International Food Security Assessment, 2015-2025

38 of 76 study countries are estimated to have met the 1996 goal of halving the number of food-insecure people by 2015.
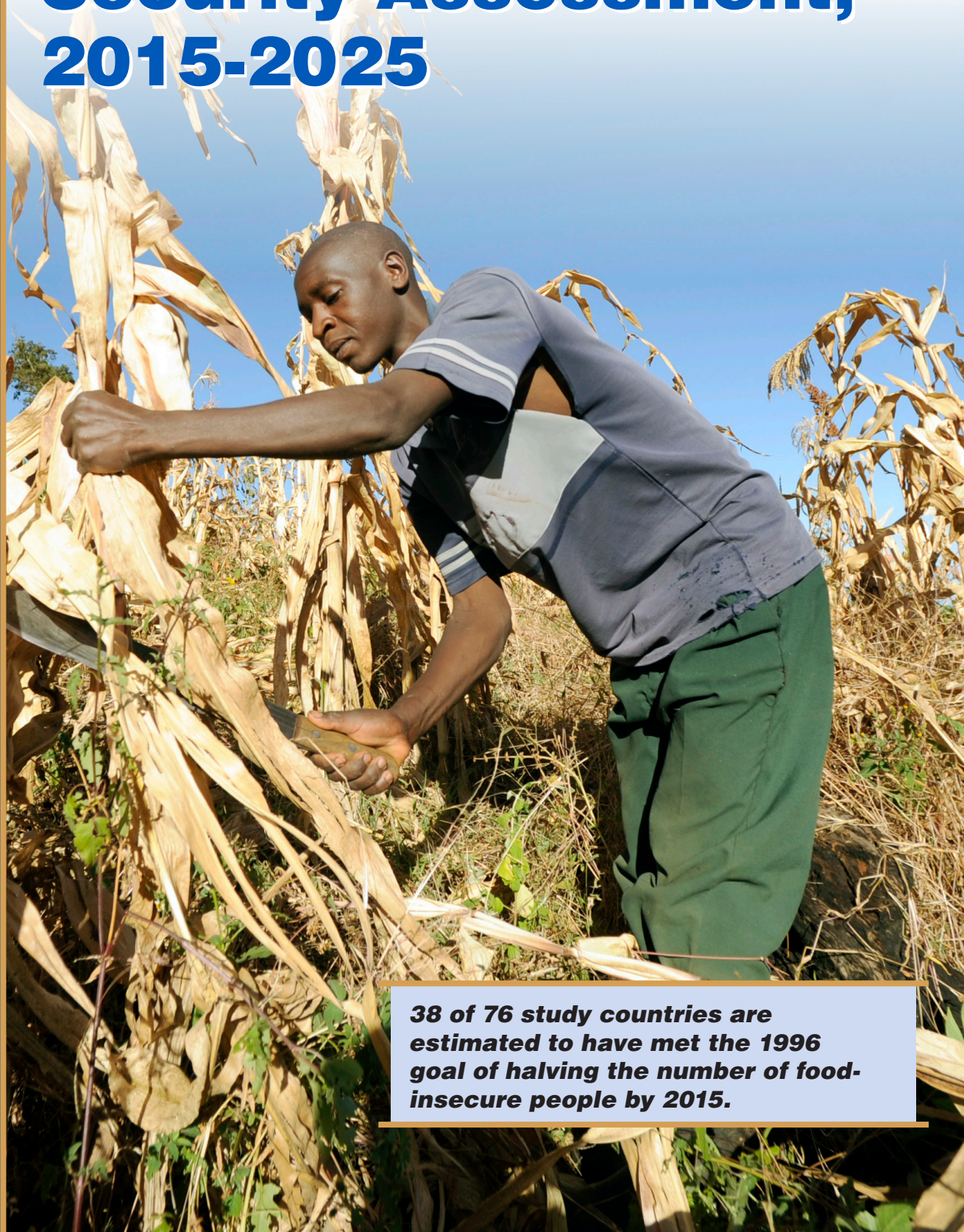
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United States Department of Agriculture

International Food Security Assessment, 2015-2025

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Abstract

Food security in the 76 low- and middle-income countries included in this report is expected to improve between 2014 and 2015. These countries are low- and middle-income countries as classified by the World Bank that are or have been receiving food aid and are experiencing or have experienced food insecurity. The number of food-insecure people is estimated to fall 9 percent, from 521 million in 2014 to 475 million in 2015. Over the longer term, the food security situation is projected to deteriorate as the share of population that is food insecure moves from 13.4 percent in 2015 to 15.1 percent in 2025. Food-insecure people are defined as those consuming less than the nutritional target of roughly 2,100 calories per day per person. Despite improvements over the years, Sub-Saharan Africa is projected to remain the most food insecure region in the world.

Keywords: Food security, production, area, yield, commercial imports, export earnings, food aid, calories, commodity food prices, World Food Summit, Sub-Saharan Africa, North Africa, Asia, Latin America and the Caribbean.

Acknowledgments

Preface

This report continues the series of food assessments in developing countries begun in the late 1970s by USDA's Economic Research Service. *Global Food Assessments* were done from 1990 to 1992, hence the GFA series. In 1993, the title was changed to *Food Aid Needs Assessment* to more accurately reflect the contents of the report, which focuses on selected developing countries with recent or ongoing food deficits. In 1997, we widened our analysis beyond the assessment of aggregate food availability to include more aspects of food security. We therefore changed the title to *Food Security Assessment.* Starting with the report published in July 2011, we changed the name to *International Food Security Assessment* to clarify that this is not an assessment of U.S. food security.

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International Food Security Assessment, 2015-2025

Stacey Rosen, Birgit Meade, and Anthony Murray

What Is the Issue?

This report projects two key determinants of food security for each country: food production and import capacity. Domestic food production performance plays the most critical role in the food security of these countries, particularly for those in the Asia and Sub-Saharan Africa regions that depend primarily on locally produced grain supplies. Conversely, the capacity to pay for imports is significant in regions like Latin America and the Caribbean and North Africa that import a large share of their food supplies. To understand how food production and import capacity affect food security, ERS researchers estimated and projected the number of food-insecure people regionally and in each of the 76 developing countries covered in this report for 2015-25.

What Did the Study Find?

Between 2014 and 2015, ERS estimates food security for the 76 countries analyzed to improve. The number of food-insecure people is estimated to fall 9 percent, from 521 million in 2014 to 475 million in 2015. The share of the population that is food insecure in these countries is expected to decrease from 14.8 percent in 2014 to 13.4 percent in 2015. The distribution gap (the amount of food needed to reach the nutritional target of roughly 2,100 calories per person per day) is estimated to decline 6 percent in 2015 to 11.8 million tons, grain equivalent. The distribution gap is a measure of the intensity of food insecurity—the extent to which consumption falls below the nutritional target.

The number of food-insecure people in *Sub-Saharan Africa (SSA)* is estimated at 254 million in 2015, virtually unchanged from 2014. The share of population estimated to be food insecure is 28.4 percent. The countries in the *North African (NA)* region are expected to remain food secure. After *NA*, *Asia* is the most food-secure region as 8.4 percent of the population, on average, is estimated to be food insecure in 2015, largely due to improved production prospects in India and Sri Lanka.

The food security situation is expected to improve in the *Latin America and Caribbean (LAC)* region as the estimated number of food-insecure people falls 19 percent, from 31 million in 2014 to 25 million in 2015. Increased grain output and continued slowing of population growth contributed to the improvements.

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Over the next decade, the number of food- insecure people for the 76 countries is projected to deteriorate as the share of population that is food insecure moves from 13.4 percent in 2015 to 15.1 percent in 2025. LAC's food security situation, on the whole, is projected to improve to the greatest extent as the share of population considered food insecure falls from 15 percent in 2015 to 10.6 percent in 2025.

Asia's share of population that is food insecure is projected at just under 10 percent in 2025. Growth in grain output and imports are projected to exceed population growth. However, food insecurity among the population that is considered food insecure is projected to intensify. The distribution gap is projected to jump 53 percent over the next decade. This result is principally driven by Afghanistan (where production growth, while higher than the regional average, fall short of population growth) and Yemen (where growth in imports, which account for the bulk of grain supplies, are projected to slow from historical trends).

The food security situation in SSA is projected to deteriorate, as the share of population that is food insecure is projected to rise from 28.4 percent in 2015 to 30.4 percent in 2025. This change is largely driven by countries where civil strife disrupts agricultural activities (i.e., Democratic Republic of Congo, Central African Republic, Somalia) or where population growth remains around or above 3 percent per year thereby precluding increase per capita food supply (i.e., Burundi, Ethiopia, Uganda, Burkina Faso). The increases in the number of food-insecure people and the distribution gap nearly match, meaning that there is little measureable intensification in food insecurity, on average. In 20 of the region's 39 countries included in this study, 20 percent or less of the population is projected to be food insecure in 2015.

How Was the Study Conducted?

The International Food Security Assessment model used in this report projects food consumption, food access, and food gaps in low- and middle-income countries through 2025. Food security of a country is evaluated based on the gap between projected domestic food consumption (domestic production plus imports minus nonfood uses) and a consumption target.

All historical and projected data are updated relative to the *International Food Security Assessment, 2014-24* report. Food production estimates for 2014 are based on data from the United Nations' Food and Agriculture Organization (FAO) as of March 2015. Historical production data are from FAO and food aid data from the World Food Programme (WFP). Financial and macroeconomic data are based on World Bank data as of March 2015. Projected macroeconomic variables are either based on calculated growth rates for the 1990s through 2013 or are taken from International Monetary Fund (IMF) and World Bank projections. Projections of food availability include food aid, with the assumption that each country will receive the 2011-12 average level of food aid throughout the next decade.

International Food Security Assessment, 2015-2025

Overview

Food security of the 76 low- and middle-income countries (as classified by the World Bank that are or have been receiving food aid) included in this study is projected to improve between 2014 and 2015. The number of food-insecure people—defined here as those who consume less than our nutritional target of roughly 2,100 calories per person per day[1]—is projected at 475 million in 2015, a 9-percent decrease from 2014. As a result, the share of the population in these countries that is food insecure is projected to decrease from just under 15 percent in 2014 to about 13 percent in 2015. In many countries, consumption in the lower income deciles is significantly below average (per capita) consumption. The distribution gap measures the food needed to raise consumption in each food-deficit income decile to the nutritional target. In other words, it measures the intensity of food insecurity, the extent to which consumption falls below the nutritional target. This gap is forecast to decline 6 percent, from 12.6 million tons in 2014 to 11.8 million tons in 2015.

Over the next decade, however, food security in these study countries is projected to deteriorate at the aggregate level. The share of the population that is food insecure is projected to rise to just over 15 percent. The increase in the number of food-insecure people, 31 percent, is projected to be surpassed by the increase in the distribution gap, nearly 37 percent. These trends suggest an increase in the intensity of food insecurity through 2025. Asia and Sub-Saharan Africa are both contributing to the increase in food-insecure people, although prospects vary widely among countries within the regions.

Sub-Saharan Africa (SSA) is the most vulnerable region in the study. The 39 SSA countries included in this study account for about 25 percent of the population of the 76 countries covered, but more than half of the food-insecure population in 2015. The intensity of food insecurity in the region is highlighted by the fact that it accounts for roughly 90 percent of the distribution gap in 2015. The region has among the lowest per capita consumption levels in the world, with daily intake for this set of countries averaging below 2,400 calories per person in 2011 according to the UN Food and Agriculture Organization. By comparison, the world average was nearly 2,900 calories. Southeast Asian countries averaged nearly 2,700 calories, and the countries of Central America averaged 2,900 calories.

Levels of food security vary widely within SSA. In 20 of the 39 countries, an estimated 80 percent or more of the population is projected to be food secure in 2015. On the other hand, there are 9 countries where 90 percent or more of the population are projected to be food insecure, including the Central African Republic, the Democratic Republic of Congo, Burundi, Eritrea, Somalia, Lesotho, Swaziland, Zimbabwe, and Chad. Many of these countries have had prolonged civil strife.

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[1]The target of 2,100 was chosen as an approximation for food security. A truly adequate dietary energy intake target is based on sex, age, body mass, and physical activity level. Not all people who consume less than 2,100 calories per day are food insecure, as there may be food insecure people consuming more than 2,100 calories per day.

Table 1

Estimates and projections of food-insecure people in 76 countries

	Region				
	Total	Asia	LAC	NA	SSA
	Millions of people				
2014	521	235	31	0	255
2015	475	195	25	0	254
2025	622	256	19	0	347

LAC = Latin America and the Caribbean, NA = North Africa, SSA = Sub-Saharan Africa.
Source: USDA, Economic Research Service.

Table 2a

Estimates and projections of food distribution gaps in 76 countries

	Region				
	Total	Asia	LAC	NA	SSA
	1,000 tons				
2014	12,571	1,474	550	-	10,547
2015	11,802	738	490	-	10,574
2025	16,120	1,131	353	-	14,636

LAC = Latin America and the Caribbean, NA = North Africa, SSA = Sub-Saharan Africa.
Source: USDA, Economic Research Service.

Table 2b

Estimates and projections of food distribution gaps, per capita

	Region				
	Total	Asia	LAC	NA	SSA
	Kilograms per capita per year				
2014	3.6	0.6	3.3	-	11.7
2015	3.3	0.3	2.9	-	11.8
2025	3.9	0.4	1.9	-	12.8

LAC = Latin America and the Caribbean, NA = North Africa, SSA = Sub-Saharan Africa.
Source: USDA, Economic Research Service.

Figure 1

In 49 (out of 76) developing countries, 20 percent or less of the population is estimated to be food insecure in 2015
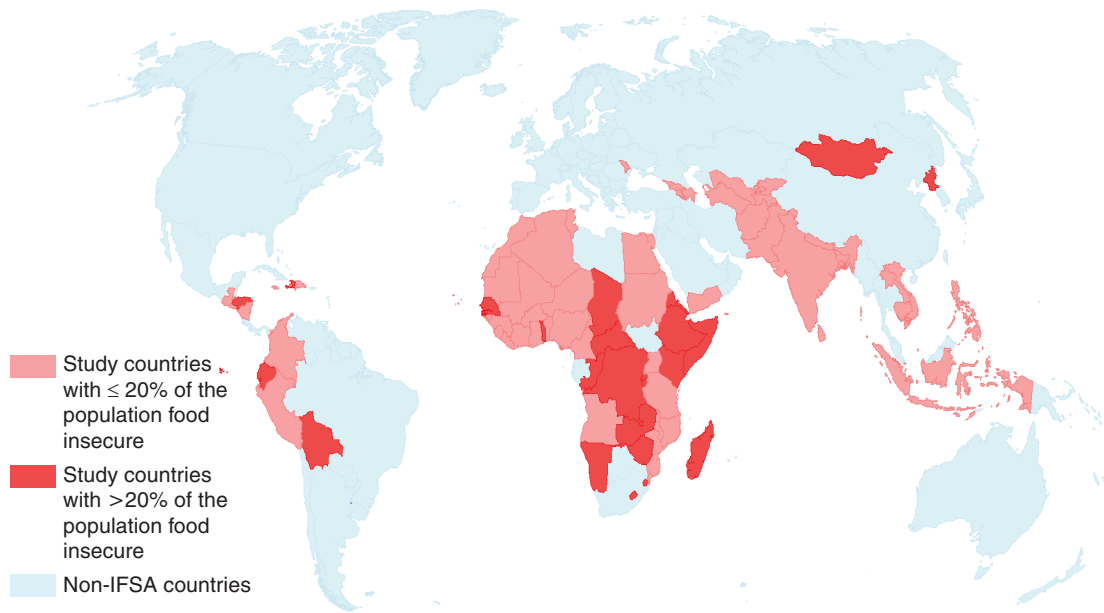
IFSA = International Food Security Assessment.
Source: Calculations by USDA, Economic Research Service.

Figure 2

Intensity of food insecurity in study countries, 2015
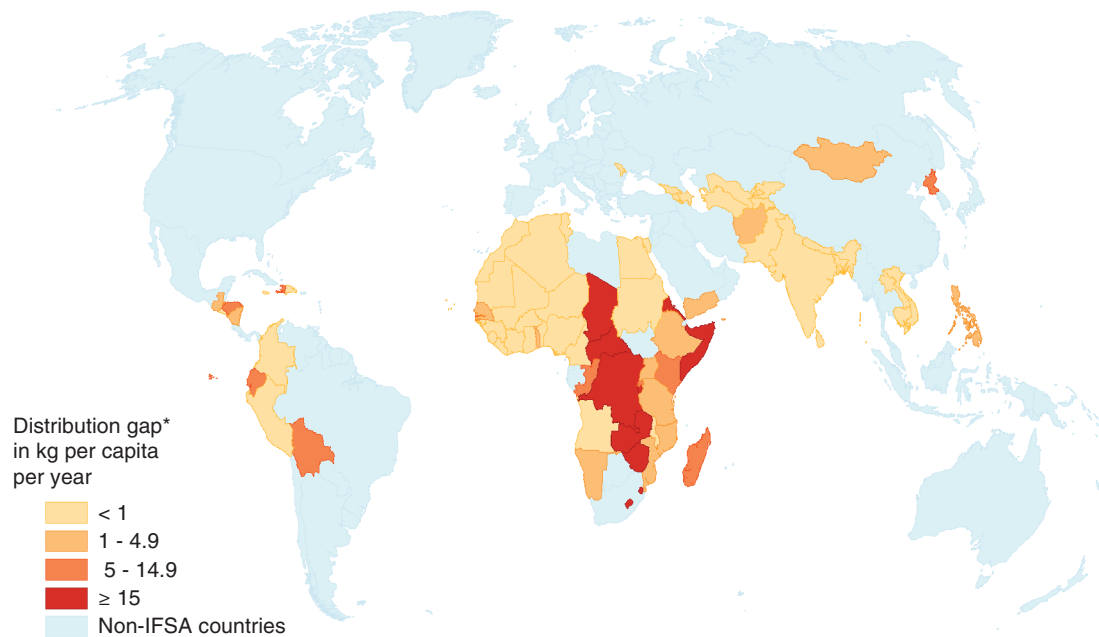
*The distribution gap is defined as the amount of food needed to raise consumption in food-deficit income deciles to the daily nutritional target of 2,100 calories per capita.
IFSA = International Food Security Assessment.
Source: Calculations by USDA, Economic Research Service.

The 22 Asian countries included in this study account for nearly two-thirds of the population of the 76 countries in 2015, but are projected to account for just 41 percent of the number of food-insecure people and only 6.3 percent of the distribution gap. These results indicate the relative well-being of the region and the relatively low level of intensity of food insecurity, at the aggregate level.

