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INTERNATIONAL FOOD SECURITY ASSESSMENT, 2012-22

Share of food-insecure people in Sub-Saharan Africa to decline over the next decade

Cover photos: Women farmers-Kenya, World Food Programme (WFP)/Rein Skullerud; girl eating-Korea, WFP/Lena Savelli; boys-Gambia, TNT/Cinzia Prencipe; children-Ethiopia, WFP/Jiro Ose; man working-Peru, WFP/Victor Mendoza.

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International Food Security Assessment, 2012-22

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Abstract

Food security is estimated to improve slightly in 2012 as the number of food-insecure people in the 76 countries covered in this report declines from 814 million in 2011 to 802 million in 2012. The share of the population that is food insecure remains at 24 percent. Over the next decade, the share of the population that is food insecure is projected to decline from 24 percent in 2012 to 21 percent in 2022, but the number of food insecure people is projected to increase by 37 million. Regionally, food insecurity is projected to remain most severe in Sub-Saharan Africa. Food-insecure people are defined as those consuming less than the nutritional target of roughly 2,100 calories per day per person.

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

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Preface

This report continues the series of food assessments in developing countries begun in the late 1970s. *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 lower income 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 last year's report, we changed the name to *International Food Security Assessment* to clarify that this is not an assessment of U.S. food security.

Approved by: USDA's World Agricultural Outlook Board.

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What Is the Issue?

Government policymakers, international development organizations, and other stakeholders are concerned with the status of international food security, a concern that has increased due to the volatility in global food prices since the late 2000s. The results in this report are based on projections of two key determinants of food security: food production and import capacity of the countries. Domestic food production performance plays the most critical role in the food security of many lower income countries, particularly in the Asian and Sub-Saharan African regions in this report that depend primarily on local grain supplies. Conversely, the capacity to pay for imports plays a significant role for regions like Latin America and North Africa that import a relatively large share of 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 2012-22.

What Did the Study Find?

Over the next decade, ERS projects that while the number of food-insecure people for the 76 countries analyzed will increase, the share of the population that is food insecure will drop from 24 to 21 percent and the distribution gap (the quantity of food required to reach the nutritional target of roughly 2,100 calories/day for each income decile) will hold constant. However, food insecurity is estimated to become more concentrated in Sub-Saharan Africa, although even there the share of the population that is food insecure falls.

- Food security is estimated to improve **between 2011 and 2012**. The number of food-insecure people is estimated to decline by about 12 million, from 814 million in 2011 to 802 million in 2012.
    - The number of food-insecure people in Sub-Saharan Africa (SSA) is estimated to decrease by 4.3 percent and the distribution gap to fall by 1.8 percent.
    - Asian countries are estimated to see a small increase in the number of food-insecure people from 2011 to 2012, but a 22-percent increase in the distribution gap.
    - Food security conditions are expected to be essentially unchanged in the North African (NA) and Latin American and Caribbean (LAC) regions.
- **Over 2012-2022**, the number of food-insecure people in the 76 countries covered by this report is projected to increase by 37 million, or 4.6 percent, much lower than the 16.7-percent increase in population. The distribution gap is projected to remain unchanged.
    - Conditions in Sub-Saharan Africa do not mirror this general finding. SSA is the only region projected to have a sizable increase (15.1 percent) in the number of food-insecure people, although the

share of the population that is food insecure is projected to fall from 42 percent in 2012 to 38 percent in 2022. The distribution gap is projected to rise nearly 19 percent, suggesting an increase in the intensity of food insecurity in the region.

- The number of food-insecure people is projected to decline both in the LAC countries (by nearly 15 percent) and Asian countries (2.5 percent) included in the report, while the distribution gap declines 28 percent in both regions.

How Was the Study Conducted?

All historical and projected data were updated relative to the *International Food Security Assessment, 2011-21* report. Food production estimates for 2011 were based on data from the United Nations' Food and Agriculture Organization (FAO) as of March 2012. Historical production data came from FAO and food aid data came from the World Food Programme (WFP) and population data are from the United Nations. Financial and macroeconomic data were based on World Bank data as of March 2012. Projected macroeconomic variables are either based on calculated growth rates for the 1990s through the late 2000s or came 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 2008-10 average level of food aid throughout the next decade.

Overview: Food Security Status of Lower Income Countries, 2012-22

The aggregate food security indicators estimated by USDA's Economic Research Service for 76[1] lower income countries point to a small decline in the number of food-insecure people in 2012 relative to 2011. The estimates include the following:

- The **number of food-insecure people** in each country—the number of people consuming less than the nutritional target of 2,100 calories per day.
- The **nutritional gap**—the difference between projected food availability and the food needed to meet the recommended nutritional target in each country.
- The **distribution gap**—the difference between projected food availability and the food needed to increase consumption in food-deficit income groups within individual countries to meet the recommended nutritional target. This measure focuses on the groups whose consumption is estimated to be below the nutritional target.

The increased amount of food needed to meet the average nutritional target (nutritional gap) and the food gap associated with unequal purchasing power or food access (distribution gap) indicate a slight deterioration in food security from 2011 to 2012 for the countries surveyed (see box, "How Food Security Is Assessed: Methods and Definitions"). The number of food-insecure people is estimated to decline by about 12 million, from 814 million in 2011 to 802 million in 2012 (table 1). The distribution gap, which takes into account unequal purchasing power within countries, is estimated at about 17.1 million tons for 2012 (table 2)—an increase of nearly 900,000 tons from 2011. This means that while food insecurity has not spread, it has generally intensified in lower-income countries.

Regionally, food security in the Asian countries is forecast to worsen moderately in 2012 relative to 2011 as the number of food-insecure people is expected to increase by 3 million (less than 1 percent) and the distribution gap to increase by 1 million tons (22 percent). In Sub-Saharan Africa (SSA),

Table 1
Estimates and projections of food-insecure people

	Region				
	Total	Asia	LAC	NA	SSA
	Million				
76 countries					
2011	814	395	46	0	373
2012	802	398	48	0	357
2022	839	388	41	0	411

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

Source: USDA, Economic Research Service.

[1]The 76 countries included in this report are lower income countries that are or have been receiving food aid and are experiencing or have experienced food insecurity.

Key Changes in This Year's Report

The only change made to this year's analysis compared to that in USDA Economic Research Service's *International Food Security Assessment, 2011-2021* report is a decrease in the number of countries covered: from 77 to 76. Kazakhstan, an upper middle-income country in Central Asia, was removed as it is now a major grain exporter with improved food availability and income. Kazakhstan's removal has no impact on the total number of food-insecure people or the total distribution gap as the country has been food secure for a number of years.

How Food Security Is Assessed: Methods and Definitions

The Food Security Assessment model used in this report is based on 2011 data (updated in March 2012), and therefore does not reflect any subsequent changes 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 2011 are estimates; those for 2012 and 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 equivalents. 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 lower income developing countries—39 in Sub-Saharan Africa, 4 in North Africa, 11 in Latin America and the Caribbean, and 22 in Asia. (See Appendix—Food Security Model: Definition and Methodology for a detailed description of the methodology and definitions of terms and appendix table 1 for a list of countries.) The 2012 estimates are based on Food and Agriculture Organization (FAO) production and import assessments, and the longer term projections are based on 2009-11 grain production and 2008-10 root and tuber production data from FAOSTAT and 2008-10 macroeconomic data from the IMF and World Bank. The periods covered include 2011, 2012 (estimate), and 2022 (10-year projection). The model analyzes the gap between projected food availability (production plus commercial and food aid imports minus nonfood use) and two alternative consumption standards. The nutritional standard is the per capita nutritional target of roughly 2,100 calories per capita per day, depending on the region. The ***nutritional gap*** measures the difference between projected food availability (domestic production plus net imports) and the amount of food needed to support a per capita nutritional standard for the entire population.

The estimated ***distribution gap*** measures the food needed to raise per capita consumption in each income decile to the nutritional requirement. In many countries, consumption in the lower income deciles is significantly below average (per capita) consumption for the country as a whole. 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 changes as a result of income or economic conditions. When our estimates show no distribution gap for the poorest 10 percent of the population, we consider the country 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 up to 10 percent of the population may be food secure. Finally, based on total population data and the population share that consumes below nutritional requirements, the projected number of people who cannot meet their nutritional requirements is calculated.

The common terms as used in this report:

- **Domestic food supply—**the sum of domestic production and commercial and food aid imports.
- **Food availability—**food supply minus nonfood use, such as feed, waste, and industrial uses, 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 or income decile falls short of the nutritional target of roughly 2,100 calories per person per day.

Table 2

Estimates and projections of distribution gaps

	Region				
	Total	Asia	LAC	NA	SSA
	Million tons				
76 countries					
2011	16.2	4.5	1.1	0	10.7
2012	17.1	5.5	1.1	0	10.5
2022	17.2	3.9	0.8	0	12.4

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

Source: USDA, Economic Research Service.

Table 3

Food availability and distribution gaps for 76 lower income countries

Year	Grain production*	Root production *(grain equiv.)*	Commercial imports	Food aid receipts *(grain equiv.)*		Aggregate availability of all food
	1,000 tons					
2003	497,569	79,009	74,763	8,345		777,524
2004	498,206	83,733	75,265	6,674		779,664
2005	514,833	87,278	85,071	7,997		808,807
2006	529,154	90,949	95,005	6,509		837,451
2007	546,293	88,703	96,820	5,660		862,462
2008	570,702	96,640	104,484	6,005		880,750
2009	580,162	94,721	102,555	5,295		897,040
2010	602,590	97,633	106,530	5,484		916,647
2011(e)	617,467	97,648	110,505	5,332		935,952
				Food gap**		
Projections				NG	DG	
2012	620,236	99,058	101,769	***8,443***	***17,074***	949,012
2017	677,536	106,358	130,277	***7,924***	***16,641***	1,042,722
2022	739,470	114,097	152,584	***8,803***	***17,183***	1,135,305

(e) estimate.

*Grain production includes rice expressed in milled rice equivalent.

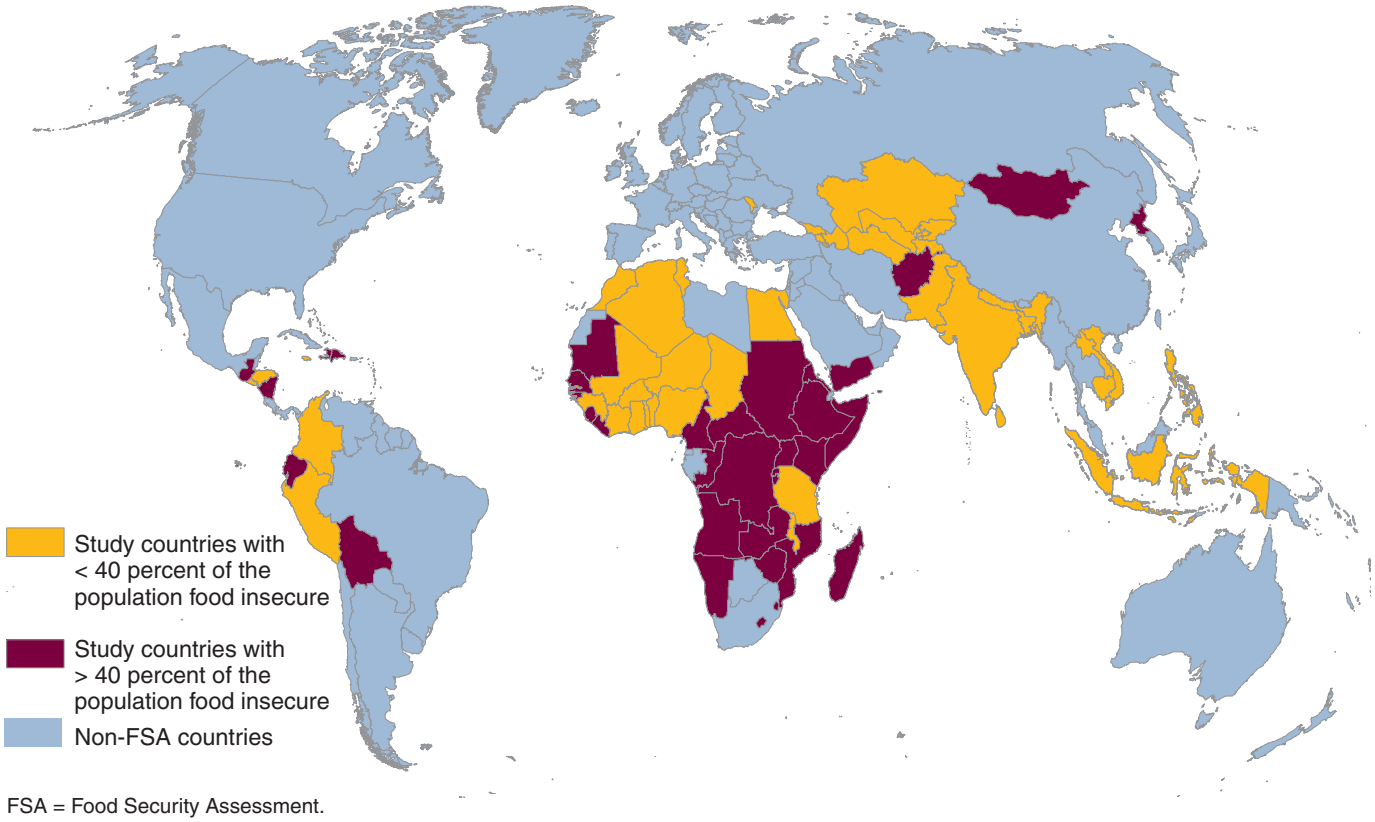
**NG stands for nutritional gap and describes the amount of grain equivalent needed to support nutritional standards on a national average level. DG stands for distributional gap, and it describes the amount of grain equivalent needed to allow each income quintile to reach the nutrional target.

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

a slight improvement in food security forecast for 2012 can be almost entirely attributed to higher anticipated food production levels. The number of food-insecure people in SSA is estimated to decline by 4.3 percent in 2012 and the distribution gap to fall by 1.8 percent. So, despite the decline in the number of food-insecure people in SSA, the intensity of food insecurity is expected to rise in 2012 compared to 2011. Food security indicators can change rapidly in SSA countries because large shares of the population are clustered at the margin of food security, and small changes in food availability can alter whether they are categorized as food secure or food insecure.

Figure 1

Distribution of lower income, food-insecure countries, 2012



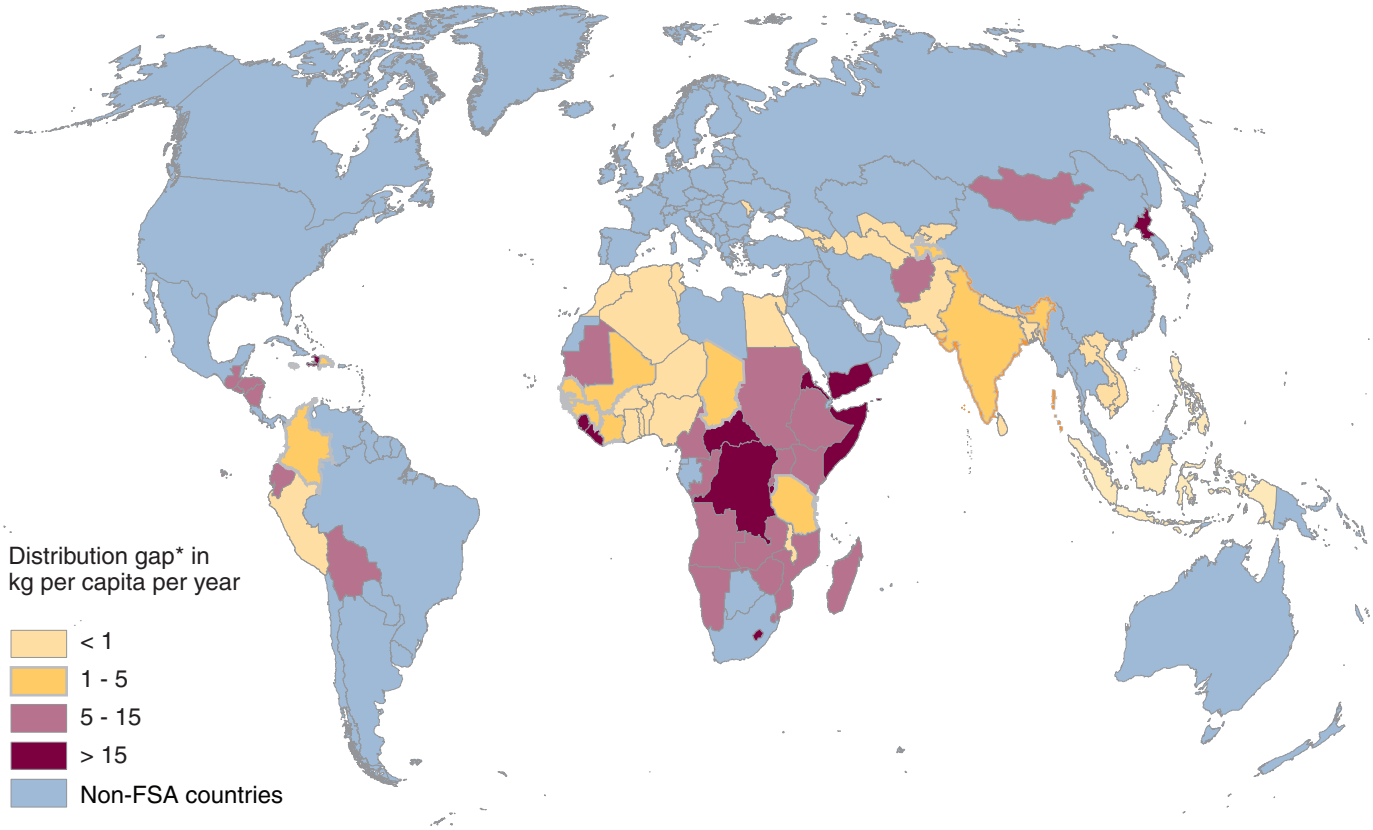
FSA = Food Security Assessment.
Source: Calculations by USDA, Economic Research Service.

North Africa (NA) is the most food-secure region included in this report. No change is expected in the region's food security in 2012, assuming there is no significant change in the projected performance of NA economies or their projected domestic production levels. NA food security is, however, subject to risk because of the uncertain political environment. In the Latin American and Caribbean (LAC) region, the number of food-insecure people and the food gap are forecast to increase in 2012, but only slightly. This is largely due to projected higher food prices, lower export earnings due to weaker demand by trading partners (particularly the United States), and continued political instability in Haiti.

Weather conditions in 2012 remain uncertain, and this tends to be a key factor affecting the food security of the surveyed countries. Production variability is high in the most vulnerable countries, largely because their food production takes place in rainfed areas that are subject to variable weather conditions. Of the 76 countries, average annual production variability (using the coefficient of variation, which measures deviation from trend, 1980-2011) is highest in North Africa (38 percent), followed by SSA (21 percent), LAC (12 percent), and Asia (10 percent). In the case of SSA, for example, grain production in any given year can range, on average, from 21 percent above trend levels to 21 percent below trend levels. Among individual countries, production variability is the lowest (less than 5 percent) in countries such

Figure 2

Intensity of food insecurity in lower income countries, 2012



*The difference between projected food availability and the food needed to increase consumption in food-deficit income groups within individual countries to meet the recommended nutritional target.

Source: Calculations by USDA, Economic Research Service.

as Egypt and India, where a large share of food is produced in irrigated areas. The countries with the highest average annual production variability in SSA—ranging from 40 to 67 percent—are Cape Verde, Eritrea, Lesotho, Liberia, Sierra Leone, and Zimbabwe. In Asia, the country with by far the highest production variability is North Korea at more than 34 percent; in LAC, Jamaica has the highest variability at 24 percent, though the country is not a major food producer. In North Africa, except for Egypt, average annual production variability is more than 40 percent.

Continued political turmoil in the North Africa-Middle East (NA-ME) region could have adverse economic implications both regionally and for other countries that rely on oil imports. The NA-ME region is a big exporter of oil, and continued instability could result in higher global oil prices. Higher oil prices would put pressure on budgets of the many countries included in this report that are net energy importers. There is also ongoing and new political instability in SSA. Recent political conflict in Mali illustrates how such instability can influence food security. After years of political stability and good economic performance in both agriculture and trade, Mali is now faced with severe food shortages. Moreover, the turmoil in Mali could spread into neighboring countries because of the country's close ties with Burkina Faso, Niger, and Mauritania (http://www.wfp.org/countries/mali). Refugees fleeing

into neighboring countries could put additional strain on scarce resources and exacerbate the food security situation.

Economic growth in developing countries has been stronger than in developed countries, a positive factor for many of the study countries (World Bank, 2012). Food commodity prices are expected to increase more slowly into 2012/13 and then generally decline over the long term, strengthening import capacity. However, a key determinant of import capacity is the prices of export commodities relative to imports. If prices for export commodities keep pace with those of imported commodities, government budgets are more easily maintained. Short-term (2011 to 2012) and long-term (2012 to 2025) prices are projected to decline across all commodity groups, but vary across commodities. For example, prices of metals and minerals are projected to decline by 10 percent, while a sharper decline of 17 percent is projected for grains by 2025.

There is also variation in the rate of change by commodities within each group. For example, prices for sugar are projected to decline more sharply than for wheat, 37 versus 22 percent by 2025. For metals, prices for aluminum (exported by Egypt, Tunisia, Zimbabwe, India, Indonesia, and Sri Lanka, among others) are projected to increase by 26 percent, while prices for copper (exported by Zambia and Indonesia) are projected to decline by 24 percent. The lower income countries that export beverage crops (i.e., coffee, tea) could face some pressures on their food import budgets since their export prices are expected to decline by 25 percent, much sharper than the 10-percent decline in food prices (World Bank, 2012).

