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# International Food Security Assessment, 2022-32





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# International Food Security Assessment, 2022-32

Yacob Abrehe Zereyesus, Lila Cardell, Constanza Valdes, Kayode Ajewole, Wendy Zeng, Jayson Beckman, Maros Ivanic, Reem Hashad, Jeremy Jelliffe, and Jennifer Kee

## Abstract

Millions of people around the world are food insecure and do not have access to sufficient, safe, and nutritious food that meets their dietary needs for an active and healthy life. Using a demand-driven international food security assessment model, this report helps the U.S. Department of Agriculture and its stakeholders estimate food security trends in 77 low- and middle-income countries. Food security in countries covered in the International Food Security Assessment (IFSA) report is expected to deteriorate in 2022 due to the continued effects of the Coronavirus 2019 pandemic and high food commodity prices that have been intensified by the Russian military invasion of Ukraine. The number of food insecure people in 2022 is estimated at 1.3 billion in the 77 low- and middle-income countries covered by this assessment, an increase of 9.8 percent (118.7 million people) from the 2021 estimate. This increase implies that 32.9 percent of the population of the countries in the assessment may be unable to consume 2,100 kilocalories a day, an average caloric level necessary to sustain a healthy and active lifestyle. However, over the next 10 years, food security is projected to improve in all countries analyzed by this assessment. By 2032, the number of food insecure people in the 77 IFSA countries is projected to be 577.3 million and falling to 12.4 percent of the population (62.5 percent less than in 2022). Given the evolving nature of the conflict in Ukraine and a rapidly changing global macroeconomic environment, the estimation results presented in this report are more representative of a conservative scenario.

**Keywords:** Calories, Coronavirus, COVID-19, Ukraine, food demand, food insecurity, food prices, income, inflation, nutritional threshold, pandemic, Asia, Latin America and the Caribbean, North Africa, Sub-Saharan Africa, U.S. Department of Agriculture, USDA, Economic Research Service, ERS

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## Preface

This report continues the series of Global Food Assessments (GFA) in low- and middle-income countries that began in the late 1970s by the U.S. Department of Agriculture, Economic Research Service (ERS). In 1993, the title of the series was changed to Food Aid Needs Assessment (FANA) to reflect the report's contents more accurately, which assess selected low- and middle-income countries with recent or ongoing food deficits. However, not all countries experiencing significant food deficits are included due to lack of data on key metrics—such as average caloric consumption, prices, or macroeconomic figures. In 1997, ERS widened the analysis beyond the assessment of aggregate food availability to include more dimensions of food security and the title was revised again to Food Security Assessment (FSA). Starting in July 2011, ERS changed the report's name to International Food Security Assessment (IFSA) to clarify the geographic scope of the analysis.

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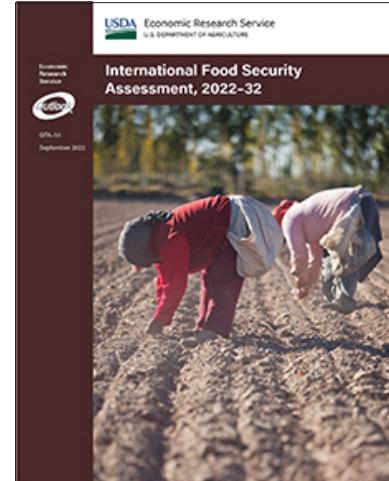
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# International Food Security Assessment, 2022-32

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## What Is the Issue?

Millions of people around the world lack access to sufficient, safe, and nutritious food. Several factors affect the prevalence of food security—including food availability (agricultural production and market conditions), access to food (economic and physical), stability (price and income shocks), and utilization. Personal income, food prices, and economic inequality are major factors determining the ability of people to access food. Widespread food availability, rising income, and low food prices improve a country's food security by increasing access to food. Food security can be worsened by declining income levels, high food prices, or food supply shocks. This report focuses on the availability and access dimensions of food security. Using a demand-driven model that integrates income, food prices, and food supply shocks, the analysis helps USDA and its stakeholders assess food security for 77 countries in Sub-Saharan Africa, North Africa, Latin America and the Caribbean, and Asia. The 2022 report uses macroeconomic and international agricultural commodity price projections completed as of August 2021 to estimate and project the potential impact on present and future food insecurity levels. However, the macroeconomic and international agricultural commodity price estimates were adjusted for the Russian invasion of Ukraine and increases in fertilizer and energy costs beyond expectations as of August 2021. Box “Global Trade Analysis Project (GTAP): A Computable General Equilibrium (CGE) Model” describes those adjustments for the low scenario estimates in this report. The special article covers estimates for medium and high scenarios representing higher impacts of these shocks.



## What Did the Study Find?

The 2022 food insecurity estimates reflect the global and country-level macroeconomic conditions and price shocks observed at the time of estimation. The macroeconomic and international agricultural commodity prices for the 2022 to 2032 period are based on projections completed in August 2021, which account for the economic impact of the pandemic crisis and the rebound in U.S. and global economic growth beginning in 2021.

ERS is a primary source of economic research and analysis from the U.S. Department of Agriculture, providing timely information on economic and policy issues related to agriculture, food, the environment, and rural America.

The main findings for the 77 countries covered by this report are:

- Most of the International Food Security Assessment (IFSA) countries across all four regions—Sub-Saharan Africa, North Africa, Latin America and the Caribbean, and Asia—are estimated to experience positive Gross Domestic Product (GDP) per capita growth in 2022, relative to 2021.
- Food security in IFSA countries is expected to deteriorate in 2022 due to the continued effects of the COVID-19 pandemic and high input and commodity prices that have been intensified by the Russian military invasion of Ukraine.
- The number of food insecure people in 2022 is estimated at 1.3 billion in IFSA countries, an increase of 118.7 million people (9.8 percent) from the 2021 estimate. This estimate reflects an additional 41.7 million people who can be considered food insecure associated with Russia's military invasion of Ukraine and fertilizer and energy price increases. The special article includes impacts on food insecurity for two additional scenarios illustrating the effects of a prolonged or intensified conflict.
- In 2022 results indicate that 32.9 percent of the population of the 77 countries is unable to consume 2,100 kilocalories (kcal) a day, an average caloric level necessary to sustain a healthy and active lifestyle. Food security is projected to improve over the next 10 years. By 2032, the number of food insecure people is projected to be 577.3 million, and falling to 12.4 percent of the population (62.5 percent less than in 2022 ).

## How Was the Study Conducted?

The USDA, ERS demand-oriented International Food Security Assessment (IFSA) model (described in appendix A) projects food demand and food gaps in 77 low- and middle-income countries through 2032. Food security is evaluated for each country by estimating the share of the population unable to reach a caloric threshold of 2,100 kilocalories per person per day. The intensity of food insecurity for those falling below the minimum caloric target is measured by the gap between projected food demand and this caloric threshold. Food demand is expressed in grain equivalents, based on caloric content to allow aggregation across four separate food groups: the primary grain consumed in the country, other grains, roots and tubers, and all other food. Average per capita food consumption data are from the United Nations' Food and Agriculture Organization (FAO) Food Balance Sheets and FAO's Global Information Early Warning System's (GIEWS) Country Cereal Balance Sheet. Observed domestic prices are from FAO-GIEWS Food Price Monitoring and Analysis Tool. Tariff data are from the World Bank's World Integrated Trade Solution. Incomes, exchange rates, and Consumer Price Indexes are from the ERS International Macroeconomic Dataset (USDA, 2021). World prices are from *USDA Agricultural Projections to 2031* (USDA, 2022).

# International Food Security Assessment, 2022–32

## Introduction

The U.S. Department of Agriculture, Economic Research Service (ERS) International Food Security Assessment (IFSA) analysis<sup>1</sup> estimates per capita food demand and compares the estimations against a global nutritional threshold of 2,100 kilocalories<sup>2</sup> (kcal) per person per day. The nutritional threshold set by the United Nations<sup>3</sup> is an average calorie level necessary to sustain a healthy and active lifestyle. The aim of IFSA is to anticipate food security trends for the current year and 10 years out in 77 low- and middle-income countries for USDA and its stakeholders.

The current report incorporates assumptions for key macroeconomic variables (e.g., income growth, inflation, and exchange rates) and populations, as reflected in ERS's International Macroeconomic Data Set and international and domestic food price trends in the short and medium term.<sup>4</sup> Nearly all economies included in the assessment sharply contracted in 2020 due to the COVID-19 pandemic, resulting lockdowns, other control measures impacting business activity,<sup>5</sup> employment, and incomes. In 2022, average GDP levels for IFSA countries surpassed the average for 2019–21, representing the recovery from COVID-19 pandemic effects on the global economy. Despite the anticipated positive income growth for the majority of the 77 countries in the assessment, food insecurity in 2022 is estimated to increase from 2021. The increase reflects two main factors: food price inflation, which is estimated to outpace growth rates of real per capita Gross Domestic Product (GDP), and Russia's military invasion of Ukraine. However, over the next decade, food security status is projected to improve for most countries covered by the assessment. Principal findings for the countries covered by this report are:

- Global GDP per capita is anticipated to rebound in 2022, following the rebound in global economic growth beginning in 2021. For all regions other than Sub-Saharan Africa, per capita income is estimated to be above the 2019–21 levels.

---

<sup>1</sup> The results from the IFSA model are not directly comparable with other analyses, such as FAO's modeling work for its report on the State of Food Insecurity (SOFI), which has a broader country coverage and different methodology. Because IFSA also uses aggregate data, it cannot be compared directly with evaluations using household-level surveys. It is also difficult to extrapolate results to the Food Security Information Network's (FSIN) report on global crises, which uses the 5-phase food insecurity measure—a consensus approach across international organizations and development practitioners directly responding to major crises. For a more in-depth discussion and comparison of USDA's IFSA model with other modeling approaches, see Tandon et al. (2017).

<sup>2</sup> A kilocalorie is the same as 1 calorie. A kilocalorie is the amount of heat required to raise the temperature of 1 kilogram of water 1 degree Celsius.

<sup>3</sup> The 2,100 kcal per capita per day threshold was an internationally agreed upon level set by the United Nations as the recommended level of dietary energy intake for a healthy, well-nourished individual (FAO, 2004).

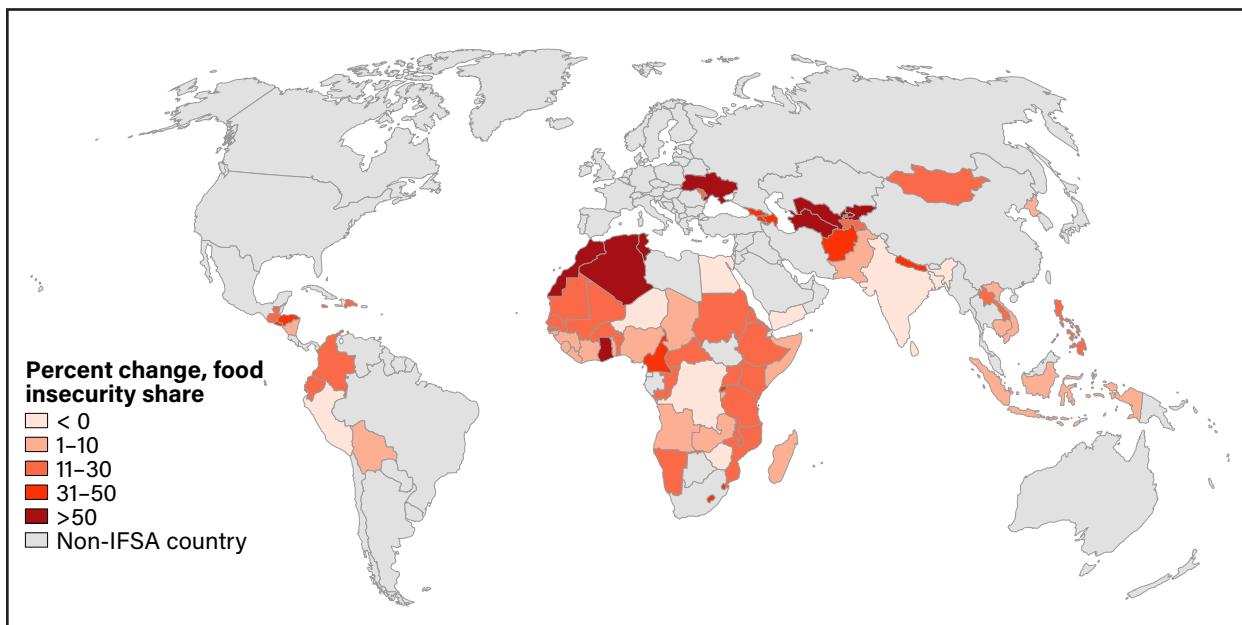
<sup>4</sup> Long-term price projections are taken from the USDA Agricultural Projections to 2031, Long-Term Projections Report OCE-2022-1. These projections are then used to project medium-term domestic price trends using data from the Global Information and Early Warning System (GIEWS) of the United Nations Food and Agriculture Organization.

<sup>5</sup> Some of the control measures that impacted business included but were not limited to curfews, closures of large venues, restrictions on operations of hotels and restaurants, and closures of borders.

- Despite the general improvement in per capita income, the transmission of high international agricultural commodity prices (major grains, vegetable oils, and cassava) in 2022 is associated with further increases in the already high levels of food insecurity in IFSA countries.
- International commodity markets were further impacted by Russia's military invasion of Ukraine because Ukraine is a leading global exporter of wheat, maize, and sunflower oil. The result of the invasion was to further increase global food prices, as exports of cereal grains from the Black Sea Region have been severely restricted.
- For the 77 countries included in IFSA, the prevalence of food insecurity in 2022 is estimated at 32.9 percent. The estimated prevalence of food insecurity in 2022 corresponds to more than 1.3 billion people potentially not having consistent access to the daily caloric threshold of 2,100 kcal.<sup>6</sup>
- The number of food insecure people in 2022 is estimated to be almost 118.7 million higher than 2021—a 9.8-percent increase (figure 1). This includes an additional 41.7 million food insecure people impacted by the Russian military invasion of Ukraine and higher than expected prices for commodity production inputs, mainly fertilizer and energy. The number of food insecure people may be higher under intensified conflict (see special article).
- By 2032, the share of the population that is food insecure is projected at 12.3 percent in the 77 countries included in IFSA, a 62.5-percent drop from the 2022 estimate (figures 2 and 3). The number of people considered food insecure is projected to decline by 56.7 percent from the 2022 estimate to 577.3 million people by 2032.

Figure 1

**With the exception of rice, high prices of food grains and vegetable oils are associated with the deterioration of food security rates in 2022 relative to 2021**



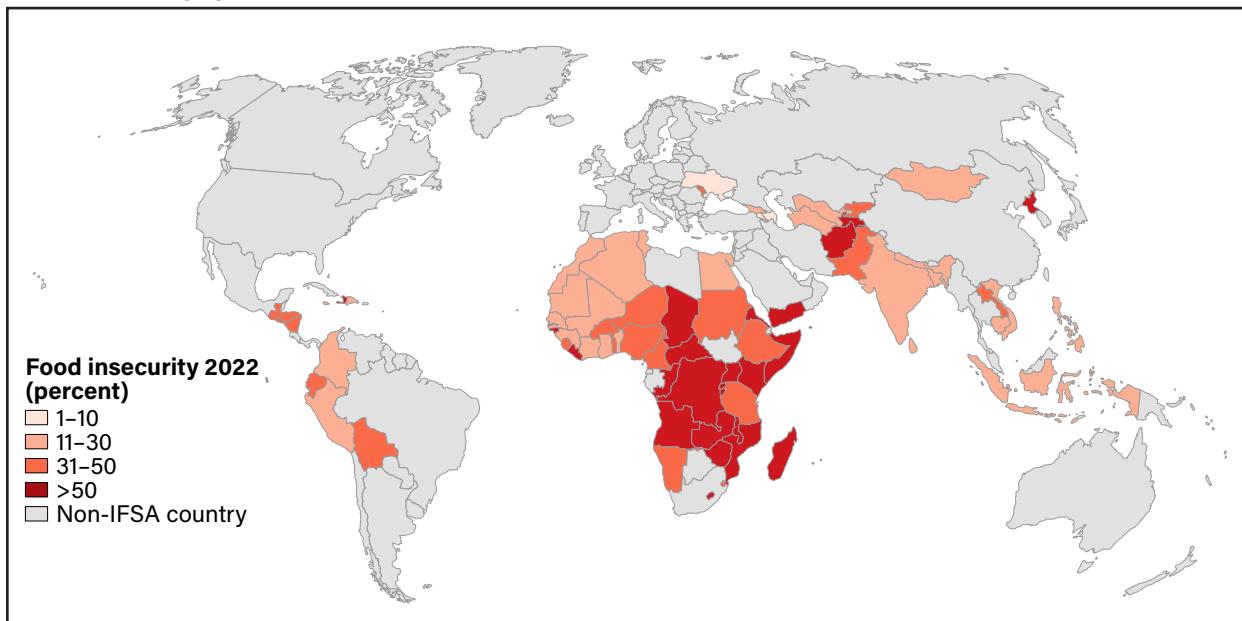
Note: IFSA = International Food Security Assessment.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

<sup>6</sup> The caloric threshold considered in the assessment is an average across men and women, age groups, regions, and activity levels.

- The food gap—defined as the amount of food needed for all food insecure people to reach the caloric threshold of 2,100 kcal/day—indicates the intensity of food insecurity. The gap can be expressed in calories per capita per day or in grain-equivalent quantities. In addition, the food gap is used to measure the annual national food shortfall. For the 77 countries examined—on average—the daily caloric food gap is projected to decline over the next 10 years, from 419 kcal in 2022 to 408 kcal in 2032.
- Per capita income and population growth are projected to lead to a 33.3-percent higher food demand in IFSA countries in the next 10 years. Population growth is responsible for 46.5 percent of this growth (15.7 percentage points), and per capita consumption (demand) is responsible for 46.3 percent of the growth (14.4 percentage points). The remaining 7.2 percent (2.4 percentage points) is due to the interaction between population and per capita consumption.

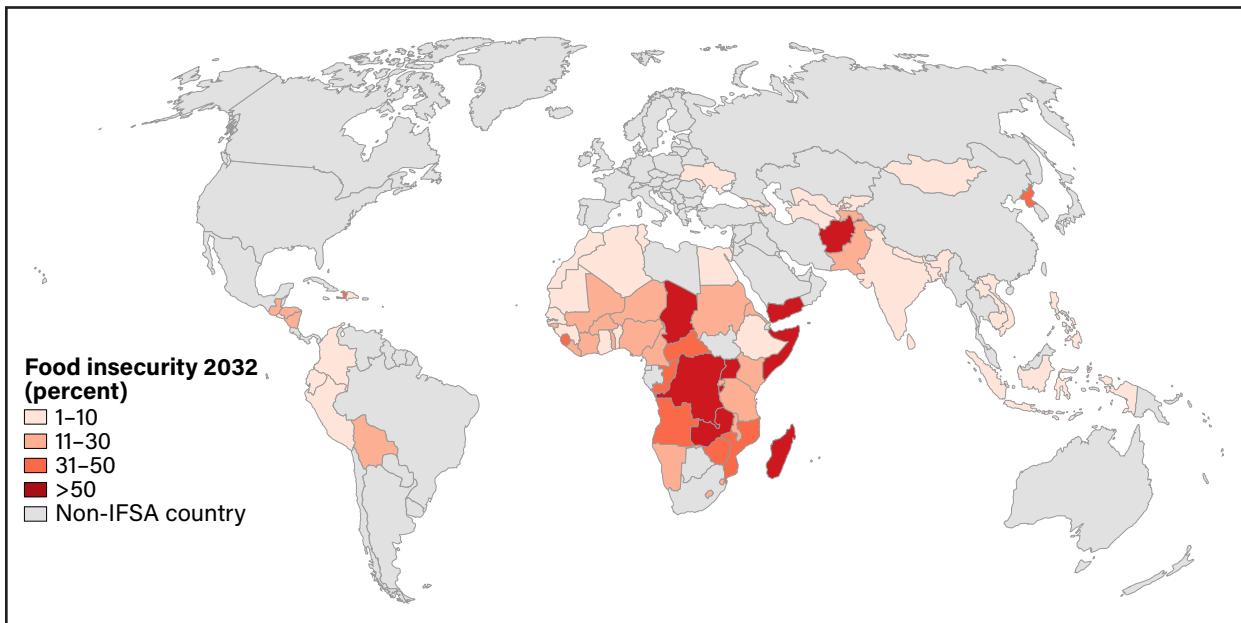
Figure 2  
**Share of IFSA population estimated to be food insecure, 2022**



Note: IFSA = International Food Security Assessment.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

Figure 3  
Share of population estimated to be food insecure, 2032



Note: IFSA = International Food Security Assessment.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

## GDP Expectations in the International Food Security Assessment (IFSA) Countries

The macroeconomic environment of the IFSA countries and trade developments in place (as of August 2021) provide the long-term baseline food demand and supply projections reported in the IFSA assessment. The recent drought in South America, supply chain disruptions and shipping bottlenecks in various countries, and higher energy prices driving up inflation help define the GDP and agricultural commodity price trends used in the IFSA analyses (USDA, 2022; WFP and FAO, 2021). Russia's military invasion of Ukraine and recent input price increases intensified by the invasion modified the short-term food outlook as estimated in August 2021—causing higher global and local food prices and dampening economic growth prospects. The macroeconomic and food price trends for the IFSA were modified for 2022 to account for the effects of the war in Ukraine. However, the growth rates for the remainder of the projection period were left unchanged. To modify GDP and food price trends for 2022 and consider the effects of the conflict in Ukraine, the Global Trade Analysis Project (GTAP), a general equilibrium model, was used (Beckman et al., 2021). The GTAP model allows ERS researchers to consider shifts to trade in response to supply shocks—such as disruptions in Ukrainian and Russian food exports and increasing input prices—that impact agricultural output and provide an estimate of the potential effect on GDP and food prices in 2022. Box, “Global Trade Analysis Project (GTAP): A Computable General Equilibrium (CGE) Model” provides a summary of the modeling assumptions used in the GTAP to account for the effect of the military conflict in Ukraine. The special article in the IFSA provides more detail on the effects of the war in Ukraine, as well as a decomposition of the effects of food price inflation and a sensitivity analysis on the potential effects of the Ukraine war on food insecurity in 2022.

## Global Trade Analysis Project (GTAP): A Computable General Equilibrium (CGE) Model

USDA, Economic Research Service (ERS) applied a CGE model to analyze the implications of Russia's military invasion of Ukraine on food security in low- and middle-income countries covered in the ERS International Food Security Assessment (IFSA). CGE models provide economy-wide and sectoral effects while considering the links and interactions between sectors, competition among these sectors for limited economic resources—and interactions among production, consumption, and trade activities. Researchers used the Global Trade Analysis Project (GTAP) model and database. GTAP is a static model that provides estimates of economic impacts for a one-time shock. A 1-year time horizon is assumed, so all shocks are for 2022, where endowments (land, labor, and capital) are somewhat immobile (land is completely immobile), representing that agricultural producers have limited options in changing production in this time frame. The model has 65 sectors representing the entire economy aggregated into rice, wheat, coarse grains (barley, corn, oats, and sorghum), oilseeds, vegetable oil, processed agriculture, manufacturing, and services. The model has 161 regions aggregated into 75 groups: Canada, the European Union, the United States, developed countries (representing those not already noted), and 71 regions representing those included in the IFSA model. Within GTAP, the following simultaneous shocks are introduced:

- A 2.5 percent yield reduction for low- and middle-income countries (from higher energy and fertilizer prices);
- Export losses for coarse grains, oilseeds, vegetable oils, and wheat from Ukraine (25 percent) and Russia (10 percent);
- Reductions in labor supply in Russia (0.5 –1 percent) and Ukraine (5 –10 percent); and
- Reduction in the price Russia receives for energy exports (representing the sanctions by many importing countries) (10 percent).

Based on these shocks, changes to GDP, food prices, and food security were estimated. The IFSA report is a reflection of these shocks, in addition to the income and price projections as prepared in August 2021. Additional decompositions of these estimated food security results are presented in a special article of this assessment. The article also contains two additional sets of incremental simultaneous shocks applied to the GTAP model.

Gross Domestic Product (GDP)<sup>7</sup> for the IFSA countries<sup>8</sup> is estimated at \$9.2 trillion in 2022 and projected to grow at annual rate of 4.9 percent, reaching 14.8 trillion by 2032. Except for a few countries (e.g., Afghanistan, Nepal, and Central African Republic), most IFSA countries are expected to report positive GDP growth in 2022, relative to 2021, as COVID-19 induced restrictions ease and macroeconomic conditions continue to improve (appendix C).<sup>9</sup> Improvements in the global health situation from COVID-19, stronger demand for goods and services, and the hiring of workers continue to lead to faster economic growth (USDA Baseline, 2022). However, for several low-income countries with significant pre-existing fragilities (e.g., climatic and health risks, and vulnerabilities to conflict and violence), coupled with COVID-19's impact, their historically high debt levels, lower foreign exchange reserves, and diminished fiscal space will likely complicate the economic recovery process and aggravate food insecurity for the foreseeable future (WFP and FAO, 2021; African Development Bank, 2022). GDP in Asia, especially in the Southeast and Central South sub-regions, is projected to grow more than the 5 percent a year for the IFSA countries in the coming 10 years (appendix C).

The total population in the countries included in IFSA is estimated to be more than 4 billion in 2022. Population is projected to grow at an annual rate of 1.4 percent a year over the next 10 years, reaching 4.6 billion by 2032 (appendix C).

At a country level, GDP per capita is estimated to grow in 2022 in more than three quarters of the IFSA countries (except for Afghanistan, Cambodia, Madagascar, and Nepal). GDP per capita in 2022 is estimated to be higher than the 2021 estimate in all four regions, including a moderate increase in Sub-Saharan Africa (SSA) (table 1). Between 2022 and 2032, GDP per capita in the Latin America and the Caribbean (LAC) region is projected to grow at 2.6 percent a year. The LAC region suffered a steep decline in GDP per capita due to the pandemic but rebounded in 2021 and 2022. Countries such as Peru, the Dominican Republic, El Salvador, Guatemala, and Colombia achieved record growth rates. In Asia, GDP per capita is projected to grow at an annual rate of 4.5 percent between 2022 and 2032 (table 1). Much of the anticipated increase in incomes in Asia reflects robust per capita GDP growth in the Central and South subregion and the Southeast subregion. In North Africa, per capita GDP growth is estimated to be more modest, averaging 2.4 percent a year between 2022 and 2032. The estimated per capita GDP growth for the SSA region lags the other three regions, mainly reflecting high population growth rates in SSA. In SSA, per capita GDP is projected to grow at 1.2 percent a year over the next 10 years (table 1). Most of the anticipated growth in incomes in SSA is driven by the East Africa subregion, where per capita GDP is projected to grow 1.6 percent a year (appendix C).

**Table 1**  
**Inflation-adjusted per capita Gross Domestic Product (GDP) in IFSA regions, 2022 and 2032**

Region	2019–21 (Average)	2021			Annual growth rate (2022–32)
		2022	2032	U.S. dollars	
Asia	2,221	2,236	2,336	3,616	4.5
Latin America and the Caribbean	5,166	5,183	5,324	6,875	2.6
North Africa	3,784	3,768	3,834	4,873	2.4
Sub-Saharan Africa	1,346	1,335	1,344	1,520	1.2

Notes: Value expressed in 2015 U.S. dollars. Regions include only countries that are a focus of the International Food Security Assessment.

Source: USDA, Economic Research Service estimates using Global Trade Analysis Project (GTAP): A Computable General Equilibrium (CGE) Model and USDA Agricultural Projections to 2032, Long-term Projections Report OCE-2022-1.

<sup>7</sup> Gross Domestic Product and per capita Gross Domestic Product are both expressed in real terms (2015 U.S. dollars) throughout the IFSA report.

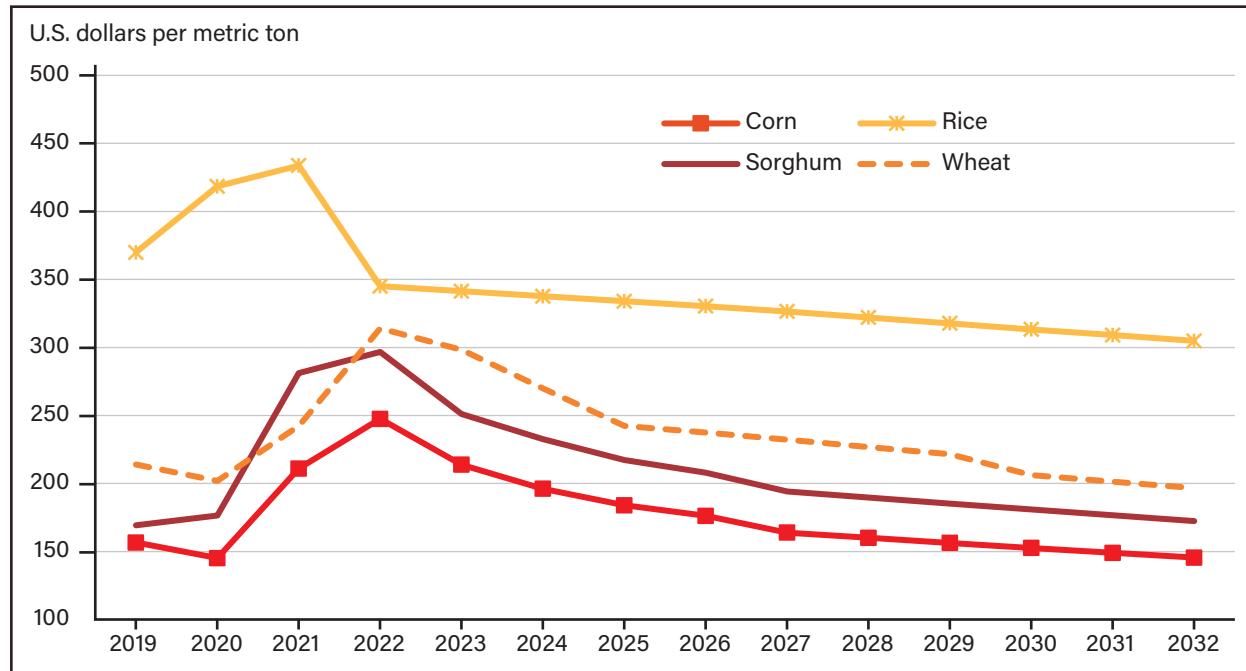
<sup>8</sup> A full list of the IFSA countries (with corresponding details on the major macroeconomic variables) is provided in appendix B.

<sup>9</sup> Appendix C provides the country, subregional, and regional macroeconomic projections that are used to model food insecurity in this year's assessment.

# International Food Price Projections and Trends

USDA's international agricultural commodity price projections have followed an upward trend since 2021, supported by rising global demand for feed and food grains and tighter global supplies (USDA, OCE, 2021). This trend is estimated to continue through 2022. Starting in 2023, international agricultural commodity prices are projected to trend downward at a relatively stable rate for the rest of the next decade<sup>10</sup> (figure 4). The downward price trend is supported by a projection of ample food supplies that will outweigh global demand (USDA, OCE, 2021).

Figure 4  
**Inflation-adjusted international agricultural commodity prices are estimated to sharply increase in 2022**



Note: Value in 2015 U.S. dollars.

Source: USDA, Economic Research Service using data from *USDA Agricultural Projections to 2032, Long-term Projections Report OCE-2022-1*.

International commodity prices are transmitted to domestic markets through trade.<sup>11</sup> Access to food by vulnerable households is constrained when food commodity prices are high, especially when they are internationally traded. High food price inflation (in turn) negatively affects food security, particularly in lower-income households that spend a relatively higher proportion of their budget on food (WFP and FAO, 2021). The recent upward trend in international prices of wheat, coarse grains, and vegetable oils was further exacerbated by Russia's military invasion of Ukraine, which significantly curtailed exports from the Black Sea region, particularly corn and wheat. In IFSA countries, world and domestic food prices are integrated through trade. Seventy of the 77 countries<sup>12</sup> covered in IFSA are projected to have rising real domestic prices of major grains in 2022. But on average, the most affected regions are North Africa and Asia (table 2). North

<sup>10</sup> Price projections come from USDA's long-term agricultural projections to 2031 (USDA, OCE, 2022) and are expressed in 2015 prices, adjusted for inflation.

<sup>11</sup> See appendix A for details about the international price transmission equations used for the IFSA countries in the IFSA demand modeling.

<sup>12</sup> The full set of food projections at the country, subregional, and regional levels of anticipated price changes of their major grain are presented in appendix C.

Africa, which is dependent on imports of wheat and corn, is estimated to see an increase in prices in real terms of 7 percent for wheat and 14 percent for corn in 2022, which is above the pre-Russian invasion of Ukraine estimate for the region. Asia is estimated to see an increase in real prices of 7 percent for corn and 5 percent for wheat in 2022, from pre-Russian invasion of Ukraine levels. Estimated real price increases in 2022 for wheat in Latin America and the Caribbean (LAC) and Sub-Saharan Africa (SSA) are similar to that of the other regions, but corn price increases are expected to be more moderate. Estimated real price increases of vegetable oils are moderate (relative to other commodities), except in Asia, where real prices are estimated to increase 4 percent from their pre-invasion levels (table 2).

Table 2

**North Africa and Asia are estimated to have the highest real price increases in 2022 for food commodities from pre-Russian invasion of Ukraine levels**

Region	Wheat	Corn	Rice	Vegetable oils
	Percent			
Asia	5	7	4	4
Latin America and the Caribbean	5	4	2	2
North Africa	7	14	6	2
Sub-Saharan Africa	5	6	4	2

Note: Value in 2015 U.S. dollars.

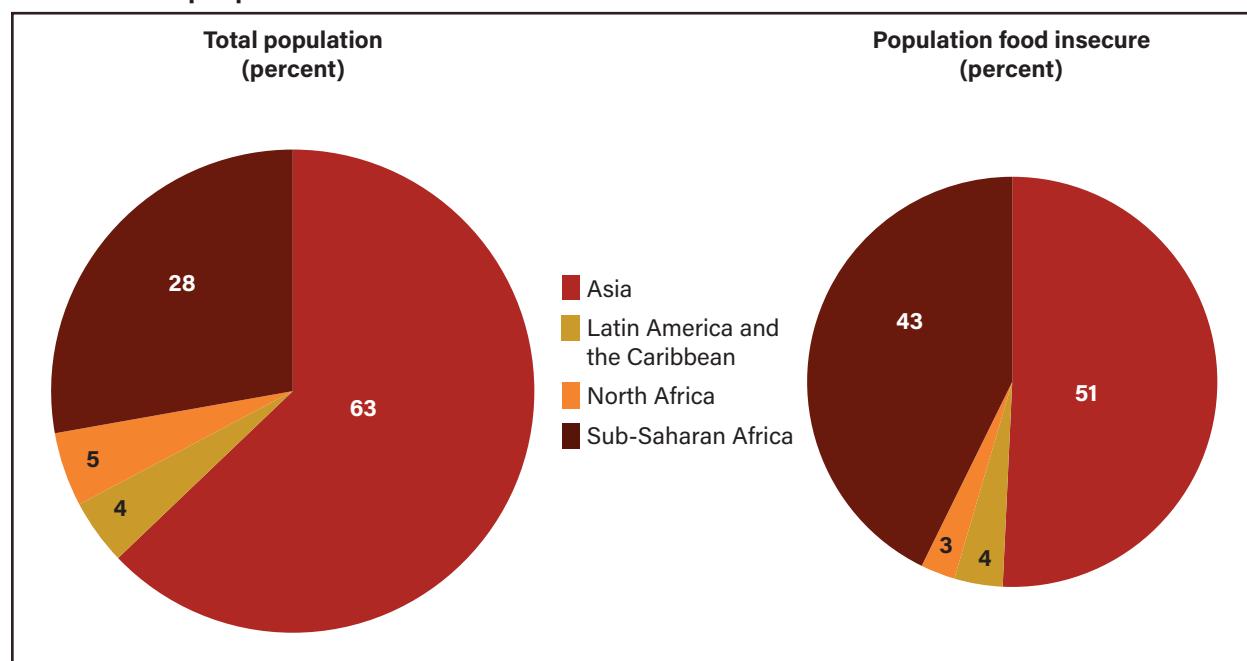
Source: USDA, Economic Research Service estimates using Global Trade Analysis Project (GTAP): A Computable General Equilibrium (CGE) Model.

## Country Coverage and Estimated Food Security Trends

The 77 countries in this study are sub-divided across 4 major regions: 39 countries and 4 sub-regions in Sub-Saharan Africa (SSA), 23 countries and 4 sub-regions in Asia, 11 countries and 2 sub-regions in Latin America and the Caribbean (LAC), and 4 countries in North Africa (NAF). Estimated levels of food insecurity for 2022 vary greatly across these regions. Asia (676.2 million people) and SSA (569.3 million people) account for 93 percent of the total number of food insecure people in 2022 (figure 5). The LAC region (50.9 million people) and NAF region (36.3 million people) account for the remaining 7 percent of food insecure people in the 2022 assessment (figure 5). The war in Ukraine and input price spikes added an additional 41.7 million to the estimate of food insecure people in 2022, with Asia—which in our aggregation includes Ukraine as a former CIS<sup>13</sup> participant—accounting for 71.5 percent of this increase (figure 6a). The SSA region has the highest estimated share of the population that is food insecure at 50.6 percent (figure 6a). By contrast, 26.6 percent of the population in Asia is considered food insecure in 2022. The prevalence of food insecurity in the LAC region is estimated to be 28.7 percent in 2022—whereas in the NAF region, the same metric averaged 18 percent—making NAF the most food secure region in the assessment (figure 6a). The Russian military invasion of Ukraine and unexpected spikes in fertilizer and energy costs, are associated with a 6.0-percent and 4.6-percent increase in the prevalence of food security estimates relative to the pre-invasion results for the North African and Asian regions, respectively—the highest increases among regions covered in the assessment (appendix B).