Figure 3a

Regional *composition* of food-insecure population in 2015 versus 2025
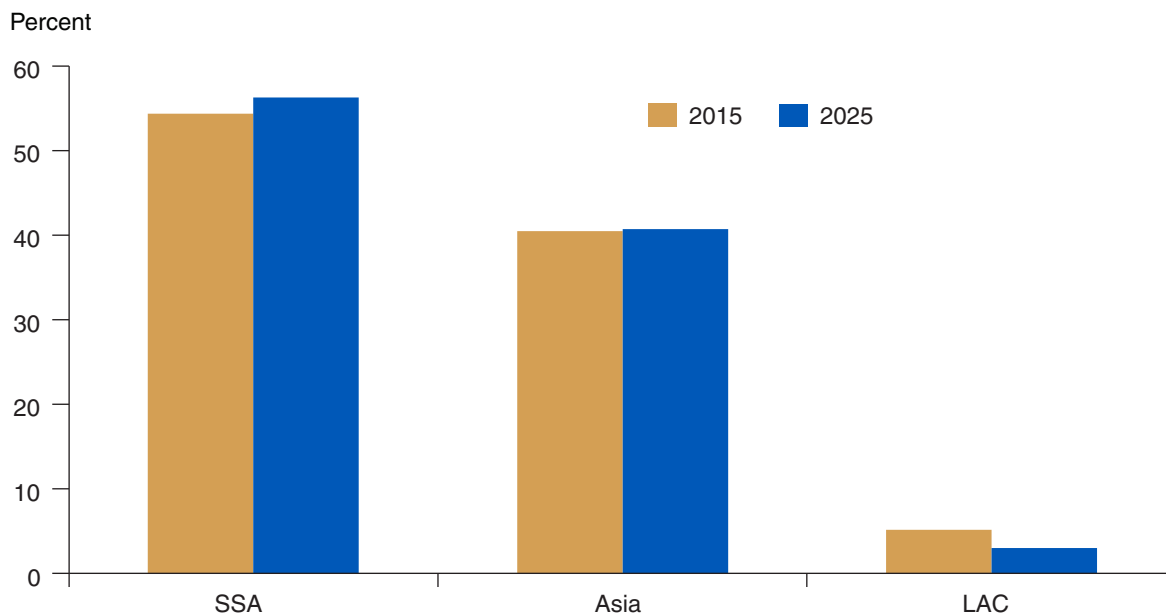
Percent

SSA = Sub-Saharan Africa, LAC = Latin America and the Caribbean.

Source: USDA, Economic Research Service.

Figure 3b

Regional *number* of food-insecure population in 2015 versus 2025
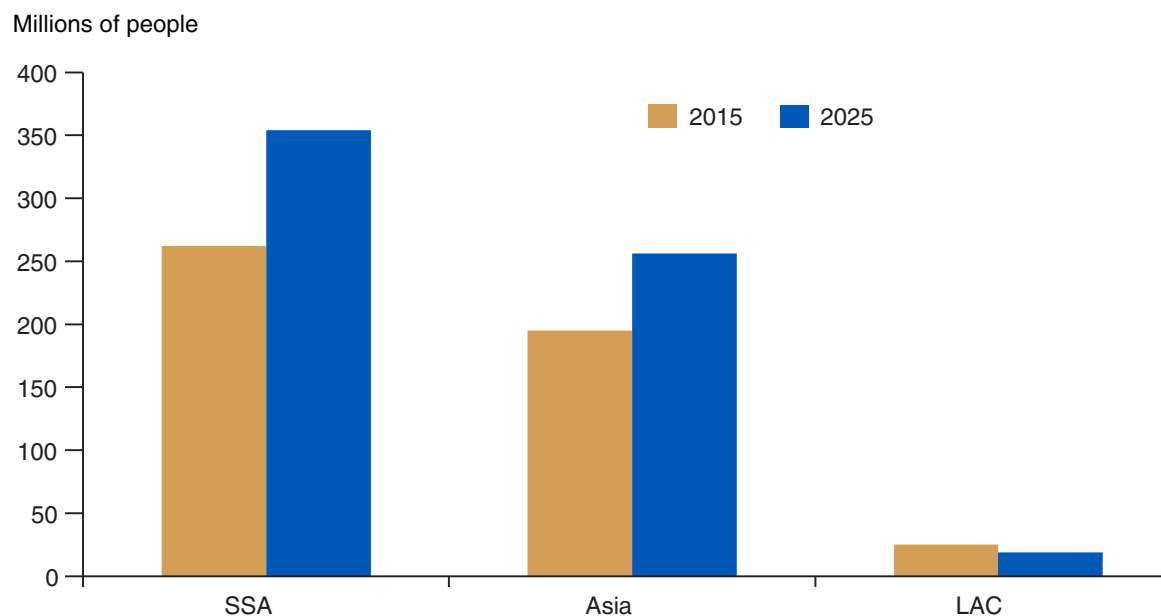
Millions of people

SSA = Sub-Saharan Africa, LAC = Latin America and the Caribbean.

Source: USDA, Economic Research Service.

In most of the Asian countries included in this study, projected consumption by even the lowest income decile is roughly 90 percent of the nutritional target. The region has the least skewed distribution of income among the regions studied: the lowest income decile holds 3.4 percent of total income while the highest decile holds roughly 30 percent. By comparison, in the Latin American countries, where income is the most highly skewed among study regions, the lowest decile holds 1.2 percent of income while the highest decile holds over 40 percent.

The 11 countries included in the Latin American and Caribbean region account for less than 5 percent of the population of the 76 countries. The region's share of the number of food-insecure people is projected to be slightly higher than that, at 5.4 percent, but the share of the distribution gap is lower, about 4 percent, in 2015. Therefore, like Asia, this is an indicator of the relative well-being of the region, which has increasingly relied on imports to augment food supplies.

Table 3
Food availability and food gaps for 76 countries

Year	Grain production*	Root production (grain equivalent)	Commercial imports	Food aid receipts (grain equivalent)	Aggregate availability of all food
			1,000 tons		
2006	522,448	92,580	95,857	7,399	853,495
2007	541,669	91,238	92,533	6,282	870,604
2008	563,666	98,053	102,853	6,736	890,398
2009	574,430	96,756	101,010	6,592	905,869
2010	600,520	105,005	110,412	7,513	929,152
2011	618,522	113,681	118,177	5,122	940,343
2012	639,332	115,970	109,194	4,982	963,189
2013	648,664	120,305	129,519	4,982	988,085
2014(e)	645,367	119,915	127,582	5,029	994,269
Projections				**Distribution food gap**	
2015	664,585	121,374	126,635	*11,802*	1,019,209
2020	719,216	129,237	142,872	*13,850*	1,087,907
2025	777,204	137,545	155,260	*16,120*	1,155,797

(e) estimate.

*Grain production includes rice expressed in milled-rice equivalent.

Sources: USDA, Economic Research Service, using data from FAOSTAT, UN Food and Agriculture Organization, and World Food Programme, Rome.

How Food Security Is Assessed: Methods and Definitions

The International Food Security Assessment model used in this report is based on historical data through 2013 or 2014 (updated in March 2015), and therefore does not reflect any subsequent changes that may have transpired related to the food security of these countries. This annual update includes revisions of historical data, as sometimes new information leads to changes in historical data series. Updates can therefore change food-security estimates for past years. Food-security indicators for 2014 are estimates; subsequent years are projections. Commodities covered in this report include grains, root crops, and "other," where the latter represents the remainder of the diet. These three groups account for 100 percent of all calories consumed in the study countries and are expressed in grain equivalent. The conversion is based on calorie content. For example, grain has roughly 3.5 calories per gram and tubers have about 1 calorie per gram. One ton of tubers is, therefore, equivalent to 0.29 ton of grain (1 divided by 3.5), and 1 ton of vegetable oil (8 calories per gram) is equivalent to 2.29 tons of grain (8 divided by 3.5).

Food consumption and food access are projected for 76 low- and middle- income countries—39 in Sub-Saharan Africa, 4 in North Africa, 11 in Latin America and the Caribbean, and 22 in Asia. (See Appendix for a detailed description of the methodology and definitions of terms and appendix tables for a list of countries.) The 2014 estimates are based on Food and Agriculture Organization (FAO) production and import assessments, and the longer term projections are based on 2012-14 grain production and 2011-13 root and tuber production data from FAOSTAT and 2011-13 macroeconomic data from the International Monetary Fund (IMF) and World Bank. The periods covered include 2014 (estimate) and 2015 and 2025 (projections). The model analyzes the gap between projected food availability (production plus commercial and food aid imports minus nonfood use) and a nutritional target of roughly 2,100 calories per capita per day, depending on the region.

The estimated *distribution gap* measures the food needed to raise average consumption in each food-deficit income decile to the nutritional target. In many countries, consumption in the lower income deciles is projected to be significantly below average (per capita) consumption. 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 as a result of income or economic conditions. When estimates show no distribution gap for the poorest 10 percent of the population, the country is assumed to be food secure despite the fact that food insecurity may exist (but only for less than 10 percent of the population). Similarly, when our estimates show a distribution gap for all deciles, we consider 100 percent of the population to be food insecure despite the fact that some of the population, but less than 10 percent, may be food secure. Finally, the projected *number of food insecure* people is calculated based on total population data and the population share—or number of deciles—that is projected to consume below the nutritional target.

Common terms used in this report include:

- **Domestic food supply**—the sum of domestic production and commercial and food aid imports.
- **Food availability**—food supply minus nonfood use, such as feed and waste, and exports
- **Import dependency**—the ratio of food imports to food supply.
- **Food consumption**—equal to food availability.
- **Food access**—depends on individual purchasing power. Food consumption is estimated by income group within each country based on an income-consumption relationship.
- **Food-insecure**—occurs when per capita food consumption for a country's income decile falls short of the nutritional target of roughly 2,100 calories per person per day.

Commodity Prices Have Declined

Since 2000, there have been two spikes in international food prices, in 2007/08 and 2011/12, which often led to higher domestic consumer food prices for countries reliant on food imports. Global food commodity prices have fallen since 2011-12, particularly for rice and soybean oil, significant imports for many of the study countries. Prices for these two commodities fell 31 percent between 2011-12 and 2014, according to the International Monetary Fund. These falling prices should relieve some of the budgetary pressure in these countries, some of which have limited commercial import capacity. In addition to food, another large part of the import bill for many of the study countries is expenditures on oil. These prices have also fallen since their 2011-12 peak, but not as sharply—8 percent through 2014.

While these import prices have fallen, it is important to consider where prices for these countries' exports have trended in order to determine the impact on their import capacity. If prices of the export items increased, this would provide added relief to their balance of payments. This, however, was not the case. Prices for beverage commodities (coffee, tea, and cocoa), exported by several of the countries studied here, fell 4.5 percent from 2011-12 to 2014. Prices for agricultural raw commodities (cotton, rubber, hides/skins, tobacco, etc.) fell by 3.5 percent. The biggest drop in export commodity prices, more than 20 percent, occurred in metals, the result of slower economic growth and therefore weaker demand in many developed countries and China.

Reliance on Food Aid Has Declined

The countries included in this study are current or past recipients of food aid. From the late 1980s through 1994, global food aid exceeded 10 million tons each year and peaked at nearly 15 million tons in 1993. Since 1994, food security improved in some countries and they became less reliant on food aid. The pronounced decline in grain food aid as a percentage of commercial grain imports during this period was driven by two parallel developments: a steep decline in food aid supplies and an increase in commercial imports. The ratio of food aid to commercial grain imports was below 10 percent in SSA in 2012, down from 46 percent 20 years prior (fig. 6). The share in Asia fell to 3.5 percent in 2012, down from 10.7 percent, and the share in LAC fell from 20 percent to below 1 percent in 2012 (the most recent data for grain food aid as reported by the World Food Programme). The United States has been a major donor, providing between 40 and 60 percent of all in-kind food aid between 1988 and 2012.

Sub-Saharan Africa has been a major food-aid recipient region. While SSA receipts have trended downward since the early 2000s, the region's share of global food aid has been increasing.

References

International Monetary Fund, International Financial Statistics, database.

United Nations Food and Agriculture Organization, FAOSTAT database.

United Nations, World Food Programme. http://www.wfp.org/fais/

Figure 4

Global commodity food prices have fallen since the 2011-12 spike

2010=100
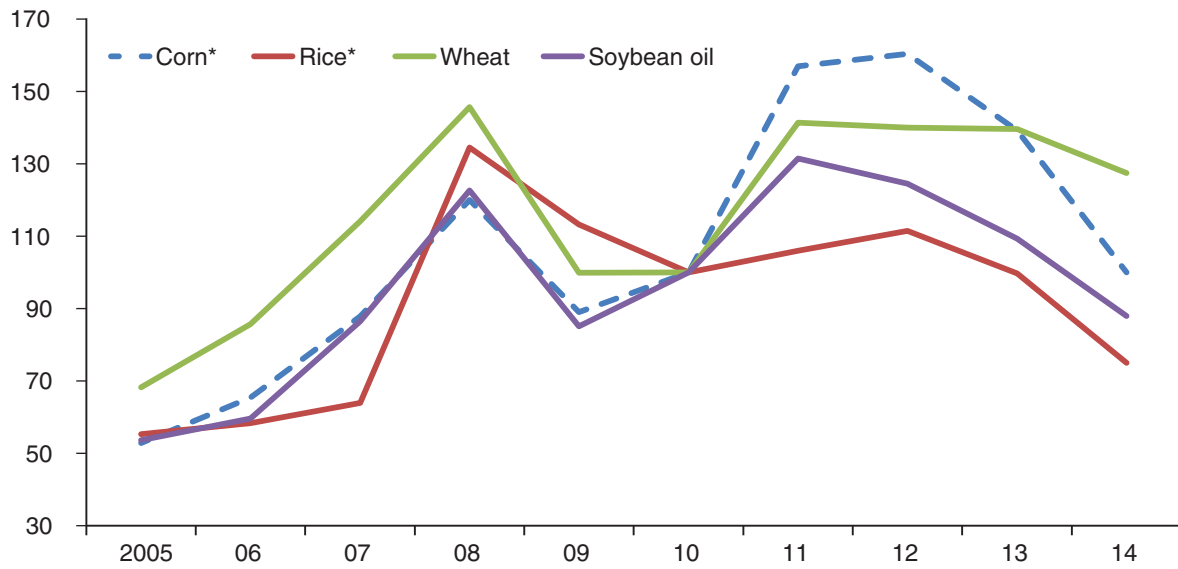
*Estimate based on partial data for 2014.

Source: International Monetary Fund, International Financial Statistics.

Figure 5

Prices for many export commodities also declined

2010=100
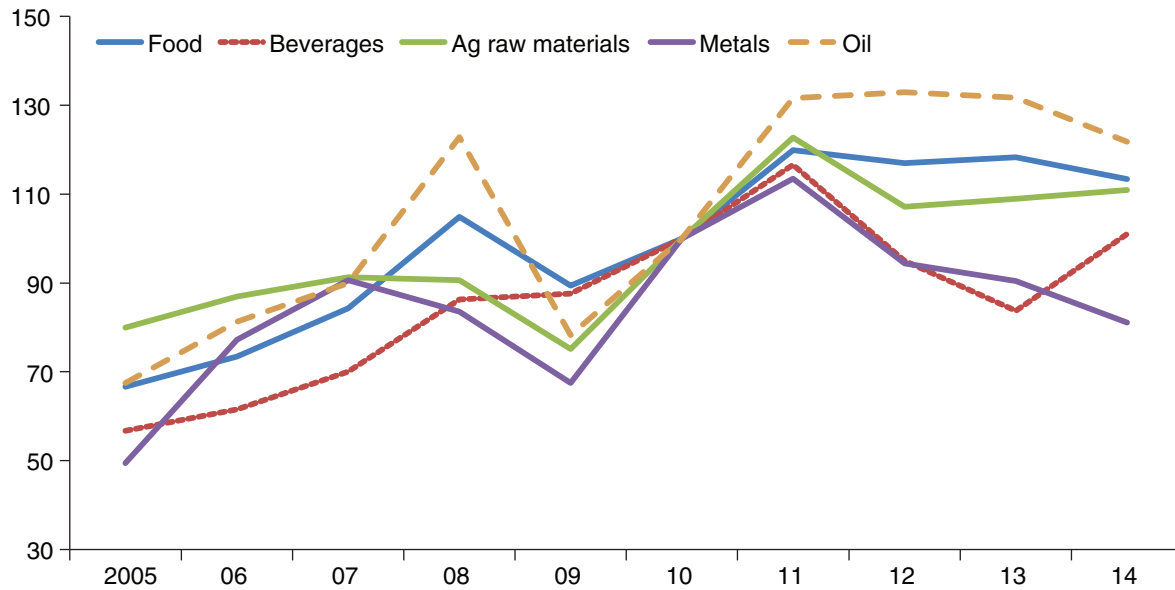
Source: International Monetary Fund, International Financial Statistics.

Figure 6

Food aid as a share of commercial grain imports in 76 countries, 1992-2012

Percent
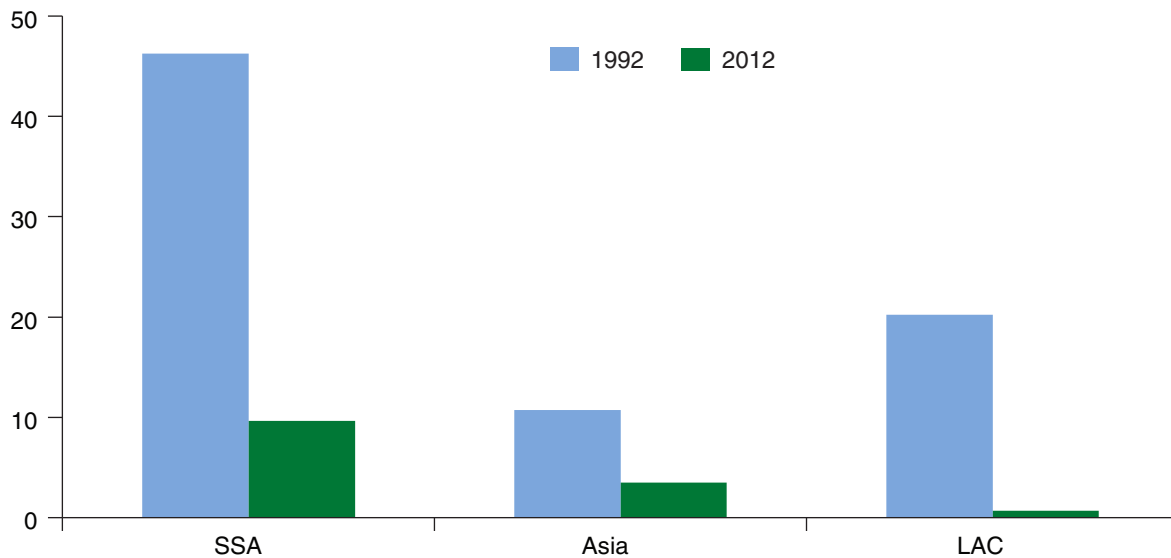
SSA = Sub-Saharan Africa, LAC = Latin America and the Caribbean.