The USDA-ERS food security analysis shows an increase in the number of food-insecure people from 802 million in 2012 to 839 million in 2022, although the share of the population that is food insecure is projected to decline from 24 percent to 21 percent. The distribution gap is projected to remain at the 2012 level—about 17 million tons in grain equivalent—which is equal to roughly 17 percent of commercial imports in 2012 and 11 percent in 2022. So although more people are projected to face food insecurity by 2022, the intensity of food insecurity is, on average, projected to ease compared with 2012.

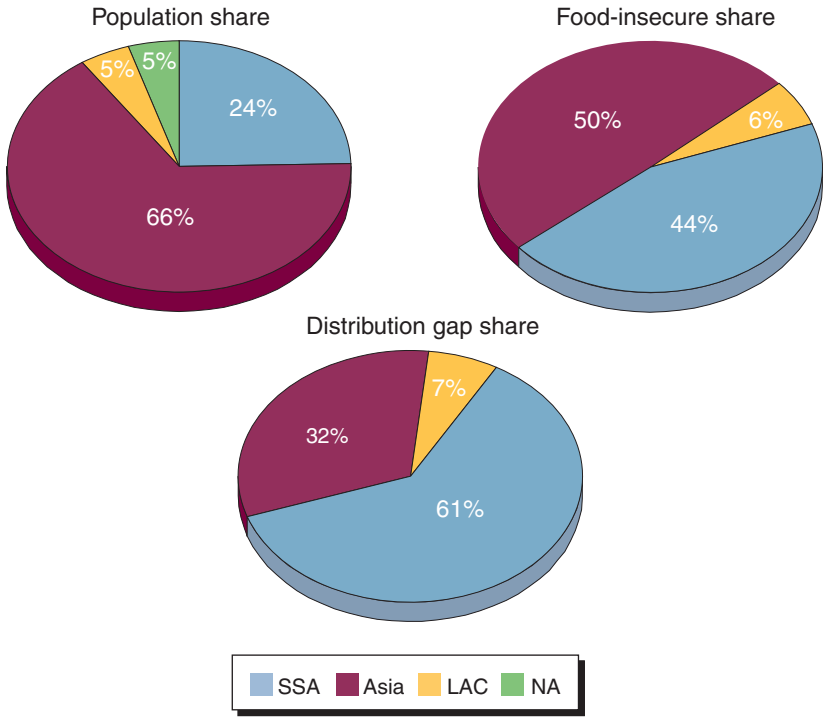
Regionally, food insecurity is concentrated in Sub-Saharan Africa, followed by the lower income Asian countries. SSA accounts for 24 percent of the population of the 76 countries, but is projected to account for 61 percent of the total distribution gap and 44 percent of the number of food-insecure people in 2012 (fig. 3). Asia, on the other hand, accounts for 66 percent of the population, but only 32 percent of the gap and 50 percent of the food-insecure people.

In This Report

This report presents three measures of food security for 76 lower income countries in Sub-Saharan Africa, Asia, Latin America and the Caribbean, and North Africa: the number of food insecure people; the size of the nutritional gap; and the size of the distribution gap (all measures are described in detail in the Appendix as well as in the box on p. 2). These measures are estimated for 2012 and projected for 2022, and they are presented by region, highlighting individual countries. Because increased domestic food production and

Figure 3

Total and food-insecure population share and distribution gap share by region, 2012



Source: USDA, Economic Research Service and UN FAOSTAT.

more robust agricultural productivity are critical to long-term food security, the report explores factors that could alter the projections of agricultural productivity and, thus, food security of countries.

This report includes two special articles. The first is "The Impact of Food Price Increases on Food Security of the Most Vulnerable Households: Evidence from Afghanistan" by Anna D'Souza and Dean Jolliffe. This article uses Afghan household survey data to examine the impact of a rapid rise in staple food prices on household food security. The second is "Agricultural Development and Food Security in Brazil" by Nicholas Rada. This article analyzes the rapid growth in Brazil's agricultural sector and then examines impediments to improving the poorest people's access to food. It also reviews the impact of Brazil's conditional cash transfer programs.

Afghanistan continues to be one of the most food-insecure countries. Lessons learned about how the country responded to the recent food price increases can be instructive for other similarly food-insecure countries. Brazil has been praised for its success in alleviating hunger and improving the food security situation of millions of its citizens. A review of Brazil's policies, programs, and results offers lessons to countries that hope to replicate Brazil's success.

Looking Forward

Although the food security indicators estimated in this report suggest that there will be little change in food security over the next decade for the 76 countries at the aggregate level, the outlook varies by region and country. Regionally, the number of food-insecure people is projected to rise only in SSA, even though the share of that region's population that is food insecure is projected to decline.

Since the rise of world food prices in 2008, and in view of the limited progress in improving global food security, development of the agricultural sector is at the center of policy discussions. Despite progress in conceptualizing the process of agricultural development, challenges remain in the lower income countries. Inadequate resources—both physical and human—along with population growth limit technical and economic opportunities. Providing adequate food for growing populations requires at least a comparable increase in food availability, if not a larger increase to compensate for unequal purchasing power and to support improved diets.

There is concrete evidence that improving agricultural performance and food security are now among the top items on development and political agendas, particularly in SSA. Under the Comprehensive African Agricultural Development Program (CAADP) (http://www.caadp.net), established by the African Union assembly in 2003, more than 20 African countries have adopted national investment plans devoting 10 percent of their budgets to agriculture. The U.S. Government, under the Feed the Future initiative, along with the World Bank Group, has increased annual commitments to agriculture and supporting sectors in these lower income African countries to about $6 billion. Similar steps have been taken by other donors (such as the European Union and Australia), targeting agricultural development in lower income countries, particularly in Sub-Saharan Africa.

These initiatives all recognize that increased domestic food production and more robust agricultural productivity are critical to long-term food security. For many of the 76 countries in this report, low yields and lagging labor productivity in agriculture present opportunities for significant improvement.

Yield potential is high. From 2000 to 2010, the 76 countries' grain yields grew at an average rate of 1.6 percent per year, versus 1.9 percent population growth. Nearly a quarter of the countries witnessed declining yield growth in that span. The average grain yield for the study countries was 53 percent of the world average, 1.7 tons per hectare versus 3.2 tons in 2008-10. In 16 countries, the average 2008-10 grain yield was less than 1 ton per hectare. The highest yields were in Egypt (6.6 tons/hectare), while the lowest (under 0.5 ton/hectare) were in Cape Verde, Namibia, Niger, and Somalia.

One reason for low and/or declining yields is the lack of access to quality resources, such as water (http://www.sciencemag.org/content/302/5649/1356.full, http://www.cid.harvard.edu/archive/events/cidneudc/papers/rosenvincent.pdf). Inputs and the use of new technologies that require money—such as fertilizer, machinery, and irrigation technology—are not widely used in many developing countries. The development and dissemination of new technologies and practices that increase yield potential for a particular area will

depend on a country's ability to make needed investments and farmers' skills and willingness to adopt the provided technologies. Technology adoption also depends on land characteristics such as soil quality and access to water, as well as factors like land tenure, income/wealth, access to credit, and access to output markets.

Fertilizer is an important yield-enhancing input. Fertilizer consumption in the study countries was about 64 kg per hectare of arable land during 2005-07. Regionally, average fertilizer consumption is the highest in North Africa (157 kg), followed by LAC (148 kg), Asia (85 kg), and SSA (10 kg).[2] These averages, however, mask large variations among countries. In Asia, for example, the range is from 4 kg in Afghanistan to 274 kg in Sri Lanka. The overall range for the study countries was less than 0.5 kg in Niger to 521 kg in Colombia. One reason for the low use of fertilizer is the cost, particularly for importing countries. Between 1990 and 2011, the nominal international price for fertilizer increased fourfold. Furthermore, domestic transport in countries with poor infrastructure can be prohibitively costly, at times costing more than the international price of the fertilizer.

[2]Average U.S. and world fertilizer consumption per hectare of arable land were 109 kg and 119 kg, respectively, in 2009.

The effectiveness of fertilizer use is compromised in many countries by the conditions and environment in which the fertilizer is applied. Fertilizer use is most productive on irrigated or moist areas. Many of the study countries in semi-arid climates are dependent on rainfall. Across the 23 lower income countries for which irrigation data are available, only 16 percent of the area was irrigated in 2005-07 (FAOSTAT, 2011). Regionally, the NA countries, entirely due to a high concentration of irrigated agriculture in Egypt, had the highest share of irrigated area, at 26 percent, followed by Asia at 22 percent, LAC at 6 percent, and SSA at about 1 percent.

Labor productivity remains low. Agriculture continues to employ the largest share of the labor force in the lower income countries surveyed. In Ethiopia, for example, agriculture's share of total employment was about 80 percent in 2007. Most of the poor live in rural areas, so any growth in labor productivity would also help rural households by increasing incomes, thus reducing poverty and food insecurity.

Agricultural value added per worker (AVAW)[3] for countries for which data were available was $1,158 per year, compared to $45,811 in the United States. There are large variations among regions and countries. The top region in terms of AVAW was NA, followed by LAC—both with AVAW averages above $2,300—then Asia at $1,302 and SSA at $458. In SSA, AVAW was over $1,000 in three countries: Cape Verde, Namibia, and Swaziland. Without these countries, the regional average falls to about $330.

[3]A 3-year average for the most recent data available since 2000, at constant 2000 US$.

Low levels of AVAW typically reflect relatively poor productivity and low profitability in the agricultural sector. Increasing returns to farming requires improvement in efficiency at every level of the agricultural sector, from production to marketing. Modernizing agriculture will require government and private investment in transportation, storage and distribution infrastructure, education, R&D, dissemination of new technologies and inputs, and the promotion of producer marketing organizations that can link small farmers to consumers.

Despite these needs, public resources are limited, and many countries are trying to create a more favorable climate for private sector investment. The Grow Africa initiative is designed to accelerate investment in agriculture (http://growafrica.com). The 2012 G-8 meetings initiated a *New Alliance for Food Security and Nutrition* that envisions significant new private sector investment in agriculture, especially in Africa. This agenda requires coordination across all the different dimensions of a production system. For example, investment in support of agriculture includes agricultural research and extension, infrastructure such as rural roads, education, health care, and in some cases, irrigation and power supplies. The availability of improved crop varieties depends on the pace of agricultural research, whereas the success of these new varieties depends on their timely and equitable dissemination among farmers. Farm management must accommodate the new varieties to sustain progress. Finally, food security hinges on the development of public institutions to efficiently implement policies and monitor the effectiveness of investments.

Food Security: Regional and Country Perspectives

Food security is estimated to improve slightly in 2012 as the number of food-insecure people in the 76 countries covered in this report declines from 814 million in 2011 to 802 million in 2012 and the share of the population that is food insecure remains unchanged at 24 percent. While the number of food-insecure people and the overall size of food gaps are projected to increase slightly between 2012 and 2022, the regions covered in this report are projected to follow different paths. North Africa is expected to remain relatively food secure, with less than 10 percent of the region's population consuming below the nutritional target, while Sub-Saharan Africa (SSA) is projected to add 54 million food-insecure people. In Asia, the number of food-insecure people is projected to decline in some countries, and to rise or remain unchanged in others, resulting in 10 million fewer food-insecure people by 2022. Latin American and the Caribbean (LAC) is projected to reduce the number of food-insecure people significantly, by 15 percent.

Sub-Saharan Africa

The number of food-insecure people in 39 Sub-Saharan African countries included in this report is estimated at 357 million in 2012, a 4.3-percent decline from 2011. The distribution gap is estimated to decline 1.8 percent. The region's grain output in 2011 fell below the bumper crop of 2010 as several countries—including Angola, Burkina Faso, Chad, Madagascar, Mali, Niger, and Sudan—saw below-average production in 2011. The improvements estimated for 2012 are driven by an estimated recovery in production.

The number of food-insecure people is expected to increase 15.1 percent over the next decade, reaching 411 million in 2022. This projected increase compares with a projected 28-percent rise in population for SSA countries, such that the share of food-insecure people is projected to fall from 42 percent in 2012 to 38 percent in 2022. However, the region's 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 nearly 19 percent over the next decade, reaching 12.4 million tons in 2022.

The region's food security situation is expected to be driven by its food production performance and population growth. Production of grain, which accounts for nearly half of this region's diet, is projected to increase roughly 30 percent over the next decade. The region's imports of grain have increased rapidly over the last decade, but domestic production still accounts for about 80 percent of the grain supplies.

Improved Food Security Projected for Some Countries

Over the next decade, the greatest improvements in food security are projected for Ethiopia, Guinea-Bissau, Kenya, Liberia, Swaziland, and Uganda. Historically, Ethiopia has suffered extensive food insecurity. According to our estimates, nearly all of the population was food insecure through the 1990s. The situation started to improve following the end of the

Table 4

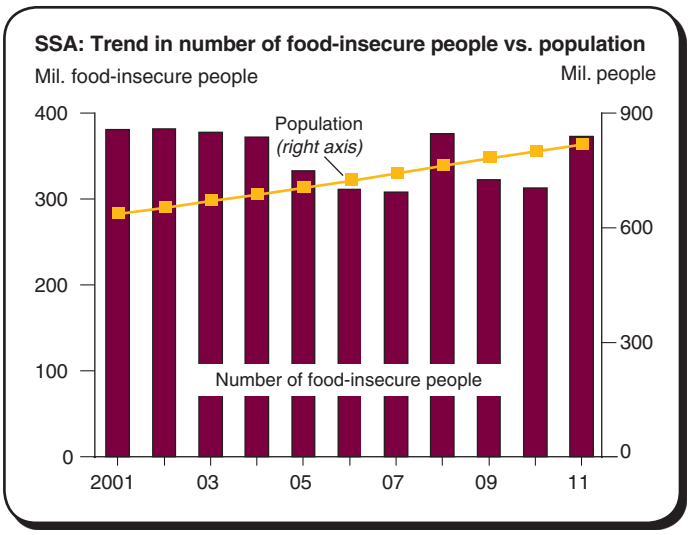
Food availability and distribution gaps for Sub-Saharan Africa

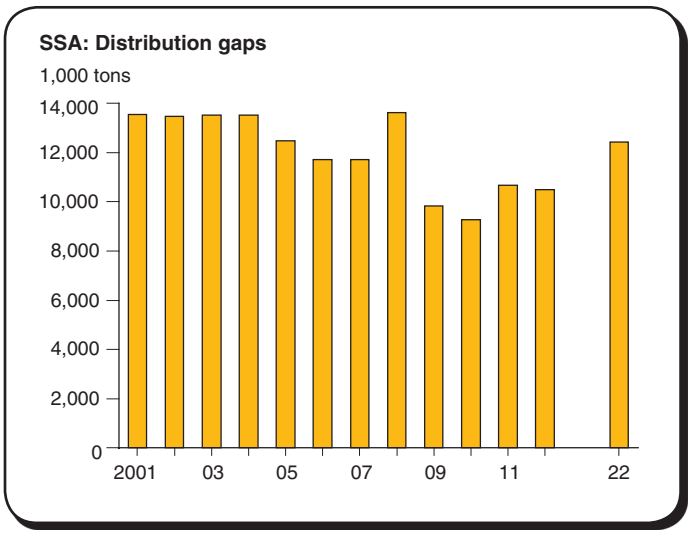
Year	Grain production	Root production	Commercial imports	Food aid receipts *(grains)*	Aggregate availability of all food
			1,000 tons		
2003	81,279	54,500	16,708	5,249	169,379
2003	81,169	57,429	18,234	3,576	174,747
2004	84,851	59,693	20,498	4,575	182,763
2005	93,831	62,056	19,333	3,939	189,981
2006	89,682	59,444	20,581	3,195	194,951
2007	97,495	63,925	23,447	4,114	201,310
2008	101,180	61,862	23,974	3,610	207,962
2009	113,863	62,745	21,713	3,450	213,967
2011(e)	107,063	64,900	24,578	3,462	214,316
Projections				Food gap* NG / DG	(w/o food aid)
2012	116,092	65,863	22,228	***6,683*** / ***10,490***	222,418
2017	132,076	70,853	28,427	***7,177*** / ***10,838***	253,415
2022	150,356	76,157	32,255	***8,282*** / ***12,437***	283,812

*See table 3.

Sub-Saharan Africa
(840 million people in 2012)

The number of food-insecure people in the Sub-Saharan African (SSA) countries studied here is projected to increase 15 percent over the next decade, reaching 411 million in 2022. The increase is, however, below the 28-percent rise projected for overall population in these countries. As a result, the number of food-insecure people as a share of the region's total population is projected to fall from 42 percent in 2012 to 38 percent in 2022.





country's civil war in 2000 and the subsequent rise in domestic grain production. Grain output doubled between the early 2000s and recent years, and as a result, Ethiopia is now SSA's second largest grain producer, close behind Nigeria. In 2012, an estimated 60 percent of the population is food insecure. Grain output is projected to be lower than the bumper crops of the last few years. The share of population that is food insecure is projected to decline from 60 percent in 2012 to 30 percent by 2022. The country's distribution gap is projected to decline faster than the number of food-insecure people, indicating that food insecurity will become less intense.

Kenya is also projected to halve the share of food-insecure people—from 60 to 30 percent—over the next decade. Kenya's grain output has grown slowly

Table 5

Sub-Saharan Africa: Projected growth in food security variables[1]

	Grain production	Grain yields	Population	Grain imports	Export earnings
			--Percent growth per year--		
Cameroon	2.5	1.4	2.0	2.4	4.5
Central African Republic	2.0	1.0	1.9	5.6	5.6
Congo	3.8	2.0	2.1	1.2	4.5
DR Congo	3.0	1.8	2.5	4.1	6.2
Burundi	4.3	2.2	1.7	2.4	5.0
Eritrea	3.4	2.4	2.5	1.9	2.0
Ethiopia	2.7	2.0	1.9	4.6	6.5
Kenya	3.3	2.2	2.6	3.2	6.6
Rwanda	3.5	2.5	2.7	4.2	6.6
Somalia	3.5	2.3	2.9	0.7	0.0
Sudan	2.5	1.5	2.3	4.1	5.2
Tanzania	3.5	2.5	3.1	2.6	7.0
Uganda	4.3	2.8	3.1	6.5	7.0
Angola	3.2	1.8	2.6	4.8	6.2
Lesotho	2.5	1.2	0.9	1.7	4.9
Madagascar	2.7	1.6	2.8	4.1	5.1
Malawi	3.1	1.9	3.4	2.4	3.7
Mozambique	2.8	1.6	2.2	4.2	7.8
Namibia	2.0	1.3	1.5	3.1	4.3
Swaziland	0.5	0.5	1.1	2.2	2.4
Zambia	3.8	1.9	3.3	4.3	7.5
Zimbabwe	2.6	1.8	2.1	2.1	3.0
Benin	2.4	1.5	2.6	2.2	5.0
Burkina Faso	2.4	1.8	3.0	2.5	6.4
Cape Verde	0.8	0.3	0.9	2.6	4.8
Chad	2.0	1.2	2.5	7.1	3.4
Cote d'Ivoire	2.2	1.1	2.2	3.4	5.3
Gambia	2.8	1.4	2.6	3.8	5.5
Ghana	2.1	1.3	2.1	1.3	4.9
Guinea	2.7	1.5	2.5	2.3	6.5
Guinea-Bissau	2.1	1.0	2.1	3.4	4.7
Liberia	4.1	1.8	2.5	3.1	5.5
Mali	2.9	1.9	2.9	2.2	5.1
Mauritania	1.7	0.9	2.1	2.8	5.6
Niger	3.3	2.2	3.6	2.8	6.6
Nigeria	1.7	0.9	2.5	4.1	6.0
Senegal	3.1	2.0	2.5	2.5	5.4
Sierra Leone	2.6	1.7	2.0	2.1	4.1
Togo	1.9	1.4	1.9	4.4	4.4
SSA	**2.7**	**1.6**	**2.4**	**3.2**	**5.1**

[1]Annual projected growth between 2012 and 2022.

Source: ERS/USDA calculations based on Food Security Assessment model results, IMF online data, April 2012, and UN Population projection data.

during the last two decades, even declining in per capita terms. Production growth is projected to accelerate over the next decade, supported by stronger yields. Also, Kenya has increasingly relied on imports to satisfy food needs. In the early 2000s, grain imports accounted for about 27 percent of grain supplies. In recent years, this share jumped to more than 40 percent. Export earnings growth of more than 6 percent per year, in real terms, during the last decade has supported this import growth. Export expansion was fueled by large increases in exports of horticultural products (i.e., cut flowers, green beans, Asian vegetables) and higher prices for traditional exports of tea and coffee.

The share of Swaziland's population that is food insecure is expected to fall from 60 percent in 2012 to 20 percent in 2022. This projected improvement is almost entirely driven by a slowdown in population growth, which is already among the lowest in SSA. This rate is projected to slow from 1.5 percent per year in the near term to 1.0 percent per year in 2022.

Uganda's projected improvement—reducing the share of food-insecure people from 40 to 20 percent over 2012-2022—is due to projected continued strong growth in grain output. Guinea-Bissau—whose share of food-insecure population is projected to fall from 40 to 10 percent—has relatively low population growth of 2 percent per year through the projection period. Imports and domestic production contribute almost equally to grain supplies in Guinea-Bissau, and both have been increasing faster than population growth; these trends are expected to continue in the projection period. Since the end of Liberia's civil war in 2003, the agricultural sector has rebounded, and projections are for a continuation of this recovery. As a result, the country's share of food-insecure people is projected to fall from 80 percent in 2012 to 40 percent in 2022.