Figure 5

**Asia accounts for 63 percent of the population of the 77 countries studied with 51 percent of the food insecure people in 2022**

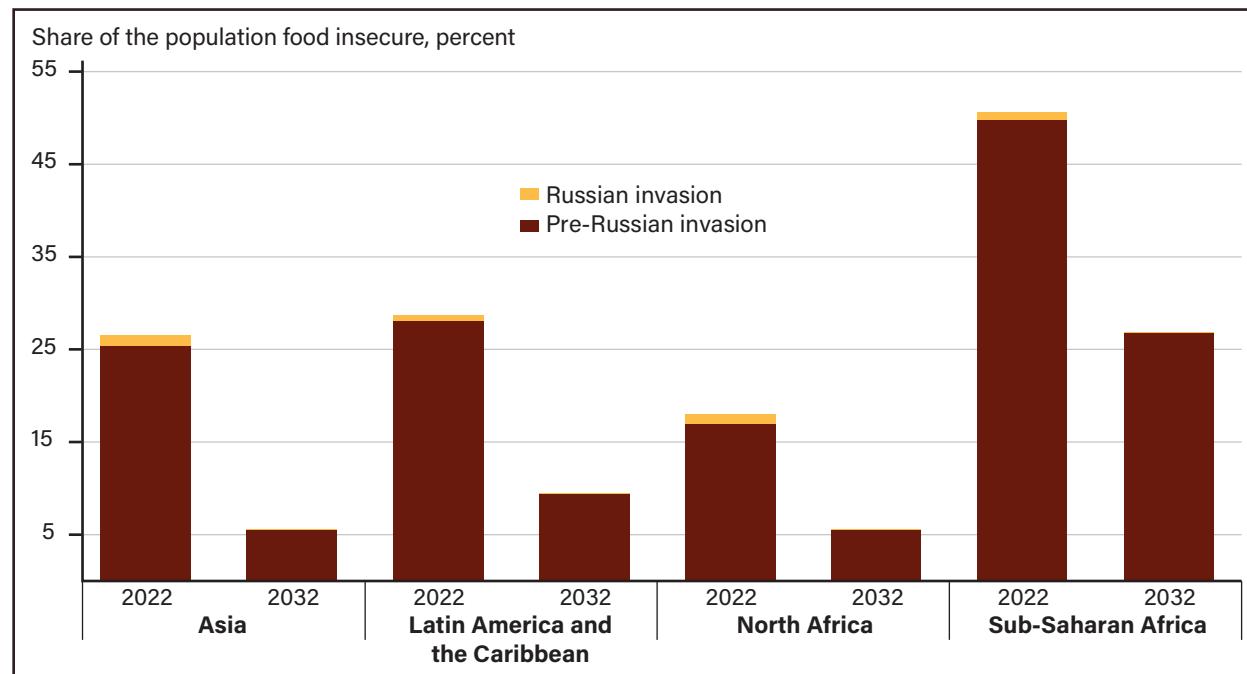


Source: USDA, Economic Research Service estimation using the International Food Security Assessment model.

<sup>13</sup> The members of Commonwealth of Independent States (CIS) are Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan. Turkmenistan is an associate member. Ukraine has not formally withdrawn from the organization but did formally end its participation in CIS statutory bodies in May 2018 (The World Fact Book, 2022). The subregional and regional aggregation here is based on the recognition of this note and is meant to facilitate comparison of food security trends across subregions.

Food security is projected to improve across all 77 countries over the next 10 years as GDP growth continues to improve. The share of the population that is food insecure is projected to fall to 12.4 percent by 2032, a 62.5-percent drop from the 2022 estimate (figures 6a and 6b). By 2032, food security in Asia is projected to improve the most among all regions. The prevalence of food insecurity and number of food insecure people are projected to decline by 78.9 percent and 76.7 percent, respectively, by 2032, to 5.6 percent of the population unable to meet caloric requirements, and the number of food insecure people is estimated at 157.3 million (appendix B). However, SSA is anticipated to make the least progress over the next decade at improving its food security metrics. While robust economic growth is projected after 2022 for SSA, population growth<sup>14</sup> is anticipated to outpace income growth over the coming 10-year period. The higher growth in population over income will likely result in lower real purchasing power for the average person in SSA. As a result, the decline in the prevalence of food insecurity in SSA is projected to be relatively slow. By 2032 in SSA, the prevalence of food insecurity is projected to be 26.8 percent—a 47-percent reduction from the 2022 estimate (figure 6a). Despite the moderate decline in the prevalence of food insecurity by 2032, SSA is projected to reduce the number of food insecure people by 180.5 million from 2022 to 388.8 million people (figure 6a). In the LAC region, the prevalence of food insecurity is projected to decline by 67.1 percent to 9.4 percent, and the number of food insecure people will decline by 64.0 percent to 18.3 million by 2032. In NAF, food security is projected to improve over the next 10 years, with the prevalence of food insecurity falling to 5.6 percent and the number of food insecure people falling to 12.9 million in 2032 (figures 6a and 6b).

**Figure 6a**  
**By 2032, the share of food insecure people is projected to decrease most in the Asian region**



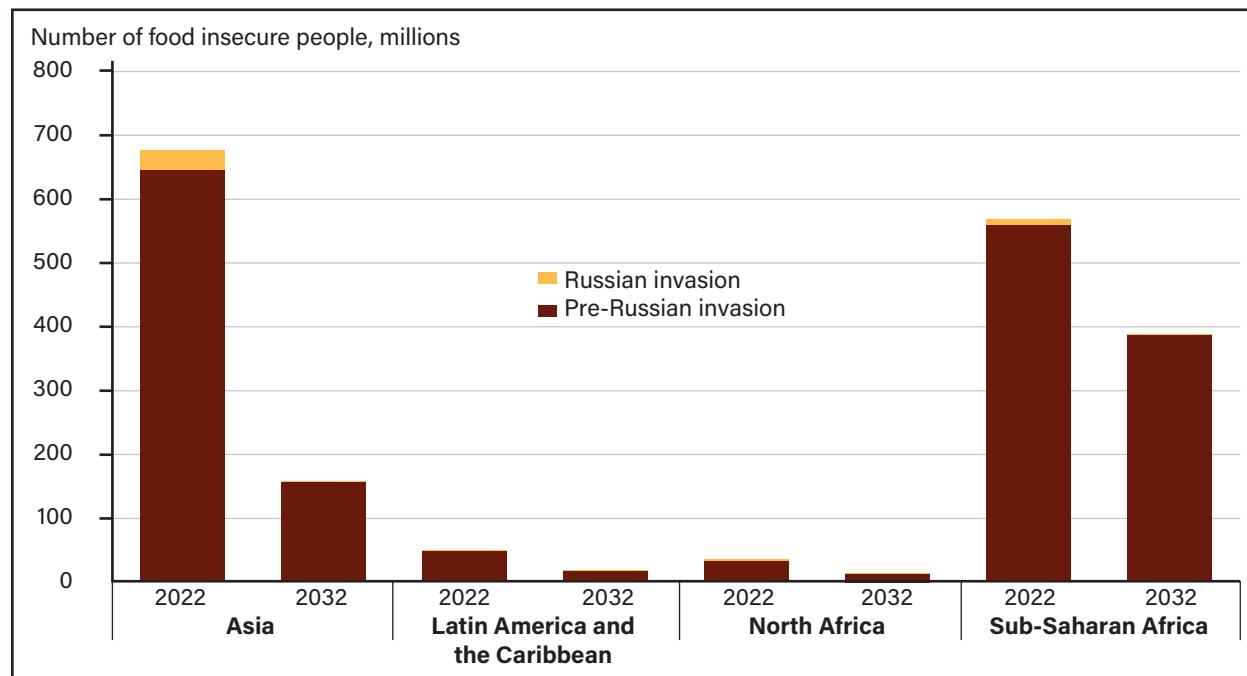
Note: Regions only include countries that are in the International Food Security Assessment.

Source: USDA, Economic Research Service estimation using the International Food Security Assessment model.

<sup>14</sup> Population growth projections for Sub-Saharan Africa and all regions in the assessment are obtained from the International Data Base (IDB) of the U.S. Department of Commerce, Bureau of the Census.

Figure 6b

**The number of food insecure people by 2032 is projected to sharply decline for most IFSA regions; Asia is projected to make the most progress**

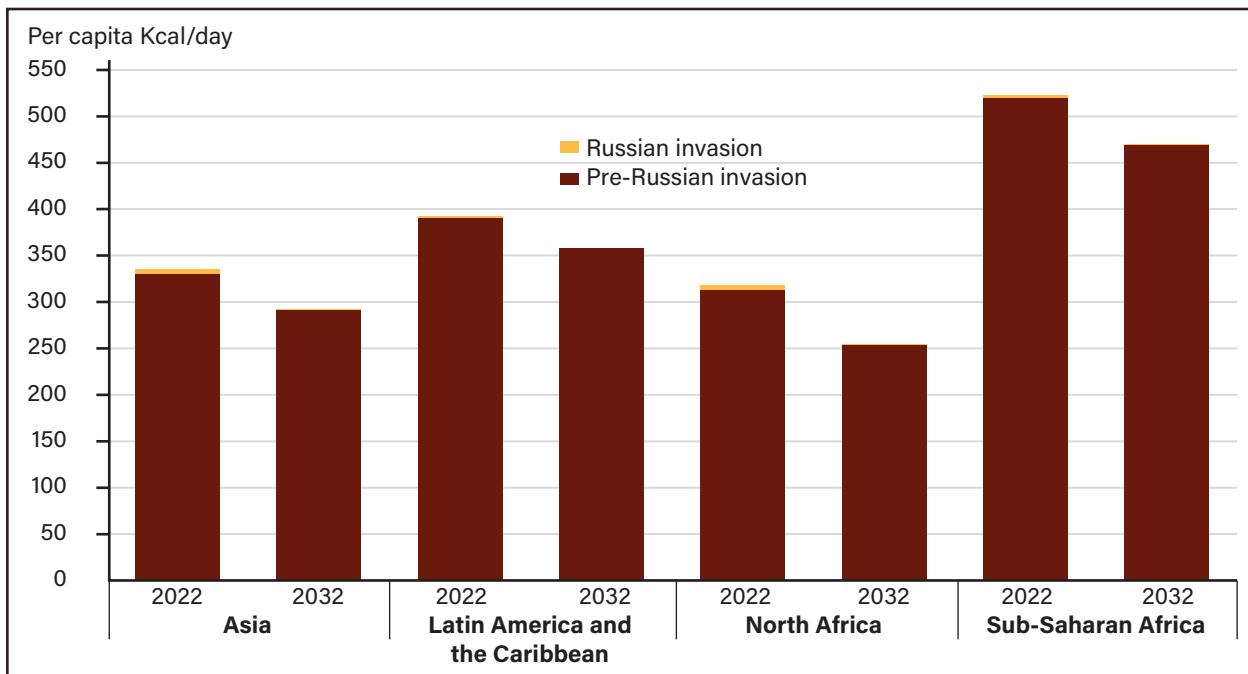


Note: IFSA = International Food Security Assessment. Regions include only countries that are in the International Food Security Assessment.

Source: USDA, Economic Research Service estimation using the International Food Security Assessment model.

For the 77 countries examined, the average daily caloric food gap is projected to decline over the next 10 years, from 419 kcal in 2022 to 408 kcal in 2032 (figure 6c). The 2022 food gap estimates in North Africa (317 kcal/capita/day) and Asia (335 kcal/capita/day) are projected to decline by 20 percent and 13 percent, respectively, in the next 10 years—the highest reductions of all regions (appendix B).

Figure 6c  
Food gap projected to decline by 2032 in IFSA regions



Notes: IFSA = International Food Security Assessment. Regions only include countries that are in the International Food Security Assessment. A kilocalorie is the same as 1 calorie. A kilocalorie is the amount of heat required to raise the temperature of 1 kilogram of water 1 degree Celsius.

Source: USDA, Economic Research Service estimation using the International Food Security Assessment model.

## Grain Demand, Production Trends, and the Implied Additional Supply Required

To further analyze the food security situation in IFSA countries, it is important to understand grain demand, production trends, and the Implied Additional Supply Required (IASR). The main components of food demand are grain demand for food and feed. The total grain demand for IFSA countries for 2022 is estimated to be more than 1 billion tons. In the next 10 years, total grain demand is projected to increase by 2.5 percent per year across all 77 countries to reach 1.4 billion tons by 2032 (table 3). Food demand is the largest component of total grain demand. Asia accounts for most of the food demand in 2022, as Asia has the largest share of the population of the four major regions defined in IFSA. Food demand (2.9 percent) is also projected to grow faster than grain demand for other uses, including feed (1.7 percent).

Grain production in IFSA countries is not expected to keep pace with demand. From 2022 to 2032, grain production is projected to grow by 1.3 percent per year (table 3). This projected increase is below the growth rate for total grain demand and the demand for food grains for the IFSA countries. Over the next decade, the NAF region is projected to see the highest annual growth rate of grain production among IFSA regions. However, the annual rate of growth of grain production in NAF is projected to be less than the rate of annual growth for total grain demand. By contrast, Asia's projected rate of growth in grain production (1 percent a year) is the lowest of any region. Asia's anticipated annual grain-production growth will fall below the growth of demand for grains for food and other uses (table 3). Grain production in the SSA region is projected to grow 2.3 percent a year from 2022 to 2032.

Despite the projected robust growth in production—in absolute terms—the gap between domestic grain production and demand for grain is anticipated to widen for the 77 countries in the assessment over the coming decade (table 3). IASR—which provides an estimate of the gap between demand and supply for grains—is projected to increase by 4.6 percent per year between 2022 and 2032. Through the upcoming decade, IASR is expected to grow the fastest in the Asian (5.8 percent) and Sub-Saharan African (4.9 percent) regions. By 2032, these same two regions are projected to have the highest IASR of all regions included in IFSA.

**Table 3**  
**Demand for grains is projected to outpace grain production over the 2022 and 2032 period, driven mainly by demand from the Asian and Sub-Saharan African regions**

Region	Food demand		Other demand*		Total grain demand		Grain production		Implied additional supply required**	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
Millions of tons										
Total IFSA Countries	722	962	320	385	1,042	1,346	693	792	348	555
Asia	508	655	173	207	681	862	513	566	168	296
Latin America and the Caribbean	25	31	22	27	47	57	17	20	30	37
North Africa	47	62	43	51	90	113	34	43	56	70
Sub-Saharan Africa	142	215	81	100	224	314	130	163	94	152

Notes: IFSA = International Food Security Assessment. \*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.

Source: USDA, Economic Research Service estimation using the International Food Security Assessment model.

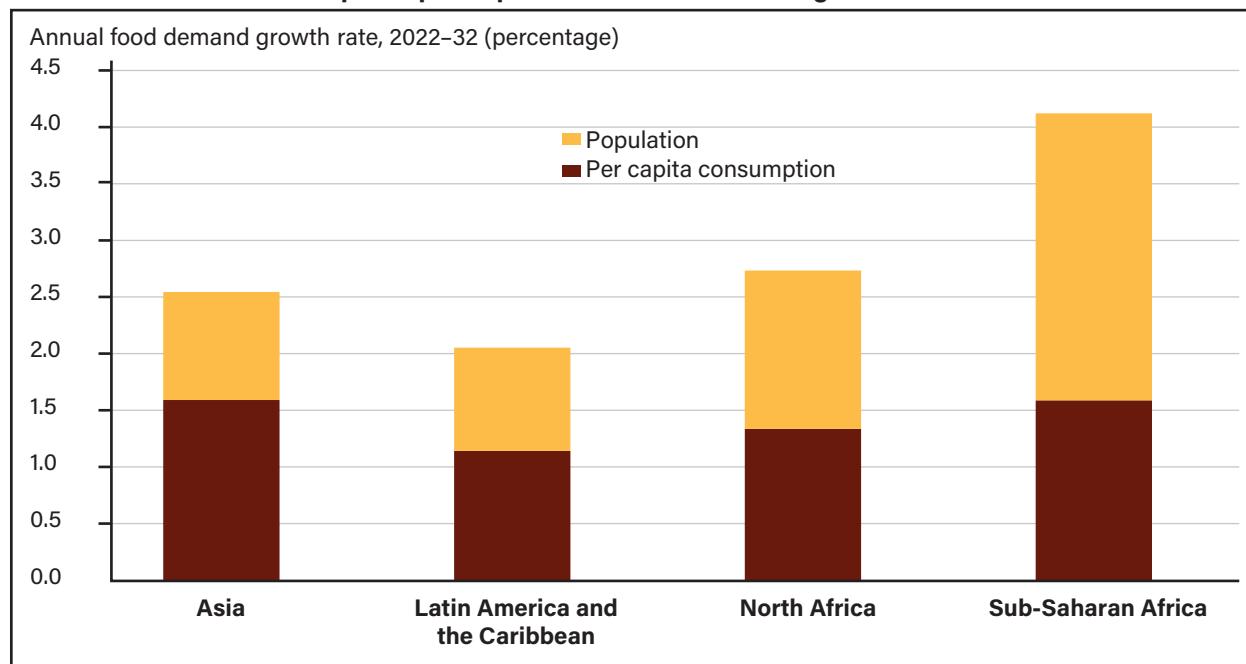
## Regional Food Demand Decompositions

Results in figure 7 show the overall annual growth rate of food demand for the countries included in the IFSA by region. The average annual food demand growth rate for all IFSA countries for the next decade is estimated to be 2.9 percent. Comparatively, SSA has the highest growth rate of 4.2 percent per year for the next 10 years. This is followed by NAF and Asia, with an annual food demand growth rate of 2.8 percent and 2.6 percent per year, respectively. The LAC region, with a 2.1 percent annual growth rate, is projected to have the lowest food demand growth across all regions.

The total food demand growth rate can be decomposed into per capita food demand and population growth rates. The average per capita food consumption for IFSA countries is projected to grow 2.5 percent per year in the next 10 years, making up 86.6 percent of the total food demand growth rate. The Asian and SSA regions are projected to show a comparable annual per capita food consumption rate of 1.6 percent per year, whereas the LAC region will have the lowest annual per capita food consumption growth rate of 1.1 percent (figure 7).

Figure 7

**Sub-Saharan Africa has the highest total annual food demand growth rate, although Asia and Sub-Saharan Africa are at par in per capita annual food demand growth rates**

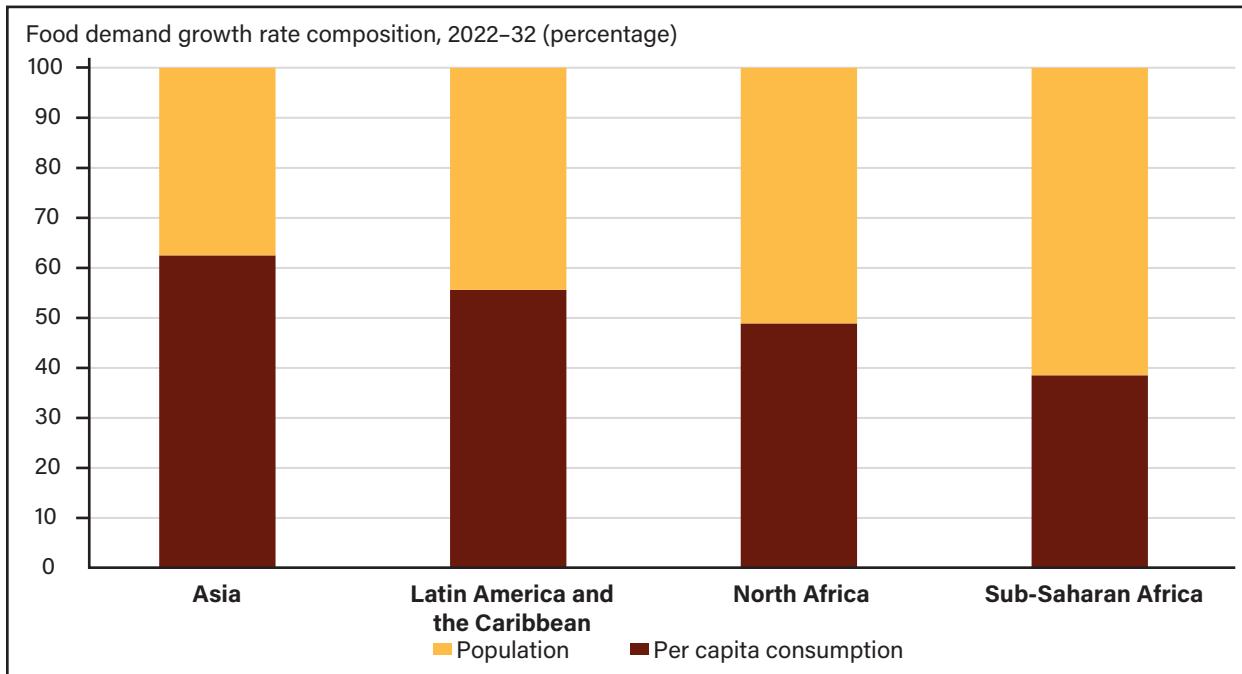


Source: USDA, Economic Research Service estimation using the International Food Security Assessment model.

The four regions display distinct trends in terms of the proportional composition of per capita food consumption and population growth rates toward overall food consumption. While SSA has the highest annual food demand consumption growth rate, a significant proportion of that growth is due to the population factor. In fact, 61.5 percent of the growth rate is due to population growth. The growth in total food demand in North Africa is also mainly due to population growth, standing at 51.1 percent. In contrast, 62.5 percent of the total food consumption growth rate in Asia is attributed to growth in per capita food consumption, while 55.6 percent of the growth in per capita demand in the LAC region is due to growth in per capita income (figure 8).

Figure 8

**A higher proportion of growth in food demand is due to population growth in the Sub-Saharan African and North African regions**



Source: USDA, Economic Research Service estimation using the International Food Security Assessment model.

## How Food Security Is Assessed: Method and Definitions

The International Food Security Assessment (IFSA) projects food demand for 77 low- and middle-income countries—39 in Sub-Saharan Africa, 4 in North Africa, 11 in Latin America and the Caribbean, and 23 in Asia. Food is divided into four groups: (1) the major grain consumed in the country, (2) other grains, (3) root crops, and (4) all other food. The IFSA model's projections of food demand are expressed in grain equivalent, based on the caloric content of food items to allow for aggregation across food groups; grain equivalent may be expressed in either kilograms or kilocalories. For example, grains have roughly 3.5 kilocalories per gram, and tubers have about 1 calorie per gram. One ton of tubers is therefore equivalent to 0.29 tons of grain.

The IFSA model analyzes the gap between projected food demand, which is a function of per capita income and food prices, and a caloric threshold of 2,100 kcal per capita per day. This report uses three indicators of food insecurity.

1. The **food gap** measures the food needed to raise consumption at every income level to the caloric threshold. In many countries, per capita consumption in the lower income deciles is significantly less than the per capita consumption for the country. In these countries, the distribution gap provides a measure of the intensity of hunger—the extent to which the food security of already hungry people deteriorates because of income declines or other negative economic conditions. This measure can be expressed on a per capita basis (in kcal per day) or as an aggregate measure (the total tons of food needed to fill the gap in each country).
2. The **share of the population that is food insecure**. Food demand is assumed to be met and equal to consumption. Consumption is not assessed by income decile but instead in a continuous manner across all income levels.
3. The **number of food insecure people**—those who cannot meet the caloric threshold—is based on the total population and the population share that consumes less than the caloric threshold.

Terms commonly used in this report include:

**Food consumption**—equal to food demand if we assume demand is met.

**Food access**—depends on a consumer's purchasing power. Food access is estimated based on income level and food prices within each country, according to an income-consumption relationship.

**Food insecurity**—occurs when estimated per capita food consumption for a consumer at a certain income level falls short of the caloric threshold of 2,100 kcal per person per day.

For more detailed information on the model, see appendix A.

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## Regional Overview

While food security deteriorated in most countries in 2022 relative to 2021 (Baquezano et al., 2021), indicators vary across regions. Sub-Saharan Africa (SSA) has the highest share of food insecure people (50.6 percent), reflecting the effects of food price inflation on the low purchasing power across the region (figure 6a, appendix B). The Latin America and Caribbean (LAC) and Asian regions are estimated to have 28.7 percent and 26.6 percent of their respective regional populations considered food insecure (figure 6a, appendix B). North Africa (NAF)—the most food-secure region in the IFSA analysis—is estimated to have 18 percent of its population be food insecure in 2022 (figure 6a, appendix B). Russia’s military invasion of Ukraine and higher input prices increased the prevalence of food insecurity by 3.2 percent from pre-invasion estimates, with the largest increases in Asia (4.6 percent) and North Africa (6.0 percent) (appendix B).

All regions will see an improvement in food security in the next 10 years, although with varying levels. Food insecurity in SSA is estimated to decline by 47.0 percent to 26.8 percent by 2032. In Asia—waning food price inflation, income growth, and a subsiding impact from the war in Ukraine—will result in the projected prevalence of food insecurity declining by 78.9 percent (the most of any region) to 5.6 percent in 2032. The prevalence of food insecurity in North Africa is projected to decline by 68.9 percent to 5.6 percent, reflecting projections for greater food price stability (particularly in wheat). In the IFSA countries in the LAC region, the share of population experiencing food insecurity is projected to fall by 67.1 percent to reach 9.4 percent by 2032 (figure 6a; appendix B).

## Sub-Saharan Africa

The population of Sub-Saharan Africa (SSA) in 2022 is estimated to be 1.1 billion and projected to grow by 2.3 percent a year (the fastest in IFSA), reaching 1.5 billion by 2032 (appendix B). Protracted conflict, the disruptions of markets and regional trade, low COVID-19 vaccination rates, reduced agricultural output (due to weather events and pest infestations), and lower per-capita income—continue to intensify the already high levels of food insecurity in SSA (Food and Agriculture Organization of the United Nations (FAO), 2020; FEWS NET, August 2021; WFP and FAO, 2021). Furthermore, recent rapid inflation and food price hikes have compounded the already fragile food security environment in the region (WFP and FAO, 2021). The Russian military invasion of Ukraine has further exacerbated food price inflation, as many countries in the sub-region are direct importers of wheat from the Black Sea Region.

The COVID-19 pandemic continues to put a strain on the economies of the SSA countries, characterized by relatively lower COVID-19 vaccination rates. However, signs of economic recovery are apparent in the region. In 2022, GDP is estimated to grow to \$ 1.3 trillion, a 2.5-percent increase from its 2021 level (appendix B). In SSA, the estimated moderate economic growth (relative to the high food price inflation), which began toward the end of 2021, has significant effects on the estimated regional food security metrics. For 2022, the estimated prevalence rate of food insecurity in SSA (50.6 percent) is the highest among the four regions covered by the assessment (appendix B). The SSA region has the second highest number of food insecure people in the assessment at 569.3 million (figure 6b). Russia's military invasion of Ukraine and input price spikes account for 8.8 million of the estimated number of food insecure people in SSA in 2022 (appendix B). The 2022 estimate of the number of food insecure people is 77.8 million higher than the 2021 estimate, reflecting the lingering effects of the COVID-19 pandemic on local economies, as well as high food price inflation (Baquezano et al., 2021).

Table 4  
**Inflation adjusted per capita income for Sub-Saharan Africa region, 2022 and 2032**

Region/subregion	2019 (pre-COVID-19)	U.S. dollars, 2015		
		2021	2022	2032
<b>Sub-Saharan Africa</b>	<b>1,378</b>	<b>1,311</b>	<b>1,344</b>	<b>1,520</b>
Central Africa	666	630	651	763
East Africa	1,042	1,025	1,050	1,346
Southern Africa	1,462	1,367	1,351	1,474
West Africa	1,905	1,794	1,855	1,972

Source: USDA, Economic Research Service estimates using Global Trade Analysis Project (GTAP): A Computable General Equilibrium (CGE) Model and USDA International Macroeconomic Dataset.

In the SSA region, GDP per capita over the next decade is projected to grow at an annual rate of 1.4 percent to \$1,520 in 2032 (table 4). By 2032, West Africa is projected to have the highest GDP per capita in SSA at \$1,972, surpassing the SSA regional average (table 4). However, despite the anticipated growth in SSA's GDP per capita over the next decade (both in absolute and relative terms), the region will still have the lowest estimated income of the four regions included in IFSA (table 1). Moreover, SSA is projected to have the highest population growth of any region, countering the effect of income gains on food security.

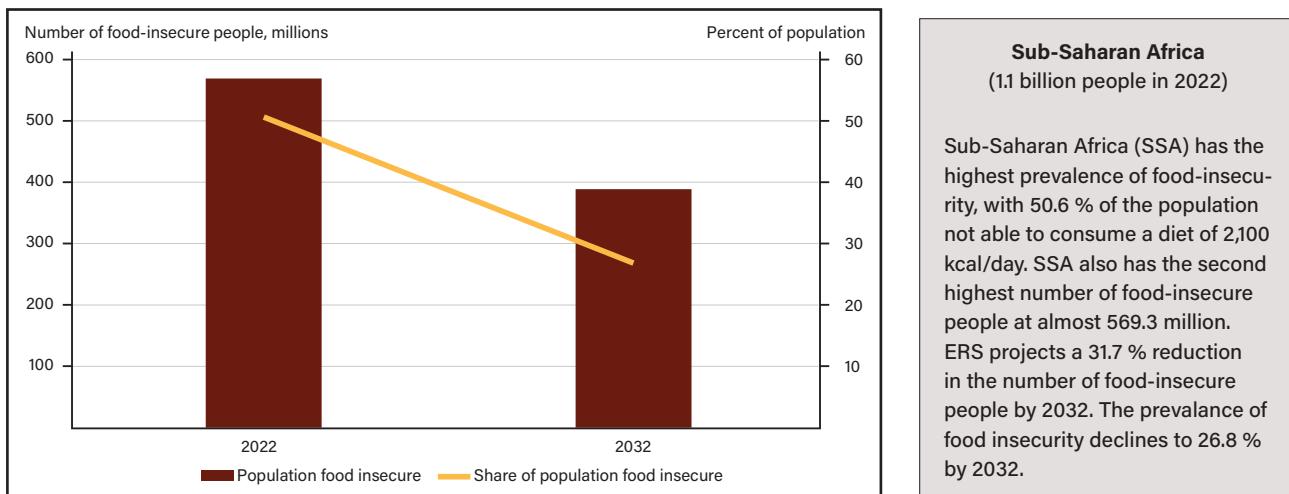
By 2032, the SSA region is expected to make the least progress in food insecurity metrics of any region in the assessment. This lack of progress reflects the effect on the purchasing power of population growth rates that exceed per capita GDP growth. From 2022 to 2032, the prevalence of food insecurity is projected to decline from 50.6 percent to 26.8 percent (or by 180.5 million people) (table 5). The West African sub-region is projected to make the most gains in SSA in decreasing both the share and number of food insecure people by 2032. By contrast, the Central African sub-region is projected to make the least progress. Over the next decade, the share of the population that is food insecure is projected to decline in Central Africa. However, mainly because of anticipated high population growth, there will be more food insecure people in Central Africa in 2032 than in 2022 (table 5). Over the next decade, the daily caloric food gap—the difference between estimated consumption and the daily consumption threshold—in SSA is projected to decline by 10.3 percent, from 523 kcal in 2022 to 469 kcal in 2032 (table 5).

Table 5  
Food security indicators for Sub-Saharan Africa, 2022 and 2032

Year	Food grain demand	Other grain demand*	Total grain demand	Grain production	Implied additional supply required**
	Million tons				
2022	142	81	224	130	94
2032	215	100	314	163	152

\*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.

Source: USDA, Economic Research Service.



Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

Region/subregion	Population		Population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (total)*	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million	Million	Million	Million	Percent	Percent	Kcal/day	Kcal/day	1,000 metric tons	1,000 metric tons
Sub-Saharan Africa	1,124.1	1,448.9	569.3	388.8	50.6	26.8	523	469	37,208	22,784
Central Africa	149.3	199.6	104.1	105.9	69.7	53.1	758	662	9,637	8,560
East Africa	393.1	502.3	219.5	133.3	55.8	26.5	505	438	13,257	6,987
Southern Africa	155.9	199.9	100.5	78.9	64.5	39.5	575	465	7,066	4,484
West Africa	425.8	547.2	145.1	70.6	34.1	12.9	382	298	7,249	2,753

\*Measured in grain equivalents.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

## Central Africa (CAF)

The Central African (CAF) sub-region is estimated to have the lowest GDP per capita of the 4 sub-regions in SSA, \$651 annually, compared to the SSA average of \$1,344 (table 4). With the CAF sub-region's limited resources towards alleviating the potential long-term effect of the COVID-19 pandemic, the share of people living below the poverty line is expected to increase in 2022 (African Development Bank, 2021a).

In 2022, the sub-region is estimated to have the highest prevalence of food insecurity in the Sub-Saharan African region (SSA), with 104 million people (69.7 percent of the population) unable to consume 2,100 calories (kcal) a day (table 5). The substantial levels of food insecurity for 2022 in CAF are due to prolonged armed conflicts, the COVID-19 pandemic, and incomes that remain below their pre-pandemic levels. The global market effects on local food supply chains and food prices are expected to have longer-term negative impacts on food security and economic growth in the CAF sub-region (African Development Bank, 2021a). The Democratic Republic of the Congo (DRC) is the largest country in Sub-Saharan Africa (in terms of area) and has the largest economy in the CAF sub-region. A combination of protracted violence, natural disasters, epidemics, refugee inflows, economic decline, and the socioeconomic impact of COVID-19 continue to inflict high levels of food insecurity in DRC (WFP and FAO, 2021). In 2022, it is estimated that nearly 80 percent of the population in DRC is food insecure (table 5). The Central Africa Republic's (CAR) increasing insecurity (due to armed conflict and economic impacts of the COVID-19-related restrictions) are likely drivers of acute food insecurity, with 82.7 percent of the population estimated to be food insecure in 2022 (FAO and WFP, 2020; WFP and FAO, 2021, table 6). Instability in major supply roads linking CAR and Cameroon has been another source of disruptions to humanitarian assistance and the supply of goods into the country (WFP and FAO, 2021). The Republic of the Congo's (COG) food security situation is continually affected by conflicts in neighboring DRC and CAR, as COG is a major recipient of large refugee populations. In COG, 68.5 percent of the population is estimated to be food insecure in 2022 (table 6).

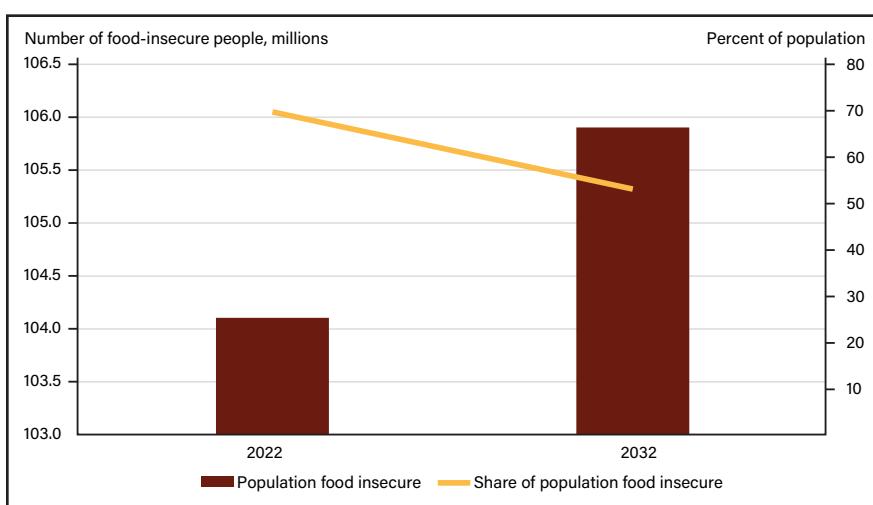
A projected slow economic recovery from the COVID-19 pandemic and global market shocks (coupled with high population growth rates over the next 10 years) will constrain the CAF sub-region's ability to make significant progress in its food security metrics (African Development Bank, 2021a). By 2032, the prevalence of food insecurity is projected to decline by 23.9 percent to 53.1 percent of the population, the highest of any sub-region. However, 2 million more people are projected to be food insecure in 2032 than in 2022 (table 6). The projected increase in the number of food insecure people in CAF is mainly driven by trends in DRC, where population growth is projected to outpace GDP per capita growth. Excluding the DRC—the most food insecure and largest country in CAF—the prevalence of food insecurity by 2032 is projected to decline by 57 percent to 18.7 percent of the population of the sub-region. Cameroon is projected to have the lowest share (11.4 percent) of its population experiencing food insecurity by 2032 (table 6).

Table 6  
Food security indicators for Central Africa sub-region, 2022 and 2032

Year	Food grain demand	Other grain demand*	Total grain demand	Grain production	Implied additional supply required**
	Million tons				
2022	8.0	7.5	15.5	6.8	8.7
2032	12.0	9.1	21.1	8.4	12.7

\*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.

Source: USDA, Economic Research Service.