Source: USDA, Economic Research Service based on data from World Food Programme.

Figure 7

Sub-Saharan Africa food aid receipts

Million tons, grain equivalent   Percent
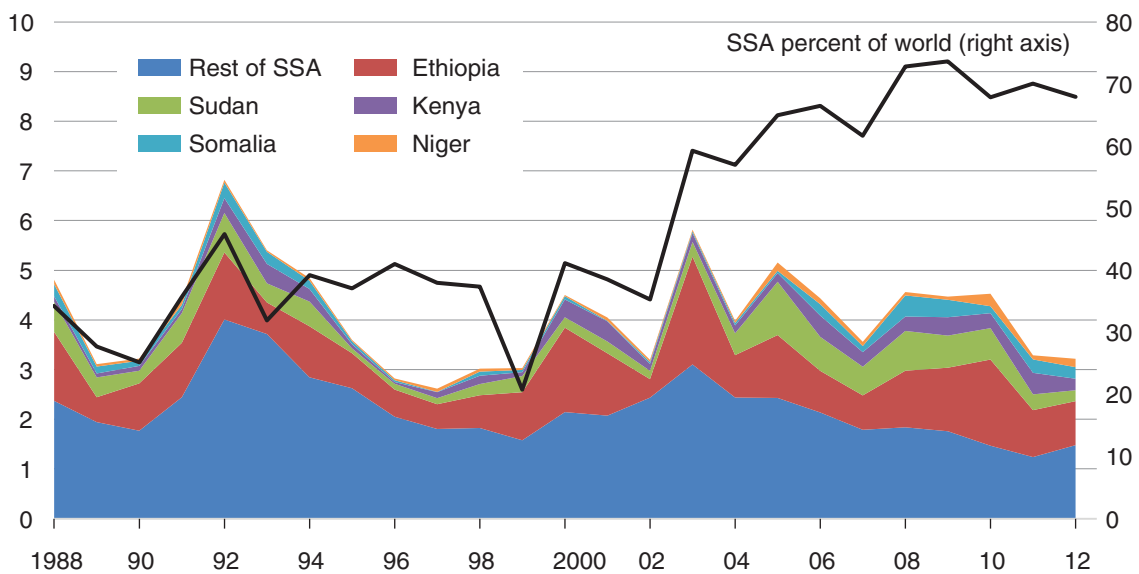
Source: USDA, Economic Research Service based on International Food Security data.

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Economic Research Service/USDA

Sub-Saharan Africa

The food security situation in the 39 Sub-Saharan African countries included in this study is expected to change very little between 2014 and 2015. Roughly 30 percent of the region's population is projected to be food insecure, with the most significant problems in 2015 found to be in many of the conflict countries, including Central African Republic, DR Congo, Somalia, and Chad. In contrast, West African countries are estimated to be the least vulnerable in 2015.

The Ebola epidemic of 2014-15, centered in Guinea, Liberia, and Sierra Leone, resulted in intermittent trade restrictions, limits on movement of people, localized disruptions of agricultural activities, closure of some markets, and reductions in household incomes. At the national level, however, food production did not suffer greatly. The most significant impact was on rice production in Liberia, which fell an estimated 12 percent in 2014. As of early 2015, however, most agricultural activities are proceeding at near-normal levels and the main restrictions on movements of people have been removed.

SSA's food security is projected to deteriorate over the next decade, at the aggregate level, as the number of food-insecure people is projected to rise nearly 37 percent, reaching 347 million in 2025. This projected increase outpaces the growth in total population for the region, so the share of food-insecure people is projected to rise, from 28.4 percent in 2015 to 30.4 percent in 2025. The distribution gap (the amount of food needed to raise consumption in each food-deficit income group to the nutritional target of roughly 2,100 calories per person per day) is projected to rise at a slightly higher rate, 38.4 percent, than the food-insecure population, meaning negligible change in the intensity of food insecurity in the region.

This aggregate regional trend masks wide variations in individual country results, with developments in a few countries driving most of the projected increase in the number of food-insecure people in the region. The share of population that is food insecure is projected to rise in only 8 of the 39 SSA countries over the next decade. In 20 of the countries, 80 percent or more of the population is food secure. However, there are several highly vulnerable countries, where nearly all of the population is projected to be food insecure, including Central African Republic (CAR), Democratic Republic of Congo, Burundi, Eritrea, Somalia, and Swaziland.

Widespread civil strife in CAR, ongoing for more than a decade, has adversely affected agricultural activities. Grain output in 2014 is estimated at 30 percent below the 2004 level. The IFSA model estimates and projects food availability, but does not account for dietary quality. Reports, however, indicate that in addition to a decline in food availability, CAR consumers are shifting from nutritious grains and vegetables to cassava.

Like CAR, DR Congo and Somalia continue to suffer the effects of long-term civil strife. Per capita grain output continues to decline, with virtually no change (or even a decline) in area planted or yields during the last two decades. Unless there is a more stable political situation, it is assumed that current trends will persist, and these three countries will remain largely food insecure.

In Burundi and Eritrea, growth in grain and root/tuber output has been slow during the last two decades and has fallen well short of the countries' relatively high population growth rates of more than 3 percent per year. Population growth is not expected to slow, so food insecurity is projected to remain high in these two countries.

| Table 4 |
| Food availability and food gaps for Sub-Saharan Africa |

Year	Grain production*	Root production	Commercial imports	Food aid receipts (grains)	Aggregate availability of all food
			1,000 tons		
2006	86,884	63,777	18,972	4,463	201,201
2007	84,709	61,927	19,591	3,560	205,534
2008	91,365	65,396	22,739	4,561	212,533
2009	94,991	63,770	23,317	4,469	218,703
2010	109,873	70,034	23,140	4,527	227,331
2011	103,485	75,283	26,235	3,288	233,075
2012	111,069	77,007	25,924	3,218	242,958
2013	108,847	80,105	28,816	3,218	248,778
2014(e)	114,713	79,821	28,812	3,241	250,271
Projections				**Distribution food gap**	
2015	117,146	75,354	29,777	*10,574*	263,969
2020	131,662	80,202	34,138	*12,439*	292,524
2025	149,235	85,352	37,547	*14,636*	319,350
*See table 3.					

Sub-Saharan Africa
(903 million people in 2015)

SSA remains the most food-insecure region as 28.4 percent of its population is estimated to be food insecure in 2015. This is an improvement from the 52-percent share in 1995.

The least vulnerable countries in the region are in West Africa. Food insecurity is severe in Central Africa.

The share of food-insecure people is projected to rise slightly from 28.4 percent in 2015 to 30.4 percent in 2025.

SSA: Trend in number of food-insecure people versus population
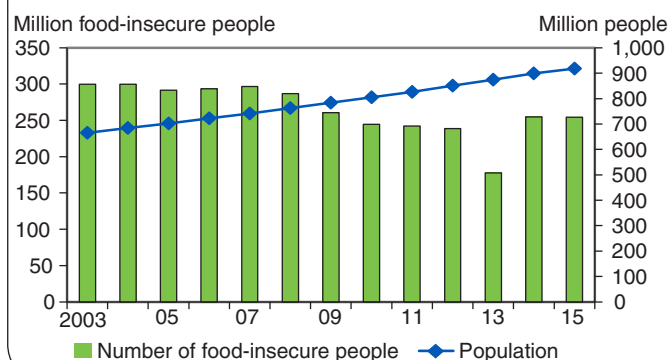
SSA: Distribution gaps
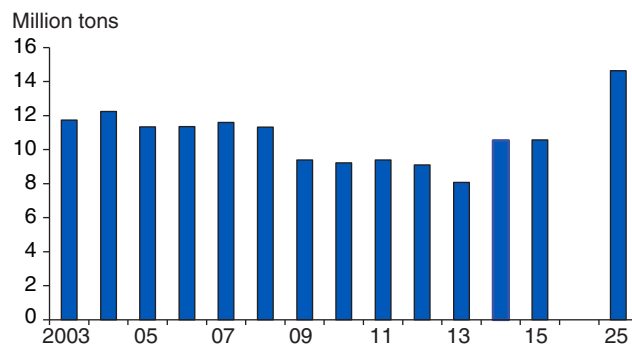
Sub-Saharan Africa: Food security indicators: 1995 and 2015, in selected countries

	Number of food-insecure people			Food gaps			Population		
	1995	2015	Change	1995	2015	Change	1995	2015	Change
	---million people---			---million tons---			---million people---		
Cameroon	11.1	0.0	-11.1	252	0	-252	13.9	23.7	9.8
Burundi	5.6	10.7	5.2	215	567	352	6.2	10.7	4.5
Ethiopia	57.0	29.8	-27.2	2744	291	-2453	57.0	99.5	42.4
Tanzania	26.9	10.2	-16.7	666	82	-584	29.9	51.0	21.1
Uganda	4.1	7.4	3.3	61	86	25	20.7	37.1	16.4
Malawi	7.0	0.0	-7.0	180	0	-180	10.0	17.7	7.8
Mozambique	14.4	5.1	-9.3	600	52	-548	16.0	25.3	9.3
Ghana	1.7	0.0	-1.7	12	0	-12	16.8	26.3	9.6
Sierra Leone	1.6	0.0	-1.6	19	0	-19	3.9	5.9	2.0
SSA	**281.9**	**254.2**	-27.7	**10,232**	**10,574**	342	**537.6**	**903.2**	365.6

Source: USDA, Economic Research Service calculations and U.S. Census population data.

Unlike much of the region, Swaziland's population growth rate is low, about 1.4 percent in 2014. Imports now account for a larger share of supplies than domestic output, but imports have stagnated over the last decade. Food production is characterized by wide swings as agricultural area is rain fed and overall growth has been slow. That being said, per capita consumption is projected to fall only slightly below the nutritional target. For example, in 2025, consumption is projected above 90 percent of the target for half the population. Therefore, if imports and/or domestic production grow slightly above projected rates, food security would improve greatly given the low rate of population growth.

The country in this region where food security is projected to deteriorate most is Uganda: the number of food-insecure people is projected to grow from 7 million to 30 million (app. Table 2), with the share of population that is food insecure rising from 20 percent in 2015 to 60 percent in 2025, and the distribution gap increasing sixfold. These results are driven by the country's high population growth, 3.4 percent per year in the near term and 3 percent per year by 2025. Even the projected 3.3-percent annual growth in grain output growth cannot offset this rise in population. Uganda's grain gains are supported by the high and rising adoption rates of modern seed varieties (MVs). In 1996-2000, only 5.6 percent of crop area was devoted to MVs. By 2006-10, this share jumped to more than 22 percent. Root crops are also an important part of the Ugandan diet, accounting for 20 percent of calories consumed in 2011, according to the United Nations Food and Agriculture Organization. Production of these crops, however, is not projected to keep pace with the grains sector, growing roughly 1 percent per year and well short of population growth.

However, the depth of food insecurity in Uganda is not projected to be as intense as in many other SSA countries. For nearly the entire population, per capita consumption does not fall far below the nutritional target. In 2025, consumption in the lowest income decile is projected at 86 percent of the target.

Countries in the region projected to see the most improvement in food insecurity are Kenya and Lesotho. For Kenya, the number of food-insecure people is projected to fall more than 60 percent (from 28 million in 2015 to 11 million in 2025) while the distribution gap falls nearly 70 percent over the next decade. The share of the country's population that is food insecure is projected to fall from 60 to 20 percent. Also, the estimated distribution gap indicates that food insecurity in Kenya is not severe, with consumption in even the lowest income decile is projected to exceed 90 percent of the nutritional target in 2025.

A key factor behind Kenya's improvement is its steadily declining population growth. Historically, Kenya had one of the highest rates of population growth in the world—nearly 4 percent per year in the early 1980s. By the mid-1990s, this rate had fallen below 3 percent and, in 2015, it is estimated at about 2 percent. The decline is forecast to continue with population growth in 2025 projected at 1.2 percent. As a result, the projected growth in grain and root crop production and imports is sufficient to allow for increasing per capita supplies and improved food security. Kenya's projected strong economic growth—real GDP rising at roughly 7 percent per year through 2020 (according to the IMF)—supports the strong import growth.

Lesotho's population growth is projected to be negligible through the next decade. Therefore, very little growth in production or imports is required for food security to improve at the per capita level. Imports have become the most significant contributor to domestic grain supplies and they are projected to grow around 1.6 percent per year through 2025, far exceeding population growth. The country's share of population that is food insecure is projected to fall from 90 percent in 2015 to 40 percent in 2025.

About half of the SSA countries are projected to maintain relatively high levels of food security. In addition to continued investment in the agricultural sectors, this improvement is predicated on continued economic growth in order to improve consumer access to food. According to the IMF, all of the study countries in the region are projected to have rising per capita incomes in real terms through 2020 (forecasts for Sudan and Somalia were not available). In fact, in only 6 of the 39 countries is real GDP growth projected to be below 5 percent per year: for the region overall, growth is projected at 5.7 percent per year. Given that population is projected to grow around 2.7 percent, this indicates net growth of 3-percent per year in per capita GDP. This economic growth is a result of continuing investment in infrastructure, increases in agricultural output, and expansion of service sectors. Risk factors that could derail these optimistic growth paths are continued or expanded conflict, reductions in foreign investment, and slower economic growth in the region's main export markets, particularly the EU and China.

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Asia

The food security situation is projected to improve in the short term in the 22 Asian countries included in this report as the share of population food insecure is projected to fall from 10.3 percent to 8.4 percent between 2014 and 2015. The number of food-insecure people is projected to fall 17 percent (235 million to 195 million) in 2015, while the distribution gap is projected to fall by half. These results indicate a reduction in the intensity of food insecurity. This result is principally driven by India and Sri Lanka. In India, grain production in 2015 is projected to exceed the slightly below-average output of 2014. Irregular monsoon rains and unfavorable weather during the main growing season resulted in reduced area and lower yields for rice and coarse grains in 2014. In Sri Lanka, rice output fell roughly 25 percent in 2014 due to dry weather and less water for irrigation. For 2015, production is projected to return to trend levels.

Asia is the least import-reliant region in this study, with imports accounting for roughly 7 percent of grain consumption, on average. In comparison, the import share in SSA exceeds 20 percent, while in LAC and North Africa it is roughly 50 percent. Therefore, Asia's food security is highly predicated on domestic production. Grain output has grown about 3 percent per year over the past decade, roughly double the region's population growth, accounting for stable or increasing per capita consumption. Production growth is projected to slow over the next decade, but is expected to exceed population growth for the region, on average.

Deteriorating stability in Afghanistan and Yemen are the primary drivers in the region's increased share of population that is food insecure—from 8.4 percent to 9.9 percent by 2025. The number of food-insecure people in the region is projected to rise 31 percent by 2025 while the distribution gap jumps 53 percent. This disparity suggests a significant rise in the intensity of food insecurity. However, the situation in most Asian countries is projected to remain stable or improve. In more than half of the countries in the region, less than 10 percent of the population is projected to be food insecure by 2025.

While the food security situation is projected to deteriorate in Afghanistan through 2025, it will remain far better than conditions in the mid-2000s when nearly the entire population was estimated to be food insecure. In 2015, 20 percent of the population is projected to be food insecure, with this share projected to rise to 40 percent in 2025. Grain output is projected to grow faster than the regional average, but still fall short of population growth of roughly 2.4 percent per year.

The share of Yemen's population that is food insecure is projected to rise from 20 percent in 2015 to 60 percent in 2025. For most of the 2000s, this share was around 70-80 percent. Yemen's relatively food-secure standing in 2015 is due to a recent rise in food imports, likely driven by lower global prices for food. Yemen relies on imports for roughly 80 percent of grain supplies, so food security is largely predicated on food import capacity. In the longer term, however, projections indicate slower growth in import capacity, reducing Yemen's food security.

In North Korea, half the population is projected to be food insecure by 2025, an improvement from 70 percent in 2015. North Korea has suffered from intense food insecurity for years, mainly due to poor weather and government policies that have resulted in a lack of inputs for farmers. National average per capita calorie consumption is less than 2,100 calories per day, versus a regional average of close to 2,500 calories. While both the country's grain output and imports are projected to grow quite slowly, the population growth rate of 0.5 percent allows for a small increase in per capita food supplies and an improved food security situation.

Table 5

Food availability and food gaps for Asia

Year	Grain production*	Root production (grain equiv.)	Commercial imports (grains)	Food aid receipts (grain equiv.)	Aggregate availability of all food
			1,000 tons		
2006	385,496	23,334	36,067	2,087	549,159
2007	413,244	23,813	28,510	2,280	559,277
2008	426,716	26,776	32,428	1,743	569,838
2009	423,046	26,766	32,483	1,698	577,009
2010	442,947	28,447	36,254	2,275	590,129
2011	463,938	31,601	37,372	1,337	593,884
2012	477,622	31,733	33,294	1,469	605,325
2013	486,834	32,553	40,896	1,469	620,601
2014(e)	482,215	32,616	41,025	1,425	626,286
Projections				**Distribution food gap**	
2015	493,751	33,005	40,402	*738*	642,772
2020	531,029	35,021	45,171	*991*	678,885
2025	567,559	37,126	48,857	*1,131*	714,622

*See table 3.

Asia
(2.3 billion people in 2015)

Between 2014 and 2015, the food security situation is projected to improve in the 22 Asian countries included in the region as the share of population food insecure is projected to fall from 10.3 percent to 8.4 percent

The number of food-insecure people during this time is projected to fall 17 percent, compared with the distribution gap, which is projected to fall by half. These trends indicate a significant reduction in the intensity of food insecurity.

By 2025, the number of food-insecure people and the food gap is projected to increase.

Asia: Trend in number of food-insecure people versus population
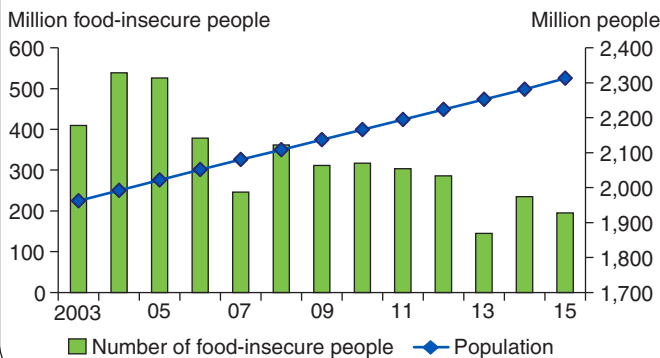
Asia: Distribution gaps

Asia: Food security indicators: 1995 and 2015, in selected countries

	Number of food-insecure people			Food gaps			Population		
	1995	2015	Change	1995	2015	Change	1995	2015	Change
	---million people---			*---million tons---*			*---million people---*		
Afghanistan	15.8	6.5	-9	459	45	-415	17.6	32.6	15
Bangladesh	107.9	16.9	-91	2788	2	-2787	119.9	169.0	49
India	191.2	125.2	-66	1902	278	-1625	955.8	1251.7	296
Nepal	4.1	0	-4.1	38	0	-38	20.6	31.6	11
Vietnam	38.0	0.0	-38	534	0	-534	76.0	94.3	18
Yemen	12.0	5.3	-7	324	54	-270	15.0	26.7	12
Asia	**464.8**	**195.0**	-270	**8,713**	**738**	-7,975	**1,711.2**	**2,312.8**	602

Source: USDA, Economic Research Service calculations and U.S. Census population data.