Another country that has made significant improvements in food security in the last decade is Malawi. In 2000, it was estimated that half of the country's population was food insecure. Since that time, the Government's input supply program has boosted yields well above the regional average. Between 2000 and 2011, grain output increased nearly 8 percent per year. In 2012, less than 10 percent of the Malawi population is estimated to be food insecure. However, given the country's projected population growth of 3.3 percent per year and limited import capacity, the share of population that is food insecure is projected to increase to 20 percent in 2012-22.

Food Insecurity Projected To Remain Severe in Four Countries

In the Democratic Republic of Congo, Burundi, Eritrea, and Lesotho, nearly 100 percent of the population is projected to remain food insecure throughout the projection period. DR Congo continues to suffer the effects of long-term civil strife, which has disrupted agricultural activities. Per capita grain output continues to decline, with virtually no change in area planted for the last two decades and negligible increases in yields. Burundi's grain output has been stagnant, meaning a decline in per capita terms. Eritrea and Lesotho have some of the lowest average grain yields in the world. Both countries' agricultural output is characterized by wide swings in output due to rainfall variability. Eritrea's coefficient of variation of grain production during the last two decades averaged 65 percent; in any given year, production could vary 65

percent above or below trend levels. Eritrea's projected population growth of 2.5 percent per year through 2022 will exacerbate the food security situation.

Factors That May Adversely Affect Food Security

Despite positive signs related to food security in many SSA countries, some factors could derail the progress. While there are fewer conflict areas in the region now and governance has improved, Côte d'Ivoire, Eritrea, DR Congo, Sudan (including South Sudan), Guinea-Bissau, Malawi, and Mali continue to suffer from civil strife and/or instability. Any escalation would likely worsen food security outcomes.

Positive Indicators for Food Security in SSA

Per capita incomes in SSA have increased throughout most of the last decade, and estimates for 2011 indicate that this trend continued. SSA's real GDP increased an estimated 5.9 percent in 2011, one of the fastest regional growth rates in the world. Domestic demand was the principal driver of this growth, but external demand and higher commodity prices also played a role. Export earnings for the region rose about 40 percent in 2011. The oil-exporting countries of the region (such as Angola, Cameroon, Chad, Congo, and Nigeria) experienced the highest growth at nearly 50 percent. However, strong export growth (average 45 percent) extended to more economically fragile countries as well (i.e., Burundi, DR Congo, Eritrea, Guinea, and Togo). The global economic recovery and associated output led to increased demand for metals and minerals. This activity benefited countries such as Zambia, Mozambique, Liberia, and Sierra Leone.

This export growth is made more sustainable by the diversification of SSA's trading partners. In the early 2000s, the EU was by far the region's most important trading partner, accounting for roughly 30 percent of SSA's exports. This share has fallen gradually and in 2011 was just under 25 percent. On the other hand, China accounted for more than 16 percent of SSA exports in 2011, up from less than 4 percent in 2000. India's share grew from around 5 percent in the early 2000s to nearly 9 percent in 2011. Since China's and India's economic growth is expected to outpace the EU's, SSA's exports are well positioned to grow.

Historically, intraregional trade in SSA was hampered by poor infrastructure, lack of harmonized regional trade policies, and slow demand growth. However, there are signs that recent income growth and policy changes are facilitating trade growth among SSA countries. The free trade area within the Common Market for Eastern and Southern Africa (COMESA) resulted in a fivefold increase in trade during the 2000s. Intraregional trade now accounts for 14 percent of the region's total trade, doubling since 1990.

Ongoing investment and research activity bodes well for SSA agriculture. The Alliance for a Green Revolution in Africa (AGRA)—an organization of farmers, research scientists, private sector groups, government leaders and institutions, and international organizations—aims to improve smallholder farmers' access to high-quality seeds and appropriate fertilizers, and make financing more available for smallholders and agricultural businesses. AGRA started a Soil Health Program in 2008 that aims to regenerate 6.3 million

hectares of degraded farmland over the next 10 years, benefiting an estimated 4 million smallholders.

Increasing output of staple crops will continue to be key for improving SSA food security. Demand for rice in particular is rising rapidly. Between 2000 and 2010, the region's rice consumption increased 4.6 percent per year, far outstripping the region's population growth of about 2.6 percent. The emergence of NERICA (New Rice for Africa), a varietal cross between African and Asian rice species, promises higher yields under a variety of soil and weather conditions, more protein, a shorter growth cycle, and greater resistance to pests and diseases.

Asia

The number of food-insecure people in the Asian countries covered in this report is estimated to increase less than 1 percent between 2011 and 2012. However, the region's distribution gap is estimated to increase 22 percent, suggesting that food insecurity may intensify. The higher distribution gap is driven by India and Yemen. India harvested a bumper grain crop in 2011, whereas production for 2012 is closer to trend levels.[4] Unlike most countries in the region, imports contribute to a large share of grain supplies in Yemen—roughly 80 percent. Higher expected grain prices for 2012 result in a reduction in imports and, therefore, reduced food availability in the country.

The Asia region accounts for two-thirds of the population of the 76 study countries, but just half of the estimated number of food-insecure people. An estimated 18 percent of the population in the covered Asian countries is food-insecure in 2012. Regional food security is projected to be stable over the next decade, with the number of food-insecure people projected to decline from 398 million in 2012 to 388 million in 2022. A much steeper decline—28 percent—is projected for the region's distribution gap, indicating that the intensity of food insecurity is expected to lessen considerably. Per capita food consumption for the region, on average, is projected to increase nearly 0.8 percent per year through the next decade.

Of the regions included in this report, Asia is the least reliant on imports to meet food demand; imports account for less than 10 percent of grain supplies. Therefore, food security is largely dependent on production performance. Between 2000 and 2010, the region's grain output grew 2.4 percent per year, versus population growth of 1.5 percent per year.

India is the most populous country among those surveyed in the region, accounting for 56 percent of the population of the Asian countries analyzed. India's food security is projected to be stable through 2022. The number of food-insecure people is expected to increase at roughly the same rate as population, 1.2 percent per year. Therefore, the share of population that is food insecure is expected to remain at about 20 percent through the decade. The distribution gap (the amount of food needed to raise consumption in each income group to the nutritional target), on the other hand, is projected to decline. So, despite a projected increase in the absolute number of food-insecure people, the intensity of food insecurity in India is projected to decline.

[4]The analysis does not account for India's large food grain stocks, which are sufficiently large to cover the estimated distribution gap.

Table 6

Food availability and distribution 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		
2003	369,073	19,461	24,763	2,623	513,595
2004	369,701	21,151	24,228	2,505	509,116
2005	384,536	22,185	24,279	2,742	525,154
2006	385,116	23,423	35,068	1,873	544,119
2007	412,808	23,700	31,335	2,083	561,286
2008	427,333	26,832	33,630	1,499	571,227
2009	423,264	26,660	33,366	1,402	579,810
2010	440,329	28,260	34,221	1,591	590,930
2011(e)	458,390	26,560	35,639	1,497	607,149
				Food gap*	
Projections				NG DG	
2012	451,915	26,927	31,860	***1,519*** ***5,456***	612,157
2017	489,265	28,823	40,005	***676*** ***4,993***	657,628
2022	529,196	30,825	45,294	***521*** ***3,933***	705,273

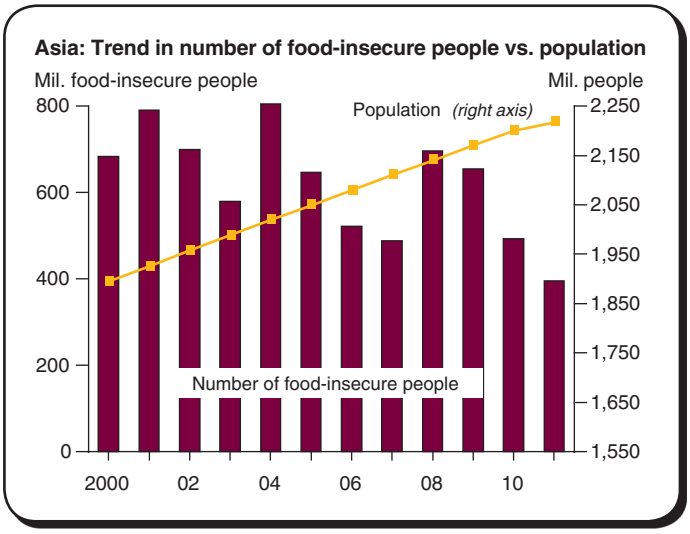
*See table 3.

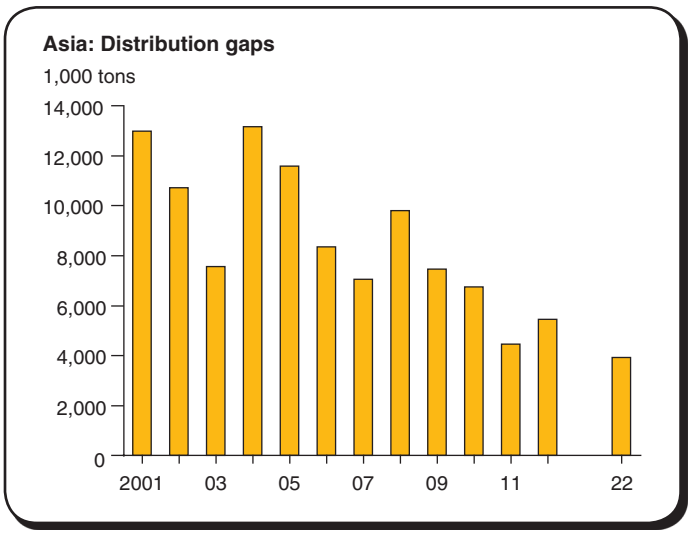
Asia
(2.25 billion people in 2012)

The food security situation in the Asian countries covered here is projected to remain stable between 2012 and 2022. The number of food-insecure people as a share of the region's population is projected to decline from 18 to 15 percent during the projection period.

The most food-insecure country in the region is North Korea, followed by Afghanistan and Yemen.

India is the most populous country in the region, accounting for 56 percent of the population of the countires studied. The share of its population that is food insecure is expected to remain at 20 percent through the decade.





The most food-insecure country in the region (in terms of share of population estimated to be food insecure) is North Korea, followed by Afghanistan and Yemen. All three are beset by issues related to governance and/or civil strife. North Korea has suffered from intense food insecurity for years, mainly due to poor weather conditions and government policies that have resulted in a lack of inputs for farmers. Per capita calorie consumption is less than 2,100 calories per day, versus a regional average of close to 2,500 calories. Nearly all of the North Korean population is estimated to be food insecure in 2012. Without a change in government policies and current trends, these numbers are not expected to improve over the next decade.

Table 7

Asia: Projected growth in food security variables[1]

	Grain production	Grain yields	Population	Grain imports	Export earnings
			--Percent growth per year--		
Afghanistan	3.3	2.1	2.9	2.6	7.0
Armenia	0.8	0.4	0.1	1.6	4.0
Azerbaijan	0.6	0.5	1.0	2.7	2.3
Bangladesh	1.8	1.6	1.1	1.5	5.1
Cambodia	2.0	1.7	1.2	14.2	7.6
Georgia	0.0	0.1	-0.7	3.1	5.0
India	1.4	1.3	1.2	4.5	8.1
Indonesia	1.4	1.0	0.9	4.4	6.9
Kyrgyzstan	0.8	0.6	1.3	3.3	5.0
Laos	2.0	1.7	1.2	13.0	7.4
Moldova	0.7	0.4	-0.6	7.6	4.9
Mongolia	1.7	1.7	1.4	14.5	7.9
N. Korea	1.0	0.5	0.4	1.8	1.5
Nepal	1.9	1.5	1.6	1.7	3.8
Pakistan	1.6	1.1	1.6	4.2	5.0
Philippines	2.6	2.3	1.6	2.2	3.4
Sri Lanka	1.0	0.6	0.6	1.3	5.5
Tajikistan	0.7	0.6	1.5	3.6	5.0
Turkmenistan	0.6	0.2	1.1	7.0	6.8
Uzbekistan	0.7	0.5	1.1	5.7	6.1
Viet Nam	2.1	1.6	0.9	3.5	7.4
Yemen	5.3	3.0	2.9	3.5	4.7
Asia	**1.5**	**1.1**	**1.1**	**4.9**	**5.5**

[1]Annual projected growth between 2012 and 2022.

Source: ERS/USDA calculations based on Food Security Assessment model results, IMF online data, April 2012, and UN Population projection data.

The food insecurity situation in Afghanistan, while improved, is still poor. In 2000, nearly all of the population was considered food insecure; by 2012, the share was an estimated 70 percent. This improvement was driven by growth in grain production of more than 8 percent per year, as well as a doubling of grain imports. The country has one of the highest population growth rates in the region at roughly 3 percent per year. In addition, armed conflict continues to hamper agricultural and economic activities. In 2022, half of the population is projected to remain food insecure.

Yemen imports most of its grain supplies. However, import growth has not kept pace with the 3-percent annual growth in population. In 2012, an estimated 90 percent of Yemen's population is food insecure as high global food prices and continued civil strife disrupt trade and inflate consumer prices. If recent trends in production and imports continue, an estimated 60 percent of the population is projected to be food insecure in 2022.

Most of the countries in the Commonwealth of Independent States (CIS) region are estimated to be relatively food secure. In 2012, nearly all the population in this subregion—except for Georgia and Tajikistan—is estimated to consume at or above the nutritional target of roughly 2,100 calories per person per day. However, this analysis may not capture food insecurity occurring among the poorest people in the lowest income decile, and it is unlikely that 100 percent of the population in these countries is food secure. In Georgia, 10 percent of the population is estimated to be food insecure in 2012; by 2022, this share is projected to fall to near zero. In Tajikistan, 20 percent of the population is estimated to be food insecure, and this share is projected to be cut in half by 2022. Tajikistan is one of the poorest countries in the CIS region and also has the lowest per capita calorie intake.

Uzbekistan and Turkmenistan are expected to have strong economic growth in the near term, supported by high energy prices. Growth in the region, however, is highly dependent on the economic health of Russia and the euro zone, which are the markets for most of the region's exports. Grain output in Armenia, Azerbaijan, and Georgia has benefited from government policies and favorable weather conditions in the last few years. However, these countries remain reliant on imports—largely wheat—to meet food demand. While consumer prices for wheat have fallen from their peak levels in mid-2011, they remain higher than the recent 3-year average.

Although most of the countries in the CIS region appear relatively food secure, the lower income segments likely remain vulnerable, particularly when food prices rise. According to a study by the Asian Development Bank, food price volatility was much higher than non-food price volatility in many Asian countries in 2000-10. Lower income groups are especially vulnerable because they spend a larger share of their incomes on food. When food prices rise, the quality of diets may suffer or spending on items such as education and health care may be reduced.

Income growth will also be key in ensuring access to food for the poorest people in the Asian study countries. According to the IMF, economic growth in the region is projected to be quite strong in the near to medium term. The highest real GDP growth—at or above 6 percent per year—in the near term is projected for India, Indonesia, Sri Lanka, Vietnam, Afghanistan, Bangladesh, Cambodia, Uzbekistan, Tajikistan, Turkmenistan, and Mongolia.

Latin America and the Caribbean

The number of food-insecure people in the Latin America and Caribbean (LAC) region increased slightly between 2011 and 2012. Forty-eight million people, or about 30 percent of the population in the 11 countries included in the study, are estimated to have consumption levels below the nutritional target of roughly 2,100 calories per person per day. This number is projected to drop to 41 million, or 22 percent of the region's population, by 2022. Distribution gaps, or the amount of food needed to raise consumption levels of the food-insecure up to the nutritional target, are estimated to drop from 1.1 million tons to just above 800,000 tons. This most recent projection points to a continuation of improved food security in the region.

Table 8

Food availability and distribution 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			
2003	14,043	3,545	12,404	438		38,652
2004	13,841	3,496	12,857	527		39,426
2005	14,341	3,527	14,009	625		41,283
2006	14,442	3,749	14,604	637		42,311
2007	15,688	3,939	15,158	351		43,230
2008	16,417	3,891	14,793	348		44,012
2009	16,625	4,141	15,196	257		44,545
2010	16,079	4,296	16,227	416		45,265
2011(e)	16,049	4,130	16,239	340		45,784
Projections				Food gap*		
				NG	DG	
2012	17,221	4,172	15,127	*240*	*1,128*	46,477
2017	18,422	4,389	18,857	*71*	*809*	51,270
2022	19,666	4,614	20,702	*0*	*812*	54,054

*See table 3.

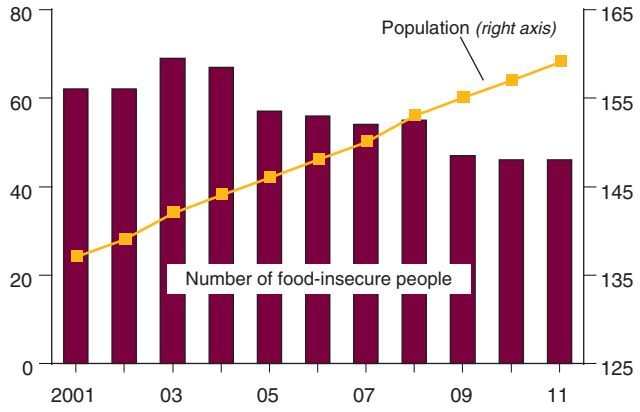
Latin America and the Caribbean (LAC) (161 million people in 2012)

Food security is projected to continue improving over the next 10 years, reducing the share of people with insufficient access to food to about one-fifth by 2022.

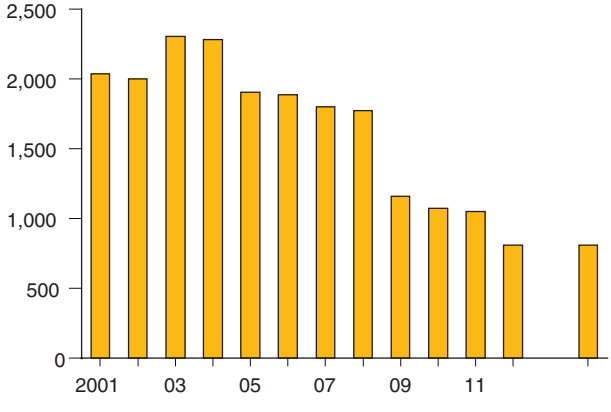
Progress is uneven, however. Peru, Colombia, and Jamaica, the LAC-countries with the highest per capita incomes included here are also those with the lowest share of food-insecure people—less than 10 percent.

Haiti, which is slowly recovering from political and natural chaos, and Guatemala, with the most extreme income inequality in the region, continue to suffer from food insecurity for the majority of their populations.

LAC: Trend in number of food-insecure people vs. population



LAC: Distribution gaps



There is disparity in LAC performance. Peru, Colombia, and Jamaica are the most food secure countries, where only the households in the lowest income decile are estimated to be food insecure between 2012 and 2022. All three countries are among those with the highest per capita GDP in this group—between $5,300 and $6,300 in 2010—and they have enjoyed a long period of sustained economic growth. All three countries depend on imports for their food supplies. Peru's and Columbia's export earnings have been growing at an average annual rate of more than 8 and 5 percent respectively between 1990 and 2010. Jamaica accumulated external debt equal to 127 percent of GDP by 2010 (IDB). Future food security could be compromised by the uncertainty arising from this likely unsustainable debt level.

Table 9

Latin America and Caribbean: Projected growth in food security variables[1]

	Grain production	Grain yields	Population	Grain imports	Export earnings
			--Percent growth per year--		
Bolivia	2.3	1.4	1.5	1.7	4.5
Colombia	1.0	0.8	1.1	3.5	4.5
Dominican Republic	1.1	0.5	1.1	1.7	6.0
Ecuador	1.1	0.7	1.2	2.7	2.7
El Salvador	0.6	0.4	0.7	1.1	4.0
Guatemala	2.4	1.4	2.4	2.6	4.2
Haiti	1.5	0.9	1.2	5.1	5.7
Honduras	1.5	1.3	1.8	0.9	4.0
Jamaica	0.6	0.4	0.3	1.2	2.9
Nicaragua	0.8	0.6	1.3	0.9	4.0
Peru	1.0	0.8	1.1	3.2	6.0
LAC	**1.3**	**0.8**	**1.2**	**2.2**	**4.4**

[1]Annual projected growth between 2012 and 2022.

Source: ERS/USDA calculations based on Food Security Assessment model results, IMF online data, April 2012, and UN Population projection data.

Ecuador, the Dominican Republic, El Salvador, and Nicaragua are projected to see marked improvements in food security over the coming decade. In 2012, between 30 and 40 percent of their populations are estimated to be consuming below the nutritional target. Each of these countries has exhibited strong economic growth for at least the last decade and strong growth in export earnings; Nicaragua led with 8.4 percent annual growth over the last decade.

By 2022—assuming average weather—steady increases in food availability are expected to reduce the share of food-insecure people to 20 percent in Nicaragua and 10 percent in Ecuador, the Dominican Republic, and El Salvador. Domestic production growth is projected to outpace population growth, and food imports are projected to grow in importance over the next decade.

Haiti, the poorest country in the Western Hemisphere, continues to be the most food insecure. Chronic political instability left the country poor even before the devastating earthquake in January 2010. The earthquake affected 3 million people, killing more than 300,000, wounding as many, and displacing more than 1 million, besides destroying crucial infrastructure and institutions. The subsequent outbreak of cholera further challenged food security in the country. Recovery has been very slow but steady. The rate of progress is hard to predict. By 2022, 70 percent of the population may still be food insecure, down from an estimated 90 percent in 2012.

