amaranth grain would lead to an increase in iron and magnesium equivalent to the requirements for all women of reproductive age. Leafy vegetables and micronutrient-rich roots/tubers harvested during lean seasons, in addition to improved preservation techniques and capacity, can also contribute to closing seasonal gaps. While opportunity crops cannot close all nutrient gaps, especially for vitamin B12 or zinc, they offer a sustainable complementary solution to other nutrition interventions. Considerations of nutrient bioavailability, cultural preferences, market access, and affordability remain essential.

Opportunity crops can be integrated into existing systems through crop rotation, intercropping, or targeted replacement, with potential benefits for soil health, biodiversity, and livelihoods. Many are cultivated by women and Indigenous producers, offering additional gender and equity co-benefits. Yet despite this promise, they are underrepresented in national policies. While over half of national policies mentioned one or more opportunity crops, only 10% did so meaningfully in relation to nutrition or climate goals. To realize their full potential, targeted action is needed across four key areas:

1. **Invest in data, research, and innovation for opportunity crops.** Improve the quality and accessibility of food composition data for all 60 VACS-prioritized crops. Scale up crop suitability and soil nutrient mapping (especially for micronutrients that are highly dependent on soil conditions, such as iodine and selenium), yield modeling, and integrated analyses of climate resilience and nutritional potential. Develop decision-support tools to guide the integration of opportunity crops into production, trade, and consumption strategies. Consider all regions with high burdens of malnutrition and soil degradation for data, research, and innovation, including South Asia.

2. **Scale location-appropriate opportunity crops to reduce micronutrient gaps.** Prioritize crops based on seasonal and geographic disparities in micronutrient intakes. Increase demand and consumption through processing and packaging for convenience, school meals, nutrition education, maternal and child health programs, and behavior change strategies. Strengthen supply through breeding programs, seed systems, technical extension services for producers, and community gardens. Support farmer access to processing, storage, and

marketing infrastructure, with a particular focus on empowering women and youth in opportunity crop value chains.

3. **Promote coherent, nutrition-sensitive policies and trade environments.** Integrate opportunity crops into national food-based dietary guidelines and policies to align nutrition, agriculture, and environmental goals, as well as the goals of Indigenous populations. Ensure a supportive regulatory environment for cross-border trade and harmonized food standards. Use modeling and decision support tools to inform evidence-based policy decisions.

4. **Embed opportunity crops in broader nutrition and food system strategies.** Position opportunity crops as a foundational component of climate-resilient, nutrient-rich food systems. Align efforts with complementary interventions to improve micronutrient intake, such as fortification, supplementation, and biofortification. Promote opportunity crops holistically with low-impact animal-source foods across landscapes, markets, and plates to ensure sustainable healthy diets. Integrate food-based solutions with multi-sectoral plans that address maternal, infant, and young child feeding; management of acute malnutrition; nutrition norms and governance; water, sanitation, and hygiene; and social protection services for nutrition.

In conclusion, opportunity crops hold untapped potential to address hidden hunger, particularly in countries most vulnerable to malnutrition and climate change. Their integration into national policies, research agendas, and programmatic efforts can not only improve nutrition but also deliver co-benefits for gender equity, climate resilience, biodiversity, and rural livelihoods. By investing in these underutilized crops and the systems that support them, countries can improve the healthfulness, inclusivity, and sustainability of their food systems.

1. INTRODUCTION

Micronutrient deficiencies affect over half of women and children around the world (Stevens et al., 2022) and account for approximately 12% of global deaths in children under 5 years (Ahmed et al, 2013). Micronutrient deficiencies are especially prevalent in countries classified as having serious or alarming levels of hunger, where diets are often dominated by starchy staples and healthy diets are not affordable for a majority of the population (Welthungerhilfe, Concern Worldwide, & IFHV et al., 2024). Women and children are disproportionately affected, with high rates of iron, zinc, calcium, vitamin A, and folate inadequacy contributing to poor birth outcomes and overall health, impaired development, and premature mortality. These same countries are simultaneously beginning to experience increasing rates of overweight, obesity, and chronic diseases related to excess energy intake (Seferidi et al., 2022).

Agricultural intensification and the widespread adoption of high-yield staples such as wheat, maize, and rice have played a key role in reducing global hunger by addressing calorie deficits (Pingali et al., 2012) and, to some extent, improving micronutrient intakes (FAO, 2004; Joyce et al., 2025). However, the global dependence on a narrow set of staple crops has left many essential micronutrient needs unmet, while also contributing to a loss of biodiversity and environmental degradation (Pingali et al., 2012). These ecological disruptions, combined with increasingly variable climate patterns, are beginning to reverse earlier gains in agricultural productivity and increase the risk of crop failures (van Dijk et al., 2021; Jägermeyr et al., 2021; Ruane et al., 2018). In addition, rising atmospheric CO_2 levels are projected to reduce the protein and micronutrient content (particularly iron and zinc) of staples (Myers et al., 2017). These declines pose a serious threat to food and nutrition security, especially in regions where dietary diversity is low and reliance on staples is high (Myers et al., 2017; Bezner Kerr et al., 2022; Beach et al., 2019).

No single strategy can solve these challenges. Healthy diets remain unaffordable for 2.8 billion people globally (FAO et al., 2024). Fortification, supplementation, and biofortification play a critical role in addressing these challenges. Yet, even with full implementation, large-scale fortification would leave an estimated 20.9 billion micronutrient gaps unmet (Friesen et al., 2025), and supplementation alone overlooks the broader benefits of diverse, minimally processed diets. Biofortification can help close specific gaps but is limited by agronomic tradeoffs and low consumer acceptability in some contexts (Saltzman et al., 2013).

In response to the need for more nutritious, resilient, and sustainable food systems, the Vision for Adapted Crops and Soils (VACS) initiative identified a set of "opportunity crops" – neglected or underutilized species that are rich in micronutrients and more resilient to harsh growing conditions than many existing staples (U.S. Dept of State et al., 2023). These crops, which include grains, legumes, roots and tubers, nuts and oilseeds, fruits, and vegetables, offer promising solutions to simultaneously address inadequate micronutrient intakes, diversify production, and improve farmers' resilience to climate change (Karl et al., 2024). In addition, opportunity crops are higher in fiber and protein than starchy staples, which can help alleviate the burden of overweight and non-communicable diseases (Karl et al., 2024; Singh & Thakur, 2025; Yanni et al., 2024). Many of these varieties are traditionally cultivated by women, and several are already grown at scale in hunger-affected countries, despite being often under-researched and overlooked in policy and investment decisions.

While opportunity crops are widely recognized for their nutritional potential, the extent to which they can close nutrient intake gaps at scale remains unclear. Current research has largely focused on the agronomic traits and individual nutrient profiles of specific species. Where research has been conducted, it has largely focused on only five micronutrients – calcium, iron, zinc, vitamin A, and folate (Karl et al., 2024; U.S. Dept of State et al., n.d.). Additionally, few studies have assessed how opportunity crops could be strategically integrated into national food systems to address gaps in nutrient intake across population subgroups or seasonal periods of food insecurity.

This report fills that gap. Building on recent VACS-led profiling and modeling work, we assessed the potential contribution of 20 VACS-identified opportunity crops to improving nutrient availability in the 41 countries with the highest burden of hunger and malnutrition (Fredenberg et al., 2024; Karl et al., 2024; Welthungerhilfe et al., 2024). We collated crop nutrient profiles and production statistics to model the potential impact on nutrient availability of substituting a portion of existing major crop production with nutrient-rich alternatives. We also examined national policies to evaluate how opportunity crops are currently reflected in nutrition, agriculture, climate, and biodiversity strategies.

This report offers a novel, systems-oriented perspective on how opportunity crops can help close persistent nutrient gaps, especially during seasonal periods of food insecurity, and contribute to more inclusive, resilient, and sustainable food systems. By expanding the evidence base on opportunity crops, we aim to equip policymakers and other stakeholders with data to inform nutrition-sensitive and climate-resilient agricultural investments.

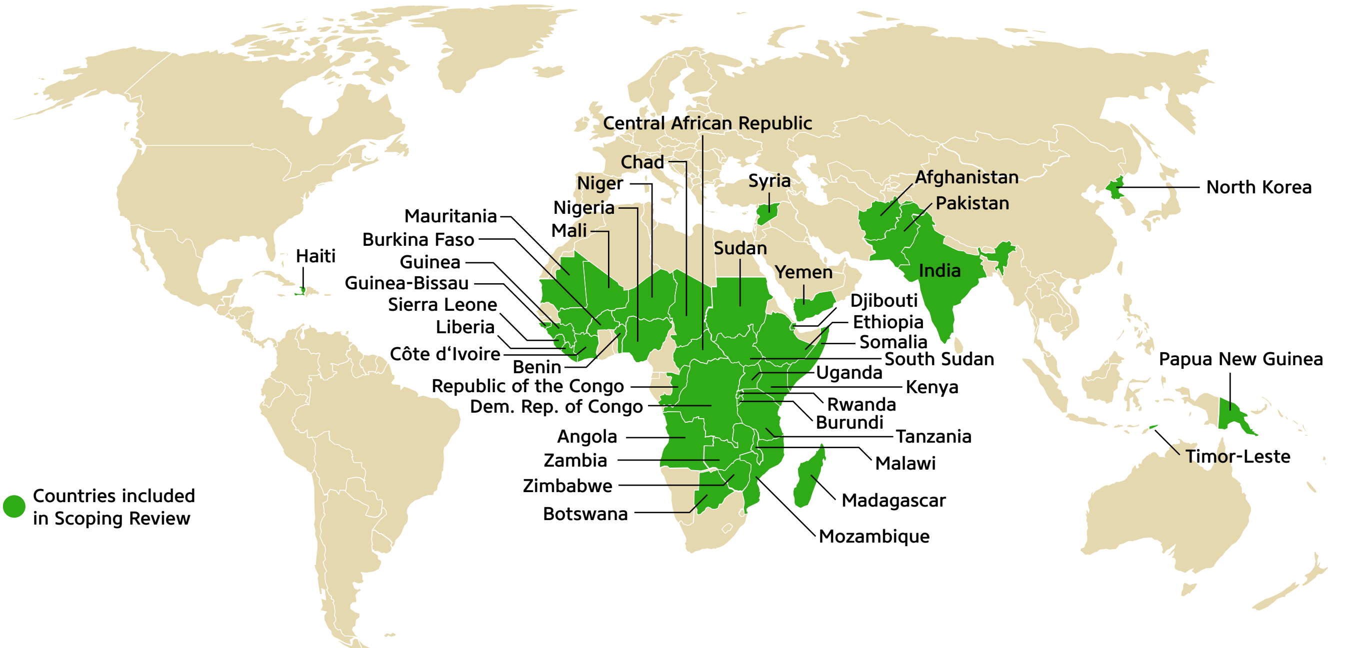
2. METHODS

Measuring and assessing the feasibility of impactful, complex pathways for improvements to the food system requires a holistic approach (CGIAR, 2024). Beyond literature reviews, we synthesized a variety of data, including food composition values, production statistics, harvest calendars, and policy documents, to provide a broad view of how opportunity crops may fill important nutrient gaps. Each data source and extraction technique is described in detail below.

2.1 Geographic scope

Previous reports on opportunity crops have focused primarily on Sub-Saharan Africa. However, many species that are indigenous and under-researched in Africa are similarly underutilized in other regions. Moreover, the burden of inadequate nutrient intake extends well beyond Sub-Saharan Africa (Passarelli et al., 2024; Chong et al., 2023). To identify the countries most affected by food and nutrition insecurity in a consistent and multi-dimensional way, we used the Global Hunger Index, which ranks countries based on undernourishment and child stunting, wasting, and mortality (Welthungerhilfe et al., 2024; Muthayya et al., 2013). In 2024, 41 countries were classified as having 'serious' or 'alarming' levels of hunger (Figure 1). Of those, 32 were in Africa and five were in South and West Asia (Afghanistan, India, Pakistan, Syria, and Yemen). The remaining four countries were North Korea, Timor-Leste, Papua New Guinea, and Haiti (Welthungerhilfe et al., 2024).

Figure 1: Map of 41 countries with serious or alarming levels of hunger, as ranked by the Global Hunger Index (**Welthungerhilfe et al., 2024**).



2.2 Review of micronutrient intake gaps and seasonal variation

Our review is based on the estimation of micronutrient intake inadequacies by Passarelli et al. (2024). Many factors affect the likelihood of achieving adequate micronutrient intake. Of particular importance to our review is the fact that many countries with a high burden of hunger rely heavily on subsistence agriculture and a narrow set of starchy staples, which means that harvest seasons act as a proxy for seasonal variation in micronutrient intakes (Karanja et al., 2022; Global Panel, 2018; Islam et al., 2023). Thus, for each country, we identified the main harvest months for existing staples, combined with annual average rainfall patterns, to estimate seasons in which food (and therefore nutrient) intakes are likely to be low (Annex 2). We recognize that many countries stretch across multiple agroecological zones, which creates subnational variation in the types and quantities of food produced or consumed (Zabel et al., 2025). Nevertheless, we aimed to identify countries with broadly similar ecological conditions so that production data (e.g., which opportunity crops are suitable for scaling and when they can be harvested) can help inform cross-national policy decisions despite existing data gaps.

The 41 countries we analyzed were grouped into six geographic clusters based on climate and agroecological characteristics:

- **Tropical West Africa, India & North Korea:** Benin, Burkina Faso, Côte d'Ivoire, Guinea, Guinea-Bissau, India, Liberia, Nigeria, North Korea, Sierra Leone
- **Semi-Arid Africa and West Asia:** Afghanistan, Botswana, Chad, Djibouti, Mali, Mauritania, Niger, Somalia, Sudan, Syria, Pakistan, Yemen
- **Central African Grasslands:** Central African Republic (CAR), Ethiopia, South Sudan
- **Equatorial Africa & Haiti:** Angola, Burundi, Democratic Republic of the Congo (DRC), Haiti, Kenya, Republic of Congo (Congo-Brazzaville), Rwanda, Tanzania, Uganda
- **Southeast Africa & Timor-Leste:** Madagascar, Malawi, Mozambique, Zambia, Zimbabwe, Timor-Leste
- **Papua New Guinea**

2.3 Calculation of micronutrient profiles of selected opportunity crops

The opportunity crops selected for this report are based on the "Vision for Adapted Crops and Soils" (VACS) movement. The methodology used to narrow the list from over 300 edible, climate-resilient traditional and indigenous crops to 20 prioritized for research is described in detail elsewhere (U.S. Dept of State et al., 2023). Briefly, from an initial list of edible varieties grown in Africa, 60 were selected for further research, development, and scaling based on their nutritional value, climate resilience, and regional relevance. This list was then further refined to 20 crops, which were selected by the VACS initiative for profiling and modeling based on data availability and the feasibility of conducting detailed analyses, given the intensive nature of such tasks (U.S. Dept of State et al., 2023).

The resulting crop list features **five grains** (fonio, teff, sorghum, finger millet, and pearl millet), **six legumes** (cowpeas, grasspeas, pigeon peas, bambara beans[1], lablab, and mung beans), **four roots and tubers and their leaves** (cocoyam, sweet potato, taro, and yam), **two nuts / oilseeds** (sesame and groundnut), and **three fruits and vegetables** (African eggplant, amaranth, and okra) (scientific names presented in Table A1.1).

For each of the 20 opportunity crops prioritized by the VACS initiative, we compiled nutrient values for calcium, iron, magnesium, zinc, vitamin A, thiamin, riboflavin, niacin, vitamin B6, folate, vitamin C, and vitamin E, as these nutrients have relatively complete data across food composition tables (unlike iodine and vitamin D, which are frequently missing values). Where possible, we used nutrient values for the boiled form of each crop, except for nuts and seeds, which were reported in their dried form. Data were drawn from the West African, Malawian, Indian, Bangladeshi, and United States (US Department of Agriculture) food composition tables (Stadlmayr et al., 2013; Longvah et al., 2017; MAFOODS, 2019; Shaheen et al., 2013; USDA, n.d.-b). For most crops, we were able to match the scientific names used in the VACS reports to those listed in the food composition tables. The two exceptions were African eggplant and bambara bean: for African eggplant, nutrient values for the more common large purple variety were used, and for bambara bean, matching was done using its common name.

We then compared the nutrient composition of each opportunity crop (boiled or dried) to the harmonized average requirements (H-AR) for children and women of reproductive age (Allen et al., 2020). Although Passarelli et al. identified iodine as the most common under-consumed nutrient globally, we excluded it from our analysis because plant-based iodine content is highly dependent on soil conditions, and most plants (excluding seaweeds) are generally poor sources of iodine (Passarelli et al., 2024; Duborska et al., 2022). Furthermore, when fortification programs are taken into account, the prevalence of inadequate iodine intake decreases substantially (Friesen et al., 2025). For children aged 6 to 23 months, we assessed nutrient contributions using a 25-gram portion size (approximately ¼ cup for most foods) and for women, we used a 100-gram portion size (roughly 1 cup). In addition to gram-based comparisons, we also calculated nutrient content per 25 kilocalories for children and per 100 kilocalories for women.

1 Vigna subterranea are often called bambara nuts; however, they are nutritionally and culinarily more similar to beans, so we've diverged from the VACS report on the common name of this crop.

2.4 Review of geographic distribution and harvesting seasons of opportunity crops by country

We aimed to identify which of the 20 opportunity crops are grown in each of the 41 countries of interest and, where possible, to document their harvest periods. Because these species are often under-researched, data on national production and seasonal availability were frequently limited or unavailable. In Table 1, which presents the geographic distribution of each crop, we did not differentiate between wild and cultivated observations – any credible report of a crop's presence in a country was included.

Our primary data sources included FAO databases (Crop Calendar, FAOSTAT, Global Information and Early Warning System (GIEWS) country briefs, and a "Millet Post-harvest Compendium"), USDA Crop Calendar Charts (FAO, n.d.; FAO, 2025e; FAO, 2025b; Kajuna, 2001; USDA, n.d.-a), and national government documents (i.e., nutrition, agriculture, biodiversity, and climate change policies, primarily accessed through FAO, 2025d). We also drew on Rural Household Multiple Indicator Survey (RHoMIS) data, which provided valuable insights on household-level crop production (Gorman et al., 2025). To supplement these sources, we conducted targeted Google searches combining each opportunity crop (using both common and scientific names) with each country name (and acronyms, where applicable). This yielded additional information from peer-reviewed publications, grey literature, local organizations (e.g., African Food Changemakers, 2025), and regional news sources (e.g., Forbes India, 2025).

When evidence of production was not available elsewhere, we consulted the Royal Botanic Gardens, Kew database (Royal Botanic Gardens Kew, n.d.). While the Kew database offers a broad inventory of geographic distribution, the underlying methodology was not always transparent, and in some cases, the list of countries appeared more expansive than what could be corroborated through peer-reviewed literature, grey literature, or other public sources. As such, we treated this information with caution and used it primarily as a supplementary reference.

We identified some important limitations in compiling the crop production table and the harvest calendars. Much of the available data (e.g., FAO statistics) relies on country-level reporting, which varies considerably across countries. In addition, funding patterns likely contribute to publication bias, with some countries better represented in the literature than others. As a result, data for many countries may be incomplete, underreported, or outdated. With respect to millet, we found that most data sources did not specify the type, although multiple millet varieties (pearl millet, finger millet, teff, and fonio) are all considered opportunity crops. Pearl millet is the most commonly cultivated variety around the world, including in India and nearly all countries in Africa (Kajuna, 2001). Therefore, if the millet type was not specified in the production calendar or production data, we assumed it to be pearl millet. Additionally, all countries in which finger millet production data were available were assumed to also grow pearl millet. However, some ambiguity remains around common names. For example, pearl millet is referred to by two species names (*Cenchrus americanus* and *Pennisetum glaucum*), while 'cocoyam' and 'taro' are often used interchangeably to describe *Xanthosoma sagittifolium* and / or *Colocasia esculenta*. Where available, we searched for sources that included the scientific name. When the crops were not identified by their scientific names, we included the data as reported.

2.5 Scenario development for scaling up opportunity crop production to increase micronutrient availability

Opportunity crops represent a largely untapped avenue for improving micronutrient intakes. To demonstrate their potential, we modeled how national nutrient availability could shift if a portion of major crop production, referred to in VACS reports as a "reference crop", were replaced by a nutrient-dense opportunity crop (Karl et al., 2024). This approach underscores the value of investing in data, research, and policies that better integrate nutrition goals into agricultural systems. To support this effort, we presented a simplified framework for assessing how shifts in production could contribute to more nutrition-sensitive food systems. The framework was guided by five core questions:

1. Which micronutrients are most under-consumed in the country of interest?
2. Among the opportunity crops that grow in the country of interest, which one is the richest in under-consumed micronutrients?
3. How does the nutrient composition of the opportunity crop compare to that of a major reference crop?

4. How does the opportunity crop's harvest period compare to the reference crop's harvest period, especially with respect to the lean season?

5. What is the potential impact on nutrient availability if 20% of the production of the reference crop was replaced with production of the opportunity crop?

We focused on women of reproductive age because they have high micronutrient requirements relative to energy needs, often face disproportionately poor diet quality, have limited access to nutrient-rich foods (Beal et al., 2024), and represent a key demographic for breaking the intergenerational cycle of malnutrition. We focused on children due to their relatively high nutrient needs and the importance of nutrition during the first 1,000 days of life (Dewey, 2013).

To explore the replacement scenarios across different contexts, we selected three countries representing distinct regions: India (South Asia), Malawi (East Africa), and Burkina Faso (West Africa / Sahel). For each country, we used nutrient inadequacy estimates from Passarelli et al. (2024), noting that these estimates do not account for fortification in the food supply. We then modeled the change in nutrient availability if 20% of a major crop's 2022 domestic edible-yield production (based on FAOSTAT data) were replaced with an equivalent quantity of an opportunity crop. Due to gaps in yield data for many opportunity crops, we could not simulate land conversion scenarios. Nevertheless, as demonstrated in Section 3.2.4, these simplified scaling scenarios offer a useful starting point for informing investment and policy decisions, despite current data gaps.

Opportunity crops differ in growing conditions, cultural relevance, and consumption patterns. The impact of scaling up their production on micronutrient intakes depends on multiple context-specific factors, including the severity of nutrient inadequacies, the nutrient composition of each crop, losses from food waste and degradation, bioavailability, and the desirability and cultural acceptance. Ecological and geographic variables, such as soil quality, pest pressure, subnational variability, and other agronomic considerations, also influence scalability. From an agricultural perspective, policymakers and institutions must weigh factors such as land availability, crop suitability, yield potential, input access, extension capacity, market linkages, and trade conditions. For farmers, considerations include profitability, access to seeds and advisory services, proximity to processors and wholesalers, marketing support, and transportation infrastructure. While a comprehensive analysis of these factors was beyond the scope of this study due to resource and data limitations, the simplified scaling scenarios presented here illustrate the need for targeted investments to close data gaps and develop more robust, context-specific models.

2.6 Analysis of opportunity crop promotion in governmental policies and action plans

In each of the 41 countries, we reviewed the national nutrition, agriculture, biodiversity, and climate change policies/action plans, as well as the national food-based dietary guidelines that were available online, including those published in French and Portuguese (FAOLEX, 2025). In each policy, we searched for the 20 opportunity crops by name and by using other possible category names (i.e., orphan, neglected, underutilized, local, and/or indigenous). We also searched for general references to crops, agriculture, and food. The relevant findings are summarized in Section 3.3. To maintain clarity and focus, the main text includes policy summaries for the three countries selected for the scaling scenarios (Malawi, Burkina Faso, and India), along with two additional countries (Sierra Leone and Tanzania) which demonstrated the most comprehensive promotion of opportunity crops across their national policies. Summaries for the remaining countries are provided in Annex 4.

3. FINDINGS

3.1 Micronutrient intake inadequacies in hunger-affected countries

3.1.1 PRIORITY NUTRIENT GAPS

According to recent estimates, the majority of people worldwide do not obtain sufficient calcium, iodine, iron, riboflavin, folate, vitamin C, or vitamin E from unfortified foods (Passarelli et al., 2024). This pattern holds across the 41 countries with serious or alarming levels of hunger, although the number of nutrient inadequacies varies widely by countries. On average, countries in South Asia face more widespread gaps than those in Africa. In fact, South Asia reports the highest rates of inadequate intakes for calcium, iron, selenium, zinc, vitamin A, thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, and vitamin C (see Passarelli et al., 2024 for global heat maps of inadequate nutrient intakes). These findings highlight the urgent need to expand access to diverse, nutrient-rich foods across the region, particularly in India, Pakistan, and Afghanistan.

3.1.2 SEASONAL DRIVERS OF INADEQUATE MICRONUTRIENT INTAKES

Seasonal fluctuations in food consumption significantly affect micronutrient intakes, particularly among rural populations in low- and middle-income countries (LMICs), where more than half the population resides and food systems are heavily reliant on local production (Cockx & Boti, 2024; Choudhury et al., 2025). While some research suggests temporal variation is decreasing in LMICs, this trend is largely driven by urban populations, who increasingly rely on food imports and more stable market access (Choudhury et al., 2025). As a result, national-level prevalence estimates may obscure seasonal and geographic disparities in micronutrient intake, masking more acute or prolonged periods of hidden hunger among rural populations.

Across many of the countries included in our analysis, we observed that harvest cycles – especially for staples such as cereals, roots, and tubers – are closely tied to rainfall patterns, reflecting the widespread dependence on rainfed agriculture (Global Panel, 2018; Abrams, 2018). Cereal harvests typically begin at the end of the rainy season, while roots and tubers often help bridge seasonal food gaps by extending availability into lean periods. In countries like Papua New Guinea, where sweet potatoes are harvested year-round, seasonal variation in nutrient intake is likely less pronounced. However, most countries analyzed experience some form of seasonal food insecurity, typically in the early part of the rainy season, just before the main cereal harvest begins (Annex 2).

Despite their relatively low micronutrient density, starchy staples contribute substantially to total micronutrient intake in many LMICs due to their high per capita consumption (FAO, 2004; Joyce et al., 2025). For example, among rural-dwelling adults in one middle-income country, refined grains (primarily white rice) provided 40% of energy intake and the highest per capita contributions of calcium, iron, zinc, thiamine, riboflavin, niacin, vitamin B6, and folate intakes of any food group (Joyce et al., 2025). When combined with whole grains and starchy roots and tubers, starchy staples accounted for 57% of energy intake (Joyce et al., 2025). Although food consumption patterns vary across contexts, starchy staples supply 42-82% of dietary energy in the 41 countries most affected by hunger (Ritchie et al., 2021). The fruits and vegetables most commonly harvested during the lean season (e.g., mangos, bananas, and – to a lesser extent – tomatoes and leafy greens) contribute vitamin A, vitamin C, and some calcium, but provide relatively modest amounts of other essential nutrients (Bai et al., 2020). This heavy reliance on a limited range of crops illustrates how pre-harvest scarcity can intensify shortfalls in both calorie and micronutrient intake. Annex 2 provides illustrative figures and further analysis of rainfall and harvest seasonality.

3.2 Nutritional and environmental benefits of opportunity crops

3.2.1 MICRONUTRIENT PROFILES

Fruits and vegetables
The leafy greens of opportunity crops show the greatest potential to address common micronutrient inadequacies – particularly calcium, iron, riboflavin, folate, vitamin C, and vitamin E. Amaranth leaves provide over 100% of a woman's daily calcium requirement per 100 kilocalories, and 60% of a child's calcium requirement per 25 kilocalories (Figures 2b and 3b). Amaranth leaves also offer the highest iron content among the crops analyzed, meeting 45% of a child's iron needs per 25 kilocalories and 106% of a woman's needs per 100 kilocalories. Cocoyam leaves are the most concentrated sources of riboflavin, folate, and vitamin E on a per-kilocalorie basis, while cowpea leaves are the richest in vitamin C.

Several other leafy greens, such as those from cowpea, cocoyam, sweet potato, taro, okra, and amaranth, also deliver substantial amounts of key nutrients, making them important contributors to adequate intake in hunger-affected regions (WVC, 2012; Oboh et al., 2005). While the eggplant variety we assessed (Solanum melongena, the widely cultivated purple type) exhibited the lowest nutrient density on a per gram basis (Figures 2a and 3a), its nutrient content per kilocalorie was comparatively high (Figures 2b and 3b), underscoring its value as a low-energy, micronutrient-dense food.

Grains
Fonio is the most nutrient-dense of the grains assessed, both on a per gram and per kilocalorie basis, with magnesium levels second only to those of groundnuts (Figures 2a - 3b). While cooked values for finger millet were unavailable and thus excluded from our analysis, its nutrient composition is likely comparable to that of pearl millet. Although grain amaranth has a lower overall micronutrient density than other grains, it is notable for its favorable amino acid profile, including relatively high concentrations of lysine and methionine, two essential amino acids often limited in cereal-based diets (Jan et al., 2023). This trait is especially relevant in settings where animal-source food consumption is low (Miller et al., 2022). While most interventions aimed at reducing childhood stunting focus on micronutrients, emerging evidence suggests that deficiencies in key amino acids may also contribute to growth faltering (Semba et al., 2016).

Legumes
The six legumes we evaluated have broadly similar nutrient compositions, with a few notable distinctions. Lablab is especially high in iron, providing 12.5% of <2-year-old children's recommended intake per 25-g serving (Figure 2a) and 14.8% percent per 25 kilocalories (Figure 2b). While grasspeas are the least nutrient-dense legume, a 25-g serving still provides about 10% of a child's magnesium and folate needs. As with grain amaranth, bambara beans are notable for containing higher levels of the amino acid methionine (Lyimo et al., 2004). Bambara beans are also versatile in terms of consumption, as they can be eaten raw, cooked, as a snack with minimal preparation, or as flour in mixed dishes (Lyimo et al., 2004).

Roots and tubers
Although the roots and tubers (cocoyam, sweet potato, taro, and yam; excluding their leaves) are relatively lower in nutrient-density compared to other opportunity crops, orange and yellow varieties of sweet potato provide significant amounts of vitamins A and C (Figures 2a - 3b). While taro ranks second to last in this group when assessed per gram, it shows a higher nutrient concentration than both yam and cocoyam when nutrients are calculated per kilocalorie (Figures 2b and 3b). Tubers also play a critical role in food security, as they can produce more energy per hectare than many other staples (Onyeka, 2014; Muimba-Kankolongo, 2018).