India is the most populous country in the region, accounting for 54 percent of the total population of the 22 countries included in this region for this study. India's food security is projected to be stable through 2025 with about 10 percent of the population projected to be consuming below the nutritional target. The number of food-insecure people is projected to grow at virtually the same rate as the distribution gap, thereby indicating no change in the intensity of food insecurity in the country.

The eight Commonwealth of Independent States (CIS) countries included in the Asia region are projected to be food secure through the next decade, with the exception of Tajikistan in 2025. That country's lowest income decile is projected to consume slightly below the nutritional target in 2025. Tajikistan is one of the poorest countries in the CIS region, with per capita income just above $1,000 in 2013 and the lowest per capita calorie intake (roughly 2,100) in 2011.

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Latin America and the Caribbean

Food security in the Latin America and the Caribbean (LAC) region has been improving steadily. The progress continued from 2014 to 2015, with the number of food-insecure people declining by 6 million, from 31 million to 25 million people in the 11 countries included in this study[2]. Per capita food availability increased due to ongoing growth in food production, fast-rising imports, and sluggish population growth. Four countries in the region—Colombia, El Salvador, Jamaica, and Peru—are estimated to be food secure, with fewer than 10 percent of the population consuming below the nutritional target. These countries have, on average, higher per capita income than others in the region and their income distribution has become more equitable, giving lower income households more purchasing power and better access to food. All four countries are becoming increasingly dependent on grain imports, with imports as a share of supplies ranging from nearly 50 percent in El Salvador to more than 75 percent in Colombia.

Haiti continues to be the most food-insecure country in the region. About 6 million people are estimated to be food insecure in 2015, up from 5.2 million in 2014. Lingering effects of the earthquake in 2010, as well as recurring damage brought on by tropical storms like Hurricanes Isaac and Sandy in 2012, have hindered improvements in the country. Agricultural producers continue to face an unfavorable environment. International aid agencies are still active in the country, and renewed efforts are directed toward eradicating the cholera outbreak that followed the 2010 earthquake. Domestic food production increased in recent years, but continues to be highly variable, as El Niño-related adverse weather reduced output in 2014. The outlook for Haiti shows some improvement, as the number of food-insecure people is projected to fall nearly 26 perecnt between 2015 and 2025.

In Central America, Honduras is projected to have about 40 percent of people food insecure in 2015, and Guatemala and Nicaragua each 20 percent. Recent improvements in food security were helped by declines in population growth. The region continues to be vulnerable to adverse weather and plant disease, causing production and income losses. In 2012, an outbreak of coffee rust disease reduced incomes for families that relied on this cash crop for their livelihood. Increasingly, governments in the region are implementing programs aimed at improving food security. Since 2012, the Dominican Republic, with 10-20 percent of the population estimated to be food insecure, along with Nicaragua and Guatemala, have announced Zero Hunger initiatives, modeled after the successful Brazilian program, Fome Zero, which aimed to combat hunger.

Bolivia and Ecuador continue to be the most food-insecure countries in South America, with 40 percent of the population estimated to be food insecure in 2015, unchanged from 2014. However, during the previous decade, poverty and food insecurity declined measurably in Bolivia, especially among the indigenous peoples who account for more than 60 percent of the total population. Income redistribution allowed incomes of the two lower income quintiles to rise three times as much as the average national income between 2001 and 2012. Food security is projected to improve in both countries over the coming decade.

Overall for the LAC region, food insecurity is projected to be most severe in 2015 for lower income groups in Haiti and the lowest income decile in Bolivia and Honduras, where households are estimated to consume 25 percent below the nutritional target.

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[2]The countries included are Bolivia, Colombia, the Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Nicaragua, and Peru.

The severity of food insecurity is also reflected in the distribution gap, or the amount of food needed for all food-deficit income groups to reach the nutritional target. Over the next decade, this gap is projected to decline 28 percent in the LAC countries, a slightly steeper decline than the number of food-insecure people, indicating a reduction in the intensity of food insecurity. The improvement is expected to occur in nearly all of the countries studied in the LAC region.

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Table 6
Food availability and food gaps for Latin America and the Caribbean

Year	Grain production*	Root production (grain equiv.)	Commercial imports (grains)	Food aid receipts (grain equiv.)	Aggregate availability of all food
			1,000 tons		
2006	14,302	3,738	15,104	791	42,400
2007	15,603	3,877	14,956	414	43,091
2008	16,127	3,904	15,235	393	44,019
2009	16,482	4,165	15,511	403	44,911
2010	15,953	4,196	16,836	670	45,190
2011	15,906	4,157	17,060	437	45,740
2012	17,037	4,404	16,861	252	46,202
2013	17,319	4,696	19,365	252	48,961
2014(e)	16,068	4,539	19,416	314	
Projections				**Distribution food gap**	
2015	17,638	4,591	19,205	**490**	50,195
2020	18,708	4,873	21,774	**420**	54,039
2025	20,073	5,166	23,354	**353**	57,128

*See table 3.

Latin America and the Caribbean
(169 million people in 2015)

The number of food insecure people dropped by 19 percent between 2014 and 2015. The most recent projection of a further decline in the number of people from 25 million in 2015 to 19 million in 2025 points to a continued trend of improved food security in the region

Food insecurity continues to be severe in Haiti with more than half of the population food insecure. Bolivia, Ecuador, Honduras, Guatemala and Nicaragua also have between 20 and 40 percent food inscurity, but all countries are projected to make improvements by 2025.

LAC: Trend in number of food-insecure versus population
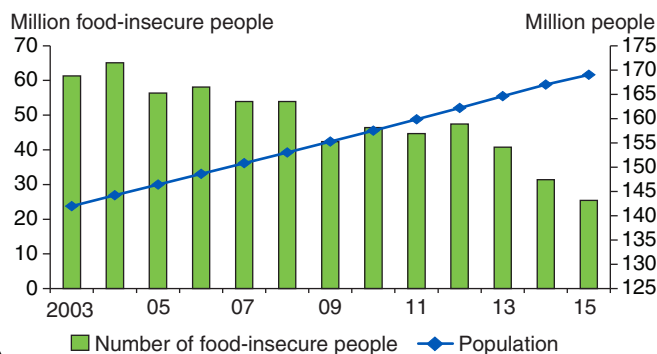
LAC: Distribution gaps

Latin America and the Caribbean: Food security indicators: 1995 and 2015, in selected countries

	Number of food-insecure people			Food gaps			Population		
	1995	2015	Change	1995	2015	Change	1995	2015	Change
	---million people---			---million tons---			---million people---		
Bolivia	6.9	4.3	-2.6	331	104	-226	7.6	11.0	3.4
Colombia	14.6	0.0	-14.6	331	0	-331	36.6	49.5	13.0
Guatemala	7.0	3.0	-4.0	234	41	-193	10.0	16.3	6.3
Haiti	7.1	6.1	-1.0	438	137	-301	7.8	10.6	2.8
Honduras	3.4	3.5	0.1	121	88	-33	5.6	8.4	2.8
Nicaragua	4.2	1.2	-3.0	222	14	-208	4.7	6.3	1.6
Peru	21.5	0.0	-21.5	673	0	-673	23.9	31.2	7.2
LAC	**79.9**	**25.4**	-54.4	**2,698**	**490**	-2,208	**123.7**	**169.4**	45.6

Source: USDA, Economic Research Service calculations and U.S. Census population data.

North Africa

The North African region continues to be relatively food secure, with all four countries in the region—Algeria, Egypt, Morocco, and Tunisia—estimated to have less than 10 percent food-insecure populations in 2015. Average consumption levels, as measured in per capita calories, are comparable to high-income countries, in part due to government policies that have traditionally subsidized food (particularly grain) consumption and high incomes compared with most of the other study countries. Grain production in Algeria, Morocco, and Tunisia is highly variable as it depends almost entirely on erratic rainfall. Water scarcity is one of the most pressing issues in this region.

Egypt, the most populous country in the region with 88 million inhabitants, increased its targeted food assistance program in 2014 by expanding its ration card system. Bread is one of 20 products, including meat, made available to low-income consumers at subsidized prices to help improve access to an improved and diversified diet. While average consumption levels of all income groups have been well above threshold levels, consumption has been declining in recent years. Unlike its neighbors, Egypt relies on irrigated agriculture. As a result, yields, reaching an average of 6.3 metric tons per hectare in 2011-13, are about four times as high as its neighbors' recent 3-year average. However, Egypt has been unable to further improve yields, and given the region's water scarcity, the Government is supporting efforts to increase water and land productivity. Higher yielding crop varieties are being introduced and investments in post-harvest handling, transportation, and storage—such as the construction of silos—are expected to lead to higher grain production and improved supply management.

Morocco's grain production in 2014 was 29 percent below the 2013 bumper crop. Production is mostly rainfed and therefore extremely variable, as the region is prone to drought. The country relies heavily on commercial wheat imports. Local wheat prices are stabilized through government subsidies used to cover the difference between a local guaranteed mill price and the actual world market price. While fuel subsidies were removed in 2014, wheat subsidies are expected to remain in place. Prospects for the 2015 winter crop are good thanks to sufficient moisture during the early stages of the planting season.

Algeria is also increasingly dependent on wheat imports, averaging 70 percent of domestic use over 2010-2015. Thanks to oil export earnings, the country has sufficient income to finance food imports. Price changes have an immediate impact on food security since food accounts for 43 percent of consumption expenditures. The Government continues to subsidize bread, dairy, milk, sugar, and cooking oil.

Tunisia has seen consumption increases over the last few years, and in 2015 it is estimated to have the highest per capita grain-equivalent consumption in the region. While crop production is as variable as in neighboring countries, the country had a bumper crop (25 percent above the recent 5-year average) in 2014 and the outlook for 2015 is favorable thanks to abundant rains in the fall of 2014. Imports accounted for 55 percent of domestic grain supplies in 2014, but government subsidies on basic foods—as in neighboring countries—contribute to relatively stable food prices even when international food prices spike.

Food availability and food gaps for North Africa

Year	Grain production*	Root production (grain equiv.)	Commercial imports (grains)	Food aid receipts (grain equiv.)	Aggregate availability of all food
			1,000 tons		
2006	35,766	1,731	25,714	58	60,735
2007	28,114	1,620	29,476	28	62,702
2008	29,457	1,977	32,451	39	64,008
2009	39,910	2,055	29,699	22	65,246
2010	31,748	2,328	34,183	41	66,501
2011	35,194	2,641	37,510	60	67,644
2012	33,604	2,826	33,114	43	68,703
2013	35,664	2,951	40,442	43	69,746
2014(e)	32,371	2,938	38,328	49	69,631
Projections				**Distribution food gap**	
2015	35,969	2,981	37,237	*0*	70,807
2020	37,727	3,245	41,772	*0*	73,245
2025	40,231	3,519	45,482	*0*	73,913

*See table 3.

North Africa
(168 million people in 2014)

Average food consumption in the four North African countries continues to be far above target levels. Owing to government policies that subsidize consumption of basic foods, average intake has been around 3,300 calories per capita per day, a level more commonly seen in high-income countries.

Even the lowest income decile in this region is estimated to have average consumption levels 33-45 percent above nutritional targets. Consumption in Morocco and Tunisia is projected to increase further, while it is projected to decline slightly in Algeria and Egypt over the next decade.

North Africa: Grain production and imports
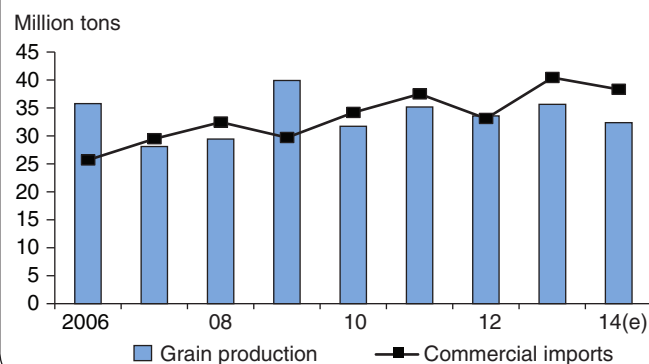
North Africa: Grain imports as a share of supplies
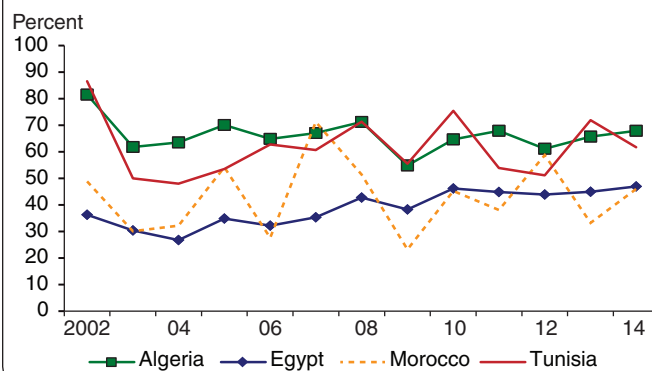
While the four North African countries studied are expected to keep food insecurity below 10 percent, consumption levels in Algeria and Egypt are projected to decline more than 10 percent over the next decade. Morocco is projected to see some increases in consumption. No changes are projected for Tunisia. Despite projected production increases in all four countries due to increased yields and greater area, imports will also have to continue to rise to satisfy demand.

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Meeting the World Food Summit Goal: Success Stories

Stacey Rosen

While estimates of the numbers of food-insecure people vary depending on the measure used, in the mid-1990s according to the Food and Agriculture Organization, close to one billion people were believed to be suffering from persistent undernourishment worldwide. At the time, the belief was that if no action were taken, the number would grow and thereby threaten additional lives, impede economic growth, and potentially contribute to political instability. As a result, in 1996 the United States, the European Community, and 184 other countries gathered at the World Food Summit (WFS) in Rome and pledged to reduce the number of undernourished people by half by no later than 2015. This declaration emphasized improving the performance of the agricultural sectors, particularly in low-income countries. To that end, there was a call for increased public and private investment in technology and its transfer, improved input distribution, greater access to land and credit, and better integration with world markets.

Now that 2015 is upon us, which countries achieved the WFS goal?[3] USDA's Economic Research Service uses an International Food Security Assessment (IFSA) model to project food availability and access in 76 low- and middle-income countries. This model has remained consistent in terms of how it is defined over the last 20 years. In this analysis, a population group is defined as food insecure if per capita consumption falls below a target of roughly 2,100 calories per day. Results from the IFSA model are used here to determine which of the 76 countries included in this study achieved the goal and to examine the underlying changes in production, import capacity, and other variables. For this analysis, the period of evaluation is from 1995 (1 year prior to the WFS) to 2015 (the goal year).

The number of food-insecure people in the 76 study countries fell from nearly 827 million in 1995 to roughly 475 million in 2015, or nearly 43 percent (table S1-1). Thirty-eight of the 76 countries included in this study have met or exceeded the WFS goal, according to the USDA-ERS analysis. An additional 10 countries (Indonesia, Pakistan, Sri Lanka, Jamaica, Algeria, Egypt, Morocco, Tunisia, Cape Verde, and Nigeria) were considered food secure in 1995 and (for the most part) through 2015, leaving 28 of the study countries that did not reach the goal. The Latin America and Caribbean (LAC) region saw the steepest decline in the number of food-insecure people, 68 percent (fig. S1-1). Countries in this region that made the greatest strides (in terms of percent decline in the number of food-insecure people) include Peru, Colombia, El Salvador, the Dominican Republic, Nicaragua, and Guatemala. The Asia region was not far behind LAC with a 58-percent decline in food-insecure people. Countries that excelled in this region include Vietnam, Nepal, Laos, Cambodia, Bangladesh, and the Commonwealth of Independent States (CIS) region. The number of food-insecure people in Sub-Saharan Africa fell just 10 percent from 1995 to 2015, but nearly half of SSA countries are estimated to have achieved the WFS goal. Countries with the greatest success include Cameroon,

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[3]The World Food Summit goal differs from the Millennium Development Goals, which endeavor to cut the share of population that is food insecure by half.

Table S1-1
Number of food-insecure people, 1995 and 2015

	1995	2015		1995	2015
	---millions---			---millions---	
Total	**826.6**	**474.7**			
Asia	464.8	195.0	**SSA**	281.9	254.2
Achievers			*Achievers*		
Afghanistan	15.8	6.5	Angola	12.1	0.0
Bangladesh	107.9	16.9	Benin	1.2	0.0
Cambodia	10.8	0.0	Burkina Faso	1.0	0.0
Laos	4.4	0.0	Cameroon	11.1	0.0
Nepal	4.1	0.0	Ghana	1.7	0.0
Vietnam	38.0	0.0	Guinea	3.9	0.0
Yemen	12.0	5.3	Guinea-Bissau	0.2	0.0
Armenia	2.9	0.0	Liberia	0.8	0.4
Azerbaijan	7.8	0.0	Malawi	7.0	0.0
Georgia	4.1	0.5	Mali	0.9	0.0
Kyrgyzstan	4.1	0.0	Mauritania	0.2	0.0
Moldova	0.9	0.0	Mozambique	14.4	5.1
Tajikistan	5.8	0.0	Namibia	1.5	0.7
Turkmenistan	1.3	0.0	Niger	5.5	0.0
Uzbekistan	9.2	0.0	Sierra Leone	1.6	0.0
Non-achievers			Sudan	21.1	0.0
India	191.2	125.2	Tanzania	26.9	10.2
North Korea	15.2	17.5	*Non-achievers*		
Mongolia	1.6	1.2	Burundi	5.6	10.7
Philippines	27.8	21.9	CAR	2.9	5.4
			Chad	7.0	10.5
LAC	79.9	25.4	Congo	2.4	1.9
Achievers			Cote d'Ivoire	1.4	2.3
Colombia	14.6	0.0	DR Congo	25.2	71.2
Dominican Republic	5.6	1.0	Eritrea	3.4	6.5
El Salvador	2.9	0.0	Ethiopia	57.0	29.8
Guatemala	7.0	3.0	Gambia	0.3	1.0
Nicaragua	4.2	1.2	Kenya	19.2	27.6
Peru	21.5	0.0	Lesotho	0.9	1.8
Non-achievers			Madagascar	5.4	9.5
Bolivia	6.9	4.3	Rwanda	5.7	8.9
Ecuador	6.8	6.3	Senegal	0.9	4.2
Haiti	7.1	6.1	Somalia	6.3	10.6
Honduras	3.4	3.5	Swaziland	0.6	1.3
			Togo	3.9	2.3
			Uganda	4.1	7.4
			Zambia	8.0	12.1
			Zimbabwe	10.5	12.8

Note: When the number is zero, we interpret that result as the country being food secure; while we realize that there are food-insecure people in these countries, our analysis does not allow us to measure food insecurity at less than 10 percent of the population.