Guatemala is the other LAC country where food insecurity is estimated to be relatively high, affecting an estimated 70 percent of the population, or about 9 million people, in 2012. Guatemala has the largest economy in

Central America, relying heavily on agriculture, with tourism and remittances providing other important sources of income. Food production has been growing at 3 percent per year over the last 15 years, due mostly to area expansion amid stagnant yields. Export earnings have been growing more modestly, constricting import capacity. Guatemala's grain imports account for just under 40 percent of supplies, and this ratio is not expected to change much over the next decade. Increases in food supplies are projected to barely keep up with population growth of 2.7 percent per year, twice the regional average. While the share of population deemed food insecure is projected to decline slightly to 60 percent, the number of food-insecure people is expected to increase. Guatemala has one of the most unequal income distributions in the region; more than 50 percent of its population is officially in poverty. Indigenous households—who make up 38 percent of the population—are disproportionately represented among the poor, with a share of 76 percent.

Bolivia and Honduras—with 20 and 40 percent of their populations living in food insecurity—show no improvements over the projection period. Bolivia, a country with relatively favorable availability of arable land, has the lowest import share among the LAC countries included in this study, at just 17 percent in 2011. Bolivia's grain production has grown on average by more than 5 percent per year over the last 15 years, and more than half of this increase is due to increasing yields. The country suffered from drought in late 2011 and flooding in early 2012, which reduced grain output. Corn and rice are the major grains produced, while soybeans occupy more area than those two crops combined. The Government's Agricultural Insurance Program benefits 350,000 peasant families by insuring them against natural disasters. On the other hand, legislation to maintain low food prices hinders farm profitability, thus reducing the incentive to expand. Bolivia has one of the higher population growth rates in the region at 1.7 percent per year. Reduction in food insecurity will depend on marked improvements in grain production or a shift toward higher imports—Bolivia benefits from strong commodity prices for its export products, such as natural gas, silver, zinc, and soybeans—and is one of the region's countries with a positive trade balance.

Honduras remains one of the poorest countries in Latin America. Poverty is concentrated in the rural areas, where more than half of the 7.6 million people live. The global financial crisis slowed Honduras' export growth in 2009, pressuring national finances. Agriculture is a major contributor to economic growth, though productivity is low. Land degradation and poor agricultural practices limit growth potential and aggravate the risk of loss due to climate-related and other natural disasters. Since 2000, grain imports have equaled or surpassed domestic production. Grain production has stalled over the last 20 years, as area declined and yields increased just 0.7 percent per year.

The countries included in the LAC region are relatively reliant on food imports. Imports as a share of total grain supply are projected to increase from 44 percent in 2012 to 46 percent by 2022. Only North Africa has a higher projected import share of consumption among the countries and regions analyzed. Of the 11 LAC countries, Jamaica imports more than 90 percent of its grain supply, the Dominican Republic about 70 percent, and Colombia and Honduras about half. The other 7 countries rely on food imports for between 15 percent (Bolivia) and about 40 percent (Ecuador and El Salvador) of grain

supplies. Given the importance of imports to food security, continued strong export performance to maintain import capacity will be key.

The decline in the number of food-insecure people over the next decade is consistent with independent reports of a decline in the rate of poverty and indigence over the last few years (ECLAC, 2011). About 30 percent of the people living in the LAC region were estimated to be living in poverty in 2011, down from 33 percent in 2009 and 48.4 percent in 1990. This decline has been facilitated by an increase in labor income and a gradual (albeit small) improvement in income distribution. The LAC region is among those with the most unequal income distribution, and recent economic improvements have not remedied that. However, since 2003, income distribution has gradually improved in most LAC countries. Gini coefficients, the measure of income inequality (1=completely unequal, 0=completely equal) has fallen by 1 percent or more per year in 10 Latin American and Caribbean countries, 5 of which are among those studied here (Bolivia, Ecuador, El Salvador, Nicaragua, and Peru). Guatemala is an exception, showing an almost 2-percent increase in income inequality, while it rose slightly in the Dominican Republic. This trend toward more equal income distribution has been attributed to rising labor incomes (per person employed) and increased public cash transfers.

Long-term improvements are partly due to a rapid decline in population growth, as indicated by revised population estimates and projections (UN, 2011). The LAC region, more than any other region in the world, has seen a dramatic decline in fertility rates (ECLAC, 2011). This trend started in the 1960s when the average number of children was close to six per woman in Latin America and the Caribbean. By 2015, this average is projected to drop to 2.1 children per woman, just slightly above the average in developed countries (1.7). The countries with the highest rates of fertility—mostly in Central America and the Caribbean—have seen the most dramatic declines.

North Africa

According to USDA-ERS analysis for the North Africa region—Algeria, Egypt, Morocco, and Tunisia—less than 10 percent of the population is food insecure. Average per capita consumption of more than 3,200 calories per day—54 percent above the nutritional target—is close to levels more commonly found in high-income countries. According to FAOSTAT data for 2007, average fat and protein consumption also exceed nutritional targets. Relatively high per capita consumption levels are a result of sustained economic growth during the previous decade as well as food policies that strive to maintain low prices for basic foods.

While the region has maintained a robust average real GDP growth rate of 4 percent since the late 1990s, 2011 brought a slowdown in Egypt (1.2 percent growth) and no growth at all in Tunisia. Only Algeria, due to its oil exports, is expected to continue to grow around 3 percent. Political instability in these countries handicapped their economies. Oil importing countries such as Egypt, Morocco, and Tunisia have seen their import bills rise, while incomes from tourism declined. Remittances and exports remained stable and were thus able to provide some relief.

Table 10

Food availability and distribution gaps for North Africa

Year	Grain production	Root production *(grain equiv.)*	Commercial imports *(grains)*	Food aid receipts *(grain equivalent)*	Aggregate availability of all food
			1,000 tons		
2003	33,174	1,503	20,889	35	55,898
2004	33,495	1,656	19,947	67	56,374
2005	31,105	1,873	26,286	56	59,606
2006	35,766	1,722	26,000	60	61,039
2007	28,114	1,620	29,746	31	62,996
2008	29,457	1,991	32,614	44	64,201
2009	39,093	2,058	30,019	26	64,722
2010	32,319	2,331	34,369	27	66,485
2011(e)	35,965	2,058	34,050	32	68,703
Projections				Food gap* NG / DG	
2012	35,009	2,096	32,554	***0*** / ***0***	67,960
2017	37,774	2,293	42,987	***0*** / ***0***	80,408
2022	40,252	2,500	54,333	***0*** / ***0***	92,165

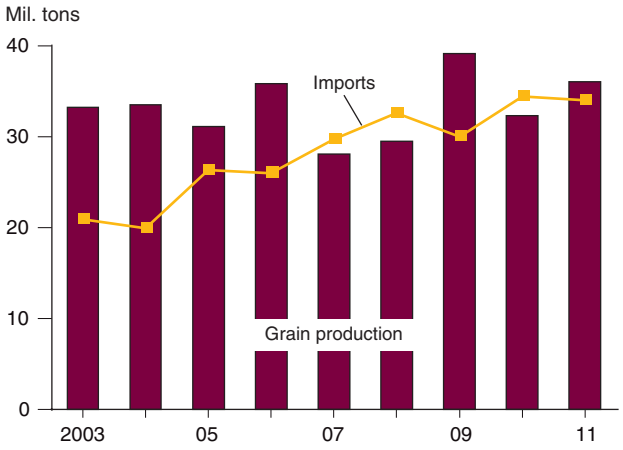
*See table 1.

North Africa
(164 million people in 2012)

Economic performance declined in some countries because of political uncertainty and turmoil. Oil importing countries such as Egypt, Morocco, and Tunisia have seen their import bills rise, while incomes from tourism declined. Remittances and exports remained stable and were thus able to provide some relief.

Assuming that economic growth will resume and given the high level of food availability in the region, food security is expected to remain stable and food consumption is projected to increase over the projection period.

North Africa: Grain production and commercial imports



North Africa: Grain imports as a share of supplies

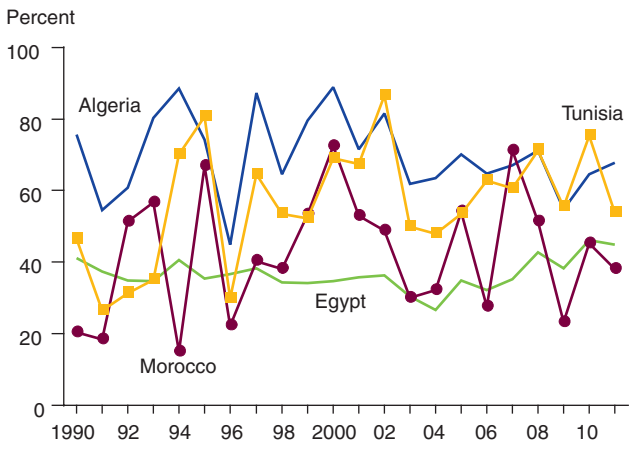


Table 11

North Africa: Projected growth in food security variables[1]

	Grain production	Grain yields	Population	Grain imports	Export earnings
			--Percent growth per year--		
Algeria	1.7	1.1	1.2	4.3	3.9
Egypt	1.5	1.3	1.5	5.5	6.3
Morocco	1.2	1.1	0.9	4.7	5.7
Tunisia	0.8	0.8	0.9	6.3	6.8
North Africa	**1.3**	**1.1**	**1.1**	**5.2**	**5.7**

[1]Annual projected growth between 2012 and 2022.

Source: ERS/USDA calculations based on Food Security Assessment model results, IMF online data, April 2012, and UN Population projection data.

However, growth is projected to recover beginning in 2012 and average almost 4 percent per year through 2016. The governments in these countries have many policies in place to support food security. Retail price controls as well as export restrictions of food products or elimination of import tariffs are all geared toward the goal of making basic foods affordable.

NA governments responded to surging global commodity prices in 2007/08 by increasing their spending on wages and subsidizing food and fuel costs, which resulted in an increase of fiscal deficits to about 8 percent of GDP for the entire North Africa and Middle East region (IMF, 2012). Government policies intended to stabilize consumer prices could not prevent an increase in inflation. Egypt suffered the highest consumer price increases, with inflation of over 11 percent in 2010 and 2011. It is forecast to rise as high as 12 percent in 2014, before declining to 7 percent by 2017 (IMF, 2012). Unemployment rates, especially among young people, rank among the highest in the world and are not expected to improve much given relatively high population growth and moderate projected income growth. The uncertainty, a worsening budget situation, and diminishing foreign reserves have had a dampening impact on foreign investment and increased borrowing costs, which will exacerbate the region's financial situation and likely delay economic recovery.

Sufficient food supplies and food security in the North African region depend on commercial imports. In 2011, commercial grain imports equaled nearly half of total grain supplies. By 2022, the import share of consumption is projected to increase to 63 percent. Tunisia is projected to import 77 percent of domestic grain supplies, ahead of Algeria, at 74 percent. Egypt and Morocco are projected to increase their import shares from around 40 percent in 2012 to around 50 percent by 2022.

Given North Africa's high import share, domestic food production is less crucial than in some other regions, such as SSA. However, about 45 percent of total food is still produced domestically in order to feed the region's 164 million people. NA production grew 2.4 percent annually over the last 20 years (versus population growth of 1.6 percent), and most of this growth was driven by yield increases rather than area expansion. Average production growth over the next 10 years is projected at about 1.4 percent, exceeding projected population growth of about 1.1 percent for the region.

Arable land is relatively abundant in Morocco and Tunisia, less so in Algeria, and scarce in Egypt. Egypt's arable land scarcity has led to high investment in irrigation technology, and most of its production is irrigated. Furthermore, fertilizer use in Egypt is among the highest in the world, at 600 kg/ha in 2007. Egypt's yields, close to 7 tons per hectare, are much higher than its neighbors' average of 1-2 tons. In fact, Egypt's yields are the highest among all 76 countries included in this study. In 2011, Egypt produced more than 20 million tons of grains.

Average production growth masks dramatic annual variations, as the region is susceptible to droughts. During the last 20 years, production levels in Algeria, Morocco, and Tunisia—where less than 5 percent of the arable land is irrigated—have been as low as 30 percent and as high as 170 percent of these 3 countries' 20-year averages. Given consumption levels, recent economic and grain production trends, and external trade performance, the North African

countries included here are projected to have the means to provide sufficient food supplies through 2022.

References

Agence France-Presse (AFP). 2011. "Over 80 dead as rain batters Central America," Oct 17. http://www.google.com/hostednews/afp/article/ALeqM5gbdNanVQ7lU8rV96rjq5P7F6_QzA?docId=CNG.a7531fdac8c142d68b402738294123a2.481

Alliance for Green Revolution in Africa (AGRA) website. 2010. "Can Africa Replicate Asia's Green Revolution in Rice?" Donald F. Larson, Keijiro Otsuka, Kei Kajisa, Jonna Estudillo, Aliou Diagne. The World Bank, Policy Research Working Paper 5478, Nov. http://www.agra-alliance.org/

Asian Development Bank, *Food Security and Poverty in Asia and the Pacific, Key Challenges and Policy Issues,* April 2012.

Canadian International Development Agency. 2012. http://www.acdi-cida.gc.ca/acdi-cida/ACDI-CIDA.nsf/eng/JUD-129123554-NN3.

Economic Commission for Latin America and the Caribbean (ECLAC). 2010. La economía del cambio climático en América Latina y el Caribe. Síntesis 2010, Dec. CEPAL, http://www.cepal.org/cgi-bin/getProd.asp?xml=/prensa/noticias/comunicados/4/44944/P44944.xml&xsl=/prensa/tpl/p6f.xsl&base=/tpl/top-bottom.xsl

Economic Commission for Latin America and the Caribbean (ECLAC). 2011. *Social Panorama of Latin America*, 2011.

Inter-American Development Bank (IDB). 2012. Latin Macro Watch, Country tables, http://www.iadb.org/research/LatinMacroWatch/CountryTable.cfm?country=Peru

International Monetary Fund. 2012. *World Economic Outlook, April 2012: Growth Resuming, Dangers Remain*.

International Monetary Fund. 2012. *Regional Economic Outlook: Sub-Saharan Africa,* April.

La Fundacion SHARE. 2011. "Tropical Depression 12E Causes Estimated $840 Million in Damage and Loss," Nov. 8. http://www.share-elsalvador.org/2011/11/tropical-depression-12e-causes-estimated-840-million-in-damage-and-loss.html, accessed 5/3/2012.

Stocking, M.A. 2003. *Tropical Soils and Food Security: The Next 50 Years*. http://www.sciencemag.org/content/302/5649/1356.full.

United Nations Food and Agriculture Organization. 2012a. *Global Information and Early Warning System (GIEWS) on Food and Agriculture, Crop Prospects and Food Situation*, No. 1, March.

United Nations Food and Agriculture Organization. 2012b. *Global Information and Early Warning System (GIEWS) on Food and Agriculture*, Country Briefs.

United Nations Food and Agriculture Organization, FAOSTAT database.

United Nations, World Food Programme, Sahel Crisis, Mali. http://www.wfp.org/countries/mali.

United Nations. 2011. W*orld Population Prospects, The 2010 Revision, Volume I: Comprehensive Tables,* United Nations, Department of Economic and Social Affairs, Population Division. http://esa.un.org/unpd/wpp/Documentation/pdf/WPP2010_Volume-I_Comprehensive-Tables.pdf

U.S. Department of Agriculture. 2011. GAIN Report # 1111, *Guatemala, Exporter Guide*, Annual, prepared by E. Vasquez.

U.S. Department of Agriculture. 2012. GAIN Report, *Bolivia, Oilseeds and Products*, Annual, prepared by Gaspar Nolte.

World Bank, 2012. *Global Economic Prospects*. http://web.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/EXTGBLPROSPECTS/0,,contentMDK:20675357~menuPK:627723~pagePK:2904583~piPK:2904598~theSitePK:612501,00.html

Special Article

The Impact of Food Price Increases on Food Security of the Most Vulnerable Households: Evidence from Afghanistan

*Anna D'Souza, Dean Jolliffe**

* The authors are grateful to the Government of Afghanistan's Central Statistics Organization for granting access to the data for this research as background for poverty assessment. This report draws on research first presented as a selected paper at the 2011 AAEA Annual Meetings.

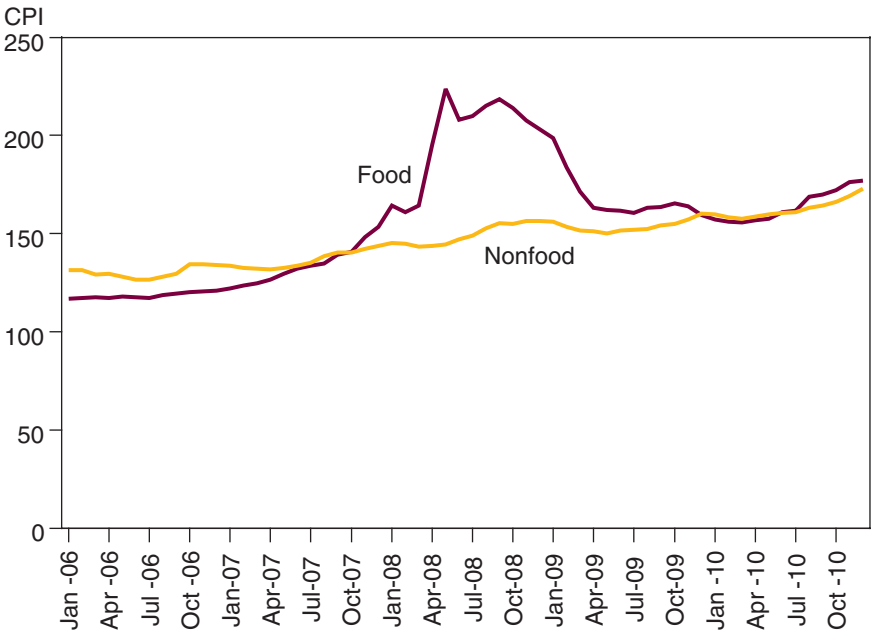
Increases in the prices of staple foods can have serious effects for households living at or near subsistence levels. Over the past few years, increases in global food prices have led to an erosion of purchasing power in many developing countries, where the poor often spend the majority of their budgets on food. Knowing how the most vulnerable households cope with food price shocks can help policymakers and aid workers in developing and targeting safety nets and poverty-alleviation programs.

In this article, we use household survey data from Afghanistan—one of the world's most food-insecure countries—to examine the impact of a rapid increase in staple food prices on household food security. The story of Afghanistan mirrors that of other developing countries. While non-food inflation was approximately 10 percent from 2007 to 2008, food price inflation was approximately 40 percent (fig. A-1). Though the prices of many foods were increasing, the largest price increases were for staple foods, including cereals and breads (fig. A-2). The price of the primary Afghan staple—wheat flour—doubled between December 2007 and July 2008. This rapid price increase was due to international (surge in global commodity prices), regional (wheat export bans in Pakistan, a major trading partner), and domestic (drought) factors. D'Souza (2011) demonstrates that this price shock resulted in a deterioration in food security for the average Afghan household. Households reduced both the quality (as measured by household dietary diversity) and the quantity (as measured by calories) of food consumed in response to the wheat flour price surge.

In this article, we extend the analysis by using a recent innovation in econometrics to disentangle the impacts of the wheat flour price increases on the households that are most vulnerable—for example, those at the bottom of the household calorie distribution—versus those households that are less vulnerable. Such differentiation is important from a policy perspective since governments are often interested in protecting vulnerable populations during periods of economic hardship.

Figure A-1

Food and nonfood consumer price indices

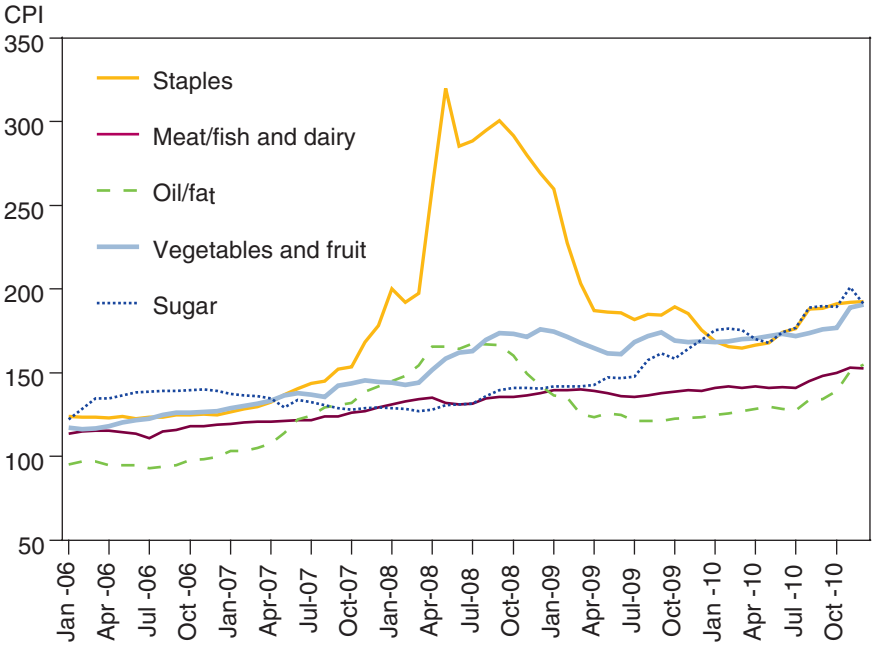


March 2004 = 100.

Source: Central Statistics Office, Government of Afghanistan.

Figure A-2

Consumer price indices by food group



March 2004 = 100.

Source: Central Statistics Office, Government of Afghanistan.