Nuts and seeds
On a per gram basis, groundnuts are the most nutrient-dense of the 25 foods assessed, providing high levels of magnesium, thiamin, riboflavin, and vitamin E (Figures 2a and 3a). Just 25 grams provide 30% of a child's folate requirement, while 100 grams meet 44% of a woman's requirement. Groundnuts also have the highest vitamin E content per gram among the opportunity crops. Although we did not assess nutrient concentrations per gram for sesame seeds due to their typically low consumption by weight, the per-kilocalorie analysis indicates that they are exceptionally nutrient-dense, delivering more calcium, iron, magnesium, zinc, thiamin, riboflavin, and vitamin B6 per kilocalorie than groundnuts (Figures 2b and 3b).

Figure 2a: Nutrients per 25 g as a percentage of nutrient requirements for children between 6–23 months.

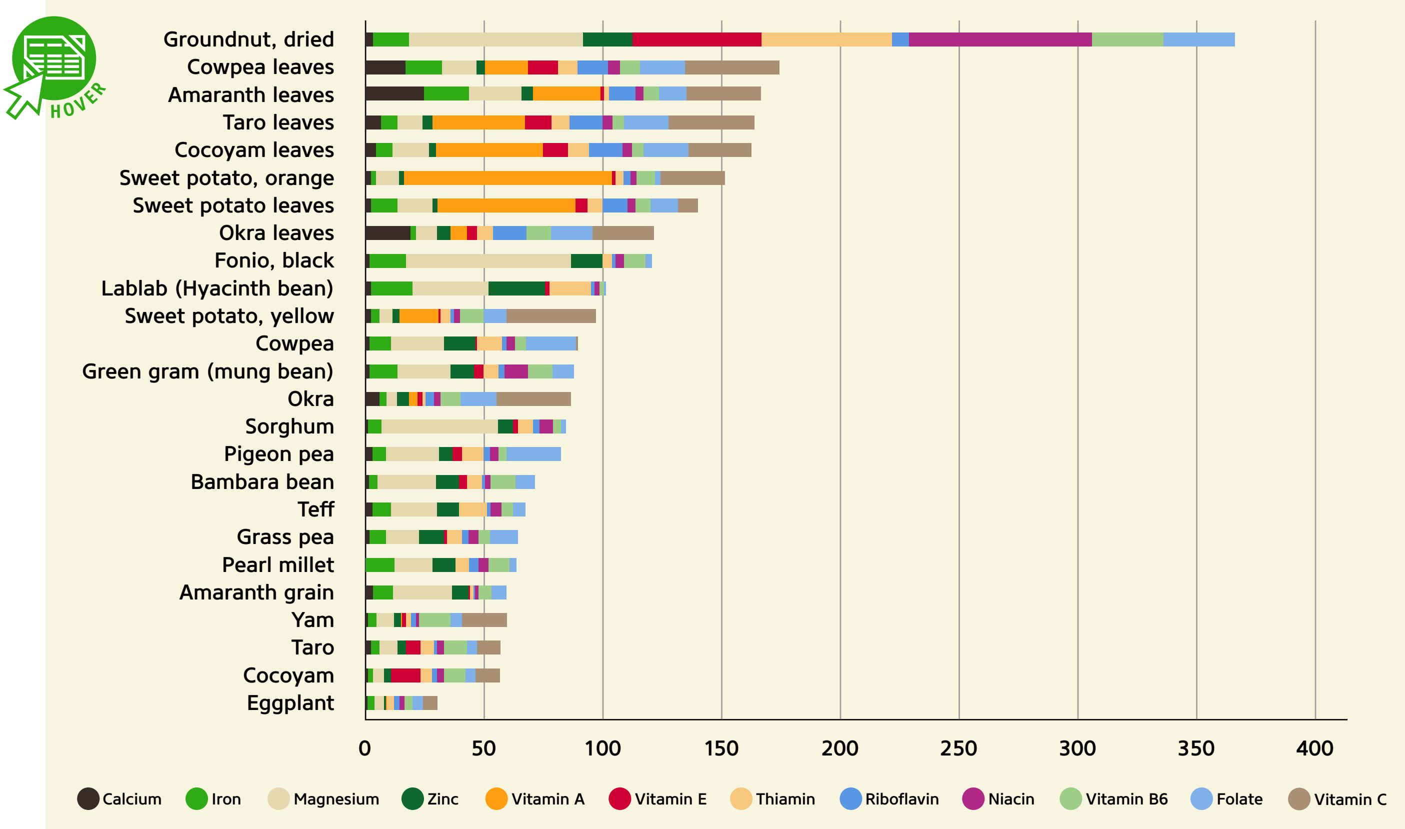
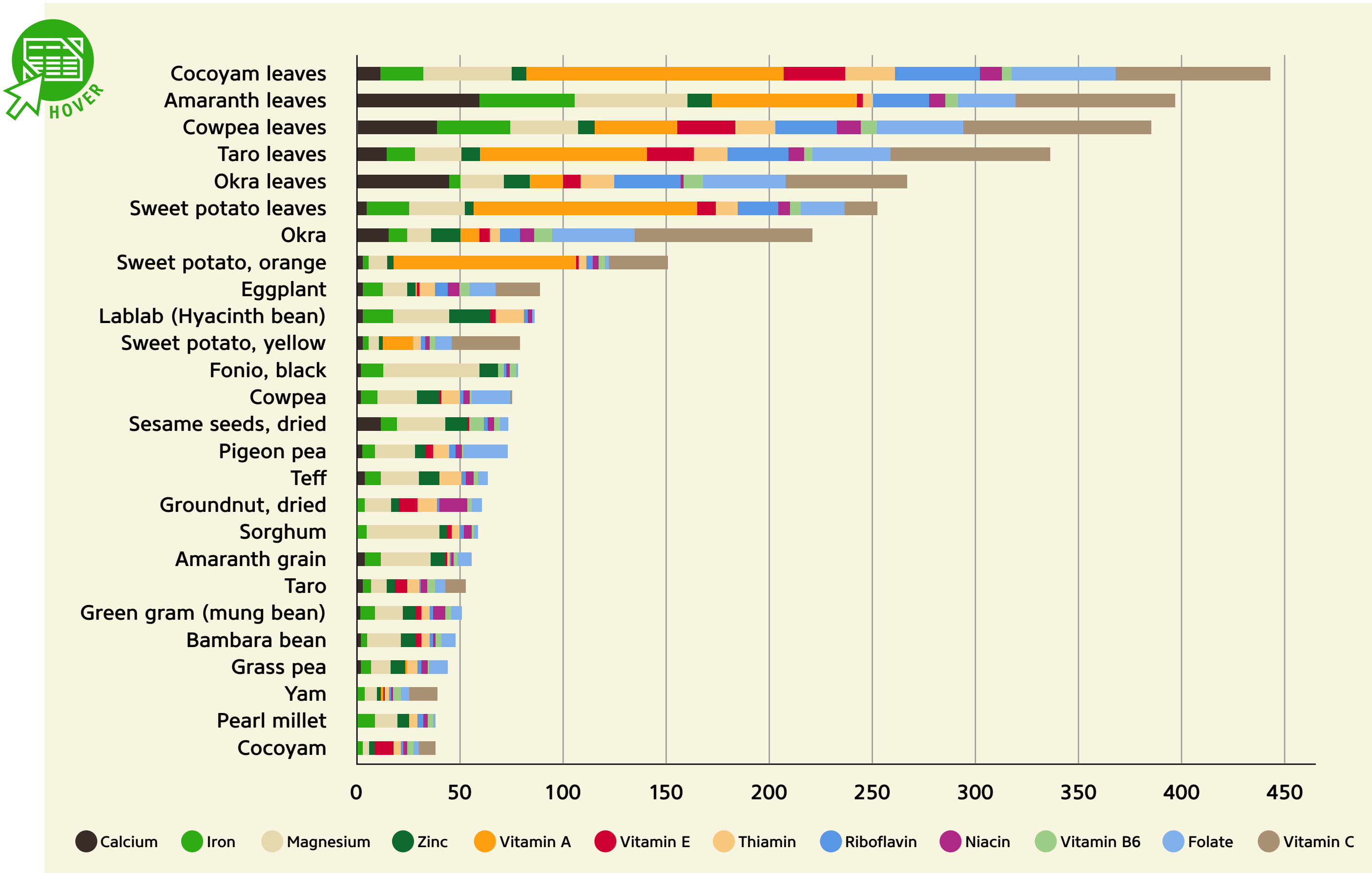


Figure 2b: Nutrients per 25 kilocalories as a percentage of nutrient requirements for children between 6–23 months.



Opportunity crops were selected based on the VACS summary report (Karl et al., 2024). Nutrient composition data was taken from the West African Food Composition Table (Stadlmayr et al., 2013), the Bangladesh Food Composition Table (Shaheen et al., 2013), and the USDA food composition database (USDA, n.d.-b). All nutrient data is from the crop in its boiled form, except for groundnuts. Sesame seeds are are only reflected in the per calorie graphs as they are not generally consumed in large amounts. Nutrient requirements are the harmonized average requirements (H-AR) (Allen et al., 2020).

Figure 3a: Nutrients per 100 g as a percentage of nutrient requirements for a non-pregnant, non-lactating woman aged 30 years old.

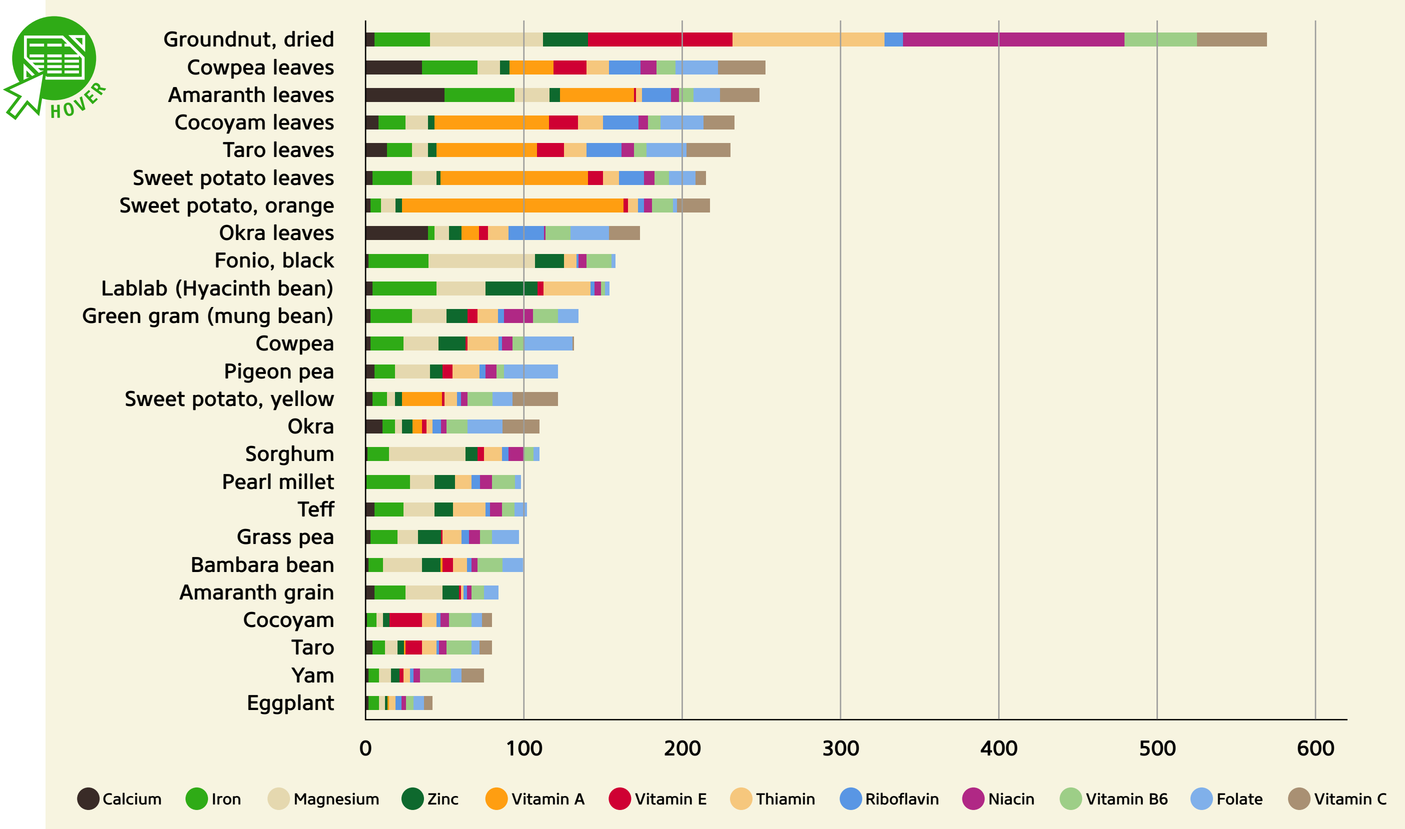
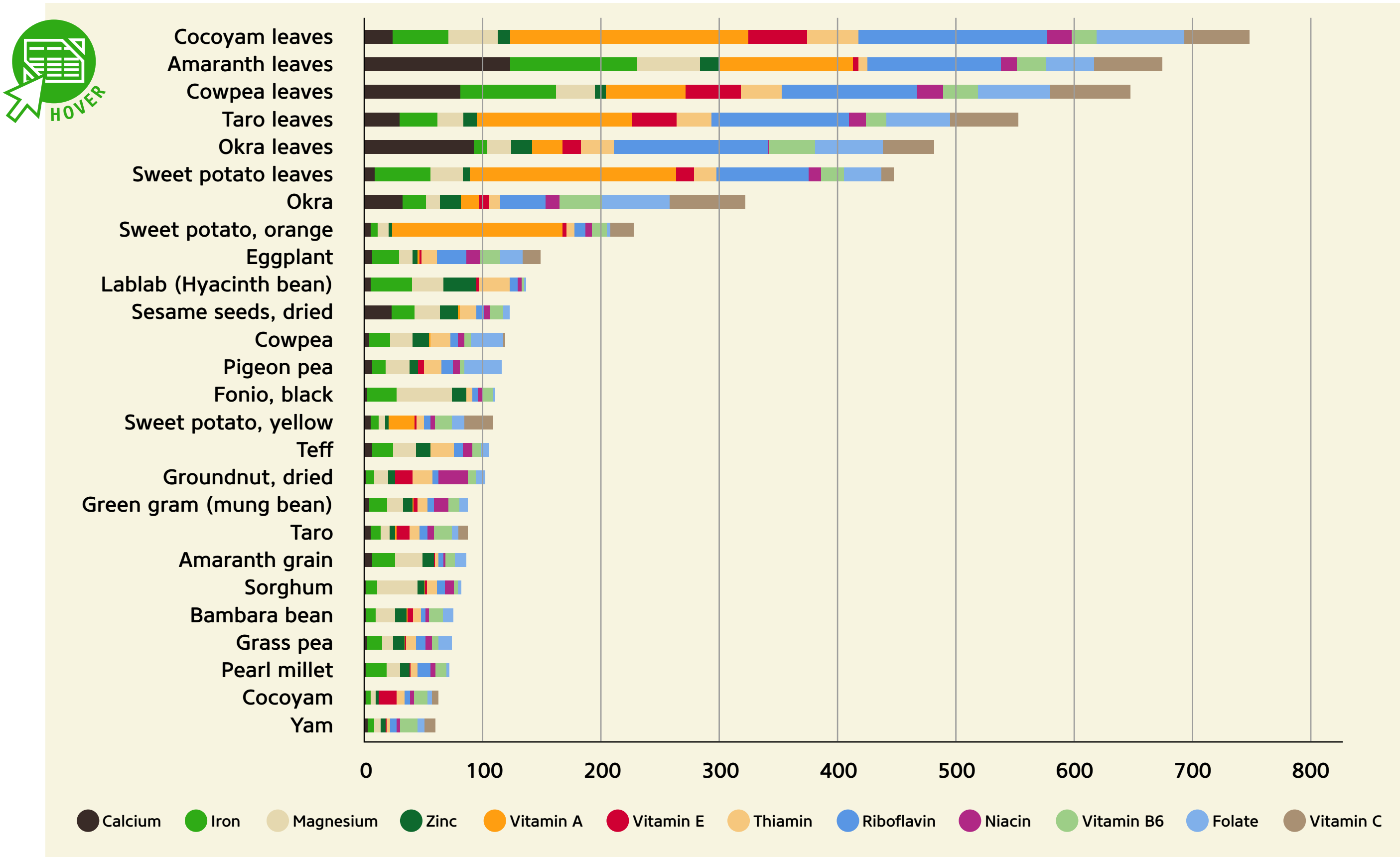


Figure 3b: Nutrients per 100 kilocalories as a percentage of nutrient requirements for a non-pregnant, non-lactating woman aged 30 years old.



Opportunity crops were selected based on the VACS summary report (Karl et al., 2024). Nutrient composition data was taken from the West African Food Composition Table (Stadlmayr et al., 2013), the Bangladesh Food Composition Table (Shaheen et al., 2013), and the USDA food composition database (USDA, n.d.-b). All nutrient data is from the crop in its boiled form, except for the groundnuts, which were dried. Sesame seeds are are only reflected in the per calorie graphs as they are not generally consumed in large amounts. Nutrient requirements are the harmonized average requirements (H-AR) (Allen et al., 2020).

3.2.2 AGRONOMIC AND ENVIRONMENTAL CONTRIBUTIONS OF OPPORTUNITY CROPS

In general, local and indigenous crops require fewer external inputs, such as synthetic fertilizers and pesticides, because they are well adapted to their native ecological conditions and often possess natural defenses against local pests (Shelef et al., 2017). While the specific climate resilience traits of each opportunity crop are detailed in other sources (Karl et al., 2024; U.S. Dept of State et al., n.d.), we have summarized several of the key environmental benefits below.

Fruits and vegetables
The vegetables included in this analysis are generally well adapted to a range of growing conditions. Okra, for example, is highly resilient, tolerating drought and performing well across a wide range of soils, rainfall patterns, and climates (National Research Council, 2006). African eggplants are similarly heat-tolerant and capable of producing high yields in small plots with minimal inputs (David-Rogeat et al., 2024; National Research Council, 2006). Some eggplant species have edible leaves, adding to their nutritional value (National Research Council, 2006). Although irrigation and fertilizer can boost productivity, eggplant can be harvested continuously for 6–7 months under favorable conditions (Lyimo, 2010).

Many of these species offer additional agronomic advantages. Okra and African eggplants, for example, are less susceptible to pests and diseases than other vegetables, making them more reliable in the face of increasing climate stressors (National Research Council, 2006; Skendzic et al., 2021). Their edible leaves also contribute to dietary diversity without requiring separate cultivation plots, increasing overall system efficiency.

Although cowpea leaves are typically consumed fresh, they can be dried or fermented for use during the lean season, improving year-round nutrient access (Owade et al., 2019; Tepe & Lemken, 2022). Amaranth leaves and African eggplants can also be dried to extend their availability beyond the harvest period (Ahmad et al., 2025; Aderibigbe et al., 2020; Sangija et al., 2021). Okra contributes to food and nutrition security through its nutrient-dense pods and leaves, which are used in a variety of stews and sauces (National Research Council, 2006). Importantly, processing techniques such as fermentation not only preserve vegetables but may also enhance their nutritional value. For example, fermented African nightshade leaves, prepared into a traditional relish, have demonstrated improved micronutrient content and are commonly consumed in several African cuisines (Sangija et al., 2022). Similar techniques could be applied to other opportunity crops to reduce seasonal gaps, manage harvest surpluses, and improve overall dietary quality.

Grains
Fonio performs well in warm climates with moderate rainfall, but it is also productive under low precipitation, cooler temperatures, and poor soils (Animasaun et al., 2023). Pearl millet – the most widely cultivated millet variety around the world – is both drought-tolerant and less susceptible to pests and diseases than maize, wheat, or sorghum (Chivenge et al., 2015; DeRouw & Winkel, 2001). Amaranth is similarly hardy: it can withstand harsh ecological conditions, including drought, extreme heat, and high-salinity soils (Chivenge et al., 2015; N. Kaur, 2024; National Research Council, 2006). Its versatility as both a grain and leafy vegetable makes it a useful crop in low-input, climate-resilient systems (N. Kaur, 2024; National Research Council, 2006).

Both sorghum and millet can serve as cover crops, improving water infiltration, enhancing soil structure, and reducing erosion (Koudahe et al., 2022). Their ground cover supports diverse soil macro- and microorganisms, which improves nutrient cycling, suppresses certain soil-borne pests and diseases, and reduces the need for chemical inputs (Koudahe et al., 2022). Additionally, millet and sorghum emit fewer greenhouse gases per kilogram produced compared to maize, rice, or wheat, largely due to their lower fertilizer requirements (Rao et al., 2019).

Legumes
From an agronomic perspective, legumes are resilient under harsh conditions. Lablab is more drought-tolerant than common beans, cowpeas, or soybeans, although cowpeas also grow well in dry conditions and are particularly well-adapted to Sub-Saharan African climates (Maass et al., 2010; National Research Council, 2006; Chivenge et al., 2015). Bambara beans prefer dry weather and, once established, can tolerate both high surface temperatures and nutrient-poor soils better than maize, sorghum, or other pulses (FAO, 2022a; Chivenge et al., 2015). Additionally, bambara beans grow underground, which protects them from pests and other insects that affect cowpeas, soybeans, and other legumes (National Research Council, 2006). Although cowpeas and mung beans are susceptible to pests, breeding programs have already begun developing pest-resistant lines (Gomez, 2023; Razakou et al., 2017; Batzer et al., 2022).

Legumes contribute significantly to agroecological sustainability. Their deep root systems improve water infiltration, reduce runoff, preserve soil moisture, and increase organic carbon content, which helps sequester atmospheric carbon (Koudahe et al., 2022). Their broad leaves act as a cover crop, protecting the soil from wind and rain, reducing evaporation, and suppressing weeds by blocking sunlight (Koudahe et al., 2022). In one study, intercropping sorghum with cowpeas reduced runoff by 20–55% compared to cultivating either crop individually (Zougmore et al., 2000). Bambara beans can also be intercropped with sorghum, millet, yams, maize, or cassava, which can increase the yields of both bambara beans and the companion crop (Egbe, 2013).

Finally, legumes enhance soil fertility through nitrogen fixation and contribute to overall agricultural productivity (Kebede, 2021). By improving soil nutrient content and reducing the need for synthetic fertilizers, legumes can increase yields of intercropped plants while lowering environmental impacts (Kebede, 2021; Koudahe et al., 2022; Ojiewo et al., 2015). This reduction in fertilizer use is critical given the environmental consequences of excess nitrogen, including toxic algal blooms, contamination of drinking water, and greenhouse gas emissions (UNEP, 2023).

Roots and tubers
Roots and tubers offer several advantages in terms of growth cycle and adaptability. Sweet potatoes, taro, and cocoyams have significantly shorter growth periods: 3–6 months for sweet potatoes and 6–16 months for taro and cocoyams, compared to cassava, which takes 8–36 months to mature (Lebot, 2013). Among these crops, sweet potatoes have the lowest water and soil fertility requirements, making them well suited to low-input systems (Lebot, 2013). Although roots and tubers typically have higher water needs than other opportunity crops, sweet potatoes and some taro varieties are moderately drought tolerant (Lebot, 2013; Chivenge et al., 2015). In contrast, taro and cocoyams have the highest water requirements and perform best in high-rainfall regions such as Timor-Leste, Haiti, and Papua New Guinea (Lebot, 2013). Taro, in particular, thrives under flooded conditions, while cocoyam can tolerate periodic flooding (Chemura et al., 2022; Juang et al., 2020). Even in drought-prone areas, roots and tubers can be cultivated near water sources or in natural depressions, allowing them to take advantage of localized moisture with minimal inputs.

These crops also offer post-harvest and ecological benefits. While cassava is known for its long in-ground storage life, sweet potatoes and yams offer longer post-harvest storage, which can reduce seasonal food insecurity (Lebot, 2013). Additionally, many tubers can be intercropped, thereby increasing total food output per hectare (FAO, 1997). For example, cocoyam grows well in shade, which facilitates intercropping with banana, coconut, citrus, oil palm, and cocoa trees (Onyeka, 2014). Like legumes, roots and tubers have deep root systems and broad leaves that provide important ecosystem services, such as soil stabilization and erosion control. In the DRC, cocoyam and taro intercropped with banana helped mitigate soil erosion when banana crops were affected by a bacterial disease (Kebede & Bekeko, 2020; Onyeka, 2014).

Nuts and seeds
Groundnuts and sesame are both well-adapted to semi-arid environments and require relatively low agricultural inputs. Sesame grows well in nutrient-poor soils with minimal fertilizer use, while groundnuts, as legumes, fix atmospheric nitrogen, reducing the need for synthetic fertilizers and improving soil fertility (Kebede, 2021). Both crops are relatively pest-resistant and suited for smallholder farming systems in areas with limited access to agricultural inputs.

The resilience of both sesame and groundnuts under climate stress makes them suitable candidates for diversifying cropping systems in drought-prone and degraded areas. Sesame functions as a cover crop and has a deep root system, which enhance drought tolerance, improve soil structure, and help suppress weeds (Koudahe et al., 2022; Wacal et al., 2024). Groundnuts share many of the ecological benefits common among legumes: their nitrogen-fixing properties improve soil fertility, and their cultivation helps reduce dependence on environmentally harmful synthetic inputs (Koudahe et al., 2022). Intercropping these crops with cereals has been shown to enhance total system yields (Wacal et al., 2024)

Groundnuts and sesame both contribute to food and nutrition security through their nutrient density and versatility. Groundnuts are commonly eaten whole, roasted, or as paste, while sesame is often used in sauces, snacks, or ground into oil (Nautiyal, 2002; Wei et al. 2022). Both can be stored for long periods under proper conditions, helping buffer households against seasonal food shortages (Nautiyal, 2002; Gebregergis et al., 2024). Additionally, in many West African countries, the leaves of *Sesamum radiatum* (commonly called "black sesame") – a species closely related to *Sesamum indicum* – are often dried and consumed during the dry season, adding to its role in bridging seasonal nutrient gaps (Catarino et al., 2019; Adeoti et al., 2012; Jimam et al., 2015).