Indonesia, Pakistan, Sri Lanka, Jamaica, Algeria, Egypt, Morocco, Tunisia, Cape Verde, and Nigeria were estimated as food secure in 1995 and (for the most part) through 2015.

Figure S1-1

Latin America and the Caribbean saw the steepest decline in food-insecure people

1995=100
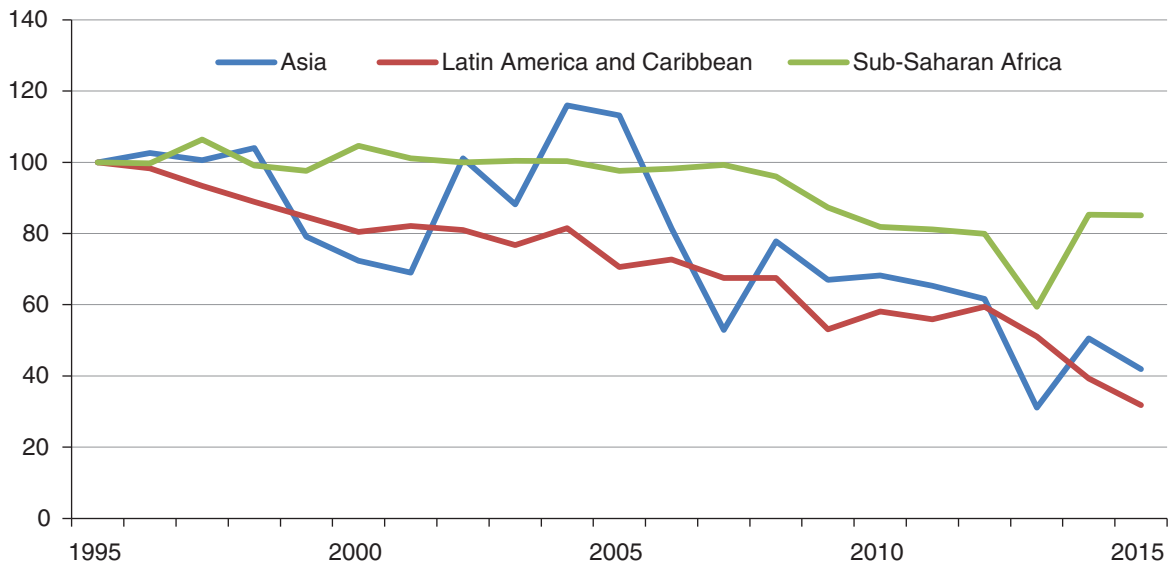
Sudan, Angola, Malawi, Benin, Burkina Faso, Ghana, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, and Sierra Leone.

In the Asian countries, success was generally due to improved grain yields (table S1-2). In Latin America and the Caribbean, success derived from growth in commercial grain imports and a slow-down in population growth. The region's population grew only 33 percent over the 20-year study period. By contrast, population grew 70 percent in SSA (fig. S1-2). In Sub-Saharan Africa, prog-ress toward food security was largely due to area expansion in grains and roots/tubers, although imports have increased in many countries. In fact, grain production grew fastest, 72 percent, in SSA compared with 61 percent in LAC and 59 percent in Asia (fig. S1-3). SSA's grain imports grew nearly threefold during the study period (fig. S1-4).

Table S1-2
Factors contributing to meeting the WFS goals

	Grain production growth due to increased area	Grain production growth due to yield gains	Root/tuber production growth due to increased area	Root/tuber production growth due to yield gains	Grain import growth	Sharp decline in population growth
Asia						
Bangladesh		x				x
Nepal		x			x	x
Vietnam		x			x	
Cambodia		x				x
Laos	x	x				x
Yemen					x	x
Armenia		x				
Azerbaijan	x	x			x	
Georgia		x				
Kyrgyzstan					x	
Moldova		x				
Tajikistan		x			x	
Turkmenistan	x	x				
Uzbekistan		x			x	
LAC						
Colombia		x				x
Dom Repub	x				x	x
El Salvador					x	x
Guatemala					x	
Nicaragua					x	x
Peru	x	x			x	x
SSA						
Cameroon	x		x		x	x
Sudan					x	
Tanzania	x		x			
Angola	x		x	x		
Malawi		x	x	x		
Mozambique	x			x	x	x
Namibia					x	x
Benin			x	x	x	
Burkina Faso	x				x	
Ghana			x		x	
Guinea	x					x
Guinea-Bissau					x	
Liberia	x				x	
Mali	x					

Continued—

Table S1-2
Factors contributing to meeting the WFS goals—continued

	Grain production growth due to increased area	Grain production growth due to yield gains	Root/tuber production growth due to increased area	Root/tuber production growth due to yield gains	Grain import growth	Sharp decline in population growth
Mauritania						x
Niger	x	x				
Sierra Leone	x	x				
Ethiopia*		x				x

*The number of food-insecure people in Ethiopia has fallen by nearly half from 1995; the number of food-insecure people in the country increased into the late 1990s, so if that were the starting point Ethiopia would have definitely achieved the halving target.
Note: Algeria, Egypt, Morocco, Tunisia, Indonesia, Pakistan, Sri Lanka, Jamaica, Cape Verde, and Nigeria had less than 10 percent of their populations food insecure through much or all of this study period.

Source: USDA, Economic Research Service.

Figure S1-2

Latin America and the Caribbean has seen the slowest population growth rates

1995=100
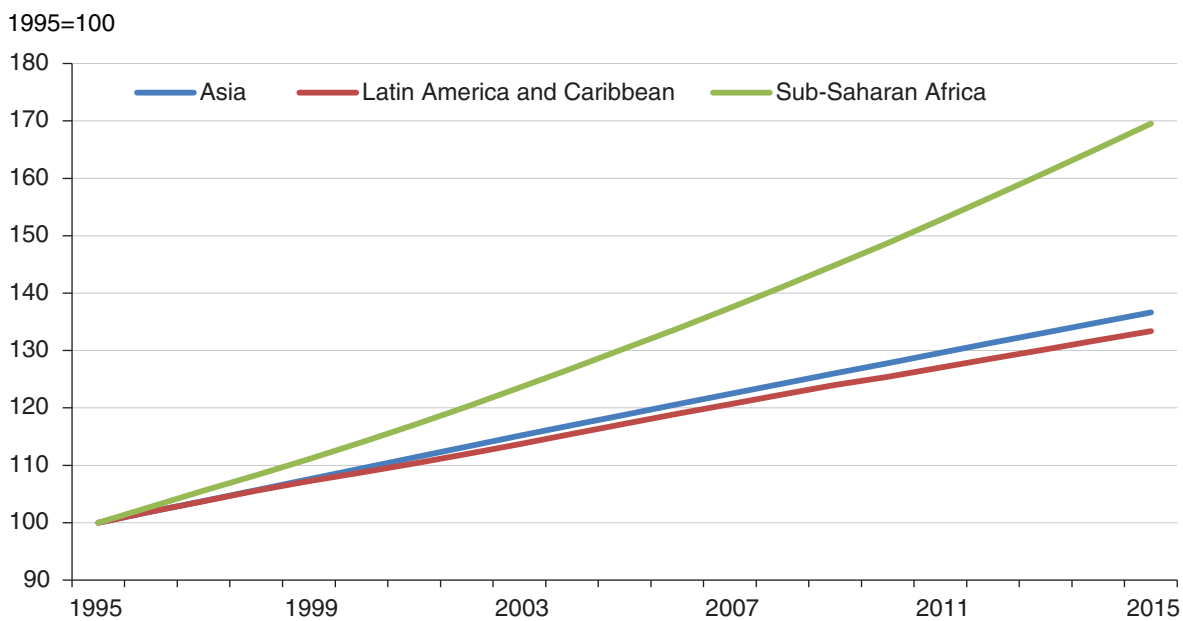
Source: USDA, Economic Research Service calculations from U.S. Census population data.

Figure S1-3

Sub-Saharan Africa experienced the fastest growth in total grain production since 1995

1995=100
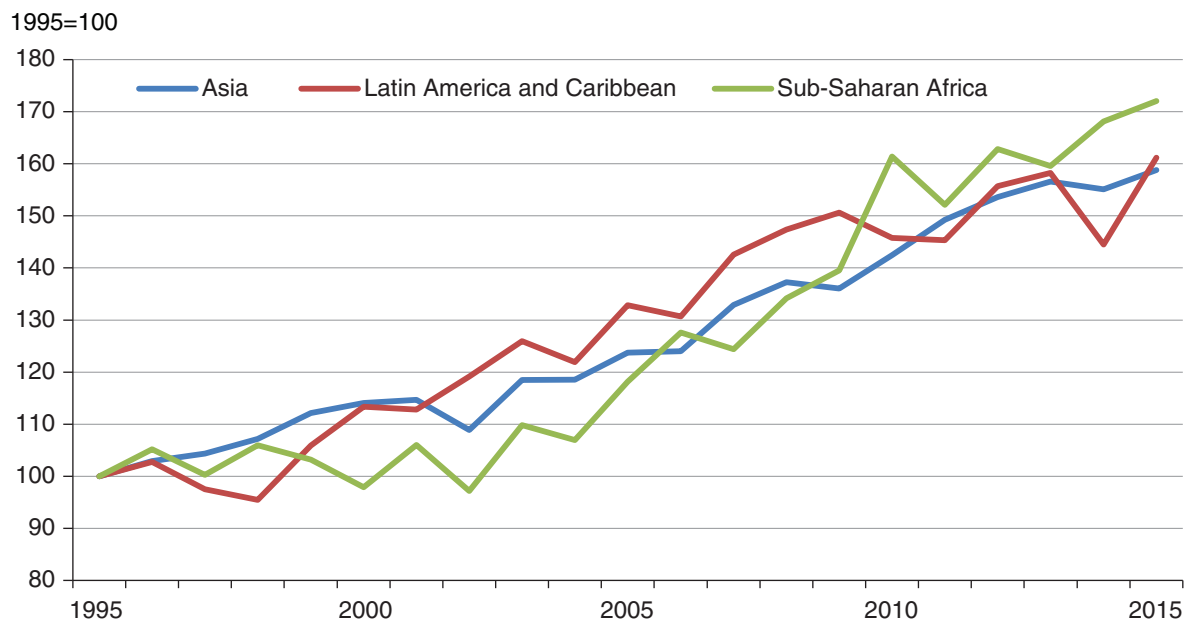
Source: USDA, Economic Research Service.

Figure S1-4

Grain imports have risen fastest in Sub-Saharan Africa

1995=100
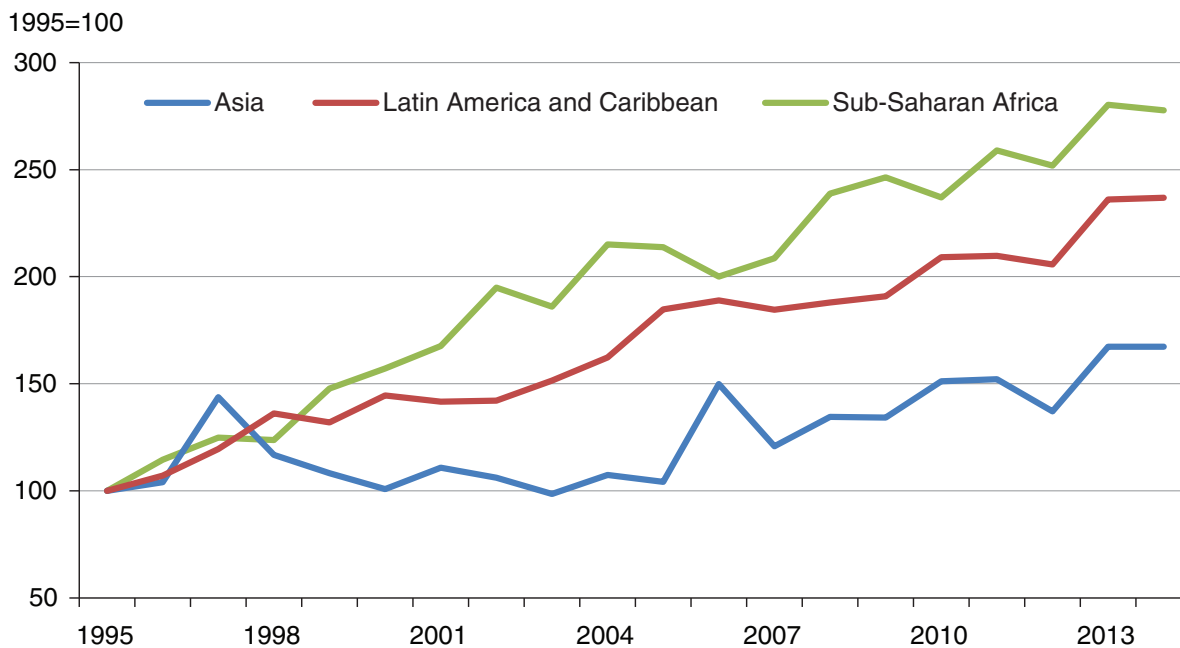
Source: USDA, Economic Research Service.

Asia

Of the 22 Asian countries included in this study, 15 have reached or exceeded the World Food Summit goal of halving the food-insecure population by 2015. In Bangladesh, more than 100 million people were estimated to be food insecure in 1995 and in 2015 that figure is estimated at 17 million (table S1-1). The improvement was almost entirely due to successes in the grain sector, since grains account for about three-quarters of the country's diet. Grain production doubled between 1995 and 2014, spurred almost entirely by higher yields. Historically, the Government of Bangladesh has had a policy of rice self-sufficiency. Yields have increased as farmers have adopted hybrids or high-yielding varieties and invested in mechanization, fertilizers, and other inputs. Growth in rice production is now largely linked to expansion of irrigation-dependent Boro rice. This growth is coming at a cost, however, as irrigation is stressing Bangladesh's water table, which is dropping by 4 to 5 feet per year in certain areas. As a result, the Government has begun to focus on expanding rainfed Aus (low-yielding) rice production and encouraging the introduction of saline- and submergence-resistant rice varieties. This production growth, coupled with a drop in the population growth rate, resulted in a jump in per capita grain output of more than 2 percent per year.

Cambodia's food security situation has improved steadily since 2001, when 90 percent of the population was estimated to be food insecure. Since 2009, ERS analysis shows the country as food secure (consumption for less than 10 percent of the population falls below the nutritional target) due to gains in per capita grain output. Grain production tripled between 1995 and 2014, driven primarily by yield growth but also acreage expansion. Rice occupies more than 80 percent of cultivated land in Cambodia. However, the country's rice yields remain among the lowest of the major Asian rice producers. Recent improvements in yields of the wet-season crop (75 percent of total rice output) have been attributed to improved access to fertilizers and other inputs. Conversely, dry-season yield improvements were due to improved seed varieties and water management. At the same time yields were increasing, Cambodia's population growth rate was cut in half.

The number of food-insecure people in Afghanistan fell from 15.8 million in 1995 to 6.5 million in 2015, or 59 percent. The driving factors were a 3.5-percent annual increase in grain yields and a more than doubling of grain imports. Grain (principally wheat) yields have trended upward since the early 2000s in response to increased availability of improved seed and chemical fertilizers that have been distributed at subsidized rates. The Food and Agriculture Organization (FAO), the EU, the World Bank, and other donors have worked toward rehabilitating the country's irrigation schemes and establishing an environment for seed multiplication, processing, storage, and testing.

Yemen exceeded the WFS goal, cutting the number of food-insecure people from 12 million to 5.3 million, or 56 percent, during the last 2 decades. In 2015, an estimated 20 percent of the population is food insecure. This estimate does account for the recent escalation in conflict and its consequences for food security. Yemen has seen negligible growth in domestic grain output, but imports, supported by increased oil revenues, have nearly doubled since 1995. In addition, population growth dropped from well over 4 percent per year in 1995 to an estimated 2.5 percent in 2015.

Half of the Laotian population, or 4.4 million, was considered food insecure in 1995, but the country has been food secure since 2009. During the last two decades, grain output grew more than three-fold while population growth was cut in half. The improved grain output was almost equally a result of increased area and higher yields.

In Vietnam, 38 million people (40 percent of the population) were estimated to be food insecure by USDA-ERS in 1995. Food security improved steadily through the remainder of the decade and since 2001 the country has been considered food secure. Vietnam's grain output roughly doubled during the last two decades, spurred largely by growth in yields that resulted from increased use of fertilizers, pesticides, and high-yielding varieties. The Cuu Long Rice Research Institute, located in the Mekong River Delta, has developed new varieties to tolerate drought, salinity, and flood. At the same time production was expanding, Vietnam's economy grew rapidly, supporting strong growth in imports. Commercial grain imports grew almost ten-fold between 1995 and 2014. Also contributing to higher per capita consumption was a decline in population growth—from 1.7 percent in 1995 to an estimated 1 percent in 2015.

USDA-ERS analysis now shows Nepal as food secure, whereas 4.1 million people, or 20 percent of the population, were food insecure in 1995. This improvement was due to strong growth in grain yields, a five- to six-fold increase in grain imports, and a slowdown in population growth. The results for 2015 do not take into account the potential impact of the April 2015 earthquake.

Indonesia and Pakistan were estimated to be food secure in 1995 and are projected to be the same in 2015 (despite a few years where roughly 10 percent of the population of each country was considered food insecure). Therefore, these two countries cannot be considered to have met the WFS goal despite being two of the most food-secure countries in the study.

In India, the number of food-insecure people has fallen from 191 million in 1995 to an estimated 125 million in 2015 with the share dropping from 20 to 10 percent. This improvement meets the Millennium Development Goal of halving the *percentage* of food-insecure people (as opposed to the *number* of people for the WFS goal).

All eight countries of the Commonwealth of Independent States (CIS) region included in the Asia region of this study have achieved the goal of halving their food-insecure populations. In fact, all of the CIS countries studied are estimated to be food secure in 2015. The base year for this analysis, 1995, immediately followed the breakup of the former Soviet Union. Therefore, these countries and their agricultural sectors were in the initial stages of transitioning from planned to free-market economies. By the early 2000s, most of the countries in the region began to exhibit growth in yields that allowed for improved food security. Some countries (such as Azerbaijan, Kyrgyzstan, Tajikistan, and Uzbekistan) also increased their imports to augment food supplies.