The Afghan Diet

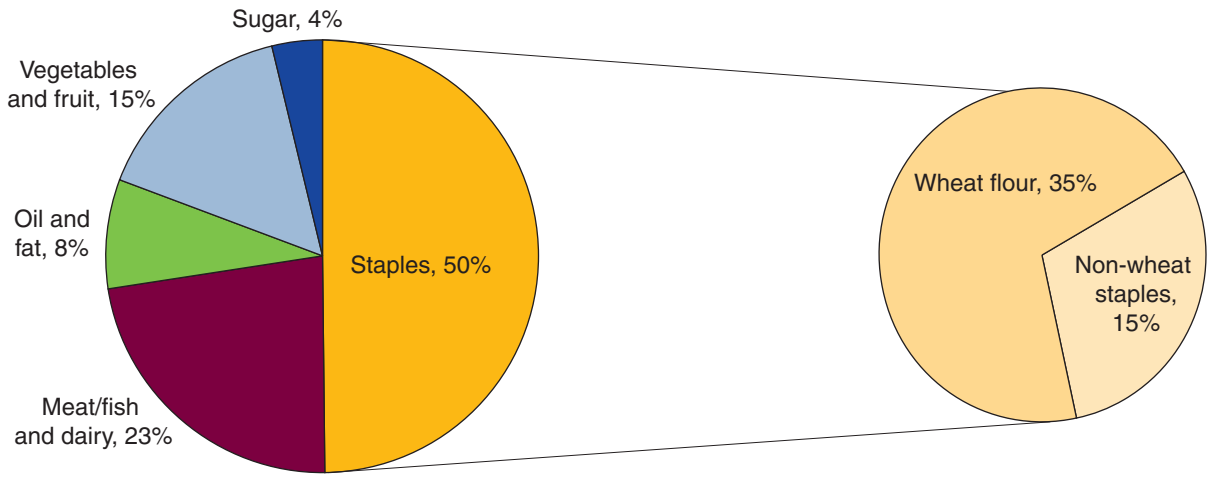
Staple foods make up 50 percent of household food expenditure and 71 percent of daily calorie intake (figs. A-3–A-4). In this analysis, we focus on wheat flour, the primary staple food; it alone accounts for 54 percent of daily calories per capita and 35 percent of household food expenditures. As is the case in many developing countries, the second most important contributor to calories is the oil and fat food group.

The differences in the calorie and expenditure shares reflect price differences between food groups. The cheapest foods—in terms of calories per Afghani (the local currency)—are grains and pulses. For 1 Afghani (approximately 2¢), a household can purchase approximately 184 calories of wheat flour, 106 calories of lentils, or 78 calories of rice. In contrast, meat and vegetables are the most expensive; one Afghani purchases only 9 calories of beef or 10 calories of cucumber.

The Status of Food Security in Afghanistan

Levels of food insecurity and malnutrition in Afghanistan are high. Based on the USDA-ERS Food Security Assessment model, approximately 70 percent of the population are estimated to consume less than 2,100 daily kilocalories per person in 2012. According to the 2004 National Nutrition Survey, approximately 60 percent of children under 5 suffered from chronic malnutrition (stunting) and 8 percent suffered from acute malnutrition (wasting) (Johnecheck and Holland, 2007). Micronutrient deficiency diseases related to deficiencies in iron, iodine, Vitamin A, and Vitamin C are widespread in Afghanistan (Dufour and Borrel, 2007).

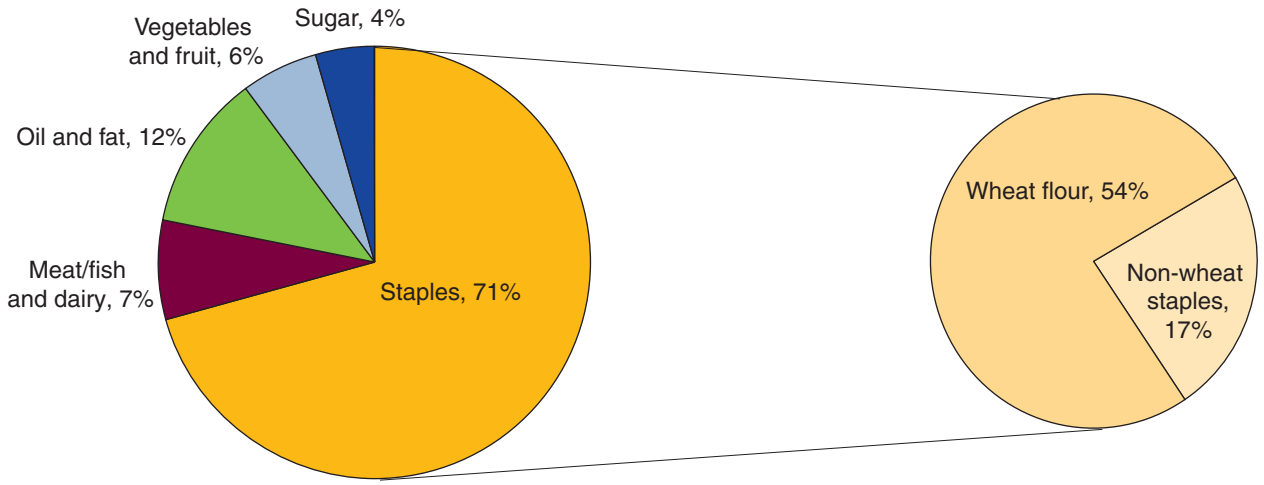
Figure A-3
Expenditure shares



Source: Author's calculations based on the National Risk and Vulnerability Assessment (Nrva), 2007/08.

Figure A-4

Calorie shares



Source: Author's calculations based on the National Risk and Vulnerability Assessment (Nrva), 2007/08.

To conduct our analysis, we use data from a unique household survey administered between August 2007 and September 2008. The survey, the National Risk and Vulnerability Assessment (NRVA) 2007/08, was conducted by the Government of Afghanistan Central Statistics Organization and the Ministry of Rural Rehabilitation and Development.[1] It covered over 20,500 households (over 150,000 individuals) in 2,572 communities in all 34 Provinces of Afghanistan. The survey timeframe covered the run-up in wheat flour prices and the peak in July 2008. Though prices have come down since then, current price levels are higher than those before 2007.

We construct three indicators of household food security: (i) the real value of monthly per capita food consumption; (ii) daily per capita calorie intake; and (iii) household dietary diversity.[2] The real value of monthly per capita food consumption provides a measure of how much food a household consumes. It is an important measure of household well-being and is often used by international aid organizations like the World Bank to analyze household poverty. The measure is calculated by multiplying prices by quantities of food consumed per capita over a month. The total nominal value is then deflated by a price index to get real values.[3]

Daily per capita calorie intake is a widely used measure of health and undernutrition. We use the FAO Food Composition Tables for the Near East to convert daily food quantities into kilocalories. Recent literature suggests that calorie intake is not a sufficient indicator of nutritional status (Deaton and Dreze, 2009); therefore, we include a measure of dietary diversity. We use the food consumption score (FCS), developed by the World Food Programme (WFP). The score represents how frequently households consume foods from

[1]The NRVA survey was stratified explicitly geographically and implicitly over time to ensure that each quarterly sample is representative at the national level. In a country where agriculture is an important form of livelihood, seasonal variations in consumption patterns are to be expected. Therefore, it is critical to capture nationally representative indicators of household food security throughout the year. The yearlong field work also enabled enumerators to access households in conflict zones without compromising the survey design. For details on survey design and implementation, see Islamic Republic of Afghanistan (2010).

[2]Respondents are asked to report the quantity of and frequency with which 91 food items were consumed over the previous week. The three indicators draw on these responses.

[3]Nominal values refer to the actual amount of money spent on food acquired; real or deflated values refer to values that have been adjusted using a price index that takes into account differences in prices over time (months during survey year) and across regions so that one gets a sense of how much less food households are able to purchase as a result of the price increases.

eight different food groups over a 1-week period.[4] The food groups include grains, pulses, vegetables, fruit, meat/fish, milk/dairy, sugar, and oil/fat. Higher scores denote a more varied diet and are suggestive of a higher quality diet with a potential for higher micronutrient intake. Indicators of dietary diversity have been validated against dietary quality (specifically, nutrient adequacy) in both developed and developing countries (Ruel, 2003). We also construct measures of total monthly consumption per capita. For more details on the construction of the variables, see D'Souza (2011).

[4]The score is the weighted sum of the frequencies with which households consume foods within the eight food groups over the previous week. Weights for the food groups range from 0.5 to 4 based on nutrient density. Condiments receive zero nutritional weight. Frequencies are truncated at 7 for each food group. The measure ranges from 0 to 112.

Table A-1 displays the average values of the food security measures, along with monthly total consumption per capita, over the survey year (August 2007 to September 2008). The estimates reveal that Afghan households spend the majority (56 percent in real terms) of their budget on food. Average daily calorie intake per capita is approximately 2,600; however nearly 30 percent of Afghan households do not meet the conventional daily food requirements of 2,100 calories per person.

Nominal values of total consumption and food consumption remained relatively flat over the survey year, but the quarterly estimates of real total consumption and food consumption indicate a general decline in well-being and food security over the survey year.[5] Real monthly total consumption per capita declined by 27 percent between quarter one and quarter four; real monthly food consumption declined by nearly 34 percent. Calorie intake and dietary diversity also declined by 17 percent and 15 percent, respectively.

[5]Nominal values are deflated by price indices that account for differences across regions and over time to obtain real values.

In the empirical analysis, we systematically examine the relationship between these changes and changes in the price of wheat flour for subpopulations of households, after controlling for other factors that may be changing over time, such as the prices of other foods. We focus on households at five points of the distribution (10^{th} quantile, 25^{th} quantile, 50^{th} quantile (median), 75^{th} quantile, and 90^{th} quantile) for each food security indicator.

Food security levels vary widely between these households (table A-2). Households at the bottom of the calorie distribution (10^{th} quantile) report less than half the daily calorie intake of those at the top of the distribution (90^{th} quantile). Households at the 25^{th} quantile and below fail to achieve the

Table A-1

Food security measures, August 2007-September 2008

	Full Year	Quarter 1 (Fall)	Quarter 2 (Winter)	Quarter 3 (Spring)	Quarter 4 (Summer)
Value of monthly total consumption per capita (nominal Afghani)	1,926	2,018	1,903	1,877	1,915
Value of monthly food consumed per capita (nominal Afghani)	1,158	1,197	1,123	1,129	1,183
Share of food in budget (nominal percent)	60	59	59	60	62
Value of monthly total consumption per capita (real Afghani)	1,672	2,022	1,718	1,519	1,478
Value of monthly food consumed per capita (real Afghani)	929	1,201	961	789	798
Share of food in budget (real percent)	56	59	56	52	54
Daily calories per capita	2,601	2,885	2,725	2,446	2,387
Food consumption score	60.9	67.9	61.3	57.9	57.7

Note: Estimated population-weighted means. Real values in Afghani reflect adjustments for spatial and temporal price differences.

Source: Islamic Republic of Afghanistan, Ministry of Economy, and the World Bank Economic Policy and Poverty Sector. 2010.

Table A-2

Food security indicators across the distribution of households

	Mean	10th quantile	25th quantile	50th quantile	75th quantile	90th quantile
Real value of monthly food consumed per capita	929	474	612	810	1,101	1,514
Daily calories per capita	2,601	1,695	2,030	2,441	3,006	3,688
Food consumption score	61	34	46	61	74	88

See notes for table A-1.

conventional 2,100-calorie benchmark. Such households are vulnerable to food price shocks and often are forced to switch to lower quality, cheaper foods in order to maintain calorie intake. The differences between the top and bottom of the other distributions are also large, with households at the 90th quantile of real food consumption consuming over three times as much in value as those at the 10th quantile. The pattern is similar for dietary diversity, with households at the 90th quantile having scores that are 2.5 times those of households at the 10th quantile. Such variation across households suggests that households may respond differently to price shocks depending on their initial level of food security.

Estimating the impact of food price increases on household food security

We use a new econometric estimator—the Unconditional Quantile Regression (UQR) proposed by Firpo et al. (2009)—that allows us to identify price effects for subpopulations of households at different points of a distribution. This flexibility is particularly relevant for policy analysis as stakeholders may be interested in the impact of high food prices on those living close to subsistence levels rather than the average response for all households.

To isolate the effect of wheat flour prices, we control for a range of household, geographic, and economic factors. The factors include prices of key foods in the Afghan diet (milk, lamb, rice, vegetable oil) and the price of kerosene (a commonly used cooking fuel); household characteristics (value of assets[6]; whether the household owns or operates agricultural land; age, literacy, and marital status of household head; household composition); and topographical characteristics (plains, plateau, mountains).[7]

The empirical model is as follows:

$$log\left(fs_h\right) = \beta_0 + \beta_1 log\left(price\ wheat\ flour_{apq}\right) + \theta log(prices_{apq}) + \alpha HH_h + \delta DIST_{dq} + \Pi_p + \varepsilon_h$$

where h denotes household, a denotes area (urban or rural), d denotes district, p denotes province, and q denotes quarter. *fs* represents the food security indicators: (i) the real value of monthly per capita food consumption; (ii) daily per capita calorie intake; and (iii) food consumption (diversity) score. The variable of interest is the log of the price of wheat flour.[8] *Prices* represent the prices of milk, lamb, rice, vegetable oil, and kerosene, included separately; *HH* represents household characteristics; *DIST* represents district-level

[6]Asset values in the regressions include durable goods, housing, and livestock. The value of durable goods is estimated based on a detailed inventory of household assets. It accounts for depreciation and the opportunity cost of the funds tied up in the good. We estimate a hedonic model for housing based on characteristics of the structure, as well as the location, and derive an imputed rental value from this.

[7]We include the household composition variables to control for differences in consumption requirements between children and adults and for economies of scale in consumption.

[8]We use the price of domestic wheat flour. However, the results are qualitatively similar when using the price of imported wheat flour or the prices of domestic or imported wheat.

Table A-3

Effects of wheat flour price increases on food security

	Mean	10th quantile	25th quantile	50th quantile	75th quantile	90th quantile
Log real value of monthly food consumed per capita	-0.425*** [0.0364]	-0.129** [0.0521]	-0.242*** [0.0437]	-0.433*** [0.0447]	-0.619*** [0.0571]	-0.725*** [0.0762]
Log daily calories per capita	-0.184*** [0.0244]	0.004 [0.0444]	-0.0866*** [0.0290]	-0.187*** [0.0268]	-0.279*** [0.0340]	-0.382*** [0.0486]
Log food consumption score	-0.189*** [0.0270]	-0.248*** [0.0576]	-0.246*** [0.0508]	-0.173*** [0.0305]	-0.158*** [0.0319]	-0.183*** [0.0331]

Note: Coefficients and standard errors are from separate, population-weighted regressions with the dependent variable listed in the first column. Total observations: 20,483. OLS standard errors are corrected for clustering and stratification, UQR standard errors are clustered bootstrap (with replacement) estimates. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

variables related to topography; $\prod$ denotes Province dummy variables[9]; and $\boldsymbol{\varepsilon}$ is an idiosyncratic error term.[10]

We use the UQR estimator to obtain the coefficient of interest, β_1, for households at the 10th, 25th, 50th, 75th, and 90th quantiles of each of the three food security indicators.[11] For comparison, we also estimate the model using Ordinary Least Squares (OLS), which provides an estimate of the average effect of wheat flour price increases for all Afghan households. OLS estimation does not allow households with different levels of food security to have different estimated responses to the wheat flour price increases.

Impact of wheat flour price increases on household food security

The econometric results show an overall decline in household food security as a result of increases in the price of wheat flour. We begin by describing the OLS estimates, which provide the average effect for all Afghan households. We find a decline in the real value of monthly per capita food consumed. This reduction is about evenly split between a reduction in calorie intake and dietary diversity. We interpret these results as a quality-for-quantity tradeoff that households make in order to maintain energy (calorie) levels in the face of reduced purchasing power. The dietary diversity coefficient suggests that households changed the composition of foods that they were consuming and moved toward less nutrient-rich foods (the food consumption score weights food consumption frequencies based on nutrient density).

The UQR results across the distributions of households provide a more comprehensive portrait of the effects of the price shocks. Better off households, in terms of the real value of food consumed, experienced a much larger drop in the real value of food consumed than worse off households. In fact, the percentage reduction for these households (90th quantile) is nearly six times as large as the reduction for households at the bottom (10th quantile). Poor households cannot make large reductions in what they are consuming since they live closer to subsistence levels. Furthermore, better off households can cut back in areas such as food away from home, on which households at the 90th quantile spend more than double those at the 10th quantile.

[9]We include province dummy variables to control for observable and unobservable time-invariant province-level factors that could confound the results. While this method does not control for time-varying province characteristics, it does control for factors such as instability and conflict that may be present in certain Provinces throughout the survey year.

[10]For the OLS estimates, we use a standard Huber-White correction to estimate the sampling variance, which allows for correlation of the residuals within primary sampling units (PSU). The standard errors are also corrected for stratification. For estimation of the sampling variance of the UQR estimator, we use a PSU-level bootstrap that accounts for correlation of the residuals within the PSUs, but does not account for the stratification.

[11]The UQR estimator uses influence functions (well-documented in the statistics literature) to estimate the behavioral responses (marginal effects) at specific quantiles of the unconditional distribution of the dependent variable.

The estimates of calorie intake support a similar story. Households with high calorie intake are able to scale back in response to the wheat flour price increases. But there is no evidence of such a response by households at the bottom of the distribution (10th quantile). Even households at the 25th quantile experience a very small decline in intake, equivalent to approximately 175 calories or one-third of a standard naan (Afghan bread). Households that live below the threshold of energy requirements (2,100 calories) are likely unable to cut back on calories without suffering serious nutritional consequences. Therefore, these vulnerable households must adjust their dietary composition to maintain calorie levels, perhaps by cutting back on more expensive, nutrient-rich foods and moving toward cheaper foods and food groups.[12] We explore this possibility below.

The results for food consumption and caloric intake stand in contrast to the literature that shows higher price elasticities for poorer households. The standard result hinges on the fact that typically richer (in terms of income) households devote a much smaller share of their budgets to food and thus are not affected by food price increases to the same extent as poorer households. In Afghanistan, however, all households—even those at the top of the income distribution—spend a large share of their budget on food. More specifically, the top income quintile spends approximately 49 percent on food and the bottom quintile spends approximately 66 percent on food.[13] Thus, it is not surprising that we observe large responses to staple food price increases, even for relatively well-off households. Furthermore, households living near subsistence levels (bottom of the food consumption and caloric intake distributions) likely cannot afford large reductions in food.

For the dietary diversity indicator (food consumption score), households across the distribution experience a decline in dietary diversity.[14] Households at the bottom of the distribution exhibit the largest declines; these households are likely to be poorer households who must move toward cheaper foods in order to maintain calorie levels in the face of the wheat flour price increases. Declines in the food consumption score, if driven by a movement toward less nutritious foods, can have potentially serious implications for vulnerable groups with high nutrient requirements, such as infants and children at developmental stages, pregnant and lactating mothers, and the elderly.

To explore potential changes in dietary composition, we unpack some of the main results. We examine the effect of wheat flour prices on calorie and expenditure shares for major food groups. We look specifically at households at the top and bottom quartiles of the calorie distribution to explain the differential effects found above.[15] Generally, the results suggest a movement toward staple foods, in terms of both expenditure shares and calorie shares (table A-4). The largest reductions in expenditure shares are observed for the meat, fish, and dairy group, which is composed of relatively expensive calories, and the vegetables and fruit group. The changes in calorie shares are generally smaller in magnitude than the changes in expenditure shares, suggesting that households may have made quality adjustments within food groups. For example, if households shifted toward lower quality meat within the food group, then we would observe a statistically significant decline in the expenditure share for the meat, fish, and dairy group, with a smaller decline in the calorie share from that food group.

[12]Households may cut back on non-food expenditures, such as health expenses, as well. Such adjustments can have long-term implications for well-being. In this article, we focus on outcomes related to food security.

[13]Food budget shares are high in many developing countries. For example, according to the 2005/06 Uganda National Household Survey, the top and bottom income quintile spent approximately 30 percent and 59 percent, respectively, on food (FAO, 2012). And according to the 2004/05 Indian Consumption Expenditure Surveys, the top and bottom income quintiles spent about 35.4 percent and 66.3 percent, respectively (FAO, 2012). In contrast, food budget shares for the top and bottom quintiles of U.S. households are 11.4 percent and 16.2 percent, respectively (Schnepf and Richardson, 2011).

[14]It is possible that seasonal differences in availability of certain foods or nutritional requirements could be influencing the results; however, it is unlikely that such typical seasonal variation would change the overall findings given the magnitude of the 2008 wheat flour price surge relative to price changes in previous years.

[15]Our objective is to explain differences in results between the top and bottom parts of the distributions. For illustrative purposes we look at changes for subpopulations at the top (75th-100th quantiles) and bottom (0-25th quantiles) quartiles of the household calorie distribution. We use an OLS estimator to identify the impact of wheat flour prices on calorie and expenditure shares from major food groups for each of these subpopulations.