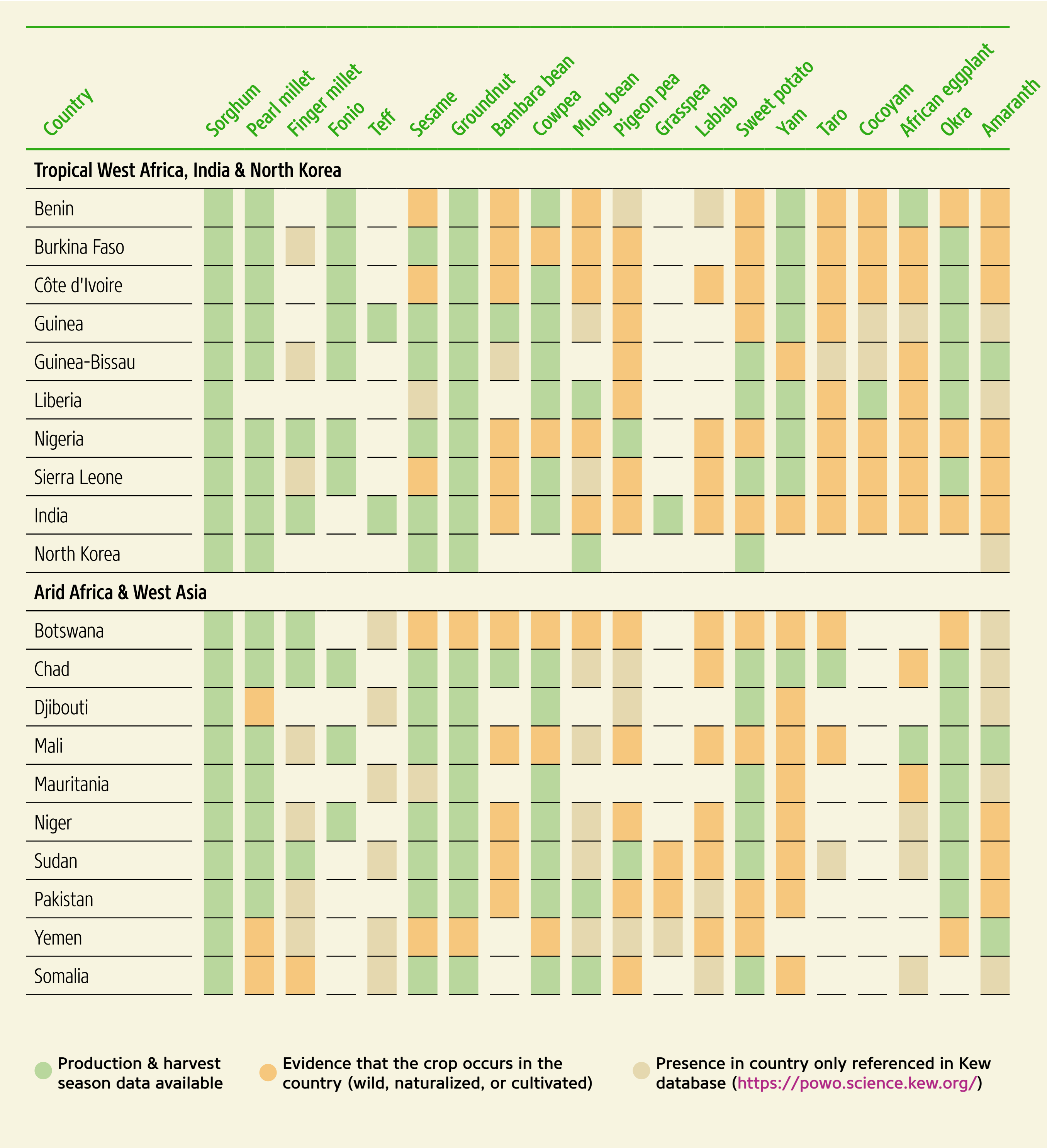
3.2.3 GEOGRAPHIC DISTRIBUTION AND HARVESTING SEASONS OF OPPORTUNITY CROPS

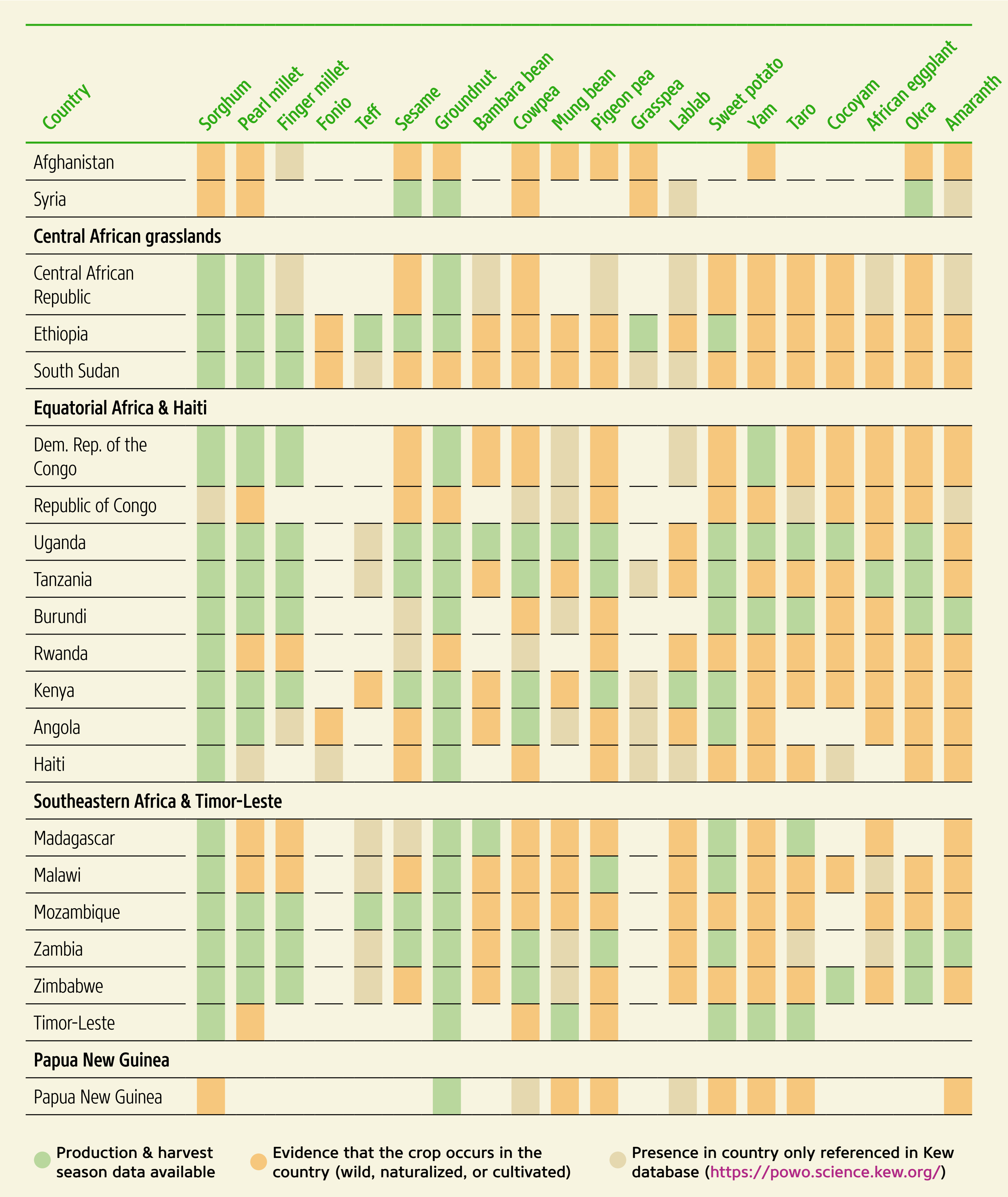
Opportunity crops are already grown across a wide range of agroecological zones and contribute meaningfully to agrobiodiversity in hunger-affected regions. Millets, sesame, groundnuts, cowpeas, pigeon peas, sweet potatoes, yams, okra, amaranth, and bambara beans are among the most widely distributed; many of which are cultivated at similar scales to major staples in several countries. Of the 20 species we assessed, 17 are indigenous to at least one of the 41 countries with the highest burden of hunger, and 12 are native to the majority of them (Royal Botanic Gardens Kew, n.d.). Their cultivation supports not only dietary diversity but also ecological resilience, as these species help maintain biodiversity – including within-species genetic diversity – which is vital for pollination, soil health, and overall ecosystem function.

To assess their potential contributions to food and nutrition security, we identified which of the 20 opportunity crops grow in each country (Table 1) and when they are harvested, where applicable (Table 2 and Annex 3). This information illustrates their potential role in addressing seasonal food insecurity, particularly in rainfed agricultural systems where nutrient availability often declines during the lean season. We found that several crops, including cowpea in Guinea, okra in Chad, and sorghum in Ethiopia, are harvested year-round or during periods when few other foods are available, offering a valuable buffer against seasonal nutrient shortfalls.

While the original VACS reports focused primarily on African countries, we found evidence that many of these crops are also cultivated in the 9 non-African countries assessed, with the exception of fonio, which remains largely restricted to West Africa and the Sahel. Teff and grasspeas had the narrowest geographic distribution, with teff primarily limited to Ethiopia and grasspeas mainly produced in Ethiopia, India, and Pakistan (FAO, 2025a; Dixit et al., 2016).

Table 1: Geographic distribution of 20 opportunity crops in countries with serious or alarming levels of hunger according to the Global Hunger Index (n=41).





Presence of finger millet in South Sudan was assumed based on a report published in 2001, 10 years before South Sudan gained independence from Sudan.

Table 2: Harvesting months of opportunity crops in countries with serious or alarming levels of hunger according to the Global Hunger Index (n=41).

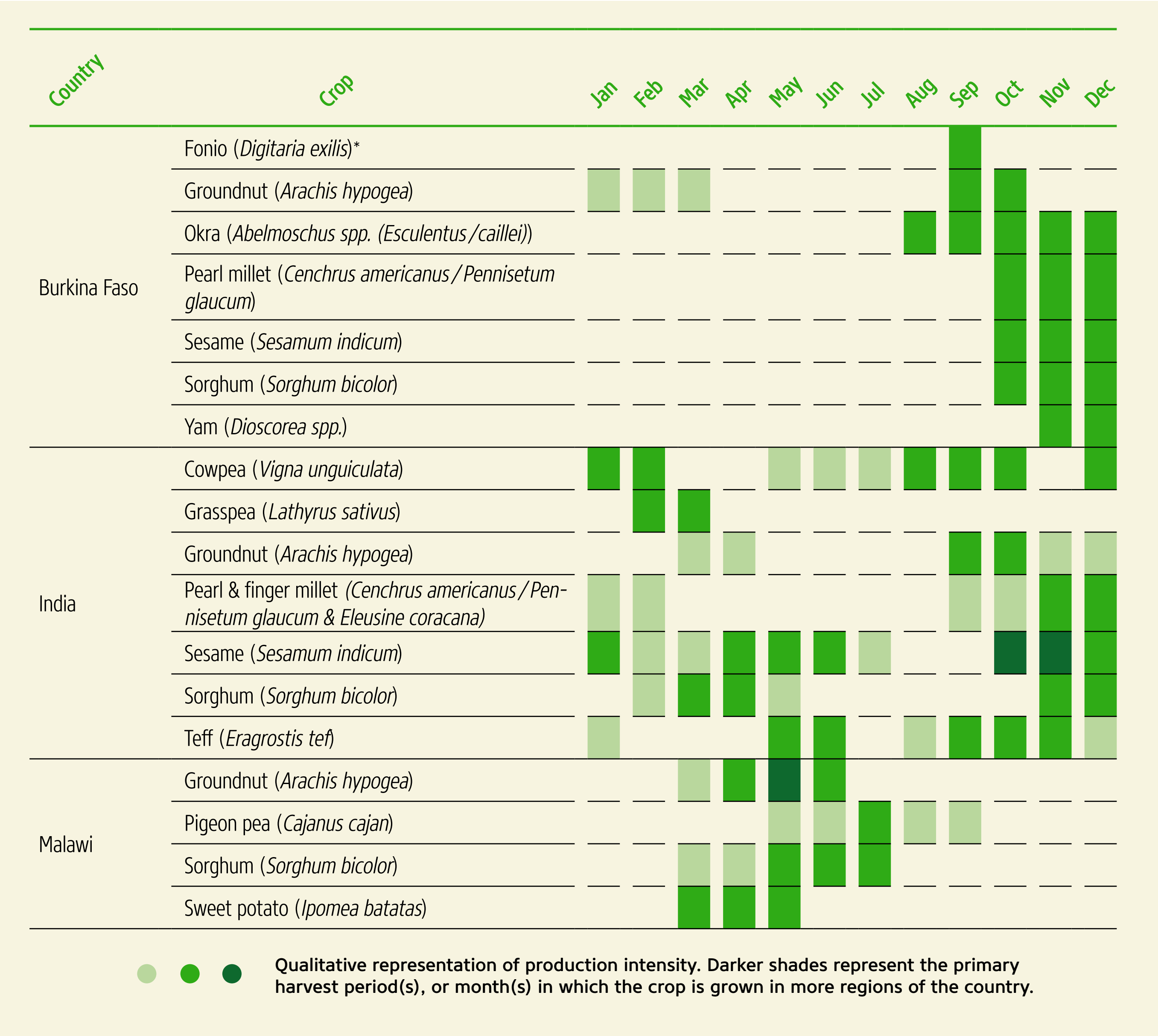


Table includes data for the three scaling scenario countries (Burkina Faso, India, and Malawi). Data for the remaining countries are provided in Annex 3.

* Only regional data available (West Africa)

3.2.4 SCALING UP OPPORTUNITY CROP PRODUCTION TO INCREASE MICRONUTRIENT AVAILABILITY: SCENARIOS FROM MALAWI, BURKINA FASO, AND INDIA

Many countries exhibit an imbalance in production, often relying heavily on just one or two species within each crop category. For example, in 2022, India produced 161 million metric tonnes of rice for domestic consumption (FAO, 2025e), while grain amaranth was not reported in FAOSTAT, suggesting it is produced at much smaller and less formalized scales. In both Malawi and Burkina Faso, tomatoes overwhelmingly dominate vegetable production. Malawi produced 732,000 metric tonnes of tomatoes in 2022, while okra production totaled only 3,372 metric tonnes – less than 0.5% of tomato volume (FAO, 2025e). In Burkina Faso, the imbalance was similar, with 410,000 metric tonnes of tomatoes compared to just 23,782 metric tonnes of okra (about 5% of tomato production; FAO, 2025e). While such patterns may reflect agronomic suitability, market demand, or investment priorities, they also highlight missed opportunities to improve nutrient availability and strengthen food system resilience through more diverse crop portfolios.

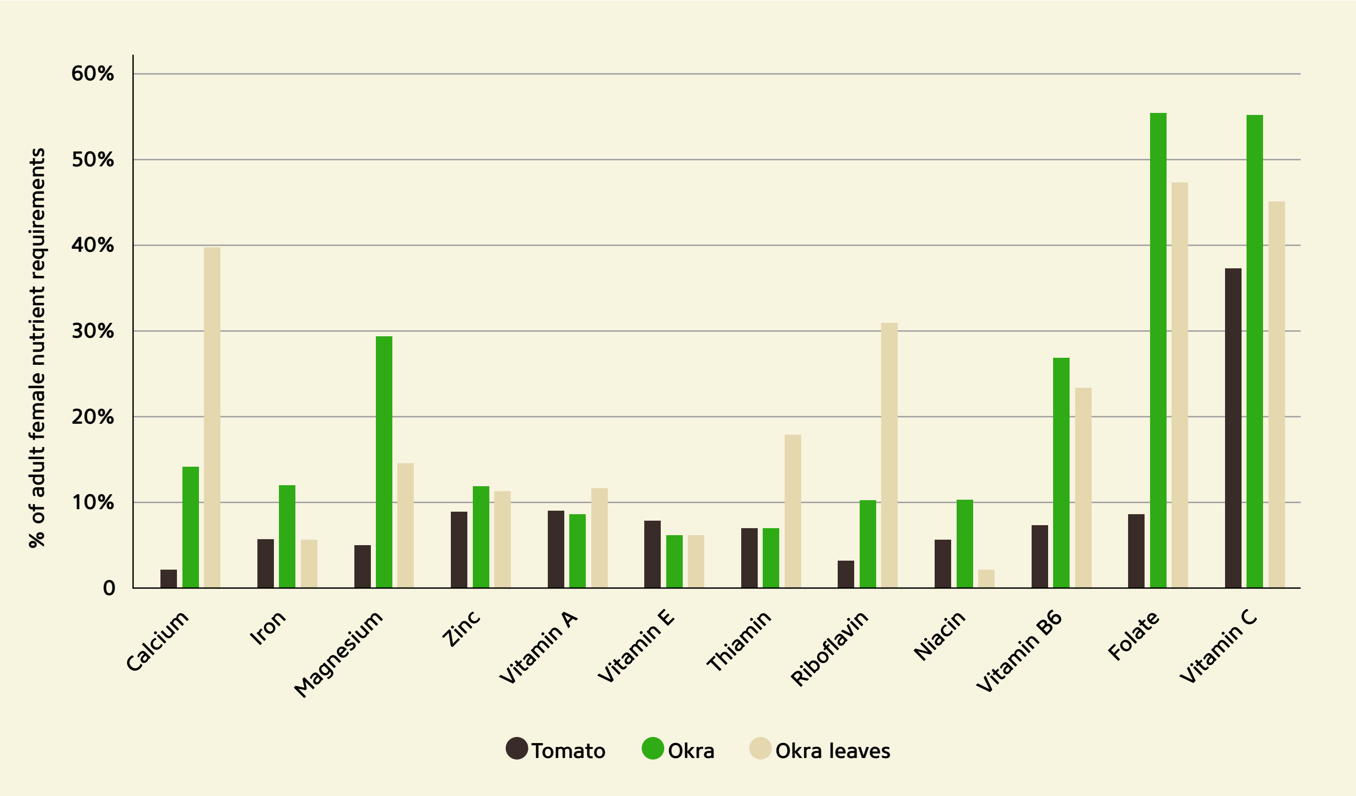
Malawi

Malawi has strong agricultural potential and produces many nutrient-dense crops. However, productivity remains constrained by low yields and widespread monocropping, particularly of maize and sugarcane.

As a result, per capita nutrient availability is projected to decline under a "business-as-usual" scenario (Hall et al., 2021). Based on available evidence, at least 15 of the 20 opportunity crops appear to be present in Malawi (Table 1). While harvest timing was available for only four of these (groundnut, pigeon pea, sorghum, and sweet potato), we incorporated additional data from neighboring Zambia, which shares comparable rainfall patterns and seasonal calendars (Annex 2). In Zambia, for example, amaranth is harvested in January and February, and okra in December. These foods may help reduce nutrient gaps during Malawi's lean season.

Irrespective of season, less than 25% of the Malawi population consumes adequate calcium, zinc, and riboflavin (Passarelli et al., 2024). Thus, okra was used for the modeling scenario based on its potential to be harvested year-round and for the contribution of both its pods and leaves to calcium intake (Figure 4).

Figure 4: Nutrient content of 100 grams of raw, edible crop expressed as a percentage of a 30-year-old woman's nutrient requirements.

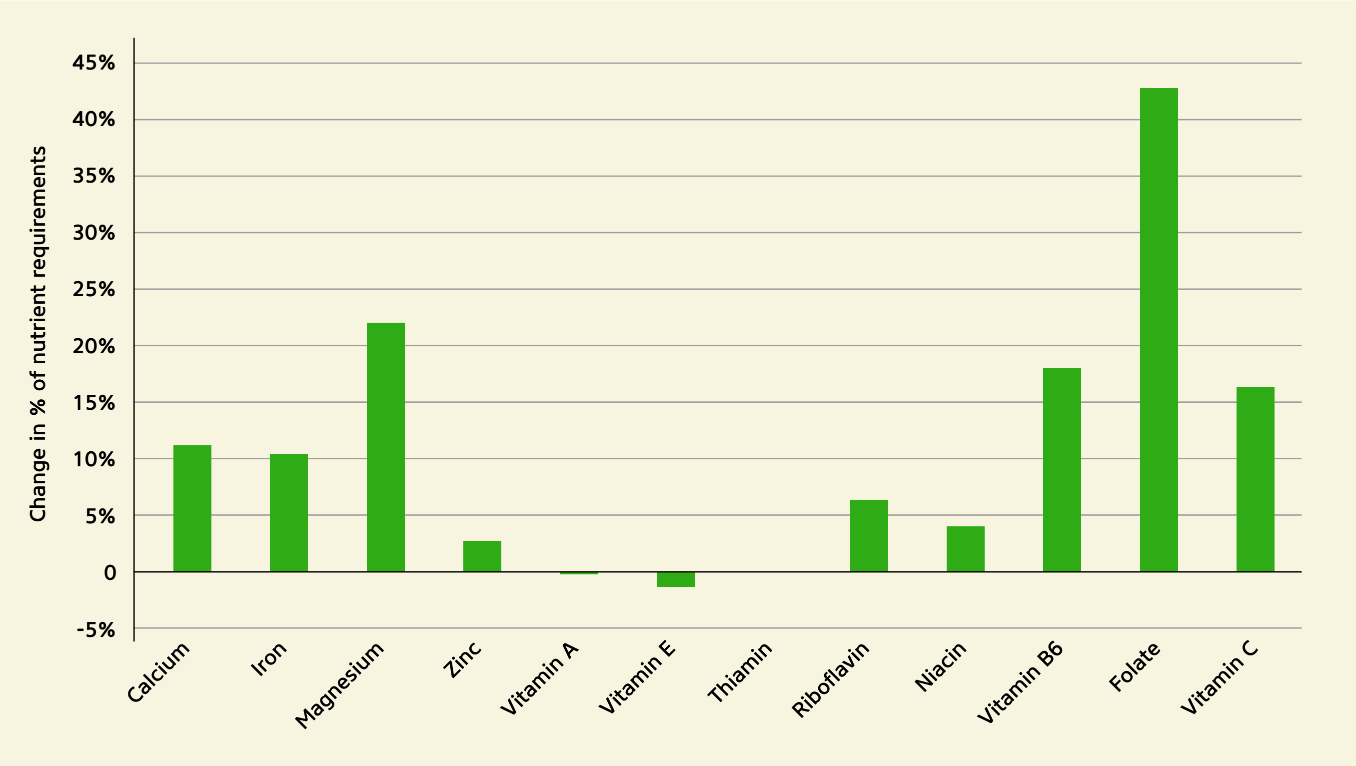


Nutrient composition values for raw okra and raw tomato were obtained from the Malawian and West African FCTs, respectively. Values are based on harvest-stage nutrients and likely overestimate actual contributions, as losses can occur during storage, processing, and cooking. Nutrient requirements are based on the harmonized average requirements (H-AR) for a non-pregnant, non-lactating 30-year-old woman (**Allen et al., 2020**).

A scenario in which 20% of Malawi's tomato production is replaced with an equivalent quantity of okra pods would result in a net gain for all modeled nutrients except vitamin A, thiamin, and vitamin E. This scenario would increase the availability of calcium by 11% of the daily requirement for all women of reproductive age, zinc by 3% of the requirement, and riboflavin by 6% (Figure 5). The modeled increase in okra pod production would also boost folate availability by an amount equivalent to 43% of the population-level requirement for women of reproductive age. Okra leaves would contribute even more to nutrient requirements; however, this scenario was not modeled due to the absence of production data and the difficulty of estimating leaf harvests.

Although exact consumption data for okra are limited, it is widely consumed throughout Malawi and is often considered a delicacy. Common preparations include okra relish, made with tomato, onion, and oil, and okra stew, which includes tomato, pumpkin leaves, and water (MAFOODS, 2019). The leaves are also boiled and eaten. Many of these dishes are served with *nsima*, a maize-based staple. Increasing the frequency or quantity of okra on plates could help create a more balanced and nutrient-rich diet by complementing staples with opportunity crops in culturally relevant ways.

Figure 5: Change in the percentage of nutrient requirements met for all 4.3 million women of reproductive age in Malawi by replacing 20% of the tomatoes produced for domestic consumption (146,400 metric tonnes) with okra pods.



This scenario increases all modeled nutrients except vitamin A, vitamin E, and thiamin. Values are based on 100 g of raw okra and tomato; some losses are expected during storage, transport, and cooking. Nutrient requirements reflect the harmonized average requirements (H-ARs) for women (**Allen et al., 2020**). The y-axis starts at -5% to illustrate declines.

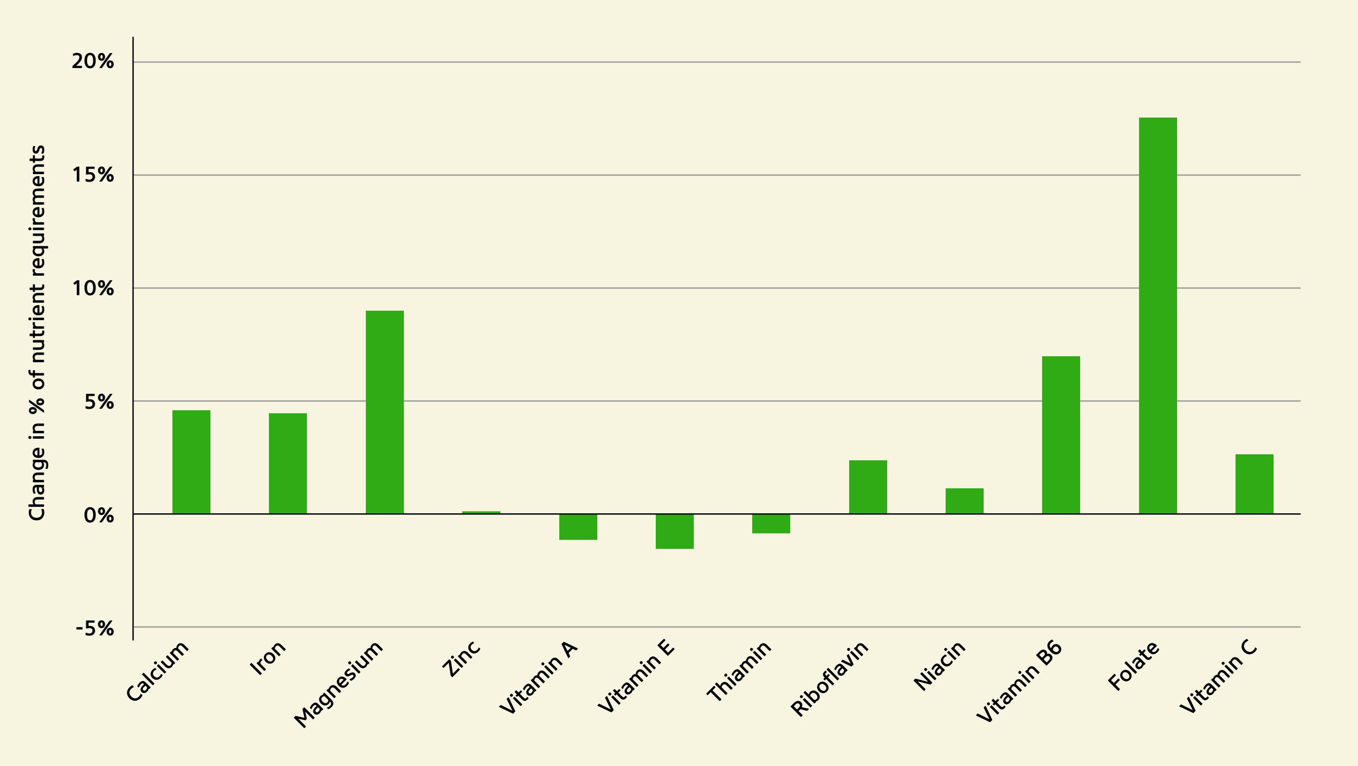
Burkina Faso

Burkina Faso experiences harsh agroecological conditions, with certain regions supporting only 3–4 months of agricultural activity annually (Dasylva et al., 2024). Nevertheless, there is evidence that at least 16 of the identified opportunity crops grow in the country to some extent (Table 1). Harvest calendar data were available for three – pearl millet, sorghum, and groundnut – and for fonio, harvest timing was inferred from regional West African estimates (Table 2). To explore the potential for year-round production in Burkina Faso's arid zones, we examined harvest patterns in neighboring countries with similar rainfall and climatic conditions. For example, okra is harvested year-round in Chad, and cowpeas are harvested year-round in Guinea (Table 2). Given that less than 1% of cropland in Chad and only about 11% in Guinea is irrigated (with irrigation concentrated on rice, potatoes, and maize) these harvests were likely achieved under rainfed conditions (UNEP/GRID, n.d.; World Bank, 2018). This suggests that both okra and cowpea could help reduce seasonal food and nutrition insecurity even in low-input, water-constrained environments.

Nutrient adequacy in Burkina Faso is alarmingly low. Of the 15 micronutrients modeled by Passarelli et al., (2024), less than 25% of the population consumes adequate amounts of nine, including calcium, iodine, and vitamins B12, B6, and C. Okra shows promise for addressing some of these gaps, particularly calcium, vitamin B6, and vitamin C, especially given its year-round harvest potential in neighboring countries, such as Chad. In a scenario where 20% of Burkina Faso's tomato production is replaced with an equivalent amount of okra pods, we estimated a net gain in all modeled nutrients except vitamin A, thiamin, and vitamin E. Because the disparity between tomato and okra production is smaller than in Malawi, the predicted shifts in nutrient availability are more modest. Even so, we estimated increases equivalent to 5% of women's calcium requirements, 3% of vitamin C requirements, and 7% of vitamin B6 requirements (Figure 6). As above, if consumption of okra leaves is also taken into account, it would further enhance the crop's contribution to nutrient adequacy.

Okra is a culturally important food in Burkina Faso and is widely available in local markets. The pods and leaves are commonly used to make stews and sauces, prized for their thickening properties. Okra typically accompanies *To*, a maize- or sorghum-based staple, and is an integral part of the national cuisine. It is also popular throughout other West African countries, where both pods and leaves are dried for use in soups and stews (Karl et al., 2024). Efforts are already underway to improve okra production in Burkina Faso, including distribution of improved seed varieties (WVC, 2021). However, several barriers remain, including limited extension service capacity, inconsistent water access, and lack of access to quality planting materials (Karl et al., 2024).

Figure 6: Change in the percentage of nutrient requirements met for all 4.3 million women of reproductive age in Burkina Faso by replacing 20% of the tomatoes produced for domestic consumption (82,000 metric tonnes) with okra pods.



This scenario increases all modeled nutrients except vitamin A, vitamin E, and thiamin. Values are based on 100 g of raw okra and tomato; some losses are expected during storage, transport, and cooking. Nutrient requirements reflect the harmonized average requirements (H-ARs) for women (**Allen et al., 2020**). The y-axis starts at -5% to illustrate declines.

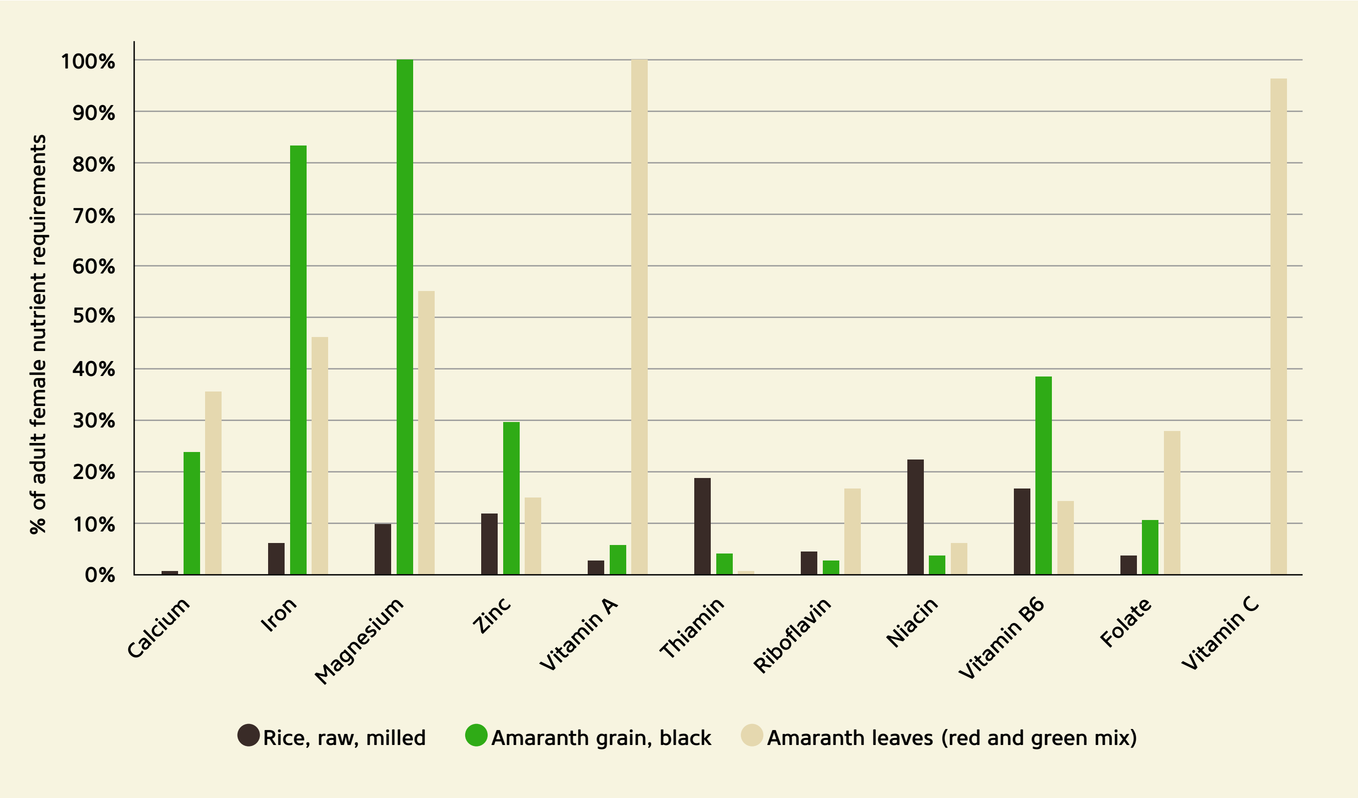
India

India is the world's largest producer of many foodstuffs, including milk, pulses, and jute, and it is the second largest producer of rice, wheat, sugarcane, groundnut, vegetables, and fruit (FAO, 2025c). During the Green Revolution India transitioned from being a net importer of grains to achieving self-sufficiency (John & Babu, 2021). However, the Green Revolution simultaneously degraded soils, destroyed ecosystems, and increased input requirements to increase crop production (John & Babu, 2021). Thus, despite relatively high food production volumes, a large population and significant disparities drive persistently high levels of hunger in India.