Latin America and the Caribbean

Six of the 11 Latin American and Caribbean (LAC) countries included in this report have achieved the WFS goal and most of those countries have exceeded that goal. El Salvador is now considered food secure (with food insecurity below 10 percent) whereas in 1995, 2.9 million people, or half the population, were estimated to have caloric consumption below the nutritional target (table S1-1). This success was almost entirely driven by the country's slow population growth of 0.5 percent per year. Consequently, little growth was required of production or imports to increase supplies on a per capita basis. Grain imports comprise nearly half of El Salvador's grain supplies and their growth, supported by strong export earnings, was robust in the mid-1990s. Imports have since slowed. Domestic grain production growth averaged 1.5 percent per year during the study period, more than enough to result in per capita gains.

In Peru, 21.5 million people (90 percent of the population) were food insecure in 1995, according to USDA-ERS. The country is estimated to be food secure in 2015, with less than 10 percent below the target. Area and yield growth led to an increase in grain output of 4.5 percent annually and in root crop output of 3.5 percent. At the same time, grain imports grew 3.5 percent per year. Meanwhile, Peru's population has been growing at just 1.1 percent per year recently, facilitating significant increases in per capita food supplies.

In 1995, 14.6 million people—or 40 percent of Colombia's population—were estimated to be food insecure. In 2015, the country is considered food secure, partly through a 140-percent increase in imports, strong growth in grain yields, and a steady decline in population growth (from over 1.8 percent per year in the mid-1990s to near 1 percent in 2015). Imports now account for two-thirds of grain supplies. Colombia is one of the fastest growing economies in the region, supported by a sharp increase in oil output and a construction boom. Oil exports account for half of the country's export earnings. Recent conditions—including declining oil output, reductions in foreign direct investment, and lower oil prices—could constrain growth and possibly affect food security.

The Dominican Republic cut the number of food-insecure people by more than 80 percent—from 5.6 million in 1995 to 1 million in 2015. In 2015, an estimated 10 percent of the population is food insecure. This improvement is mostly due to a doubling of grain imports, which now account for roughly three-quarters of the country's grain supplies. The Dominican Republic now has the second largest economy in Central America and the Caribbean and per capita income levels just below those of Costa Rica and Panama. In addition to the higher level of imports, a decline in population growth contributed to larger per capita food supplies.

In Nicaragua, the number of food-insecure people fell by more than 70 percent—from 4.2 million in 1995 to 1.2 million in 2015, or 20 percent of the country's population. This success was driven by a 3-percent annual increase in grain output since 1995, a near 5-percent annual growth in imports, and a sharp decrease in population growth—from 2.2 percent per year to roughly 1 percent. Export earnings, roughly three-fourths of which are from agricultural products, jumped over four-fold since 2000. These earnings have supported the growth in grain imports, which now account for a third of supplies.

Guatemala cut the number of food-insecure people by 57 percent—from 7 million to 3 million—between 1995 and 2015. The beginning of the study period coincides with the end of the country's longstanding civil war. Stabilization created a more favorable environment for addressing food security issues and achieving the WFS goal. While the country's growth in grain output did outpace population growth, the main driver behind the significant improvement was the sharp rise in grain imports—growing nearly 5 percent per year. During the last two decades, exports of goods and services rose roughly five-fold while remittances jumped 14-fold, thereby providing the foreign exchange to support the strong import growth. The Dominican Republic-Central America Free Trade Agreement (which came into force for Guatemala in 2006) has also facilitated the increase in exports.

Sub-Saharan Africa

Of the 39 Sub-Saharan African (SSA) countries included in this study, 17 are estimated to have met or exceeded the WFS goal of halving their food insecure populations since 1995. Many countries—including Angola, Mozambique, Liberia, and Sierra Leone—achieved the success due to the resumption of agricultural activities following the end of longstanding civil strife.

Angola has made some of the greatest strides in the world in moving toward food security. Nearly all of the population was estimated to be food insecure in 1995, but the country is estimated to be basically food secure in 2015, with less than 10 percent of the population consuming below the target. The country's civil war ended in 2002 and since then grain area harvested has doubled. Area and yields of roots and tubers, which account for nearly a third of calories consumed, have grown at more than 5 percent per year.

Mozambique has also seen great improvement in its food security, with a 65-percent decline in food-insecure people (from 14.4 to 5.1 million) from 1995 to 2015 (table S1-1). The end of the civil war in 1992 was followed by a significant increase in agricultural activity. Grain output doubled between 1995 and 2014; root crop production increased even faster. Commercial grain imports doubled during this time and now account for 40 percent of grain supplies. At the same time, population growth slowed from 3.4 percent in 1995 to roughly 2.5 percent in 2015.

Liberia's most recent civil war ended in 2003 and since then the country has been able to cut the number of food-insecure people by more than half. During the last decade or so of peace, food production and imports increased significantly. Grain output nearly tripled from 2005 to 2014 while imports, which account for two-thirds of grain supplies, increased 50 percent.

Sierra Leone is also enjoying improved food output following the end of a civil war. According to USDA-ERS analysis, the country has been food secure since 2010. In 1995, an estimated 1.6 million people, or 40 percent of the population, consumed below the nutritional target. The country's grain area bottomed out at 200,000 hectares in 2000, but in recent years it has exceeded 700,000 hectares. During the same time yields nearly tripled, thereby allowing for strong gains in per capita supplies.

In addition to these previously strife-affected countries, other countries in the region have also achieved and/or exceeded the WFS goal. Cameroon is now considered food secure. This marks a significant improvement from 1995 when 80 percent of the population (11 million people) was considered food insecure. Since 1995, grain production nearly tripled (mostly due to area expansion) while root/tuber production more than doubled, and grain imports tripled. At the same time that food availability was rising, population growth was slowing, enabling even higher per capita supply growth.

Roughly 70 percent of Malawi's population was food insecure in 1995. In 2015, the country is estimated to be food secure. The Government has long subsidized inputs to encourage planting. For example, the Starter Pack (SP) provided free seed and fertilizer to households for corn production. The Targeted Input Program (similar to the SP), and the Farm Input Subsidy Program (FISP) also included support for tobacco, coffee, tea, cotton, and legumes. FISP targets roughly half of Malawi's smallholder farmers. Since 1995, the country's grain yields jumped 3.3 percent per year and accounted for two-thirds of the growth in grain output. Root and tuber output also soared. As a result, food output growth allowed for gains in food security despite Malawi's having one of the highest population growth rates in the world at well over 3 percent per year.

In Sudan, 21 million people, or roughly 70 percent of the population, were considered food insecure in 1995. Since 2013, the country has been considered food secure. While grain output growth slightly exceeded population growth during the last two decades, the biggest change in food availability has been rising imports. In 1995, grain imports equaled roughly 600,000 tons. In 2014, they were roughly 2.5 million tons. In 1995, imports accounted for about 15 percent of grain supplies; in more recent years this share has averaged more than 30 percent. This jump was supported by rapidly rising export earnings, which were boosted by higher oil production and prices.

In 1995, nearly 4 million people, or half of Guinea's population, were considered food insecure. However, since 1999, the country has been food secure. Rice comprises most of Guinea's grain production and accounts for nearly 40 percent of calories consumed. During the last two decades rice output increased more than three-fold, largely due to increased area. This increase, coupled with slowing population growth, contributed to rising per capita food supplies.

Namibia cut the number of food-insecure people by more than 50 percent since 1995, from 1.5 to 0.7 million. Namibia experienced a slow but steady increase in grain imports (which account for a large share of domestic supplies) as population growth slowed from more than 3 percent per year to less than 2 percent.

In 1995, nearly 27 million Tanzanians were estimated to be food insecure. Since then, this number has declined by more than 60 percent to just over 10 million. In 2015, roughly 20 percent of the population is estimated to be food insecure. Tanzania is one of the rare cases where improved food security has been driven largely by growth in area planted rather than by reduced population growth or improved yields. In fact, population growth rates remain high at roughly 3 percent per year. Yields vary widely from year to year and have shown no sustained growth in the last two decades. In contrast, both grain and root/tuber area roughly doubled from 1995 to 2015.

Niger is now considered food secure while in 1995, 60 percent of its population was food insecure. This success was achieved despite the country having one of the highest population growth rates in the world, roughly 3.5 percent per year. Grain output has grown 5 percent per year, driven almost equally by yield and area growth.

An estimated 10 percent of the population of Mali, Mauritania, and Ghana was food insecure in 1995. All are now considered food secure and have therefore met the WFS target. Mali achieved the goal in 2003 due to strong growth in grain output. Area increased nearly 5 percent per year since 1995 while yields grew more than 2 percent. The near 7-percent annual growth in grain production far exceeded the roughly 3-percent annual growth in population.

Mauritania has been considered food secure since 2012. Only 10 percent of the population was considered food insecure in 1995 and through much of the study period it remained at that level or below. Grain imports, a significant contributor to domestic supplies, nearly doubled between 1995 and 2014. Mauritania exports iron ore, gold, copper, and oil, and the prices of these commodities experienced strong growth over the last two decades.

USDA-ERS estimates indicate that Ghana has been food secure since 1998. FAO estimates average per capita consumption above 3,000 calories in 2011, one of the highest levels in the region and nearing levels of the North African countries, which are much wealthier. Root crops account for the largest share of the country's diet, 40 percent, and output has grown more than 4 percent per year since 1995. Growth in grain output, closer to 3 percent per year, also exceeded population growth. Grain imports have grown: in 1995, they accounted for about 15 percent of supplies, but in recent years they exceeded 25 percent.

Twenty percent of Benin's population (1.2 million) was food insecure in 1995. However, since 1999, the country has been considered food secure. While growth in grain production was lower than population growth, grain imports have grown four-fold and root crop production has more than doubled since 1995, facilitating the increase in per capita food supplies.

Burkina Faso met the WFS goal even though annual population growth has remained high, near 3 percent. The country has been considered food secure since 2008 because both grain output and imports more than doubled since 1995. As a result, growth in grain supply of more than 4 percent per year has outpaced population growth.

Since 2009, Guinea-Bissau has been estimated to be food secure. In 1995, 20 percent of the population (200,000) was estimated to be food insecure. Like Mauritania, the WFS goal was achieved through rising imports as grain output declined in per capita terms. Imports, however, doubled during the study period and now account for half of grain supplies.

Cape Verde and Nigeria are estimated to have been food secure through much or all of this study period.

Ethiopia is just short of meeting the WFS goal, but its progress toward the goal is notable. The country's civil war ended in 1991 and from that time until the mid-2000s it was one of the most food-insecure countries in the world. However, it is now roughly tied with Nigeria as the two largest grain producers in the SSA region. Grain area has increased nearly 60 percent since 1995 while yields have increased 33 percent. From the mid-1990s to the mid-2000s, area expansion led the way to higher output. More recently, improved yields have been the source of growth. During the last decade, yields—while still low relative to world standards—have increased 4.7 percent per year. The Government of Ethiopia has a 5-year Growth and Transformation Plan, starting in 2010, with a goal of doubling grain output by 2015. While this goal has not been met, the Government has encouraged production by providing credit, fertilizer, improved seeds, and training to farmers. It has also provided low lease prices for land to local and foreign investors to encourage commercial farming.

Ethiopia's food-insecure population fell 48 percent between 1995 and 2015 according to USDA-ERS analysis, just short of meeting the WFS goal. In 1995, 57 million people—virtually the entire country—were estimated to be food insecure and this remained so until the mid-2000s. Since then, food security has steadily improved and in 2015, an estimated 30 million people (30 percent of the population) are estimated to be food insecure. Ethiopia did, however, meet the MDG of halving the *share* of food-insecure people, as that fell from roughly 100 percent of the population in 1995 to 30 percent in 2015.

North Africa

The four North African countries included in this study have been considered food secure during the entire study period. The countries are included in this report because they were, at some point, recipients of food aid. However, their food consumption approaches levels more commonly seen in high-income countries. Grains remain the staple of the diets and governments in the region have shown a commitment to protecting the low-income households from food insecurity by subsidizing basic staples.

Summary

Agricultural sector performance was the principal factor determining whether study countries achieved the WFS goal of cutting the number of food-insecure people by half between 1995 and 2015. Through most of the study period, domestic grain production accounted for more than 90 percent of supplies in Asia, roughly 80 percent in SSA, and just 55 percent in LAC. Therefore, it is not surprising that the countries in Asia that far surpassed the WFS goal—such as Bangladesh,

Cambodia, Laos, Nepal, and those in the CIS region—were the ones that experienced significant growth in grain output. In these cases, the growth was supported by gains in yields, as in SSA countries such as Cameroon, Tanzania, Angola, Mozambique, Guinea, Liberia, Mali, Niger, and Sierra Leone. However, SSA gains were driven more by increased area than higher yields.

The LAC countries saw the steepest decline in the number of food-insecure people from 1995 to 2015, 68 percent. Imports played an increasingly important role in this region's food supplies through the study period. In addition, most LAC countries experienced a significant slowdown in population growth.

The results highlighted above indicate that great strides have been made in terms of improved food availability across all regions. Food security, measured as access to calories, has improved greatly, even if the ambitious goal of reducing the number of food insecure people by half has not been met in all countries. While increased quantities of food are now available to many people in the countries studied here, it is not necessarily the case that the diets being consumed are nutritionally adequate. Improving nutritional diversity is another urgent part of improving food security. Until people are consuming varied diets and are meeting targeted levels of proteins, carbohydrates, and fats, overall food security may still remain elusive.

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A Demand System Approach To Modeling Food Security

Anthony Murray

The USDA-ERS International Food Security Assessment model (IFSA) is used to analyze food security for 76 low- and middle-income countries. The current model was originally created in 1995. It provides an estimate of food security for the current year as well as 10-year projections of food security for each country based on whether estimated food supplies are sufficient to meet a nutritional target of 2,100 calories per person per day. Over the next year, the current ERS IFSA model will be replaced with a model that also incorporates estimates of market-based food demand (Beghin et al., 2015). This demand-driven framework includes information about domestic prices, consumer responsiveness to changes in prices and incomes, and food quality differences among income groups. With these changes, the new model will enable analysis of gaps between market demand and nutritional benchmarks, and the implications of domestic and international price changes on food security. This article explains the new model and highlights the new capabilities of the model. Finally, using Tanzania as an example, it compares the results from the new model, and estimates included in this year's international food security assessment.

Introduction

The current USDA-ERS International Food Security Assessment model grew out of earlier efforts within ERS to evaluate the food needs of developing countries. Beginning in the late 1970s, ERS conducted food assessments for many developing countries that evolved into assessments of food aid needs by the early 1990s. At the 1996 World Food Summit, global leaders agreed upon a definition of food security as existing "when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." The World Food Summit definition codified four dimensions of food security: availability, access, utilization, and, more recently, stability. The International Food Security Assessment (IFSA) model, first developed in 1995, facilitates the analysis of food access and food availability for the current year, as well as a 10-year projection.

A significant amount of information about developing countries exists today that was not available when the model was originally specified. Over the next year, the IFSA will better incorporate this new information by providing a framework that facilitates analysis of domestic and international price effects on food security. This article introduces the new model and assesses some of the biggest advantages in adopting this framework. Finally, preliminary results of the new model for Tanzania are discussed and contrasted with results of the current model.

A Demand System Approach To Modeling Food Security

The current IFSA model is a partial equilibrium model that uses national production data to estimate food consumption, access, and availability. The model projections focus on three major food groups: grains, root crops, and a category encompassing all "other food." These three categories of food are used to determine the food supply necessary to meet a 2,100-calorie daily per capita threshold.

Projections focus on calculating the estimated food supplies available within a country, based on production, net imports, and food aid. Nutrition and distribution gaps are calculated from this information to determine the additional food necessary to meet the 2,100-calorie target. These food gaps, however, do not incorporate information about market demand, such as changes in domestic and world prices. Under the new demand-driven framework, this information is utilized in food insecurity projections.

The new model analyzes and projects consumption for a country's major grain (an aggregate of all other grains consumed), roots and tubers, and an "other" category covering the remainder of the diet. Previously, all grains were aggregated. Like the current model, the new modeling framework continues to analyze income deciles for the study countries, but incorporates estimates of how consumers in each decile respond to changes in income and prices. In contrast to the current model, which estimates whether each income decile is or isn't food secure, the new framework can also estimate food insecurity levels along a continuum, thus providing more precise levels of food insecurity within a country.

The Price Independent Generalized Logarithmic (PIGLOG) demand specification provides some useful characteristics that can be applied to the new food security model. This type of demand specification is rooted in microeconomic theory and allows aggregate food consumption to be modeled by a representative consumer who follows common assumptions about utility maximization (Muellbauer, 1975; Lewbel, 1989). Additionally, this type of specification ensures that individual decile estimates aggregate to total market demand for each good.

The newly specified demand model incorporates own-price and income elasticities estimated by Muhammad et al. (2011). Their study presents own-price and income elasticities for all food, as well as for eight food subgroups such as grains, fruits and vegetables, meat and dairy products, and fats and oil. Cross-price elasticities are not currently used in the new model due to limited data and difficulty in consistently calculating them across the wide set of countries. However, the new approach is flexible and designed such that if the data become available, cross-price elasticities can easily be included. The way elasticities are estimated allows households in different income deciles to have different responses to changes in food commodity prices and incomes. This reflects the fact that price sensitivity declines as incomes rise and consumers are less responsive to price (and income) shocks for specific food commodities as income rises. Through accurate calibration, the new IFSA model specification ensures that standard assumptions about consumer behavior hold, including income and own-price (in absolute terms) elasticities decreasing with rising income. For a more technical discussion.

The new model specification incorporates many of the inputs and components of the current IFSA model. It uses macroeconomic data from the ERS International Macroeconomic Data Set as well as the ERS International Food Security data. The latter database includes data on production, supply, and distribution for grains and roots/tubers, gross domestic product, trade in goods and services, and food aid. Data on income distribution, primarily derived from the UN Food and Agriculture Organization (FAO) and the World Bank, are also common to both models. Income distribution continues to be broken into deciles. International prices are from the USDA Agricultural Projections, which is updated annually. The model explicitly includes all costs associated with trading goods between world and domestic markets. The relationship between international and domestic prices is captured in a price transmission equation, which allows for an explicit understanding of international and domestic price effects on food security, which is then incorporated in the current model.

The framework is flexible enough when no observed domestic price is available to create a synthetic estimate of the domestic price based on the world price, tariffs, shipping/transportation costs, a consumer price index, and an additional parameter that reflects the imperfect transmission of effects between international and domestic markets.