Table A-4

Changes in expenditure and calorie shares

	Expenditure share		Calorie share	
Food group	Bottom quartile	Top quartile	Bottom quartile	Top quartile
Staples	0.198***	0.248***	0.042***	0.097***
Meat/fish and dairy	-0.072***	-0.084***	-0.001	-0.024***
Oil and fat	-0.035***	-0.026***	-0.020***	-0.024***
Vegetables and fruit	-0.070***	-0.133***	-0.010**	-0.042***
Sugar	-0.021***	-0.005	-0.012***	-0.008**

Note: Coefficients and standard errors are from separate, population weighted regressions with the dependent variable listed at the top of each column, for each food group listed in the first column. Total observations: 20,483. OLS standard errors are corrected for clustering. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Conclusions

The 2008 surge in wheat flour prices in Afghanistan led to declines in the real value of food consumed, in calorie intake, and household dietary diversity for Afghan households. Using the unconditional quantile regression estimator, we find distinct effects based on how well-off a household is with respect to each of these key indicators of food security. We find that households with very low levels of food consumption or very low levels of calorie intake do not make large reductions in either of these indicators, relative to those households with higher levels of food security. These results suggest that the most vulnerable households have little room to scale back in terms of the value of the food they consume or in terms of calorie intake. We find that the surge in wheat flour price causes all Afghan households to reduce the diversity of their diets; however, those households with low levels of dietary diversity make even larger reductions than those with high levels. Thus, households that were likely to be consuming poor diets even before the price surge may have suffered an even greater reduction in dietary diversity, with consequences for nutrient adequacy. Even short bouts of poor nutrition can have long-term health and economic implications (Branca and Ferrari, 2002)—a point that underscores the importance of micronutrient interventions, such as fortification of staples and vitamin distributions during periods of high food prices, for the most vulnerable populations.

References

Branca, F., and M. Ferrari. 2002. "Impact of Micronutrient Deficiencies on Growth: The Stunting Syndrome," *Annals of Nutrition and Metabolism*, 46(Suppl. 1), 8-17.

D'Souza, Anna. 2011. *Wheat Flour Price Shocks and Household Food Security in Afghanistan,*" ERR-121. U.S. Department of Agriculture, Economic Research Service.

Deaton, Angus, and Jean Dreze. 2009. "Food and Nutrition in India: Facts and Interpretations., *Economic and Political Weekly*, XLIV(7): 42-65.

Dufour, Charlotte, and Annalies Borrel. 2007. "Towards a Public Nutrition Response in Afghanistan: Evolutions in Nutritional Assessment and Response," *Reconstructing Agriculture in Afghanistan*. A. Pain and J. Sutton (eds.). Warwickshire: FAO and Practical Action Publishing.

Food and Agriculture Organization of the United Nations (FAO). 2012. "Integrating Food Security Information in National Statistical Systems," S. Ramasawmy, Rome.

Firpo, Sergio, Nicole Fortin, and Thomas Lemieux. 2009. "Unconditional Quantile Regression," *Econometrica*, 77(3): 953-73.

Islamic Republic of Afghanistan, Ministry of Economy, and the World Bank Economic Policy and Poverty Sector. 2010. "Poverty Status in Afghanistan: A Profile Based on the National Risk and Vulnerability Assessment (Nrva) 2007/08," Kabul.

Johnecheck, Wendy A., and Diane E. Holland. 2007. "Nutritional Status in Postconflict Afghanistan: Evidence from the National Surveillance System Pilot and National Risk and Vulnerability Assessment." *Food & Nutrition Bulletin*, 28(1): 3-17.

Ruel, Marie T. 2003. "Operationalizing Dietary Diversity: A Review of Measurement Issues and Research Priorities," *The Journal of Nutrition*, 133(11): 3911S-26S.

Schnepf, Randy, and Joe Richardson. 2011. "Consumers and Food Price Inflation," Congressional Research Service.

Special Article

Agricultural Development and Food Security in Brazil

Nicholas Rada

Brazil is widely recognized for its substantial progress in improving food security and reducing poverty. These achievements reflect success in a number of areas—increased agricultural productivity, policies that support growth and trade, and national programs to reduce food insecurity. Brazil's achievements are now being linked to broader food security efforts. In April 2012, the United States and Brazil signed a new Memorandum of Understanding (MOU) to support Feed the Future through collaborative food security work in Latin America and Sub-Saharan Africa.[1] The Brazilian program of conditional cash transfers in particular has catalyzed the adoption of similar programs in other countries, most recently in Sub-Saharan Africa (Garcia and Moore, 2012).

Brazil has long implemented public programs to boost its food production and consumer access. Yet it was not until the 1980s that the Brazilian Government made national food security a priority (Chmielewska and Souza, 2011). Building on previous initiatives, President Luiz Ignácio Lula da Silva initiated Brazil's progressive Fome Zero (Zero Hunger) food security strategy in 2003. This program, which is often credited with alleviating poverty and improving food security, has had the benefit of coinciding with economic growth. For example, Brazilian average per capita GDP rose 0.24 percent per year between 1980 and 2002, and then rose by 3.5 percent per year between 2003 and 2008 (World Bank, 2011). The latter growth was concurrent with significant improvements in the incomes—and, thus, the food access—of Brazil's poorest people.

National food security strategies universally include two key goals: improving food availability and food access. That is, such strategies often try to ensure the availability of and access to a targeted number of daily calories per person, with 2,100 calories a commonly recommended target. Brazil has extended that concept to include not only food but nutritional security, emphasizing a regular supply of food that is not only of sufficient quantity but also of sufficient nutritional quality (Fome Zero, 2012). To improve our understanding of Brazil's rising food security status, this article reviews the country's agricultural development and food security policies, analyzes the composition and efficiency of its agricultural production and growth in agricultural trade, evaluates consumer access to food and the impact of some of Brazil's conditional cash transfer programs, and measures the progress of Brazilian food security.

[1]The announcement citation is: http://iipdigital.usembassy.gov/st/english/texttrans/2012/04/201204093524.html#axzz1vDyP9Kwl).

Agricultural Development and Food Security Policy

Fome Zero builds upon policies fostering growth in agricultural productivity and trade. Those policies were implemented over a long period in which the economy slowly transitioned from import substitution industrialization (ISI) to a more liberalized economic environment.

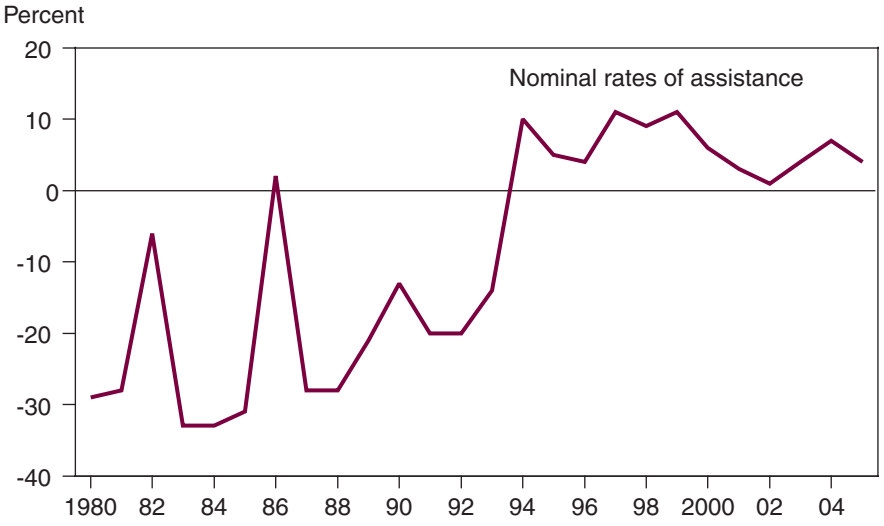
From Import Substitution Industrialization to the Real Plan

Brazil's economic development strategy historically centered on ISI policies aimed at increasing domestic capital production and foreign currency reserves. A 1964 military *coup* altered economic planning, and Brazilian agriculture in the 1970s enjoyed rapid export-led growth, largely through soybean trade and the expansion of processed and semi-processed agricultural exports (Graham et al., 1987). A 1980s debt crisis initiated an economywide shift from ISI to a liberalized strategy, one that intensified under a macroeconomic strain of hyperinflation in the early 1990s. With the return of elected officials in 1985, policymakers implemented a variety of stabilization schemes, including the *Cruzado* (1986), *Bresser* (1987), and *Verao* (1989) plans. Each aimed unsuccessfully at harnessing inflation. The broader *Collor I* and *II* plans were introduced in 1990-1992 to stabilize prices, deregulate and modernize the economy, and facilitate trade. The failure of the *Collor* plans led to the largely successful 1994 *Real* plan, which included market-oriented reforms such as a reduced government role in production, trade, and setting prices and contributed to agricultural modernization, especially in the pig, poultry, and dairy sectors (Helfand and Rezende, 2004).

The *Real* plan substantially altered producer incentives, as measured by the World Bank's nominal rates of assistance (NRA) to agriculture (fig. B-1) (Anderson et al., 2008). For example, Brazil's NRA estimates of the percent annual change that price-distorting policies induced in gross farm returns show that in 1993, producers faced an implicit taxation rate of 14 percent,

Figure B-1

Brazil's improving producer incentives, 1980-2005



Source: Anderson, et al., 2008.

while by 1994 they faced implicit subsidization of 10 percent (fig. 1). Thus, the *Real* plan affected agricultural producers by providing a 24-percent policy-induced improvement in gross returns, a shift that likely boosted farm technology investment.

Development of Fome Zero

Brazil's return to elected officials marked the onset of a national emphasis on food and nutritional security, starting in 1985 with the Ministry of Agriculture's technical discussion, "Food Security – Proposal for a Policy to Fight Hunger" (Chmielewska and Souza, 2011). As policymakers wrestled with macroeconomic instability, they sought to define the best approach to improving national food security. To this end, President Franco (1992-95) focused on hunger, declaring its alleviation a priority in 1993. That year, an important policy instrument emerged for transferring incomes among the Brazilian population: the Social Assistance Organic Law (SAOL) (Garbelotti, 2007). This social welfare policy provides the elderly and disabled with a monthly stipend, set at the minimum wage, if the household earns one-quarter of the minimum wage (per capita in the household) or if care by family members is not possible.

President Cardoso's 1995 *Comunidade Solidária* program shifted the policy emphasis from hunger to poverty reduction (Chmielewska and Souza, 2011). In 2001, President Cardoso created the federal *Bolsa Escola* (School Grant) program, a broader application of the education-focused conditional cash transfer program initiated in Brasilia (the Federal District) and Campinas (in São Paulo State) in 1995 (Glewwe and Kassouf, 2012). Garbelotti (2007) notes that since the late 1990s, conditional cash transfer programs became the primary policy instrument for fighting food insecurity.

President Luiz Ignácio Lula da Silva (2003-2010) created Fome Zero (Zero Hunger) in 2003, a national strategy that employs a multifaceted approach to reducing food insecurity (Fome Zero Booklet, 2012). Widening food access and strengthening family agriculture are the primary components of Fome Zero.[2]

Fome Zero Programs

The most widely recognized Fome Zero program to improve consumer food access is *Bolsa Família* (Family Grant), a conditional cash transfer scheme initiated in 2003/04 that focuses primarily on immediate poverty relief and strengthening basic health and education. The program has three dimensions: (i) immediate poverty alleviation through income transfers, (ii) investment in human capital through health and education programs, and (iii) the coordination of complementary programs (Garbelotti, 2007). In 2009, the program's level of funding reached R$12 billion (US$5.87 billion),[3] making it the largest conditional cash transfer program in the world (Rocha, 2009).

To improve operational efficiency, five conditional cash transfer programs were brought under the purview of Bolsa Família: Bolsa Escola, Bolsa Alimentação (Food Grant), Cartão Alimentação (Food Card), Auxílio Gás (Gas Aid), and later, the Program of Child Labor Eradication (PETI) (Garbelotti, 2007). Some of the programs had been coordinated by different

[2]For more information about Fome Zero's allocated budget, see: http://www9.senado.gov.br/portal/page/portal/orcamento_senado/LOA/Elaboracao:PL.

[3]Conversion factor: R$1 = U.S.$0.49 (www.xe.com; accessed 06/04/2012).

Government Ministries; for example, Bolsa Escola was administered by the Ministry of Education; Bolsa Alimentação, by the Ministry of Health; and Auxílio Gás, by the Ministry of Mines and Energy. In 2004, Bolsa Família absorbed the programs, placing them all under the control of the Ministry of Social Development and Hunger Alleviation. Bolsa Família itself is administered in partnership with municipal governments, which are in charge of registering and monitoring program beneficiaries.

Benefits from this scheme are conditional on participants meeting specific educational and health requirements. Families must ensure that their children, ages 6 to 15, maintain an 85-percent attendance rate at school, rather than simply being enrolled. Moreover, families must keep a record of health clinic visits and vaccinations for children ages 0 to 6. Pregnant and nursing women must also maintain a record of health clinic visits (Rocha, 2009).

Other activities to improve food access include various food and nutrition programs aimed at both consumers and producers. They include the National School Food Program (PNAE), a program aimed at increasing the number of rainwater cisterns in Brazil's semi-arid regions, basic food tax exemptions, vitamin A and iron distribution, and a public network of food banks, low-price restaurants, community kitchens, and markets (*Fome Zero Booklet*, 2012). The National School Food Program has three primary objectives: (i) to cover a minimum 15 percent of a child's daily nutritional needs, including calories, proteins, and other nutrients; (ii) to boost a child's learning capabilities; and (iii) to foster healthy food habits in children and adolescents (Rocha, 2009). PNAE requires the Federal Government to fund the cost of food, but municipal governments are responsible for all other costs, such as those related to infrastructure and personnel. Rocha (2009) notes that Federal funds account for 49 percent of the financial requirements, municipal governments cover 42 percent, and State governments 3 percent—with the remaining 6 percent accounted for through funds from foundations and the private sector.

The National Program for Strengthening Family Farming (PRONAF) and the Food Acquisition Program (PAA) are the primary instruments for strengthening family agriculture. PRONAF was established in 1996 as a credit program targeted to producers who rely on family labor. This assistance is important because in 2006, over 80 percent of Brazil's rural enterprises were classified as family farms, generating 38 percent of all agricultural value and employing 74 percent of all agricultural labor (Rocha, 2009). PAA, established in 2003, is a program that facilitates market access exclusively for family farmers through direct government purchase of farm commodities at market prices, generating food stocks to help regulate prices, and distributing food to food-insecure individuals as well as schools and hospitals (*Fome Zero Booklet*, 2012). By providing credit and strengthening food chains, these two investment programs aim to boost food availability and accessibility. In 2008, the Food Acquisition Program benefited 118,000 farmers and was present in over 3,500 municipalities (Rocha, 2009). By 2009, the program had donated food to over 13 million people (Chmielewska and Souza, 2011).

Analyzing Food Availability[4]

The *Real* plan appears to have coincided with significant growth in agricultural production and trade. Improved agricultural production, while generally

[4]For the purposes of the present article, food availability is defined as agricultural production plus net trade and changes in stocks minus non-food use and waste.

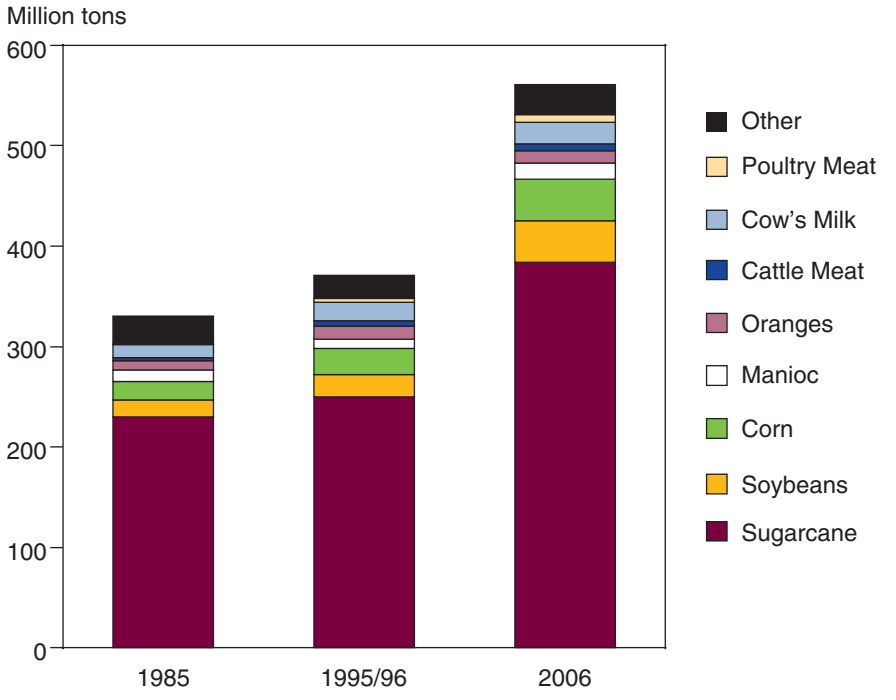
credited with increasing food availability, may also contribute to wider food access. For example, food access at the household level could be widened when greater production improves local availability and lowers consumer food prices. Higher farm revenues could also expand consumer access, as may occur when production beyond household consumption requirements is sold. At the national level, excess production may also boost food access. When domestic production of some goods is above the requirements of the general population, exports generate income that can boost consumer purchasing power and government revenues, as well as create foreign reserves to be applied toward food imports. Thus, boosting production and trade, whether at the household or national level, are important elements of raising food availability and improving food access.

Measuring Agricultural Production and Productivity Growth

Brazil's decennial agricultural census data (1985, 1995/6, and 2006) indicate that farm production rose 77 percent between 1985 and 2006 (IBGE, 2011).[5] Thirty percent of that growth occurred between the 1985 and 1995/6 census periods and 70 percent between the 1995/6 and 2006 censuses (fig. B-2).[6] Over that time, production shifted away from the traditional export crops of coffee and cocoa toward soybeans, corn, sugarcane, and livestock products. The proportion of total revenues generated by the livestock subsector rose from 28 percent in 1985 to 34 percent in 2006.

Brazil has made substantial gains in boosting agricultural output (fig. B-2), and these gains were not completely resource driven. Aggregate land and labor employed in production declined over the three census periods while material input expenditures rose, suggesting an intensification of production

Figure B-2
Brazil's rising production, 1985-2006



Source: Rada and Valdes (2012).

[5]The output data are constructed as a revenue-share-weighted output quantity index using 19 Brazilian commodities.

[6]Logarithmic growth is used to measure the change in output.

processes. However, that aggregate land figure masks shifts across different land groups. For example, over the 3 census periods, permanent cropland expanded by 17 percent, but temporary cropland contracted by 9 percent, suggesting that annual crop production may have intensified amid an expansion of permanent cropland.[7]

[7]Permanent croplands are those planted to perennials, and temporary croplands are planted to annuals, forages, and flowers.

Output and input changes may provide general indications of production's resource-intensive nature, but it is total factor productivity (TFP) growth that most accurately captures the long-term sustainability of any production process. Unlike partial productivity measures such as land productivity (output per hectare) or labor productivity (output per laborer)—which attribute production improvements to only one production factor—TFP growth accounts for all measureable farm inputs to production. Thus, any output growth not accounted for by all measurable production factors is often attributable to technical progress.[8]

[8]The improvement or degradation of resource quality is another, albeit often unmeasured, source of productivity growth.

Analysis by Rada and Valdes (2012) finds that Brazil has indeed improved its productive efficiency. Their results indicate that between 1985 and 2006, average TFP growth on Brazil's farms improved by 2.6 percent per year. Thus, Brazil's farmers were able to produce 62 percent more in 2006 than in 1985, holding 1985 input levels constant. Such strong productivity growth is likely to translate into improved food availability. And indeed, calories available per capita and per day in Brazil rose nearly 18 percent, from 2,632 available calories in 1985 to 3,100 in 2007 (FAO, 2011).

Contributions from Agricultural Trade

Consistent with the rapid rise in production over the last 30 years, Brazil has experienced substantial agricultural export growth. Between 1985 and 2008, the total real value of Brazilian agricultural exports increased by more than 5 percent per year, reaching more than $45 billion (2000 $) in 2008 (fig. B-3) (FAO, 2011; World Bank, 2011).

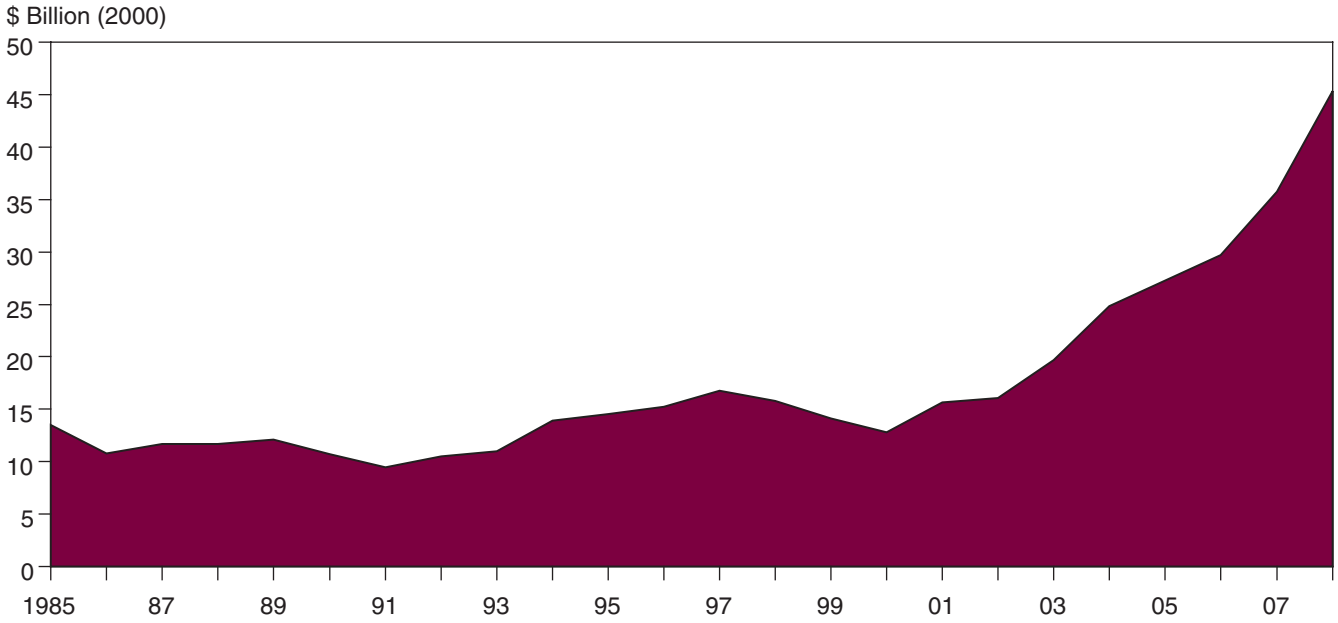
Brazil's export growth was driven by grains, oilseeds, meats, and sugar, which accounted for nearly 59 percent of total export value, or over $26.6 billion (2000 $) in 2008.[9] Annual export growth averaged 23.5 percent for grains, 9 percent for oilseeds, and 10 percent for meat from 1985 to 2008. This growth was particularly pronounced in the 1994-2008 period, with export growth of cereals topping 42 percent per year and that of oilseeds reaching 13 percent per year. And these growth rates are not simply price effects; average annual export value growth mirrors volume growth over the same span.