Of the opportunity crops identified in the VACS report, we found evidence that 19 of them are grown to some extent in India. Additionally, we were able to identify the harvest months for pearl and finger millet, teff, sorghum, sesame, groundnuts, cowpeas, and grasspeas. Cowpeas play an important role in addressing food insecurity during the dry season, as they can be harvested from June to September. Several other opportunity crops can be harvested year-round and may deserve further investigation for their potential role in addressing seasonal hunger in India. For example, okra and amaranth are harvested year-round in Guinea-Bissau, which has similar rainfall patterns to some regions of India (Table 2). These two are especially advantageous from a nutritional standpoint since they both provide edible nutritious leaves in addition to their function as a green vegetable (in the case of okra) or as a grain (in the case of amaranth, though grain amaranth and leaf amaranth are sometimes harvested from different species). Additionally, the leaves of some tubers, such as sweet potatoes, are highly nutrient-dense and can be harvested twice over the tuber growing period without drastically affecting root yields (Kiozya et al., 2001).

Considering that folate, riboflavin, and zinc have the highest rates of inadequate intakes in India (Passarelli et al., 2024), and that grain amaranth is high in these nutrients (Figures 2a - 3b) and potentially harvestable year-round, we selected it for this scenario. The previous VACS Summary Report (Karl et al., 2024) used cassava leaves as the reference crop for amaranth leaves; however, we selected rice as the reference from here, given our focus on grain amaranth. A nutrient comparison between rice, grain amaranth, and amaranth leaves shows that both parts of the amaranth plant are higher in many nutrients, although rice contains more niacin, riboflavin, and thiamin than grain amaranth (Figure 7).

Figure 7: Nutrient content of 100 grams of raw, edible crop expressed as a percentage of a 30-year-old woman's nutrient requirements. Nutrient values were obtained from the Indian FCT.



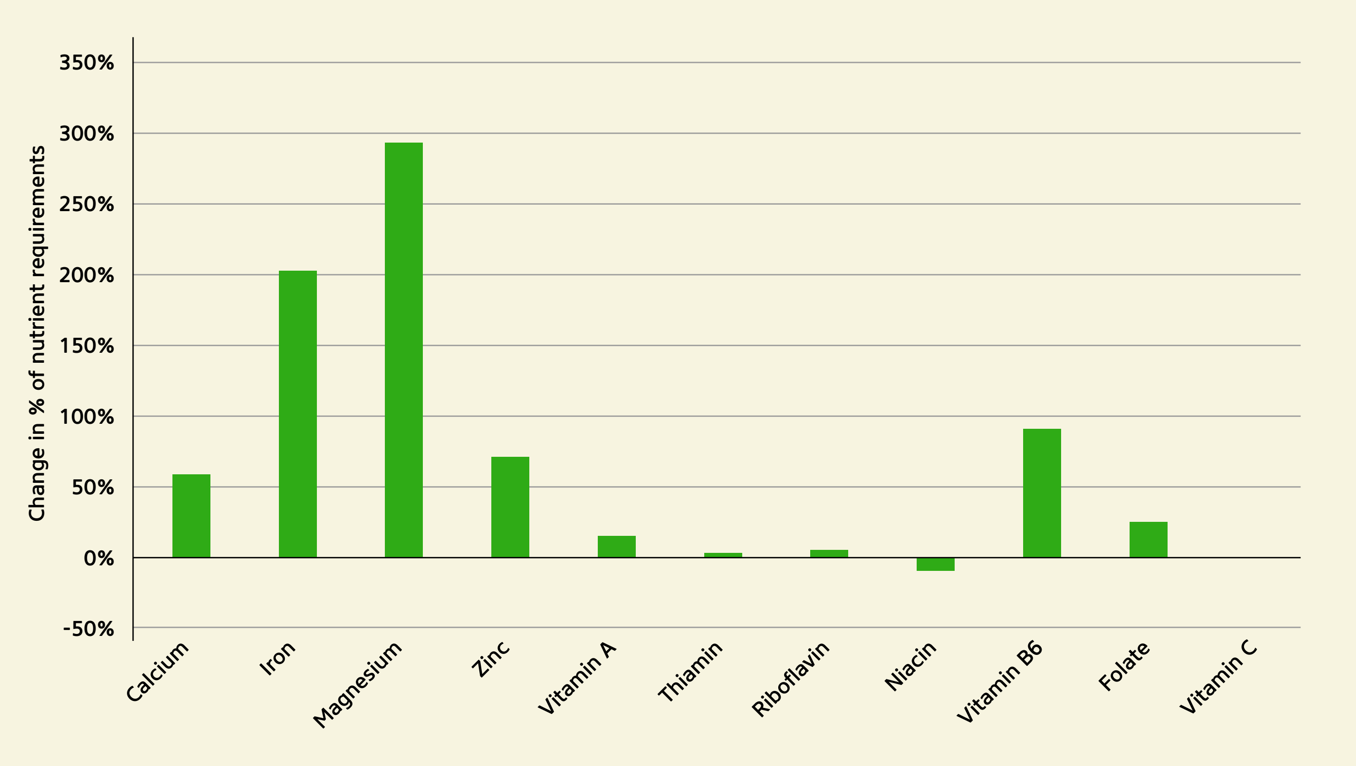
Values are based on harvest-stage nutrients and likely overestimate actual contributions, as losses can occur during storage, processing, and cooking. Nutrient requirements are based on the harmonized average requirements (H-AR) for a non-pregnant, non-lactating 30-year-old woman (Allen et al., 2020).

Note: The magnesium value for amaranth seed and the vitamin A values for amaranth leaves were capped at 100% of the nutrient requirement, but their exact values are 122% and 863%, respectively.

A scenario in which 20% of rice produced in India (32 million metric tonnes) is replaced by amaranth would lead to a net gain in several nutrients (Figure 8). Folate availability would increase to a level equivalent to 15% of the nutrient requirement for all women of reproductive age. For riboflavin, the second most under-consumed nutrient in India, this shift would not increase availability in the food system, given that rice and amaranth seeds have relatively similar riboflavin concentrations. However, for iron, the third highest nutrient with inadequate intakes in India, an additional 202% of the nutrient requirement would be available per woman if 32 million metric tonnes of rice were replaced with grain amaranth (Figure 8). The change would also provide an additional 59% of the calcium requirement for women. These significant increases in nutrient availability are due to the fact that grain amaranth provides nine times more iron and 22 times more calcium than refined rice (Figure 7). This replacement scenario would cause a net loss in niacin, however. The additional nutrients for a replacement scenario are modeled below.

Several varieties of amaranth have been cultivated throughout Asia for millennia (Sorenson & Johannessen 2004); however, today it is only cultivated and harvested in small amounts among smallholder farmers (Karl et al., 2024). Amaranth leaves, seeds, and seed oil provide both healing and nutritional benefits. It has many uses in cooking; amaranth kheer is one dish that is made in India, by lightly roasting the grain in ghee, then adding milk, sugar, and sometimes dry fruits (Niyogi & Gheevarghese 2024). However, estimates of amaranth consumption at a national level are lacking.

Figure 8: Change in the percentage of nutrient requirements met for all 353 million women of reproductive age in India by replacing 20% of rice produced for domestic consumption (32 million metric tonnes) with amaranth grain.



This scenario increases all modeled nutrients except niacin and vitamin C. Values are based on 100 g of raw rice and amaranth grain; some losses are expected during storage, transport, and cooking. Nutrient requirements reflect the harmonized average requirements (H-ARs) for women (**Allen et al., 2020**). The y-axis starts at -50% to illustrate declines.

We acknowledge that these are crude estimates, as increased production does not guarantee equivalent increases in consumption, let alone equitable access among household members. Nutrient losses occur throughout the supply chain, and nutrient uptake may be further constrained by bioavailability. Nevertheless, this exercise provides a useful visual representation of how more balanced crop production could improve population-level nutrient intakes. Moreover, recent evidence from a randomized controlled trial shows that increased production of nutrient-rich crops, when paired with social and behavior change communication, can lead to greater household consumption (Byrd et al., 2024).

3.3 Extent of opportunity crop promotion in governmental policies and action plans

3.3.1 FOOD-BASED DIETARY GUIDELINES

Of the 41 countries included in our analysis, only ten had publicly available national food-based dietary guidelines (Government of Afghanistan, 2016; Government of Benin, 2015; Government of Ethiopia, 2022; Government of India, 2011; Government of Kenya, 2017; Government of Nigeria, 2006; Government of Pakistan, 2018; Government of Sierra Leone, 2016; Government of Tanzania, 2023; and Government of Zambia, 2021) (Table 3). Nearly all of the available FBDG promoted whole grains, legumes, nuts, seeds, but only six guidelines specifically mentioned any of the 20 opportunity crops assessed in this report. Millet, cowpeas, groundnuts, sweet potato, and okra were the primary opportunity crops mentioned, primarily in the context of consuming sufficient fiber, protein, calcium, iron, and/or vitamin A. Neither fonio nor lablab were mentioned in any of the guidelines we reviewed, and only the Ethiopian FBDG mentioned teff or grasspeas.

Sierra Leone's guidelines (2016) recommended consuming millet and sorghum instead of rice and cassava, as well as seeds and nuts rather than the overconsumption of oils. The Tanzanian guidelines (2023) included a similar recommendation to replace refined grains (e.g., white maize and rice) with whole grains, including sorghum, while the Zambian FBDG (2021) promoted millet and sweet potatoes over other starchy staples to increase fiber and dietary diversity. Benin's FBDG (2015) underscored the importance of fruits and vegetables, including eggplant and green leaves, for their vitamins, minerals, and antioxidants, as well as beans and groundnuts as a source of protein when animal-source foods are unavailable. Benin's guidelines also included examples of healthy meal plans, which included millet, groundnuts, legumes/beans, and okra.

The Ethiopian FBDG (2022) did not necessarily promote opportunity crops in place of existing foods, but nevertheless highlighted sesame seeds for their high antioxidant content and sweet potatoes for their pro-vitamin A carotenoids. Similarly, the Indian FBDG (2011) promoted amaranth leaves for their high levels of beta-carotene, iron, calcium, folic acid, riboflavin; millet for calcium; and sweet potatoes for their contribution to vitamin A intake. The Indian guidelines also noted that cereals/millet, pulses, nuts (specifically groundnuts and sesame), and oilseeds can be combined to increase protein intake and supplement infants' diets.

Table 3: Promotion of opportunity crops (OCs) in food-based dietary guidelines and relevant national policies/ action plans by countries with serious or alarming levels of hunger (n=41).

	Food-based Dietary Guidelines	Nutrition policies	Agriculture policies	Biodiversity policies	Climate Change policies
Afghanistan	2016	2019–2023	2016–2021	2024–2030	2015
Angola		2025–2034	2013–2017	2019–2025	2018–2030
Benin	2015	2023–2033		2011–2020	2022
Botswana			2020	2016–2025	2021
Burkina Faso		2020–2029	2013	2011–2015	2024–2028
Burundi		2019–2023	2018–2027	2013–2020	2019
CAR		*	2023		2019
Chad		2022–2025		2016-2025	2021–2026
Côte d'Ivoire		2016–2020			2015–2020
DRC					2022–2026
Djibouti		2012–2017		2017	2015
Ethiopia	2022	2021–2025	2017	2015–2020	2021–2025
Guinea		*	2018–2025	2011–2020	2019–2030
Guinea-Bissau		2015–2019		2015–2020	2021
Haiti		2018–2030	2010–2025	2020–2030	2019
India	2011		2007	2014–2020	2021–2030
Kenya	2017	2018–2022	2024	2019–2030	2023–2027
Liberia		2019–2024	2024–2030	2017–2025	2018
Madagascar		2022–2026	2016–2020	2015–2025	2023
Malawi		2018–2022	2020–2024	2015–2025	2016
Mali		2021–2025		2015–2020	2011
Mauritania		2016–2025	2015–2025	2011–2020	2017–2021
Mozambique		2024–2030	2022–2030	2015–2035	2013–2025
Niger		2017–2025	2020	2014–2020	2022–2026

No publicly available policy · No discussion of opportunity crops (OCs) · One or more OCs mentioned but not promoted or prioritized · OCs discussed or promoted to some extent · Several OC explicitly promoted and/or prioritized

	Food-based Dietary Guidelines	Nutrition policies	Agriculture policies	Biodiversity policies	Climate Change policies
Nigeria	2006	2016 – 2025	2016 – 2025	2016 – 2020	2021
North Korea (DPR)				2007 – 2010	2000
Pakistan	2018	2018 – 2025	2018	2017 – 2030	2021
Papua New Guinea		2016 – 2026	2024 – 2033	2019-2024	2015
Republic of Congo		2015 – 2025		2015 – 2020	2021
Rwanda		2013 – 2018	2018 – 2024	2016 – 2020	2019
Sierra Leone	2016	2019 – 2025	2023 – 2028	2017 – 2026	2021
Somalia		2020 – 2025	2016 – 2020	2015 – 2020	2023
South Sudan			2012 – 2017	2018 – 2027	2021
Sudan		2014 – 2025	2015 – 2019	2015 – 2020	2021
Syria		2010		2002**	2018
Tanzania	2023	2021 – 2026	2015 – 2025	2015 – 2020	2021 – 2026
Timor-Leste		2022 – 2026	2017	2011 – 2020	2022
Uganda		2020 – 2025	2018	2025 – 2030	2015
Yemen		2020 – 2023	2024 – 2030	2017 – 2050	2018
Zambia	2021	2011 – 2015	2022 – 2026	2015 – 2025	2016
Zimbabwe		2023 – 2025	2019 – 2030	2014 – 2020	2017

No publicly available policy; No discussion of opportunity crops (OCs); One or more OCs mentioned but not promoted or prioritized; OCs discussed or promoted to some extent; Several OC explicitly promoted and / or prioritized

Section 3.3 includes policy summaries for the three scaling scenario countries (Malawi, Burkina Faso, and India), plus two exemplary examples (Sierra Leone and Tanzania). Summaries for the remaining countries are provided in Annex 4.

* Combined with agriculture

** Published in Arabic; not reviewed

3.3.2 NATIONAL NUTRITION POLICIES

Five of the 41 countries did not have publicly available national nutrition policies (Table 3; FAOLEX, 2025). Two additional countries, CAR and Guinea, both published combined national food and agriculture strategies, which were analyzed alongside the agriculture policies (Government of Central African Republic, 2023; Government of Guinea, 2018). Although only 21 countries had publicly available policies which were still ‘active' during the period in which they were reviewed (i.e., 2025 or beyond), the most recently published policies were included in this review. Fifteen countries did not promote or otherwise discuss any opportunity crops in their national nutrition policies.

To our knowledge, India did not have a publicly available nutrition policy at the time of analysis. Although Malawi published a nutrition policy in 2018, it did not specifically discuss any of the opportunity crops of interest (Government of Malawi, 2018). In contrast, Burkina Faso's nutrition policy (2020) promoted off-season gardening and marketing of many of the opportunity crops to improve food security and provide additional income to smallholder farmers. The government aimed to increase the use of improved seeds and/or bio-fortified crop varieties, particularly to increase production and consumption of cowpeas, orange-fleshed sweet potatoes, and other nutrient-dense tubers and vegetables. The policy discussed programs which have previously promoted the use of improved seed varieties, including sorghum, cowpeas, peanuts, and sesame. However, it was noted that these programs have faced challenges with respect to implementation and attention to nutritional quality. Burkina Faso had also developed a nutrition policy specifically targeted to vulnerable populations (2024). This policy described a program which distributed free inputs (maize, sorghum, millet, and cowpea seeds, as well as mineral and organic fertilizers) to producers, especially internally displaced persons with access to farmland. To address gender disparities, the activity exclusively allocated cowpea seeds to women-headed households. The policy noted that production of some foods, including cowpeas and yams, had increased by nearly 22% compared to the five-year average, although it was unclear if this increase was attributable to the input distribution program.

Promotion of opportunity crops was limited in Sierra Leone and Tanzania's nutrition plans. Nevertheless, the Sierra Leonean nutrition policy (2019) aimed to increase the production of sweet potatoes, legumes, and groundnuts, and Tanzania's nutrition policy (2021) promoted the multiplication of seeds, seedlings, and cuttings of nutrient-rich varieties, including orange-fleshed sweet potatoes. Tanzania is also a member of the Southern African Development Community, alongside Angola, Botswana, DRC, Madagascar, Malawi, Mozambique, Zambia, and Zimbabwe, which has maintained a Plant Genetic Resources Center (SPGRC) since 1996. The SPGRC collects, documents, and preserves seed samples to maintain genetic diversity in Southern Africa (SADC, 2022). The collections contain several opportunity crops, including pearl millet, sorghum, amaranth, groundnut, bambara beans, cowpeas, sweet potato, taro, and okra (SPGCR, 2014). They also recognize the importance of landraces, which are critical to the development of improved (e.g., more heat- and drought-tolerant) crop varieties (SADC, 2022; Marone et al., 2021).

3.3.3 NATIONAL AGRICULTURE POLICIES

Nine of the countries included in our review did not have publicly available national agriculture policies (Table 3). Of the remaining 32 policies, 27 referenced and/or promoted one or more opportunity crops (see Annex 4 for summaries of countries not included below). At least 13 of the policies cover 2025 or beyond; 11 additional policies had unclear end dates, although eight of them were published in the past ten years and may still be 'active'.

Both India and Malawi's national agriculture policies briefly mentioned millet: India's policy (2007) aimed to increase storage and sale of millet and other crops through the Public Distribution System, while Malawi's policy (2020) intended to scale up community seed banks and promote underutilized nutritious foods, including finger millet. The agriculture policy from Burkina Faso (2013) included data on the yields of several opportunity crops. Sorghum and millet yields (kg/hectare) increased, on average, from 1990 to 2007, while yields of fonio, sesame, groundnut, and cowpea were significantly lower in 2007 relative to 1990. The policy did not specify why output of these crops changed over time or whether this was considered positive from a nutrition security or climate resilience perspective.

Sierra Leone's 2023–2028 Feed Salone Strategy focused on scaling up production of nutrient-dense foods at the community and household levels, particularly crops with year-round availability and affordable prices (Government of Sierra Leone, 2023). The initiative initially focused on increasing production of vitamin A-fortified cassava, orange-flesh sweet potatoes – which had recently been introduced in Sierra Leone – and pulses (i.e., cowpeas, pigeon peas, and groundnuts). Although the orange-fleshed variety of sweet potatoes remained less common in Sierra Leonean markets, the government had already incorporated them into their Home-Grown School Feeding Programme. Tanzania's agricultural plan (2015) proposed the addition of "Made in Tanzania" labels to products to increase demand, namely of sesame oil. While not explicit, this suggests that the government aimed to increase production and/or consumption of sesame.

3.3.4 BIODIVERSITY POLICIES/ ACTION PLANS

All but three countries (CAR, Côte d'Ivoire, and DRC) had publicly available national biodiversity policies or action plans (Table 3). However, Syria's policy was published in Arabic and thus was not reviewed. These action plans emphasized the protection of wildlife, wetlands, and natural ecosystems, and recognized the various threats to biodiversity (i.e., invasive species, expansion of agriculture, replacement of traditional varieties with modern cultivars, pollution, climate change, etc.). Most of the policies also underscored the importance of maintaining genetic diversity, particularly its potential contribution to breeding stress- and disease/pest-resistance crop varieties to adapt to climate change. Nearly all of the action plans highlighted the need to sustainably manage agricultural activities, and 23 mentioned at least one of the opportunity crops by name.

The biodiversity action plans from Burkina Faso (2011) and India (2014) did not mention any of the 20 opportunity crops explicitly. Meanwhile, the Malawian plan (2015) recognized the nutritional value of eight opportunity crops, all of which were considered neglected and underutilized: pearl and finger millets, sorghum, bambara beans, sesame, mung beans, yam, and amaranth. Malawi's action plan also acknowledged that the decline in production of these has led to a corresponding decline in genetic diversity. Although the National Genebank had preserved local varieties of sorghum and finger millet, Malawi's biodiversity action plan did not specify whether or how the neglected crops should be used for breeding or re-integrated into the production system.

Despite Sierra Leone's attention to opportunity crops in other national policies, none were specifically mentioned in their biodiversity policy (2017). In contrast, the 2015–2020 Tanzanian action plan stated that improved cultivars were available for sorghum, pearl millet, legumes, sesame, and sweet potato, suggesting that there has been research on these, and that the government sought to increase production (Government of Tanzania, 2015). However, the Tanzanian plan also recognized that land degradation was due, in part, to the production of stress-adapted species, including sorghum and millet, because the modern cultivars were genetically uniform and replaced the diversity of traditional local cultivars and landraces. The government highlighted additional threats to land degradation, including lack of research, production, and awareness of indigenous vegetables, and poor distribution and availability of seeds.

3.3.5 CLIMATE CHANGE POLICIES

All 41 countries had publicly available national climate change policies, only three of which were published prior to 2015 (Table 3). The majority of these policies were developed in response to the 2016 Paris Climate Agreement or earlier meetings of the United Nations Framework Convention on Climate Change (UNFCCC, n.d.). Few national climate change policies promoted the production of opportunity crops, per se, but many recognized that those commonly grown in their respective countries had been and would continue to be affected by climate change. Most commonly, the policies highlighted the negative impacts of climate change on sorghum, millet, groundnuts, and sweet potatoes. Only 18 of the 41 policies referenced one or more of the crops of interest. The Malawian (2016) and Indian (2021) policies were not among them.

Burkina Faso's climate change adaptation plan (2024) did not contain much discussion of opportunity crops; however, it did acknowledge that rainfed crops, including millet, cowpeas, groundnuts, sesame, and tubers were suitable for growing in many parts of the country. It also noted that sorghum yields were low in the Central Plateau Region.

In Sierra Leone, groundnuts – a staple – were expected to increase in production, but only by expansion of cropland (2021). Yams were also among the main crops listed under cultivation. Climate change and land degradation were expected to negatively impact yields, which would hinder the country from meeting the demands of a growing population. However, the policy stated that only 13% of the arable land in the country was presently under cultivation. Similarly, the Tanzanian government expected sorghum yields to decrease 5–9% by 2050. Their climate change policy (2021) stated that millet, pulses, groundnuts, and sesame were also staples, and that overall food production may decrease up to 13% by 2050.

3.4 Potential gender, social inclusion, and economic benefits of increasing production and consumption of opportunity crops

3.4.1 GENDER AND SOCIAL INCLUSION

Women play a critical role in the agricultural sector across LMICs, particularly in the cultivation, marketing, and sale of traditional crops (Dinssa et al., 2016; Weinberger & Pichop, 2009). However, in many hunger-affected countries, women's agricultural participation is primarily through subsistence farming and household gardens, while men typically dominate the production of cash crops (Government of Afghanistan, 2016; Government of Mali, 2011; Dinssa et al., 2016; World Bank, FAO, & IFAD, 2009). Women also serve as custodians of traditional knowledge, particularly in seed conservation and the cultivation of local and indigenous plants (Government of India, 2007).

The global shift toward ultra-processed foods has reduced demand for many traditional foods (Popkin & Ng, 2021). However, some, such as leafy greens in Kenya and Uganda and bambara beans in Zimbabwe, are regaining popularity, creating new opportunities to improve the livelihoods of women and smallholder farmers (Shiundu & Oniang'o, 2007; National Research Council, 2006). In Nigeria and Mali, for instance, bambara beans and products made from bambara bean flour provide important income for women, while in Malawi, Mozambique, and Tanzania, cowpeas are a key source of livelihood for women and youth smallholder farmers (National Research Council, 2006; Chipeta et al., 2024). These examples demonstrate the potential of opportunity crops to enhance economic empowerment and household nutrition, especially in poor communities (Wang et al., 2022). Increasing women's income and decision-making power is also associated with improved nutrition and health outcomes for children (Wang et al., 2022, Abreha & Zereyesus, 2020).

Still, realizing the gender equity potential of opportunity crops depends on targeted support. In some countries, men control the income from crops cultivated by women (Tekalign et al., 2020), and as demand or profitability rises, men often take over high-value, less labor-intensive aspects of production (Farnworth & Colverson, 2015; Hackfort et al., 2023). Structural barriers, such as women's limited access to land, credit, fertilizer, technology, extension services, and markets, continue to constrain their ability to scale up production (Farnworth & Colverson, 2015; Bryan et al., 2024). Without deliberate, gender-sensitive strategies, efforts to expand opportunity crop production risk reinforcing existing inequalities. To ensure more equitable outcomes, policies must not only improve access to resources, but also adopt gender-transformative approaches that address the social norms and systemic barriers driving inequity (FAO, 2025f).

Relative to discussions about gender imbalances, there is less discussion in the literature about engaging youths and other marginalized groups in the agricultural sector. Nevertheless, the Liberian (2024), Kenyan (2024), Rwandan (2018), and South Sudanese (2012) agriculture policies acknowledged that their youth populations were reluctant to participate in farming due to its unprofitability, financial unpredictability, and a general preference for white-collar work. The Rwandan agriculture policy affirmed their concerns: at the time of publication, >50% of the rural youth population in Rwanda worked in agriculture, but many of them were under-employed. The poor infrastructure in rural areas and lack of successful role models or mentors in the agricultural sector further drove young people's desire to migrate to urban areas in search of more formal employment opportunities (Oluwatayo & Ojo, 2024). Given the resilience of opportunity crops to increasing climate variability, they have the potential to enhance the stability of farming-related income, which may in turn enable governments in hunger-affected countries to engage the vast population of youths in agriculture. The climate-sensitive nature of these species may appeal more to younger generations who are increasingly conscious of the impact of modern-day agriculture on planetary health (Oluwatayo & Ojo, 2024).

Youth populations face similar barriers to women, with limited access to credit and financing, land, markets, training and other resources (Government of Kenya, 2024; Oluwatayo & Ojo, 2024). The public and private sectors will need to concurrently improve youth access to training, financing, and other incentives to improve the youths' perception of farming and their ability to participate profitably (Oluwatayo & Ojo, 2024).

3.4.2 NATIONAL TRADE OPPORTUNITIES

At the national level, opportunity crops have the potential to generate income and improve livelihoods, particularly in countries where agriculture represents a large share of GDP and employment (World Bank, 2025b). Several hunger-affected countries already produce and consume opportunity crops at scale, yet their broader market potential remains underutilized. For example, Nigeria, Papua New Guinea, Madagascar, Burundi, Rwanda, and CAR are among the top ten taro producers globally, yet none rank among the top 20 exporters (Otekunrin et al., 2021), suggesting that these countries' integration into formal regional markets is still limited. In Nigeria, which accounts for over a quarter of global taro production, cultivation is primarily led by women and used for home consumption (Otekunrin et al., 2021; Opara, 2003). Similar patterns exist for sesame in South Sudan and Burkina Faso, sorghum in Sudan, and yam in Benin (Wacal et al., 2024, USDA, 2025, World Bank, 2025a, Srivastava, 2010, Dansi et al., 2024), where high production levels do not consistently translate into strong regional trade or income-generation opportunities.

Strengthening domestic and regional trade systems could unlock the economic and nutritional value of opportunity crops. International trade in nutrient-rich foods, such as fruits, vegetables, legumes, and nuts, has been linked to reduced diet-related mortality (Springmann et al., 2023; Wood et al., 2018). However, regional trade and the expansion of midstream value chains (e.g., storage, processing, logistics) may offer more accessible pathways for improving market access and lowering costs for smallholder farmers (Reardon et al., 2024; FAO, 2022b). FAO research shows that intra-regional trade can stabilize food prices by shifting surpluses from production zones to deficit areas, thereby expanding markets and reducing risks for smallholder producers, including women (FAO, 2022b). Improving infrastructure and reducing market barriers between surplus and deficit regions can strengthen food system resilience and support the livelihoods of marginalized groups, especially women farmers who grow these crops (Obeng-Amoako et al., 2023).

3.5 Limitations of opportunity crops

3.5.1 GAPS IN MICRONUTRIENT INTAKE THAT CANNOT BE SUFFICIENTLY ADDRESSED BY OPPORTUNITY CROPS

While this report highlights a subset of crops that are more micronutrient-dense than many current staples, dietary diversity remains the foundation of a healthy diet. Diets low in animal-source foods, if not sufficiently varied, can make it challenging to meet all nutrient requirements. Among the 41 countries examined, calcium consistently ranks among the most inadequately consumed nutrients from unfortified foods (Passarelli et al., 2024). Several opportunity crops could help close this gap. However, no single food should be relied on exclusively. A nutritionally adequate diet requires a variety of plant foods and, where culturally and economically appropriate, some animal-source foods to ensure sufficient intake of all essential nutrients.

The EAT-Lancet diet was the first to provide dietary recommendations that consider both human and planetary health. However, these recommendations come with important caveats. Most notably, the EAT-Lancet diet is not appropriate for children under two years of age (Willet et al., 2019). If applied to this age group, the diet would not meet WHO guidance, which recommends daily consumption of animal-source foods for children between 6 and 24 months. This underscores that scaling up opportunity crop production alone is not sufficient to meet the nutrient needs of all population groups. Furthermore, none of the opportunity crops contain vitamin B12, as is typical of nearly all plant-based foods. While some are relatively high in iron, zinc, and magnesium, these nutrients are significantly more bioavailable from animal-source foods due to the inhibitory effects of phytates in plants (Gibson et al., 2010). Additionally, the absorption of some micronutrients (i.e., iron and zinc) from plant-source foods is suboptimal when consumed in the absence of animal-source foods (Consalez et al., 2022). Scaling up production of many opportunity crops could help support adoption of the EAT-Lancet diet; however, additional investment in animal-source foods is recommended in some regions to efficiently close nutrient gaps (Beal et al., 2023).