More Precise Estimates of Food Insecurity by Income Group

The new model estimates consumer demand for four food categories (major grain, all other grains, roots/tubers, and all other food) for each income decile. Per capita daily caloric consumption is estimated by adding the calories associated with each food category. This total is then evaluated against a specific nutritional threshold (2,100 or 1,800 calories per capita per day) to determine whether households are considered food secure. The ability to evaluate the more severe level of food insecurity, as measured by failing to meet the 1,800-calorie threshold, is another benefit of the new demand-driven framework.

Evaluating food security using deciles implies that all households within a decile are food insecure (food secure) when the estimated daily per capita consumption falls below (above) the threshold. By incorporating information from the annual *State of Food Insecurity* (SOFI), published jointly by FAO and the International Fund for Agricultural Development (IFAD), it is possible to estimate a continuous distribution of available calories, which allows for a more precise measurement of the food-insecure population within a country. Continuous estimates of food security are important because it eliminates large discrete jumps in estimates of the food-insecure population. For example, suppose that two continuous estimates of food insecurity are 29.99 percent and 30.01 percent. Under the decile approach, an estimate of 29.99 percent implies that two deciles are considered food insecure (equivalent to 20 percent of population). An estimate of 30.01 percent means three deciles are considered food insecure (30 percent of the population). The continuous approach smooths the discrete jumps between deciles and leads to more precise estimates of the food-insecure population. Therefore, the share of chronically food-insecure people within a country can now be more precise than previously feasible. In the previous example, the share of food insecure can now be recorded as 29 percent versus 20 percent.

Accounting for Differences in Food Quality

The new modeling framework captures the fact that lower income consumers tend to eat lower value products within a food group due to budgeting. Higher income consumers tend to buy higher value products purchased at higher prices. For example, lower income households might purchase basic ingredients like wheat flour while wealthier households purchase commercially produced baked goods. In the new model, the span from lower value to higher value products within a food group is reflected in a quality scale index. Higher income people are more willing to pay a premium for attributes such as convenience and may choose more costly prepared foods in a particular food group. As long as quality differences exist they can be represented using this methodology.

Decomposing Changes in Food Security

The new model structure also allows for additional analysis in determining and quantifying the drivers of change in food security projections by fully specifying consumer demand. Food demand rises due to increased per capita demand as well as larger populations. Changes in per capita demand

can be decomposed into an income and price component. The price component is a function of responses to real world price and real exchange rate changes for that country. Therefore, there are four components that can affect food consumption: population growth, income change, changes in real world price, and changes in the real exchange rate. The magnitude of each component's contribution, as well as their combined effect, can be uniquely estimated through the newly introduced decomposition method. The decomposition of demand change can be calculated for each decile, enabling additional scenario analyses by changing domestic exchange rates, world prices, or population and income growth rates.

Comparing Food Security Estimates

The current IFSA model, which estimates consumption needs using a nutritional benchmark, and the demand-driven modeling framework differ in their approach to estimating and projecting food consumption. Here we explore similarities and differences in results of the two specifications for Tanzania, a country in eastern Africa. Results from the current specification presented here are the same estimates as in the Appendix of this report. However, instead of reporting estimates in per capita grain equivalent kilograms per day, results are reported in daily calories per capita.

The estimate of the number of food-insecure people for Tanzania is reported in table S2-1. To facilitate direct comparisons between the two models, the newer framework continues to use the decile approach (in table S2-1) that is used in the current model to calculate the estimates of the number of food-insecure people. Several important differences between the models are apparent from these results. First, the new framework suggests that at least some people consume fewer than 1,800 calories per day in Tanzania. The ability to measure this more severe form of food insecurity is one benefit of the demand-driven framework. Many of the most damaging aspects of hunger and malnutrition occur when individuals are consuming fewer than 1,800 calories per day.

Table S2-1
Calculating food-insecure population, Tanzania

	Current model			
	Number of food-insecure deciles		Population of food insecure (millions)	
Year	< 1,800 kcal/day	< 2,100 kcal/day	< 1,800 kcal/day	< 2,100 kcal/day
2015	---	2	---	10.21
2020	---	2	---	11.71
2025	---	2	---	13.38

	Demand-driven model[1]			
	Number of food-insecure deciles		Population of food insecure (millions)	
Year	< 1,800 kcal/day	< 2,100 kcal/day	< 1,800 kcal/day	< 2,100 kcal/day
2015	2	3	10.21	15.31
2020	1	2	5.86	11.71
2025	1	1	6.69	6.69

[1]For comparison purposes, the same grain calorie conversion factor is used for both the old and new model calculations. The new model also provides a framework to better estimate the caloric content of grains based on improved data from the Food Balance Sheets.

Source: USDA, Economic Research Service.

In addition to reporting the number of food-insecure deciles, table S2-1 presents the estimated food-insecure population for 2015, 2020, and 2025 under both models. In Tanzania, the food-insecure population is projected to increase in 2025 relative to 2015 due to population growth, but the number of deciles (2) that are food insecure (at the 2,100-calorie threshold) remains constant under the current model.[4] The new demand-based framework, on the other hand, predicts higher levels of food insecurity in 2015 (roughly 15 million people), with two-thirds of the food-insecure population not even meeting the 1,800-calorie threshold. However, the number of food-insecure people is projected to fall by more than half, with projections for 2025 showing an estimated population of 6.7 million that are food insecure compared to 13.3 million projected by the current model. The differences in projections between the models occur because the demand-driven framework increases food consumption based on steadily falling food prices and increases in income, which lowers the number of food insecure over time. The current model cannot as easily incorporate changes in prices into its projections, which therefore affects its estimates of food insecure.

The new demand-driven model is also able to evaluate the food-insecure population over a continuous distribution. This allows for estimates of food insecurity that are more exact than a decile, thereby resulting in slight differences in food insecurity estimates. Table S2-2 provides the estimates of the number of food-insecure people for Tanzania using the continuous approach. Focusing on the 2,100-calorie threshold, a smaller percentage of households are food insecure in 2015 (approximately 29 percent) relative to the estimates of the demand-driven model using deciles (30 percent, not shown). The small difference of 1 percentage point between the decile and continuous approaches, however, is extremely important. Under the decile approach, only 20 percent of Tanzania's population would be considered food insecure, whereas the continuous demand-driven estimate shows that it is much closer to 30 percent (fig. S2-1).

Finally, the new model also incorporates quality-adjusted caloric consumption. This concept allows households with higher incomes to eat higher value foods, matching observed behavior. Lower income deciles eat lower quality food relative to higher income deciles (table S2-3). Over time, as incomes rise throughout the country, the difference in quality converges.

Table S2-2

Calculating food insecurity over a continuous distribution, Tanzania

	Demand-driven model				
	Percent of population food insecure			Population of food insecure (millions)	
Year	< 1,800 kcal/day	< 2,100 kcal/day		< 1,800 kcal/day	< 2,100 kcal/day
2015	15.7	28.5		7.99	14.56
2020	9.2	18.7		5.36	10.94
2025	5.4	12.2		3.63	8.18

Source: USDA, Economic Research Service.

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[4]The population of food insecure that fail to meet the 2,100-caloric threshold in the demand-driven framework includes the population that fails to meet the 1,800-caloric threshold as well as those who consume between 1,800 and 2,100 calories per capita per day.

Figure S2-1

Percent of population food insecure, Tanzania

Percent
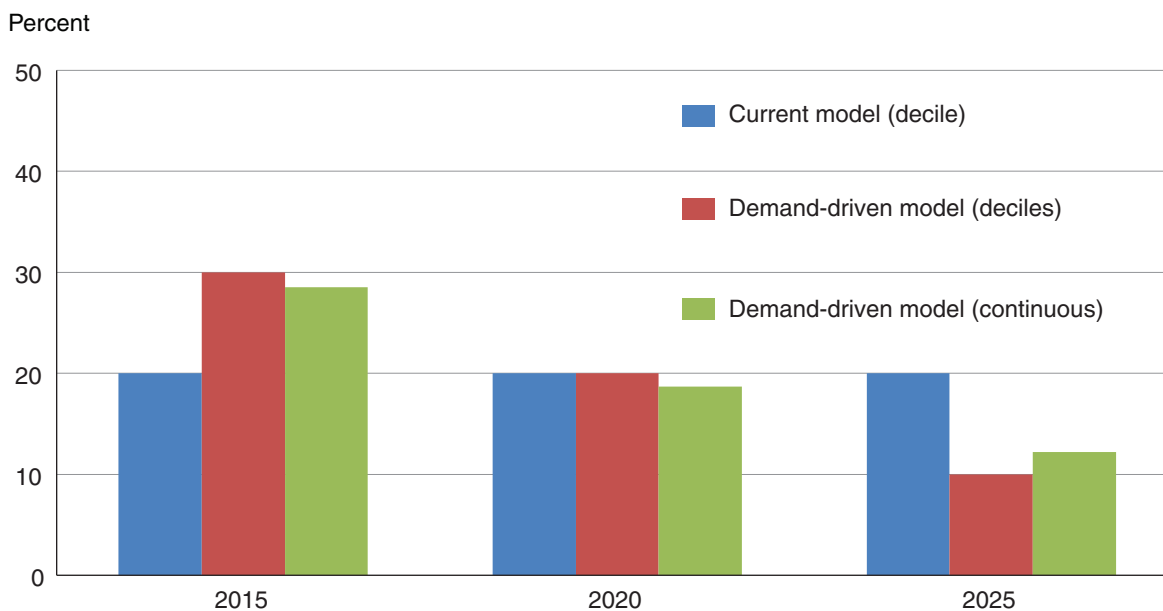
Source: USDA, Economic Research Service.

Table S2-3

Quality adjusted caloric consumption

Country	Year	1st decile	2nd decile	3rd decile	4th decile	5th decile	6th decile	7th decile	8th decile	9th decile	10th decile
	2015	0.90	0.94	0.96	0.98	0.99	1.00	1.01	1.02	1.03	1.05
Tanzania	2020	0.93	0.96	0.97	0.98	0.99	1.00	1.01	1.01	1.02	1.03
	2025	0.96	0.97	0.98	0.99	1.00	1.00	1.00	1.01	1.01	1.02
	2015	0.63	0.76	0.83	0.88	0.93	0.98	1.02	1.07	1.12	1.19

Source: USDA, Economic Research Service.

Conclusions

The new demand-driven modeling framework that USDA-ERS will use to assess international food security has many strengths. First, it allows for differences in food quality across deciles. Second, given the volatility of world prices over the last decade, the new model captures the effect of changes in domestic and international prices on food security and allows for alternative scenario analyses. Finally, estimates of food security can now be estimated at levels below a decile as we recognize that no country included in this study is 100 percent food secure.

Results from the new framework versus the current model reveal several differences for Tanzania. The demand-driven model predicts much higher levels of food insecurity in 2015. However, under the new demand-driven framework, population growth is not as large a driver of food insecurity as it is in the current framework, leading to lower estimates of food insecurity in 2025 (6.7 million versus 13.4 million). The new framework is more flexible, incorporates more information, and provides policymakers with more refined estimates of the food-insecure population. Over the next year, more countries will be modeled using this demand-driven framework and its methodology will be incorporated into future *International Food Security Assessments*.

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Appendix—Food Security Model: Definition and Methodology

The International Food Security Assessment model used in this report was developed by USDA's Economic Research Service to project food consumption, food access, and food gaps (previously called food needs) in low-income countries through 2025. Food is divided into three groups: grains, root crops, and a category called "other," which includes all other commodities consumed, thus covering 100 percent of food consumption. All of these commodities are expressed in grain equivalent.

Food security of a country is evaluated based on the gap between projected domestic food consumption (domestic production plus imports minus nonfood uses) and a consumption requirement. Like last year, we include total food aid data (grain and non-grain food commodities) provided by the World Food Program (WFP). All food aid commodities were converted into grain equivalent based on calorie content to allow aggregation. For example: grain has roughly 3.5 calories per gram and tubers have about 1 calorie per gram. One ton of tubers is therefore equivalent to 0.29 ton of grain (1 divided by 3.5); 1 ton of vegetable oil (8 calories per gram) is equivalent to 2.29 tons of grain (8 divided by 3.5).

While projection results provide a baseline for the food security situation in the countries, the results depend on the specification of the model and the underlying assumptions. Since the model is based on historical data, it implicitly assumes that the historical trend in key variables will continue in the future.

One food security indicator provided is the *distribution gap* where the objective is to let each income group maintain the daily caloric intake standard of about 2,100 calories per capita per day—depending on the region—recommended by the UN's Food and Agriculture Organization (FAO). The caloric targets (based on total share of grains, root crops, and "other") used in this assessment are those necessary to sustain life at a moderate level of activity. If food availability in a given income group is lower than this target, that difference is part of the distribution gap for this country.

This nutrition-based food gap measure assists in comparisons of relative well-being and addresses inequalities of food distribution within a country.

Structural framework for estimating and projecting food consumption in the aggregate and by income group

Projection of food availability. The simulation framework used for projecting aggregate food availability is based on partial equilibrium recursive models of 76 low- and middle-income countries. The country models are synthetic, meaning that the parameters that are used are either cross-country estimates or are estimated by other studies. Each country model includes three commodity groups: grains, root crops, and "other." The production side of the grain and root crops is divided into yield and area response. Crop area is a function of 1-year lagged returns (real price times yield) to crop production, lagged returns to substitute crops, and lagged crop area. Yield responds to input use. Commercial imports are assumed to be a function of domestic price, world commodity price, and foreign exchange availability. Food aid received by countries is assumed constant at the base level during the projection period. Foreign exchange availability is a key determinant of commercial food imports and is the sum of the value of export earnings and net flow of credit. Foreign exchange availability is assumed to be equal to foreign exchange use, meaning that foreign exchange reserves are assumed constant during the projection period.

Countries are assumed to be price takers in the international market, meaning that world prices are exogenous in the model. However, producer prices are linked to the international market through food imports and their impact on domestic supply. The projection of consumption for the "other" commodities is simply based on a trend that follows the projected growth in supply of the food crops (grains plus root crops). Although this is a very simplistic approach, it is an improvement from the previous approach where the contribution of commodities such as meat and dairy products to the diet was overlooked. The plan is to enhance this aspect of the model in the future.

Food consumption (FC) for grains and root crops (c) is defined as domestic supply (DS) minus nonfood use (NF), where n is a country index and t is a time index.

$$FC_{cnt} = DS_{cnt} - NF_{cnt} \tag{1}$$

Nonfood use is the sum of seed use (SD), feed use (FD), exports (EX), and other uses (OU).

$$NF_{cnt} = SD_{cnt} + FD_{cnt} + EX_{cnt} + OU_{cnt} \tag{2}$$

Domestic supply of a commodity group is the sum of domestic production (PR) plus commercial imports (CI), changes in stocks ($CSTK$), and food aid (FA).

$$DS_{cnt} = PR_{cnt} + CI_{cnt} + CSTK_{cnt} + FA_{cnt} \tag{3}$$

Production is generally determined by the area and yield response functions:

$$PR_{cnt} = AR_{cnt} * YL_{cnt} \tag{4}$$
$$YL_{cnt} = f(LB_{cnt}, FR_{cnt}, K_{cnt}, T_{cnt}) \tag{5}$$
$$RPY_{cnt} = YL_{cnt} * DP_{cnt} \tag{6}$$
$$RNPY_{cnt} = NYL_{cnt} * NDP_{cnt} \tag{7}$$
$$AR_{cnt} = f(AR_{cnt-1}, RPY_{cnt-1}, RNPY_{cnt-1}, Z_{cnt}) \tag{8}$$

where AR is area, YL is yield, LB is rural labor, FR is fertilizer use, K is an indicator of capital use, T is the indicator of technology change, DP is real domestic price, RPY is yield times real price, NDP is real domestic substitute price, NYL is yield of substitute commodity, $RNPY$ is yield of substitute commodity times substitute price, and Z represents exogenous policies.

The commercial import demand function is defined as:

$$CI_{cnt} = f(WPR_{ct}, NWPR_{ct}, FEX_{nt}, PR_{cnt}, M_{nt}) \tag{9}$$

where WPR is real world food price, $NWPR$ is real world substitute price, FEX is real foreign exchange availability, and M is import restriction policies.

The real domestic price is defined as:

$$DP_{cnt} = f(DP_{cnt-1}, DS_{cnt}, NDS_{cnt}, GDP_{nt}, EXR_{nt}) \tag{10}$$

where NDS is the supply of a substitute commodity, GDP is real income, and EXR is the real exchange rate.

Estimations/projections of food consumption by income group. Inadequate access to food is the most common cause of chronic food insecurity among developing countries and is related to income level. Estimates of food gaps at the aggregate or national level fail to take into account the distribution of food consumption among different income groups. Lack of distribution data for the study countries is the key factor preventing estimation of food consumption by income group. An attempt was made to fill this information gap by using an indirect method of projecting calorie consumption by different income groups based on income distribution data.[5] This approach ignores the substitution of different food groups by income class. The procedure uses the income/consumption relationship to allocate the total projected amount of available food among different income groups in each country (income distributions are assumed constant during the projection period).

Assuming that consumption increases with income but at a declining rate (semi log functional form), the income/consumption relationship was specified as shown below:

$$C = a + b \ln Y \qquad\qquad (11)$$

$$C = C_o/P \qquad\qquad (12)$$

$$P = P_1 + \text{........} + P_i \qquad\qquad (13)$$

$$Y = Y_o/P \qquad\qquad (14)$$

$$i = 1 \text{ to } 10$$

where C and Y are known average per capita food consumption (all commodities in grain equivalent) and per capita income (all deciles), C_o is total food consumption, P is the total population, i is income deciles, a is the intercept, and b is the consumption-income propensity. A consumption-income elasticity, b/C, is calculated for individual countries. The parameter b was estimated based on cross-country (76 low-income countries) data for per capita calorie consumption and income. The parameter a is estimated for each country based on the known data for average per capita calorie consumption and per capita income.

Data

Historical crop production, supply and use balance, and trade data for 1990-2013—or 2014 when available—are from FAOSTAT, FAO/GIEWS and USDA as of March 2015. Food aid data are from the UN's World Food Program (WFP) for 1988-2012, and financial data are from the International Monetary Fund and World Bank. Population data are from the U.S. Census. The base year data used for projections are the average for 2012-2014, where possible, or else the most recent 3-year average available.

Endogenous projection variables:

Production, *area*, *yield*, *commercial imports*, *domestic producer prices*, and *food consumption*.

Exogenous projection variables:

Population—U.S. Census.

World price—USDA/baseline projections.

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[5]The method is similar to that used by Shlomo Reutlinger and Marcelo Selowsky in "Malnutrition and Poverty," World Bank, 1978.

Stocks—FAO data; assumed constant during the projection period.