[9]Soybeans account for an average 99.3 percent of total oilseed values between 1985 and 2008.

Brazil's strong production growth has contributed to substantial trade surpluses (values of exports less values of imports). Total agricultural import values rose from $1.96 billion (2000 $) in 1985 to $6.5 billion (2000 $) in 2008, or 4 percent per year. Brazil's trade surplus thus rose from $11.6 billion in 1985 to nearly $39 billion in 2008 (FAO, 2011). More specifically, figure B-4 shows the trade surplus with respect to the primary agricultural imports and exports in 2009. In that year, wheat, corn, barley, and rice accounted for 62 percent of total import volumes, while soybeans, sugar, corn, and chicken meat accounted for 64 percent of total export volumes. Evaluating the trade surplus with respect to these seven commodities suggests Brazil is exporting

Figure B-3

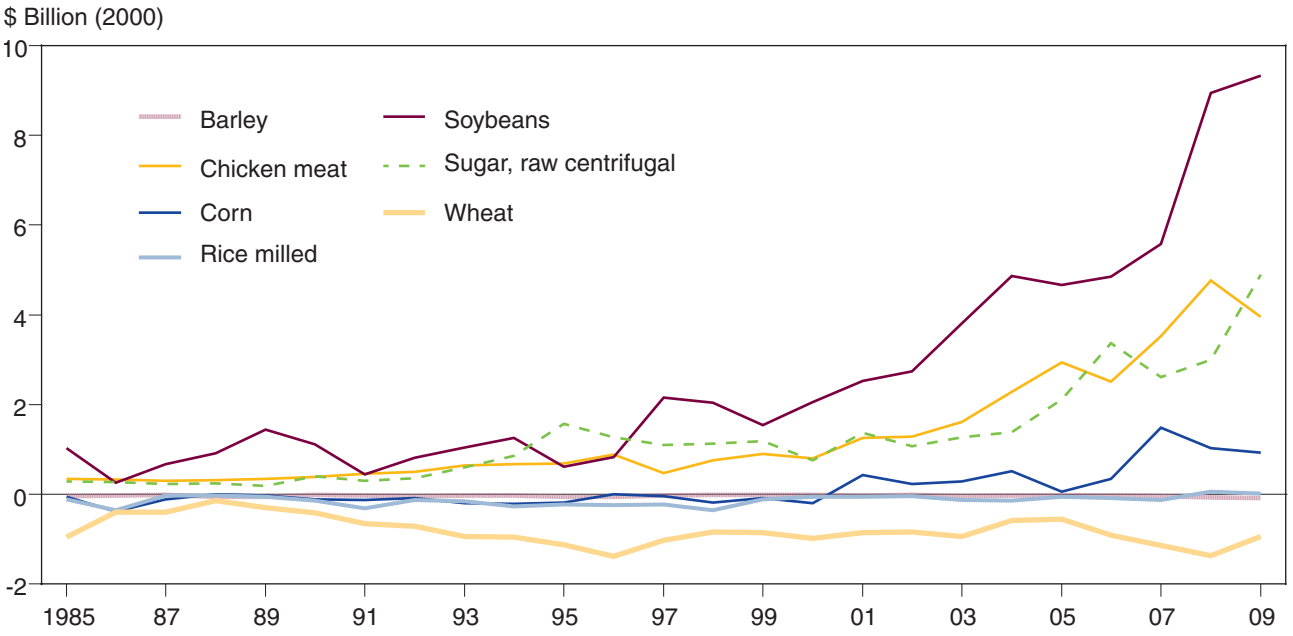
Brazil's agricultural export growth, 1985-2008



Source: FAO (2011) and World Bank (2011).

Figure B-4

Brazil's trade surplus of selected commodities, 1985-2009



Source: World Bank, 2011.

commodities in which it has a comparative advantage while importing food crops wheat, rice, and barley. Those commodity surpluses suggest that farm exports have helped strengthen farm incomes, government revenues, and export earnings, all of which may contribute to improved food security.

Evaluating Food Access

Despite Brazil's ample food supply, access to it eludes many. A highly skewed income distribution has contributed to high poverty rates, creating an economic barrier to food. For example, in 2004, 30 percent of the Brazilian population—or 52.5 million people—were considered poor, living on a monthly income that is up to half of the country's minimum wage (Garbelotti, 2007).[10]

Improving Economic Access

Meade et al. (2004) report that consumer access has been Brazil's greatest constraint to improving food security; lower income households are unable to gain the necessary access. For example, Meade et al. find that in 2002, the poorest 10 percent of Brazilians consumed only 79 percent of their nutritional requirement. Between 1985 and 2003, the share of the nation's income held by the poorest sector remained at 0.88 percent.

The implementation of Fome Zero has, however, coincided with substantial changes in consumer income. The lowest quintile enlarged their share of income by nearly 4 percent each year between 2003 and 2009 (table B-1), achieving 3.3 percent of Brazil's total income in that last year. And Brazil's poorest 10 percent achieved a mean income share of 1.1 percent during the 2003-2009 period, topping the share achieved over the previous two decades.

[10]In April 2006, Brazil's monthly minimum wage was 350 Reals (IPEA, 2006).

Table B-1
Average income shares by quintile and decade, 1980-2009

	Average income shares			Average growth rates		
	1985 - 1993	1994 - 2002	2003 - 2009	1985/86 - 1993/94	1994/95 - 2002/03	2003/04 - 2006/09
	Percent			*Percent change*		
Top 10 percent	47.1	46.2	43.8	0.0	-0.3	-1.0
Top 20 percent	63.3	62.1	59.4	-0.1	-0.3	-0.8
Second 20 percent	5.5	5.7	6.7	-0.2	0.9	2.8
Third 20 percent	10.2	10.7	11.5	0.6	0.5	1.2
Fourth 20 percent	18.5	19.0	19.4	0.3	0.2	0.3
Lowest 20 percent	2.4	2.4	2.9	-1.8	1.4	4.0
Lowest 10 percent	0.9	0.9	1.1	-1.8	1.8	3.0

Source: World Bank, 2011.

Unsurprisingly, as the middle and lower income classes of the Brazilian population increased their share of total wealth, poverty declined (fig. B-5). Between 2003 and 2009, the proportion of Brazilians living on $2 (PPP) per day declined more than 13 percent per year, falling to 9.9 percent in 2009 (World Bank, 2011). While incomes have improved for many Brazilians and poverty has been nearly halved in 4 years, food access constraints likely persist for more than 19 million Brazilians who lived on less than $2 per day in 2009 (World Bank, 2011).

Impacts from Bolsa Família

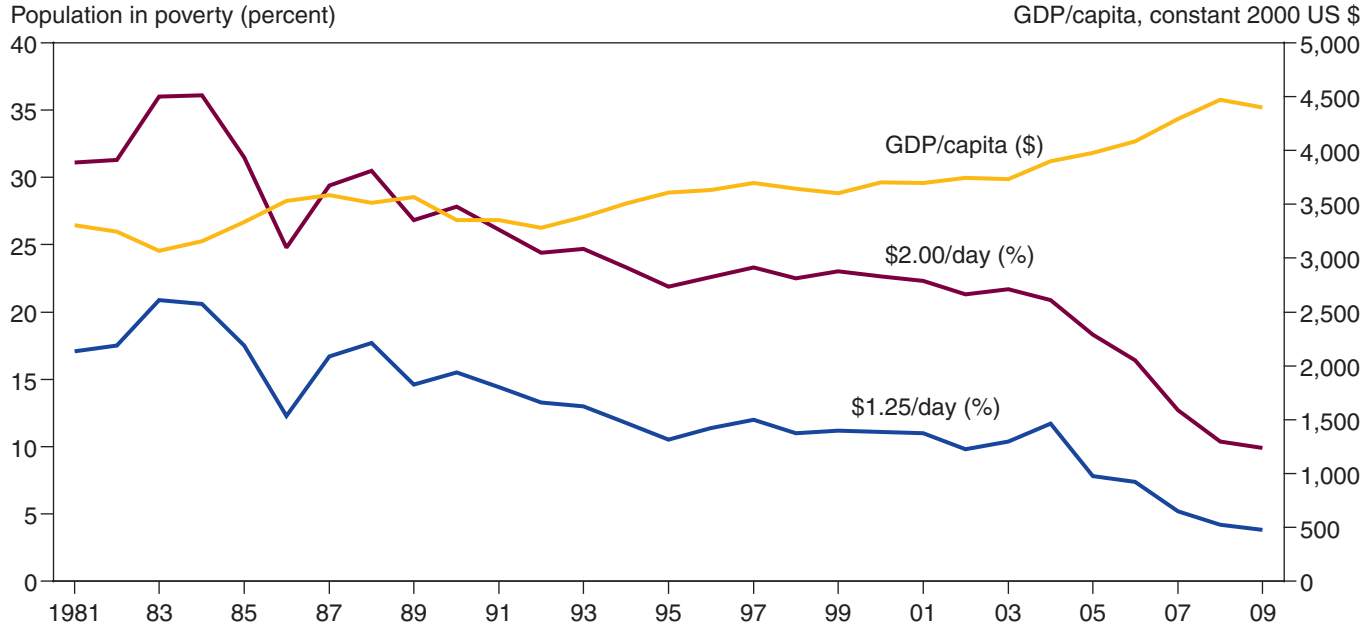
The overarching purpose of the Bolsa Família program is to help the poorest Brazilians rise out of poverty.[11] Through investments in human capital, the goal is to break the intergenerational transmission of poverty through capital accumulation and stimulating demand for social services such as schools and medical clinics (Garbelotti, 2007). Intergenerational poverty is perpetuated through a number of channels, and primarily through children (Barrientos and DeJong, 2006). In 2000, Brazil had approximately 8.3 percent of its entire population between the ages of 10 and 15 in the labor force, or 1.5 million child laborers (Cardoso and Souza, 2004).

Barrientos and DeJong (2006) note that childhood poverty is strongly linked to less schooling and that lower education leads to nutritional deficiencies and stunting. Furthermore, nutritional deficiencies lead to lower learning outcomes, and a mother's education has been shown to be important to a child's well-being. Not surprisingly then, using a 1999 household survey to simulate the potential future impacts of Bolsa Escola on schooling and child labor, Bourguignon et al. (2003) found that, in their sample, children ages 10 to 15 who strictly attend school (i.e., do not work) come from wealthier and more educated households.

[11]For a budgetary review of Bolsa Família, see Garbelotti (2007).

Figure B-5

Brazil's rising incomes and falling poverty, 1981-2009



Source: World Bank, 2011.

Questioning the impact of conditional cash transfers on school enrollments and child labor, Bourguignon et al. further find that 40 percent of all 10- to 15-year-olds and 60 percent of 10- to 15-year-olds from poor households not enrolled in school enroll in response to the program. Cardoso and Souza (2004), estimating the impact of Brazilian cash transfers on child labor and school attendance, suggest that while the program does alter a child's time allocation between school and work, it is not associated with a net reduction in child labor. Both sets of authors indicate that the amount of the cash transfer is inadequate to alter family incentives to forgo a child laborer's income. Glewwe and Kassouf (2012) employ a panel data of school census information to evaluate the impact of the conditional cash transfer scheme on school enrollment, drop-out rates, and grade promotion in primary and lower secondary levels. They find that the programs increased enrollment by at least 5.5 percent, lowered dropout rates by at least 0.4 percentage points, and raised grade promotion rates by at least 0.3 percentage points.

These analyses suggest a consistent impact on a child's human capital from the conditional cash transfer programs: more children who were not in school are able to attend. Yet enforcement is difficult. In 2005, 8.7 million families were enrolled in Bolsa Família, comprising 78 percent of the 11.1 million families targeted by the program (Garbelotti, 2007). Of those 8.7 million families, Garbelotti indicates that 75.6 percent of them were satisfying the educational conditions for the program, while 31.3 percent of those families were satisfying the health conditions.

Measuring Progress on Food Security

Given the improving incomes for Brazil's poorest and the substantially lower poverty levels after Fome Zero's implementation (table B-1), we should anticipate improvement in Brazil's food security after 2003. Because Brazil is not included in the ERS' International Food Security Assessment, two alternative food security measures are evaluated: the International Food Policy Research Institute's (IFPRI) global hunger index and the Brazilian Institute of Geography and Statistics' (IBGE) household food security survey. Overall, these two assessments show improvement in Brazil's food security. Differences in methodology and sample time periods, though, produce results that vary in terms of progress.

IFPRI's Hunger Index

IFPRI's global hunger index relies heavily on the nutritional status of children. The index is an equally weighted indicator of the proportion of the undernourished population as a percentage of the total population, the prevalence of underweight children under the age of 5, and the under-5 mortality rate (IFPRI, 2011). IFPRI's global hunger index has a minimum score of 4, indicating minimal or zero evidence of hunger. In 1990, there were 11 countries with that optimal score; Brazil ranked ninth outside of that optimal category.

Each of the measure's three factors has fallen substantially, leading to a decline in Brazil's hunger index score from 7.6 in 1990 to 4 in 2011 (fig. B-6). As of 2011, there were 35 countries with a top score, Brazil being one of them. This is in stark contrast to other countries such as South Africa, which

fell from 8th position in the hunger index to 13th. The worst global hunger scores in 2011 were ascribed to Burundi and the Democratic Republic of Congo, with scores of 37.9 and 39, respectively.

Between each sample year, Brazil achieved substantial improvement in every factor IFPRI uses to construct its global hunger index. The greatest declines in each measure, however, occurred between 2001 and 2011, a period roughly concurrent with Fome Zero. Between those sample years, the share of children undernourished fell 41 percent, the prevalence of underweight children declined 52 percent, and the under-5 mortality rate fell 42 percent.

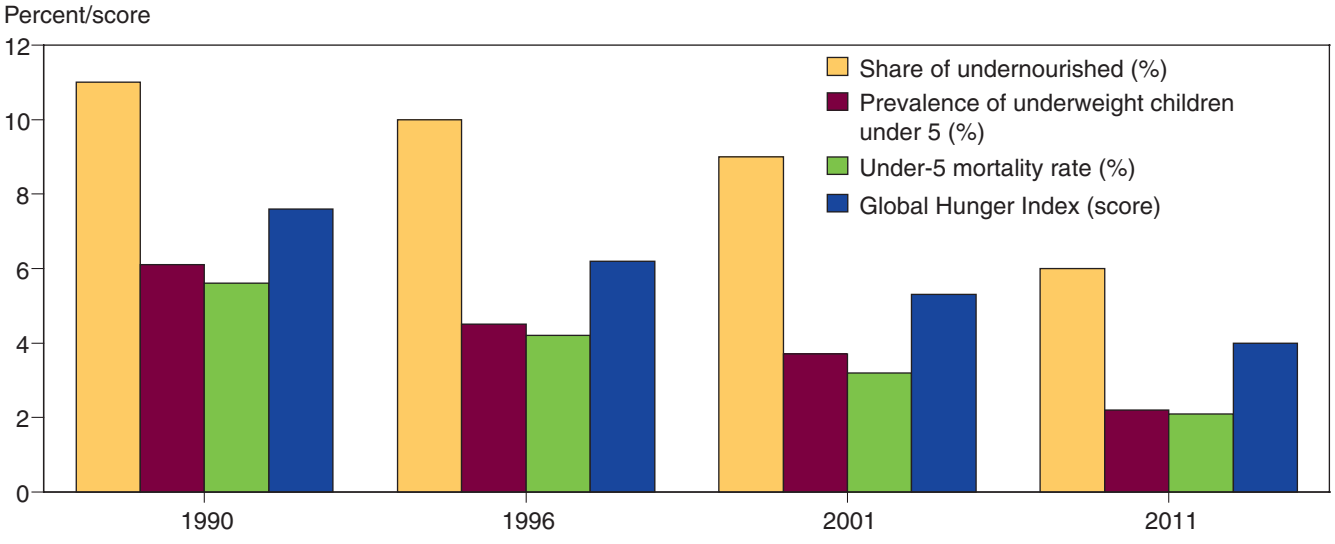
IBGE's Household Survey of Food Security

In 2004 and 2009, Brazil implemented a random, nationally representative sample survey of household food security (IBGE, 2010). Results from those surveys indicate that residents who considered themselves as having some food insecurity fell from 39.8 percent in 2004 to 34.2 percent in 2009. The survey data also provide a measure of children's food insecurity. For children less than 4 years old, those that were considered as having some food insecurity declined by the largest margin of all age groups: down from 50.5 percent in 2004 to 43.4 percent in 2009. That 7-percentage-point drop was nearly achieved by children between the ages of 5 and 17 years as well. This category of children experienced a 6-percentage-point decline in food insecurity from 48 percent in 2004 to 42 percent in 2009.

The survey further estimates food security by gender and race/color. Between 2004 and 2009, food insecurity declined from nearly 40 percent among both male and female populations to 34 percent, suggesting no gender bias in Brazil's food insecurity. Estimates of food insecurity with respect to race/color,

Figure B-6

Brazil's improving food security, 1990-2011



Notes: Proportion of undernourished in the population (%) data are for years 1990-92, 1995-97, 2000-02, 2005-07.
Prevalence of underweight in children under 5 years of age (%) data are for years 1988-92, 1994-98, 1999-2003, 2004-09.
Under-5 mortality rate (%) data are for years 1990, 1996, 2001, and 2009.

Source: IFPRI, 2011.

however, vary widely. In 2004, Brazil's Black and Brown population experienced a food-insecure proportion (52.4 percent) nearly double that of the White population (28 percent) and the Yellow or Indigenous population (27 percent). By 2009, these proportions of food insecurity had fallen to 43 percent (among the Black and Brown populations), 25 percent (among the White population), and 22.9 percent (among the Yellow or Indigenous populations). Thus, while Brazil's Black and Brown population had the highest rates of food insecurity, this group also experienced the greatest decline in food insecurity (9 percentage points) between 2004 and 2009.

Other indications of improved food security that revolve around children's health include infant mortality. Rocha (2009) notes a 47-percent decline in infant mortality, down from 47 deaths per 1,000 in 1990 to 25 deaths per 1,000 in 2006. Rocha further notes that in the semi-arid Brazilian Northeast (the poorest region of the country), malnutrition has dropped from 17.9 percent in 1996 to 6.6 percent in 2005.

Conclusion

Over the previous three decades, Brazil has made significant strides in boosting agricultural production and per capita incomes and lowering food insecurity and poverty rates. These successes appear to have been supported by agricultural and economic development policies that boosted agricultural productivity growth and generated large trade surpluses.

The most widely recognized program in Brazil's Fome Zero food security strategy is Bolsa Família, the conditional cash transfer scheme. Bolsa Família is 1 of 16 cash transfer schemes, and the largest conditional cash transfer program, worldwide (Garcia and Moore, 2012). In keeping with the progressive nature of Bolsa Família, the State lets citizens decide for themselves what foods to access. This freedom has, however, led to questions of whether Brazilians are accessing the most nutritious foods. For example, Chmielewska and Souza (2011) note that among the 5-year-old children registered in the Brazilian health sector's System of Food and Nutritional Surveillance program, the incidence of overweight children rose from 6.4 percent in 2003 to 9.7 percent in 2009.

Lacking a quantitative analysis of the role Fome Zero—or even Bolsa Família—has played makes it extremely difficult to characterize Brazil's food security strategy as the sole driver of its improving food security status and poverty reductions. Garbelotti (2007) suggests the primary drivers of lower poverty rates are Brazil's robust economic growth, an adjustment of the minimum wage above the level of inflation, and the cash transfers associated with Bolsa Família. Rocha (2009) asserts that the 4-percent reduction in income inequality between 2001 and 2004, responsible for lifting 5 million Brazilians out of poverty, is a result that could not have been achieved by economic growth alone. Yet the pre-Fome Zero analyses by Cardoso and Souza (2004) and Bourguignon et al. (2003), evaluating the impact of conditional cash transfers on education and child labor, suggest a limited impact on poverty. More research is needed on the role of these conditional cash transfers in lowering poverty, hunger, and food insecurity rates. In particular, there should be a focus on analyzing the impact of robust economic growth on those declining rates.

References

Anderson, K., M. Kurzweil, W. Martina, D. Sandri, and E. Valenzuela. 2008. *Measuring Distortions to Agricultural Incentives, Revisited*. WPS4612, World Bank, Washington, DC.

Barrientos, A., and J. DeJong. 2006. "Reducing Child Poverty with Cash Transfers: A Sure Thing?" *Development Policy Review*, Vol. 24, No. 5, pp. 537-552.