Sustainable and resilient animal-source food production is essential and is already occurring in many parts of the world. For example, small fish production from capture fisheries has a lower greenhouse gas footprint than tuber production (Koehn et al., 2022). When powdered, some indigenous freshwater fish species rival the iron, zinc, and calcium concentrations found in commercially produced infant foods (Byrd et al., 2021) and contribute significantly to the dietary diversity of infants and young children (O'Meara et al., 2021). Insects are also an important animal-source food in some contexts, which can contribute to closing nutrient intake gaps with a relatively low environmental impact (van Huis & Oonincx, 2017).

3.5.2 FOOD SECURITY AND ECONOMIC IMPACTS

The major trade-off to promoting opportunity crops is that many of them remain under-researched and under-invested. As a result, their yields under optimal, high-input conditions are often lower than those of highly improved staples such as maize or rice (National Research Council, 2006; Lyimo et al., 2004; Kebede & Bekeko, 2020). However, this comparison can be misleading, as these species – particularly drought-tolerant grains, legumes, and vegetables – often outperform traditional staples under heat, water, or nutrient stress (Chivenge et al., 2015). As climate change intensifies, many of these underutilized crops offer a more resilient and reliable food source. Still, shifting national production and investment priorities toward 'new' staples carries risk (Shelef et al., 2017). Countries with existing gaps in energy and micronutrient intake cannot afford transitional periods where food production drops below current levels. At the household level, a single harvest season with poor yields can be nutritionally and financially devastating, particularly for vulnerable groups such as children and women of reproductive age.

In a review of nutrient-dense vegetables and legumes in Sub-Saharan Africa, Ojiewo et al. (2015), described several collaborative initiatives that improved opportunity crop yields from 25% to 90%. They also noted that even greater gains, such as a tenfold increase in African eggplant yields, were possible with sustained investment. However, achieving such gains will require substantial investment in breeding programs, agricultural technologies, integrated pest and disease management, extension services, and other inputs to improve yields, reduce production costs, expedite harvesting, and enhance post-harvest efficiency, all while supporting better working conditions and livelihoods in the agriculture sector (Opara, 2003; Namibian Agronomic Board & FAO, 2021; Wang et al., 2022). Local and national governments will also need to invest in storage facilities to minimize food loss, marketing and demand-generation strategies for opportunity crops, and rural infrastructure to connect producers to distribution hubs such as markets and ports (Wang et al., 2022). International initiatives, such as the VACS initiative, are also critical in driving breeding efforts and building the capacity needed to make neglected crops viable. Although research on these varieties is ongoing in many countries, the level of investment required means that scaling up production will take time. In the meantime, consumer awareness campaigns and marketing efforts can help accelerate adoption by stimulating demand and incentivizing farmers to shift production (Deo & Monterrosa, 2020).

3.5.3 ACCESSIBILITY, AVAILABILITY, AND PRODUCER AND CONSUMER PREFERENCES

Consumption of opportunity crops also remains constrained by producer preferences and the structural barriers they face. Many are underutilized not because they lack value, but because they tend to be lower yielding, less profitable, and less supported by extension services or market infrastructure compared to dominant staples (Ndlovu et al., 2024). For instance, maize, rice, and wheat typically benefit from government subsidies, established value chains, and greater access to improved inputs (Abay et al., 2022). At the same time, increasing urbanization, land degradation, and pressure for higher yields per hectare reinforce preferences for high-output crops (Weinberger and Pichop 2009). As a result, farmers prioritize varieties with secure demand, reliable returns, and institutional support, even when opportunity crops are culturally familiar and environmentally well-suited (Lencucha et al., 2020).

Supply chain limitations further restrict accessibility. Seed systems for opportunity crops are often informal or fragmented, with few certified or improved varieties available in low resource settings (Ndlovu et al., 2024). Storage and post-harvest infrastructure may be inadequate, leading to high levels of food loss, especially for perishable vegetables or leafy greens (Weinberger and Pichop 2009). Transportation barriers, weak rural market networks, and underinvestment in processing facilities reduce profitability and producers' ability to scale-up effectively (Weinberger and Pichop 2009).

From the demand side, consumer awareness, cultural practices, preservation methods, and preparation requirements all influence acceptability (Ndlovu et al., 2024; Owade et al., 2019). Even where opportunity crops are available, they may not be widely consumed if they are perceived as "poor people's food," require long cooking times, or are not included in modern retail and school feeding programs (Ndlovu et al., 2024). Furthermore, prices may be prohibitive during off-season months or in urban areas where supply is limited (Abay et al., 2022).

Increasing consumption of opportunity crops may require a trade-off in terms of current cultural practices and consumer preferences. In LMICs, urbanization, food imports, and the prevalence of supermarkets and fast-food establishments are increasing rapidly (Ghosh et al., 2023; Winichagoon & Margetts, 2017). As a result, consumption has markedly shifted towards highly processed convenience foods and away from local and indigenous foods, including whole grains, legumes, and nutrient-dense vegetables (Ghosh et al., 2023; Lufuke et al., 2023). Promoting whole, diverse foods in the diet – and increasing the availability and affordability of such foods – may help to counteract the barrage of marketing around ultra-processed foods. Since many opportunity crops are grown by subsistence farmers who are not well connected to markets or other distribution points, mechanisms to improve transportation, storage, and handling are needed (Mwadzingeni et al., 2021). Incorporating opportunity crops into packaged and processed foods may offer an effective solution (S. Kaur et al., 2025). In addition to encouraging production and consumption of these varieties and addressing storage and post-harvest loss challenges, this approach would enable food manufacturers to formulate convenience foods that contain more fiber and essential micronutrients than many existing products (Aderibigbe et al., 2020).

Taken together, these constraints suggest that scaling opportunity crops requires not only agronomic and nutritional suitability, but also targeted investments in gender-responsive extension systems, seed and input supply, post-harvest handling, value chain development, market linkages, and consumer demand. Multi-sectoral coordination between agriculture, health, trade, and education stakeholders is essential to ensure that opportunity crops can move from marginal cultivation to mainstream inclusion in food systems.

4. DISCUSSION AND RECOMMENDATIONS FOR POLICY AND PRACTICE

Despite global progress in reducing hunger, inadequate micronutrient intake – especially among women and children – remain widespread and under-addressed (Stevens et al., 2022). These gaps are often linked to limited dietary diversity, seasonally restricted access to nutrient-dense foods, and the relatively high nutrient needs of women and children (Beal et al., 2024). This report highlights opportunity crops as an underutilized strategy to improve micronutrient intake in countries facing high burdens of malnutrition and climate vulnerability.

Importantly, our findings underscore the role of seasonal alignment. Many opportunity crops can be harvested during periods when nutrient intake is constrained by total food availability, helping to fill critical gaps. In settings where seasonal variation in supply, market access, and affordability drives nutrient shortfalls, these species can offer greater dietary stability and reduce vulnerability during lean seasons.

The predominance of rain-fed agriculture in many African and South Asian countries makes food systems highly vulnerable to climate variability (Thompson et al., 2010; Devendra 2012). As climate change continues to alter rainfall patterns, it is essential that governments invest in strategies to build agricultural resilience (Omay et al., 2023). Opportunity crops can be part of the solution, as many are more tolerant of harsh conditions than widely cultivated staples and offer co-benefits for climate adaptation by improving soil health, enhancing water use efficiency, and supporting biodiversity (Karl et al., 2024).

However, the extent to which this potential can be realized depends not only on the crops themselves, but on the broader policy and structural environment. Our policy analysis found that most governments do not yet systematically promote opportunity crops across key sectors. Despite growing global interest in nutrition-sensitive agriculture, opportunity crops remain underrepresented or absent from national dietary guidelines, extension services, and agricultural investment strategies. A small number of countries, including Tanzania and Sierra Leone, have demonstrated what a more integrated approach could look like, with multiple policies actively supporting the cultivation, consumption, and commercialization of traditional and underutilized species.

Our modeling shows that many opportunity crops are rich in the micronutrients most commonly underconsumed in high-hunger countries, including iron, folate, and calcium. Shifting production toward these crops could substantially improve the availability of key nutrients, especially in resource-constrained settings where fortification and supplementation programs may be limited. However, addressing micronutrient inadequacies and achieving SDG2: Zero Hunger will require a multifaceted approach, including large-scale food fortification, home-based solutions like micronutrient powders and lipid-based supplements, and health system interventions such as vitamin A distribution. The countries included in this report represent those with the highest hunger burdens globally. Notably, we also found that South Asian countries, which were excluded from the original VACS initiative, have the greatest number of nutrients with inadequate intakes, underscoring the need to extend efforts to this region.

The report also highlights several important limitations. While many opportunity crops may have lower yields compared to dominant staples, yield alone does not capture their full value, particularly when considering nutrient output, environmental benefits, and resilience to climate stress. Other barriers include limited market demand, weak or informal seed systems, and post-harvest challenges such as perishability, antinutritional factors, and poor market integration. Actual consumption also hinges on factors like affordability, accessibility, preparation requirements, and cultural acceptability. These considerations underscore the importance of pairing crop promotion with investments in infrastructure, behavior change strategies, and context-specific support to enable adoption and scale.

Overall, our analysis provides strong evidence that opportunity crops, when scaled alongside investments in processing and distribution, can help improve micronutrient intakes while supporting climate resilience, biodiversity, and rural livelihoods. Their contributions will vary by context, but across geographies and seasons, they represent an underutilized yet promising strategy in the fight against malnutrition. As countries face persistent nutrient gaps alongside growing climate risks, this is a moment of both urgency and opportunity. To support action, we have identified four key policy recommendations:

1. **Invest in data, research, and innovation for opportunity crops.** Improve the quality and accessibility of food composition data for all 60 VACS-prioritized opportunity crops. Scale up crop suitability and soil nutrient mapping (especially for micronutrients that are highly dependent on soil conditions, such as iodine and selenium), yield modeling, and integrated analyses of climate resilience and nutritional potential. Develop decision-support tools to guide the integration of opportunity crops into production, trade, and consumption strategies. Consider all regions with high burdens of malnutrition and soil degradation for data, research, and innovation, including South Asia.

2. **Scale location-appropriate opportunity crops to reduce micronutrient gaps.** Prioritize crops based on seasonal and geographic disparities in micronutrient intakes. Increase demand and consumption through processing and packaging for convenience, school meals, nutrition education, maternal and child health programs, and behavior change strategies. Strengthen supply through breeding programs, seed systems, technical extension services for producers, and community gardens. Support farmer access to processing, storage, and marketing infrastructure, with a particular focus on empowering women and youth in opportunity crop value chains.

3. **Promote coherent, nutrition-sensitive policies and trade environments.** Integrate opportunity crops into national food-based dietary guidelines and policies to align nutrition, agriculture, and environmental goals, as well as the goals of Indigenous populations. Ensure a supportive regulatory environment for cross-border trade and harmonized food standards. Use modeling and decision support tools to inform evidence-based policy decisions.

4. **Embed opportunity crops in broader nutrition and food system strategies.** Position opportunity crops as a foundational component of climate-resilient, nutrient-rich food systems. Align efforts with complementary interventions to improve micronutrient intake, such as fortification, supplementation, and biofortification. Promote opportunity crops holistically with low-impact animal-source foods across landscapes, markets, and plates to ensure sustainable healthy diets. Integrate food-based solutions with multi-sectoral plans that address maternal, infant, and young child feeding; management of acute malnutrition; nutrition norms and governance; water, sanitation, and hygiene; and social protection services for nutrition.

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ANNEXES

ANNEX 1. LIST OF OPPORTUNITY CROPS' COMMON AND SCIENTIFIC NAMES

Table A1.1: List of opportunity crops[1]

Opportunity crop	Scientific name from VACS report[1]	Name in food composition table
Grains		
Fonio	*Digitaria exilis*	*Digitaria exilis*
Teff	*Eragrostis tef*	*Eragrostis tef*
Sorghum	*Sorghum bicolor*	*Sorghum bicolor*
Finger millet	*Eleusine coracana*	
Pearl millet	*Cenchrus americanus / Pennisetum glaucum*	*Pennisetum glaucum*
Legumes		
Cowpea[2]	*Vigna unguiculata*	*Vigna unguiculata*
Grasspea	*Lathyrus sativus*	*Lathyrus sativus*
Pigeon pea	*Cajanus cajan*	*Cajanus cajan*
Bambara bean / bambara groundnut	*Vigna subterranea*	*Voandezia subterranea*
Lablab	*Lablab purpureus*	*Lablab purpureus*
Mung bean / green gram	*Vigna radiata*	*Vigna radiata*
Roots and tubers		
Cocoyam[2]	*Xanthosoma sagittifolium*	*Xanthosoma sagittifolium*
Sweet potato[2]	*Ipomea batatas*	*Ipomea batatas*
Taro[2]	*Colocasia esculenta*	*Colocasia esculenta*
Yam	*Dioscorea spp.*	*Dioscorea alata*
Nuts and seeds		
Sesame	*Sesamum indicum*	*Sesamum indicum*
Groundnut	*Arachis hypogaea*	*Arachis hypogaea*
Fruits and vegetables		
African eggplant	*Solanum aethiopicum / Solanum macrocarpon*	*Solanum melongena*[4]
Amaranth[3]	*Amaranthus spp. (cruentus, caudatus, hybridus, graecizans, viridis)*	*Amaranthus spp.*
Okra[2]	*Abelmoschus spp. (esculentus / caillei)*	*Abelmoschus esculentus / Hibiscus esculentus*

1 Karl, K., MacCarthy, D., Porciello, J., Chimwaza, G., Fredenberg, E., Freduah, B. S., Guarin, J., Mendez Leal, E., Kozlowski, N., Narh, S., Sheikh, H., Valdivia, R., Wesley, G., Van Deynze, A., van Zonneveld, M., & Yang, M. (2024). Opportunity Crop Profiles for the Vision for Adapted Crops and Soils (VACS) in Africa. https://doi.org/10.7916/7msa-yy32
2 Nutrient composition of leaves were also assessed
3 Nutrient composition of seeds and leaves were assessed
4 We were not able to find the species of cooked African eggplant in the food composition tables, thus we substituted the nutrient composition of Solanum Melongena, the more commonly found purple eggplant

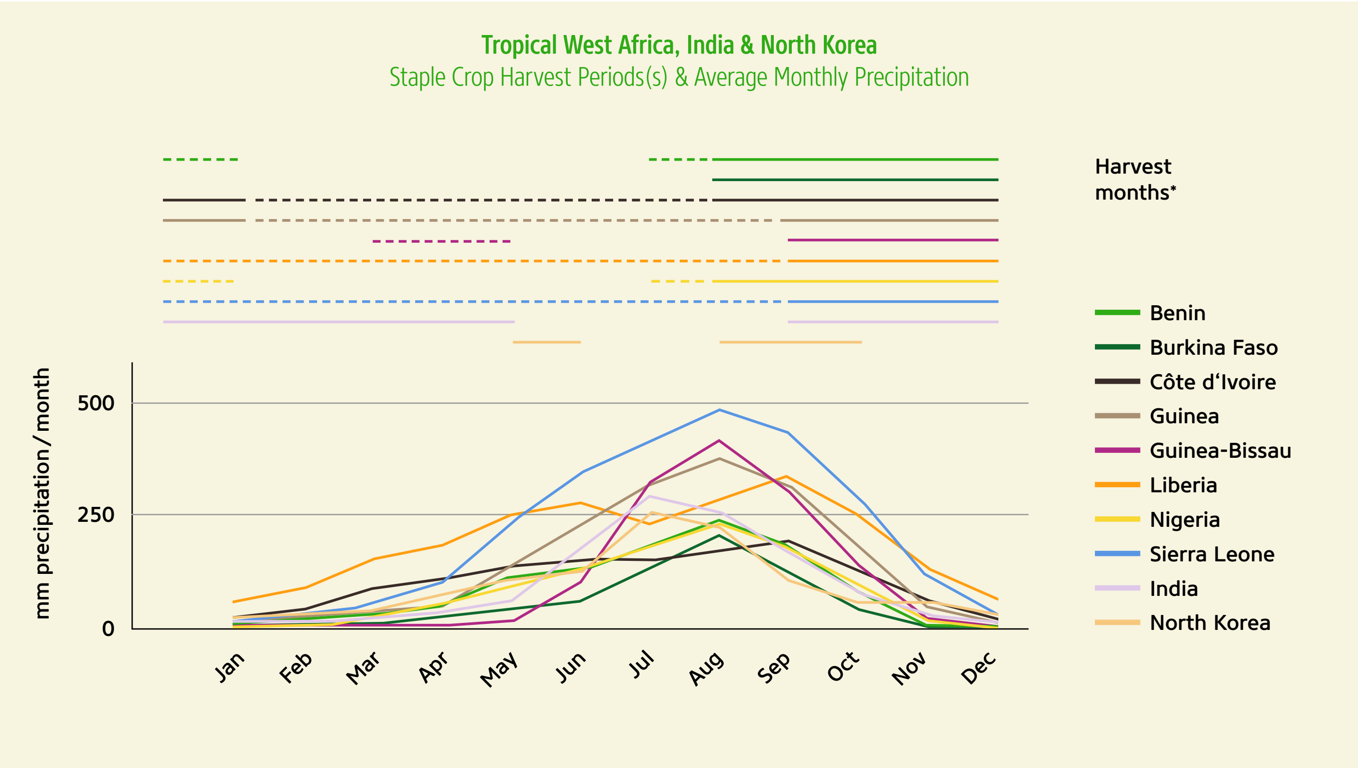
ANNEX 2. SEASONALITY OF EXISTING STAPLE CROPS IN HUNGER-AFFECTED COUNTRIES

Tropical West Africa, India, and North Korea
In tropical West Africa, the rainy season lasts from May/June to October, while the remaining months are considered the dry season (Figure A2.1). Although rainfall patterns have been unreliable in recent years (Prendergrass et al., 2017), the harvest season for the main cereal crops in these countries (maize, rice, millet, and sorghum) usually begins in the latter months of the rainy season (August/September) and are readily available through December/January (USDA, n.d.). This results in high rates of hunger and inadequate intake of some micronutrients from April/May until the next harvest period in August, as indicated by gaps in the harvest lines on Figure A2.1 (World Bank, 2021).

Tropical West Africa is also considered the 'yam belt' in Africa (Conde et al., 2024). In most West African countries, yams are harvested concurrently with the cereal grains. In Guinea and Liberia, the yam harvest periods extend through May and March, respectively. In some parts of Guinea, Guinea-Bissau, Liberia, and Sierra Leone, cassava and/or sweet potatoes can be harvested in the months between cereal crop harvests, which reduces the length and intensity of the lean season in these countries.

Although North Korea and India are ecologically quite different from the tropical West African countries, they experience similar rainfall patterns and, consequently, have relatively similar harvest periods (FAO, 2001; USDA, n.d.). Because of North Korea's latitude, its cereal harvest occurs slightly earlier and is shorter than those of the tropical west African countries. Additionally, India's diverse ecology likely supports greater diversification of crops and harvest periods, even during the summer months, which appear to be the lean season in national staple crop calendars (USDA, n.d.; FAO, 2025).

Figure A2.1: Staple crop harvest period(s) and average monthly precipitation in Tropical West African countries, India, and North Korea.



* The thick solid lines represent the primary harvest period in each country, including cereals and, in some cases, roots and tubers. The dashed lines represent additional months in which only roots and tubers are harvested, and the comparatively thinner lines (solid or dashed) represent secondary or minor harvest periods.
Sources: World Bank, 2021; USDA, n.d.; FAO, 2025

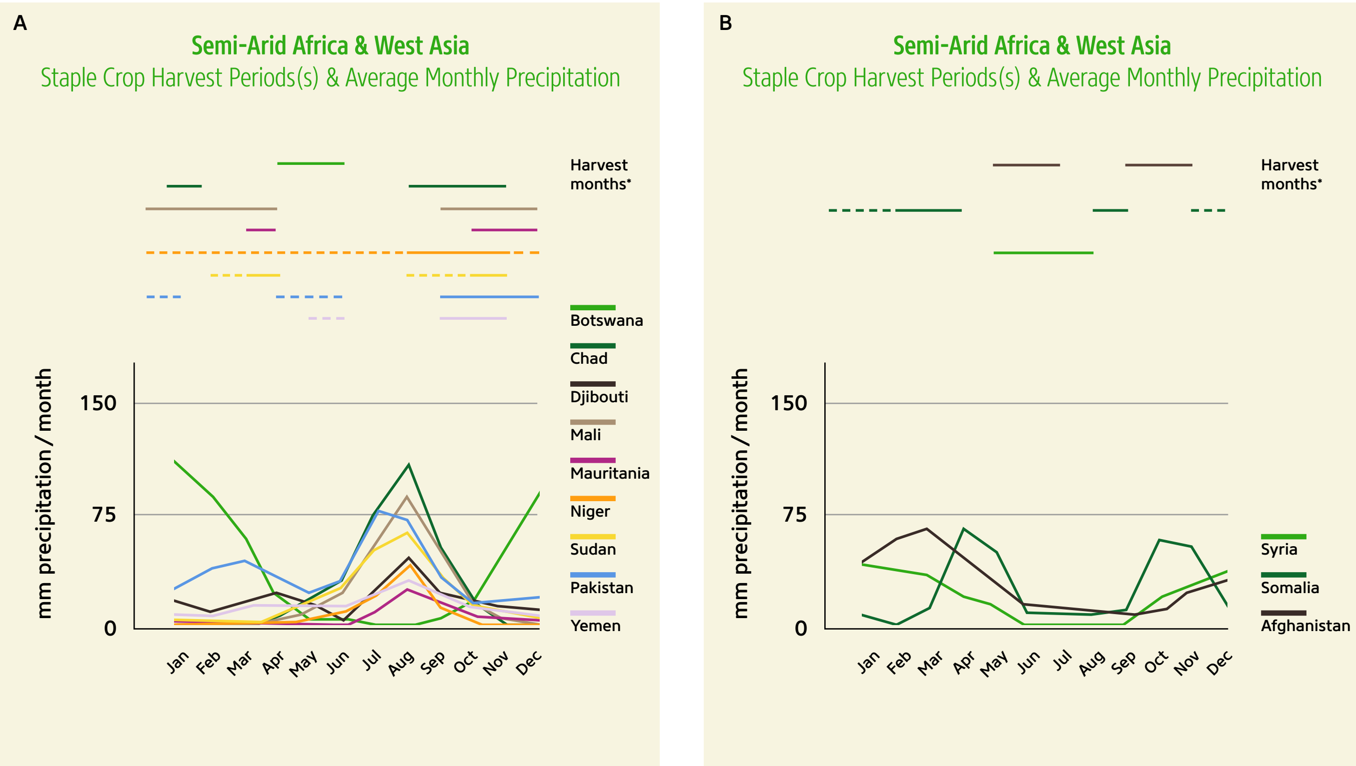
Semi-Arid Africa & West Asia
Many of the countries considered to have serious or alarming levels of hunger are in hot, semi-arid parts of the world, including the Sahel, the Horn of Africa, Southern Africa, and West Asia. The countries in this region receive little overall annual precipitation and short rainy seasons, and rainfall is becoming increasingly unpredictable and erratic due to climate change (Figure A2.2; World Bank, 2021). These countries experience higher levels of food insecurity, from April to August/September (conversely, from August/September to April in Botswana).

In Chad, Mali, Mauritania, Niger, Sudan, and Yemen, June–October is considered the rainy season (World Bank, 2021). In these countries, the staple cereals (sorghum, millet, and rice) are harvested just after the rainy season (August/September-November/December; USDA, n.d.; FAO, 2025). Some countries (i.e., Mali, Mauritania, and Sudan) also have minor secondary harvests in the spring (March-May/June; USDA, n.d.; FAO, 2025) The pre-harvest period (~June-September) corresponds with higher food insecurity in these countries (FAO, 2025).

Pakistan experiences a similar rainy season as the dry African countries, in addition to a secondary rainy season February–April (World Bank, 2021). Wheat, the staple cereal in Pakistan, barley, and potatoes are harvested from April to June, following the shorter season, which tempers the impact of seasonality on food insecurity (USDA, n.d.). Djibouti and Yemen also receive rainfall between July and October; however, these countries import >90% and >80% of their food, respectively, since <1% of the land is considered arable in Djibouti and <3% is considered arable in Yemen (World Bank, 2025; WFP 2025; Britannica, 2025; ACAPS et al., 2023).

In Botswana, total annual rainfall is similar to the Sahel countries, with inverted seasons due to its location in the southern hemisphere. The rainy season lasts from November to March, but can be erratic, (World Bank, 2021) and the staple cereals are usually harvested April/May–June (USDA, n.d.). As in the other countries in this region, the months leading up to the harvest (January–March) are considered the lean season (FAO, 2025).

Figure A2.2: Staple crop harvest period(s) and average monthly precipitation in semi-arid African and West Asian countries.



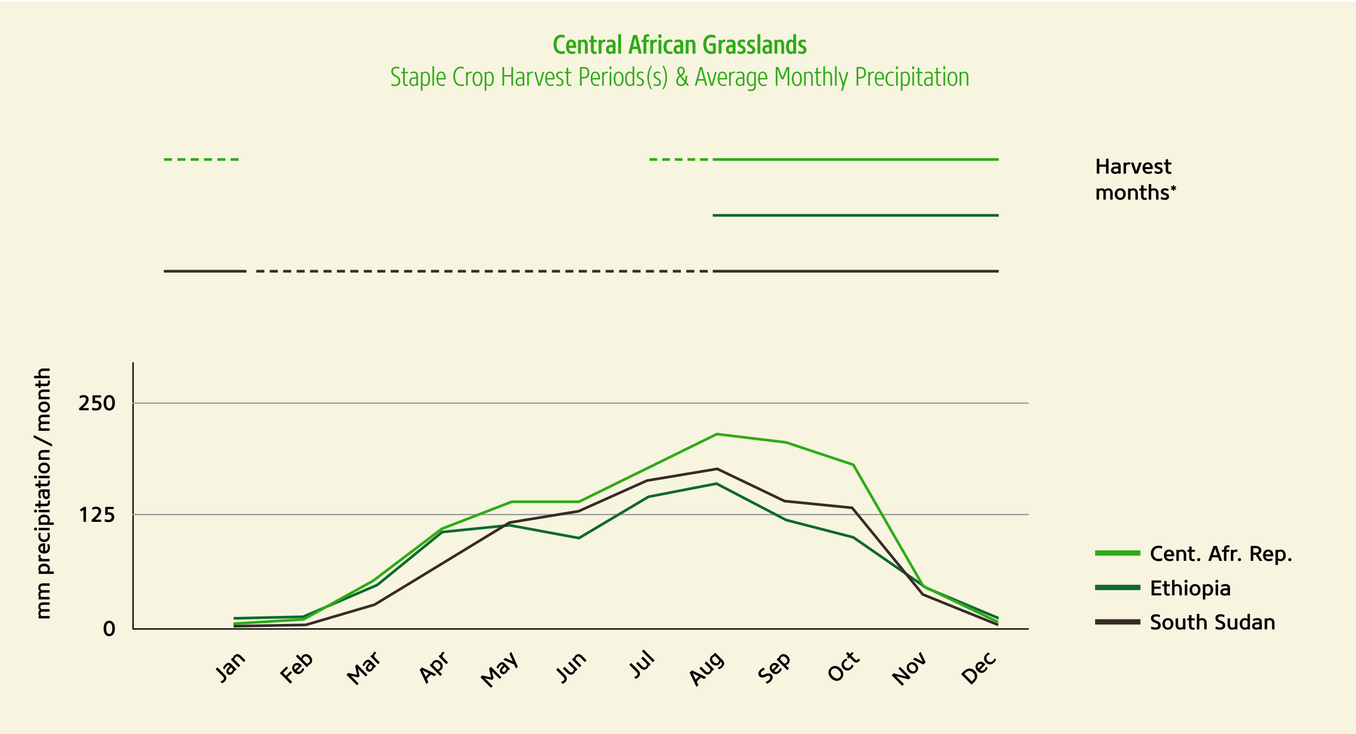
Panel A: Arid African & West Asian countries with predominantly unimodal rainfall and a more defined harvest season.
Panel B: Arid African & West Asian countries with less precipitation and a more bimodal pattern, leading to variable harvest periods.
* The thick solid lines represent the primary harvest period in each country, including cereals and, in some cases, roots and tubers. The dashed lines represent additional months in which only roots and tubers are harvested, and the comparatively thinner lines (solid or dashed) represent secondary or minor harvest periods.
Sources: World Bank, 2021; USDA, n.d.; FAO, 2025

In Somalia, Afghanistan, and Syria, rainfall and harvest periods are quite different from the other countries in the Arid Africa and West Asia region (Figure A2.2). The main cereal harvest takes place May–July/August, following the rainy period in January–April (World Bank, 2021; FAO, 2025), as in Pakistan, as these three countries predominantly grow and consume wheat. In Afghanistan, some secondary crops (corn and rice) are harvested August-September/October (USDA, n.d.). February through April is considered the pre-harvest, or 'lean', season (FAO, 2025). However, the lean season may last anywhere from two to six months in Afghanistan, depending on the ecological conditions of the area (Zanello et al., 2019). Somalia experiences brief rainy seasons April–May and October-November (World Bank, 2021). Cereals are primarily harvested in August-September and March–April (USDA, n.d.); however, due to the scarcity of rain and arable land, Somalia imports upwards of 60% of its food (FAO et al., 2022).