**Central Africa**  
(149.3 million people in 2022)

Central Africa has the highest prevalence of food-insecurity within Sub-Saharan Africa, with 69.7 % of the population not being able to consume a diet of 2100 kcal/day. It is estimated that almost 104.1 million people will be food-insecure. Central Africa is the only sub-region in the assessment that despite a projected improvement of the prevalence of food insecurity by 2032 will see an increase in the number of food-insecure people.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

	Population		Population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (total)*	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million	Million	Million	Million	Percent	Percent	Kcal/day	Kcal/day	1,000 metric tons	1,000 metric tons
<b>Central Africa</b>	<b>149.3</b>	<b>199.6</b>	<b>104.1</b>	<b>105.9</b>	<b>69.7</b>	<b>53.1</b>	<b>758</b>	<b>662</b>	<b>9,637</b>	<b>8,560</b>
Cameroon	29.3	38.1	9.0	4.3	30.7	11.4	338	263	397	149
Central African Republic	6.0	7.2	5.0	3.0	82.7	41.2	628	390	354	130
Congo	5.5	7.0	3.8	2.5	68.5	35.5	459	322	229	105
Congo, DR**	108.4	147.3	86.3	96.1	79.6	65.3	862	731	8,657	8,176

\*Measured in grain equivalents. \*\* Congo, DR refers to Democratic Republic of the Congo.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

Over the next decade, the daily caloric food gap—the difference between observed consumption and the daily consumption threshold—is projected to decline by 12.7 percent, from 758 kcal in 2022 to 662 kcal in 2032 in Central Africa. However, there is significant variation in the sub-regional projections. By 2032, DRC is anticipated to see a 15.2-percent decline in the daily caloric food gap. By contrast, CAR is projected to see a 38-percent decline in its daily food calorie gap, the highest reduction in the sub-region by 2032 (table 6).

## East Africa (EAF)

In East Africa (EAF), food insecurity and poverty have been exacerbated by reduced agricultural output—because of desert locust infestations, protracted conflicts in some countries, the socioeconomic effects of the COVID-19 pandemic, and pandemic containment efforts (FAO and WFP, 2020; WFP and FAO, 2021). Moreover, food price inflation has emerged as a significant issue that directly impacts food security in the subregion. Food price inflation in EAF has been more elevated than in the rest of SSA, reaching as high as 307.8 percent in Sudan<sup>15</sup> in 2021 (African Development Bank, 2021b). GDP per capita in 2022 is estimated to be 1.1 percent above its 2019 level, the only subregion in SSA to exceed its 2019 level (table 4). But this level of GDP growth may not be sufficient to counter the food security environment in the sub-region, particularly in the context of high food prices.

In 2022, 55.8 percent of the population (219.5 million people) in the EAF sub-region are estimated to be food insecure (table 7). Ethiopia, with a population of 113.7 million people, is estimated to have 49.3 million people considered food insecure (43.4 percent of the population). Ethiopia's food security environment continues to be highly affected by armed conflict and ethnic violence, economic deterioration, below-average rainfall, and desert locust infestation (FAO, 2021a). Following Ethiopia, both Uganda and Kenya are estimated to have more than 33 percent of their respective population food insecure (table 7).

In Sudan, a protracted economic crisis (coupled with very high food prices) is expected to worsen food insecurity. Inflation has been persistent at a three-digit level since 2020, reaching 307.8 percent in 2021 (African Development Bank, 2021b). High commodity prices, record high inflation rates, and depreciation of the Sudanese pound will likely continue to weaken the purchasing power of consumers, especially for the low-income segments of the population. Somalia is estimated to have the lowest GDP per capita of all countries included in the assessment—at \$101 in 2022, making the country vulnerable to high food prices; this low GDP is reflected in the estimated prevalence of food insecurity of 88.5 percent of the population in 2022 (table 7; appendix B).

Burundi and Chad are estimated to have 84.6 percent and 68.9 percent of their respective populations considered food insecure in 2022, respectively (table 7). Food inflation and localized insecurity are expected to drive the food insecurity situation in Chad (WFP and FAO, 2021). Inflation is expected to persist through 2022 in Burundi but is projected to ease in the medium term<sup>16</sup> (African Development Bank, 2021b). Both countries are projected to have more than 600 kcal of per capita food gap in 2022, among the highest in the EAF region (table 7).

From 2022 to 2032, the population of EAF is expected to increase from 393.1 million to 502.3 million people, a projected growth rate of 2.5 percent a year (table 7). Over the same period, GDP is anticipated to grow at 4 percent a year and reach \$675.9 billion (appendix C). Reflecting the anticipated trends in population and GDP growth, GDP per capita in EAF for the next 10 years is projected to grow at an annual rate of 2.5 percent, the highest rate in SSA (table 3, appendix C). Reflecting the projected per capita income growth, the prevalence of food insecurity is anticipated to decline by 52.5 percent by 2032. The number of food insecure people is projected to decline by 39.3 percent from 2022 to 2032 to 133.3 million (table 7). Also, the daily caloric food gap—defined as the difference between the estimated level of consumption and the recommended threshold of 2,100 kcal per day—is projected to decline 12.6 percent from 2022 and reach 438 kcal (table 7).

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<sup>15</sup> Until 2011, the current Sudan and South Sudan were one country. Following decades of civil war, the southern section seceded, becoming one of the world's newest nations called South Sudan.

<sup>16</sup> The medium-term is typically defined as 3–5 years.

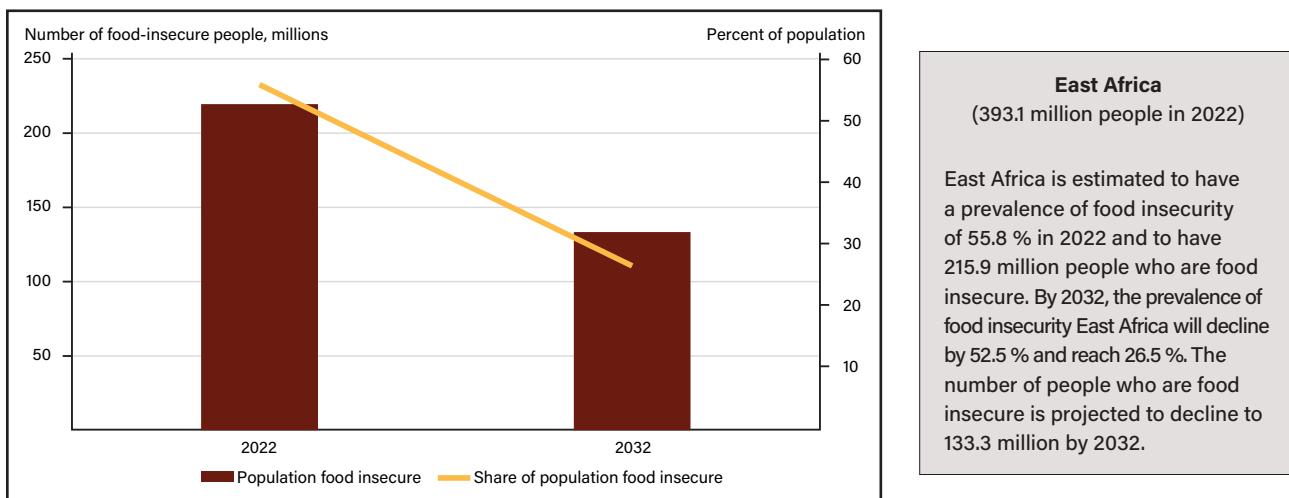
Uganda has the highest projected population growth rate in the sub-region over the next decade and is anticipated to make modest progress toward improving its food security metrics. In 2032, the prevalence of food insecurity in Uganda is projected to decline by 26.2 percent. But the number of food insecure people (33.2 million) is projected to remain unchanged from 2022, reflecting the anticipated high population growth (table 7). Ethiopia's GDP from 2022 to 2032 is projected to grow at one of the fastest paces in the EAF subregion, at 7.1 percent a year (appendix C). Due to the anticipated economic growth by 2032, Ethiopia is expected to have the lowest prevalence of food insecurity (7.4 percent) in the EAF sub-region (table 7). However, because Ethiopia has the largest population in EAF, the country will still have a significant number of food insecure people in the region (10.5 million) by 2032 (table 7). In 2032, the daily caloric food gap—defined as the difference between the estimated level of consumption and the recommended threshold of 2,100 kcal per day—for the EAF sub-region is projected at 438 kcal, a 12.6-percent decline from 2022 (table 7). By 2032, Burundi and Chad are projected to cut their per capita food gap to 511 kcal and 518 kcal, respectively (table 7). The prevalence of food insecurity is projected to decline moderately by 2032 in Burundi (17.7 percent decline) and Chad (25.4 percent decline). But due to anticipated population growth exceeding income growth, the number of food insecure people is projected to increase from 2022 in both Burundi and Chad (table 7).

Table 7  
Food security indicators for East Africa sub-region, 2022 and 2032

Year	Food grain demand	Other grain demand*	Total grain demand	Grain production	Implied additional supply required**
	Million tons				
2022	49.8	20.6	70.5	52.0	18.4
2032	76.9	25.2	102.1	67.2	35.0

\*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.

Source: USDA, Economic Research Service.



Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

	Population		Population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (total)*	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million	Million	Million	Million	Percent	Percent	Kcal/day	Kcal/day	1,000 metric tons	1,000 metric tons
<b>East Africa</b>	<b>393.1</b>	<b>502.3</b>	<b>219.5</b>	<b>133.3</b>	<b>55.8</b>	<b>26.5</b>	<b>505</b>	<b>438</b>	<b>13,257</b>	<b>6,987</b>
Burundi	12.7	16.9	10.7	11.8	84.6	69.6	631	511	789	701
Chad	18.0	24.1	12.4	12.4	68.9	51.5	622	518	976	814
Eritrea	6.2	7.0	5.0	1.6	80.7	22.7	558	289	347	57
Ethiopia	113.7	142.5	49.3	10.5	43.4	7.4	374	234	2,036	271
Kenya	55.9	68.1	33.6	11.5	60.1	16.9	431	268	1,801	384
Rwanda	13.2	15.4	7.6	1.9	57.8	12.6	489	294	445	68
Somalia	16.8	22.4	14.9	16.8	88.5	74.8	786	638	1,343	1,227
Sudan	48.0	61.9	22.3	17.8	46.4	28.8	423	352	1,107	738
Tanzania	62.5	81.4	30.5	15.8	48.7	19.4	527	386	2,002	763
Uganda	46.2	62.6	33.2	33.2	71.9	53.1	601	490	2,412	1,964

\*Measured in grain equivalents.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

## Southern Africa (SAF)

In 2022, the food security environment in the Southern Africa (SAF) sub-region continues to be affected by several factors, including but not limited to: natural hazards, pest infestations such as locusts, macroeconomic challenges such as food price inflation, and the COVID-19 induced economic slowdown (WFP and FAO, 2021). Moreover, restrictions stemming from the response to the COVID-19 pandemic continue to affect countries that are strongly dependent on tourism, including Namibia and Zimbabwe, further impacting economic activity (African Development Bank, 2021c).

Notwithstanding the difficult food security environment, SAF's economy is estimated to grow 1.0 percent in 2022 (appendix C; Baquedano et al., 2021<sup>17</sup>). However, GDP per capita in 2022 in SAF is estimated to be 7.6 percent and 1.2 percent below the 2019 and 2021 levels, respectively. SAF is the only subregion in SSA where GDP per capita is estimated to have deteriorated relative to 2021 (table 4). However, there is some variation in the estimates of economic growth across the SAF sub-region. For example, only the estimates for GDP per capita growth in 2022 for Lesotho and Malawi are estimated to be higher than their 2019–21 average values. Except for Madagascar, with no estimated change in its GDP per capita, the rest of the countries in SAF region have their estimated GDP per capita value below the 2019–21 average (appendix C).

The SAF sub-region is estimated to have the second-highest prevalence of food insecurity in SSA after CAF (table 5). In 2022, 64.5 percent of the population (100.5 million people) in the SAF sub-region is estimated to be food insecure (table 8). The most food insecure country in the SAF sub-region is estimated to be Zimbabwe (81.5 percent of the population), followed by Zambia (78 percent) and the Republic of Madagascar (71.5 percent). The Republic of Madagascar—an island country in the Indian Ocean—is experiencing the worst drought in 40 years amidst the COVID-19 pandemic. Weather related shocks and crop and livestock diseases are among key drivers worsening food security in the country (African Development Bank, 2021d; IPC, 2021). On the other hand, Eswatini, formerly known as Swaziland, is the least food-insecure country in the SAF sub-region (41.9 percent of the population) (table 8).

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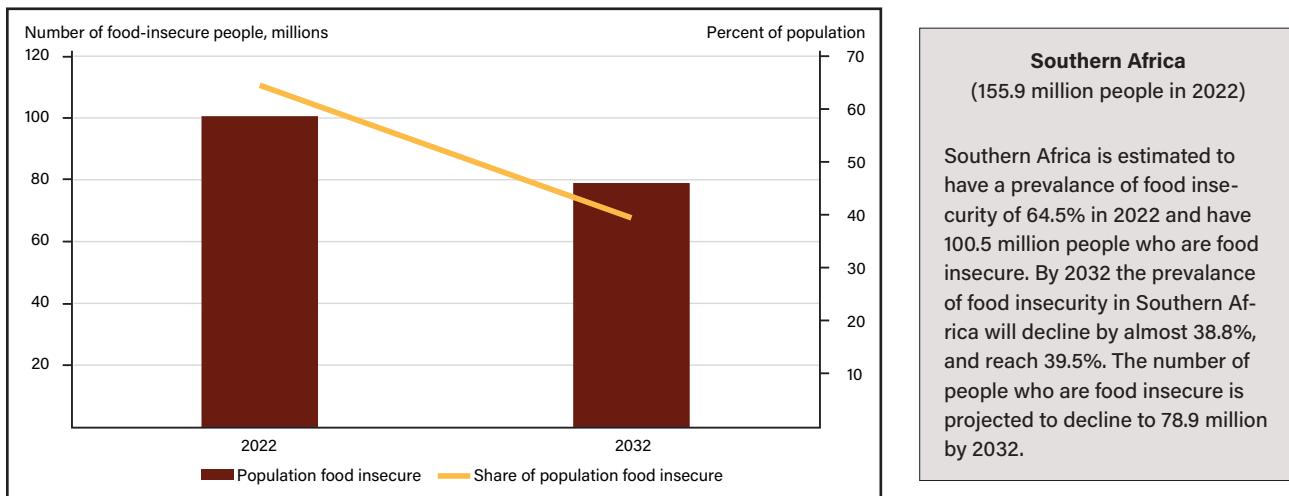
<sup>17</sup> The International Food Security Assessment report for 2021 contains the prevailing macroeconomic projections at the time of last year's estimation, which can be found in Baquedano et al. (2021).

Table 8  
Food security indicators for Southern Africa sub-region, 2022 and 2032

Year	Food grain demand	Other grain demand*	Total grain demand	Grain production	Implied additional supply required**
Million tons					
2022	19.0	15.3	34.3	16.2	18.1
2032	28.2	17.2	45.3	17.7	27.7

\*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.

Source: USDA, Economic Research Service.



Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

	Population		Population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (total)*	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million	Million	Million	Million	Percent	Percent	Kcal/day	Kcal/day	1,000 metric tons	1,000 metric tons
<b>Southern Africa</b>	<b>155.9</b>	<b>199.9</b>	<b>100.5</b>	<b>78.9</b>	<b>64.5</b>	<b>39.5</b>	<b>575</b>	<b>465</b>	<b>7,066</b>	<b>4,484</b>
Angola	34.8	48.4	18.8	23.6	53.9	48.8	456	433	1,089	1,303
Lesotho	2.0	2.2	1.1	0.3	55.9	14.3	426	267	56	10
Madagascar	28.2	34.6	20.2	17.3	71.5	50.1	523	414	1,513	1,027
Malawi	21.6	26.6	10.9	2.8	50.4	10.4	453	283	575	91
Mozambique	31.7	40.9	21.0	13.2	66.2	32.3	563	397	1,523	677
Namibia	2.7	3.2	1.3	0.7	48.5	20.5	343	252	56	21
Eswatini	1.1	1.2	0.5	0.2	41.9	17.0	345	259	19	6
Zambia	18.6	24.4	14.5	14.7	78.0	60.4	752	616	1,294	1,078
Zimbabwe	15.1	18.3	12.3	6.1	81.5	33.2	667	391	940	271

\*Measured in grain equivalents.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

From 2022 to 2032, SAF's GDP is projected to expand 3.4 percent a year, a reversal of the previous contraction of 0.6 percent a year during 2016–21 (appendix C). With a projected annual population growth rate of 2.0 percent—a slight decline from 2.2 percent a year during the 2016–21 period—the population in the Southern Africa region is expected to increase from 156 million in 2022 to 200 million people in 2032 (table 8; appendix C). The projected population and GDP growth trends imply that, over the same period, annual SAF's GDP per capita is projected to expand by 1.4 percent a year, which is an improvement from -1.6 percent a year during 2016–21 (appendix C). GDP per capita in SAF is estimated to grow from \$1,351 in 2022 to \$1,474 in 2032 (table 4). Reflecting the projected income growth and moderation of food prices over 2022–32, the prevalence of SAF food insecurity is expected to decline by 38.8 percent from its 2022 level to 39.5 percent. The number of food insecure people in the SAF sub-region is projected to decline by 21.5 percent, from 100.5 million in 2022 to 78.9 million in 2032 (table 8). All SAF countries are projected to see an improvement in their daily per capita calorie food gap in the next decade. The daily per capita calorie food gap—which represents the difference between estimated consumption and the daily requirement of 2,100 kcal—is projected to decline 19.1 percent, from 575 kcal in 2022 to 465 kcal in 2032 (table 8).

By 2032, Lesotho and Malawi are projected to make the most progress at reducing the prevalence of food insecurity—in Lesotho by 74.4 percent and in Malawi by 79.4 percent (table 8). Over the coming decade, Mozambique's GDP is expected to grow annually by 5.7 percent (the fastest in the sub-region) and its population by 2.6 percent. As a result of these trends, GDP per capita in the country is projected to increase significantly, from \$597 in 2022 to \$803 in 2032. Real domestic prices of major grains in Mozambique are projected to increase at a significantly lower rate (1 percent annually) than per capita GDP (appendix C). Reflecting the projected macroeconomic trends, the share of the population considered food insecure is expected to decline by 51.2 percent to 32.3 percent in 2032. By contrast, Angola is projected to make the least progress over the decade, reducing its share of the population considered food insecure by 9.5 percent. Angola and Zambia are projected to see an increase in the number of food insecure people between 2022 and 2032 (table 8). The anticipated high level of food insecurity in Zambia in 2032 mainly reflects slower projected per capita GDP growth (0.7 percent a year from 2022 to 2032) and increasing prices for major grains (9.4 percent a year) (appendix C).

## West Africa (WAF)

The food security environment in West Africa (WAF) and the Sahel region continues to be markedly affected by conflict and political instability. Persistent insecurity and armed conflict continue to cause massive population displacement in the region, particularly in Central Sahel and Liptako-Gourma, Burkina Faso, the Lake Chad Basin, and Nigeria (WFP and FAO, 2021). As countries grapple with the COVID-19 challenges, the recent surges in food and feed prices added a new dimension to the worsening food insecurity situation in the region. Staple food prices remained above the 5-year average, especially in Nigeria. Cross-border trade remained below average due to lingering COVID-19 restrictions, harassment along corridors, transport costs, governmental restrictions, and insecurity-related disruptions (FEWS NET, 2021). Higher prices of agricultural commodities (especially coarse grains) were observed in WAF during 2021, particularly in the regions where worsening conditions continued to disrupt food trade and markets (FAO, 2021b). Several countries (e.g., Ghana, Guinea, Liberia, Nigeria, and Sierra Leone) in the WAF region have already experienced high inflation (African Development Bank, 2021e).

The population of WAF is estimated at 426 million people in 2022 and is projected to grow 2.4 percent a year over the coming decade. GDP is also projected to grow by 4.4 percent a year from 2022 to 2032, reaching \$1.1 trillion (appendix C). GDP per capita in 2022 (\$1,855) increased by 3.5 percent relative to 2021 (Baquedano et al., 2021); however, this estimate is still slightly below the 2019–21 average (-0.4 percent) and 2.5 percent below its pre-pandemic level of \$1,905 in 2019 (table 3). In WAF, 34.1 percent of the population is unable to meet the daily nutritional requirement in 2022, the lowest estimate in SSA (table 4). The number

of food insecure people in WAF in 2022 is estimated at 145.1 million (Nigeria accounts for 59 percent of this estimate) (table 9). Nigeria has the largest economy and is the most populous country in the WAF sub-region. Inflation and high food prices in Nigeria are projected to increase further, affecting access to food (WFP and FAO, 2021). In addition to the widespread socioeconomic effects from the COVID-19 pandemic, rising conflict and violence in the northeastern and north-central parts of the country continue to impact food security (WFP and FAO, 2021).

The food security environment in the Central Sahelian countries of the WAF sub-region—including Burkina Faso, Mali, and Niger—continues to be affected by protracted armed conflicts as well as the socioeconomic effects from the COVID-19 pandemic. Burkina Faso and Mali were also impacted by decreased cotton prices in 2020, a major source of export revenues for both economies. In the conflict areas of the Central Sahelian countries, displaced populations face limited access to food (GNFAC, 2020). Moreover, severe disruptions to marketing chains were reported because of the pandemic, affecting price levels for the general populations of Central Sahelian countries. In Liberia and Sierra Leone, the main drivers of the declining economic environment and deteriorating food security metrics since 2021 have been the continued impacts from the COVID-19 pandemic, high food price inflation, and a strong depreciation of the local currency. Moreover, the lack of inputs in 2020 and 2021—particularly because of high fertilizer prices—continued to depress crop outputs (FAO and WFP, 2020).

Despite the challenging macroeconomic and food security environment in the Central Sahelian countries of the WAF sub-region in 2021 and 2022—Burkina Faso, Mali, and Niger are projected to see a moderate rebound in economic growth prospects over the next decade. By 2032, the prevalence of food insecurity across the three countries is projected to decline by 65.9 percent to 11.5 percent, with the sharpest declines projected in Burkina Faso and Niger (table 9).

Over the next decade, the number of food insecure people in WAF is projected to decline by 51.3 percent to 70.6 million people. The prevalence of food insecurity in the WAF sub-region is projected to fall by 62.1 percent to 12.9 percent of its population (table 9). By 2032, Benin, Cabo Verde, Gambia, Ghana, Guinea, Mauritania, and Senegal are projected to be among the least food insecure countries in the WAF sub-region, with less than 10 percent food insecurity rates. Côte d’Ivoire and Ghana are projected to see real income gains over the next decade, as GDP growth is projected to outpace population growth. By 2032, Ghana is projected to cut the prevalence of food insecurity by 76.4 percent and the number of food insecure people by 71 percent. Over the next decade, in Côte d’Ivoire, the share of the population considered food insecure is projected to decline by 51.7 percent and the number of food insecure people to decline by 40.7 percent (table 9). By 2032, GDP per capita in Gambia is projected to make a strong recovery and grow at a rate of 3.6 percent a year (appendix C). Given the expected robust income gains in Gambia, the prevalence of food insecurity is projected to decline by 89.7 percent to 3.1 percent of the population being food insecure, and the number of food insecure people by 88 percent to fewer than 100,000 people being food insecure (table 9). Guinea-Bissau’s income growth is anticipated to be less than Gambia’s, with GDP per capita growth projected at 0.9 percent per year from 2022 to 2032 (appendix C). The prevalence of food insecurity in Guinea-Bissau is projected to decline 50.5 percent by 2032, but reflecting the slower income growth, more than a quarter of the population may not be able to consume 2,100 kcal a day. Sierra Leone is projected to make the least progress over the next decade, with the prevalence of food insecurity projected to decline by 34 percent to 32.6 percent of the population (table 9) being food insecure.

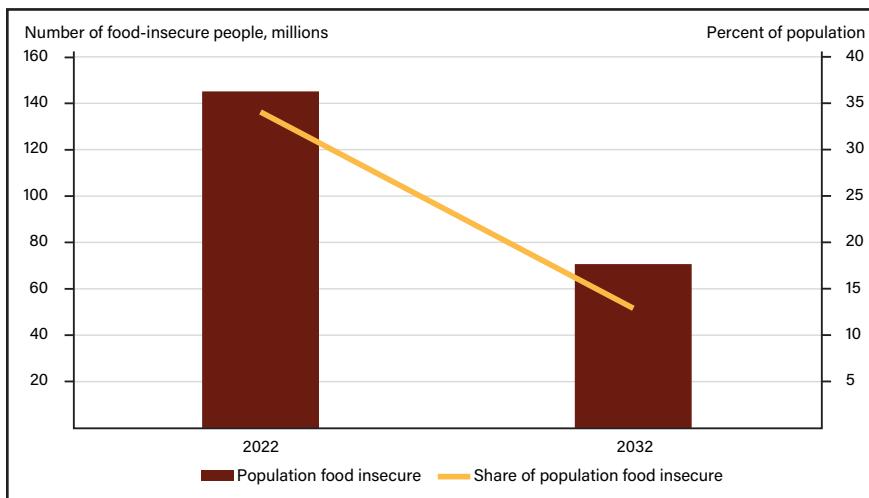
Over the next decade, all WAF countries included in IFSA are projected to see an improvement in the daily per capita calorie food gap, with a projected decrease of 22 percent, from 382 kcal in 2022 to 298 kcal in 2032 (table 9).

Table 9  
Food security indicators for the West Africa sub-region, 2022 and 2032

Year	Food grain demand	Other grain demand*	Total grain demand	Grain production	Implied additional supply required**
Million tons					
2022	65.4	37.6	103.0	54.9	48.2
2032	97.8	46.5	144.3	69.5	74.8

\*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.

Source: USDA, Economic Research Service.



Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

**West Africa**  
(425.8 million people in 2022)

West Africa has the largest population of the Sub-Saharan Africa sub-regions in the assessment. West Africa is also the most food secure region in Sub-Saharan Africa, with the prevalence of food insecurity estimated at 34.1% in 2022, and the number of food insecure people in the sub-region estimated at 145.1 million people in 2022. By 2032 the prevalence of food insecurity in West Africa will decline by 62.1%, and reach 12.9%. The number of people who are food-insecure is projected to decline to 70.6 million by 2032.

	Population		Population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (total)*	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million	Million	Million	Million	Percent	Percent	Kcal/day	Kcal/day	1,000 metric tons	1,000 metric tons
<b>West Africa</b>	<b>425.8</b>	<b>547.2</b>	<b>145.1</b>	<b>70.6</b>	<b>34.1</b>	<b>12.9</b>	<b>382</b>	<b>298</b>	<b>7,249</b>	<b>2,753</b>
Benin	13.8	19.0	3.4	1.0	24.7	5.4	336	245	154	34
Guinea-Bissau	2.0	2.6	1.1	0.7	54.3	26.9	432	325	62	30
Burkina Faso	21.9	27.4	8.1	3.6	36.9	13.1	489	369	492	165
Cabo Verde	0.6	0.7	0.2	0.1	41.0	8.8	353	234	11	2
Côte d'Ivoire	28.7	35.2	7.5	4.4	26.0	12.6	427	358	458	228
Gambia	2.3	2.6	0.7	0.1	30.5	3.1	327	206	25	2
Ghana	31.0	38.1	4.4	1.3	14.2	3.4	275	215	154	35
Guinea	13.2	17.4	3.2	1.2	24.2	7.1	363	279	181	54
Liberia	5.4	7.0	3.3	1.8	61.9	25.4	638	442	237	88
Mali	20.7	27.5	5.6	2.9	27.1	10.6	355	284	253	105
Mauritania	4.2	5.0	1.0	0.2	25.1	4.8	338	241	45	7
Niger	24.5	35.1	9.6	4.0	39.3	11.3	459	327	620	182
Nigeria	225.1	289.1	85.3	44.1	37.9	15.2	365	280	3,921	1,551
Senegal	16.5	20.2	4.6	1.0	28.0	4.9	297	205	193	28
Sierra Leone	7.0	8.9	3.4	2.9	49.4	32.6	519	439	276	197
Togo	9.0	11.4	3.6	1.4	39.9	11.9	373	265	168	45

\*Measured in grain equivalents.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

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## North Africa

North Africa (NAF) is the most food-secure region in the IFSA analysis, with 18.0 percent of its regional population (36.3 million) estimated to be food insecure in 2022 (table 11). Nonetheless, the NAF region is estimated to be one of the most affected regions by increasing food price inflation and Russia's military invasion of Ukraine. As a result of the Russian invasion of Ukraine, the 2022 estimate for the number of food insecure people in the NAF region is 6.0 percent (2.1 million people) higher than the pre-invasion estimates (appendix B). The country most affected is Egypt, as it heavily depends on wheat imports from the Black Sea Region (box "Egypt Depends on Imports from the Black Sea Region"). Egypt accounts for 66.4 percent (1.4 million) of the estimated additional food insecure people because of the invasion.

The 2022 GDP per capita for the region is estimated as \$3,834, which is 8.5 percent higher than its 2021 value (\$3,537) (table 1; table 10). The 2022 GDP per capita growth is mainly driven by an expectation of growth in Egypt's GDP. However, the countries in the region continue to be affected by the economic slowdown associated with the COVID-19 pandemic. Moreover, Russia's military invasion of Ukraine exacerbated Egyptian budget problems, as the cost of food subsidies has increased significantly during the first quarter of 2022. The impact on the energy and tourism sectors of North Africa—both main sources of government revenues and employment for low-income workers—continues to affect the purchasing power of households, especially in urban areas (FAO, 2021). Continued subsidies for basic food commodities mitigated income decline while also buffering consumers from recent international food price increases (FAO, 2021). The recent food price hike compounded food security in the NAF region.

### **Egypt Depends on Imports from the Black Sea Region**

Egypt is the world's largest wheat importer, importing 12 million–13 million tons of wheat annually. Egypt imports 62 percent of its wheat, with 38 percent produced domestically. Egypt is also the largest importer of Russian wheat—importing 21 percent of Russia's total wheat exports (8.1 million metric tons) in the 2020/2021 marketing year. Egypt is the second largest importer of Ukrainian wheat—importing 15 percent of Ukraine's wheat (2.5 million metric tons) in 2020/2021 (Trade Data Monitor, 2022).

Egypt's wheat imports are driven by its extensive consumption of bread. Egyptians consume 150–180 kilograms of bread annually per capita. This is more than double the global average of 70–80 kilograms (Tanchum, 2022). As such, bread accounts for 35–39 percent of the caloric intake of Egyptians (Abay, 2022). Bread is the most heavily subsidized food item in the Egyptian Government's budget and has been subsidized since 1988. Sourcing wheat to subsidize bread is expensive: \$3.24 billion is paid annually by the Egyptian Government to finance the bread subsidy program. This subsidy program offers five loaves of subsidized Baladi bread daily to roughly 70 million people (70 percent of the population). To keep this subsidy program running, 9 million tons of wheat are required annually, which is three-quarters of Egypt's food imports (Abay, 2022).

The start of Russia's invasion of Ukraine on February 24, 2022, had an almost immediate impact on the Egyptian economy. Global wheat prices rose sharply. In the month prior to the invasion, the global price of wheat was slightly less than \$300 per ton. Early in March 2022, the price escalated to \$523 per ton—among the highest global wheat price ever reported. This price led to the Egyptian Government paying an additional \$763 million on top of its annual \$3.2 billion budget for wheat subsidies (WFP, 2022). As global wheat prices remain at high levels and volatility continues, the pressure on Egypt's budget remains significant.

The share of the NAF population estimated to be food insecure in 2022 increased by 24.7 percent from 2021 (table 11; appendix B). Egypt is estimated to have both the highest prevalence of food insecurity (19.7 percent) and the highest number of food insecure people (21.4 million) in the region. By contrast, Tunisia and Morocco are estimated to have the lowest levels of food insecurity in the region—with 13.5 percent and 12.9 percent, respectively, of their populations considered food insecure (table 11). However, compared to 2021, the food insecurity rate in Tunisia more than doubled in 2022, the highest increase in the region (Baquedano et al., 2021). Over the last few years, the COVID-19 pandemic significantly impacted Tunisia’s tourism sector—leading to a sharp contraction of its economy, rising debt levels, and high inflation and unemployment rates that are close to 20 percent (IMF, 2022; World Bank, 2021). NAF countries import grains, especially wheat from Russia and Ukraine, the world’s leading wheat exporters. The Russian military action in Ukraine and the ensuing crisis are expected to push wheat prices into record highs and likely cause a further increase in food insecurity in NAF countries.

**Table 10**  
**Inflation adjusted per capita income for the North Africa region, 2022 and 2032**

	2019 (pre-COVID-19)	2021	2022	2032
	U.S. dollars, 2015			
<b>North Africa</b>	<b>3,864</b>	<b>3,537</b>	<b>3,834</b>	<b>4,873</b>
Algeria	4,190	3,838	3,790	4,271
Egypt	3,950	3,551	4,112	5,367
Morocco	3,188	3,068	3,087	3,986
Tunisia	3,973	3,732	3,743	4,864

Source: USDA, Economic Research Service International Macroeconomic Dataset.

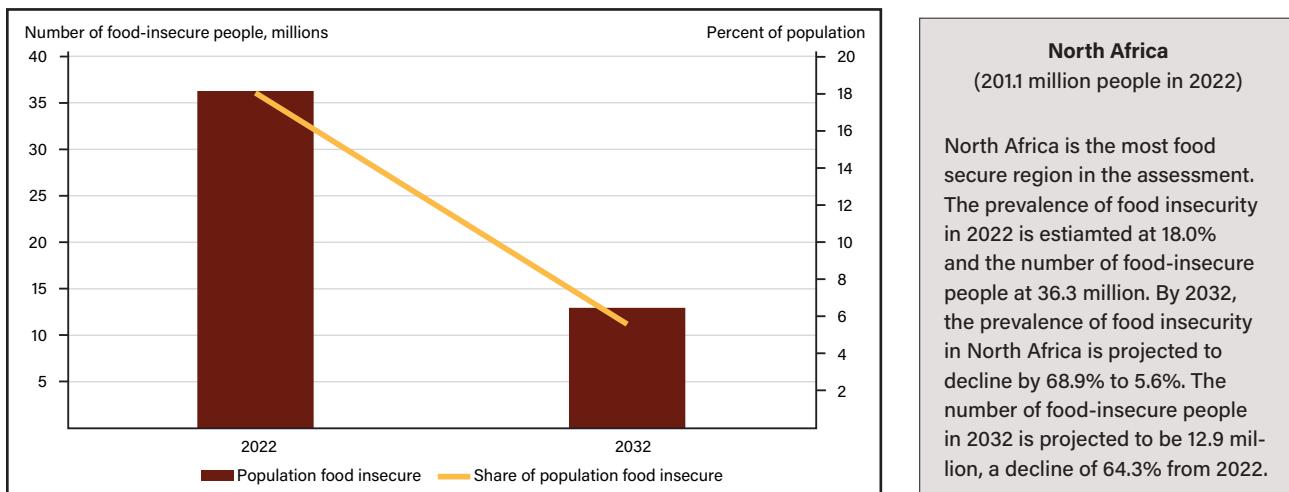
The NAF region’s GDP is projected to expand by 3.3 percent, from \$771 billion in 2022 to \$1.1 trillion in 2032. (appendix C). With an anticipated annual population growth rate of 1.0 percent, the population in the NAF region is projected to increase from 201 million to 231 million people by 2032 (appendix C). During the same period, GDP per capita is anticipated to expand by 2.3 percent (an improvement from 0.3 percent from 2016–21) annually, from \$3,834 to \$4,873 (table 10; appendix C).

Table 11  
Food security indicators for North Africa region, 2022 and 2032

Year	Food grain demand	Other grain demand*	Total grain demand	Grain production	Implied additional supply required**
	Million tons				
2022	46.9	43.1	90.0	33.8	56.1
2032	61.6	51.2	112.9	43.1	69.8

\*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.

Source: USDA, Economic Research Service.



Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

	Population		Population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (total)*	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million	Million	Million	Million	Percent	Percent	Kcal/day	Kcal/day	1,000 metric tons	1,000 metric tons
<b>North Africa</b>	<b>201.1</b>	<b>231.2</b>	<b>36.3</b>	<b>12.9</b>	<b>18.0</b>	<b>5.6</b>	<b>317</b>	<b>255</b>	<b>1,466</b>	<b>420</b>
Algeria	44.2	49.1	8.5	2.2	19.3	4.6	314	239	350	70
Egypt	108.7	130.5	21.4	9.2	19.7	7.1	335	271	877	305
Morocco	36.2	39.1	4.7	1.2	12.9	3.1	295	233	182	37
Tunisia	11.9	12.5	1.6	0.3	13.5	2.3	281	212	57	8

\*Measured in grain equivalents.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

By 2032, reflecting income and population trends over the next 10 years, 12.9 million people are projected to be food insecure in the NAF region, a 68.9-percent decline from 2022 (table 10). The per capita daily caloric food gap (defined as the difference between estimated consumption and the daily nutritional threshold of 2,100 kcal) in the NAF region is projected to decline from 317 kcal in 2022 to 255 kcal in 2032, a 19.8-percent reduction (table 11). Egypt is expected to account for most of the region's food insecure population in 2032.

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## Latin America and the Caribbean

The population of the Latin America and the Caribbean (LAC)<sup>18</sup> region in 2022 is estimated to be more than 177 million and is projected to reach 194 million by 2032 (table 13). The average population growth rate for LAC countries is projected to decline to 0.9 percent in 2022–32 compared to a 1.1 percent annual growth rate during the 2016–21 period (appendix C). The Gross Domestic Product (GDP) of LAC is estimated to increase by 3.9 percent in 2022, following a strong rebound of 5.4 percent in 2021 after the 2020 COVID-19 induced recession when the region’s GDP fell by 7.6 percent (appendix III; Baquedano et al., 2021). Despite the spread of new pandemic variants and expectations for higher price inflation, GDP growth for LAC is expected to exceed pre-pandemic levels early in the projection period and continue to grow between 2022–32, at an average of 3.1 percent annually (appendix C).

Prolonged lockdowns and high levels of informal employment affected economic activity and per-capita incomes. This situation—compounded by the resurgence of inflation—reduced the food security gains of past years. In 2022, 28.7 percent of the LAC population is estimated to be food insecure, which is 1.5 percentage points higher than in 2021 (table 13; Baquedano et al., 2021). Food insecurity differs across countries in the LAC region due to their populations, economic conditions, and government policies in place to benefit vulnerable populations. The estimated prevalence of food insecurity during 2022 ranged from 13.5 percent in the Dominican Republic to 65.4 percent in Haiti (appendix B). The number of people considered food insecure in 2022 in the LAC region is estimated to be 50.9 million. The Russian military invasion and fertilizer and energy price increases account for close to 2 percent of this estimated number of food insecure people (1 million people) in the LAC region (see box “Global Trade Analysis Project (GTAP): A Computable General Equilibrium (CGE) Model” for details on these factors) (appendix B).