Seed use—USDA data; projections are based on area projections using constant base seed/area ratio.

Food exports—FAOSTAT data; projections are either based on the population growth rate or extrapolation of historical trends.

Inputs—fertilizer and capital projections are, in general, extrapolations of historical growth data from FAO.

Agricultural labor—projections are based on United Nations population projections, accounting for urbanization growth.

Net foreign credit—assumed constant during the projection period.

Value of exports—projections are based on World Bank data (*Global Economic Prospects and the Developing Countries*, various issues), IMF data (*World Economic Outlook*, various issues), or extrapolation of historical growth.

Export deflator or terms of trade—World Bank (*Commodity Markets: Projection of Inflation Indices for Developed Countries*).

Income—projected based on World Bank report (*Global Economic Prospects and the Developing Countries*), or extrapolation of historical growth.

Income distribution—World Bank data; income distributions are assumed constant during the projection period.

Appendix table 1
List of countries and their distribution gaps[1] in 2015 and 2025

	2015	2025		2015	2025
	1,000 tons			*1,000 tons*	
Cameroon	0	43	Algeria	0	0
CAR	307	449	Egypt	0	0
Congo, Dem. Rep.	6,263	8,870	Morocco	0	0
Burundi	567	1,131	Tunisia	0	0
Eritrea	626	595	**North Africa**	**0**	**0**
Ethiopia	291	477			
Kenya	426	131	Afghanistan	45	108
Rwanda	132	167	Bangladesh	2	219
Somalia	399	717	India	278	314
Sudan	0	0	Indonesia	0	0
Tanzania	82	110	Korea, Dem. Rep.	235	140
Uganda	86	535	Nepal	0	0
Angola	0	0	Pakistan	0	0
Lesotho	51	14	Philippines	114	123
Madagascar	126	115	Sri Lanka	0	0
Malawi	0	0	Vietnam	0	0
Mozambique	52	138	Cambodia	0	0
Swaziland	49	42	Laos	0	0
Zambia	331	300	Mongolia	11	9
Zimbabwe	391	377	Yemen	54	217
Benin	0	0	Armenia	0	0
Burkina Faso	0	26	Azerbaijan	0	0
Cape Verde	0	1	Georgia	0	0
Chad	257	159	Kyrgyzstan	0	0
Cote d'Ivoire	8	4	Tajikistan	0	1
Gambia	17	17	Turkmenistan	0	0
Ghana	0	0	Uzbekistan	0	0
Guinea	0	0	Moldova	0	0
Guinea-Bissau	0	0	**Asia**	**738**	**1,131**
Liberia	0	3			
Mali	0	0	Bolivia	104	96
Mauritania	0	0	Colombia	0	0
Niger	0	7	Dominican Republic	5	2
Nigeria	0	0	Ecuador	101	79
Senegal	49	59	El Salvador	0	0
Sierra Leone	0	0	Guatemala	41	26
Togo	30	51	Haiti	137	91
Congo, Rep.	25	97	Honduras	88	55
Namibia	7	2	Jamaica	0	0
Sub-Saharan Africa	**10,574**	**14,636**	Nicaragua	14	3
			Peru	0	0
			Latin America and the Carribean	**490**	**353**
			Total	**11,802**	**16,120**

[1]Distribution gap: amount of food needed to raise consumption in each income decile to the nutritional standard.

Source: USDA, Economic Research Service.

Appendix table 2
Number of food-insecure people, 2015 and 2025

	2015	2025		2015	2025
	Millions of people			*Millions of people*	
Asia	**195**	**256**	**SSA**	**254**	**347**
Afghanistan	7	16	Cameroon	0	6
Bangladesh	17	40	CAR	5	7
India	125	140	Burundi	11	15
Indonesia	0	0	Eritrea	7	8
Korea	17	13	Ethiopia	30	53
Nepal	0	0	Kenya	28	11
Pakistan	0	0	Rwanda	9	11
Philippines	22	26	Somalia	11	13
Sri Lanka	0	0	Sudan	0	0
Viet Nam	0	0	Tanzania	10	13
Cambodia	0	0	Uganda	7	30
Laos	0	0	Angola	0	0
Mongolia	1	1	Lesotho	2	1
Yemen	5	20	Madagascar	10	12
Armenia	0	0	Malawi	0	0
Azerbaijan	0	0	Mozambique	5	10
Georgia	0	0	Swaziland	1	1
Kyrgyzstan	0	0	Zambia	12	14
Tajikistan	0	1	Zimbabwe	13	14
Turkmenistan	0	0	Benin	0	0
Uzbekistan	0	0	Burkina Faso	0	5
Moldova	0	0	Cape Verde	0	0
			Chad	10	10
LAC	**25**	**19**	Cote d'Ivoire	2	3
Bolivia	4	4	Gambia	1	1
Colombia	0	0	Ghana	0	0
Dominican Republic	1	1	Guinea	0	0
El Salvador	0	0	Guinea-Bissau	**0**	**0**
Guatemala	3	2	Liberia	0	1
Haiti	6	5	Mali	0	0
Honduras	3	2	Mauritania	0	0
Jamaica	0	0	Niger	0	2
Nicaragua	1	1	Nigeria	0	0
Ecuador	6	5	Senegal	4	5
Peru	0	0	Sierra Leone	0	0
			Togo	2	4
North Africa	**0**	**0**	Congo, Rep.	2	5
Algeria	0	0	Namibia	1	0
Egypt	0	0			
Morocco	0	0	**Total**	**475**	**622**
Tunisia	0	0			

LAC = Latin American and the Caribbean; SSA = Sub-Saharan Africa.

Source: USDA, Economic Research Service.

Country indicators

Region and country	Population, 2014	2014 Population growth rate	Grain production		Annual root production growth, 1990-2013	Projected annual growth in supply, 2014-2025
			Annual growth, 1990-2014	Coefficient of variation, 1990-2014		
	1,000	————————————Percent————————————				
North Africa:						
Algeria	40,633	1.8	4.0	46.7	7.0	1.9
Egypt	84,706	1.6	2.2	16.6	4.6	1.2
Morocco	33,955	1.4	2.2	44.4	2.8	2.3
Tunisia	11,235	1.1	1.2	40.1	2.6	1.5
Central Africa:						
Cameroon	23,393	2.5	6.1	44.6	4.6	5.3
Cent. Afr. Rep.	4,803	2.0	3.7	30.4	1.5	1.8
Congo, Dem. Rep.	71,246	2.7	0.4	6.0	-1.1	2.0
Congo, Rep.	4,671	2.5	7.1	46.1	3.2	1.4
West Africa:						
Benin	10,880	2.6	4.5	32.1	5.2	1.5
Burkina Faso	17,915	2.8	3.7	29.0	5.7	2.1
Cape Verde	508	0.8	-2.9	83.9	0.9	1.0
Chad	13,606	3.0	6.0	48.9	1.6	1.9
Côte d'Ivoire	21,295	2.4	0.9	8.8	2.6	1.8
Gambia	1,970	3.2	3.9	37.1	-0.8	2.7
Ghana	26,984	2.0	3.3	26.3	4.9	1.2
Guinea	12,348	2.5	8.1	50.8	2.7	1.8
Guinea-Bissau	1,788	2.4	1.1	18.5	3.3	2.1
Liberia	4,503	2.4	6.5	47.5	3.5	2.3
Mali	16,259	3.1	5.5	45.5	13.5	2.1
Mauritania	4,080	2.4	2.5	33.8	1.1	1.7
Niger	19,268	4.0	4.3	35.3	2.6	2.9
Nigeria	183,523	2.8	0.2	10.8	4.1	1.4
Senegal	14,967	2.9	1.6	28.0	9.4	2.6
Sierra Leone	6,319	1.8	5.1	52.1	15.8	2.0
Togo	7,171	2.5	4.2	30.9	2.6	2.5
East Africa:						
Burundi	10,813	3.1	-0.04	7.6	2.0	2.0
Eritrea[1]	6,738	3.1	3.7	55.1	-3.6	3.4
Ethiopia[1]	98,942	2.5	5.5	37.2	3.7	2.8
Kenya	46,749	2.6	1.7	17.5	6.1	2.5
Rwanda	12,428	2.7	6.8	62.9	7.2	2.7
Somalia	11,123	2.9	-1.0	32.3	0.0	1.6
Sudan	49,072	2.4	1.1	30.7	5.1	1.1
Tanzania	52,291	3.0	3.6	30.6	1.2	2.9
Uganda	40,141	3.3	3.6	27.4	0.4	2.4

See footnotes at end of table.   *Continued——*

Country indicators—continued

Region and country	Per capita Gross National Income (GNI), 2013	Per capita GDP growth, 2013	GDP growth, 2013	Export earnings growth, 2013	Official develop-ment assistance as a share of GNI, 2013	External debt present value as a share of GNI, 2013
	U.S. dollars	————————————————Percent————————————————				
North Africa:						
Algeria	5,330	0.9	2.8	-3.0 '09	0.1	2.5
Egypt	3,140	0.4	2.1	5.9	2.1	16.7
Morocco	3,020	2.8	4.4	2.4	1.9	38.7
Tunisia	4,200	1.5	2.5	--	1.6	55.5
Central Africa:						
Cameroon	1,290	2.9	5.6	26.0	2.6	17.1
Cen. Afr.Rep.	320	-37.3	-36.0	--	12.8	37.4
Congo, Dem. Rep.	430	5.6	8.5	17.3	8.8	21.9
Congo, Rep.	2,590	0.9	3.4	-10.0	1.3	30.4
West Africa:						
Benin	790	2.8	5.6	12.0	8.0	28.7
Burkina Faso	750	3.7	6.6	4.9	8.2	23.2
Cape Verde	3,620	-0.4	0.5	11.5 '11	13.5	80.9
Chad	1,030	0.9	4.0	--	3.0	17.2
Côte d'Ivoire	1,450	6.2	8.7	7.8	4.3	37.9
Gambia	500	1.5	4.8	2.8	11.9	59.0
Ghana	1,770	5.4	7.6	-6.8	2.9	33.8
Guinea	460	-0.3	2.3	1.2	9.3	20.8
Guinea-Bissau	590	-2.1	0.3	--	10.3	32.3
Liberia	410	8.6	11.3	3.2 '12	30.6	30.9
Mali	670	-0.8	2.1	--	13.6	33.3
Mauritania	1,060	4.1	6.7	9.2	7.1	91.7
Niger	400	0.2	4.1	1.4	10.9	36.3
Nigeria	2,710	2.5	5.4	-45.8	0.5	2.8
Senegal	1,050	-0.2	2.8	5.0	6.6	34.9
Sierra Leone	660	3.6	5.5	91.5	11.0	31.1
Togo	530	2.4	5.1	10.7 '11	6.1	24.4
East Africa:						
Burundi	260	1.4	4.6	3.0	20.6	23.5
Eritrea[1]	490	-1.9	1.3	233.1 '11	2.7	27.7
Ethiopia[1]	470	7.7	10.5	--	8.6	26.8
Kenya	1,160	2.9	5.7	-0.8	6.3	30.8
Rwanda	630	1.9	4.7	20.6	14.6	23.0
Somalia	..	..	..	--	..	..
Sudan	1,550	-7.9	-6.0	--	2.0	47.9
Tanzania	860	4.1	7.3	0.6	8.4	39.7
Uganda	600	-0.1	3.3	7.9	7.5	21.0

See footnotes at end of table.   *Continued——*

Country indicators—continued

Region and country	Population, 2014	2014 Population annual growth rate	Grain production		Root production growth 1990-2013	Projected annual growth in supply 2014-2025
			Annual growth, 1990-2014	Coefficient of variation, 1990-2014		
	1,000	————————————————*Percent*————————————————				
Southern Africa:						
Angola	22,820	3.1	6.1	47.2	11.2	1.3
Lesotho	2,120	1.0	-2.6	45.2	3.3	1.7
Madagascar	24,235	2.8	3.2	26.9	1.9	2.7
Malawi	17,309	2.9	5.3	43.5	14.8	1.8
Mozambique	27,122	2.5	6.9	41.4	4.3	2.1
Namibia	2,392	1.9	2.5	33.2	2.8	0.8
Swaziland	1,286	1.4	-1.8	32.5	1.7	1.0
Zambia	15,520	3.3	5.1	53.9	3.2	2.8
Zimbabwe	15,046	3.1	-1.7	40.7	3.3	1.8
South Asia:						
Afghanistan	32,007	2.3	4.2	36.9	0.0	1.9
Bangladesh	160,411	1.2	3.5	25.5	8.2	1.7
India	1,282,390	1.2	1.7	13.4	3.9	1.5
Nepal	28,441	1.1	2.5	18.5	6.1	1.7
Pakistan	188,144	1.6	2.8	20.4	5.7	1.1
Sri Lanka	21,612	0.8	2.8	23.9	-1.4	1.2
Yemen	25,535	2.3	0.7	21.1	2.3	1.8
East/Southeast Asia:						
Cambodia	15,677	1.7	7.3	52.5	23.5	2.2
Indonesia	255,709	1.1	2.3	19.2	2.0	1.1
Korea, Dem. Rep.	25,155	0.5	-1.4	33.7	5.2	0.6
Laos	7,020	1.8	6.7	48.1	6.3	1.6
Mongolia	2,923	1.5	-1.1	57.9	5.1	1.0
Philippines	101,803	1.7	3.0	22.8	-0.1	1.9
Vietnam	93,387	0.9	4.0	27.6	5.5	1.3
Central Asia:[2]						
Armenia	2,989	0.2	2.4	24.7	2.8	0.9
Azerbaijan	9,613	1.0	4.8	35.3	11.4	1.5
Georgia	4,305	-0.4	-1.3	28.4	-1.1	1.1
Kyrgyzstan	5,708	1.5	0.6	13.9	7.2	1.4
Moldova	3,437	-0.7	1.2	27.1	-3.4	0.1
Tajikistan	8,610	2.4	7.3	45.2	12.6	1.7
Turkmenistan	5,373	1.2	3.5	44.4	15.5	1.4
Uzbekistan	29,710	1.3	6.5	39.7	8.1	1.4
Latin America and the Caribbean:						
Bolivia	11,025	1.6	5.0	37.2	1.1	2.3
Colombia	49,529	1.2	0.2	12.0	0.1	2.3
Dominican Republic	10,652	1.2	2.6	20.5	1.6	0.9
Ecuador	16,226	1.5	2.6	21.1	-1.8	1.2
El Salvador	6,426	0.7	1.1	12.4	0.6	0.7
Guatemala	16,255	2.5	1.7	21.3	3.6	1.6
Haiti	10,604	1.4	1.2	19.4	2.2	1.7
Honduras	8,424	2.0	-0.7	14.1	3.7	1.4
Jamaica	2,813	0.5	-3.4	45.5	-2.1	0.7
Nicaragua	6,257	1.4	3.6	27.1	3.4	1.2
Peru	31,161	1.3	4.9	33.1	4.9	1.4

See footnotes at end of table.   *Continued——*

Country indicators—continued

Region and country	Macroeconomic indicators					
	Per capita GNI, 2013	Per capita GDP growth, 2013	GDP growth, 2013	Export earnings growth, 2013	Official develop-ment assistance as a share of GNI, 2013	External debt present value as a share of GNI, 2013
	U.S. dollars	—————————————*Percent*—————————————				
Southern Africa:						
Angola	5,170	3.6	6.8	0.0	0.3	22.0
Lesotho	1,500	4.3	5.5	-1.0 '12	10.3	30.9
Madagascar	440	-0.4	2.4	32.4	4.9	27.3
Malawi	270	2.0	5.0	8.8	25.5	43.6
Mozambique	610	4.8	7.4	7.2	14.7	45.0
Namibia	5,870	3.1	5.1	9.6	1.9	--
Swaziland	1,550	1.3	2.8	-22.7 '12	3.1	13.1
Zambia	1,810	3.3	6.7	17.9	4.3	25.9
Zimbabwe	860	1.3	4.5	-2.9	6.7	69.5
South Asia:						
Afghanistan	690	-0.5	1.9	--	25.0	12.3
Bangladesh	1,010	4.7	6.0	2.5	1.7	19.5
India	1,570	5.6	6.9	7.3	0.1	23.0
Nepal	730	2.6	3.8	10.3	4.3	19.7
Pakistan	1,360	2.7	4.4	13.6	0.9	22.8
Sri Lanka	3,170	6.4	7.3	5.9	0.7	38.5
Yemen	1,330	1.8	4.2	--	3.1	22.1
East/Southeast Asia:						
Cambodia	5.5	5.5	7.4	10.5	5.6	44.4
Indonesia	4.5	4.5	5.8	5.3	0.0	30.8
Korea, Dem. Rep.	--	--	--	--	--	--
Laos	6.5	6.5	8.5	--	4.3	81.4
Mongolia	10.1	10.1	11.7	13.9	4.0	176.0
Philippines	5.3	5.3	7.2	-1.1	0.1	18.6
Vietnam	4.3	4.3	5.4	17.2	2.6	40.2
Central Asia/CIS:[2]						
Armenia	3,800	3.2	3.5	16.3	2.6	79.4
Azerbaijan	7,350	4.4	5.8	1.5	-0.1	13.3
Georgia	3,560	3.4	3.3	--	4.1	86.4
Kyrgyzstan	1,210	8.4	10.5	20.1	7.8	98.4
Moldova	2,470	8.9	8.9	10.7	4.3	75.0
Tajikistan	990	4.8	7.4	5.5	4.7	41.8
Turkmenistan	6,880	8.8	10.2	42.5 '06	0.1	1.3
Uzbekistan	1,880	6.3	8.0	10.9	0.5	18.1
Latin America and the Caribbean:						
Bolivia	2,550	5.0	6.8	4.2	2.6	27.5
Colombia	7,590	3.3	4.7	5.4	0.2	25.3
Dominican Republic	5,770	3.3	4.6	9.7	0.2	41.2
Ecuador	5,760	3.0	4.6	2.4	0.2	22.9
El Salvador	3,720	1.0	1.7	4.6	0.7	57.1
Guatemala	3,340	1.1	3.7	5.3	1.0	32.0
Haiti	810	2.8	4.3	5.0	13.9	14.9
Honduras	2,180	0.5	2.6	0.2	3.6	39.6
Jamaica	5,220	1.0	1.3	1.6 '12	0.5	100.6
Nicaragua	1,790	3.1	4.6	3.1	4.6	87.7
Peru	6,270	4.4	5.8	-0.9	0.2	29.0

[1] Data start in 1993. [2] Data start in 1992.

GNI = gross national income.

-- = data unavailable or not applicable due to inconsistent data set.

Note: If 2013 data were not available, year(s) of data used indicated by '11, etc., next to number.

Source: U.S. Census data, Macroeconomic indicators = World Development Indicators online (as of June 2015), World Bank Online.