Central African grasslands

CAR, South Sudan, and Ethiopia lie between the Sahel and the Congo Basin. As in the West African Sahel region, rainfall peaks in August; however, the rainy season begins earlier (~May), and total rainfall in this region more closely aligns with the Central and East African countries (Figure A2.3; World Bank, 2021). In CAR and South Sudan, the staple cereals are harvested starting in July/August (FAO, 2025). CAR also produces and consumes a significant amount of cassava, which staves off the lean season until approximately April (FAO, 2025). In South Sudan, the main cereal harvest lasts until December/January – the exact timing varies by region within the country – resulting in a longer period of food insecurity (February–July) (FAO, 2025). In Ethiopia, the main cereals (teff, sorghum, and millet) are harvested after the rainy season (October–January; FAO, 2025; World Bank, 2021; Tiguh et al., 2024) In some regions in Ethiopia, sorghum is harvested through the spring and summer months, which may help minimize food insecurity in those areas (FAO, 2025; Roba et al., 2015).

Figure A2.3: Staple crop harvest period(s) and average monthly precipitation in Central African Grasslands.



* The thick solid lines represent the primary harvest period in each country, including cereals and, in some cases, roots and tubers. The dashed lines represent additional months in which only roots and tubers are harvested, and the comparatively thinner lines (solid or dashed) represent secondary or minor harvest periods.

Sources: **World Bank, 2021**; **USDA, n.d.**; **FAO, 2025**

Equatorial Africa & Haiti

Countries that lie across or near the equator in Africa and Haiti share similar agricultural seasons and rainfall patterns (Figure A2.4). Because of the bimodal rainfall and higher total annual precipitation, countries in this region can diversify their production systems and harvest crops more continuously throughout the year, leading to shorter, less intense periods of food insecurity (FAO, 2025).

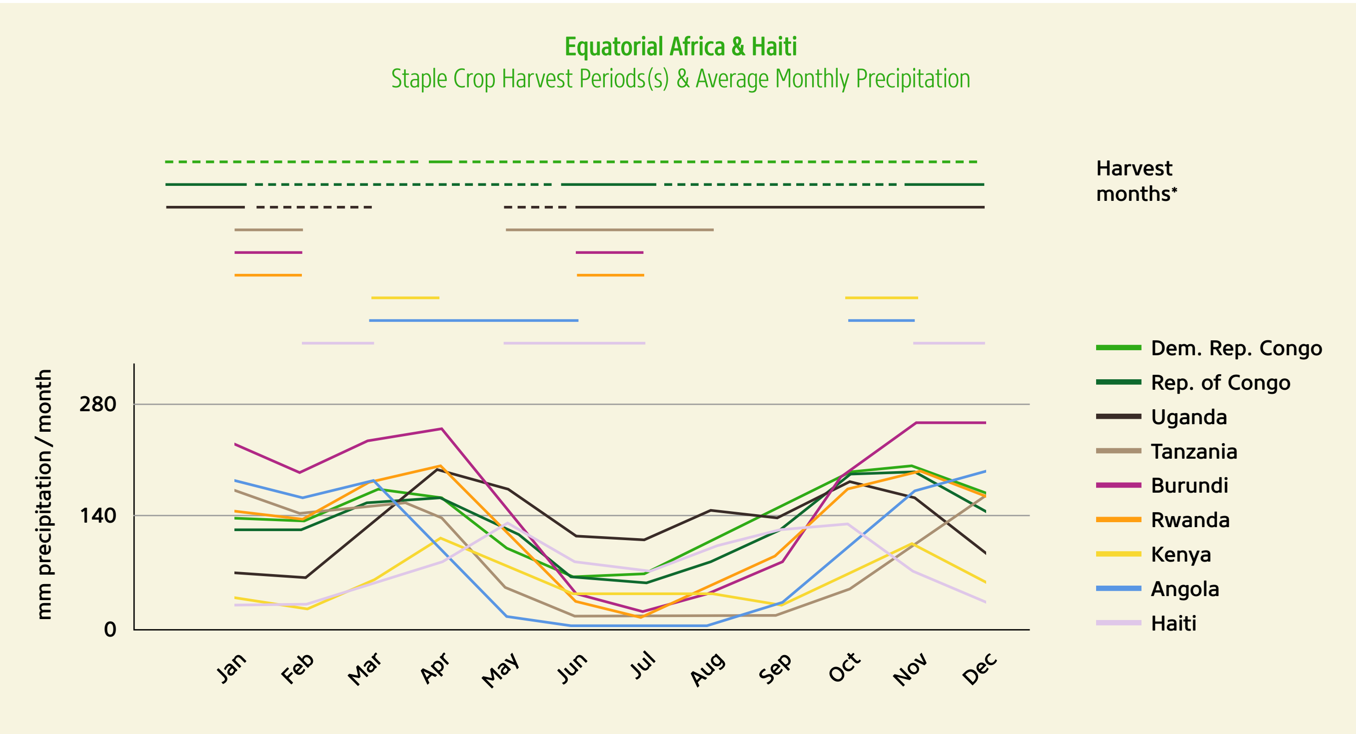
In southern DRC, the staple crops – cassava and yams – are harvested March-December, while the staple cereal – maize – is harvested May–June (FAO, 2025). The months in between cassava harvests (November-February) are considered the lean season. In the northern part of the DRC, cassava and yams are harvested July–March and maize is harvested October-November. March-May is considered the lean season in northern DRC (FAO, 2025). Uganda also experiences seasonality differences between the north and south parts of the country. Most of the country receives bimodal rainfall (April–May and September–November) and harvests cereal crops during the dry months (June–July and December-January; Sridharan et al., 2019; USDA, n.d.). The northern, drier portion of Uganda only has one rainy season (August–October), and the main cereal harvest takes place between August and October. Cassava and sweet potatoes are also grown in the northern parts of Uganda, which are harvested from September to March. Both parts of the country have lean periods in April–May and November–December. Cassava is also the staple crop in Congo (Brazzaville), in addition to maize and yams. Maize is harvested June–July and December–January, while yams and/or cassava are grown throughout the year (FAO, 2025). As a result, there is no defined lean period in Congo.

In Rwanda, Burundi, and Tanzania, the rainy season runs from October/November to April, although rainfall tapers off slightly in February (World Bank, 2021; Keding et al., 2012). Staple crops are harvested during the dry months, with the primary harvest from May/June to July/August and a secondary harvest in January/February (USDA, n.d.; Keding et al., 2012). In Kenya, the two rainy seasons are more distinct, and total precipitation is the lowest of the countries in this region (World Bank, 2021). As a result, the main cereal harvest takes place slightly later (predominantly September/October–November; USDA, n.d.; M'Kaibi et al., 2015).

In Angola, the rainy season concludes earlier, and the dry season receives less rainfall than other countries in this region, due to its more southern latitude (World Bank, 2021). As a result, the staple cereals are harvested several months earlier (March–May/June), and the lean season occurs at the beginning of the subsequent calendar year (January–April; FAO, 2025).

Rice – Haiti's staple crop – is planted and harvested three times throughout the year (June–July, November, and March; Moyo, 2024). The summer harvest is the largest of the three (Moyo, 2024). Maize and sorghum are also grown in Haiti and are harvested June–August and November–February, while April and May are considered the lean season (Moyo, 2024; FAO GIEWS, 2025; USDA, n.d).

Figure A2.4: Staple crop harvest period(s) and average monthly precipitation in Equatorial Africa and Haiti.



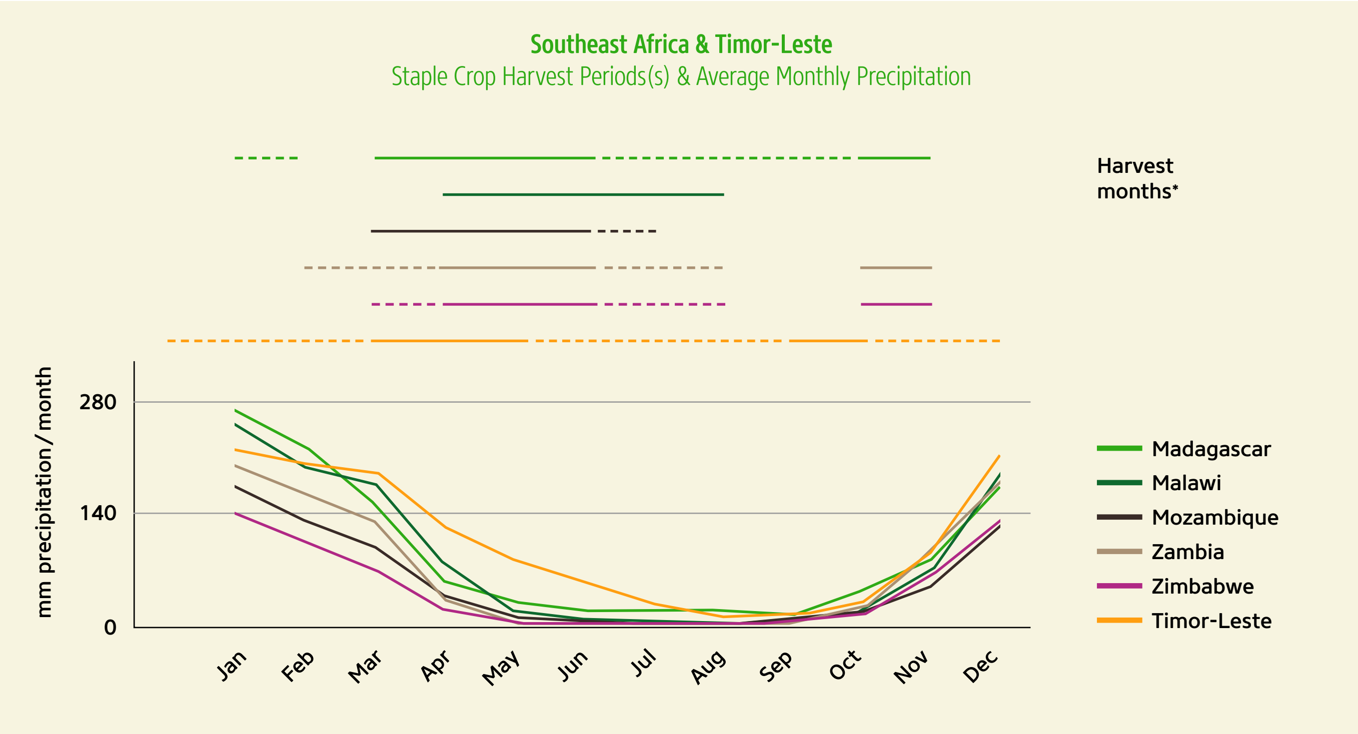
* The thick solid lines represent the primary harvest period in each country, including cereals and, in some cases, roots and tubers. The dashed lines represent additional months in which only roots and tubers are harvested, and the comparatively thinner lines (solid or dashed) represent secondary or minor harvest periods.

Sources: **World Bank, 2021**; **USDA, n.d.**; **FAO, 2025**

Southeastern Africa & Timor-Leste

In southeastern Africa (Madagascar, Malawi, Mozambique, Zambia, and Zimbabwe), the staple crop harvest occurs from the end of the rainy season (March/April) until June (Figure A2.5). The wet months (October–February/March) are considered the 'lean' season, when food shortages occur, especially among rural populations (FAO, 2025; Matavel et al., 2022) Wheat production in Madagascar and Zimbabwe delays the lean season until January/February (FAO, 2025). Root and tuber production in Madagascar, Timor-Leste, and – to a lesser extent – in Zambia and Zimbabwe, also help to minimize the risk of inadequate nutrient intakes throughout the rainy season. Although precipitation patterns are similar in Timor-Leste, the dry season is slightly less pronounced and begins later in the year (July–October) relative to Southeastern African countries (World Bank, 2021). As a result, it has a less pronounced lean season, which lasts from November through February (FAO, 2025).

Figure A2.5: Staple crop harvest period(s) and average monthly precipitation in Southeast Africa and Timor-Leste.



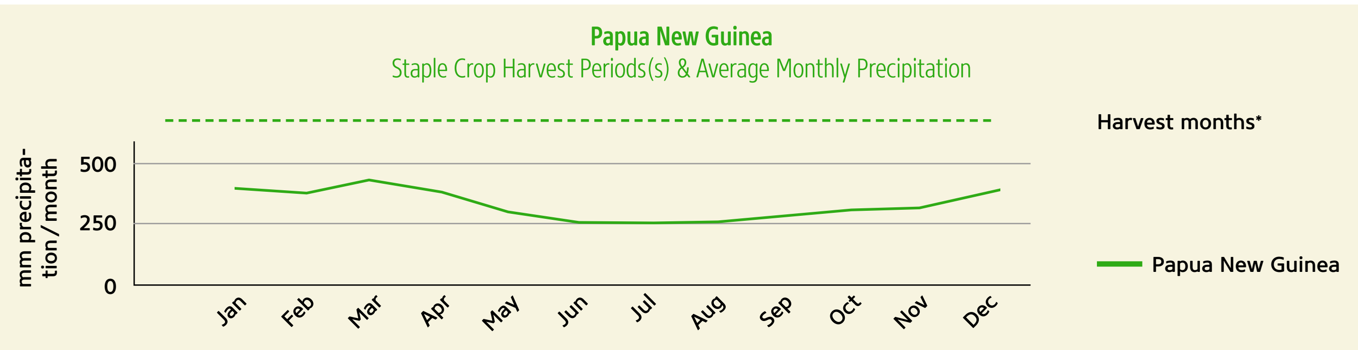
* The thick solid lines represent the primary harvest period in each country, including cereals and, in some cases, roots and tubers. The dashed lines represent additional months in which only roots and tubers are harvested, and the comparatively thinner lines (solid or dashed) represent secondary or minor harvest periods.

Sources: World Bank, 2021; USDA, n.d.; FAO, 2025

Papua New Guinea

Rainfall and surface temperature are consistently high throughout the year in Papua New Guinea (Figure A2.6; FAO, 2001). Although June–November could be considered the 'drier' season, the average rainfall during those months is approximately 200 mm/month – comparable to the rainiest months in Timor-Leste and Haiti, which share similar ecologic features (World Bank, 2021). In Papua New Guinea, precipitation peaks in January and March, at >400 mm/month. Sweet potato is the staple, and it can be harvested all year; therefore, Papua New Guinea generally does not experience season-related food insecurity.

Figure A2.6: Staple crop harvest period(s) and average monthly precipitation in Papua New Guinea.



* The dashed line represents the harvest period for roots and tubers, the primary staple category in Papua New Guinea.

Sources: World Bank, 2021; USDA, n.d.; FAO, 2025

ANNEX 3. DISTRIBUTION AND HARVESTING PERIODS OF OPPORTUNITY CROPS

Table A3.1: Harvesting months of opportunity crops in countries with serious or alarming levels of hunger according to the Global Hunger Index (n=41).

Country	Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tropical West Africa, India & North Korea													
Benin	African eggplant (*Solanum aethiopicum / macrocarpon*)	medium	medium	medium	medium		light	light	light	light	light	medium	medium
	Cowpea (*Vigna unguiculata*)						medium	medium			light	medium	medium
	Fonio (*Digitaria exilis*)*									medium			
	Groundnut (*Arachis hypogea*)									medium	medium		
	Pearl millet (*Cenchrus americanus / Pennisetum glaucum*)									light	medium	medium	
	Sorghum (*Sorghum bicolor*)										medium	medium	
	Yam (*Dioscorea spp.*)	medium						light	medium	medium	medium	medium	medium
Burkina Faso	Fonio (*Digitaria exilis*)*									medium			
	Groundnut (*Arachis hypogea*)	light	light	light						medium	medium		
	Okra (*Abelmoschus spp. (Esculentus / caillei)*)								medium	medium	medium	medium	medium
	Pearl millet (*Cenchrus americanus / Pennisetum glaucum*)										medium	medium	medium
	Sesame (*Sesamum indicum*)										medium	medium	medium
	Sorghum (*Sorghum bicolor*)										medium	medium	medium
	Yam (*Dioscorea spp.*)											medium	medium
Côte d'Ivoire	Cowpea (*Vigna unguiculata*)									medium	medium		
	Fonio (*Digitaria exilis*)*									medium			
	Groundnut (*Arachis hypogea*)						medium	medium			dark	dark	
	Okra (*Abelmoschus spp. (Esculentus / caillei)*)					medium	dark	dark	dark	medium			
	Pearl millet (*Cenchrus americanus / Pennisetum glaucum*)										medium	medium	
	Sorghum (*Sorghum bicolor*)									light	medium	medium	
	Yam (*Dioscorea spp.*)	medium						medium	medium	dark	dark	dark	dark
Guinea	Bambara bean (*Vigna subterranea*)									medium	dark		
	Cowpea (*Vigna unguiculata*)	light	light	light	light	light	light	light	medium	medium	dark	dark	medium
	Fonio (*Digitaria exilis*)							light	medium	dark	dark	medium	
	Groundnut (*Arachis hypogea*)		medium	medium	light				medium	medium	dark	dark	
	Okra (*Abelmoschus spp. (Esculentus / caillei)*)	medium			light	light		dark	dark	dark	medium	medium	medium
	Pearl millet (*Cenchrus americanus / Pennisetum glaucum*)										medium	medium	
	Sesame (*Sesamum indicum*)									medium	dark		
	Sorghum (*Sorghum bicolor*)										medium	medium	light
	Teff (*Eragrostis tef*)	medium										medium	medium
	Yam (*Dioscorea spp.*)	medium	light	light	light	light			medium	medium	medium	medium	medium

Qualitative representation of production intensity. Darker shades represent the primary harvest period(s), or month(s) in which the crop is grown in more regions of the country.

Country	Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Guinea-Bissau	Amaranth (*Amaranthus spp.*)	medium	medium	medium	medium	medium	medium	medium	medium	medium	medium	medium	medium
	Cowpea (*Vigna unguiculata*)								medium	medium	medium	medium	light
	Fonio (*Digitaria exilis*)*									medium			
	Groundnut (*Arachis hypogea*)								medium	dark	dark		
	Okra (*Abelmoschus spp. (Esculentus/caillei)*)	dark	dark	dark	medium	medium	medium	medium	medium	medium	medium	dark	dark
	Pearl millet (*Cenchrus americanus/Pennisetum glaucum*)									medium	medium		
	Sesame (*Sesamum indicum*)		medium	medium	medium								
	Sorghum (*Sorghum bicolor*)									light	medium	medium	light
	Sweet potato (*Ipomea batatas*)									medium	dark	medium	
Liberia	Cocoyam (*Xanthosoma sagittifolium*)	dark	dark	dark		medium	medium					dark	dark
	Cowpea (*Vigna unguiculata*)	medium				dark	dark	medium	medium	medium	medium	medium	medium
	Groundnut (*Arachis hypogea*)	light	light				medium	medium					
	Mung bean/green gram (*Vigna radiata*)	medium	medium	medium			medium	dark	dark				
	Okra (Abelmoschus spp. (*Esculentus/caillei*))	dark				light	dark	dark					dark
	Sorghum (*Sorghum bicolor*)									medium	medium	medium	
	Sweet potato (*Ipomea batatas*)	light					medium	medium	medium	medium	medium		light
	Yam (*Dioscorea spp.*)	medium	medium	medium		light	light	medium	medium	medium	medium	medium	medium
Nigeria	Fonio (*Digitaria exilis*)*									medium			
	Groundnut (*Arachis hypogea*)	light		light						light	medium	medium	medium
	Pearl & finger millet *(Cenchrus americanus/Pennisetum glaucum & Eleusine coracana)*									medium	medium		
	Pigeon pea (*Cajanus cajan*)	light	medium										
	Sesame (*Sesamum indicum*)						light	medium	light	light	medium	medium	
	Sorghum (*Sorghum bicolor*)									medium	medium	medium	medium
	Yam (*Dioscorea spp.*)	medium						medium	medium	medium	medium	medium	medium
Sierra Leone	Cowpea (*Vigna unguiculata*)			light	light	light	light	light	light	light	light	light	light
	Fonio (*Digitaria exilis*)*									medium			
	Groundnut (*Arachis hypogea*)	light	light	light	light				light	light	light	light	light
	Okra (*Abelmoschus spp. (Esculentus/caillei)*)								light	light	light	light	
	Pearl millet (*Cenchrus americanus/Pennisetum glaucum*)										medium	medium	
	Sorghum (*Sorghum bicolor*)										medium	medium	
	Sweet potato (*Ipomea batatas*)				light	light	light	light	light	light	light	light	
	Yam (*Dioscorea spp.*)							medium	medium	medium	medium	medium	medium
India	Cowpea (*Vigna unguiculata*)	medium	medium			light	light	light	medium	medium	medium		medium
	Grasspea (*Lathyrus sativus*)		medium	medium									
	Groundnut (*Arachis hypogea*)			light	light					medium	medium	light	light
	Pearl & finger millet *(Cenchrus americanus/Pennisetum glaucum & Eleusine coracana)*	light	light							light	light	medium	medium
	Sesame (*Sesamum indicum*)	medium	light	light	medium	medium	medium	light			dark	dark	medium
	Sorghum (*Sorghum bicolor*)		light	medium	medium	light						medium	medium
	Teff (*Eragrostis tef*)	light				medium	medium		light	medium	medium	medium	light

Qualitative representation of production intensity. Darker shades represent the primary harvest period(s), or month(s) in which the crop is grown in more regions of the country.

Country	Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
North Korea	Groundnut (*Arachis hypogea*)										medium		
	Mung bean / green gram (*Vigna radiata*)									dark			
	Pearl millet (*Cenchrus americanus / Pennisetum glaucum*)									medium	medium		
	Sesame (*Sesamum indicum*)									dark			
	Sorghum (*Sorghum bicolor*)									medium	medium		
	Sweet potato (*Ipomea batatas*)										dark		
Arid Africa & West Asia													
Botswana	Pearl & finger millet *(Cenchrus americanus / Pennisetum glaucum & Eleusine coracana)*					medium	medium						
	Sorghum (*Sorghum bicolor*)					medium	medium						
Chad	Bambara bean (*Vigna subterranea*)									medium	dark		
	Cowpea (*Vigna unguiculata*)								medium	medium			
	Fonio (*Digitaria exilis*)*									medium			
	Groundnut (*Arachis hypogea*)								light	dark	dark	medium	
	Okra (*Abelmoschus spp. (Esculentus / caillei)*)	dark	dark	dark	medium	medium	medium	medium	medium	medium	medium	dark	dark
	Pearl & finger millet *(Cenchrus americanus / Pennisetum glaucum & Eleusine coracana)*									medium	medium		
	Sesame (*Sesamum indicum*)									dark			
	Sorghum (*Sorghum bicolor*)								medium	dark	dark	dark	
	Sweet potato (*Ipomea batatas*)									medium	dark	medium	
	Taro (*Colocasia esculenta*)										medium	medium	
	Yam (*Dioscorea spp.*)									medium	dark	medium	
Djibouti	Cowpea (*Vigna unguiculata*)	medium				medium					medium	medium	medium
	Groundnut (*Arachis hypogea*)				medium						medium		medium
	Okra (Abelmoschus spp. (*Esculentus / caillei*))	medium	medium	medium		medium					medium		medium
	Sesame (*Sesamum indicum*)				medium						medium		medium
	Sorghum (*Sorghum bicolor*)	dark	medium			medium	medium						medium
	Sweet potato (*Ipomea batatas*)	medium	medium	medium			medium	medium					medium
Mali	African eggplant (*Solanum aethiopicum / macrocarpon*)	medium	medium	medium						light	medium	medium	medium
	Amaranth (*Amaranthus spp.*)									medium	medium	medium	medium
	Fonio (*Digitaria exilis*)								light	medium	medium		
	Groundnut (*Arachis hypogea*)										medium	medium	
	Okra (*Abelmoschus spp. (Esculentus / caillei)*)	medium	medium	medium						light	medium	medium	medium
	Pearl millet (*Cenchrus americanus / Pennisetum glaucum*)									medium	medium	medium	medium
	Sesame (*Sesamum indicum*)									medium	medium		
	Sorghum (*Sorghum bicolor*)				light	light				medium	medium	medium	light

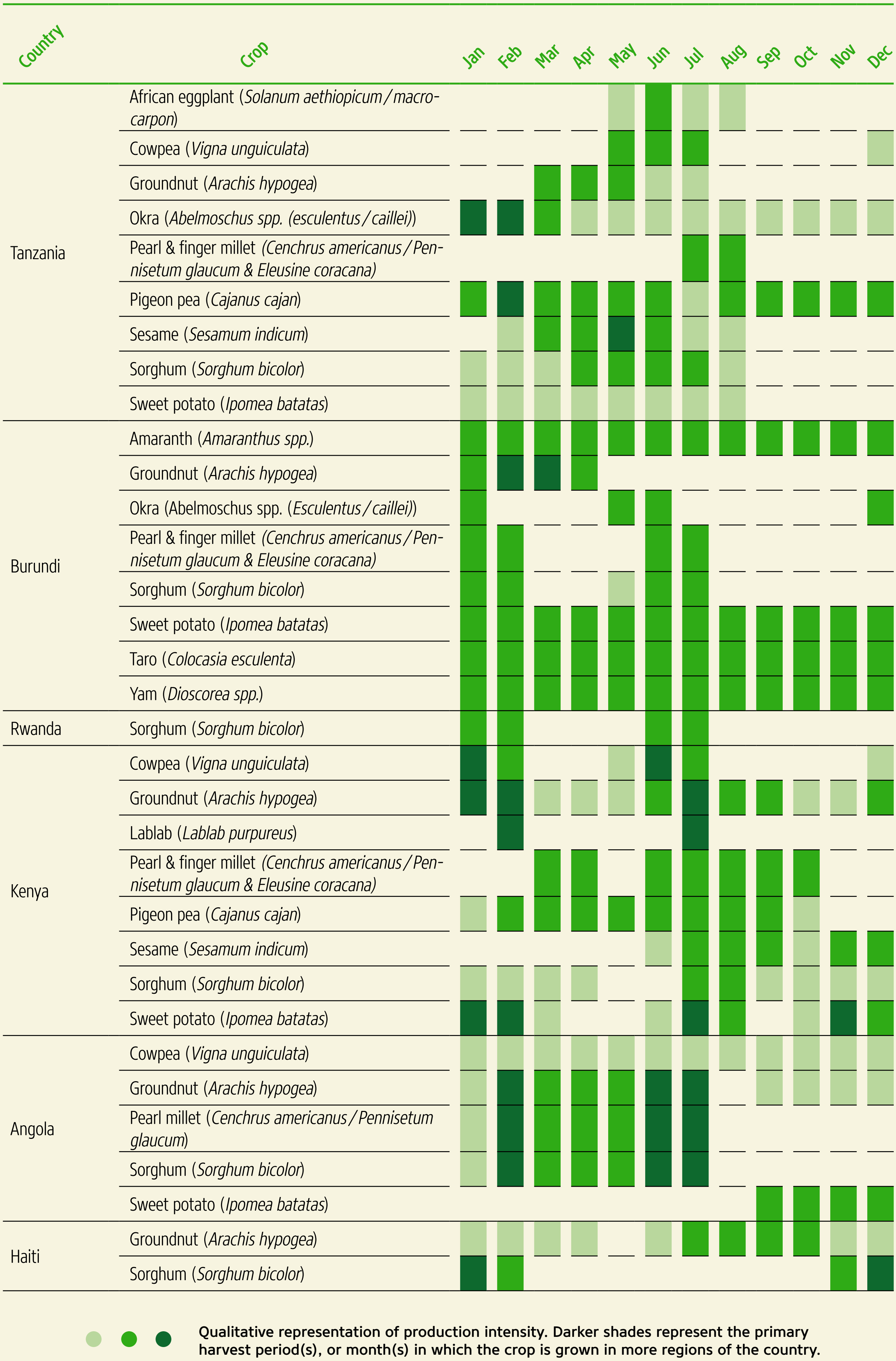
Qualitative representation of production intensity. Darker shades represent the primary harvest period(s), or month(s) in which the crop is grown in more regions of the country.

Country	Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mauritania	Cowpea (*Vigna unguiculata*)	dark	medium						medium	dark	dark		medium
	Groundnut (*Arachis hypogea*)					light	light	light		light	light	light	
	Okra (*Abelmoschus spp. (Esculentus / caillei)*)					medium	medium	medium					
	Pearl millet (*Cenchrus americanus / Pennisetum glaucum*)										medium	medium	
	Sorghum (*Sorghum bicolor*)	medium	medium	medium			light	light	light	medium	dark	dark	dark
	Sweet potato (*Ipomea batatas*)	light											
Niger	Cowpea (*Vigna unguiculata*)									medium	medium	medium	medium
	Fonio (*Digitaria exilis*)*									medium			
	Groundnut (*Arachis hypogea*)									medium	medium	medium	
	Okra (*Abelmoschus spp. (Esculentus / caillei)*)									medium	medium		
	Pearl millet (*Cenchrus americanus / Pennisetum glaucum*)									medium	medium	medium	
	Sesame (*Sesamum indicum*)									medium			
	Sorghum (*Sorghum bicolor*)									light	medium	medium	light
	Sweet potato (*Ipomea batatas*)	medium									medium	medium	medium
Sudan	Cowpea (*Vigna unguiculata*)									light	light		
	Groundnut (*Arachis hypogea*)									medium	medium		
	Okra (*Abelmoschus spp. (Esculentus / caillei)*)				light				light	light			
	Pearl & finger millet *(Cenchrus americanus / Pennisetum glaucum & Eleusine coracana)*											medium	medium
	Pigeon pea (*Cajanus cajan*)										light	light	
	Sesame (*Sesamum indicum*)									light	light		
	Sorghum (*Sorghum bicolor*)		light	light							medium	medium	medium
	Sweet potato (*Ipomea batatas*)		light	light	light								
Pakistan	Cowpea (*Vigna unguiculata*)					light	light						
	Groundnut (*Arachis hypogea*)								medium	medium	medium		
	Mung bean / green gram (*Vigna radiata*)									light	light		
	Okra (*Abelmoschus spp. (Esculentus / caillei)*)					medium	medium	dark	medium				
	Pearl millet (*Cenchrus americanus / Pennisetum glaucum*)									medium	medium	medium	
	Sesame (*Sesamum indicum*)										medium	medium	
	Sorghum (*Sorghum bicolor*)								medium	medium			
Yemen	Amaranth (*Amaranthus spp.*)		light	light	light			medium	medium	medium	medium		
	Sorghum (*Sorghum bicolor*)									medium	medium	medium	
Somalia	Cowpea (*Vigna unguiculata*)							medium	medium				dark
	Groundnut (*Arachis hypogea*)							medium	medium			medium	
	Mung bean / green gram (*Vigna radiata*)	medium						medium					medium
	Sesame (*Sesamum indicum*)	light											
	Sorghum (*Sorghum bicolor*)	dark	medium					medium	dark	medium			
	Sweet potato (*Ipomea batatas*)	light	light										

Qualitative representation of production intensity. Darker shades represent the primary harvest period(s), or month(s) in which the crop is grown in more regions of the country.