The pandemic exacerbated the structural problems historically affecting the LAC region, including high inequality, severe social coverage gaps, a high degree of labor informality, and high prevalence of food insecurity. Some of the significant developments in 2021—the rebound in the region’s economic growth, the spread of new pandemic variants, and the high prices of food commodities—remain influential on the 2022 economic outlook.

At the country level, the economic recovery is expected to be more heterogeneous. Colombia, Dominican Republic, Guatemala, and Peru registered more significant rebounds in 2021 than other LAC countries and are expected to recover fully, experience a faster recovery, and have higher long-term GDP growth (averaging 3.7 percent between 2022–32). By contrast, Bolivia, Ecuador, El Salvador, Honduras, and Jamaica suffered huge pandemic induced contractions in GDP in 2020, and the estimated long-term recovery for these countries remains limited through 2032, with growth averaging 2.8 percent over the next 10 years. The economies of Haiti and Nicaragua—which were already experiencing low growth rates prior to the economic crisis—continue to experience the impacts of the evolving pandemic situation, enduring economic disruption to business activity, employment, and remittances. GDP growth in these economies is expected to average 2.4 percent in 2022–32 (appendix C).

In 2022, GDP per capita growth in the LAC region is expected to increase 2.7 percent from 2021, a strong rebound from the 9.0 percent decline in 2020. GDP per capita is projected to grow at 2.6 percent a year for the next 10 years (appendix III; Baquedano et al., 2021). This growth implies that GDP per capita is projected to rise from \$5,324 in 2022 to \$6,875 in 2032 (table 12).

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<sup>18</sup> The countries studied include four Central American countries: El Salvador, Guatemala, Honduras, and Nicaragua; three Caribbean countries: the Dominican Republic, Haiti, and Jamaica; and four South American countries: Bolivia, Colombia, Ecuador, and Peru.

Table 12  
**Inflation adjusted per capita income for the Latin America and the Caribbean region, 2022 and 2032**

Region/subregion	2019 (pre-COVID-19)	2021	2022	2032
	U.S. dollars, 2015			
<b>Latin America and the Caribbean</b>	<b>5,395</b>	<b>4,936</b>	<b>5,324</b>	<b>6,875</b>
Central America and the Caribbean	3,935	3,789	3,942	5,007
South America	5,395	5,602	5,550	7,181

Source: USDA, Economic Research Service International Macroeconomic Dataset.

LAC countries' economic growth will remain a key factor in the region's outlook for improved food security. The food gap—the difference between estimated consumption and the nutritional threshold of 2,100 kcal—is estimated at 392 kcal per capita per day in 2022 and projected to decrease to 358 kcal per capita per day by 2032 (table 13).

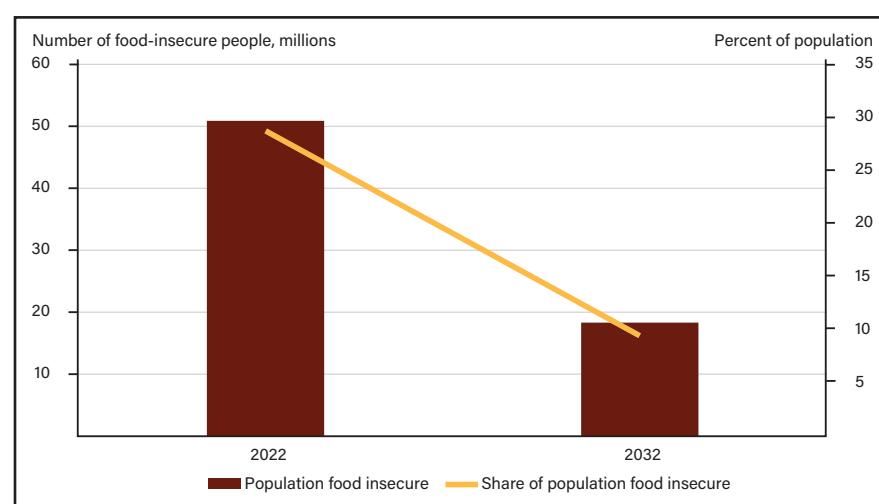
Table 13

## Food security indicators for the Latin America and the Caribbean region, 2022 and 2032

Year	Food grain demand	Other grain demand*	Total grain demand	Grain production	Implied additional supply required**
	Million tons				
2022	24.9	22.4	47.3	17.0	30.3
2032	30.5	26.7	57.2	20.3	37.0

\*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.

Source: USDA, Economic Research Service.



### Latin America and the Caribbean (177.1 million people in 2022)

The prevalence of food insecurity in Latin America and the Caribbean is estimated at 28.7% for 2022 and 50.9 million people are estimated to be food insecure. By 2032, the region is projected to make significant improvements in its food security indicators, mainly driven by improvements in South America. The prevalence of food insecurity is projected to fall by 67.1% by 2032 and reach 9.4%. The number of food-insecure people is projected to decline by 64.0%, to 18.3 million people.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

Region/subregion	Population		Population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (total)*	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million	Million	Million	Million	Percent	Percent	Kcal/day	Kcal/day	1,000 metric tons	1,000 metric tons
Latin America and the Caribbean	177.1	194.0	50.9	18.3	28.7	9.4	392	358	2,566	844
Central America and the Caribbean	64.9	71.5	24.3	12.2	37.4	17.0	396	301	1,473	663
South America	112.2	122.5	26.6	6.1	23.7	5.0	298	210	1,093	181

\*Measured in grain equivalents.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

## Central America and the Caribbean (CAC)

The Central America and the Caribbean (CAC) sub-region accounts for about a third of the population of Latin America and the Caribbean in 2022 but nearly half of the food insecure population. In CAC, 37.4 percent of the population is estimated to be food insecure in 2022 (table 13). CAC's GDP per capita growth rate over the next decade is projected to be 2.7 percent a year. By contrast, the population growth rate is estimated to be much lower, averaging 0.8 percent a year from 2022 to 2032 (appendix C). As a result of the higher rate of growth in incomes per capita, the prevalence of food insecurity is expected to decline from 37.4 percent in 2022 to 17.0 percent of the population in 2032. The number of food insecure people is also projected to decline, from 24.3 million to 12.2 million. By 2032, the daily per capita calorie food gap is anticipated to decline from 396 kcal in 2022 to 301 kcal in 2032 (table 13).

In 2022, Nicaragua, Honduras, and Guatemala continue to suffer the adverse effect from hurricanes Eta and Iota—which led to devastating losses of crops and livestock production, reducing people’s purchasing power. During the pandemic, El Salvador’s economy experienced a decline in services and tourism revenues. However, the decline was compensated with larger flows of family remittances. The government was able to provide fiscal support to low-income households, but family remittances provided more income support, totaling \$5.1 billion in 2021 (World Bank, 2021). In 2022, in El Salvador, 30.5 percent of the population is estimated to be food insecure, and this figure is projected to drop to 9.2 percent by 2032, a reduction of 69.8 percent (table 14). Guatemala’s GDP per capita is estimated at \$4,274 in 2022 and is projected to increase to \$4,775 by 2032, a 1.1 percent annual growth during the next 10 years (appendix C). In 2022, 37.5 percent of Guatemala’s population is estimated to be food insecure, however, the prevalence of food insecurity is projected to fall to 16.1 percent by 2032 (table 14).

GDP per capita in Honduras is projected to grow annually by 2.1 percent over the 2022–32 period, significantly improving the stagnant growth of per-capita income during the 2016–21 period (appendix C). In 2022, Honduras is estimated to have 37.1 percent of its population experiencing food insecurity. By 2032, the prevalence of food insecurity is projected to fall by 66.0 percent to 12.6 percent (table 14).

Prior to the pandemic, Guatemala experienced economic stability and relatively higher real GDP growth rates, compared to neighboring economies. This economic stability was anchored by conservative fiscal management, inflation targeting, and a managed floating exchange rate (World Bank, 2021). Pandemic-related lockdown measures resulted in falling demand, disruptions to supply chains, and lower fiscal revenues. The government has been able to provide fiscal support, expand social programs for families, and supplement family remittances. Agriculture is one of Guatemala’s largest economic sectors, and participation of multinational companies in the sector ensured less disruption to supply chains during the pandemic (IMF, 2021). In 2022, 37.5 percent of the population of Guatemala is estimated to be food insecure (table 14).

Nicaragua is Central America’s smallest economy, and 43.9 percent of Nicaragua’s 6.3 million population is estimated to be food insecure in 2022 (table 14). The pandemic crisis affected both per capita GDP and remittance inflows, significantly reduced trade and tourism, and disrupted food distribution (ECLAC, 2021). Per capita GDP in Nicaragua is projected to grow annually by 1.6 percent in the 2022–32 period, compared to the -1.5 percent growth in per-capita income during the 2016–21 period (appendix C). The prevalence of food insecurity in Nicaragua in 2032 is projected to decline 55.1 percent, to 19.7 percent (table 14).

Haiti’s GDP per capita is estimated at \$759 in 2022 and is projected to increase to \$852 by 2032, growing by 1.2 percent a year between 2022 and 2032 (appendix C). The country is estimated to have the highest share of food insecure people in the LAC region (appendix B). Since the start of the pandemic in 2019, Haiti has been among the 10 countries experiencing acute food crises—a level of food insecurity that requires urgent life and livelihood-saving assistance—in the world (WFP and FAO, 2021). During the pandemic, the Haitian economy has been sustained by an increase in the flow of family remittances (FAO, 2021). Despite dire fiscal conditions, the government was able to provide cash transfers and food assistance to some of the most vulnerable, which partly helped alleviate the food insecurity condition in Haiti (USAID, 2021). Of the estimated 11.3 million people in Haiti, 65.4 percent are estimated to be food insecure in 2022 (table 14). Over the next 10 years, Haiti is projected to make the least progress in terms of food security metrics in the sub-region. Despite an anticipated drop by 35.0 percent in the prevalence of food insecurity by 2032, 42.5 percent of the population will still be projected to be food insecure (table 14).

The economy of the Dominican Republic was severely impacted by the pandemic as it relies heavily on the service and tourism sectors, which were both affected by lockdowns to restrict the spread of the virus. In 2022, 13.5 percent of the population of the Dominican Republic is estimated to be food insecure (table 14). The annual GDP growth in the Dominican Republic is projected to average 4.7 percent over the next 10 years, which is the highest projected economic growth in the LAC region, while the population is projected to rise to 11.6 million (appendix C). The number of food insecure people in the Dominican Republic is projected to fall to just 0.2 million people in 2032 (table 14).

Jamaica is estimated to have 18.7 percent of its 2.8 million population experiencing food insecurity in 2022, the third least food insecure country in the LAC region (after the Dominican Republic and Colombia) (table 14). The important tourism sector—which contributes about 35.0 percent to GDP income—was significantly affected by pandemic-related border closures (World Bank, WDI, 2022). Jamaica is expected to make the most progress in its food security status over the next decade in the CAC sub-region, with the prevalence of food insecurity projected to decline 87.2 percent to just 2.4 percent by 2032 (table 14).

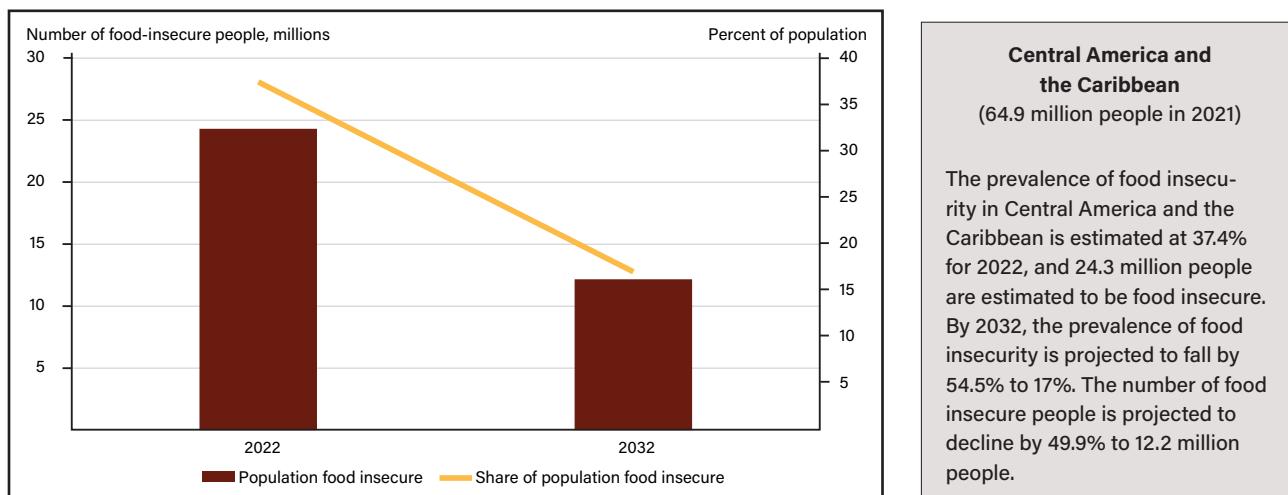
Table 14

## Food security indicators for the Central America and the Caribbean sub-region, 2022 and 2032

Year	Food grain demand	Other grain demand*	Total grain demand	Grain production	Implied additional supply required**
	Million tons				
2022	7.5	5.4	12.8	4.0	8.8
2032	9.3	5.9	15.2	4.6	10.6

\*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.

Source: USDA, Economic Research Service.



Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

	Population		Population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (total)*	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million	Million	Million	Million	Percent	Percent	Kcal/day	Kcal/day	1,000 metric tons	1,000 metric tons
<b>Central America and the Caribbean</b>	<b>64.9</b>	<b>71.5</b>	<b>24.3</b>	<b>12.2</b>	<b>37.4</b>	<b>17.0</b>	<b>396</b>	<b>301</b>	<b>1,473</b>	<b>663</b>
Dominican Republic	10.7	11.6	1.4	0.2	13.5	1.3	237	167	49	4
El Salvador	6.6	6.7	2.0	0.6	30.5	9.2	316	236	72	16
Guatemala	17.7	20.4	6.6	3.3	37.5	16.1	386	301	292	113
Haiti	11.3	12.6	7.4	5.4	65.4	42.5	755	605	734	427
Honduras	9.5	10.5	3.5	1.3	37.1	12.6	385	285	152	43
Jamaica	2.8	2.9	0.5	0.1	18.7	2.4	246	172	17	2
Nicaragua	6.3	6.8	2.8	1.3	43.9	19.7	447	344	157	59

\*Measured in grain equivalents.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

## South America (SA)

In 2022, an estimated 23.7 percent of the population (26.6 million people) of the South American (SA) sub-region is considered food insecure (table 15). GDP per capita in SA decreased from \$5,602 in 2021 to \$5,550 in 2022 (table 12), however it is projected to grow at 2.5 percent annually over the next decade (appendix C).

Bolivia is the second highest food insecure country in the LAC region—after Haiti—and the most food insecure among the South American countries considered in this assessment, with 47.3 percent of its 12 million population estimated to be food insecure (table 15). The food security situation in Bolivia is anticipated to continue to worsen in 2022, with primary drivers including the socioeconomic impacts of the pandemic, reduced aid, and a decline in remittances, among others. The pandemic severely affected GDP per capita and remittances in Bolivia. However, due to an anticipated economic recovery, GDP per capita is projected to grow by 2.3 percent per year during the 2022–32 period (appendix C). In sharp contrast with all other LAC countries in the IFSA assessment, Bolivia adopted mitigation measures based mainly on employment protection and income transfers to the self-employed and the most vulnerable, which helped keep a larger number of people employed and alleviated the loss of income from wages and salaries for many, ultimately preventing a more severe reduction in national per capita income levels (ECLAC, 2021). While food prices remained stable during most of 2020, emerging food supply problems in 2021 are projected to lead to rising food prices in the longer term. As a result, prices of major grains in Bolivia are projected to increase (0.6 percent annually) over the 2022–32 period (appendix C). The prevalence of food insecurity in Bolivia is projected to decline by 69.0 percent by 2032, the sharpest decline in the South American sub-region. As a result, the number of food insecure people in Bolivia is projected to fall from 5.7 million in 2022 to 2 million by 2032 (table 15).

Colombia is an important agricultural producer and exporter. Unlike other sectors, the agricultural sector was less affected by the pandemic and recorded growth for 2021. The extended lockdowns to contain the pandemic, social unrest, blockades, and violent protests significantly impaired Colombia's marketing and distribution of food (USDA, FAS, 2021). Large fiscal measures to support the most vulnerable households were successful in softening the impact of the drastic reduction in economic activity. A strong economic performance is expected in 2022, as an increase in vaccination rates and the adverse effects of the COVID-19 pandemic fade. The prevalence of food insecurity in Colombia is estimated at 14.8 percent, significantly below the sub-regional average for SA of 23.7 percent (table 15). Colombia's population of 50.4 million people in 2022 is projected to increase by an additional 4.5 million people by 2032 (table 15). A large share of the projected population increase is driven by more than 1.74 million migrants, refugees, and asylum seekers from Venezuela (UNHCR, 2021). By 2032, Colombia is projected to have 1.9 percent of its population considered food insecure, an 87.1 percent decline in the prevalence of food insecurity from 2022 estimates (table 15).

Ecuador is the third most populous South American country included in IFSA, with 17.3 million people in 2022. In 2022, 33.6 percent of its population is estimated to be food insecure (table 15). Ecuador derives an important share of its GDP from crude oil exports. The recent rise in oil and energy prices benefited Ecuador's economy—as is also the case for other energy-export dependent countries (such as Colombia and Bolivia). In all three countries, the expected positive terms-of-trade for energy products will contribute to economic growth in 2022.

As a result, GDP per capita in Ecuador is projected to annually increase 2.1 percent during 2022–32 (appendix C). By 2032, Ecuador is expected to see a reduction of 77.3 percent in food-insecurity prevalence (to 7.6 percent of the population being food insecure)—driven by anticipated increases in per capita income, higher export revenues, and increased food production (table 15). Agriculture has traditionally employed a large proportion of the population in the production of subsistence food crops—including grains, potatoes, beans, and cassava. Commercial production of tropical crops (e.g., coffee, cacao, and bananas) allows Ecuador to buy rice and wheat imports.

Peru had better economic fundamentals than all other countries in the LAC region, which allowed for an unprecedented expansion of fiscal and monetary transfers to counter the effects of strict lockdowns, which lasted for several months resulting in significant job losses. The currency depreciation also helped increase foreign exchange revenues to the country from agricultural exports. Peru is estimated to have 23.5 percent of its population considered food insecure in 2022 (table 15). Agricultural production in Peru was hindered in the near term by weather effects, which resulted in reduced 2022 plantings (FAO, 2021). However, with an anticipated increase in production over the medium term,<sup>19</sup> food insecurity is estimated to drop significantly—from 7.6 million in 2022 to 1.6 million in 2032, a reduction in food insecurity of 79.9 percent (table 15). GDP per capita in Peru is projected to annually increase 3.1 percent during 2022–32 (appendix C).

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<sup>19</sup> The medium-term is typically defined as 3–5 years.

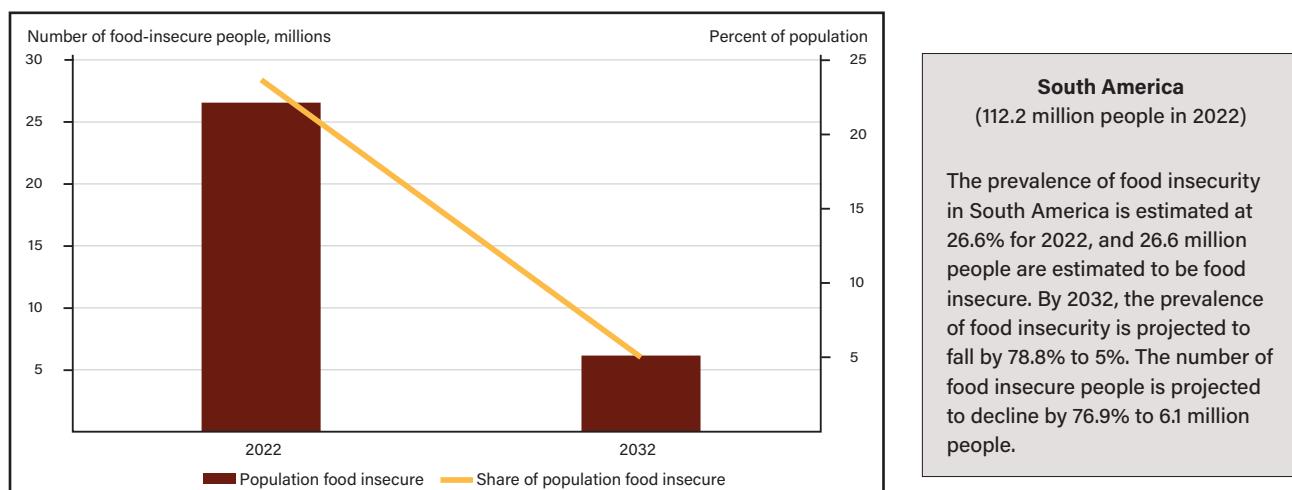
Table 15

## Food security indicators for the South America sub-region, 2022 and 2032

Year	Food grain demand	Other grain demand*	Total grain demand	Grain production	Implied additional supply required**
Million tons					
2022	17.4	17.1	34.4	12.9	21.5
2032	21.2	20.8	42.0	15.7	26.3

\*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.

Source: USDA, Economic Research Service.



Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

	Population		Population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (total)*	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million	Million	Million	Million	Percent	Percent	Kcal/day	Kcal/day	1,000 metric tons	1,000 metric tons
South America	112.2	122.5	26.6	6.1	23.7	5.0	298	210	1,093	181
Bolivia	12.0	13.5	5.7	2.0	47.3	14.7	351	241	261	63
Colombia	50.4	54.9	7.5	1.1	14.8	1.9	269	194	290	29
Ecuador	17.3	19.1	5.8	1.5	33.6	7.6	282	195	228	40
Peru	32.5	34.9	7.6	1.6	23.5	4.7	292	211	313	49

\*Measured in grain equivalents.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

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## Asia

In the Asian region, the prevalence of food insecurity (26.6 percent) for 2022 is anticipated to remain relatively unchanged from its 2021 estimate (appendix B; Baquedano et al., 2021). Most governments in Asia prioritized protecting the agricultural sector and key food supply chain actors during the pandemic (WFP-RBB and Dikoda, 2022). Despite these measures, the region is estimated to have the most food insecure people (676.2 million) of any IFSA region in 2022 (table 17; appendix B). The higher number of food insecure people in many Asian countries is not only due to reduced incomes but mobility restrictions, weak fiscal and monetary measures, persistent energy and food inflation, and supply chain disruptions from the Delta and Omicron COVID-19 variants (IMF, 2022). The effects of multiple waves of the COVID-19 pandemic will continue to impact the economies of the Asian region, especially with respect to inflation and supply chain disruptions.

Russia's invasion of Ukraine and higher fertilizer and energy prices, which caused food prices to reach record levels, affected the Asian region's food security metrics the most of any region in the IFSA. An estimated 28.9 million additional people are estimated to be food insecure in Asia because of Russia's war in Ukraine. The Commonwealth of Independent States (CIS) sub-region (12 percent increase), which includes Ukraine, and the Southeast Asian sub-region (5.5 percent increase) are anticipated to see the sharpest increases in the prevalence of food insecurity within the Asian region. In absolute terms, the Central and Southern Asian sub-region is estimated to have the largest increase in food insecure people (21.9 million) as it includes India, the country with the largest population in IFSA (appendix B).

The per capita GDP for the Asian region in 2022 (\$2,336) is estimated to grow by 5.2 percent relative to 2021 (\$2,221), which is 2.5 percent higher than its 2019 (pre-COVID) value (\$2,279) (table 16). However, the CIS sub-region is estimated to see an 8.1-percent decline in per capita GDP from 2021 and a 10.4-percent decline from its pre-pandemic level in 2019. The anticipated decline in per capita GDP mainly reflects the effects of Russia's military invasion of Ukraine.

Table 16  
Inflation adjusted per capita income for the Asian region, 2022 and 2032

Region/subregion	2019 (pre-COVID-19)	2021	2022	2032
	U.S. dollars, 2015			
Asia	2,279	2,221	2,336	3,616
Commonwealth of Independent States*	3,591	3,502	3,219	4,439
Central and Southern Asia	1,923	1,861	1,966	3,082
Other Asia	1,092	1,068	1,084	1,286
Southeast Asia	3,516	3,484	3,620	5,682

\*The members of Commonwealth of Independent States (CIS) are Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan. Turkmenistan is an associate member. Ukraine has not formally withdrawn from the organization but did formally end its participation in CIS statutory bodies in May 2018 (The World Fact Book, 2022). The subregional and regional aggregation here is based on the recognition of this note and is meant to facilitate comparison of food security trends across subregions.

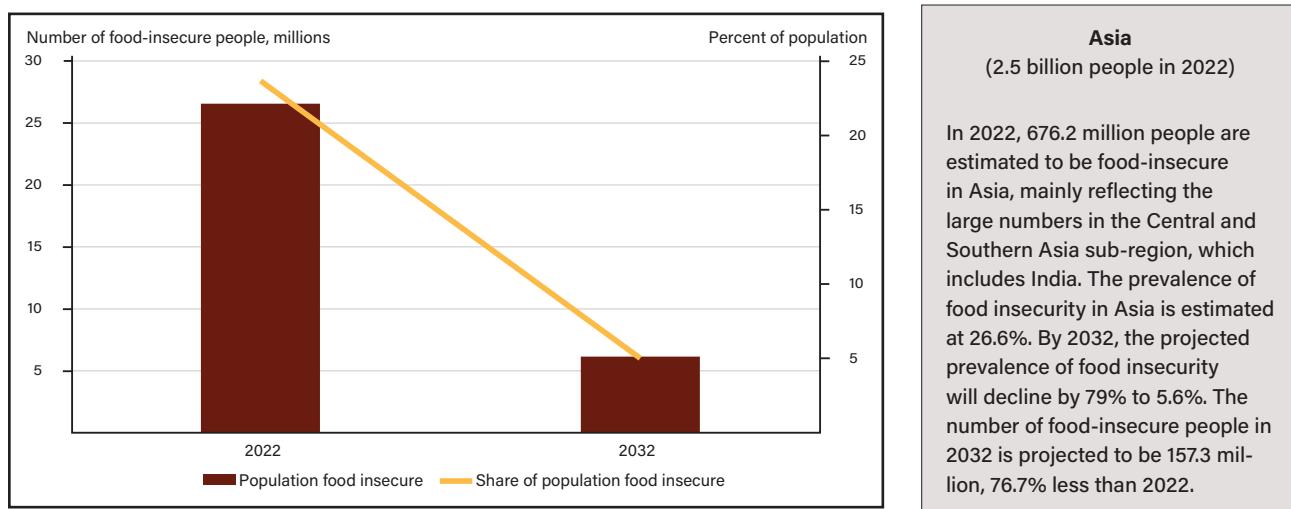
Source: USDA, Economic Research Service International Macroeconomic Dataset.

Food security in Asia is expected to improve between 2022 and 2032. Over the next 10 years, the number of food insecure people in Asia is projected to decline by 76.7 percent to 157.3 million people in 2032 (table 17). This substantial reduction in food insecurity is mostly driven by a GDP per capita growth projection of 4.5 percent a year, which will significantly outpace population growth (1 percent a year) (appendix C). In addition, the per capita daily calorie food gap, which is the difference between estimated consumption and a nutritional threshold of 2,100 kcal, is projected to decline from 335 kcal/day in 2022 to 292 kcal/day in 2032, a 12.9-percent decline (table 17).

Table 17  
Food security indicators for Asia region, 2022 and 2032

Year	Food grain demand	Other grain demand*	Total grain demand	Grain production	Implied additional supply required**
	Million tons				
2022	507.7	173.1	680.8	512.7	168.1
2032	654.7	207.1	861.9	565.5	296.3

\*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.  
Source: USDA, Economic Research Service.



Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

Region/subregion	Population		Population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (total)*	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million		Million		Percent		Kcal/day		1,000 metric tons	
Asia	2,542.6	2,797.1	676.2	157.3	26.6	5.6	335	292	30,428	6,163
CIS**	117.1	119.1	17.1	3.2	14.6	2.7	319	280	692	114
Central and Southern Asia	1,854.0	2,052.7	514.0	96.7	27.7	4.7	340	231	21,672	3,257
Other Asia	60.3	66.9	45.1	34.7	74.8	51.9	568	430	3,341	1,947
Southeast Asia	511.3	558.5	100.1	22.7	19.6	4.1	308	244	4,723	845

\*Measured in grain equivalents. \*\*The members of Commonwealth of Independent States (CIS) are Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan. Turkmenistan is an associate member. Ukraine has not formally withdrawn from the organization but did formally end its participation in CIS statutory bodies in May 2018 (The World Fact Book, 2022). The subregional and regional aggregation here is based on the recognition of this note and is meant to facilitate comparison of food security trends across subregions.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

## Commonwealth of Independent States (CIS)

Despite Russia's military invasion of Ukraine, the Commonwealth of Independent States (CIS)<sup>20</sup> is the most food secure sub-region in Asia in 2022, with an estimated 14.6 percent of the population (17.1 million people) considered food insecure (table 18). However, this represents an increase of more than 43.0 percent in the number of food insecure people and in the prevalence of food insecurity relative to 2021 (appendix B; Baquedano et al., 2021). The increase in estimated food insecurity in the CIS sub-region mainly reflects the sharp increase in food price inflation faced by countries in the sub-region during 2021. This led to reductions in the affordability of food and the effects of Russia's invasion of Ukraine, which further increased food prices and input prices. The estimate of the number of food insecure people in Ukraine for 2022 is 41 percent higher than pre-war and fertilizer spike estimates, the highest increase in the CIS sub-region.<sup>21</sup> Reflecting a further increase in food prices in the CIS sub-region from the war in Ukraine, Armenia (26 percent) and Azerbaijan (36 percent) are anticipated to have the second highest increases in their food insecurity metrics from pre-war estimates (appendix B).

For Tajikistan, 63.3 percent of its population is estimated to be food insecure, the highest share in the CIS sub-region. Kyrgyzstan and Moldova are the next countries with the highest food insecure percentage, 33.4 percent and 30.5 percent, respectively (table 18). The Armenian economy recovered faster than anticipated in 2021—due to high growth in the agriculture, construction, and investment sectors. However, high food price inflation and a reduction in consumers' purchasing power are associated with estimated increases in the number of food insecure people in 2022 (ADB, 2021). Food price inflation and increases in the prices of other goods also led to increases in the prevalence of food insecure people in Azerbaijan, Georgia, Kyrgyzstan,<sup>22</sup> Turkmenistan, and Uzbekistan (ADB, 2021). Despite the ongoing war, only 4.5 percent of the population of Ukraine is estimated to be food insecure in 2022 (table 18). But this national average may obscure high rates of food insecurity in active conflict zones, which may vary significantly from the national average.

By 2032, the prevalence of food insecurity (2.7 percent of the population) and the number of food insecure people (3.2 million) in the CIS sub-region are projected to be more than 81 percent lower than the 2022 estimate (table 18). The anticipated improvement in food security metrics over the decade is linked to a projected acceleration in income growth and an assumption that Russia's war in Ukraine will end relatively soon in the projection period. During 2022–20, per capita GDP is projected to grow at an annual rate of 3.3 percent, slightly higher than the 2016–21 rate of 2.5 percent (appendix C). By 2032, the per capita daily calorie food gap is projected to decline by 12.2 percent, from 319 kcal in 2022 to 280 kcal in 2032 (table 18).

Relative to sub-regional food security trends, over the coming decade, Tajikistan is anticipated to make the least progress in absolute terms (i.e., number of food insecure people) and relative terms (i.e., prevalence of food insecurity). This number mainly reflects a projection for population growth rates (1.2 percent a year) that exceed the CIS average (0.2 percent a year) and a per capita GDP growth that is less than the regional average—2.5 percent a year for Tajikistan versus 3.3 percent a year for the CIS sub-region (appendix C). Nonetheless, by 2032, the share of the population projected to be food insecure in Tajikistan is 22.7 percent (2.3 million people) (table 18).

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<sup>20</sup> The members of Commonwealth of Independent States (CIS) are Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan. Turkmenistan is an associate member. Ukraine has not formally withdrawn from the organization but did formally end its participation in CIS statutory bodies in May 2018 (The World Fact Book, 2022). The subregional and regional aggregation here is based on the recognition of this note and is meant to facilitate the comparison of food security trends across subregions.

<sup>21</sup> IFSA's demand-driven model integrates income (per capita GDP) and food prices to assess food security at a country level. The four shocks introduced in the model (see box "Global Trade Analysis Project (GTAP): A Computable General Equilibrium (CGE) Model") to analyze the implications of Russia's military invasion of Ukraine on food security in countries covered in the IFSA include the impact on Ukraine's labor force (i.e., reduction in labor availability of 5–10 percent) and its economy (through reductions in GDP via the GTAP model). However, the analysis does not account for the displacement of people or the full impact of disruptions to Ukraine's economy, which can affect the food security status of Ukraine.

<sup>22</sup> Lower wheat output also contributes to a year-on-year price increase (FAO, 2022).

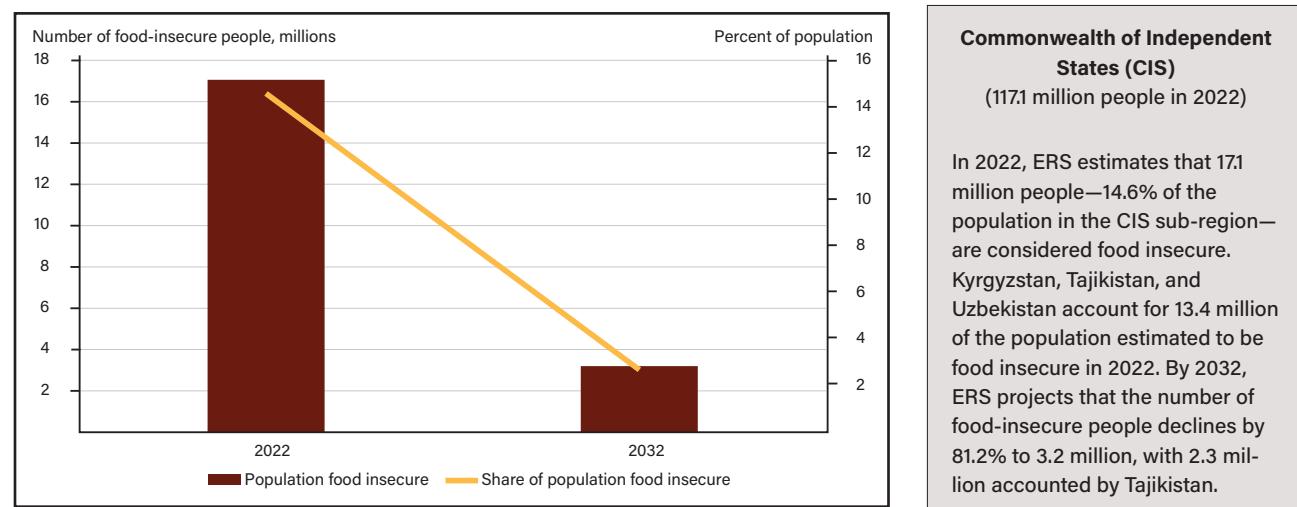
Table 18

## Food security indicators for the Commonwealth of Independent States sub-region, 2022 and 2032

Year	Food grain demand	Other grain demand*	Total grain demand	Grain production	Implied additional supply required**
	Million tons				
2022	19.5	26.9	46.4	16.7	29.7
2032	24.5	30.4	54.9	19.0	35.9

\*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.

Source: USDA, Economic Research Service.



Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

	Population		Population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (total)*	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million	Million	Million	Million	Percent	Percent	Kcal/day	Kcal/day	1,000 metric tons	1,000 metric tons
CIS**	117.1	119.1	17.1	3.2	14.6	2.7	319	280	692	114
Armenia	3.0	2.9	0.3	0.0	8.4	0.2	207	136	7	0
Azerbaijan	10.4	10.9	0.8	0.1	8.0	0.5	189	134	18	1
Georgia	4.9	4.9	0.7	0.1	13.5	1.4	246	175	21	2
Kyrgyzstan	6.1	6.5	2.0	0.5	33.4	7.8	315	221	82	14
Moldova	3.3	2.9	1.0	0.02	30.5	0.5	261	134	35	0
Tajikistan	9.1	10.3	5.8	2.3	63.3	22.7	490	319	352	93
Turkmenistan	5.6	6.1	0.9	0.1	16.5	1.1	248	164	30	1
Ukraine	43.5	41.2	2.0	0.0	4.5	0.0	172	107	45	0
Uzbekistan	31.1	33.3	3.6	0.1	11.5	0.4	220	141	102	2

\*Measured in grain equivalents. \*\*The members of Commonwealth of Independent States (CIS) are Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan. Turkmenistan is an associate member. Ukraine has not formally withdrawn from the organization but did formally end its participation in CIS statutory bodies in May 2018 (The World Fact Book, 2022). The subregional and regional aggregation here is based on the recognition of this note and is meant to facilitate comparison of food security trends across subregions.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

## Central and South Asia (CSA)

The Central and South Asian (CSA) sub-region accounts for 73 percent of the total population of the Asian region in IFSA, as it includes India (table 17). Like most sub-regions in Asia covered by IFSA, the CSA economy improved since the COVID-19 shock in 2019, with an estimated increase in per capita GDP of 5.7 percent from 2021 to \$1,966. This per capita GDP estimate is slightly greater than the 2019 pre-pandemic level of \$1,923 (table 16). India's 2021 estimated growth in per capita GDP of 6 percent captures most of the anticipated sub-regional income growth (appendix C; Baquedano et al., 2021). In addition to the challenges posed by COVID-19, an escalated conflict caused significant displacement across Afghanistan—thereby disrupting labor supply and reducing agricultural production (FEWS NET, 2021). As a result, Afghanistan's per capita GDP in 2022 is estimated to remain relatively unchanged from 2021. In Pakistan, the second and third waves of the COVID-19 pandemic forced the government to put some mobility restrictions in place to reduce reported cases (ADB, 2021). In Pakistan, GDP is anticipated to grow almost by 4.3 percent in 2022; however, GDP per capita is expected to increase by only 2.3 percent in 2022 due to estimated population increases of 2 percent in the same year (appendix C; Baquedano et al., 2021). While inflation is expected to slow down in 2022 (ADB, 2021), the above normal food price inflation helped compound the already high levels of food insecurity (Baquedano et al., 2021).

Because of its population size, India tends to distinctly influence food insecurity trends in the Asian region. India is estimated to account for 65 percent of the food insecure population in 2022 in the CSA sub-region. However, Afghanistan has the highest estimated prevalence of food insecurity in 2022 in CSA, with 81.0 percent of the population estimated to be unable to meet the daily calorie requirement of 2,100 kcal (table 19). Pakistan has the second highest estimated prevalence of food insecurity for 2022 in the CSA at 42.0 percent. The high estimated prevalence of food insecurity in Pakistan is supported by high rates of inflation, driven by food prices trending upward since mid-2021.

Over the next 10 years, CSA's per capita GDP is projected to grow at a rate of 4.6 percent a year (appendix C). The estimated strong economic growth over the next decade is expected to lead to a significant decrease in the number of food insecure people by 2032 (table 19). Government support, especially in India and Bangladesh, are expected to contribute to a significant reduction in the number of food insecure people in the region in the next decade. Since the beginning of the COVID-19 pandemic through September 2021, India spent more than 10 percent of its 2020 GDP level to combat the impacts of the COVID-19 pandemic (IMF, 2021b). The Bangladesh government prioritizes the agriculture sector through subsidies on seeds, fertilizer, irrigation, and farm mechanization (ADB, 2021). In addition, the Bangladesh government expanded existing social transfer programs to vulnerable households, implemented wage supports for export-oriented industries, and provided income tax relief (IMF, 2021b). Bangladesh's economy was on a robust recovery path in 2021 after it was significantly affected by the COVID-19 pandemic. The quick recovery was a result of fiscal and monetary policies, strong remittances, moderate inflation compared to the developed world, higher domestic demand, and recovery of global trade (ADB, 2021). The opening of the global economy helps the country's economic recovery, especially in the garment industry—as Bangladesh is the main exporter of garments—which is both a source of export revenue and of employment for low-skilled workers. Bangladesh's GDP per capita is estimated to grow by 9.3 percent in 2022 (appendix C; Baquedano et al., 2021). The improvement in the country's macroeconomic environment, coupled with relative lower food inflation (partly due to the stable international rice price—which is the main grain in the country—and to the replenishment of the central government rice stocks quickly through import expansion and a good winter harvest) (ADB, 2021) is anticipated to improve the country's food security metrics.

While most countries in the region will see improvements in food security metrics, poor macroeconomic conditions in Afghanistan and Pakistan contribute to their status as the countries within the region with the lowest improvement in the number of food insecure people by 2032, with the share of population suffering from food insecurity only reducing to 50.2 percent and 13.4 percent, respectively (table 19).

The prevalence of food insecurity in the CSA sub-region is projected to decline from 27.7 percent in 2022 to 4.7 percent in 2032. By 2032, CSA's food insecure population is projected to decline by 81.2 percent to 96.7 million people (table 19). The improvement in food security is driven by estimates of stronger growth in GDP per capita, starting from 2022, and slower population growth, as well as an anticipated stability in food prices after a current inflation adjustment. All countries in the CSA sub-region are projected to see a substantial reduction in the number of food insecure people in the next 10 years, apart from Afghanistan. By the end of the next decade, Nepal, India, Sri Lanka, Bangladesh, and Pakistan are projected to reduce the number of food insecure people by more than 60 percent (table 19). With the expectations that inflation will relax and supply chain issues will resolve, the measures implemented by the government of India to increase food affordability are expected to lead to increases in food production—especially through price support and procurement, and consumer food availability through subsidized and extra grain distribution—leading to fewer food insecure people in India. Despite the major shock to the economy by the first and second waves of COVID-19, India's GDP per capita is projected to grow at an annual rate of 4.9 percent between 2022 and 2032 (appendix C). The anticipated higher income prospects are projected to result in a marked improvement in the country's food-security metrics. The number of food insecure people in India is projected to decrease to 24.7 million by 2032, or 1.7 percent of India's population (table 19).

Due to stronger economic growth and higher incomes by 2032, the prevalence of food insecurity in Bangladesh is projected to decline by 78.7 percent to 4.7 percent of the population. In Pakistan, the prevalence of food insecurity is projected to decline by 68.1 percent by 2032 to 13.4 percent, reflecting more robust economic growth and government programs targeted at increasing agricultural productivity. In contrast, Afghanistan is projected to make the least progress in food security metrics by 2032 relative to the other CSA sub-regional countries. Over the next decade, in Afghanistan, the number of food insecure people and the prevalence of food insecurity are projected to decline 23.7 percent and 38.1 percent, respectively. The daily per capita calorie food gap in CSA is projected to decline 31.9 percent, from 340 kcal in 2022 to 231 kcal in 2032 (table 19).

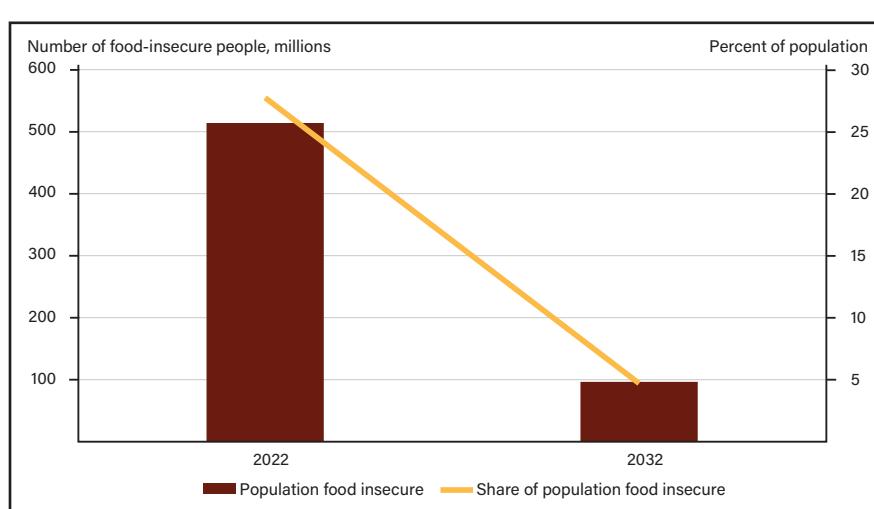
Table 19

## Food security indicators for the Central and Southern Asia sub-region, 2022 and 2032

Year	Food grain demand	Other grain demand*	Total grain demand	Grain production	Implied additional supply required**
Million tons					
2022	352.1	80.6	432.7	384.9	47.8
2032	461.2	105.7	566.9	426.4	140.5

\*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.

Source: USDA, Economic Research Service.



Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

**Central and Southern Asia**  
(1.8 billion people in 2022)

The prevalence of food insecurity in Central and Southern Asia is estimated at 27.7% in 2022. In 2022, 514 million people are estimated to be food insecure in Central and Southern Asia, with 65% accounted by India. By 2032, ERS projects that the prevalence of food insecurity will decline by 81.2% to 4.7%. However, the prevalence of food-insecurity is projected to remain high in Afghanistan at 50.2%. The number of food insecure people in 2032 is projected to decline by 81.2% to 96.7 million.

	Population		Population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (total)*	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million	Million	Million	Million	Percent	Percent	Kcal/day	Kcal/day	1,000 metric tons	1,000 metric tons
Central and Southern Asia	1,854.0	2,052.7	514.0	96.7	27.7	4.7	340	231	21,672	3,257
Afghanistan	38.4	47.3	31.1	23.7	81.0	50.2	524	362	1,936	1,021
Bangladesh	165.8	179.8	36.9	8.5	22.3	4.7	288	211	1,561	264
India	1,353.0	1,478.9	333.5	24.7	24.7	1.7	286	178	12,773	588
Nepal	30.7	32.8	6.0	0.1	19.6	0.4	278	160	237	3
Pakistan	242.9	289.5	101.9	38.8	42.0	13.4	404	289	4,993	1,358
Sri Lanka	23.2	24.4	4.5	0.8	19.3	3.5	257	187	172	24

\*Measured in grain equivalents.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

## Other Asia (OA)

The Other Asia (OA) sub-region is estimated to be the most food insecure of any sub-region in the assessment, as it includes both Yemen and The Democratic People's Republic of Korea (DPRK). In 2022, it is estimated that 74.8 percent of the 60.3 million people in the OA sub-region are food insecure (table 20). Yemen—with an estimated 26.3 million food insecure people and a prevalence of food insecurity of 84.8 percent in 2022—is the most food insecure country in the OA sub-region (table 20). The COVID-19 pandemic and ongoing conflicts in Yemen are expected to further weaken the growth of OA per capita income in 2022, burdening Yemen's food security situation. In the Democratic People's Republic of Korea (DPRK), economic constraints (aggravated by the impact of COVID-19 pandemic measures, devastating weather, and global supply chain issues) led to a substantial shortfall of food in DPRK, thereby increasing the susceptibility of the local population to food insecurity (O'Reilly, 2021). North Korean economic growth estimates for 2022 point to a modest 2.9 percent GDP growth (appendix C; Baquedano et al., 2021). However, DPRK's food insecurity indicators are estimated to be higher in 2022 than in 2021 (Baquedano et al., 2021; table 20).

By 2032, the sub-region is projected to see moderate income growth, helping to improve OA's food security metrics. The number of food insecure people in the OA sub-region is projected to decline by 23.0 percent in 2032 to 34.7 million. However, by 2032, the prevalence of food insecurity is projected to remain high at 51.9 percent (table 20). These results reflect trends in Yemen, as a greater improvement is expected in DPRK and Mongolia. The anticipated moderate decline in the number of food insecure people over the next decade in OA mainly reflects trends in DPRK and Yemen. The improvements in DPRK's food security prospects over the next decade are mainly driven by the expectation that annual per capita GDP growth (1.0 percent) will exceed average annual population growth (0.3 percent) (appendix C). By 2032, the daily per capita calorie food gap for OA is projected to decline by almost 25 percent, from 568 kcal in 2021 to 430 kcal in 2032 (table 20).

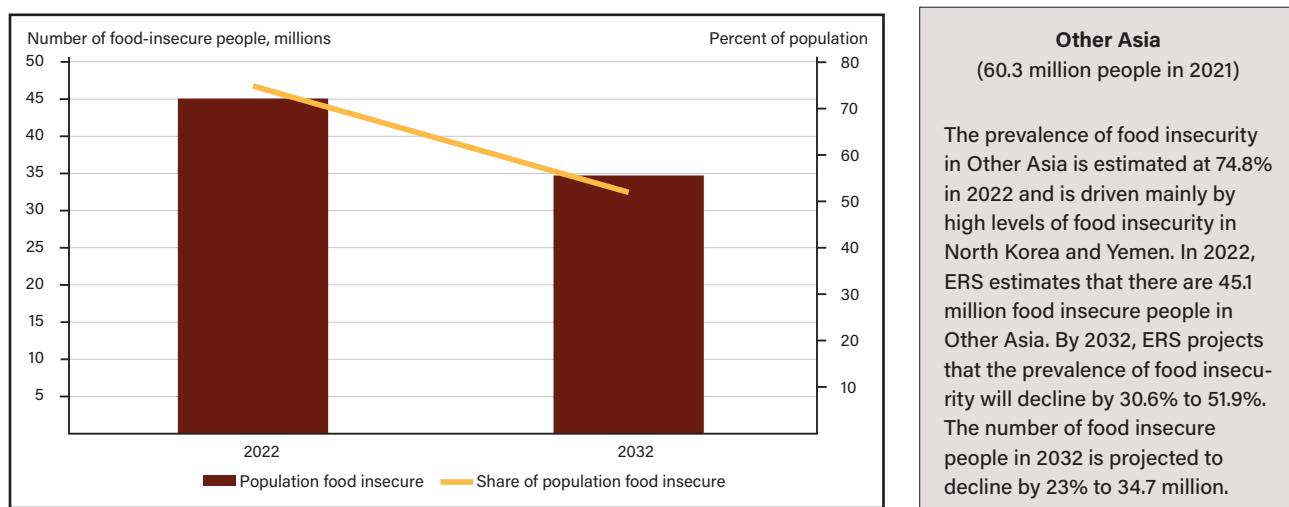
Table 20

## Food security indicators for the Other Asia sub-region, 2022 and 2032

Year	Food grain demand	Other grain demand*	Total grain demand	Grain production	Implied additional supply required**
	Million tons				
2022	9.7	2.5	12.1	1.5	10.6
2032	12.2	2.7	15.0	1.9	13.1

\*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.

Source: USDA, Economic Research Service.



	Population		Population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (total)*	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million	Million	Million	Million	Percent	Percent	Kcal/day	Kcal/day	1,000 metric tons	1,000 metric tons
Other Asia	60.3	66.9	45.1	34.7	74.8	51.9	568	430	3,341	1,947
Korea, Democratic People's Republic of	26.0	26.8	17.8	12.9	68.6	48.3	475	381	1,210	703
Mongolia	3.2	3.4	0.9	0.1	28.2	2.7	319	202	36	2
Yemen	31.0	36.6	26.3	21.7	84.8	59.2	633	455	2,095	1,241

\*Measured in grain equivalents.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

## Southeast Asia (SEA)

Southeast Asia (SEA) is estimated to be the second least food insecure sub-region in Asia, with an estimated average prevalence of food insecurity of 19.6 percent of its people considered food insecure in 2022 (table 21). Almost half of the estimated food insecure population in SEA is in Indonesia (49.9 million people) (table 21). In the Laos People's Democratic Republic (LAO), policies to stop the spread of COVID-19 affected the tourism, retail, transportation, and manufacturing sectors (all of which significantly contribute to the country's GDP) (ADB, 2021). It is estimated that almost 34.6 percent of the LAO population (2.7 million people) is considered food insecure in 2022 (table 20). In 2022, the average per capita GDP in the SEA sub-region is expected to grow by 3.9 percent from 2021 and above the pre-pandemic level (table 15). Mobility restrictions were put in place by many countries in the sub-region in early 2021 to curb the spread of the Delta variant of COVID-19 (ADB, 2021).

Although some SEA countries will see higher economic growth than in 2021, increases in the prices of goods (due to demand exceeding supply) will marginally increase the number of food insecure people. Mobility restrictions adopted by Indonesia in the middle of 2021 to slow the spread of the COVID-19 Delta variant also slowed economic growth in 2021 due to sluggish domestic demand (ADB, 2021). In 2022, the GDP of Indonesia is estimated to grow by 5.5 percent and may reach \$1.1 trillion, 6.4 percent higher than the 2019–21 average (appendix C). The increase in GDP growth will come from strong demand for Indonesian commodity exports. In addition, GDP per capita in 2022 is estimated to be 4.0 percent above the 2021 level, a faster increase in average income than the previous 3 years and a full recovery above the pre-pandemic levels. In Indonesia, the prevalence of food insecurity for 2022 is estimated at 18.3 percent, and the number of food insecure people is estimated at 49.9 million, an increase of 18.2 percent from the 2021 estimate (appendix B; Baquedano et al., 2021).

In the Philippines, GDP growth in 2021 helped alleviate the shock to the economy in 2020 due to the COVID-19 pandemic. Despite the strong economic rebound (reflecting both a sharp drop in COVID-19 cases and accelerated vaccination programs), the food security metrics of Philippines did not improve as robustly as economic activity in 2021 (ADB, 2021). In 2022, the prevalence of food insecurity and the number of food insecure in the Philippines are estimated to be 17.4 percent and 19.2 percent higher than the 2021 estimate, respectively (appendix B; Baquedano et al., 2021). In Vietnam, continued mobility restrictions to control the spread of COVID-19 led to labor shortages and reduced domestic demand, thereby constraining GDP growth (ADB, 2021). Despite impediments from the COVID-19 pandemic, Vietnam remains the most food secure country in the SEA sub-region. In addition, in 2022, it is estimated that the prevalence of food insecurity will only be 10.2 percent, with 10.4 million people estimated to be food insecure (table 21).

For the SEA sub-region, per capita GDP growth over the next decade is projected to be 4.6 percent a year. By contrast, the population growth rate is estimated to be much lower, averaging 1.0 percent a year from 2022 to 2032 (appendix C). As a result of the anticipated robust income growth in SEA, the prevalence of food insecurity is expected to decline from 19.6 percent in 2022 to 4.1 percent of the population in 2032 (table 21). The number of food insecure people is also projected to decline sharply, from 100.1 million to 22.7 million. By 2032, the daily per capita calorie food gap is anticipated to decline from 308 kcal in 2022 to 244 kcal in 2032. In all countries in SEA, per capita GDP is projected to grow at a greater pace than population growth, resulting in reductions in the prevalence of food insecurity by 2032 (appendix C).

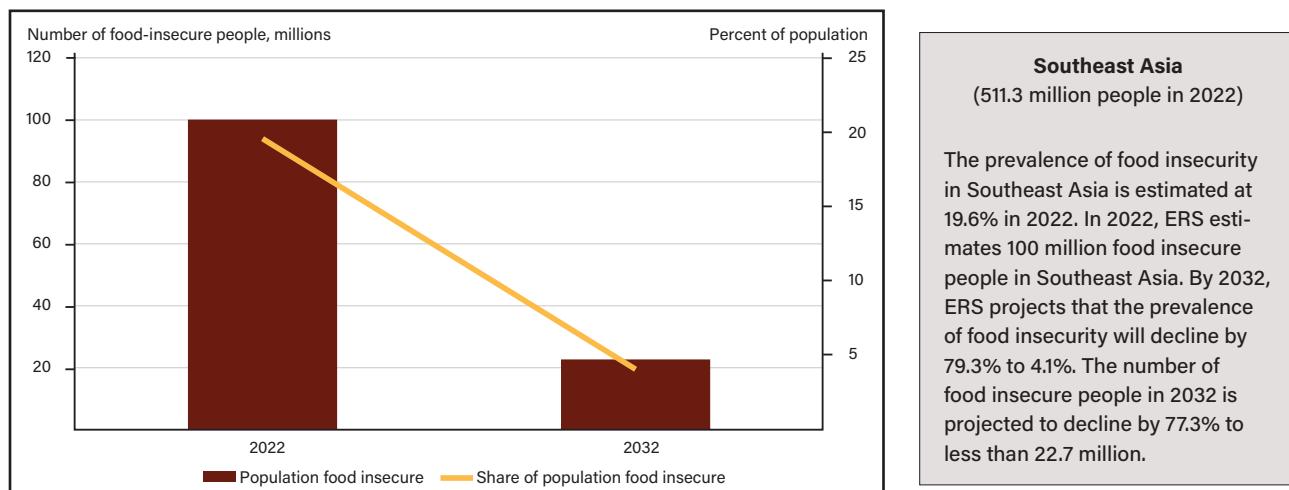
Table 21

## Food security indicators for the Southeast Asia sub-region, 2022 and 2032

Year	Food grain demand	Other grain demand*	Total grain demand	Grain production	Implied additional supply required**
Million tons					
2022	126.4	53.5	179.9	109.6	70.2
2032	156.8	57.8	214.6	118.3	96.3

\*Other grain demand includes seed, feed, waste, and processing. \*\*The gap between grain demand and domestic grain production.

Source: USDA, Economic Research Service.



Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

	Population		Population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (total)*	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million	Million	Million	Million	Percent	Percent	Kcal/day	Kcal/day	1,000 metric tons	1,000 metric tons
<b>Southeast Asia</b>	<b>511.3</b>	<b>558.5</b>	<b>100.1</b>	<b>22.7</b>	<b>19.6</b>	<b>4.1</b>	<b>308</b>	<b>244</b>	<b>4,723</b>	<b>845</b>
Cambodia	17.4	19.4	4.1	0.5	23.7	2.8	303	203	190	17
Indonesia	272.2	291.1	49.9	8.5	18.3	2.9	292	211	2,165	266
Laos	7.7	8.7	2.7	0.4	34.6	5.1	308	198	133	14
Philippines	112.5	129.3	33.0	12.6	29.4	9.7	365	279	1,820	531
Vietnam	101.6	110.0	10.4	0.6	10.2	0.6	265	182	415	17

\*Measured in grain equivalents.

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

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## Special Article

### Additional Analysis of the Implications of Russia's Military Invasion of Ukraine and Recent Input Price Increases on the 2022 IFSA Estimates

Yacob Abrehe Zereyesus, Lila Cardell, Jayson Beckman, Maros Ivanic, Jennifer Kee, Reem Hashad, Jeremy Jelliffe, Constanza Valdes, Kayode Ajewole and Wendy Zeng

Food insecurity in International Food Security Assessment (IFSA) countries significantly increased since the Coronavirus (COVID-19) pandemic began. In 2020, the pandemic-driven Gross Domestic Product (GDP) contraction for IFSA countries was associated with a sharp increase in the number of food insecure people (Baquedano et al., 2020). Food prices continued to rise in 2021 due to high demand for food and animal feed. Moreover, supply shortfalls are expected to be compounded by higher costs associated with supply-chain shortages, shipping bottlenecks, and higher energy prices driving up inflation (USDA, OCE, 2021). High food prices leading up to the Russian military invasion of Ukraine were expected to result in worsening food insecurity in low- and middle-income countries in 2022. The Russian military invasion of Ukraine and continued input price spikes modified the short-term perspective in the IFSA assessment (as projected in August 2021), leading to higher global and local food prices, and dampening prospects for economic growth.

The aim of this special article is to provide a range of prospective food insecurity estimates in addition to the main IFSA report, based on the possibility that the magnitude of the shocks could be larger. The authors provide two additional scenarios (the main IFSA estimates use the low scenario) adjusting the 2022 GDP and commodity price trends to account for the effects of the Russian military invasion of Ukraine and input price spikes that exceeded August 2021 projections. Note that these three scenarios are evaluated against a baseline model that reflects price and income projections as of August 2021 for the food security status of the 77 low- and middle-income countries included in IFSA. However, separating the effect of the Russian military invasion of Ukraine on food security is challenging, as input prices (such as fertilizer and energy costs) were rising prior to the invasion and continue to rise. The authors provide a decomposition of the impacts on commodity prices, GDP, and food insecurity between the shocks unique to the invasion and estimated yield changes because of input price spikes.

To modify GDP and commodity price trends for 2022 and estimate the effects of the Russian military invasion of Ukraine, the Global Trade Analysis Project (GTAP) was used. GTAP (a general equilibrium model) computes changes in trade in response to supply shocks, such as disruptions in Ukrainian and Russian grain exports and elevated input prices that affect agricultural output, to estimate potential effects on GDP and commodity prices in 2022, which are then used to estimate impacts on food insecurity.

To assess the potential effect of ongoing uncertainty in agricultural markets on international food security in 2022, the authors used the IFSA model. The baseline estimation was compared to scenarios with simultaneous shocks including: (1) yield reductions due to higher fertilizer and energy costs, (2) export losses for agricultural products from Russia and Ukraine, (3) changes in labor supply in Russia and Ukraine, and (4) a reduction in the price Russia receives for its energy exports. Given the uncertainty, three scenarios are specified for the model with intensifying levels of impacts (low, medium, and high). Calculations found that in 2022, an additional 41.7 million to 134.7 million people may be food insecure (in addition to the baseline

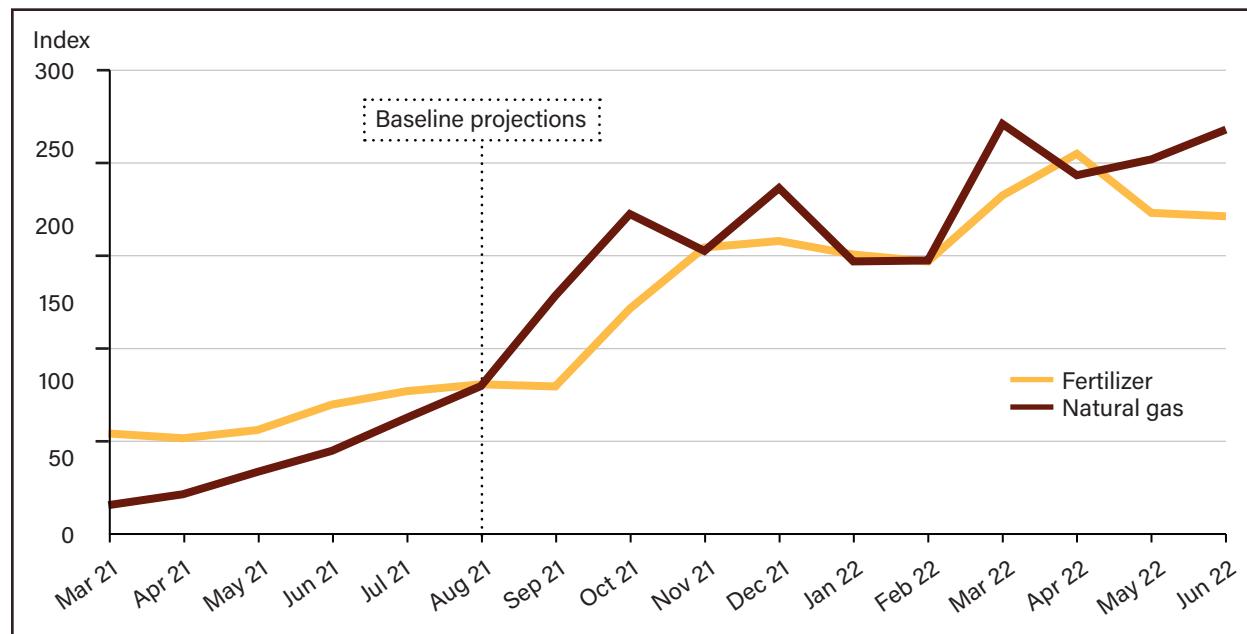
estimates), for a total of 118.7 million to 211.7 million additional food insecure people over 2021 estimates.<sup>23</sup> The yield reductions comprise a significant portion of the increase in food insecurity and show the largest increases in the prevalence of food insecurity associated with the Russian military invasion of Ukraine will be in the North Africa region.

## Higher Input Prices are Associated with Lower Yields and Higher Food Prices in Low- and Middle-Income Countries

Prior to the Russian military invasion of Ukraine, input prices were trending upward due to high energy and raw material costs, supply disruptions, strong demand, and Chinese and Russian export restrictions (World Bank, 2022). Figure 9 shows an index for fertilizer and gas prices from March 2021–June 2022. The USDA, Economic Research Service (ERS) baseline global food insecurity estimates for 2022 were developed using input price projections as of August 2021, when most fertilizer prices were 25 percent above March 2021 prices. However, by March 2022, fertilizer prices were 125 percent higher than in March 2021, and prices remained elevated through June 2022. The Russian military invasion of Ukraine will likely contribute to fertilizer prices rising by nearly 70 percent in 2022, as Russia and Belarus provide a large portion of the world supply of fertilizers.<sup>24</sup> In 2021, the European Union and the United States imposed sanctions on fertilizer imports from Belarus and in early 2022, Lithuania banned rail transport of Belarussian potash (World Bank, 2022).

Higher fertilizer prices are likely to reduce demand by farmers, leading to lower nutrient application, and as a result, reduced productivity and yield, and potentially reduced exports of cereal grains (FAO, 2022c).

**Figure 9**  
**Fertilizer and gas prices have significantly increased since early 2021**



Source: World Bank Commodity Outlook Report (2022).

<sup>23</sup> The Food and Agriculture Organization of the United Nations' (FAO) simulations suggest the global number of undernourished people could increase by 8 million to 13 million people in 2022/23, with the most pronounced increases taking place in the Asia-Pacific region, followed by Sub-Saharan Africa, and the Near East and North Africa (FAO, 2022a). These estimates are generated using a different model and assumptions and may not be directly comparable.

<sup>24</sup> In 2020, Russia and Belarus accounted for more than 14.6 and 6 percent, respectively, of world exports of fertilizers (World Bank Commodity Outlook Report 2022).

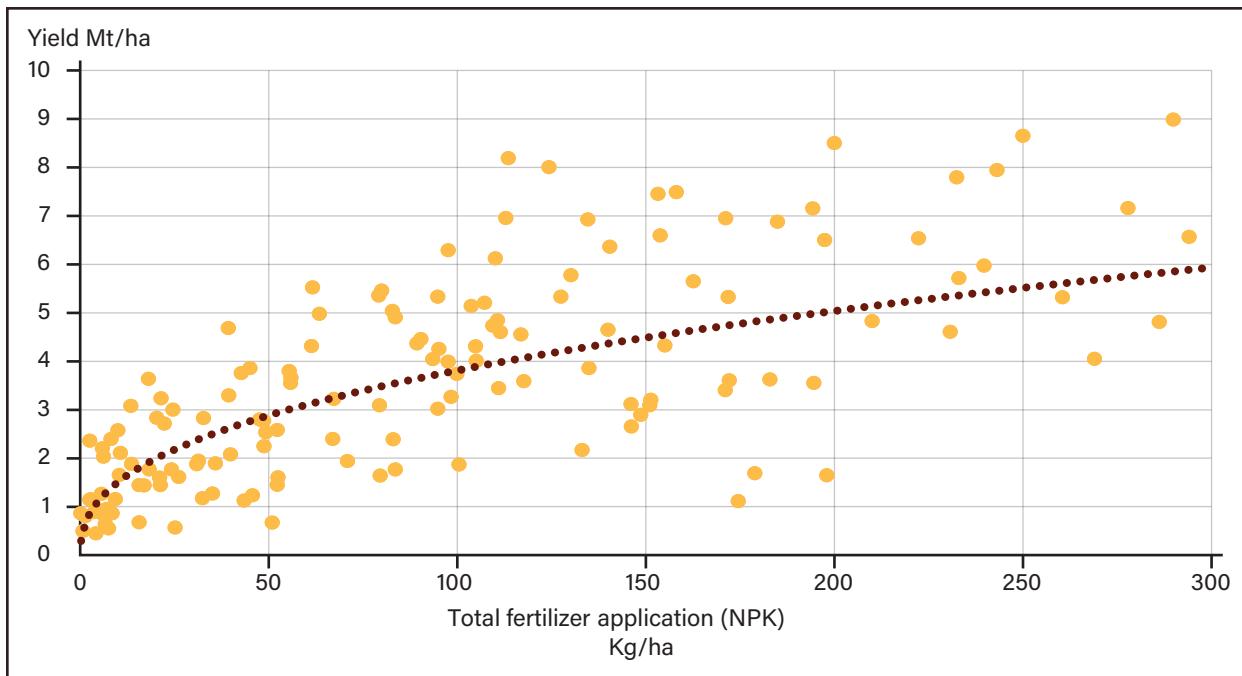
## The Importance of Russia and Ukraine in Agricultural Markets

Russia and Ukraine are among the top global wheat producers and exporters. During the marketing year (MY) 2020/21 (July-June), Russia produced 85 million metric tons of wheat, of which 39 million metric tons were exported. Ukraine produced 25 million metric tons of wheat, of which 17 million metric tons were exported (*WASDE*, May 2022). Together, Russia and Ukraine comprise 23 percent of global wheat exports for MY 2020/21 (July–June) (Trade Data Monitor, 2022). Russia and Ukraine export their wheat to many global trading partners. In MY 2020/21 Ukraine's biggest export partners were Indonesia (15 percent), Egypt (15 percent), Pakistan (8 percent), Bangladesh (6 percent), and Morocco (6 percent). Those countries accounted for half of Ukraine's total wheat exports. Russia's main wheat trading partners were Egypt (21 percent) and Ukraine (18 percent), accounting for about 40 percent of Russia's wheat exports for the MY 2020/21 (July-June) (Trade Data Monitor, 2022). For MY 2021/22, wheat exports from Russia and Ukraine were estimated to be 33 million metric tons and 19 million metric tons, respectively (*WASDE*, May 2022).

Russia was a top producer of barley and corn during MY 2020/21 (July-June) (*WASDE*, May 2022). Ukraine was among the world's top barley and corn producers and is the world's third largest corn exporter, exporting 12 percent of global corn exports during MY 2020/21 (July-June). In MY 2020/21, Ukraine produced 30 million metric tons of corn and exported 24 million metric tons of corn (*WASDE*, May 2022). During MY 2020/21 (September-August), Ukraine was the world's largest producer and exporter of sunflower seed oil, followed by Russia. During the MY 2020/21 (September-August), Russia and Ukraine accounted for 75 percent of all sunflower seed oil exports (*WASDE*, May 2022).

Figure 10 shows the relationship between fertilizer application (kilograms per hectare) and cereal yields (tons per hectare) at the country level, based on the Food and Agriculture Organization of the United Nations' (FAO) cross-country data in 2019. The figure shows that (on average) cereal yield is positively associated with the application of fertilizer (all nutrients), with increasing marginal return rates at lower levels of applications gradually leading to decreasing marginal return rates at higher levels of application.

Figure 10  
**Fertilizer use is associated with higher cereal yields**



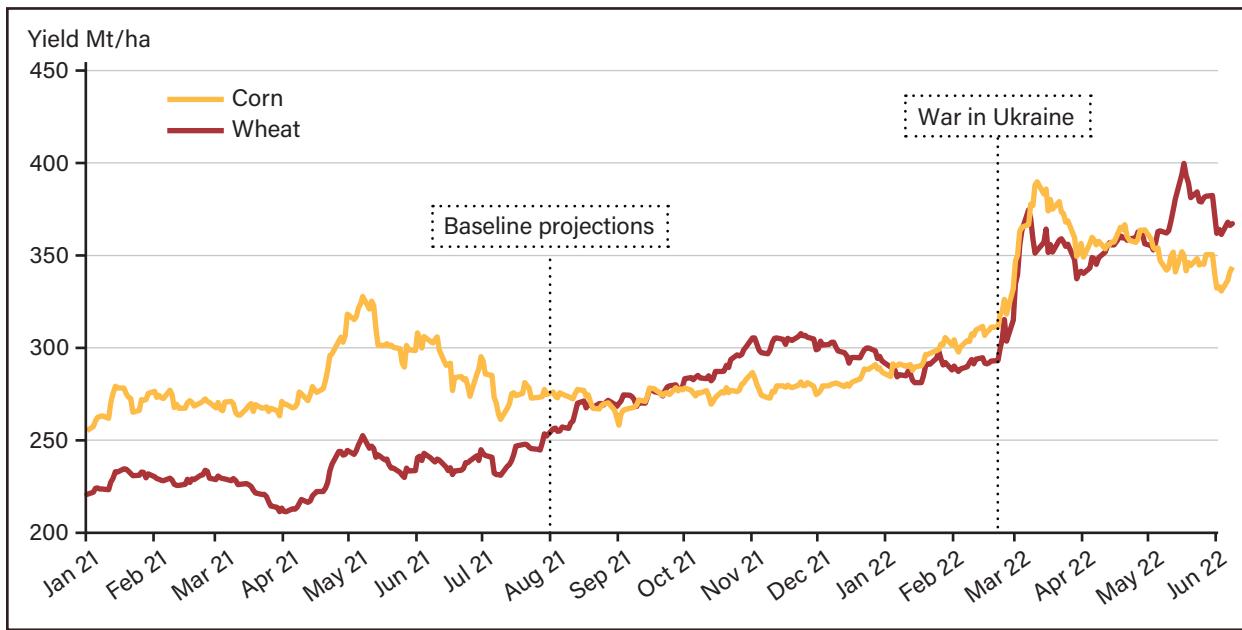
Note: NPK = nitrogen, phosphorus, and potassium; Mt = metric tons; Kg = kilograms; Ha = hectares.

Source: Food and Agriculture Organization data for 2019 (cereal yield, fertilizer application).

Energy prices also increased significantly since mid-2021. Grain and oilseed crops depend on energy for production and transportation, and supply disruptions led to higher prices since early 2021. Figure 9 shows trends in natural gas over the past year, with significant increases occurring after August 2021 baseline projections. The Russian military invasion of Ukraine and the subsequent NATO sanctions against Russia contributed to energy price increases, due to a reduced world energy supply (World Bank Commodity Outlook, 2022). However, the sanctions on Russian energy exports may lead to Russia reducing the price it receives for natural gas, crude oil, and coal in order to facilitate sales.

Fertilizer and energy price spikes affect agricultural markets by reducing yields and disrupting supply chains, leading to higher commodity prices. Figure 11 shows daily world price indices for wheat and corn since early 2021. While corn price spikes in the first half of 2021 appeared to subside, the spikes in corn and wheat prices in late 2021 and early 2022 may be associated with higher input prices and Russia's military invasion of Ukraine (figure 11).

Figure 11  
**International wheat and corn prices rose since baseline projections**



Notes: The Wheat Index is comprised of 10 varieties from Argentina, Australia, the Black Sea region, Canada, the European Union, and the United States. The Corn Index is comprised of four varieties from Argentina, the Black Sea region, Brazil, and the United States. Basis is January 2000 = 100.

Source: International Grains Council.

## Russia's Military Invasion of Ukraine Further Disrupted Commodity Markets

Given that Russia and Ukraine together account for one quarter of global wheat exports, Russia's invasion of Ukraine is expected to contribute to further deterioration of global food security, particularly in low- and middle-income countries (see box: "The Importance of Russia and Ukraine in Agricultural Markets"). The invasion is expected to lead to: (1) reductions in farming activities in Ukraine during spring 2022, a critical period for crop establishment; (2) disruptions to shipping in the Black Sea region which will reduce output and trade from the region; and (3) destruction of agricultural output and storage facilities. The Black Sea region is also an important supplier of farm inputs in the form of fuel and fertilizer.