Country	Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Syria	Groundnut (*Arachis hypogea*)										medium		
	Okra (Abelmoschus spp. (*Esculentus / caillei*))							medium	medium	medium			
	Sesame (*Sesamum indicum*)											medium	
Central African grasslands													
Central African Republic	Groundnut (*Arachis hypogea*)							medium	medium	medium	medium		
	Pearl millet (*Cenchrus americanus / Pennisetum glaucum*)										medium	medium	
	Sorghum (*Sorghum bicolor*)								light	medium	medium	medium	
Ethiopia	Grasspea (*Lathyrus sativus*)						medium	medium	medium	medium	medium	medium	medium
	Groundnut (*Arachis hypogea*)									medium	medium		
	Pearl & finger millet *(Cenchrus americanus / Pennisetum glaucum & Eleusine coracana)*	medium										medium	medium
	Sesame (*Sesamum indicum*)							medium	medium	medium	dark	medium	medium
	Sorghum (*Sorghum bicolor*)		light	light	light	light	light	medium	medium	dark	dark	medium	medium
	Sweet potato (*Ipomea batatas*)						medium	medium	medium	medium	medium	medium	medium
	Teff (*Eragrostis tef*)	light						light	light	medium	dark	dark	medium
South Sudan	Pearl & finger millet *(Cenchrus americanus / Pennisetum glaucum & Eleusine coracana)*	medium						medium	medium			medium	medium
	Sorghum (*Sorghum bicolor*)	medium						medium	medium			medium	medium
Equatorial Africa & Haiti													
Dem. Rep. of the Congo	Groundnut (*Arachis hypogea*)		medium	medium									
	Pearl & finger millet *(Cenchrus americanus / Pennisetum glaucum & Eleusine coracana)*									medium	medium	medium	
	Sorghum (*Sorghum bicolor*)									medium	medium	medium	
	Yam (*Dioscorea spp.*)							medium	medium	medium	medium	medium	medium
Uganda	Bambara bean (*Vigna subterranea*)	light	medium	light									
	Cocoyam (*Xanthosoma sagittifolium*)	light	light	light	light	light	light	light	light	light	light	light	light
	Cowpea (*Vigna unguiculata*)					light	dark	dark	medium	medium	medium	medium	light
	Finger millet (*Eleusine coracana*)	medium					medium	medium	medium	medium	medium	light	medium
	Groundnut (*Arachis hypogea*)	medium				light	medium	dark	medium	light	light	medium	medium
	Mung bean / green gram (*Vigna radiata*)	light					light	light	light	light	light	light	light
	Okra (Abelmoschus spp. (*Esculentus / caillei*))	light	light	light	light	light	medium	medium	medium	medium	medium	light	light
	Pigeon pea (*Cajanus cajan*)						light	medium	medium	medium	medium	medium	light
	Sesame (*Sesamum indicum*)						light	light	light	light	light	light	light
	Sorghum (*Sorghum bicolor*)	light	light					medium	medium	light	medium	medium	medium
	Sweet potato (*Ipomea batatas*)	medium	medium	light			light	light	light	medium	medium	medium	medium
	Taro (*Colocasia esculenta*)	light	light	light	light	light	light			light	light	light	light
	Yam (*Dioscorea spp.*)	medium	medium	medium	medium	light	light	light	light	medium	medium	medium	medium

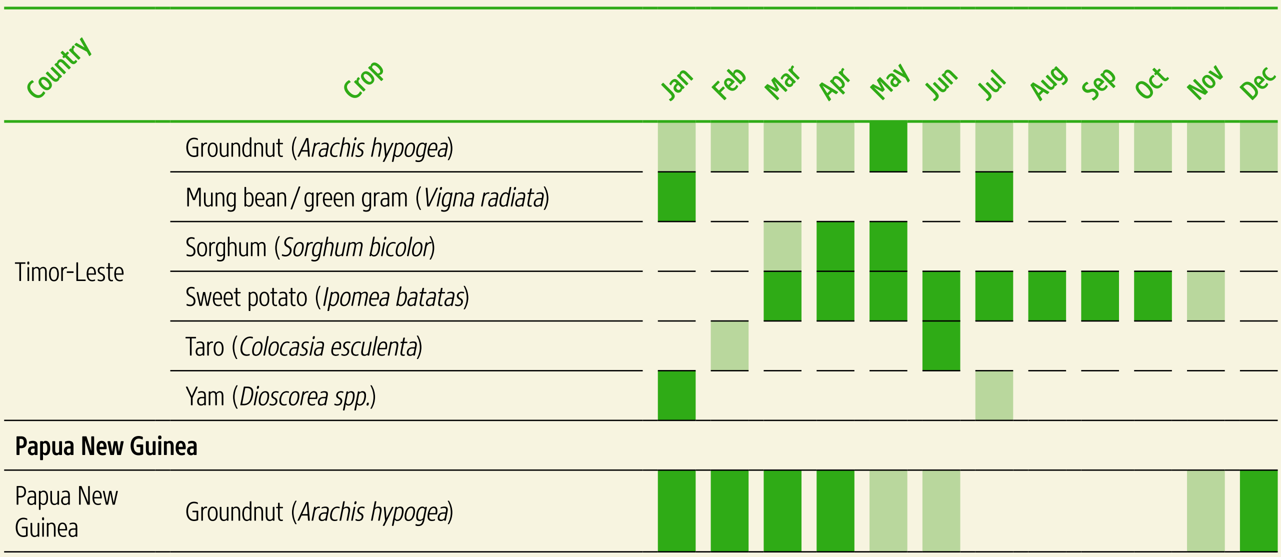
Qualitative representation of production intensity. Darker shades represent the primary harvest period(s), or month(s) in which the crop is grown in more regions of the country.



Qualitative representation of production intensity. Darker shades represent the primary harvest period(s), or month(s) in which the crop is grown in more regions of the country.

Country	Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Southeastern Africa & Timor-Leste													
Madagascar	Bambara bean (*Vigna subterranea*)			dark	dark								
	Groundnut (*Arachis hypogea*)			medium	dark	dark	medium		light	medium	medium	light	
	Sorghum (*Sorghum bicolor*)	light	light	light	light	medium							
	Sweet potato (*Ipomea batatas*)		light	light	light	light	medium	medium	dark	medium	medium	medium	
	Taro (*Colocasia esculenta*)					light	light		light	medium	medium	medium	medium
Malawi	Groundnut (*Arachis hypogea*)			light	medium	dark	medium						
	Pigeon pea (*Cajanus cajan*)					light	light	medium	light	light			
	Sorghum (*Sorghum bicolor*)			light	light	medium	medium	medium					
	Sweet potato (*Ipomea batatas*)			medium	medium	medium							
Mozambique	Groundnut (*Arachis hypogea*)		light	light	medium	light							
	Pearl & finger millet *(Cenchrus americanus / Pennisetum glaucum & Eleusine coracana)*	light	light										
	Sesame (*Sesamum indicum*)			light	light								
	Sorghum (*Sorghum bicolor*)			medium	medium	medium	medium						
	Teff (*Eragrostis tef*)	light	light									light	light
Zambia	Amaranth (*Amaranthus spp.*)	medium	medium	medium		medium	medium						medium
	Cowpea (*Vigna unguiculata*)			dark	dark	dark	dark						
	Groundnut (*Arachis hypogea*)			dark									
	Okra (*Abelmoschus spp. (Esculentus / caillei)*)			medium	medium	medium	medium	medium	medium	medium	medium	medium	medium
	Pearl & finger millet					light	medium	medium					
	Pigeon pea (*Cajanus cajan*)			medium	medium	medium					light	light	
	Sesame (*Sesamum indicum*)			medium	medium	medium							
	Sorghum (*Sorghum bicolor*)				light	medium	medium	light					
	Sweet potato (*Ipomea batatas*)		medium	medium	medium								
Zimbabwe	Cocoyam (*Xanthosoma sagittifolium*)			medium	medium	medium	medium	medium	medium				
	Cowpea (*Vigna unguiculata*)	medium	medium	medium	medium								
	Groundnut (*Arachis hypogea*)	light	medium	medium	medium	light	light						
	Okra (*Abelmoschus spp. (Esculentus / caillei)*)	dark	dark	dark									dark
	Pearl & finger millet				medium	medium	light						
	Sorghum (*Sorghum bicolor*)	light	light	medium	medium	medium	medium						

Qualitative representation of production intensity. Darker shades represent the primary harvest period(s), or month(s) in which the crop is grown in more regions of the country.



Qualitative representation of production intensity. Darker shades represent the primary harvest period(s), or month(s) in which the crop is grown in more regions of the country.

* Only regional data available (West Africa)

Table A3.2: Data sources for the geographic distribution and harvest months of opportunity crops in countries with serious or alarming levels of hunger according to the Global Hunger Index

Country	Sorghum	Pearl millet	Finger millet	Fonio	Teff	Sesame	Groundnut	Bambara bean	Cowpea	Mung bean	Pigeon pea	Grasspea	Lablab	Sweet potato	Yam	Taro	Cocoyam	African eggplant	Okra	Amaranth
Tropical West Africa, India & North Korea																				
Benin	32, 97	32, 97		16		33, 2	97	27	10	14	76		92	33	32	33, 2	2	5	33	99
Burkina Faso	32, 97	32, 97	92	16		56, 95	97, 67	33, 37	33, 37	61	76			33	58	40	25	71, 3	67	87
Côte d'Ivoire	29, 97	32, 97		16		33	29, 97	27	29	101	76		8	33	29, 32	33	73	3, 99	29	99
Guinea	29, 97	32, 97		17	29	29	29, 97	29	29	92	76			33	29, 32	33	92	92	29	92
Guinea-Bissau	29, 97	32, 97	92	16		19	29	92	29		76			29	41	92	92	18	29	18
Liberia	29					92	29		29	29	76			29	29, 33	33	29	44	29	92
Nigeria	32, 97	32, 97	32, 97	16		24	97	27	33	21	86		8, 68	33	32	33	73	3	33	99, 60
Sierra Leone	32, 97	32, 97	92	16		33	29	55	29	92	50		8	29	32	33	15	84	29	99
India	32, 97	32, 97	32, 97		34	89	32, 97	27	43	21	33	23	8, 68	33	57	73	73	3	33	60
North Korea	29, 32	29, 32				29	29			29				29						92

Production & harvest season data available

Evidence that the crop occurs in the country (wild, naturalized, or cultivated)

(1) Abrar et al., 2024, (2) Achigan-Dako et al., 2010, (3) Adeniji et al., 2012, (4) AFC, 2020, (5) Aguessy et al., 2021, (6) Alain et al., 2024, (7) Al-Fatimi, 2021, (8) Al-Snafi, 2017, (9) Amarteifio & Moholo, 1998, (10) Anago et al., 2021, (11) Animasaun et al., 2023, (12) Ates, 2018, (13) BAMB, 2025, (14) Bankole et al., 2023, (15) Beah et al., 2015, (16) BI, 2018, (17) Burton et al., 2025, (18) Catarino et al., 2016, (19) Catarino et al., 2019, (20) Dembélé et al., 2021, (21) Diatta et al., 2024, (22) Dinssa et al., 2019, (23) Dixit et al., 2016, (24) Doko, 2014, (25) Donatien et al., 2017, (26) Dossa et al., 2017, (27) El Bilali et al., 2024, (28) FAO & WFP, 2001, (29) FAO, n.d.-a, (30) FAO, n.d.-b, (31) FAO, 2025a (FAO.org), (32) FAO, 2025b (GIEWS), (33) FAO, 2025c (FAOSTAT), (34) Forbes India, 2025, (35) Godinho et al., 2023, (36) Gorgon et al., 2021, (37) Gorman et al., 2025, (38) Govt of Afghanistan, 2024, (39) Govt of Angola, 2018, (40) Govt of Burkina Faso, 2013, (41) Govt of Guinea-Bissau, 2015, (42) Govt of Haiti, 2010, (43) Govt of India, 2024, (44) Govt of Liberia, 2024, (45) Govt of Madagascar, 2015, (46) Govt of Malawi, 2015, (47) Govt of Mozambique, 2022, (48) Govt of Niger, 2020, (49) Govt of Rwanda, 2018, (50) Govt of Sierra Leone, 2023, (51) Govt of South Sudan, 2012, (52) Govt of South Sudan, 2018, (53) Govt of Sudan, 2015, (54) Govt of Zambia, 2023, (55) Greenhalgh, 2000, (56) Groupe Olvea, 2020, (57) Guchhait et al., 2022, (58) Heller et al., 2022, (59) Hughes et al., 2008, (60) Jamalluddin et al., 2022, (61) Kabre et al., 2022, (62) Kajuna, 2001, (63) Kalumbu et al., 2015, (64) Kostandini et al., 2021, (65) Larbi et al., 2008, (66) Leyo et al., 2022, (67) Lourme-Ruiz et al., 2022, (68) Maass et al., 2010, (69) Madisa et al., 2015, (70) Magwé-Tindo et al., 2016, (71) Maundu et al., 2009, (72) Maurin et al., 2016, (73) Mbugua & Shimelis, 2023, (74) McCulloch et al., 2025, (75) Muimba-Kankolongo, 2018, (76) Mula & Saxena, 2010, (77) Munimbazi & Bullerman, 1996, (78) Mweta et al., 2010, (79) NAB, 2021, (80) NARO, 2025, (81) Nguie et al., 2022, (82) NRC, 2006, (83) Oballim et al., 2023, (84) Oboh et al., 2005, (85) Olubayo & Port, 1997, (86) Olufelo et al., 2023, (87) Ouedraogo et al., 2024, (88) Quartermain et al., 2015, (89) Ranganatha, 2013, (90) Ribeiro et al., 2017, (91) Robinson, 2004, (92) Royal Botanic Gardens Kew, n.d., (93) Shackleton et al., 2009, (94) Sharma et al., 1993, (95) Somda, 2022, (96) Touckia et al., 2021, (97) USDA, n.d., (98) Uwiringiyimana et al., 2024, (99) Vandebroek et al., 2019, (100) WFP, 2024, (101) Yao et al., 2020, (102) Yegrem et al., 2024

Country	Sorghum	Pearl millet	Finger millet	Fonio	Teff	Sesame	Groundnut	Bambara bean	Cowpea	Mung bean	Pigeon pea	Grasspea	Lablab	Sweet potato	Yam	Taro	Cocoyam	African eggplant	Okra	Amaranth
Arid Africa & West Asia																				
Botswana	32 97	32 97	32 97		92	79	33	27 9	13	9	76		8	33	75	74			69	92
Chad	29 97	32 97	32 97	16		29	29 97	29	29	92	92		8	29	29	29		3	29	92
Djibouti	29	80			92	29	29		29		92			29	70				29	92
Mali	29 97	32 97	92	29		26	97	33 37	33 37	92	76		68	33 20	33 20	20		20	20	20
Mauritania	29 97	32 97			92	92	29		29					29	33			3	29	92
Niger	29 97	32 97	92	16		29	29 97	33 27	29 32	92	76		8	29	48			92	29	66
Sudan	29 97	32 97	32 97		92	29	29 97	53	29	92	29	102	53	29	33	92		92	29	22 60
Pakistan	29 97	32 97	92			29	97	27	29	29	33	102	92	33					29	1 60
Yemen	32 97	33	92		92	33	33		33	92	92	92	68	33					33	7
Somalia	29 97	62	62		92	29	29		29	29	76		92	29	70			92		92
Afghanistan	12	12	92			33 12	12		65	12	12	102			38				94	60
Syria	33	33				30	30		33			102	92						30	92

Production & harvest season data available

Evidence that the crop occurs in the country (wild, naturalized, or cultivated)

(1) Abrar et al., 2024, (2) Achigan-Dako et al., 2010, (3) Adeniji et al., 2012, (4) AFC, 2020, (5) Aguessy et al., 2021, (6) Alain et al., 2024, (7) Al-Fatimi, 2021, (8) Al-Snafi, 2017, (9) Amarteifio & Moholo, 1998, (10) Anago et al., 2021, (11) Animasaun et al., 2023, (12) Ates, 2018, (13) BAMB, 2025, (14) Bankole et al., 2023, (15) Beah et al., 2015, (16) BI, 2018, (17) Burton et al., 2025, (18) Catarino et al., 2016, (19) Catarino et al., 2019, (20) Dembélé et al., 2021, (21) Diatta et al., 2024, (22) Dinssa et al., 2019, (23) Dixit et al., 2016, (24) Doko, 2014, (25) Donatien et al., 2017, (26) Dossa et al., 2017, (27) El Bilali et al., 2024, (28) FAO & WFP, 2001, (29) FAO, n.d.-a, (30) FAO, n.d.-b, (31) FAO, 2025a (FAO.org), (32) FAO, 2025b (GIEWS), (33) FAO, 2025c (FAOSTAT), (34) Forbes India, 2025, (35) Godinho et al., 2023, (36) Gorgon et al., 2021, (37) Gorman et al., 2025, (38) Govt of Afghanistan, 2024, (39) Govt of Angola, 2018, (40) Govt of Burkina Faso, 2013, (41) Govt of Guinea-Bissau, 2015, (42) Govt of Haiti, 2010, (43) Govt of India, 2024, (44) Govt of Liberia, 2024, (45) Govt of Madagascar, 2015, (46) Govt of Malawi, 2015, (47) Govt of Mozambique, 2022, (48) Govt of Niger, 2020, (49) Govt of Rwanda, 2018, (50) Govt of Sierra Leone, 2023, (51) Govt of South Sudan, 2012, (52) Govt of South Sudan, 2018, (53) Govt of Sudan, 2015, (54) Govt of Zambia, 2023, (55) Greenhalgh, 2000, (56) Groupe Olvea, 2020, (57) Guchhait et al., 2022, (58) Heller et al., 2022, (59) Hughes et al., 2008, (60) Jamalluddin et al., 2022, (61) Kabre et al., 2022, (62) Kajuna, 2001, (63) Kalumbu et al., 2015, (64) Kostandini et al., 2021, (65) Larbi et al., 2008, (66) Leyo et al., 2022, (67) Lourme-Ruiz et al., 2022, (68) Maass et al., 2010, (69) Madisa et al., 2015, (70) Magwé-Tindo et al., 2016, (71) Maundu et al., 2009, (72) Maurin et al., 2016, (73) Mbugua & Shimelis, 2023, (74) McCulloch et al., 2025, (75) Muimba-Kankolongo, 2018, (76) Mula & Saxena, 2010, (77) Munimbazi & Bullerman, 1996, (78) Mweta et al., 2010, (79) NAB, 2021, (80) NARO, 2025, (81) Nguie et al., 2022, (82) NRC, 2006, (83) Oballim et al., 2023, (84) Oboh et al., 2005, (85) Olubayo & Port, 1997, (86) Olufelo et al., 2023, (87) Ouedraogo et al., 2024, (88) Quartermain et al., 2015, (89) Ranganatha, 2013, (90) Ribeiro et al., 2017, (91) Robinson, 2004, (92) Royal Botanic Gardens Kew, n.d., (93) Shackleton et al., 2009, (94) Sharma et al., 1993, (95) Somda, 2022, (96) Touckia et al., 2021, (97) USDA, n.d., (98) Uwiringiyimana et al., 2024, (99) Vandebroek et al., 2019, (100) WFP, 2024, (101) Yao et al., 2020, (102) Yegrem et al., 2024

Country	Sorghum	Pearl millet	Finger millet	Fonio	Teff	Sesame	Groundnut	Bambara bean	Cowpea	Mung bean	Pigeon pea	Grasspea	Lablab	Sweet potato	Yam	Taro	Cocoyam	African eggplant	Okra	Amaranth
Central African grasslands																				
Central African Republic	32, 97	32, 92	92			33	97	92	6		92		92	96	33	33, 36	36	92	100	92
Ethiopia	29, 97	32, 92	32, 97	4	29, 32	29	29	27	99	21	76	29	8, 68	29	33	33	73	84	99	60
South Sudan	32, 97	32, 92	32, 97	4	92	33	33	52	33	52	51		92	33	33	91	91	91	33	91
Equatorial Africa & Haiti																				
Dem. Rep. of the Congo	32, 97	32, 92	32, 97			33	97	33, 27	33, 37	92	33		92	33	33	33, 37	73	71	63	37
Republic of Congo	92	33				33	33		92	92	76			33	33	92	81	3	33	92
Uganda	29, 97	32, 92	32, 97		92	29	29, 97	83	29	29	29		8	29, 32	29	29	29	71, 3	29	22
Tanzania	29, 97	32, 92	32, 97		92	29	29, 97	37	29	37	29	92	8, 68	29	33, 37	37	73	29	29	99, 22
Burundi	29, 97		62, 97			92	29		37	77	33			29	29	29	73	3	29	29
Rwanda	32, 97	33	62			92	33		92		76		8	33	49	33	73	3	98	22
Kenya	29, 97	32, 92	32, 97		31	29	29	27	85	37	29	92	29	29	33, 37	73	73	71	33	37
Angola	28, 32	32, 92	92	39		33	28	27	28	92	76	92	8	28	72			82	99	99
Haiti	32, 97	92		92		33	64		33, 99		33	92	92	33	33	42	92		99	99

Production & harvest season data available

Evidence that the crop occurs in the country (wild, naturalized, or cultivated)

(1) Abrar et al., 2024, (2) Achigan-Dako et al., 2010, (3) Adeniji et al., 2012, (4) AFC, 2020, (5) Aguessy et al., 2021, (6) Alain et al., 2024, (7) Al-Fatimi, 2021, (8) Al-Snafi, 2017, (9) Amarteifio & Moholo, 1998, (10) Anago et al., 2021, (11) Animasaun et al., 2023, (12) Ates, 2018, (13) BAMB, 2025, (14) Bankole et al., 2023, (15) Beah et al., 2015, (16) BI, 2018, (17) Burton et al., 2025, (18) Catarino et al., 2016, (19) Catarino et al., 2019, (20) Dembélé et al., 2021, (21) Diatta et al., 2024, (22) Dinssa et al., 2019, (23) Dixit et al., 2016, (24) Doko, 2014, (25) Donatien et al., 2017, (26) Dossa et al., 2017, (27) El Bilali et al., 2024, (28) FAO & WFP, 2001, (29) FAO, n.d.-a, (30) FAO, n.d.-b, (31) FAO, 2025a (FAO.org), (32) FAO, 2025b (GIEWS), (33) FAO, 2025c (FAOSTAT), (34) Forbes India, 2025, (35) Godinho et al., 2023, (36) Gorgon et al., 2021, (37) Gorman et al., 2025, (38) Govt of Afghanistan, 2024, (39) Govt of Angola, 2018, (40) Govt of Burkina Faso, 2013, (41) Govt of Guinea-Bissau, 2015, (42) Govt of Haiti, 2010, (43) Govt of India, 2024, (44) Govt of Liberia, 2024, (45) Govt of Madagascar, 2015, (46) Govt of Malawi, 2015, (47) Govt of Mozambique, 2022, (48) Govt of Niger, 2020, (49) Govt of Rwanda, 2018, (50) Govt of Sierra Leone, 2023, (51) Govt of South Sudan, 2012, (52) Govt of South Sudan, 2018, (53) Govt of Sudan, 2015, (54) Govt of Zambia, 2023, (55) Greenhalgh, 2000, (56) Groupe Olvea, 2020, (57) Guchhait et al., 2022, (58) Heller et al., 2022, (59) Hughes et al., 2008, (60) Jamalluddin et al., 2022, (61) Kabre et al., 2022, (62) Kajuna, 2001, (63) Kalumbu et al., 2015, (64) Kostandini et al., 2021, (65) Larbi et al., 2008, (66) Leyo et al., 2022, (67) Lourme-Ruiz et al., 2022, (68) Maass et al., 2010, (69) Madisa et al., 2015, (70) Magwé-Tindo et al., 2016, (71) Maundu et al., 2009, (72) Maurin et al., 2016, (73) Mbugua & Shimelis, 2023, (74) McCulloch et al., 2025, (75) Muimba-Kankolongo, 2018, (76) Mula & Saxena, 2010, (77) Munimbazi & Bullerman, 1996, (78) Mweta et al., 2010, (79) NAB, 2021, (80) NARO, 2025, (81) Nguie et al., 2022, (82) NRC, 2006, (83) Oballim et al., 2023, (84) Oboh et al., 2005, (85) Olubayo & Port, 1997, (86) Olufelo et al., 2023, (87) Ouedraogo et al., 2024, (88) Quartermain et al., 2015, (89) Ranganatha, 2013, (90) Ribeiro et al., 2017, (91) Robinson, 2004, (92) Royal Botanic Gardens Kew, n.d., (93) Shackleton et al., 2009, (94) Sharma et al., 1993, (95) Somda, 2022, (96) Touckia et al., 2021, (97) USDA, n.d., (98) Uwiringiyimana et al., 2024, (99) Vandebroek et al., 2019, (100) WFP, 2024, (101) Yao et al., 2020, (102) Yegrem et al., 2024

Country	Sorghum	Pearl millet	Finger millet	Fonio	Teff	Sesame	Groundnut	Bambara bean	Cowpea	Mung bean	Pigeon pea	Grasspea	Lablab	Sweet potato	Yam	Taro	Cocoyam	African eggplant	Okra	Amaranth
Southeastern Africa & Timor-Leste																				
Madagascar	29, 31	62	62		92	92	29	29	33	21	76		8	29	45	29		3		22, 60
Malawi	29, 31	33	62		92	33	29, 97	46, 27	33	46	29		8, 68	29	46	78	73	92	33	46
Mozambique	31, 97	97	62, 97		29	29	29, 97	27	33	21	47		8	33	72	74		82	93	90
Zambia	29, 97	32, 97	32, 97		92	29	29, 97	33, 27	29	92	29		8	29	72	92		54	29	29
Zimbabwe	29, 31	29, 97	29		92	33	97	33	29	92	76		8	33	72	74	29	84	29	99
Timor-Leste	29	35					29		35	29	35			29	29	29				
Papua New Guinea																				
Papua New Guinea	33						59		92	21	76		68	29	29	29				88, 60

Production & harvest season data available

Evidence that the crop occurs in the country (wild, naturalized, or cultivated)

(1) Abrar et al., 2024, (2) Achigan-Dako et al., 2010, (3) Adeniji et al., 2012, (4) AFC, 2020, (5) Aguessy et al., 2021, (6) Alain et al., 2024, (7) Al-Fatimi, 2021, (8) Al-Snafi, 2017, (9) Amarteifio & Moholo, 1998, (10) Anago et al., 2021, (11) Animasaun et al., 2023, (12) Ates, 2018, (13) BAMB, 2025, (14) Bankole et al., 2023, (15) Beah et al., 2015, (16) BI, 2018, (17) Burton et al., 2025, (18) Catarino et al., 2016, (19) Catarino et al., 2019, (20) Dembélé et al., 2021, (21) Diatta et al., 2024, (22) Dinssa et al., 2019, (23) Dixit et al., 2016, (24) Doko, 2014, (25) Donatien et al., 2017, (26) Dossa et al., 2017, (27) El Bilali et al., 2024, (28) FAO & WFP, 2001, (29) FAO, n.d.-a, (30) FAO, n.d.-b, (31) FAO, 2025a (FAO.org), (32) FAO, 2025b (GIEWS), (33) FAO, 2025c (FAOSTAT), (34) Forbes India, 2025, (35) Godinho et al., 2023, (36) Gorgon et al., 2021, (37) Gorman et al., 2025, (38) Govt of Afghanistan, 2024, (39) Govt of Angola, 2018, (40) Govt of Burkina Faso, 2013, (41) Govt of Guinea-Bissau, 2015, (42) Govt of Haiti, 2010, (43) Govt of India, 2024, (44) Govt of Liberia, 2024, (45) Govt of Madagascar, 2015, (46) Govt of Malawi, 2015, (47) Govt of Mozambique, 2022, (48) Govt of Niger, 2020, (49) Govt of Rwanda, 2018, (50) Govt of Sierra Leone, 2023, (51) Govt of South Sudan, 2012, (52) Govt of South Sudan, 2018, (53) Govt of Sudan, 2015, (54) Govt of Zambia, 2023, (55) Greenhalgh, 2000, (56) Groupe Olvea, 2020, (57) Guchhait et al., 2022, (58) Heller et al., 2022, (59) Hughes et al., 2008, (60) Jamalluddin et al., 2022, (61) Kabre et al., 2022, (62) Kajuna, 2001, (63) Kalumbu et al., 2015, (64) Kostandini et al., 2021, (65) Larbi et al., 2008, (66) Leyo et al., 2022, (67) Lourme-Ruiz et al., 2022, (68) Maass et al., 2010, (69) Madisa et al., 2015, (70) Magwé-Tindo et al., 2016, (71) Maundu et al., 2009, (72) Maurin et al., 2016, (73) Mbugua & Shimelis, 2023, (74) McCulloch et al., 2025, (75) Muimba-Kankolongo, 2018, (76) Mula & Saxena, 2010, (77) Munimbazi & Bullerman, 1996, (78) Mweta et al., 2010, (79) NAB, 2021, (80) NARO, 2025, (81) Nguie et al., 2022, (82) NRC, 2006, (83) Oballim et al., 2023, (84) Oboh et al., 2005, (85) Olubayo & Port, 1997, (86) Olufelo et al., 2023, (87) Ouedraogo et al., 2024, (88) Quartermain et al., 2015, (89) Ranganatha, 2013, (90) Ribeiro et al., 2017, (91) Robinson, 2004, (92) Royal Botanic Gardens Kew, n.d., (93) Shackleton et al., 2009, (94) Sharma et al., 1993, (95) Somda, 2022, (96) Touckia et al., 2021, (97) USDA, n.d., (98) Uwiringiyimana et al., 2024, (99) Vandebroek et al., 2019, (100) WFP, 2024, (101) Yao et al., 2020, (102) Yegrem et al., 2024

ANNEX 4. ANALYSIS OF OPPORTUNITY CROP PROMOTION IN NATIONAL POLICIES AND ACTION PLANS

A4.1 National nutrition policies

One of the high-impact interventions described in Burundi's nutrition policy (2019), which had previously been initiated and implemented, involved the introduction of millet and other new export crops to diversify income sources. The government had also introduced new nutrient-dense foods, such as edible mushrooms, orange-fleshed sweet potatoes, beans, and other bio-fortified crops, and promoted the consumption of diverse foods, including maize, beans, peas, bananas, and sweet potatoes to address key inadequate nutrient intakes among vulnerable populations.