The Russian military invasion of Ukraine could impact global markets, as around one quarter of the countries in the world (47 countries) depend on Russia and Ukraine for more than 30 percent of total wheat imports. Twenty-seven countries receive more than 50 percent of their wheat imports from Russia and Ukraine (FAO, 2022b). In addition, a notable share of grain from Russia and Ukraine is used for animal feed that will drive up the cost of animal products (e.g., milk, eggs, and meat). These factors contributed to a further surge in agricultural commodity prices, in particular wheat and corn. High international food prices, once transmitted to domestic markets in IFSA countries, could constrain food access of vulnerable households and negatively impact food security (WFP and FAO, 2021). Higher agricultural commodity prices impact global food security, especially for countries that are major importers.

## Simulation Scenarios

Authors relied on the GTAP model to analyze the implications of Russia's military invasion of Ukraine on global- and country-level GDP growth and food prices to evaluate the food security impact in low- and middle-income countries covered in IFSA. Computable General Equilibrium (CGE) models provide economy-wide and sectoral effects, while considering the links and interactions between sectors, competition among these sectors for limited economic resources—and interactions among production, consumption, and trade activities. GTAP is a static model that provides estimates of economic impacts for a one-time shock.<sup>25</sup> The model has 65 sectors representing the entire economy that are aggregated into: rice, wheat, coarse grains (barley, corn, oats, and sorghum), oilseeds, vegetable oil, processed agriculture, manufacturing, and services. Given the model has 161 regions, authors aggregated the region into 75 groups: Canada, the European Union, the United States, developed countries (representing those not already noted), and 71 regions representing those included in the IFSA model.

The shocks in the model are based on changes that might occur from higher agricultural input prices, changes in Russia and Ukraine's agricultural production and exports, changes in Russia's energy prices, and changes in Russia and Ukraine's labor supply. A 1-year time horizon is assumed, so all shocks are for 2022, where endowments (labor and capital) are somewhat immobile (land is completely immobile), representing that agricultural producers have very limited options in changing production in this time frame. This is a strong assumption and also assumes that farmers and the global trade system can respond quickly and efficiently by providing alternative supplies within the year. Given the supply chain issues experienced since 2020 and continued into 2022, estimates of any shocks can be considered conservative. However, even under the assumption of an efficient global market, the impacts on global incomes and prices result in significant effects on global food security.

To assess the possible impacts of ongoing uncertainty in agricultural markets on international food security in 2022, authors used the IFSA model. The baseline model reflects the price and income projections as of August 2021 for the food security status of the 77 low- and middle-income countries included. This baseline is compared to scenarios with simultaneous shocks including (1) yield reductions from higher energy and fertilizer prices; (2) export losses for coarse grains, oilseeds, vegetable, oils, and wheat from Russia and Ukraine; (3) changes in labor supply in Russia and Ukraine; and (4) a reduction in the price Russia receives for its energy exports (representing the sanctions imposed by many importing countries) (table 22).

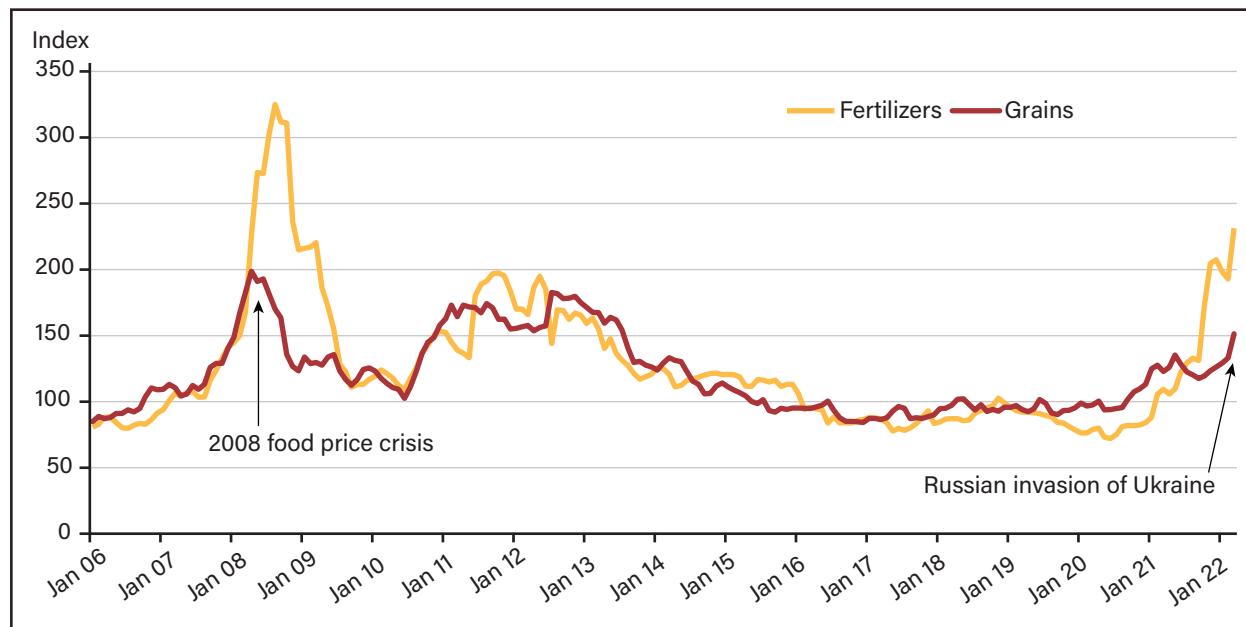
(1) Yield reductions: To represent the potential effect of higher agricultural input prices, including fertilizer, yield reductions are specified for each region in the model. The Russian military invasion of Ukraine further compounds existing fertilizer and energy price increases. The yield shocks account for some of the effects of increasing fertilizer and energy costs that began prior to Russia's invasion.

The three yield scenarios also account for what occurred during 2008 and 2011 when both energy and food commodity prices significantly increased (figure 12). Higher input costs can lead to lower food production and reduced commodity exports (FAO, 2022c). As noted in table 22, the yield reduction for low- and middle-income countries is more than double that for high-income countries, assuming farmers in high-income countries likely can still purchase these inputs or have sufficient fertilizer stored (FAO, 2022b). Moreover, even with the increase in agricultural production input cost, the ratio of output prices relative to input prices remains high. Authors note various degrees of changes with yield restrictions increasing by 2.5 percentage points for low- and middle-income countries between the low, medium, and high scenarios, and lower variation for high income countries that likely have sufficient fertilizer stores.

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<sup>25</sup> Information from the latest database, which is set to 2017.

Figure 12  
Real prices for food and fertilizer



Note: Basis 100 is average of 2000-20 constant U.S. dollars.

Source: USDA, Economic Research Service using data from World Bank and Bureau of Labor Statistics.

(2) Export losses: The next set of shocks is based on export losses, and the difficulty both Russia and Ukraine will face in exporting products, due to policy or transportation constraints (export restrictions may be used to ensure domestic supply and temper price increases). As noted in box, “The Importance of Russia and Ukraine in Agricultural Markets,” Russia and Ukraine are significant global suppliers of wheat, coarse grains, and sunflower oil. Russian blockades in Black Sea ports and the destruction of existing Ukrainian grain supplies have already reduced 2022 global exports (WFP, 2022). In March 2022, both Russia and Ukraine imposed temporary export restrictions on wheat, certain coarse grains, and sugar. The export restrictions were estimated to cover more than 50 percent of Russian food exports, and more than 20 percent in Ukraine. Both Ukraine and Russia lifted the export restrictions in May and June, respectively, however informal blockades have continued to limit exports from the Black Sea Region (Laborde, 2022). In April 2022, the Ministry of Agrarian Policy and Food of Ukraine estimated a nearly 30 percent reduction in 2022/23 wheat exports, a more than 50 percent decrease in 2022/23 maize exports, and a more than 75 percent reduction in sunflower seed oil exports (State Statistics Service of Ukraine, 2022). Export losses for Ukraine are included between the low to high scenarios ranging from 25–99 percent, and for Russia 10–30 percent. Export losses are based on products that each country exports the most: coarse grains, oilseeds, vegetable oils, and wheat for Ukraine and coarse grains and wheat for Russia (table 22).

(3) Energy prices: The model includes a decrease in Russia’s energy prices, to mimic the discounts Russia had to offer to China, India, and others that buy products.<sup>26</sup>

<sup>26</sup> The overall increases in global energy prices are excluded, since these increases predated the war. Adding higher energy prices would increase Russia’s GDP; the model includes how the war is estimated to impact Russian GDP (through lower energy prices). Currency effects are not directly considered; however, restrictions on Russia’s access to financial resources would contribute to lower Russian exports and decreased energy prices, which are included in the model.

(4) Labor supply: The model includes changes in the labor supply in Russia and Ukraine due to fewer people available to work the fields due to the ongoing conflict. The model differentiates between skilled and unskilled labor assuming that unskilled labor is more impacted (double that of skilled), since unskilled people are more likely to be fighting in the war.<sup>27</sup>

Table 22  
**Three scenarios (low, medium, and high) considered in the simulation exercise<sup>28</sup>**

	Low	Medium	High
Yield restriction for low- and middle-income countries	2.5%	5%	7.5%
Yield restriction for high-income countries	0%	1.5%	3%
Export losses of Ukraine's coarse grains, oilseeds, vegetable oils, and wheat	25%	50%	99%
Russia export losses on coarse grains, oilseeds, vegetable oils, and wheat	10%	20%	30%
Decrease in Russia's energy export price	10%	20%	30%
Skilled labor losses in Russia	0.5%	1.5%	2.5%
Unskilled labor losses in Russia	1%	3%	5%
Skilled labor losses in Ukraine	5%	10%	15%
Unskilled labor losses in Ukraine	10%	20%	30%

Source: USDA, Economic Research Service, estimates using a Global Trade Analysis Project model.

## Higher Wheat and Maize Prices are Estimated in Low- and Middle-Income Countries

The GTAP model estimates the percentage change in prices for agricultural crops for the three scenarios, at both the global and country levels. These price changes affect both GDP and food security at the country level and have differential impacts by region and crop. The model estimates that the four crop types (rice, wheat, coarse grains, and oilseeds) all have price increases and are similar across all scenarios. This similarity is because the model reallocates production to the most profitable commodity to plant. Ukraine and Russia do not produce rice and although production (and exports) are restricted for coarse grains, oilseeds, and wheat, the model indicates that other countries can increase their production, dampening those price increases.

Appendix D: table D.1 shows regional price change averages for wheat, vegetable oils, corn, and rice over the three scenarios. The largest price changes are for corn and wheat, which are major exports from Russia and Ukraine and are traded in high volumes. Globally, wheat prices are estimated to increase by 5–19 percent between the low to high scenario; corn prices are estimated to increase by 6–23 percent (appendix D, table D.1).

Changes in wheat prices are estimated to be highest in North Africa (7–25 percent) as the region relies on wheat imports from the Black Sea region and includes Egypt, the largest importer of wheat globally. The North African region will also see the largest changes in corn prices, between 14–42 percent. Three countries in the North African region (Morocco, Tunisia, and Algeria) source a significant portion of corn from Ukraine. For vegetable oils, the largest changes in price are expected in Asia (between 4–12 percent), as the region includes India, a major importer of vegetable oils from Russia and Ukraine (appendix D, table D.1).

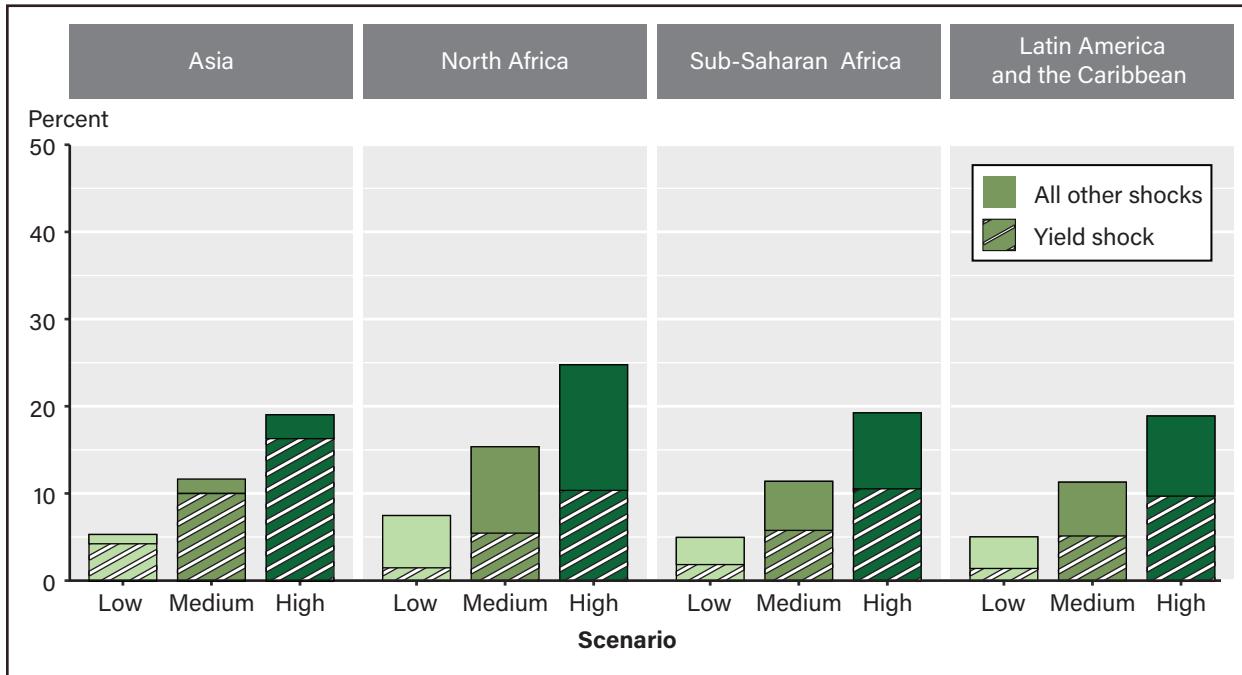
<sup>27</sup> GTAP uses International Labor Organization standards for categorizing skilled and unskilled labor. Skilled labor includes managers and administrators (including farmer managers), professionals, and paraprofessionals. Unskilled labor includes tradespersons, clerks, salespersons and personal service workers, plant and machine operators, drivers, laborers and related workers, and farm workers (Liu et al., 1998).

<sup>28</sup> The low scenario corresponds with the estimates in the 2022 IFSA report.

Figures 13 and 14 show the decomposition of the overall shock for changes in wheat and corn prices, respectively. The striped sections represent the portion of change attributed to the yield shock (representing input price spikes) and the solid sections represent the remaining shocks, based on the Russian military invasion of Ukraine (export restrictions, labor changes, and changes in Russia's energy price). For both wheat and corn, yield shocks are the primary driver of changes in the Asian region. For the North African region, the remaining shocks (which represent the consequences of the Russian military invasion of Ukraine) comprise the majority of price increases for wheat and corn. The invasion also accounts for about half of the wheat price increases in the Sub-Saharan Africa and Latin America and the Caribbean regions.

Figure 13

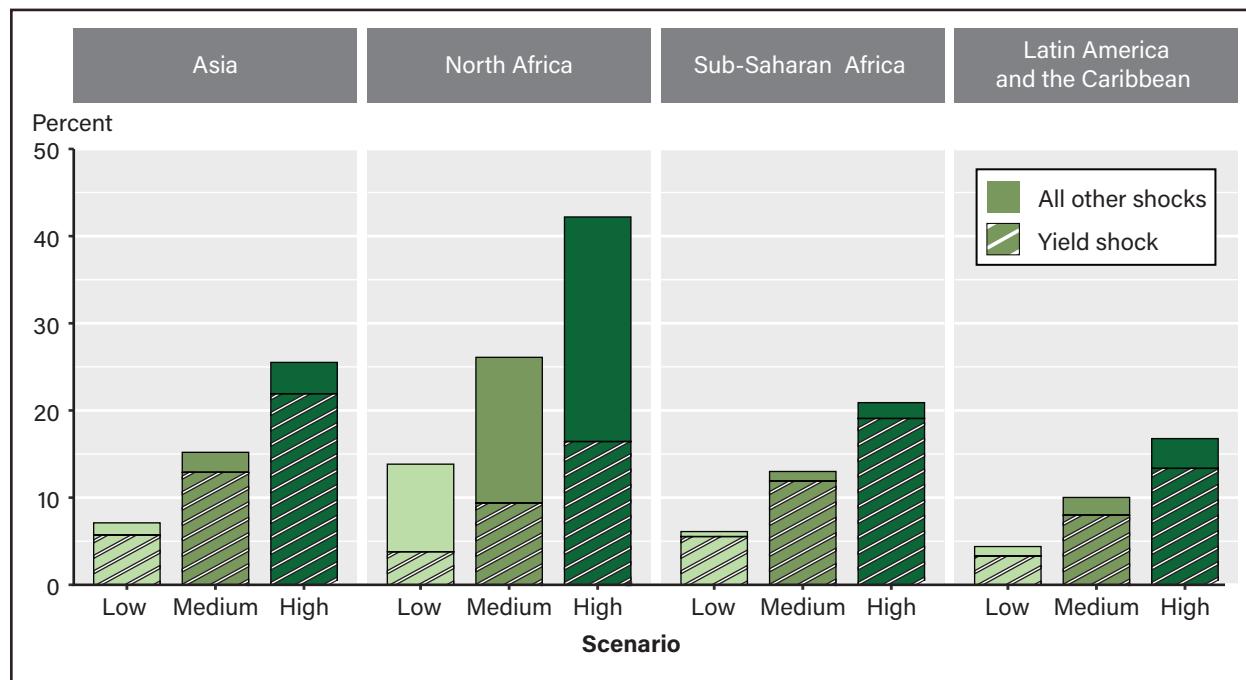
**Percent change in wheat prices relative to baseline under the three alternative scenarios**



Source: USDA, Economic Research Service, estimation using the International Food Security Assessment model and the Global Trade Analysis Project model.

Figure 14

## Percent change in corn prices relative to baseline under the three alternative scenarios



Source: USDA, Economic Research Service, estimation using the International Food Security Assessment model and the Global Trade Analysis Project model.

## Post-Pandemic GDP Gains will be Attenuated in Low- and Middle-Income Countries

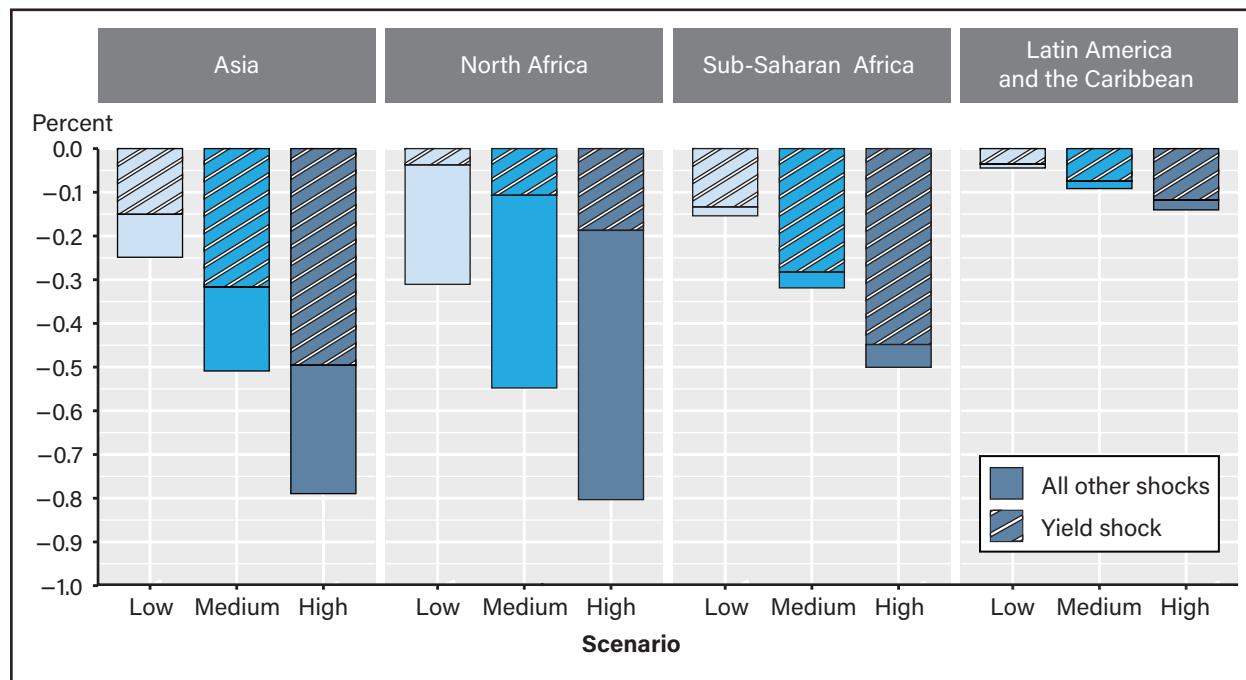
Changes in GDP drive food security estimates by affecting the population's ability to afford 2,100 calories, a typical adult daily caloric intake. Appendix D: table D.2 shows estimates for 2022 GDP levels and growth at baseline (in millions of 2015 U.S. dollars (USD) and percent, respectively) and the estimated changes in GDP under the three scenarios, as both a percentage and level (million 2015 U.S. dollars). Figure 15 shows the estimated changes to GDP under each scenario, relative to the 2022 baseline, disaggregated by region. Global GDP is estimated to decrease in 2022 by 0.2 percent under the low scenario and 0.4 percent under the medium scenario. The steepest declines are estimated in Asia (0.2–0.8 percent) and North Africa (0.3–0.8 percent). By subregion, the largest decline in GDP is estimated in the Commonwealth of Independent States (CIS)<sup>29</sup> subregion (which includes Ukraine) with the region experiencing a decline of 1.5 percent under the low scenario, representing a loss of 5.7 billion (in 2015 U.S. dollars) and a nearly 3 percent decline under the medium scenario, equivalent to 11.4 billion (in 2015 U.S. dollars). In Sub-Saharan Africa, GDP losses are estimated to be greatest in East Africa and West Africa (appendix D: table D.2).

The disaggregation of GDP losses by shock is also shown in figure 15. The yield shock, representing higher input prices, comprises most of the decline in GDP in the Sub-Saharan Africa and Latin American and the Caribbean regions. However, in North Africa, the remaining shocks—based on Russia's military invasion of Ukraine (export restrictions, labor changes, and changes in Russia's energy price)—represent about 75 percent of the GDP decline and nearly 40 percent of the GDP change in Asia, due to the effects on Ukraine's economy.

<sup>29</sup> The members of Commonwealth of Independent States are Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan. Turkmenistan is an associate member. Ukraine has not formally withdrawn from the organization but did formally end its participation in CIS statutory bodies in May 2018 (The World Fact Book, 2022). The subregional and regional aggregation here is based on the recognition of this note and is meant to facilitate comparison of food security trends across subregions.

Figure 15

## Percent change in GDP relative to baseline under the three alternative scenarios



GDP = Gross Domestic Product

Source: USDA, Economic Research Service, estimation using the International Food Security Assessment model and the Global Trade Analysis Project model.

## Food Insecurity Is Expected to Increase in Low- and Middle-Income Countries

IFSA is a demand-oriented model that is used to estimate the food security impacts associated with commodity price and income shocks. In the IFSA model, food is divided into four groups: (1) the major grain consumed in the country, (2) other grains, (3) root crops, and (4) all other food. Food demand is composed of two parts: population—which influences how much food is demanded—and income—how much food someone can afford (for more detail, see appendix A). The Russian military invasion of Ukraine is expected to increase prices (especially wheat, corn, and vegetable oils), in addition to causing generally negative impacts on GDP. Three estimated scenarios with increasing impacts on agricultural crop yields, agricultural commodity trade, and labor, find the effect of Russia's military invasion of Ukraine and higher input prices will lead to an increase in food insecurity by an additional 41.7 million people in a low scenario (as reported in the accompanying IFSA report) and up to 134.7 million in a high scenario, resulting in the estimated number of additional food insecure people between 118.7 million to 211.7 million in 2022.

Authors estimated three sets of food security results for 2022, using GTAP outputs from the three scenarios for the modeled simultaneous shocks presented in increasing order of magnitude as low, medium, and high. Also included are the baseline estimates with no shocks, showing the change in estimates under each scenario.<sup>30</sup> Note that the baseline 2022 estimate, which does not incorporate the shocks from the Russian military invasion of Ukraine or the recent spikes in input prices, is influenced by high food price inflation experienced in 2021.

<sup>30</sup> The IFSA model produces estimates for 2022 and projections for 2032. Focus is on the short-term 2022 estimates, as the length of the Russia/Ukraine crisis and long-term impacts are uncertain. The accompanying IFSA report is based on the low scenario.

In 2022, in the absence of the crisis, over 30 percent of the world population is estimated to be food insecure, representing 1.3 billion people. Of that population, 43 percent are in Sub-Saharan Africa and 50 percent are in Asia. Across regions, the Latin America and the Caribbean and North African regions were relatively food secure—with 28 percent and 17 percent of their respective populations unable to meet caloric requirements of 2,100 kcal per day.<sup>31</sup> However, the Russian military invasion of Ukraine (combined with higher input prices) is estimated to have the largest regional impact (by percent) for the North African region, followed by the Asian region, which includes the CIS. The CIS subregion (which includes Ukraine)<sup>32</sup> had the lowest prevalence of food insecurity at baseline, with 13 percent of its population estimated to be food insecure in 2022, prior to the invasion (appendix D: table D.3).

When the effects of the Russian military invasion of Ukraine and yield decreases are incorporated, an additional 3 percent of the population covered by this assessment in the low scenario are estimated to be food insecure—representing 41.7 million people. In the medium scenario, an additional 7 percent are estimated to be food insecure, representing an additional 86.1 million people over the pre-invasion estimate. The IFSA model incorporates both price and income effects—and the scenarios include additional shocks to yield, labor, and energy prices, which likely account for size of the estimates.<sup>33</sup> The high scenario included in this analysis could be viewed as a worst-case scenario and it is estimated that an additional 134.7 million people over baseline would be unable to meet daily caloric requirements (appendix D: table D.3).

In the low scenario, the highest increases in the percent of population food insecure (prevalence of food insecurity) are expected in the Asian (5 percent) and North African regions (6 percent). The Asian region includes the CIS subregion, which includes Ukraine. The CIS subregion is estimated to have an additional 12 percent of the population experiencing food insecurity under the low scenario, with intensified impacts under the medium and high scenarios (appendix D: table D.3). Ukraine is estimated to have a 40 percent increase in its population suffering from food insecurity in the low scenario over baseline estimates and more than a 100 percent increase in the medium scenario (appendix D: table D.4). Asian countries' grain and vegetable oils dependency on imports from Russia and Ukraine makes them vulnerable to fluctuations in these markets. For corn, Georgia and Azerbaijan are the most dependent countries on Russian and Ukrainian imports—37 percent and 13 percent, respectively. Like other regions, the Asian region is heavily dependent on wheat imports from the Black Sea region; Georgia and Armenia import more than 70 percent of their wheat from Russia and Ukraine. Similarly, Kyrgyzstan, Yemen, and Azerbaijan also get more than 30 percent of their wheat from these two countries. In absolute terms, Yemen is one of the top 5 countries that import significant quantities of wheat from this region (USDA Production, Supply, and Distribution Database, 2022).

The North African Region is expected to see a 6–18 percent increase in the prevalence of food insecurity between the low to high scenarios (appendix D: table D.3). Countries in North Africa are highly dependent on food imports (including wheat, corn, and vegetable oil) from Russia and Ukraine. Tunisia and Egypt import 47 percent and 14 percent, respectively, of their corn from Russia and Ukraine. Other countries in North Africa are also vulnerable: Morocco is a large wheat importer, Libya imports about half of its wheat from Ukraine and Russia, and Algeria is one of the 10 largest wheat importers globally. The low- and middle-income countries in North Africa (particularly Egypt and Tunisia), rely on Russia and Ukraine for at least 25

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<sup>31</sup> The 2,100 kcal (kilocalorie) per capita per day threshold was an internationally agreed upon level set by United Nations as the recommended level of dietary energy intake for a healthy, well-nourished individual (FAO, 2004).

<sup>32</sup> The members of the Commonwealth of Independent States are Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan. Turkmenistan is an associate member. Ukraine has not formally withdrawn from the organization but did formally end its participation in CIS statutory bodies in May 2018 (The World Fact Book, 2022). The subregional and regional aggregation here is based on the recognition of this note and is meant to facilitate comparison of food security trends across subregions.

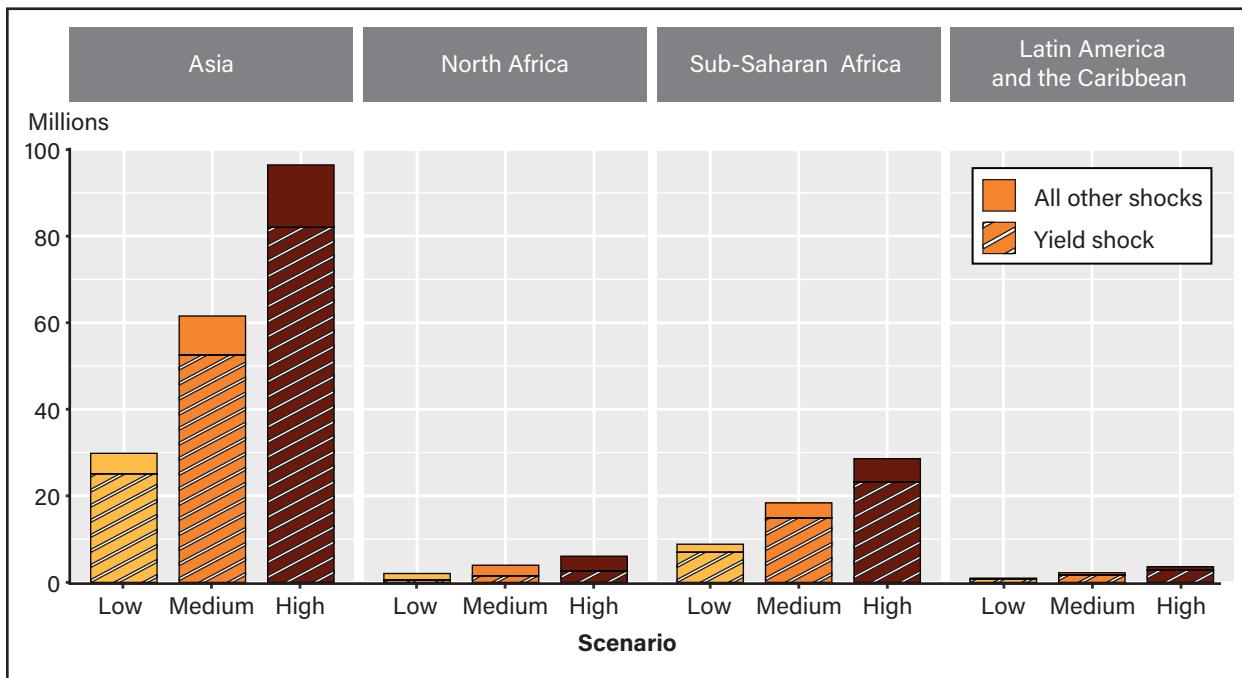
<sup>33</sup> This estimate, as with the main IFSA estimates, assumes that countries and the global food trade system will be able to efficiently respond to any food supply shortages.

percent of wheat imports. For Egypt, almost half (47 percent) of its domestic wheat consumption comes from Russia and Ukraine, 38 percent from domestic production, and 15 percent from the rest of the world. More specifically, the majority of Egypt's wheat imports (76 percent) come from Russia and Ukraine. The majority of Tunisia's wheat imports (59 percent) come from the rest of the world. In absolute terms, Egypt imports the highest quantity of wheat in the world, followed by Algeria (USDA Production, Supply, and Distribution Database, 2022).

While the Russian military invasion of Ukraine is expected to increase the prevalence of food insecurity the most in Asia and North Africa, the number of additional food insecure individuals is estimated to increase the most in the Asian and Sub-Saharan African regions (figures 16 and 17). In Sub-Saharan Africa, the number of additional food insecure people is estimated to be between 9 million and 29 million between the low to high scenarios (appendix D: table D.3). Eight SSA countries import more than 50 percent of domestic wheat consumption from Russia and Ukraine. The Democratic Republic of the Congo imports 80 percent of its wheat from Russia, while Mauritania imports 46 percent of its wheat from Ukraine. Additionally, 13 SSA countries import more than 30 percent of their wheat from Russia and Ukraine (USDA Production, Supply, and Distribution Database, 2022). In Asia, the largest population of food insecure is in Central and Southern Asia due to the inclusion of India, while the highest prevalence of food insecurity is in Other Asia, due to the inclusion of the Democratic People's Republic of Korea (appendix D: table D.3). In the low scenario, India is estimated to see an additional 5 percent increase in the prevalence of food insecurity, due to the Russian military invasion of Ukraine, equivalent to nearly 16 million people. India is a major importer of sunflower oil from Russia and Ukraine and would be affected by estimated price increases for vegetable oils (appendix D: table D.4).

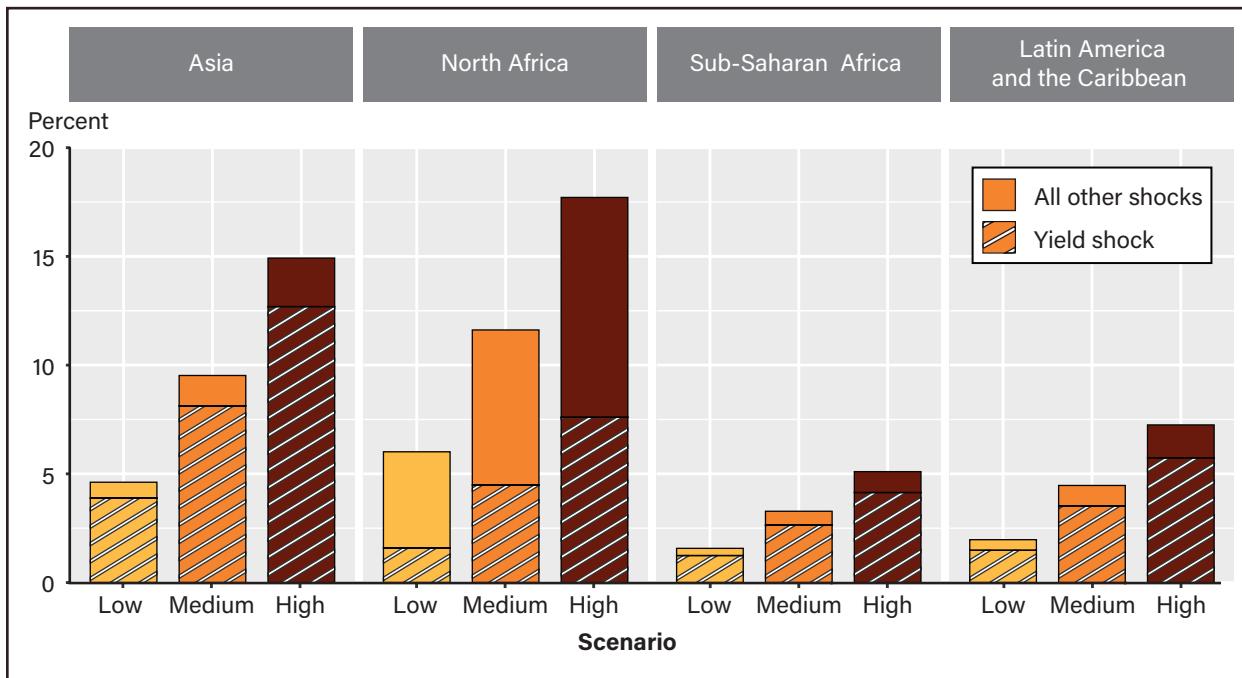
The additional population (in millions) and share of population (percent) that is estimated to be food insecure is shown for baseline and the three scenarios in figures 16 and 17, respectively. Figures 8 and 9 also show the disaggregation of changes in food security, due to the simulated shocks. The yield shock comprises most of the increase in the additional number of food insecure people (figure 16). However, the remaining shocks (based on the Russian military invasion of Ukraine, export restrictions, labor changes, and changes in Russia's energy price) drive the increase in the share of the population that is food insecure, particularly in the North African region where the non-yield shocks comprise nearly 60 percent of the total change in the prevalence of food insecurity (figure 17).

Figure 16

**Additional food insecure population in millions under the three alternative scenarios**

Source: USDA, Economic Research Service, estimation using the International Food Security Assessment model.

Figure 17

**Percentage of additional food insecure population relative to baseline under the three alternative scenarios**

Source: USDA, Economic Research Service, estimation using the International Food Security Assessment model.

## Conclusion

The COVID-19 pandemic contributed to sharp increases in food insecurity in 2020 and 2021, adding to the effects of protracted conflict and extreme weather. Prior to Russia's military invasion of Ukraine, high international commodity prices and supply shortages resulted in higher food prices, affecting the most vulnerable consumers around the world—especially in low- and middle-income countries. The Russian military invasion of Ukraine led to uncertainty in world markets and further increases in commodity prices. Additionally, input prices (mainly fertilizer and energy) began increasing in late 2021 beyond prior expectations and continued to rise after Russia invaded Ukraine. It is difficult to disentangle the short-term effect of the invasion from the structural and underlying drivers of recent increases in global food security. However, Russia's military invasion of Ukraine compounded the food security situation, especially for countries that trade with the Black Sea region and for consumers who spend a higher proportion of their income on food. Authors' estimates show that in addition to the high pre-invasion food insecurity levels recorded in the 77 countries covered by the USDA, ERS assessment, the invasion of Ukraine and higher input prices could cause an additional 41.7 million to 134.7 million people to be unable to reach a caloric threshold of 2,100 kilocalories per person per day. This number would lead to total 118.7 million to 211.7 million additional food insecure people in 2022 over the 2021 estimate.