Madagascar's 2022–2026 multi-sectoral nutrition policy stated that traditional agriculture remained dominant, relying on non-mechanized labor and an extensive list of foods, including sweet potatoes and beans (Government of Madagascar, 2022). However, it also acknowledged that further production diversification was needed, which could be accomplished through staple food fortification; biofortification; increased production of legumes, fruits, and vegetables; and animal husbandry. Although some export-oriented sectors had begun to develop in Madagascar (e.g., sweet potatoes, fruits and vegetables), the country aimed to continue increasing agricultural productivity by 35%, especially that of fruits and vegetables, legumes, and cow's milk.

Niger's nutrition policy (2017) aimed to improve the value chains for products with high nutritional and commercial potential, including crops such as legumes, fruits, and vegetables. The Government of Niger had also published a multi-sectoral policy (2021) regarding their Nigeriens Nourish Nigeriens (3N) Initiative, which noted that cereals (millet, sorghum, rice, maize, and fonio) comprised nearly 90% of the diet; however, groundnuts, cowpeas, and sesame were also widely produced. The multi-sectorial nutrition and agriculture policy aimed to increase the production of rain-fed cereals and cash crops, especially through enhancing the value chains for millet, sorghum, and cowpeas, among others.

The Afghani government aimed to increase the production of cereals, legumes, and oil seeds (Government of Afghanistan, 2019). This included wheat, rice, and maize, but also specified peas, beans, and sesame. Importantly, their policy acknowledged the importance of protecting, conserving, and promoting wild and indigenous species for ensuring adequate micronutrient intake, especially during the hunger season. The Syrian food security plan (2010) also sought to improve agricultural efficiency through research on high-yielding varieties of sorghum and novel soil management techniques. The policy noted that zero tillage had been effective in increasing sorghum yields in major production areas.

Zimbabwe's national nutrition policy (2023) included two goals related to opportunity crops. The first was to become self-sufficient in cereals and legumes at the national level by 2025. In particular, the government promoted the production and consumption of sorghum, millet and cowpeas. The second goal was to increase production and consumption of micronutrient-dense foods, including traditional and biofortified crops, especially biofortified beans, iron- and protein-rich millet, and orange-fleshed sweet potatoes. Similarly, the national nutrition policies from Ethiopia (2021), Rwanda (2013), Uganda (2020), and Zambia (2011) promoted research, household access, and/or consumption of biofortified foods, especially beans and sweet potatoes. Promotion of these foods was primarily targeted at vulnerable groups (i.e., children, adolescent girls, and women of reproductive age).

Four African countries mentioned opportunity crops in the context of food security. One of Guinea-Bissau's nutrition-specific objectives (2015–2019) was to increase household food security by 30%, in part through the promotion of micronutrient-dense food production (Government of Guinea-Bissau, 2015). The government planned to support the production of fruits, vegetables, legumes, roots, and tubers through household and community gardens, specifically noting okra, cassava leaves, sweet potato (including the leaves), eggplant, peanuts, beans, and yams. Mozambique aimed to strengthen the management of and investment in the Strategic Food Reserve to bolster food availability throughout the year (Government of Mozambique, 2024). Specifically, the Mozambican government planned to increase budgetary support for essential foods, including corn, rice, pulses, tubers, and animal source foods.

One of the priority interventions outlined in Chad's nutrition policy (2022) specified the provision of technical support to promote the production of nutritious fruits, vegetables, tubers, cereals, and legumes to improve the consumption of diversified foods at the household level. Similarly, Haiti aimed to promote and educate consumers on the nutritional value of local products (e.g., tubers, maize, sorghum, plantains, vegetables, and leaves) to counteract the negative externalities of trade liberalization in the preceding decades (Government of Haiti, 2018). The Haitian nutrition policy also promoted the consumption of traditional foodstuffs – specifically maize, sorghum, and tubers – in place of rice.

Benin's 2023–2033 nutrition policy (2023) noted that agricultural yields had decreased due to climate change, but at the national level, food balance data across several agricultural seasons showed surpluses for maize, yam, and cassava. In contrast, Angola's 2025–2034 nutrition policy stated that yields of several opportunity crops (i.e., millet, sorghum, beans, groundnuts, and sweet potatoes) had increased slightly from the 2021 growing season to the 2022 season, but that production deficits remained for cereals, legumes, oilseeds, and tubers (Government of Angola, 2025). Djibouti's nutrition policy (2012) did not necessarily promote the production or consumption of opportunity crops, given that the country imports most of its food; however, it recognized that low diversification of cultivated crops in Ethiopia and Sudan (i.e., monocropping of wheat, sorghum, and sunflower) pose a risk to domestic nutrition security.

A4.2 National agriculture policies

The Angolan agriculture development plan (2013) described several goals from the 2008–2012 development plan which aimed to improve food security and the socioeconomic development of rural communities. The government sought to achieve food self-sufficiency through increased legume, root, and tuber production (i.e., beans, groundnuts, and sweet potatoes), and although they succeeded in increasing production – in addition to improving food availability and generating jobs – the target output was not met. Therefore, the 2013 plan aimed to continue increasing production and achieve food self-sufficiency through expansion of research activities and the establishment of two national research centers – one focused on corn and beans, the other focused on cassava, sweet potato, and groundnuts. The development plan also included an objective to promote the production of food products, including beans, sorghum, millet, and groundnuts, for food security as well as commercial products, including fruits and vegetables, for income. Finally, the development plan noted that millet and sorghum production had increased and remained dominant in some regions of the country, but that cassava and sweet potato production were increasing in those areas because of their ability to grow well in poor soils and the increasing variability of cereal production.

The 2018–2025 Guinea national agriculture and food security plan identified several strategic products for growth and development of value chains, including fonio, groundnuts, and vegetables (Government of Guinea, 2018). Although the policy specified that groundnuts were mainly consumed in processed form (oil), it acknowledged that producers were not adequately connected to markets. Furthermore, the government recognized the need to develop fonio, millet, sorghum, and yam production for food and nutrition security. The policy also aimed to improve yield, production, preservation, and storage of eggplant, okra, and groundnuts through support for professional agricultural organizations, public-private partnerships, and infrastructure development.

Most farming households in Liberia were considered subsistence farmers and produced a variety of crops, including legumes (cowpeas, peanuts), vegetables (African eggplant, okra), roots and tubers (sweet potatoes, yam, eddoes (a relative of taro), and fruits (Government of Liberia, 2024). However, opportunities for commercialization and export of these crops remained largely untapped. Furthermore, demand for vegetables was considered high in Liberia, but farmers could not adequately increase their supply in the dry season to meet the demand. Although new technologies and improved seeds had been introduced, the vegetable value chain continued to face challenges ranging from limited inputs and infrastructure to climate change. The 2024–2030 agriculture development plan described a detailed strategy for enhancing productivity of the vegetable value chain and consumption of the resulting crops to support economic growth, poverty reduction, and food security. In particular, the country planned to develop and irrigate farmland for the cultivation of vegetables, including beans and groundnuts.

Nigeria's agricultural policy (2016) included an objective to scale up coverage of biofortified staples, including orange-fleshed sweet potato and iron-rich sorghum, and introduce new biofortified crops, such as iron-rich beans. The policy outlined several interventions and investments the government planned to support to achieve the goal, ranging from compilation of best practices to social mobilization among the public about the benefits of biofortification. The Nigerian policy also planned to disseminate samples of these crops and provide technical assistance to smallholder farmers.

According to South Sudan's agriculture policy (2012), finger millet, sorghum, groundnuts, sesame, cowpeas, pigeon peas, sweet potato, and yams continued to be important crops in the country. Groundnuts were considered a cash crop in some areas, and sesame production had increased in recent years. The framework stated that the country aimed to produce a surplus of sorghum and to design and implement a 'Sorghum Value Chain Development Program'. South Sudan also planned to support farmer organizations, the private sector, and NGOs to produce and distribute improved seeds of staple foods, including sorghum.

Sudan's agriculture, food security and nutrition policy (2015) outlined a short-term project focused on climate change adaptation, which focused on the development of drought- and heat-tolerant millet, sorghum, legumes, groundnut, oil seeds, and sesame to diversify household income sources and increase production value. While not directly nutrition-related, increasing and improving the stability of income have been shown to indirectly improve food and nutrient security (Fraval, et al., 2019).

The Timor-Leste government recognized the importance of dietary diversification, highlighting the need to reduce reliance on rice (Government of Timor-Leste, 2017). Thus, the agriculture policy was generally nutrition-sensitive, aiming to improve the year-round availability of nutrient-dense foods through production diversification, with underutilized indigenous foods/plants, livestock, and fish as priority areas. Strategic interventions included the integration of pulse production (e.g. mung beans) into the national cropping system; promotion of groundnut, millet, and sweet potato production, among other crops; and identification and promotion of resilient, nutrient-dense neglected and underutilized species. Several new and improved crop management technologies and practices had already been implemented and successfully increased production. These included legume intercropping, biodiversity research centers, and market linkages for distribution of vegetables. The policy also stated that it would consider subsidies for low-income populations to increase consumption of legumes and millet.

Although the Haitian agricultural development plan (2010) did not describe strategies to promote or increase production of opportunity crops specifically, it included several overarching objectives and activities that aimed to improve food security and national economic development. The priority development areas ranged from trade promotion to improved processing and marketing of important foods, which included pigeon peas, vegetables, and tubers. Sorghum was highlighted as being particularly important, as it was the third most produced cereal in Haiti, but the government noted that its production was threatened by water scarcity, in addition to weak processing infrastructure and limited marketing. The development plan also noted that tubers (i.e., sweet potatoes, yams, and taro) were also commonly grown in Haiti, although yellow and white tuber varieties were most common.

The Mozambican government highlighted pigeon peas and sesame as important crops in the country (Government of Mozambique, 2022). Exportation of these crops had increased but was somewhat limited by domestic processing capacity. The 2022–2030 national strategic plan aimed to increase production, marketing, and competitiveness of pigeon peas and sesame, in addition to beans and sorghum.

The 2018–2024 Rwandan agricultural strategic plan included a goal to increase productivity, nutritional value, and resilience through sustainable, diversified, and integrated crop, livestock, and fish production systems (Government of Rwanda, 2018). This objective included sorghum, groundnut, sweet potato, yam, and taro yields as indicators to track progress. The plan also specifically noted that sweet potatoes and beans were considered foods for sustainable livelihoods, food security, and nutrition in Rwanda. Sweet potatoes were considered a high performing crop in terms of both revenue and calories per hectare.

Millet, sorghum, groundnuts, cowpeas, pigeon peas, and sweet potatoes were among the 17 major crops grown in Uganda, according to their agricultural adaptation plan (2018). However, the government forecasted economic losses for millet, sorghum, groundnuts, pigeon peas, and sweet potato due to climate change. To combat this, they aimed to strengthen climate information and disaster preparedness to increase agricultural resilience, which involved establishing a six-month national stockpile of maize, rice, sorghum, and millet.

Similarly, Zimbabwe's 2019–2030 agriculture policy stated that millet, sorghum, groundnuts, and legumes were considered cash crops, but production had declined since 1985 due to low productivity and unreliable markets (Government of Zimbabwe, 2019). The policy acknowledged that increasing production of biofortified crops (e.g., OFSP and iron-rich beans) would help diversify the agricultural sector while reducing micronutrient deficiencies.

Although the Mauritanian government expected sorghum and millet yields to increase, the 2015–2025 development plan identified multiple constraints throughout the cereal value chain, including lack of research and production of certified seeds, lack of organization in marketing, insufficient production yields, and inadequate storage capacity (Government of Mauritania, 2015). The plan outlined multiple programs to intensify agricultural production, but the objectives were not particularly oriented towards opportunity crops. Nevertheless, sorghum, millet, cowpea, groundnuts, and sweet potatoes were considered important crops in some areas of the country.

Five countries briefly mentioned support for opportunity crops in their national agriculture plans:

- Niger (2020) aimed to increase production and availability of sorghum, groundnuts, cowpeas, and yams.
- Ethiopia (2017) sought to increase production of bio- and commercially fortified crops (e.g., beans and sweet potatoes) using behavior change communication strategies.
- Papua New Guinea (2024) planned to increase the area under cultivation and yields of taro, yam, sweet potatoes, vegetables, and other staples.
- CAR (2023) aimed to increase production of peanuts and several other crops and animal source foods. It also sought to promote the integration of these products into the market.
- Syria (2010) stated that the government sponsored research on high-yielding varieties of crops, including sorghum.

Somalia's agriculture policy (2016) listed the major crops grown in each state, which included sorghum, millet, groundnut, sesame, cowpea, mung bean, and sweet potato. However, the policy noted that the importation of cereals from the World Food Program and other importers (especially food aid organizations) undercut the local market for these grains. Farmers in Somalia therefore have no incentive to increase production of sorghum or other cereals.

According to the 2024–2030 agriculture plan, Yemen had been self-sufficient in millet and sorghum, but yields had declined in recent years (Government of Yemen, 2024). The productivity of sorghum landraces in Yemen was low due to climate change, poor seed and soil quality, pests, and lack of knowledge in best agricultural practices. The plan also noted that the country grew pulses and high value crops, including sesame, but up to 85% of all locally consumed foods were imported. Because of this, sustainably increasing productivity, value, and commercialization in the agricultural value chains was of critical importance in Yemen; however, the implementation plan did not specify which crops would be prioritized. In contrast, Burundi's agriculture policy (2018) stated that the cultivated area at the household level more than doubled from 2011–2016, and that sweet potatoes, taro, beans, peas, sorghum, and groundnuts were among the most important crops.

The 2022–2026 Zambian agriculture policy only mentioned that it planned to support strategies that would increase production of millet, sorghum, groundnuts, and cowpeas, among other crops (Government of Zambia, 2022). However, the Zambian Ministry of Agriculture had previously developed (in collaboration with the World Bank) a Climate-Smart Agriculture Investment Plan (2019). By 2050, the country aimed to double crop yields and profits, while improving household food and nutrition security. Because of the projected decline in yields of sorghum, millet, groundnuts, and sweet potatoes due to climate change, the policy explored, in great depth, the potential to mitigate losses through climate-smart agriculture (CSA). They identified that reducing post-harvest losses would enable Zambia to reach their goal of doubling net exports of millet by 2050, while crop diversification would enable them to become a net exporter of groundnuts. Not only were groundnuts considered a staple food in Zambia, but the government also recognized that there are opportunities for export that had not yet been exploited. Additionally, the policy acknowledged the need to invest in improved groundnut and cowpea varieties, since yields were significantly lower in Zambia compared to other African countries. They also stated that the country produced pigeon peas for the Indian market, and that demand for pigeon peas was increasing in Zambia. Although CSA practices hold promise for increasing crop yields and profits, the Zambian government recognized that adopting such practices will require them to address financing, input and output markets, and capacity building to achieve their objectives.

A4.3 Biodiversity policies / action plans

In Mali, pearl millet, sorghum, and fonio were listed among the main cereal crops (Government of Mali, 2015). Groundnuts, cowpeas, and bambara beans were considered the main oilseed and protein crops. The 2015–2020 climate change action plan stated that although sorghum and bambara beans are threatened, Malian farmers use several local varieties of bambara bean seeds, which they preserve using a variety of techniques. While sorghum cultivation had declined over the preceding 20 years (in favor of maize cultivation), sorghum prospecting and collection efforts had been implemented and led to the establishment of the Malian sorghum collection. Several varieties and local accessions of groundnuts, cowpeas, and bambara beans had also been stored. Furthermore, research efforts had identified varieties that were drought-tolerant; early, intermediate, and late cycle; and disease- and pest-resistant. Finally, the action plan noted that although fonio had previously been a secondary crop in Mali, it was known to be adaptable to unfavorable ecological conditions.

The 2015–2035 Mozambican action plan stated that the government has invested in developing and disseminating improved varieties of beans and sweet potatoes, among other crops (Government of Mozambique, 2015). While these improved crop varieties help to improve agricultural productivity, the action plan acknowledges their potential detrimental effect on biodiversity. To combat this, the government maintains a Plant Genetic Resources Center which contains samples of sorghum, cowpea, and sweet potato. Cowpeas are particularly important to Mozambique since they are among the three most common crops grown in the country. Furthermore, the action plan referenced Mozambique's participation in the Southern African Development Community (SADC), which is discussed in further detail below.

Several opportunity crops were identified as important food sources in Sudan – namely cowpeas, pigeon peas, lablab, groundnuts, bambara beans, sesame, and okra (Government of Sudan, 2015). Sudanese farmers depend almost entirely on the use and production of local cultivars and landraces for most of these crops. As a result, collections of pearl millet, groundnut, sesame, lablab, cowpea, and okra still show considerable genetic variation. One of the national targets in the 2015–2020 biodiversity action plan was to minimize genetic erosion of cultivated plants, including those of economic and cultural importance (most of which are opportunity crops). Conservation of pearl millet and sorghum were specifically mentioned in the list of actions proposed to achieve the target. Increasing public awareness and preservation of traditional knowledge / practices relevant for conservation and sustainable use of biodiversity were also key targets in Sudan's action plan, although no crops were specifically targeted for promotion.

Although Uganda's 2025–2030 biodiversity action plan stated that traditional crop varieties, wild relatives, and landraces, e.g., millet, bambara nuts, cowpeas, and pigeon peas, have been neglected, the government has made efforts to conserve the genetic material for pearl and finger millets, sorghum, groundnuts, cowpeas, and sweet potato (Government of Uganda, 2025). Significant research has been done to develop improved crops in Uganda using recombinant gene technologies. One of the crops currently in development is a weevil-resistant variety of sweet potato.

Haiti's 2020–2030 action plan listed cereals (including sorghum), bananas, and tuber crops as the main subsistence crops, and beans among the main export crops (Government of Haiti, 2020). However, the action plan noted that many bean, sweet potato, and yam cultivars were threatened by habitat destruction. The government planned to promote "green natural infrastructure" to increase resilience to climate-related water scarcity and extreme weather events. Activities to achieve this goal included using legumes to fix nitrogen, thereby enhancing agricultural soil quality.

The Nigerien action plan (2014) listed millet, sorghum, and fonio among the main food crops, and cowpeas, groundnuts, bambara beans, and sesame among the main cash crops. As of 2007, millet, cowpea, and sorghum comprised 97% of the area planted and the crops produced. However, several factors had negatively affected the cultivation of opportunity crops, e.g., the lack of availability of fonio seeds and labor-intensive requirements. Droughts, lower rainfall totals, and the shortening of the rainy season, were cited as reasons for abandoning local varieties of okra, cowpea, millet, sorghum, and other crops. Groundnuts, cowpeas, sweet potatoes, and sesame were also highlighted as being threatened or having disappeared due to changes in eating habits, pest and disease pressure, the overuse of agricultural inputs, bushfires, and the lack of proper conservation techniques.

Sorghum, yams, and sweet potatoes were among the crops listed as having increased production in the years preceding the development of Benin's action plan (2011). However, the government recognized that prioritizing high-yielding crop varieties, particularly at the expense of nutrient-dense indigenous crops (e.g., yams and millet) was a major threat to biodiversity. Although the action plan stated that the country did not have a strategy in place for minimizing genetic erosion or preserving genetic diversity, it listed several known strategies for improving agricultural biodiversity (e.g., promotion of poly-varietal cultivation, varietal exchanges between farmers, and wild species domestication).

Ethiopia's 2015–2020 biodiversity action plan included a goal to understand the value chain and geographic origin of at least 12 species and products that contribute to agrobiodiversity, including teff and sesame (Government of Ethiopia, 2015). North Korea's action plan (2007) also listed several crops for conservation priority, including a cultivar of groundnut which seems to be specific to a county near the Chinese border. The plan called for the conservation and sustainable use of genetic resources, including foxtail millet and sorghum, which are considered ancestral crops. Somalia's action plan (2015) emphasized cultivation-based agriculture with indigenous crop varieties – specifically sorghum and cowpeas – as vehicle for livelihood improvement.

Among the various threats to plant genetic resources in South Sudan, the 2018–2027 national action plan stated that combatting "genetic erosion" resulting from uniform, high yielding commercialized crops was a top priority for ensuring food security (Government of South Sudan, 2018). The plan mentioned 11 opportunity crops which were cultivated and important in the country: pearl and finger millets, sorghum, groundnuts, bambara nuts, sesame, mung beans, cowpeas, sweet potatoes, yam, and okra. Although sorghum was considered the primary staple crop, only 3.8% of land in South Sudan was used for agriculture. The country imported over 70% of its food from neighboring countries. Despite the need to expand agricultural production and conservation of opportunity crops, genetic characterization of wild or domestic plants was nearly non-existent.

Afghanistan sought to "develop climate-resilient food production systems" and "promote crop and livestock diversity", but did not specify how to do so, or which crops may be beneficial (Government of Afghanistan, 2024). The annex of the 2024–2030 action plan contains a list of protected species in Afghanistan, which primarily focused on animals, but did include one species of yam (Dioscorea deltoidea). Yemen's 2017–2050 action plan recognized the importance of several opportunity crops (i.e., millet, sorghum, and cowpeas) for their genetic, medicinal, and forage values (Government of Yemen, 2017). The plan also acknowledged that conservation of cultivated plant species had been inadequate, and risk assessments of food imports on agrobiodiversity had been insufficient. Pakistan's 2017–2030 national action plan recognized the genetic erosion of sorghum and other crops due to displacement with high-yielding varieties (Government of Pakistan, 2017). But, like Afghanistan, did not incorporate any specific crops into their targets or monitoring indicators. Nevertheless, Pakistan did state their aim to improve "important local varieties, land races, and breeds" by 2020 through "selection for resistance to disease, drought tolerance, and for increased production."

The Guinean biodiversity policy (2011) stated that only 22% of the arable land in the country was utilized for annual crops (i.e., rice, fonio, sorghum, millet, maize, groundnuts, cassava, yams, sweet potatoes, taro, and vegetables). This may have been in part because the soil in some areas was considered highly degraded. While production and consumption of opportunity crops were not specifically promoted, the action plan included a comprehensive 5-goal approach to preserving and enhancing biodiversity. Sorghum, cowpeas, groundnuts, and sesame were among the crops grown in the Sahelian zone of Chad, while millet, okra, and other vegetables were among the main crops grown in the oases (Government of Chad, 2016). The 2016–2025 action plan stated that the government planned to support the development of the main value chains, which included sesame and several other products.

In Madagascar, from 2005 to 2008, groundnut production declined slightly and production of beans and sweet potato increased slightly (Government of Madagascar, 2015). The national action plan acknowledged the importance of agrobiodiversity, particularly the contribution of groundnuts, cowpeas/ beans, and yams to the Malagasy diet and income. The action plan from Guinea-Bissau (2015) listed the main species of crops cultivated in the country, which included sorghum, groundnut, sweet potato, yam, and okra. The Republic of Congo's biodiversity plan (2015) also stated that groundnuts and beans were among the most widely used food crops. Similarly, millet, sorghum, and cowpeas were listed among the most important crops in Mauritania (Government of Mauritania, 2011). The action plan noted that drought and desertification had prevented the country from achieving food security, despite water management practices. They also acknowledged that legumes contribute to the stabilization and fixation of dunes and enriches soil, but did not necessarily describe programs or policies to support their production. Dijbouti's action plan (2017) stated that some crops could be grown in the southeastern portion of the country, including eggplants and okra, but production and distribution faced constraints ranging from variable climate to unreliable workforce and transportation.

Although Zimbabwe's National Biodiversity Strategy and Action Plan (2014) did not explicitly reference or promote opportunity crops, in 2022, the government published a National Strategy and Action Plan for Plant Genetic Resources for Food and Agriculture (2022). The plan acknowledged the importance of landraces and wild relatives of crops (i.e., sorghum, millet, cowpeas, and bambara nut) for their potential contribution to breeding improved cultivars. Research on these crops was in its infancy, but the action plan specifically noted that they would play a key role in ensuring food security in the context of climate change. To this end, Zimbabwe maintains an institution called the Agriculture Research and Innovation Development Directorate (ARID), which is tasked with conserving Plant Genetic Resources for Food and Agriculture through the National Genebank of Zimbabwe and the Crop Breeding Institute (CBI). The CBI develops and maintains field crop varieties, including six opportunity crops (groundnuts, cowpea, bambara nuts, sorghum, pearl millet, and finger millet). ARID also supports a Grasslands Research Institute, which conserves additional varieties of legumes.

A4.4 National climate change policies

The Malian climate change policy (2011) only stated that climate change will negatively impact sorghum, millet, and rice yields, but the country also published a climate investment plan in 2019 which included an extensive discussion of opportunity crops (Government of Mali, 2019). In order of percent land area, millet, sorghum, maize, rice, and groundnuts, were the most important crops for food security in Mali (although rice produced the greatest quantity of kcal per person per day). Sesame was also commonly grown as a cash crop. In addition to the main cereal crops, subsistence farmers cultivated cowpeas, fruit, tubers (e.g., yams), and vegetables (including okra). Although consumed in small quantities, vegetables and legumes were a fundamental source of nutrients, and the government recognized that they would benefit from increased promotion. The policy aimed to increase the productivity and climate-resilience of vegetable production while minimizing environmental degradation. To that end, it was noted that cowpea production, inter-cropping, and cover cropping can improve soil quality and crop productivity, and that millet and sorghum are among the most climate-resilient crops. However, despite being more resilient than maize, climate models predicted that millet may no longer be viable in Mali after 2040. The government aimed to increase the resilience and production of vegetables (including okra), legumes (i.e., cowpeas and groundnuts), sweet potatoes, millet, sorghum, fonio through extension agents, producer associations, technical support, research, and policies to strengthen value chains.

Niger's 2022–2026 climate policy described programs to expand production of innovative, climate-adapted, and high-value crops, including sesame and cowpeas (Government of Niger, 2022). They planned to do this through the development of public-private partnerships and by providing resources for production, marketing, storage/ preservation, processing, and sale of products both domestically and internationally. The policy also outlined a program to disseminate climate-adapted plant material (e.g., cereals, legumes, roots, and tubers) and climate risk management practices, such as crop diversification and intercropping (e.g., legumes and cereals). The most recent policy available from North Korea (2000) identified crop rotation and changing crop varieties as potential solutions to adapt to climate change, i.e., the conversion of low yielding corn fields to sweet potato fields.

In Chad, climate change (including droughts, high temperatures, delayed onset of rainy seasons, and/ or early cessation of rains) had caused crop yields to decrease by -10 to -25%, according to the 2021–2026 national climate change adaptation plan (2021). Millet and sorghum were listed among the affected crops. The country had implemented at least one project, funded by USAID, for strengthening socio-economic resilience for vulnerable groups, and it included the distribution of groundnut and sorghum seeds. The government also aimed to strengthen the sesame and groundnut value chains to achieve food sovereignty and support national economic growth.

Angola's policy (2018) stated that the country aimed to achieve self-sufficiency in basic food products and increase exports. Beans and legumes were considered important crops for achieving these objectives and economic diversification. The government recognized the importance of promoting sustainable agricultural practices to ensure sustainable food security from an environmental and energy standpoint. The Guinean climate change policy (2019) did not necessarily promote the production of opportunity crops; however, it did state that the government provided technical assistance in 2015 following the Ebola outbreak to improve production of the 5 main crops (rice, corn, fonio, cassava, groundnut).

Benin's climate adaptation plan (2022) included climate-related yield projections for groundnuts and cowpeas. The 2030 projections indicated 2.5% and 27% decreases in groundnut and cowpea production, respectively, while 2050 projections showed similar declines for cowpea, alongside yield improvements of approximately 6% for groundnuts. The DRC policy (2022) stated that groundnuts were among the four staples produced in the country. It also acknowledged that yields of cassava and maize – the two most important foods – would be affected by climate change.

Sweet potatoes, mung beans, groundnuts and soybeans, were listed among the staples in Timor-Leste's national climate change policy (2022). The government stated that the agricultural sector was the most likely to be negatively affected by climate change; therefore, it was designated as the primary sector for government expenditure. CAR's adaptation plan (2019) noted that climate change had negatively impacted the production of sorghum, maize, millet, and groundnuts, but that the extent of impact on cassava, maize, and groundnuts was not well understood due to lack of agricultural statistics. Additionally, the plan stated that plantains, tuberous plants, and roots (i.e., cassava, taro, and yams) were at risk of rotting because of increased floods.

The Sudanese and South Sudanese climate change policies also noted that sorghum, which accounted for 70% of cultivated land in South Sudan, was vulnerable to rainfall variability (Government of Sudan, 2021; Government of South Sudan, 2021). The South Sudanese government expected sorghum yields to decline by 5–25% by 2025, although the policy did recognize that sorghum and millet were more resilient to climate change than maize, the second most cultivated crop in the country. In contrast, the Sudanese policy stated that sorghum and millet could no longer be cultivated in some parts of the country. Climate modeling studies expected that trend to continue for sorghum, millet, sesame, and other staples. The Sudanese government outlined several adaptation priorities, which included resilience-building for crop and livestock production via sustainable water management, development of climate-resilient crop varieties (i.e., high yielding and heat-tolerant), and introduction of forage legumes for livestock. Kenya's 2023–2027 climate change policy included an objective to ensure food and nutrition security by increasing agricultural productivity and resilience (Government of Kenya, 2023). They planned to track progress on this objective using the productivity of sorghum and other food crops.

The Papua New Guinean climate change development plan (2015) stated that sweet potato – which the country depended on for food and livelihoods – was sensitive to climate change. Similarly, Côte d'Ivoire conducted an analysis of the strengths and weaknesses of their agricultural sector in the context of climate change and found that yam production was particularly vulnerable (Government of Côte d'Ivoire, 2015).