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## Appendix A: Food Security Assessment Model: Definitions and Methodology

The International Food Security Assessment (IFSA) model<sup>34</sup> used in this report projects food consumption (food demand), food access, and food gaps in 77 low- and middle-income countries. Each country's food security metrics are estimated for 2022 and projected to 2032. Food is divided into four groups, covering 100 percent of food consumption: the major grain (determined by calorie share), other grains, root crops, and all other food.

The food security of a country is evaluated based on the gap between estimated domestic food consumption (food demand) and a caloric threshold, set at 2,100 kcal per capita per day—a caloric level necessary to sustain life at a moderate level of activity. The modeling projections of food demand are expressed in grain equivalent, based on each food group's caloric content to allow aggregation across food groups, allowing this grain equivalent to be easily expressed in either kilograms or kcal.

Three food security indicators are provided: (1) the share of food insecure, which is the share of the total population unable to reach the nutritional threshold; (2) the number of food insecure people; and (3) the food gap, which is the amount of food needed to allow each individual consuming below the threshold level to reach the caloric target. This caloric threshold indicates relative well-being and helps to quantify unequal food access within a country. Projection results provide a baseline for the food security situation in each country, and the results depend on the model's specification and underlying assumptions. The simulation framework used to project food demand is based on partial-equilibrium models for each country in the assessment. Beghin et al. (2015) introduced the methodology, and Beghin et al. (2017) provide more detail on price transmission and food security projections.

Each country model comprises a price-independent generalized log-linear (PIGLOG)<sup>35</sup> demand system for each of the four food groups (Deaton and Muellbauer, 1980; Muellbauer, 1975). The demand system is calibrated on a 3-year-average of prices and incomes (2019–21), observed consumption levels, a measure of inequality, and income and price elasticities. Demand projections are based on projected prices and incomes; the model implicitly assumes that both the preferences represented by the demand system and the income distributions embedded in the calibration and that the projections are constant over time.

The distribution of consumption used to calculate food security measures is described by a constant coefficient of variation, which implies an increasing standard deviation of consumption as consumption rises over the projection period. But, this does not account for potential structural changes in an economy. The implied price and income elasticities evolve over the projection period as prices and incomes change; generally, food groups become more income-inelastic because incomes rise.

<sup>34</sup> The methodology to estimate the IFSA model indicators was replaced in 2016. To understand the changes to the model and their impact on food security estimates, see Rosen et al. (2016).

<sup>35</sup> PIGLOG refers to a class of demand systems that provide flexible structure with nonlinear income response and exact aggregation of individual demand into a representative consumer demand function of per capita income and, as shown later, the Theil entropy measure of income inequality.

# Structural Framework for Estimating and Projecting Food Demand in the Aggregate Demand System

## Definition and Calibration

The demand  $q_i^h$  for a given food group  $i$ , for income-decile  $h$  is specified as:

$$(1) \quad q_i^h = (x_i^h/p_i)(A_i(p_i) + B_i(p_i)\ln(x^h))$$

where  $p_i$  is the price (expressed in real local currency), and  $x^h$  is the decile-level income.  $A_i(p_i) = a_{i0} + a_{i1}p_i$  and  $B_i(p_i) = b_{i0} + b_{i1}p_i$ .

The PIGLOG demand formulation allows for aggregation of income decile-level demands in (1) into average per capita market demand for each food group  $i$  as shown in (2).

$$(2) \quad \bar{q}_i = \left(\frac{x_i}{p_i}\right)((a_{i0} + a_{i1}p_i) + (b_{i0} + b_{i1}p_i)(\ln(\bar{x}) + \ln(\frac{10}{z}))$$

The latter in equation (2) is a function of average per capita income  $\bar{x}$  and Theil's entropy measure of income inequality  $z$ .

The average expenditure share for good category  $i$  is also defined as:

$$(3) \quad \bar{w}_i = (a_{i0} + a_{i1}p_i) + (b_{i0} + b_{i1}p_i)(\ln(\bar{x}) + \ln(\frac{10}{z}))$$

The elasticity of average demand for good  $i$ , with respect to average income (or total expenditure), is:

$$(4) \quad \varepsilon_{\bar{q}_i \bar{x}} = 1 + (b_{i0} + b_{i1}) / \bar{w}_i$$

The own-price elasticity of the average demand is:

$$(5) \quad \varepsilon_{\bar{q}_i p_i} = -1 + \left(\frac{p_i}{\bar{w}_i}\right)(a_{i1} + b_{i1}(\ln(\bar{x}) + \ln(\frac{10}{z})))$$

In each country, consumers at different income levels have similar underlying preferences over good  $i$  as embodied in parameters  $a_{i0}$ ,  $a_{i1}$ ,  $b_{i0}$ ,  $b_{i1}$ , but their respective consumptions vary because their respective incomes vary.

With a system of three linear equations (equations 3, 4, and 5), with four unknown variables, one parameter remains free. The free parameter (chosen to be  $b_{i0}$ ) is used to ensure that decile demands behave consistently with stylized facts of food security as follows: Price sensitivity and income responsiveness decline with income levels; own-price elasticities must be negative; and food expenditure shares tend to fall with increasing income. A range of values of the free parameters allows ensuring these stylized facts are satisfied by the calibrated demand system. Here  $b_{i0}$  is pinned down such that the ratio of price elasticities for the bottom and top deciles is equal to the ratio of the natural logarithm of their national income shares.

For any given free parameter value, the system of equations is solved for parameters  $b_{i1}$ ,  $a_{i1}$ , and  $a_{i0}$  as a function of the free parameter. Once these three parameters are recovered, parameters  $\tilde{a}_{i0}$ ,  $\tilde{a}_{i1}$ ,  $\tilde{b}_{i0}$ , and  $\tilde{b}_{i1}$ , along with income  $x^h$  and price  $p_i$ , are used to generate the consumption level of good  $i$  for each decile specified in equation (1). In this initial calibration, the quality of any good  $i$  is assumed to be constant across the income distribution.

For each country, a demand system is calibrated for each of the four food groups—based on income, consumption levels, and prices from the 3 years preceding the projection period (2018–20). The *major grain*

(which varies across countries) is determined, based on caloric share in the diet. The *other grains* food group contains all other grains; the prices for this food group are weighted by its components' caloric shares. At the calibration stage, domestic food prices are either observed (including the components of a price index for other grains that is weighted by caloric share), or synthetic prices are created.

For the food prices not observed in the calibration stage, a synthetic domestic price,  $p_i^{ds}$ , that is linked to the world price,  $p_i^w$ , is created and expressed in local currency. The parameter  $\theta$  is the price transmission slope, which is assumed 0.7. The parameter  $trc^{int}$  represents international transportation and market costs (e.g., cost, insurance and freight (CIF) and free on board (FOB)), which are assumed 10 percent, and  $trc^{dom}$  are domestic trade costs, which are assumed \$20 per ton in real terms:

$$(6) \quad p_i^{ds} = \theta * p_i^w * (1 + trc^{int} / \theta) * (1 + tariff / \theta) + trc^{dom}.$$

At this stage, the calibration also includes a price transmission equation that links the domestic price  $p_i^{dom}$  (either observed or synthetic) to the world price. The generic price transmission equation is:

$$(7) \quad p_i^{dom} = \theta * p_i^w + \hat{I}$$

During the calibration stage, the intercept,  $I$ , is solved in real terms and is held constant during the projection period.

#### *Projection of Food Demand Calculation and Food Security Indicators*

The IFSA food security indicators (share of food insecure population, number of food insecure people, and food-gap) are derived from the levels of food demand projected, using the calibrated demand system.

For each country, the demand parameters and projected income,  $x_t$ , and prices,  $p_{it}$ , are used to project food demand,  $q_{it}$ , for each of the four food groups  $i$  in each year  $t$  so that  $q_{it} = \hat{A}_i(x_t/p_{it})((p_{it}) + \hat{B}_i(p_{it})\ln(x_t))$ . The demand for the four food groups is aggregated into total food demand expressed in calories, so that  $\sum q_{it} = Q_t$ , which is also referred as food or calorie consumption. This measure of total demand is used to calculate food security indicators.

The FAO (2019) is followed to estimate the distribution of calorie consumption—beginning with a coefficient of variation (CV) of food availability—which characterizes consumption distributed with a mean  $m$  and variance  $v$ , so that  $CV = (\sqrt{v}/m)$ .<sup>36</sup> Given the CV and the projected mean caloric consumption ( $Q_t$ ), the variance,  $v$ , of the empirical distribution for a given year  $t$  can be recovered. with a specific focus on the enabling environment for food security and nutrition that reflects commitment and capacities across four dimensions: policies, programmes and legal frameworks; mobilization of human and financial resources; coordination mechanisms and partnerships; and evidence-based decision-making.

Assuming food consumption  $Q_t$  is distributed lognormal, then  $\ln(Q_t)$  is distributed  $N(\mu, \sigma^2)$  with  $\mu = \ln(\frac{m}{\sqrt{v+m^2}})$  and  $\sigma^2 = \ln(1 + v/m^2)$ . Once  $\mu$  and  $\sigma^2$  are computed, the proportion of the population that falls below the calorie threshold (2,100 kcal per capita per day) is recovered using the standard normal CDF,  $\Phi: \Phi^{insecure} = \Phi(\frac{\ln(2,100) - \mu}{\sigma})$ . Here,  $\Phi^{insecure}$  indicates the share of the population that is food insecure. Using this share and total population in the respective country, the total number of food insecure people in this country is calculated.

<sup>36</sup> See the appendix of Beghin et al. (2015b) for more detail.

Next, the expected average food intake of food insecure people,  $q_{cal\ average}^{food\ insecure}$ , can be recovered using the partial mean of the calorie availability below the threshold (2,100), which is calculated as  $q_{cal}^{food} = e^{\mu-\sigma/\Phi^2 2100[\phi(\ln(2100)-\mu)/\sigma]}$ , where  $\phi$  is the standard normal density function.

The food gap is the difference between the caloric threshold of 2,100 and the average calorie availability for food insecure people. This provides a measure of the food gap in kcal per day per food insecure person. The latter, multiplied by the number of food insecure people and converted into grain equivalent per year, yields a food-gap measure based on annual grain volume.

## *Data*

The model is calibrated for each of the four food groups based on average prices and income from 2019–21. Prices are expressed in real local currency units. Quantities are expressed in grain-equivalent units.

### **Calibrated parameters and variables:**

Demand parameters ( $\tilde{a}_{i0}$ ,  $\tilde{a}_{i1}$ ,  $\tilde{b}_{i0}$ , and  $\tilde{b}_{i1}$ ), price intercepts, and domestic prices (synthetic) projections are based on data from the *ERS International Macroeconomic Data Set* and the *USDA Agricultural Projections to 2030*. They utilize the calibrated demand parameters and price transmission between world and domestic prices.

### **Endogenous projection variables:**

Food demand, domestic prices.

### **Exogenous variables used in calibration and projection:**

Average consumption per capita—Food and Agriculture Organization (FAO) of the United Nations Food Balance Sheet (most recent available).<sup>37</sup>

Grain shares—FAO Food Balance Sheet<sup>38</sup>

Elasticities of price and income calculations based on 2011 International Comparison Program (ICP) data, following the methodology in Muhammad et al. (2011).<sup>39</sup>

Domestic prices (observed)—FAO Global Information and Early Warning System (GIEWS), annual average; market depends on reporting.

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<sup>37</sup> Food Balance Sheets (FBS) are for 2018. There are no current FBS for Somalia, Eritrea, Burundi, and Democratic Republic of the Congo. Calculations use grain consumption levels and share of grains in total calories, as reported in the Food Agriculture Organization of the United Nations—Global Information Early Warning Systems Cereal Supply and Demand Balance for Sub-Saharan African Countries: Situation as of November 2016 report, to generate per capita consumption for each food group. Reported consumption of all food groups uses information from FAO's grain supply data and changes in caloric intake.

<sup>38</sup> For Somalia, an FBS from the original Food and Agriculture Organization Statistical Database was used, which is no longer maintained. The FBS of neighboring countries used (Burundi-Rwanda; Democratic Republic of Congo-Congo; Eritrea-Ethiopia) to approximate the shares of grains and roots and tubers in total calories for the other countries.

<sup>39</sup> Elasticities are not available for all countries. Estimates used from neighboring countries (Somalia-Ethiopia; Eritrea-Ethiopia; Algeria-average Tunisia and Morocco; Afghanistan-average Tajikistan and Pakistan; Turkmenistan- average Tajikistan, Kyrgyzstan, Kazakhstan; Uzbekistan-average Tajikistan, Kyrgyzstan, Kazakhstan). Less elastic values were used for major grain in Vietnam, Philippines, Indonesia, India, Pakistan, and Bangladesh—and for other grain in India.

Tariffs—World Bank’s World Integrated Trade Solution (WITS)<sup>40</sup>

Exchange Rates and Consumer Price Indices (CPIs)—*ERS International Macroeconomic Data Set*.<sup>41</sup>

Population—U.S. Department of Commerce, Bureau of the Census.

World prices—*USDA Agricultural Projections to 2027*.<sup>42</sup>

Per capita income—generated using GDP and population from *ERS International Macroeconomic Data Set*<sup>43</sup>

Income distribution—World Bank Data Bank.<sup>44</sup> Assumed constant during the projection period.

Coefficient of variation (CV) of food consumption—FAO State of Food Insecurity (FAO, 2019). Assumed constant during the projection period.

### *Modeling staple cereal production*

The current production module of the IFSA model aggregates a panel of agricultural production data for all 77 countries in the assessment to provide a model-based estimation for the current year and a projection 10 years out for yield and area dynamics.

Agricultural production is decomposed into yield (production per hectare) and area for grains. Production (PR) for a given country  $c$  in year  $t$  is obtained by multiplying projected yield (YL) and area (AR).

$$PR_{ct} = AR_{ct} * YL_{ct}$$

The projections cover the period 2021–31 based on producer price projections in local currency units and world price projections from the USDA Agricultural Projections.

### *Yield*

Yield parameters are estimated econometrically using panel data consisting of observations for each country and are calibrated to observed yields for the immediate past 3 years (e.g., 2017–19 yields). The calibration procedure involves in-sample prediction using observed yield data and consensus estimates for the expected return ratio—an indicator of the relative profitability of fertilizer use. Yields respond to expected relative return ratios per hectare (RR), autonomous technical change over time (T), and include a country-specific effect.

$$YL_{ct} = f(RR_{ct}, T_t)$$

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<sup>40</sup> Tariff rates are available through 2018. Tariff rates are not available for Somalia, Turkmenistan, Eritrea, and North Korea. For Eritrea, the Common Market for Eastern and Southern Africa (COMESA) average was used. Somalia has imposed a 12.3 percent tariff on commercial imports (LCU Logistics). Turkmenistan has no tariff but imposes excise taxes that have historically been 10 percent. North Korea does not import on the open market, so calculations assume there are zero tariffs and do not quantify other trade frictions.

<sup>41</sup> Ecuador and El Salvador are modeled in the currency of U.S. dollars (instead of local currency), as in the ERS International Macroeconomic Dataset—based on data from the International Monetary Fund (IMF) and Oxford Economics. Projections constructed for Somalia, North Korea, and Zimbabwe—using data from International Monetary Fund, IHS Markit, and Oxford Economics.

<sup>42</sup> The world price series are maize (U.S. gulf #2 yellow); rice (Thai, B, fob Bangkok); sorghum (U.S. Gulf, #2 yellow); wheat (gulf, #2 Hard Red Wheat); barley (E.C., French, Rouen); Oats (U.S. farm); roots and tubers (cassava; tapioca, hard pellets, Rotterdam, fob); other food (represented by soybean oil, Dutch fob, ex-mill). World price projections are not available for all cereals represented in the Food and Agriculture Organization of the United Nations (FAO) Food Balance Sheets and the FAO Global Information Early Warning System price database. The world price of wheat to represent rye; and sorghum to represent all other cereals (e.g., millet, teff, fonio) was used.

<sup>43</sup> Projections were constructed using information from IMF, Oxford Economics, and IHS Markit for Zimbabwe, Somalia, and North Korea.

<sup>44</sup> Income distributions are not available for all countries. Report uses Eritrea-Ethiopia; Somalia-Ethiopia; Zimbabwe-Zambia; North Korea-Mongolia; and Afghanistan-average Uzbekistan, Pakistan, Tajikistan.

The return ratios are the ratio of the return per hectare—revenue from yield divided by the price of fertilizer,  $RR_{ct} = (yp_{ct} * Y_{ct}) / fp_{ct}$ , where  $yp$  and  $fp$  are yield and fertilizer prices, respectively. The expected return ratios include a current-year component and a long-term expectation component, expressed in real local currency unit (*rlcu*). USDA Agricultural Projection (to 2030) prices for superphosphate and the major grain by production volume (for grain) are used.

The domestic price for each grain is linked to its world reference price, expressed in real local currency unit, through the following price transmission equation:

$$P^{domestic} = 0.7 \times p^{world} + 0.3 \times I$$

The expected domestic price is a weighted average of 70 percent of the current-year world price (*pworld*) and 30 percent of the mean domestic price (*I*) over the analysis time period. The grain production data used in the estimation come from USDA's Production Supply and Demand (PSD) database and from the Food and Agriculture Organization of the United Nations (FAO). The intercept, *I*, is the mean of the price over the regression time period (1985–2020).

### *Modeling area*

Crop area,  $AR_{ct}$ , is modeled with the widely used Nerlovian specification—in which lagged area, expected crop and fertilizer prices, and a time trend—enter into the equation as follows:

$$AR_{ct} = f(yp_{ct}, fp_{ct}, AR_{ct-1}, T)$$

The expected prices are averages of contemporaneous and lagged relative prices. A time trend is included in the area equation to capture non-price factors in area, and a country fixed effect. The area equation is numerically calibrated to the base year average of the preceding 3 years of the report (e.g., 2018–20), using consensus estimates for price and lagged acreage responses. Regional and sub-regional models are fitted to allow for heterogeneity among diverse countries included in the IFSA model. The regional specification disaggregates the estimation of area and yield by the four regional classifications of the IFSA countries: Sub-Saharan Africa (SSA), Asia, Latin America and the Caribbean (LAC), and North Africa (NAF). The sub-regional specification disaggregates the model to 10 sub-regions of the IFSA countries: Central Africa (CAF), East Africa (EAF), Southern Africa (SAF), West Africa (WAF), North Africa (NAF), Latin America and Caribbean (LAC), Commonwealth of Independent States (CIS), Central and South Asia (CSA), Southeast Asia (SEA), and Other Asia (OA).

Model-based projection performance is assessed in terms of how well the specified model can be expected to perform on an independent (out-of-sample) data set, often assessed by the actual estimate of the out-of-sample Mean Squared Error (MSE). When an independent out-of-sample dataset is not available, a Cross-Validation (CV) approach (used in this report) can be used to choose the best model—by estimating the out-of-sample MSE using an in-sample data set. The out-of-sample error (often referred to as the test error) is the average error that results from using the regression method to predict the response on a new observation that was not used in regression estimation. Given an in-sample dataset, the choice of a particular specification (in this report, the regional and sub-regional model specifications) is warranted if the model results in a low test error (James et al., 2017). The models are assessed with a “leave-one-out-cross-validation” (LOOCV) to simulate their out-of-sample prediction performance (James et al. 2017).

The performances of regional and sub-regional model specifications are assessed using the overall out-of-sample MSE scores. The model with the smallest out-of-sample MSE is selected for estimation.

## Modeling Implied Additional Supply Required

The Implied Additional Supply Required (IASR) quantifies the total grain demand in each country that is not projected to be met through domestic production. Total grain demand (TD) is comprised of food demand (FD) generated by our demand-driven model and nonfood use (NFD)—which is comprised of seed, feed, processing, and other uses. The IASR for grains thus can be expressed as: IASR = TD-PR.

The demand for grain for processing, seed, and other uses is assumed to grow at the same rate as production. The demand for grain feed grows at the average rate observed during 2006–20.

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## Appendix B: Food Security Measures for International Food Security Assessment Countries, 2022–32

Appendix Table B.1

Summary food security indicators for 77 countries in the International Food Security Assessment

	Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates	
			Population	Population food insecure			Population	food insecure			Food gap (per capita)	Food gap (per capita)			Food gap (total)	Food gap (total)
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million		Million		Million		Percent		Percentage		Kilo-calories/day		Percentage		1,000 metric tons	
Total for IFSA countries	4,044.9	4,671.1	1,332.6	577.3	41.7	2.0	32.9	12.4	3.2	0.4	419.2	407.8	0.6	0.0	71,667.7	30,210.1
Asia	2,542.6	2,797.1	676.2	157.3	29.8	0.7	26.6	5.6	4.6	0.5	334.8	291.6	1.3	0.1	30,427.8	6,162.7
CIS*	117.1	119.1	17.1	3.2	1.9	0.0	14.6	2.7	12.2	0.9	319.0	280.2	0.7	0.1	692.1	114.0
Armenia	3.0	2.9	0.3	0.0	0.1	0.0	8.4	0.2	25.7	1.8	207.2	136.2	4.1	0.1	6.5	0.1
Azerbaijan	10.4	10.9	0.8	0.1	0.2	0.0	8.0	0.5	36.3	2.1	188.7	134.4	5.4	0.2	18.1	0.9
Georgia	4.9	4.9	0.7	0.1	(0.1)	0.0	13.5	1.4	(11.9)	0.1	245.8	174.7	(2.8)	0.0	21.3	1.6
Kyrgyzstan	6.1	6.5	2.0	0.5	0.2	0.0	33.4	7.8	10.0	1.1	315.3	220.6	3.4	0.2	82.4	14.4
Moldova	3.3	2.9	1.0	0.0	0.0	0.0	30.5	0.5	1.0	1.6	260.9	134.4	0.3	0.1	34.8	0.3
Tajikistan	9.1	10.3	5.8	2.3	0.3	0.0	63.3	22.7	5.5	0.7	490.0	318.8	3.7	0.2	352.2	93.1
Turkmenistan	5.6	6.1	0.9	0.1	0.1	0.0	16.5	1.1	13.6	0.4	247.7	163.9	3.0	0.0	29.9	1.5
Ukraine	43.5	41.2	2.0	0.0	0.6	0.0	4.5	0.0	41.3	86.8	172.1	106.6	5.0	3.6	44.7	0.1
Uzbekistan	31.1	33.3	3.6	0.1	0.5	0.0	11.5	0.4	15.8	0.5	220.1	141.0	3.0	0.0	102.2	2.1
Central and Southern Asia	1,854.0	2,052.7	514.0	96.7	21.9	0.6	27.7	4.7	4.5	0.6	339.5	231.3	1.8	0.1	21,671.8	3,256.8
Afghanistan	38.4	47.3	31.1	23.7	0.8	0.1	81.0	50.2	2.5	0.3	524.1	361.9	3.1	0.2	1,936.4	1,020.8
Bangladesh	165.8	179.8	36.9	8.5	1.4	0.0	22.3	4.7	3.8	0.6	287.6	211.1	1.0	0.1	1,560.5	264.1
India	1,353.0	1,478.9	333.5	24.7	15.7	0.3	24.7	1.7	4.9	1.1	285.7	177.7	1.4	0.1	12,773.0	587.7
Nepal	30.7	32.8	6.0	0.1	0.4	0.0	19.6	0.4	7.0	1.6	278.0	160.4	1.7	0.1	237.0	3.1
Pakistan	242.9	289.5	101.9	38.8	3.6	0.2	42.0	13.4	3.6	0.4	404.3	289.0	1.5	0.1	4,993.1	1,357.5
Sri Lanka	23.2	24.4	4.5	0.8	0.1	0.0	19.3	3.5	3.1	0.3	257.5	187.4	0.8	0.0	171.7	23.5

\*The members of Commonwealth of Independent States (CIS) are Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan. Turkmenistan is an associate member. Ukraine has not formally withdrawn from the organization but did formally end its participation in CIS statutory bodies in May 2018 (The World Fact Book, 2022). The subregional and regional aggregation here is based on the recognition of this note and is meant to facilitate comparison of food security trends across subregions.

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			Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates			
			Population		Population food insecure		Population		food insecure		Share of population food insecure		Share of population food insecure		Food gap (per capita)		Food gap (per capita)		Food gap (total)	
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032
	Million		Million		Million		Percent		Percentage		Kilo-calories/day		Percentage		1,000 metric tons		Percentage		Food gap (total)	
Other Asia	60.3	66.9	45.1	34.7	0.8	0.1	74.8	51.9	1.8	0.2	568.3	429.9	1.8	0.2	3,341.3	1,946.5	3.6	0.4		
Korea, Democratic People's Rep. of	26.0	26.8	17.8	12.9	0.3	-	68.6	48.3	1.8	-	474.8	380.8	1.4	-	1,210.4	703.4	3.2	-		
Mongolia	3.2	3.4	0.9	0.1	0.1	0.0	28.2	2.7	12.5	1.0	318.8	201.8	3.7	0.1	36.0	2.3	16.6	1.1		
Yemen	31.0	36.6	26.3	21.7	0.4	0.1	84.8	59.2	1.5	0.4	633.2	455.0	2.1	0.2	2,094.9	1,240.8	3.6	0.6		
South East Asia	511.3	558.5	100.1	22.7	5.2	0.0	19.6	4.1	5.5	0.2	308.5	243.6	1.2	0.0	4,722.7	845.3	6.8	0.2		
Cambodia	17.4	19.4	4.1	0.5	0.3	0.0	23.7	2.8	7.7	1.3	302.6	203.0	2.1	0.2	190.3	16.7	9.9	1.4		
Indonesia	272.2	291.1	49.9	8.5	3.9	(0.0)	18.3	2.9	8.4	(0.1)	292.1	211.1	2.0	(0.0)	2,164.8	265.9	10.6	(0.1)		
Laos	7.7	8.7	2.7	0.4	0.0	0.0	34.6	5.1	0.7	1.0	307.9	198.5	0.2	0.2	133.0	14.4	0.9	1.1		
Philippines	112.5	129.3	33.0	12.6	1.0	0.0	29.4	9.7	3.1	0.2	364.7	279.2	1.0	0.0	1,819.9	531.3	4.1	0.2		
Vietnam	101.6	110.0	10.4	0.6	0.1	0.0	10.2	0.6	0.6	0.9	265.3	182.3	0.1	0.1	414.7	16.9	0.7	0.9		
Latin America and the Caribbean	177.1	194.0	50.9	18.3	1.0	0.0	28.7	9.4	2.0	0.2	391.9	357.8	0.3	(0.0)	2,565.9	843.6	2.3	0.1		
South America	112.2	122.5	26.6	6.1	0.5	0.0	23.7	5.0	2.1	0.2	298.4	210.3	0.5	0.0	1,092.6	181.1	2.6	0.3		
Bolivia	12.0	13.5	5.7	2.0	0.0	0.0	47.3	14.7	0.2	0.3	351.4	241.1	0.1	0.1	260.8	62.8	0.3	0.4		
Colombia	50.4	54.9	7.5	1.1	0.3	0.0	14.8	1.9	3.5	0.1	268.7	193.9	0.8	0.0	289.9	29.5	4.3	0.1		
Ecuador	17.3	19.1	5.8	1.5	0.1	0.0	33.6	7.6	2.5	0.3	281.6	195.4	0.9	0.1	228.4	39.8	3.4	0.3		
Peru	32.5	34.9	7.6	1.6	0.1	0.0	23.5	4.7	1.9	0.1	291.8	211.0	0.5	0.0	313.4	49.0	2.4	0.2		

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	Population		Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates	
			Population	Population food insecure	Population	Population food insecure	Share of population	Share of population food insecure	Food gap (per capita)	Food gap (per capita)	Food gap (total)	Food gap (total)	Food gap (per capita)	Food gap (per capita)	Food gap (total)	Food gap (total)		
	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032	2022	2032		
	Million		Million		Million		Percent		Percentage		Kilo-calories/day		Percentage		1,000 metric tons		Percentage	
Central America and the Caribbean	64.9	71.5	24.3	12.2	0.4	0.0	37.4	17.0	1.8	0.1	395.9	301.4	0.7	0.0	1,473.4	662.5	2.1	0.1
Dominican Republic	10.7	11.6	1.4	0.2	0.0	0.0	13.5	1.3	3.4	0.2	236.5	166.7	0.7	0.0	49.3	3.7	4.2	0.2
El Salvador	6.6	6.7	2.0	0.6	0.0	0.0	30.5	9.2	2.4	0.1	316.4	235.8	0.8	0.0	71.6	16.4	3.2	0.1
Guatemala	17.7	20.4	6.6	3.3	0.1	0.0	37.5	16.1	2.1	0.1	386.2	301.2	0.8	0.0	292.5	113.0	2.9	0.1
Haiti	11.3	12.6	7.4	5.4	0.0	0.0	65.4	42.5	0.6	0.0	754.8	605.3	0.4	0.0	734.1	426.5	1.0	0.0
Honduras	9.5	10.5	3.5	1.3	0.1	0.0	37.1	12.6	2.7	0.3	384.9	285.4	1.0	0.1	152.3	42.7	3.7	0.3
Jamaica	2.8	2.9	0.5	0.1	0.0	0.0	18.7	2.4	3.5	0.3	245.7	171.8	0.9	0.0	16.8	1.5	4.5	0.3
Nicaragua	6.3	6.8	2.8	1.3	0.1	0.0	43.9	19.7	2.0	0.3	446.9	343.6	0.8	0.1	156.8	58.7	2.8	0.4
North Africa	201.1	231.2	36.3	12.9	2.1	0.1	18.0	5.6	6.0	0.6	317.4	254.7	1.4	0.1	1,465.7	420.0	7.5	0.7
Algeria	44.2	49.1	8.5	2.2	0.4	0.0	19.3	4.6	4.6	0.3	314.5	239.2	1.1	0.0	350.1	70.0	5.8	0.3
Egypt	108.7	130.5	21.4	9.2	1.4	0.1	19.7	7.1	6.8	0.7	334.7	271.3	1.7	0.1	876.9	305.5	8.6	0.8
Morocco	36.2	39.1	4.7	1.2	0.2	0.0	12.9	3.1	4.2	0.3	295.2	233.0	0.9	0.0	182.1	36.7	5.2	0.4
Tunisia	11.9	12.5	1.6	0.3	0.1	0.0	13.5	2.3	8.2	1.6	280.8	212.2	1.7	0.2	56.5	7.8	10.0	1.8

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	Population		Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates	
			Population food insecure	Population food insecure	2022	2032	Share of population food insecure	Share of population food insecure	2022	2032	Food gap (per capita)	Food gap (per capita)	2022	2032	Food gap (total)	Food gap (total)	2022	2032
	Million		Million		Million		Percent		Percentage		Kilo-calories/day		Percentage		1,000 metric tons		Percentage	
Sub-Saharan Africa	1,124.1	1,448.9	569.3	388.8	8.8	1.2	50.6	26.8	1.6	0.3	523.2	469.0	0.5	0.0	37,208.2	22,783.8	2.1	0.3
Central Africa	149.3	199.6	104.1	105.9	0.4	0.1	69.7	53.1	0.4	0.1	757.7	661.6	(0.0)	(0.0)	9,636.7	8,559.7	0.3	0.1
Cameroon	29.3	38.1	9.0	4.3	0.3	0.0	30.7	11.4	2.9	0.7	338.4	262.7	0.9	0.1	397.0	148.8	3.9	0.8
Central African Republic	6.0	7.2	5.0	3.0	0.0	0.0	82.7	41.2	0.6	0.0	628.3	389.7	0.8	0.0	354.4	129.9	1.5	0.0
Congo, Republic of the	5.5	7.0	3.8	2.5	0.1	0.0	68.5	35.5	2.2	0.5	458.6	322.3	1.7	0.2	228.8	104.8	3.9	0.7
Congo, Democratic Rep. of the	108.4	147.3	86.3	96.1	0.0	0.0	79.6	65.3	0.0	0.0	862.5	731.5	0.0	0.0	8,656.5	8,176.2	0.0	0.0
East Africa	393.1	502.3	219.5	133.3	3.6	0.6	55.8	26.5	1.7	0.4	504.5	437.7	0.8	0.1	13,257.0	6,987.1	2.5	0.6
Burundi	12.7	16.9	10.7	11.8	0.1	0.0	84.6	69.6	0.8	0.2	631.2	511.4	1.2	0.2	789.5	701.2	2.0	0.4
Chad	18.0	24.1	12.4	12.4	0.1	0.1	68.9	51.5	0.9	0.7	622.1	518.0	0.7	0.4	976.3	813.8	1.6	1.1
Eritrea	6.2	7.0	5.0	1.6	0.1	0.0	80.7	22.7	1.2	0.5	557.5	289.1	1.4	0.1	346.8	57.3	2.6	0.6
Ethiopia	113.7	142.5	49.3	10.5	1.3	0.1	43.4	7.4	2.8	1.0	374.5	234.5	1.2	0.2	2,036.1	271.1	4.0	1.2
Kenya	55.9	68.1	33.6	11.5	0.8	0.1	60.1	16.9	2.5	0.5	431.0	267.9	1.6	0.1	1,800.5	383.7	4.1	0.7
Rwanda	13.2	15.4	7.6	1.9	0.1	0.0	57.8	12.6	1.3	0.6	488.6	293.9	0.8	0.1	444.9	68.4	2.1	0.7
Somalia	16.8	22.4	14.9	16.8	0.0	-	88.5	74.8	0.3	-	786.2	638.0	0.5	-	1,342.7	1,226.8	0.8	-
Sudan	48.0	61.9	22.3	17.8	0.4	0.1	46.4	28.8	1.9	0.6	422.9	352.3	0.9	0.2	1,107.0	738.3	2.8	0.8
Tanzania	62.5	81.4	30.5	15.8	0.1	0.1	48.7	19.4	0.4	0.6	526.7	386.4	0.2	0.1	2,001.6	762.5	0.6	0.7
Uganda	46.2	62.6	33.2	33.2	0.5	0.1	71.9	53.1	1.5	0.3	601.4	490.1	1.3	0.2	2,411.6	1,964.1	2.8	0.5

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	Population		Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates		Current projection		Difference from baseline estimates					
			2022	2032	Population food insecure	Population food insecure	2022	2032	Share of population food insecure	2022	2032	Share of population food insecure	2022	2032	Food gap (per capita)	2022	2032	Food gap (per capita)	2022	2032	Food gap (total)	2022	2032	Food gap (total)	2022	2032
	Million		Million		Million		Percent		Percentage		Kilo-calories/day		Percentage		1,000 metric tons		Percentage		1,000 metric tons		Percentage					
Southern Africa	155.9	199.9	100.5	78.9	1.6	0.2	64.5	39.5	1.7	0.2	575.2	465.1	1.1	0.0	7,065.8	4,484.0	2.8	0.2	10,895.5	1,303.0	2.3	0.1	15,128.8	1,026.8	3.8	0.3
Angola	34.8	48.4	18.8	23.6	0.3	0.0	53.9	48.8	1.5	0.0	456.3	433.2	0.8	0.0	55.9	9.7	4.3	0.1	523.3	413.7	1.7	0.1	574.8	91.0	5.6	2.0
Lesotho	2.0	2.2	1.1	0.3	0.0	0.0	55.9	14.3	2.7	0.1	425.8	266.7	1.5	0.0	562.7	397.2	0.8	0.1	1,523.2	677.2	2.0	0.5	1,294.3	1,078.1	1.7	0.1
Madagascar	28.2	34.6	20.2	17.3	0.4	0.0	71.5	50.1	2.0	0.2	66.2	32.3	1.2	0.4	342.7	251.7	0.9	0.0	667.0	390.6	1.5	0.0	940.3	271.4	2.8	0.2
Malawi	21.6	26.6	10.9	2.8	0.4	0.0	50.4	10.4	3.7	1.7	452.9	282.7	1.8	0.3	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0	1,294.3	1,078.1	1.7	0.1
Mozambique	31.7	40.9	21.0	13.2	0.2	0.1	48.5	20.5	1.8	0.1	425.8	266.7	1.5	0.0	574.8	91.0	5.6	2.0	523.3	413.7	1.7	0.1	574.8	91.0	5.6	2.0
Namibia	2.7	3.2	1.3	0.7	0.0	0.0	41.9	17.0	2.1	0.1	344.6	259.1	0.9	0.0	19.0	6.2	3.1	0.1	342.7	251.7	0.9	0.0	1,523.2	677.2	2.0	0.5
Eswatini	1.1	1.2	0.5	0.2	0.0	0.0	41.9	17.0	2.1	0.1	344.6	259.1	0.9	0.0	1,294.3	1,078.1	1.7	0.1	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Zambia	18.6	24.4	14.5	14.7	0.1	0.0	78.0	60.4	0.9	0.1	752.2	616.1	0.9	0.0	1,294.3	1,078.1	1.7	0.1	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Zimbabwe	15.1	18.3	12.3	6.1	0.2	0.0	81.5	33.2	1.2	0.1	667.0	390.6	1.5	0.0	1,523.2	677.2	2.0	0.5	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
West Africa	425.8	547.2	145.1	70.6	3.2	0.4	34.1	12.9	2.3	0.6	381.6	297.7	0.8	0.2	7,248.7	2,753.0	3.1	0.7	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Benin	13.8	19.0	3.4	1.0	0.1	0.0	24.7	5.4	4.4	1.9	336.0	245.5	1.2	0.3	153.7	34.1	5.7	2.2	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Guinea-Bissau	2.0	2.6	1.1	0.7	0.0	0.0	54.3	26.9	0.9	1.3	432.2	324.5	0.5	0.4	62.2	29.8	1.3	1.7	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Burkina Faso	21.9	27.4	8.1	3.6	0.2	0.0	36.9	13.1	2.6	0.8	488.9	369.3	1.0	0.2	491.9	165.4	3.6	0.9	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Cabo Verde	0.6	0.7	0.2	0.1	0.0	0.0	41.0	8.8	3.9	1.5	353.3	233.6	1.6	0.3	11.3	1.8	5.5	1.8	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Côte d'Ivoire	28.7	35.2	7.5	4.4	0.0	0.0	26.0	12.6	0.3	0.3	427.1	358.3	0.1	0.1	457.7	227.6	0.3	0.4	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Gambia	2.3	2.6	0.7	0.1	0.0	0.0	30.5	3.1	6.0	2.4	327.1	206.2	1.9	0.3	25.5	1.9	8.0	2.7	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Ghana	31.0	38.1	4.4	1.3	0.1	0.0	14.2	3.4	2.4	0.4	275.3	215.2	0.5	0.1	153.8	34.9	3.0	0.4	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Guinea	13.2	17.4	3.2	1.2	0.1	0.0	24.2	7.1	4.3	1.0	362.9	279.2	1.2	0.2	181.2	53.9	5.5	1.2	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Liberia	5.4	7.0	3.3	1.8	0.1	0.0	61.9	25.4	3.1	0.9	638.0	442.0	1.9	0.3	237.0	87.6	5.1	1.1	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Mali	20.7	27.5	5.6	2.9	0.2	0.0	27.1	10.6	4.3	1.7	355.5	284.0	1.3	0.3	252.9	105.3	5.7	2.0	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Mauritania	4.2	5.0	1.0	0.2	0.1	0.0	25.1	4.8	6.3	1.9	337.9	240.8	1.8	0.3	44.8	7.3	8.2	2.2	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Niger	24.5	35.1	9.6	4.0	0.2	0.1	39.3	11.3	2.2	1.5	459.1	327.3	0.8	0.3	619.6	182.0	3.1	1.8	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Nigeria	225.1	289.1	85.3	44.1	1.5	0.1	37.9	15.2	1.8	0.3	365.3	279.6	0.7	0.1	3,921.1	1,551.1	2.6	0.4	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Senegal	16.5	20.2	4.6	1.0	0.2	0.0	28.0	4.9	4.0	0.8	296.9	204.5	1.2	0.1	193.0	28.5	5.3	1.0	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Sierra Leone	7.0	8.9	3.4	2.9	0.1	0.0	49.4	32.6	3.6	0.9	518.8	438.7	1.7	0.3	275.5	196.8	5.4	1.2	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0
Togo	9.0	11.4	3.6	1.4	0.1	0.0	39.9	11.9	3.3	0.6	372.8	265.2	1.3	0.1	167.6	45.1	4.6	0.7	327.1	206.2	1.9	0.3	574.8	91.0	5.6	2.0

Source: USDA, Economic Research Service based on results from the International Food Security Assessment model.

# Appendix C: Macroeconomic Measures for the International Food Security Assessment Countries, 2022-32

Appendix Table C.1

## Summary: Macroeconomic information for 77 countries in the International Food Security Assessment

Country	Population: Annual growth rate						GDP: Annual growth rate						Per capita GDP: Annual growth rate			CPI: Annual growth rate		RER: Annual growth rate		Real domestic price of major grain: Annual growth rate				
	Population (million)			(percentage)			Gross Domestic Product (GDP, million 2015 USD)			(percentage)			Per capita GDP (2015 USD)			(percentage)		2016-21		2022-32		(percentage)		
	2019-21	2022	2032	2016-21	32	2019-21	2022	2032	2016-21	32	2019-21	2022	2032	2016-21	2022-32	21	32	2016-21	2022-32	21	32	2016-21	2022-32	
Total IFSA Countries	3,920	4,045	4,671	1.6	1.4	8,587,380	9,162,984	14,775,202	2.9	4.9	2,190	2,265	3,163	1.2	3.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Asia	2,487	2,543	2,797	1.2	1.0	5,522,908	5,938,640	10,113,234	3.4	5.5	2,221	2,336	3,616	2	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
CIS*	116	117	119	0.4	0.2	360,098	376,734	528,587	2.9	3.4	3,096	3,219	4,439	2.5	3.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Armenia	3	3.0	2.9	-0.3	-0.5	12,389.1	13,096.8	18,530.2	3.2	3.5	4,100.6	4,364.3	6,475.1	3.5	4.0	2.5	2.6	1.3	(0.8)	(2.9)	1.1			
Azerbaijan	10	10.4	10.9	0.8	0.5	52,523.1	54,045.2	71,430.5	0.6	2.8	5,146.8	5,220.3	6,549.2	(0.2)	2.3	4.9	3.5	(1.3)	(1.2)	(3.4)	0.4			
Georgia	5	4.9	4.9	0.0	0.0	17,323.7	18,320.3	24,806.5	2.6	3.1	3,513.6	3,712.0	5,045.7	2.6	3.1	5.0	3.5	4.5	(1.4)	2.2	1.5			
Kyrgyzstan	6	6.1	6.5	1.0	0.7	7,531.2	7,669.1	10,287.9	1.3	3.0	1,263.1	1,262.9	1,578.0	0.3	2.3	4.6	5.5	1.8	1.3	(2.0)	1.7			
Moldova	3	3.3	2.9	-11	-1.2	8,830.8	9,235.0	13,291.7	1.8	3.7	2,624.3	2,805.3	4,554.6	2.9	5.0	4.4	3.9	(4.2)	(2.0)	(4.5)	0.9			
Tajikistan	9	9.1	10.3	1.6	1.2	10,842.4	11,766.3	16,968.2	6.2	3.7	1,222.1	1,289.0	1,643.9	4.5	2.5	7.5	4.6	2.6	(0.2)	(2.7)	2.1			
Turkmenistan	6	5.6	6.1	1.1	0.8	46,864.2	50,767.5	74,292.1	5.0	3.9	8,477.8	9,000.8	12,153.6	3.9	3.0	11.0	5.6	(7.9)	(0.0)	(2.9)	(2.8)			
Ukraine	44	43.5	41.2	-0.2	-0.5	100,430.1	100,749.9	139,968.9	1.8	3.3	2,289.2	2,314.5	3,394.5	2.0	3.9	9.0	6.5	(4.8)	(5.4)	(5.8)	(1.7)			
Uzbekistan	31	31.1	33.3	0.9	0.7	103,363.0	111,084.2	159,010.7	4.2	3.7	3,381.1	3,572.0	4,778.7	3.2	3.0	14.0	6.3	15.8	(0.5)	(3.4)	7.9			
Central and Southern Asia	1,811	1,854	2,053	1.2	1.0	3,377,618	3,645,644	6,325,560	3.5	5.7	1,865	1,966	3,082	2.3	4.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Afghanistan	37	38	47	2.4	2.1	21,379.8	22,250.8	33,382.7	1.0	4.1	584.0	579.9	705.4	(1.3)	2.0	3.7	5.2	2.5	1.0	(2.6)	2.4			
Bangladesh	163	166	180	1.0	0.8	267,436.4	283,624.6	497,308.7	5.5	5.8	1,644.3	1,711.1	2,765.6	4.4	4.9	5.7	6.1	(1.7)	1.2	(0.3)	0.6			
India	1,325	1,353	1,479	1.1	0.9	2,646,912.9	2,882,070.0	5,088,212.8	3.5	5.8	1,997.4	2,130.1	3,440.5	2.4	4.9	4.6	4.9	(0.3)	(2.5)	(2.8)	1.7			
Nepal	30	31	33	1.0	0.6	26,395.6	26,861.2	48,080.6	3.8	6.0	872.8	874.4	1,467.0	2.8	5.3	4.8	5.1	(0.5)	(2.7)	(3.1)	1.6			
Pakistan	233	243	289	2.1	1.8	324,317.0	334,686.2	521,007.3	2.8	4.5	1,389.4	1,377.6	1,800.0	0.6	2.7	7.5	5.7	3.3	(0.8)	(3.9)	3.3			
Sri Lanka	23	23	24	0.7	0.5	91,176.5	96,151.5	137,568.3	1.9	3.6	3,983.0	4,146.7	5,637.1	1.2	3.1	4.5	4.5	4.4	(0.6)	(1.3)	4.1			
Other Asia	59	60	67	1.3	0.9	62,405	65,326	86,003	(3.8)	2.8	1,061.1	1,084.2	1,286.0	(5.1)	1.7	NA	NA	NA	NA	NA	NA	NA		
Democratic People's Republic of Korea	26	26	27	0.5	0.3	30,715.3	32,617.7	37,261.6	0.2	1.3	1,191.4	1,255.0	1,391.4	(0.2)	1.0	3.5	5.0	1.7	1.5	(0.3)	3.6			
Mongolia	3	3	3	1.1	0.7	13,903.6	15,192.7	24,732.1	3.7	5.0	4,388.2	4,705.7	7,173.0	2.6	4.3	5.7	5.5	2.6	0.0	(3.0)	2.0			
Yemen	30	31	37	2.3	1.7	17,786.3	17,515.9	24,008.7	(12.6)	3.2	596.2	564.4	655.2	(14.4)	1.5	26.1	8.6	1.3	(1.6)	(3.0)	1.5			
Southeast Asia	500	511	558	1.3	1.0	1,722,787	1,850,935	3,173,085	4.0	5.7	3,442	3,620	5,682	2.6	4.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Cambodia	17	17	19	1.5	1.1	23,225.8	24,534.6	44,479.2	3.8	6.1	1,372.7	1,411.4	2,290.1	2.4	5.0	2.5	3.1	(0.2)	(0.8)	(1.9)	1.8			
Indonesia	268	272	291	0.8	0.6	1,042,526.1	1,106,697.7	1,887,020.4	3.0	5.5	3,896.4	4,066.1	6,482.3	2.1	4.8	2.8	4.2	1.2	(1.9)	(1.9)	1.2			
Laos	7	8	9	1.5	1.3	18,510.9	19,820.0	34,177.7	4.3	5.6	2,482.1	2,580.2	3,927.9	2.7	4.3	3.2	4.8	1.9	0.2	(0.3)	1.4			

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Country	Population: Annual growth rate (percentage)						GDP: Annual growth rate (percentage)						Per capita GDP: Annual growth rate (percentage)			CPI: Annual growth rate (percentage)			RER: Annual growth rate (percentage)		Real domestic price of major grain: Annual growth rate (percentage)		
	Population (million)			Gross Domestic Product (GDP, million 2015 USD)			Per capita GDP (2015 USD)			2016-21			2022-32			2016-21			2022-32			2016-21	
	2019-21	2022	2032	2016-21	32	2019-21	2022	2032	2016-21	32	2019-21	2022	2032	2016-21	2022-32	21	32	2016-21	2022-32	21	32	2016-21	2022-32
Philippines	109	112	129	1.6	1.4	378,188.8	408,793.1	659,448.8	3.0	4.9	3,465.2	3,634.2	5,102.0	1.4	3.5	3.4	2.9	(0.6)	(1.1)	(1.2)	0.8		
Vietnam	99	102	110	0.9	0.6	260,335.1	291,089.7	547,958.4	5.7	6.5	2,620.0	2,865.8	4,982.7	4.6	5.7	3.2	3.9	0.3	(0.3)	(1.2)	2.4		
Latin America and the Caribbean	173	177	194	1.1	0.9	894,666	942,735	1,333,419	0.8	3.1	5,166	5,324	6,875	-0.3	2.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Central America and the Caribbean	63	64	76	1.0	0.8	242,128	256,152	355,885	0.9	2.7	3,817	3,942	5,007	(0.1)	1.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dominican Republic	10	11	11	1.0	0.8	87,491.8	94,330.8	148,902.4	3.4	4.7	8,333.6	8,819.9	12,862.1	2.4	3.8	4.1	3.5	2.7	1.6	(0.1)	1.8		
El Salvador	6	7	17	0.9	0.2	24,796.3	25,594.4	31,275.2	0.7	2.0	3,827.8	3,896.4	4,666.7	(0.2)	1.8	0.8	2.0	-	-	(1.7)	1.5		
Guatemala	17	17	7	1.7	1.4	71,005.2	75,679.8	97,196.1	2.7	2.5	4,141.0	4,273.7	4,774.7	1.0	1.1	3.8	3.9	(1.1)	(1.1)	(2.5)	1.6		
Haiti	11	11	18	1.3	1.1	8,698.4	8,609.0	10,771.9	(0.8)	2.3	786.4	759.3	852.1	(2.1)	1.2	15.0	5.5	(8.0)	(1.9)	(0.5)	(1.0)		
Honduras	9	9	11	1.3	1.1	23,217.6	24,050.9	32,910.8	1.3	3.2	2,515.3	2,542.2	3,126.6	(0.0)	2.1	4.2	4.8	(0.6)	0.7	(2.1)	2.0		
Jamaica	3	3	9	0.0	0.1	14,098.6	14,705.9	18,014.2	(0.6)	2.0	5,010.0	5,217.1	6,310.3	(0.6)	1.9	4.3	5.0	1.7	(1.7)	(5.3)	3.5		
Nicaragua	6	6	3	1.0	0.8	12,820.0	13,181.3	16,814.4	(0.6)	2.5	2,067.5	2,086.9	2,455.8	(1.5)	1.6	4.4	4.5	2.0	0.0	(0.9)	1.7		
South America	110	111	112	1.2	1.0	652,538	686,583	977,534	0.8	3.5	5,945	5,550	7,181	(0.4)	2.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bolivia	12	12	12	1.5	1.25	36,560.9	37,956.0	53,682.7	1.2	3.5	3,143.6	3,173.7	3,966.3	(0.3)	2.3	2.1	3.9	0.2	0.0	(1.1)	0.6		
Colombia	49	50	50	1.1	0.86	314,124.3	331,562.6	470,699.2	1.4	3.6	6,371.7	6,576.0	8,570.9	0.3	2.7	3.3	3.1	2.4	(0.6)	(0.8)	1.9		
Ecuador	17	17	17	1.2	1.00	97,324.1	99,523.7	135,273.4	(0.3)	3.1	5,759.5	5,753.1	7,082.3	(1.6)	2.1	(0.0)	2.7	-	-	(2.9)	1.5		
Peru	32	32	32	0.9	0.72	204,529.1	217,540.1	317,878.4	1.0	3.9	6,410.2	6,697.5	9,106.5	0.1	3.1	2.2	2.1	2.1	(0.0)	(0.7)	1.6		
North Africa	194	201	231	1.5	1.0	735,425	770,960	1,126,705	1.2	3.3	3,784	3,834	4,873	(0.3)	2.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Algeria	43	44	49	1.6	1.06	167,259.8	167,493.9	209,786.0	(0.8)	2.3	3,895.3	3,789.9	4,271.1	(2.4)	1.2	3.9	4.3	2.8	(0.8)	(4.5)	4.2		
Egypt	104	109	131	2.4	1.84	415,811.3	447,103.9	700,398.7	4.3	4.6	3,993.4	4,111.6	5,366.7	1.9	2.7	12.5	4.6	(0.3)	(1.0)	(3.5)	0.9		
Morocco	36	36	39	1.0	0.77	108,338.0	111,824.3	155,956.3	1.1	3.4	3,047.2	3,087.0	3,985.9	0.1	2.6	0.9	1.9	(0.3)	0.7	(2.4)	1.1		
Tunisia	12	12	12	0.9	0.46	44,015.7	44,537.8	60,563.6	0.0	3.1	3,757.0	3,743.4	4,864.3	(0.9)	2.7	6.2	4.0	2.6	0.8	(3.8)	4.2		
Sub-Saharan Africa	1,066	1,124	1,449	2.5	2.3	1,434,381	1,435,631	2,130,361	2.2	4.0	1,346	1,344	1,520	(0.2)	1.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Central Africa	141	149	200	2	2	91,493	97,243	152,367	2	4	650	651	763	(1)	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cameroon	28	29.3	38.1	2.8	2.67	36,148.6	37,970.3	55,185.6	2.5	3.8	1,303.1	1,294.9	1,446.6	(0.3)	1.1	1.8	2.4	(1.2)	(0.6)	(2.0)	1.1		
Central African Republic	6	6.0	7.2	1.5	1.71	1,981.3	2,050.2	3,040.7	2.2	4.0	337.1	339.3	424.7	0.7	2.3	2.6	4.7	(2.0)	(2.8)	(3.6)	1.4		
Congo	5	5.5	7.0	2.2	2.33	7,920.7	8,030.0	10,440.6	(1.1)	2.7	1,496.9	1,447.8	1,494.8	(3.3)	0.3	1.7	2.3	(0.9)	(0.5)	(4.6)	1.3		
Democratic Republic of the Congo	102	108.4	147.3	3.3	3.11	45,442.4	49,192.8	83,700.3	3.9	5.5	446.4	453.8	568.3	0.6	2.3	27.2	1.0	(7.9)	4.9	(0.2)	(1.1)		
East Africa	373	393	502	2.6	2.4	383,412	412,958	675,858	2.8	4.0	1,028	1,050	1,346	0	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Burundi	12	12.7	16.9	2.7	2.91	3,128.2	3,161.9	3,973.3	0.2	2.3	263.7	249.0	234.8	(2.5)	(0.6)	5.2	3.8	0.7	1.2	(2.0)	2.2		
Chad	17	18.0	24.1	3.3	2.98	10,395.1	10,579.6	14,609.7	0.3	3.3	616.3	588.9	606.4	(2.9)	0.3	1.2	2.6	(0.4)	(0.9)	(3.1)	4.4		
Eritrea	6	6.2	7.0	0.9	1.25	5,018.7	5,043.0	6,195.8	1.9	2.1	825.3	813.2	882.1	1.0	0.8	(3.5)	7.6	6.0	(5.0)	(6.6)	5.8		
Ethiopia	108	113.7	142.5	2.7	2.29	93,942.8	104,139.0	207,529.4	6.6	7.1	868.6	916.3	1,456.6	3.8	4.7	15.8	12.0	1.4	2.1	(2.0)	2.9		
Kenya	54	55.9	68.1	2.2	2.00	80,574.2	86,243.1	136,906.0	4.1	4.7	1,505.3	1,543.4	2,010.5	1.8	2.7	5.9	5.0	(2.0)	0.3	(2.7)	1.6		

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Country	Population: Annual growth rate (percentage)						GDP: Annual growth rate (percentage)						Per capita GDP: Annual growth rate (percentage)			CPI: Annual growth rate (percentage)			RER: Annual growth rate (percentage)			Real domestic price of major grain: Annual growth rate (percentage)		
	Population (million)			Gross Domestic Product (GDP, million 2015 USD)			2016-21			2022-32			2019-21			2022-32			2016-21			2022-32		
	2019-21	2022	2032	2016-21	32	2019-21	2022	2032	21	32	2019-21	2022	2032	2016-21	2022-32	21	32	2016-21	2022-32	21	32	2016-21	2022-32	
Rwanda	13	13.2	15.4	2.2	1.58	11,107.2	11,774.9	20,189.5	4.3	5.5	874.4	893.7	1,309.9	2.1	3.9	4.7	4.4	2.2	0.7	(2.8)	3.7			
Somalia	16	16.8	22.4	2.9	2.90	1,641.5	1,704.3	2,363.3	1.5	3.3	103.3	101.2	105.4	(1.3)	0.4	4.3	4.5	0.6	0.2	(0.0)	0.0			
Sudan	46	48.0	61.9	2.9	2.58	73,625.0	75,939.1	92,979.2	(1.2)	2.0	1,617.8	1,583.3	1,503.1	(3.9)	(0.5)	101.5	10.0	12.2	(2.3)	(2.6)	6.6			
Tanzania	59	62.5	81.4	3.0	2.67	63,090.3	69,433.8	124,776.9	5.4	6.0	1,069.7	1,106.8	1,533.1	2.4	3.3	3.8	3.4	(0.4)	1.4	(1.9)	2.5			
Uganda	43	46.2	62.6	3.6	3.08	40,888.7	44,939.1	66,334.9	4.7	4.0	945.0	972.6	1,059.7	1.1	0.9	3.3	3.2	(0.1)	2.3	(2.4)	3.1			
Southern Africa	148	156	200	2.2	2.0	205,505	210,579	294,666	0.6	3.4	1,388	1,351	1,474	(1.6)	1.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Angola	33	34.8	48.4	3.5	3.36	106,550.1	108,830.4	147,113.1	(1.3)	3.1	3,279.4	3,127.8	3,038.7	(4.7)	(0.3)	21.7	6.9	10.0	(0.8)	(1.3)	1.4			
Lesotho	2	2.0	2.2	0.8	0.77	2,437.4	2,557.4	3,491.7	(0.3)	3.2	1,217.6	1,251.8	1,582.8	(1.1)	2.4	4.9	5.1	(2.6)	(0.1)	(4.5)	2.3			
Madagascar	27	28.2	34.6	2.5	2.06	13,158.3	13,772.9	19,700.5	2.4	3.6	488.5	488.0	569.3	(0.1)	1.6	6.5	5.4	0.4	1.2	(0.4)	2.2			
Malawi	21	21.6	26.6	2.6	2.10	7,404.9	7,775.3	11,598.2	2.9	4.1	357.2	360.0	436.3	0.3	1.9	10.2	5.8	(5.6)	(3.3)	(4.6)	(0.0)			
Mozambique	30	31.7	40.9	2.7	2.59	18,111.0	18,919.5	32,862.1	1.9	5.7	601.9	597.0	802.8	(0.7)	3.0	6.0	4.8	(2.8)	1.2	(1.9)	1.0			
Namibia	3	2.7	3.2	1.9	1.74	10,636.3	10,683.4	14,357.6	(1.4)	3.0	4,046.9	3,916.8	4,428.7	(3.2)	1.2	4.0	4.4	(2.0)	0.6	(1.1)	0.1			
Swaziland	1	1.1	1.2	0.8	0.64	4,267.7	4,306.5	5,213.6	0.7	1.9	3,862.5	3,837.1	4,357.1	(0.2)	1.3	4.5	5.8	(2.3)	(0.8)	(1.8)	0.8			
Zambia	17	18.6	24.4	3.1	2.76	23,798.5	24,321.3	34,368.7	1.6	3.5	1,361.7	1,309.9	1,409.4	(1.4)	0.7	12.1	5.2	6.3	1.0	(3.8)	9.4			
Zimbabwe	15	15.1	18.3	1.7	1.92	19,140.2	19,411.8	25,961.1	(1.4)	2.9	1,316.4	1,283.8	1,419.3	(3.1)	1.0	159.0	11.3	5.9	(7.6)	(5.0)	6.4			
West Africa	404	426	547	2.6	2.4	753,972	743,776	1,077,252	3.6	4.4	1,865	1,855	1,972	1.0	1.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Benin	13	13.8	19.0	3.5	3.26	14,585.8	15,972.9	28,521.2	5.1	6.0	1,133.7	1,161.2	1,504.1	1.6	2.6	1.5	2.5	(0.8)	(0.8)	(1.0)	0.7			
Guinea-Bissau	2	2.0	2.6	2.5	2.57	1,271.6	1,331.8	1,876.6	2.9	3.5	659.9	657.1	718.2	0.4	0.9	1.1	2.5	(0.5)	(0.6)	(1.2)	1.5			
Burkina Faso	21	21.9	27.4	2.8	2.27	15,261.5	16,361.3	24,915.2	4.6	4.3	732.6	745.9	907.8	1.8	2.0	0.8	2.3	(0.2)	(0.4)	(4.6)	4.0			
Cabo Verde	1	0.6	0.7	1.3	1.07	1,757.4	1,801.1	2,899.7	0.6	4.9	3,015.9	3,014.1	4,364.7	(0.7)	3.8	1.1	1.2	(0.5)	0.6	(0.7)	0.7			
Côte d'Ivoire	27	28.7	35.2	2.3	2.06	61,835.3	68,380.0	98,374.4	5.6	3.7	2,249.8	2,380.9	2,792.9	3.2	1.6	0.8	1.6	(0.3)	0.2	(0.4)	1.0			
Gambia	2	2.3	2.6	2.0	1.58	1,656.9	1,796.8	2,980.5	4.3	5.2	761.8	796.5	1,129.0	2.3	3.6	6.6	5.0	(0.1)	(0.0)	(1.5)	2.1			
Ghana	30	31.0	38.1	2.4	2.09	62,460.5	66,636.1	95,366.5	5.0	3.6	2,115.3	2,151.9	2,505.4	2.6	1.5	7.3	7.1	3.0	0.4	(0.6)	2.0			
Guinea	13	13.2	17.4	2.8	2.76	12,593.0	13,877.1	22,947.5	6.2	5.2	1,004.7	1,048.3	1,320.9	3.3	2.3	10.0	8.7	(4.2)	0.0	(0.7)	(0.7)			
Liberia	5	5.4	7.0	2.6	2.67	3,135.9	3,276.7	4,364.3	0.3	2.9	618.2	611.5	625.7	(2.3)	0.2	17.4	12.7	1.4	(6.3)	(3.6)	2.2			
Mali	20	20.7	27.5	3.0	2.85	16,046.7	17,139.2	24,669.7	3.3	3.7	820.8	826.3	898.1	0.3	0.8	0.6	1.3	(0.0)	0.5	(0.8)	1.3			
Mauritania	4	4.2	5.0	2.1	1.85	6,963.6	7,395.2	11,838.1	2.5	4.8	1,739.7	1,774.3	2,365.4	0.4	2.9	2.5	4.2	0.6	0.2	(2.2)	1.1			
Niger	23	24.5	35.1	3.7	3.68	12,459.1	13,615.8	25,751.2	4.8	6.6	547.1	556.1	733.0	1.0	2.8	1.6	1.9	(0.9)	(0.1)	(2.0)	3.1			
Nigeria	214	225.1	289.1	2.6	2.53	510,544.5	526,381.3	678,789.4	1.3	2.6	2,385.7	2,338.2	2,348.3	(1.2)	0.0	14.0	7.5	(1.8)	(3.0)	(0.8)	0.2			
Senegal	16	16.5	20.2	2.4	2.07	23,181.3	25,102.1	39,534.9	4.7	4.6	1,473.5	1,525.6	1,957.0	2.3	2.5	1.6	2.1	(1.0)	(0.4)	(1.1)	0.8			
Sierra Leone	7	7.0	8.9	2.4	2.51	5,041.9	5,268.5	7,351.8	2.6	3.4	761.4	757.8	825.6	0.2	0.9	15.3	9.9	(2.8)	(0.1)	(0.9)	(0.1)			
Togo	9	9.0	11.4	2.6	2.36	5,177.2	5,533.3	8,771.8	3.7	4.7	601.5	611.5	767.8	1.1	2.3	0.6	2.2	(0.4)	0.4	(2.4)	2.0			

Source: USDA, Economic Research Service, International Macroeconomic Dataset.

## Appendix D: Simulation Results

Appendix Table D.1

Changes in agricultural commodity prices (percent) in each scenario relative to baseline

Region	Subregion	Change in wheat prices (percent)			Change in maize prices (percent)			Change in rice prices (percent)			Change in vegetable oils prices (percent)		
		Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
Asia	Commonwealth of Independent States*	3%	8%	12%	9%	17%	26%	2%	4%	6%	7%	13%	18%
	Central and Southern Asia	6%	14%	23%	7%	15%	24%	4%	8%	12%	2%	5%	8%
	Other Asia	10%	21%	32%	1%	7%	21%	3%	7%	11%	3%	7%	10%
	South East Asia	4%	11%	18%	9%	18%	30%	7%	15%	24%	2%	4%	7%
Asia total		5%	12%	19%	7%	15%	26%	4%	8%	12%	4%	8%	12%
Sub-Saharan Africa	Central Africa	6%	14%	23%	7%	15%	24%	4%	8%	13%	1%	3%	4%
	East Africa	6%	14%	22%	6%	13%	20%	4%	9%	14%	2%	4%	6%
	South Africa	5%	10%	18%	5%	12%	19%	4%	8%	12%	1%	3%	5%
	West Africa	4%	10%	17%	6%	14%	22%	4%	9%	14%	2%	4%	7%
Sub-Saharan Africa total		5%	11%	19%	6%	13%	21%	4%	8%	13%	2%	4%	6%
North Africa total		7%	15%	25%	14%	26%	42%	6%	12%	19%	2%	5%	9%
Latin America and the Caribbean total		5%	11%	19%	4%	10%	17%	2%	4%	7%	2%	4%	7%
IFSA total		5%	12%	19%	6%	14%	23%	4%	8%	12%	2%	5%	8%

\*The members of Commonwealth of Independent States are Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan.

Turkmenistan is an associate member. Ukraine has not formally withdrawn from the organization but did formally end its participation in CIS statutory bodies in May 2018 (The World Fact Book, 2022). The subregional and regional aggregation here is based on the recognition of this note and is meant to facilitate comparison of food security trends across subregions.

Source: USDA, Economic Research Service estimation using Global Trade Analysis Project (GTAP): A Computable General Equilibrium (CGE) Model and the International Food Security Assessment model.

Appendix Table D.2

## Changes in GDP (percent and millions 2015 U.S. dollars) in each scenario relative to baseline

Region	Subregion	Baseline		Low scenario relative to baseline		Medium scenario relative to baseline		High scenario relative to baseline	
		GDP (billions)	Growth (percent)	Change in GDP (millions)	Change in GDP (percent)	Change in GDP (billions)	Change in GDP (percent)	Change in GDP (billions)	Change in GDP (percent)
Asia	Commonwealth of Independent States*	382	4.1%	-5,724.0	-1.5%	-11,400.0	-3.0%	-17,036.0	-4.5%
	Central and Southern Asia	3,651	5.9%	-5,514.0	-0.2%	-11,443.0	-0.3%	-18,202.0	-0.5%
	Other Asia	65	3.7%	-95.0	-0.1%	-194.0	-0.3%	-292.0	-0.4%
	South East Asia	1,854	6.3%	-3,469.0	-0.2%	-7,255.0	-0.4%	-11,472.0	-0.6%
<b>Asia total</b>		<b>5,953</b>	<b>5.9%</b>	<b>-14,802.0</b>	<b>-0.2%</b>	<b>-30,293.0</b>	<b>-0.5%</b>	<b>-47,001.0</b>	<b>-0.8%</b>
Sub-Saharan Africa	Central Africa	97	4.1%	-104.0	-0.1%	-213.0	-0.2%	-328.0	-0.3%
	East Africa	414	5.3%	-972.0	-0.2%	-1,984.0	-0.5%	-3,059.0	-0.7%
	South Africa	211	3.0%	-153.0	-0.1%	-320.0	-0.2%	-505.0	-0.2%
	West Africa	791	2.7%	-1,100.0	-0.1%	-2,306.0	-0.3%	-3,678.0	-0.5%
<b>Sub-Saharan Africa total</b>		<b>1,513</b>	<b>3.5%</b>	<b>-2,328.0</b>	<b>-0.2%</b>	<b>-4,823.0</b>	<b>-0.3%</b>	<b>-7,570.0</b>	<b>-0.5%</b>
North Africa total		773	3.8%	-2,402.0	-0.3%	-4,236.0	-0.5%	-6,212.0	-0.8%
Latin America and the Caribbean total		943	3.9%	-419.0	0.0%	-863.0	-0.1%	-1,323.0	-0.1%
<b>IFSA total</b>		<b>9,183</b>	<b>5.1%</b>	<b>-19,951.0</b>	<b>-0.2%</b>	<b>-40,214.0</b>	<b>-0.4%</b>	<b>-62,106.0</b>	<b>-0.7%</b>

\*The members of Commonwealth of Independent States are Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan. Turkmenistan is an associate member. Ukraine has not formally withdrawn from the organization but did formally end its participation in CIS statutory bodies in May 2018 (The World Fact Book, 2022). The subregional and regional aggregation here is based on the recognition of this note and is meant to facilitate comparison of food security trends across subregions.

Source: USDA, Economic Research Service estimation using Global Trade Analysis Project (GTAP): A Computable General Equilibrium (CGE) Model and the International Food Security Assessment model.

Appendix Table D.3

## Increase in population food insecure (percent and millions) in each scenario relative to baseline

Region	Subregion	Baseline		Low scenario relative to baseline		Medium scenario relative to baseline		High scenario relative to baseline	
		Population food insecure (millions)	Population food insecure (percent)	Change in population food insecure (millions)	Change in population food insecure (percent)	Change in population food insecure (millions)	Change in population food insecure (percent)	Change in population food insecure (millions)	Change in population food insecure (percent)
Asia	Commonwealth of Independent States*	15.2	13	1.9	12	3.8	25	5.6	37
	Central and Southern Asia	492.1	27	21.9	4	45.0	9	71.0	14
	Other Asia	44.3	74	0.8	2	1.7	4	2.6	6
	South East Asia	94.8	19	5.2	6	11.0	12	17.3	18
<b>Asia total</b>		<b>646.4</b>	<b>25</b>	<b>29.8</b>	<b>5</b>	<b>61.6</b>	<b>10</b>	<b>96.5</b>	<b>15</b>
Sub-Saharan Africa	Central Africa	103.7	69	0.4	0	0.8	1	1.2	1
	East Africa	215.9	55	3.6	2	7.4	3	11.4	5
	South Africa	98.9	63	1.6	2	3.4	3	5.2	5
	West Africa	141.9	33	3.2	2	6.8	5	10.7	8
<b>Sub-Saharan Africa total</b>		<b>560.4</b>	<b>50</b>	<b>8.8</b>	<b>2</b>	<b>18.4</b>	<b>3</b>	<b>28.6</b>	<b>5</b>
<b>North Africa total</b>		<b>34.2</b>	<b>17</b>	<b>2.1</b>	<b>6</b>	<b>4.0</b>	<b>12</b>	<b>6.1</b>	<b>18</b>
<b>Latin America and the Caribbean total</b>		<b>49.9</b>	<b>28</b>	<b>1.0</b>	<b>2</b>	<b>2.2</b>	<b>4</b>	<b>3.6</b>	<b>7</b>
<b>IFSA total</b>		<b>1,290.9</b>	<b>32</b>	<b>41.7</b>	<b>3</b>	<b>86.1</b>	<b>7</b>	<b>134.7</b>	<b>10</b>

\*The members of Commonwealth of Independent States are Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan. Turkmenistan is an associate member. Ukraine has not formally withdrawn from the organization but did formally end its participation in CIS statutory bodies in May 2018 (The World Fact Book, 2022). The subregional and regional aggregation here is based on the recognition of this note and is meant to facilitate comparison of food security trends across subregions.

Source: USDA, Economic Research Service estimation using Global Trade Analysis Project (GTAP): A Computable General Equilibrium (CGE) Model and the International Food Security Assessment model.

Appendix Table D.4

## Top 20 countries ranked by the increase in the prevalence of food insecurity (percent) in each scenario relative to baseline

Country	Region	Subregion	Baseline		Low scenario relative to baseline		Medium scenario relative to baseline		High scenario relative to baseline	
			Population food insecure (millions)	Population food insecure (percent)	Change in population food insecure (millions)	Change in population food insecure (percent)	Change in population food insecure (millions)	Change in population food insecure (percent)	Change in population food insecure (millions)	Change in population food insecure (percent)
Ukraine	Asia	Commonwealth of Independent States*	1.4	3%	0.6	41%	1.4	102%	2.1	148%
Azerbaijan	Asia	Commonwealth of Independent States	0.6	6%	0.2	36%	0.4	64%	0.6	91%
Armenia	Asia	Commonwealth of Independent States	0.2	7%	0.1	26%	0.1	43%	0.1	61%
Uzbekistan	Asia	Commonwealth of Independent States	3.1	10%	0.5	16%	1	33%	1.6	51%
Turkmenistan	Asia	Commonwealth of Independent States	0.8	15%	0.1	14%	0.2	28%	0.4	43%
Mongolia	Asia	Other Asia	0.8	25%	0.1	12%	0.2	23%	0.3	33%
Kyrgyzstan	Asia	Commonwealth of Independent States	1.8	30%	0.2	10%	0.4	19%	0.5	28%
Indonesia	Asia	Southeast Asia	46	17%	3.9	8%	8.1	18%	12.6	27%
Tunisia	North Africa	North Africa	1.5	12%	0.1	8%	0.2	17%	0.4	27%
Cambodia	Asia	Southeast Asia	3.8	22%	0.3	8%	0.6	16%	1	26%
Nepal	Asia	Central and South Asian	5.6	18%	0.4	7%	0.8	15%	1.3	24%
Egypt	North Africa	North Africa	20.1	18%	1.4	7%	2.4	12%	3.5	18%
Mauritania	Sub-Saharan Africa	West Africa	1	24%	0.1	6%	0.1	14%	0.2	22%
Gambia	Sub-Saharan Africa	West Africa	0.6	29%	0	6%	0.1	13%	0.1	21%
Tajikistan	Asia	Commonwealth of Independent States	5.5	60%	0.3	6%	0.6	10%	0.8	14%
India	Asia	Central and South Asian	317.8	23%	15.7	5%	32	10%	50.8	16%
Algeria	North Africa	North Africa	8.1	18%	0.4	5%	0.8	10%	1.4	17%
Benin	Sub-Saharan Africa	West Africa	3.2	24%	0.1	4%	0.3	10%	0.5	16%
Mali	Sub-Saharan Africa	West Africa	5.4	26%	0.2	4%	0.5	9%	0.8	15%
Guinea	Sub-Saharan Africa	West Africa	3.1	23%	0.1	4%	0.3	9%	0.4	15%

\*The members of Commonwealth of Independent States (CIS) are Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan. Turkmenistan is an associate member. Ukraine has not formally withdrawn from the organization but did formally end its participation in CIS statutory bodies in May 2018 (The World Fact Book, 2022). The subregional and regional aggregation here is based on the recognition of this note and is meant to facilitate comparison of food security trends across subregions.

Source: USDA, Economic Research Service estimation using Global Trade Analysis Project (GTAP): A Computable General Equilibrium (CGE) Model and the International Food Security Assessment model.