Bourguignon, F., F. Ferreira, and P. Leite. 2003. "Conditional Cash Transfers, Schooling, and Child Labor: Micro-Simulating Brazil's Bolsa Escola Program," *The World Bank Economic Review*, Vol. 17, No. 2, pp. 229-254.

Baer, W. 2008. *The Brazilian Economy*, London: Lynne Rienner Publishers.

Cardoso, E., and A. Souza. 2004. "The Impact of Cash Transfers on Child Labor and School Attendance in Brazil." Working Paper No. 04-W07. April. Vanderbilt University.

Chmielewska, D., and D. Souza. 2011. "The Food Security Policy Context in Brazil." International Policy Centre for Inclusive Growth. Country study no. 2. June.

Dornbusch, R. 1998. "The Case for Trade Liberalization," *International Agricultural Development*, C.K. Eicher and J.M. Staatz (eds.). Baltimore and London. The Johns Hopkins University Press.

Food and Agricultural Organization, United Nations (FAO). 2011. FAOSTAT Agricultural Databases., Rome. http://faostat.fao.org/.

Fome Zero. 2012. F*ome Zero: Brazil's Food Security Policy*. http://www.fomezero.gov.br/download/Security%20Policy%20OK.pdf.

Fome Zero Booklet. 2012. "Citizenship: The Main Ingredient of Fome Zero." http://www.fomezero.gov.br/publicacoes.

Garbelotti, M.A. 2007. "An Overview of the Strategy of Income Distribution in Brazil." Working paper. Minerva Program – The George Washington University School of Business and Public Management and the Institute of Brazilian Business and Management Issues. April.

Garcia, M., and C. Moore. 2012. "The Cash Dividend: The Rise of Cash Transfer Programs in Sub-Saharan Africa." The World Bank: Washington, DC. DOI: 10.1596/978-0-8213-8897-6

Glewwe, P., and A Kassouf. 2012. "The Impact of the Bolsa Escola/Familia Conditional Cash Transfer Program on Enrollment, Dropout Rates, and Grade Promotion in Brazil," *Journal of Development Economics*, vol. 97, pp. 505-517.

Graham, D., H. Gauthier, and J. Mendonca de Barros. 1987. "Thirty Years of Agricultural Growth in Brazil: Crop Performance, Regional Profile, and Recent Policy Review," *Economic Development and Cultural Change*, pp. 1-34.

Helfand, S., and G. Rezende. 2001. "Brazilian Agriculture in the 1990s: Impact of Policy Reforms." Institudo de Pesquisa Econômica Aplicada (IPEA). Discussion paper no. 785. Rio de Janeiro, April.

Instituto Brasileiro de Geografia e Estatística (IBGE), Rio de Janeiro. 2010. "Segurança Alimentar: Pesquisa Nacional por Amostra de Domícilios, 2004/2009. http://www.ibge.gov.br/home/estatistica/populacao/seguranca_alimentar_2004_2009/pnadalimentar.pdf.

Instituto Brasileiro de Geografia e Estatística (IBGE), Rio de Janeiro. 2011. Instituto Brasileiro de Geografia e Estatística (IBGE), Rio de Janeiro. http://ibge.gov.br/.

International Food Policy Research Institute (IFPRI). 2011. 2011 Global Hunger Index. http://www.ifpri.org/publication/2011-global-hunger-index.

Meade, B., C. Valdes, and S. Rosen. 2004. "Brazil's Food Security and Food Assistance Programs to Reduce Poverty." *Food Security Assessment*, GFA-15, U.S. Department of Agriculture, Economic Research Service, May.

Rada, N., and C. Valdes. 2012. *Policy, Technology, and Efficiency of Brazilian Agriculture*. ERR-37. U.S. Department of Agriculture, Economic Research Service. June.

Rocha, C. 2009. "The Positive Experience of Brazil in Combating Hunger." Presentation to the Parliamentary Meeting on the Occasion of the World Summit on Food Security, Rome, 13 Nov.

World Bank. 2011. World Development Indicators Online. http://publications.worldbank.org/subscriptions/WDI/WDI.html.

Appendix—Food Security Model: Definition and Methodology

The 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 2022. 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 (cereal and non-cereal 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.

Two kinds of food gaps are estimated and projected:

1) The national average **nutrition gap**, where the objective is to 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.

2) The **distribution gap**, where the objective is to let each income group reach the nutritional target. If food availability in a given income group is lower than this target, that difference is part of the distribution gap for this country.

The nutrition-based food gaps assist in comparisons of relative well-being. Large nutrition-based needs mean additional food must be provided if improving nutrition levels are the main objective. The national average nutritional gap approach, however, fails to address inequalities of food distribution within a country. Those are addressed by the distribution gap.

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 lower 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 sides of the grain and root crops are 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 represents 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.

$$FC_{cnt} = DS_{cnt} - NF_{cnt} \quad (1)$$

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

$$NF_{cnt} = SD_{cnt} + FD_{cnt} + EX_{cnt} + OU_{cnt} \quad (2)$$

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*).

$$DS_{cnt} = PR_{cnt} + CI_{cnt} + CSTK_{cnt} + FA_{cnt} \quad (3)$$

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

$$PR_{cnt} = AR_{cnt} * YL_{cnt} \quad (4)$$

$$YL_{cnt} = f(LB_{cnt}, FR_{cnt}, K_{cnt}, T_{cnt}) \quad (5)$$

$$RPY_{cnt} = YL_{cnt} * DP_{cnt} \quad (6)$$

$$RNPY_{cnt} = NYL_{cnt} * NDP_{cnt} \quad (7)$$

$$AR_{cnt} = f(AR_{cnt}\text{-}1 , RPY_{cnt}\text{-}1 , RNPY_{cnt}\text{-}1 , Z_{cnt}) \quad (8)$$

where *AR* is area, *YL* is yield, *LB* is rural labor, *FR* is fertilizer use, *K* is an indicator of capital use, *T* is an 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:

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

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:

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

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 important 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 consumption 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.[1] This approach ignores the consumption 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).

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

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

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

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

$$P = P_1 + \ldots\ldots + P_i \quad (13)$$

$$Y = Yo/P \quad (14)$$

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

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 supply and utilization data for 1990-2010 are from FAOSTAT, FAO/GIEWS, and USDA as of March 2012. Food aid data are from the UN's World Food Program (WFP) for 1988-2010, and financial data are from the International Monetary Fund and World Bank. Population data are from the UN Population Division, 2010 Revision, medium variant. The base-year data used for projections are the average for 2008-2010.

Endogenous projection variables:

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

Exogenous projection variables:

Population—data are medium-variant United Nations population projections, 2010 Revision.

World price—data are USDA/baseline projections.

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 based either 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—is assumed constant during the projection period.

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

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

Appendix table 1a

List of countries and their food gaps in 2012

	2012 food gaps			2012 food gaps	
	Nutrition[1]	Distribution[2]		Nutrition	Distribution
	---1,000 tons---			*---1,000 tons---*	
Cameroon	0	138	Algeria	0	0
CAR	62	129	Egypt	0	0
Zaire	4,744	5,187	Morocco	0	0
Burundi	440	473	Tunisia	0	0
Eritrea	561	573	**North Africa and Middle East**	**0**	**0**
Ethiopia	0	531			
Kenya	0	401			
Rwanda	0	158	Afghanistan	144	287
Somalia	488	516	Bangladesh	0	128
Sudan	190	523	India	0	3,086
Tanzania	0	118	Indonesia	0	233
Uganda	0	197	Korea, Dem. Rep.	843	977
Angola	0	246	Nepal	0	17
Lesotho	110	132	Pakistan	0	0
Madagascar	0	127	Philippines	0	20
Malawi	0	15	Sri Lanka	0	2
Mozambique	0	220	Vietnam	0	0
Swaziland	0	12	Cambodia	0	7
Zambia	0	130	Laos	0	1
Zimbabwe	0	122	Mongolia	0	22
Benin*	0	0	Yemen	532	660
Burkina Faso	0	6	Armenia	0	0
Cape Verde	0	0	Azerbaijan	0	0
Chad	0	33	Georgia	0	2
Cote d'Ivoire	0	26	Kyrgyzstan	0	0
Gambia	0	5	Tajikistan	0	14
Ghana	0	0	Turkmenistan	0	0
Guinea	0	29	Uzbekistan	0	0
Guinea-Bissau	0	7	Moldova	0	0
Liberia	26	65	**Asia**	**1,519**	**5,456**
Mali	0	21			
Mauritania	19	51	Bolivia	0	120
Niger	0	0	Colombia	0	121
Nigeria	0	60	Dominican Republic	0	45
Senegal	0	63	Ecuador	0	104
Sierra Leone	43	102	El Salvador	0	35
Togo	0	2	Guatemala	0	220
Congo	0	45	Haiti	240	383
Namibia	0	24	Honduras	0	52
Sub-Saharan Africa	**6,683**	**10,490**	Jamaica	0	3
			Nicaragua	0	33
			Peru	0	12
			Latin America and the Caribbean	**240**	**1,128**
			Grand total	**8,443**	**17,074**

[1]Nutrition gap: gap between available food and food needed to support a per capita nutritional standard.

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

Source: USDA, Economic Research Service.

Appendix table 1b

List of countries and their food gaps in 2022

	2022 food gaps			2022 food gaps	
	Nutrition[1]	Distribution[2]		Nutrition	Distribution
	---1,000 tons---			*---1,000 tons---*	
Cameroon	0	98	Algeria	0	0
CAR	83	164	Egypt	0	0
Zaire	6,264	6,825	Morocco	0	0
Burundi	237	282	Tunisia	0	0
Eritrea	681	696	**North Africa and Middle East**	0	0
Ethiopia	0	180			
Kenya	0	238			
Rwanda	0	186	Afghanistan	0	145
Somalia	952	985	Bangladesh	0	153
Sudan	0	336	India	0	2,745
Tanzania	0	154	Indonesia	0	0
Uganda	0	122	Korea, Dem. Rep.	521	681
Angola	0	301	Nepal	0	6
Lesotho	64	90	Pakistan	0	0
Madagascar	0	241	Philippines	0	0
Malawi	0	116	Sri Lanka	0	6
Mozambique	0	176	Vietnam	0	0
Swaziland	0	4	Cambodia	0	0
Zambia	0	144	Laos	0	10
Zimbabwe	0	103	Mongolia	0	0
Benin*	0	6	Yemen	0	188
Burkina Faso	0	69	Armenia	0	0
Cape Verde	0	0	Azerbaijan	0	0
Chad	0	83	Georgia	0	0
Cote d'Ivoire	0	44	Kyrgyzstan	0	0
Gambia	0	0	Tajikistan	0	0
Ghana	0	49	Turkmenistan	0	0
Guinea	0	49	Uzbekistan	0	0
Guinea-Bissau	0	2	Moldova	0	0
Liberia	0	34	**Asia**	**521**	**3,933**
Mali	0	38			
Mauritania	0	35	Bolivia	0	123
Niger	0	5	Colombia	0	138
Nigeria	0	447	Dominican Republic	0	10
Senegal	0	35	Ecuador	0	30
Sierra Leone	0	72	El Salvador	0	19
Togo	0	0	Guatemala	0	195
Congo	0	19	Haiti	0	192
Namibia	0	7	Honduras	0	74
Sub-Saharan Africa	**8,282**	**12,437**	Jamaica	0	0
			Nicaragua	0	14
			Peru	0	17
			Latin America and the Caribbean	**0**	**812**
			Grand total	**8,803**	**17,183**

[1]Nutrition gap: gap between available food and food needed to support a per capita nutritional standard.

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

Source: USDA, Economic Research Service.

Appendix table 2

Number of food-insecure people, 2012 and 2022

	2012	2022		2012	2022
	Million people				
Asia	**398**	**388**	**SSA**	**357**	**411**
Afghanistan	23	22	Cameroon	10	10
Bangladesh	30	34	CAR	4	5
India	252	283	Zaire	70	89
Indonesia	24	0	Burundi	9	10
Korea	25	23	Eritrea	6	7
Nepal	3	4	Ethiopia	52	31
Pakistan	0	0	Kenya	26	17
Philippines	10	0	Rwanda	8	10
Sri Lanka	2	2	Somalia	10	13
Viet Nam	0	0	Sudan	32	29
Cambodia	1	0	Tanzania	14	19
Laos	1	1	Uganda	14	10
Mongolia	2	0	Angola	10	13
Yemen	23	17	Lesotho	2	2
Armenia	0	0	Madagascar	11	17
Azerbaijan	0	0	Malawi	2	9
Georgia	0	0	Mozambique	12	12
Kyrgyzstan	0	0	Swaziland	1	0
Tajikistan	1	1	Zambia	7	8
Turkmenistan	0	0	Zimbabwe	7	6
Uzbekistan	0	0	Benin*	0	1
Moldova	0	0	Burkina Faso	2	7
			Cape Verde	0	0
			Chad	4	6
LAC	**48**	**41**	Cote d'Ivoire	2	5
Bolivia	4	5	Gambia	0	0
Colombia	5	5	Ghana	0	3
Dominican R.	4	1	Guinea	2	4
Ecuador	6	2	Guinea-Bissau	1	0
El Salvador	2	1	Liberia	3	2
Guatemala	11	12	Mali	3	4
Haiti	9	8	Mauritania	3	3
Honduras	2	3	Niger	0	2
Jamaica	0	0	Nigeria	17	43
Nicaragua	2	1	Senegal	5	3
Peru	3	3	Sierra Leone	5	4
			Togo	1	1
North Africa	**0**	**0**	Congo	3	2
Algeria	0	0	Namibia	1	1
Egypt	0	0			
Morocco	0	0			
Tunisia	0	0			
			Grand total	**802**	**839**

Source: USDA, Economic Research Service.

Appendix table 3

Country indicators

Region and country	Population, 2012	2012 Population annual growth rate	Grain production		Annual root production growth, 1990-2010	Projected annual growth in supply, 2011-2022
			Annual growth, 1990-2011	Coefficient of variation, 1990-2011		
	1,000	*Percent*				
North Africa:						
Algeria	36,486	1.4	3.9	47.1	5.8	3.2
Egypt	83,958	1.7	2.7	17.5	4.0	3.1
Morocco	32,599	1.0	2.1	46.6	2.6	2.6
Tunisia	10,705	1.0	0.7	39.6	3.1	4.0
Central Africa:						
Cameroon	20,469	2.2	3.7	23.5	3.5	2.4
Central African Rep.	4,576	2.0	5.3	31.5	1.3	2.0
Congo, Dem. Rep.	69,575	2.7	0.3	3.7	-1.4	2.4
Congo, Republic	4,233	2.3	7.0	41.3	2.4	1.6
West Africa:						
Benin	9,352	2.8	4.9	32.2	5.3	1.7
Burkina Faso	17,482	3.0	3.6	25.8	4.1	3.0
Cape Verde	505	0.9	-2.8	74.2	0.1	1.9
Chad	11,831	2.6	5.6	44.3	1.8	3.2
Côte d'Ivoire	20,595	2.2	0.6	5.3	3.2	1.9
Gambia	1,825	2.7	6.5	45.6	0.1	3.3
Ghana	25,546	2.3	3.4	25.4	5.0	1.4
Guinea	10,481	2.5	5.5	35.9	2.6	2.0
Guinea-Bissau	1,580	2.1	1.4	17.6	3.8	2.6
Liberia	4,245	2.8	5.3	48.6	4.3	3.1
Mali	16,319	3.0	5.2	41.7	13.5	3.1
Mauritania	3,623	2.3	0.4	31.3	1.2	2.3
Niger	16,644	3.6	4.0	31.7	1.4	4.1
Nigeria	166,629	2.6	1.4	10.5	4.0	2.0
Senegal	13,108	2.7	2.6	29.4	12.6	3.0
Sierra Leone	6,126	2.2	3.2	42.6	5.2	2.1
Togo	6,283	2.1	3.6	23.3	2.6	2.1
East Africa:						
Burundi	8,749	2.0	0.12	7.8	-1.3	3.1
Eritrea[1]	5,581	3.1	4.3	62.5	-3.2	2.5
Ethiopia[1]	86,539	2.1	7.0	40.4	4.2	2.1
Kenya	42,749	2.7	0.9	12.6	1.0	3.2
Rwanda	11,272	3.0	5.9	56.1	6.2	2.4
Somalia	9,797	2.5	-1.9	38.6	4.1	1.7
Sudan	45,722	2.4	1.4	29.0	3.9	3.4
Tanzania	47,656	3.1	2.6	22.7	0.4	3.5
Uganda	35,621	3.2	2.9	19.7	3.7	3.4

See footnotes at end of table.

Continued——

Appendix table 3

Country indicators—continued

Region and country	Macroeconomic indicators					
	Per capita GNI 2010	Per capita GDP growth, 2010	GDP growth, 2010	Export earnings growth, 2010	Official development assistance as a share of GNI, 2010	External debt present value as a share of GNI, 2010
	U.S. dollars	*Percent*				
North Africa:						
Algeria	4,390	1.8	3.3	-3.0 '09	0.1	3.4
Egypt	2,420	3.3	5.1	-3.0	0.3	16.2
Morocco	2,850	2.6	3.7	16.3	1.1	28.1
Tunisia	4,160	2.6	3.7	4.8	1.3	51.1
Central Africa:						
Cameroon	1,200	1.0	3.2	-0.1	2.4	13.5
Central African Rep.	470	1.4	3.3	14.4 '06	13.1	19.2
Congo, Dem. Rep.	180	4.3	7.2	52.9	27.8	47.1
Congo, Republic	2,240	6.0	8.8	0.0	14.6	43.9
West Africa:						
Benin	780	0.1	3.0	5.0 '05	10.4	18.4
Burkina Faso	550	6.0	9.2	24.4 '06	12.1	23.3
Cape Verde	3,270	4.5	5.4	24.5	20.8	54.3
Chad	620	1.6	4.3	-3.2 '06	7.3	25.7
Côte d'Ivoire	1,160	1.0	3.0	-0.5	3.9	52.6
Gambia	450	2.1	5.0	4.1	16.3	63.3
Ghana	1,250	5.2	7.7	24.6	5.3	27.2
Guinea	400	-0.3	1.9	1.5	5.1	69.1
Guinea-Bissau	590	1.4	3.5	--	16.0	124.8
Liberia	200	1.3	5.5	--	176.8	28.3
Mali	600	1.4	4.5	3.4 '07	12.3	26.1
Mauritania	1,000	2.7	5.2	12.2	10.5	67.0
Niger	370	5.0	8.8	--	13.6	20.5
Nigeria	1,230	6.0	8.7	--	1.1	4.5
Senegal	1,080	1.4	4.1	5.6	7.3	28.5
Sierra Leone	340	2.7	4.9	--	24.9	40.8
Togo	490	1.2	3.4	7.5 '05	14.9	61.1
East Africa:						
Burundi	170	1.3	3.9	--	39.8	33.8
Eritrea[1]	340	-0.8	2.2	-2.3 '07	7.7	48.2
Ethiopia[1]	390	7.8	10.1	14.4	11.9	24.1
Kenya	810	2.8	5.6	16.5	5.1	26.9
Rwanda	520	4.3	7.5	--	18.5	14.2
Somalia	..	..	..	..	..	..
Sudan	1,270	1.9	4.5	23.0 '08	3.7	39.1
Tanzania	540	4.0	7.0	-4.3	12.9	37.7
Uganda	500	1.9	5.2	5.6	10.3	17.9

See footnotes at end of table.

Continued——

Appendix table 3

Country indicators—continued

Region and country	Population, 2012	2012 Population annual growth rate	Grain production: Annual growth, 1990-2011	Grain production: Coefficient of variation, 1990-2011	Annual root production growth, 1990-2010	Projected annual growth in supply, 2011-2022
	1,000			*Percent*		
Southern Africa:						
Angola	20,163	2.8	6.4	45.2	11.8	2.5
Lesotho	2,217	1.0	-2.8	45.3	3.2	1.9
Madagascar	21,929	2.9	3.6	27.3	1.1	2.7
Malawi	15,883	3.3	5.1	42.1	16.7	2.5
Mozambique	24,475	2.3	8.1	45.9	3.3	2.4
Namibia	2,364	1.7	3.0	33.4	3.0	2.3
Swaziland	1,220	1.4	-2.3	30.8	1.1	1.5
Zambia	13,884	3.0	4.0	48.1	3.0	3.1
Zimbabwe	13,014	2.0	-1.5	39.3	3.3	1.9
South Asia:						
Afghanistan	33,397	3.2	3.7	33.2	1.7	3.6
Bangladesh	152,409	1.3	3.5	23.4	8.3	1.6
India	1,258,351	1.4	1.5	10.8	3.6	1.3
Nepal	31,011	1.7	2.5	16.4	6.1	1.5
Pakistan	179,951	1.8	2.9	18.8	5.6	1.4
Sri Lanka	21,224	0.8	2.9	22.9	-2.4	1.0
Yemen	25,569	3.1	0.3	22.0	2.4	3.7
East/Southeast Asia:						
Cambodia	14,478	1.2	7.1	46.8	20.8	1.8
Indonesia	244,769	1.0	2.1	15.2	1.6	1.6
Korea, Dem. Rep.	24,554	0.4	-2.4	39.8	6.2	0.4
Laos	6,374	1.4	6.3	42.0	2.2	2.2
Mongolia	2,844	1.6	-3.9	62.1	3.0	5.4
Philippines	96,471	1.7	2.8	20.1	-0.5	2.6
Vietnam	89,730	1.1	4.3	26.0	5.3	2.1
Central Asia:[2]						
Armenia	3,109	0.3	2.1	22.5	2.7	1.3
Azerbaijan	9,306	1.3	5.4	33.8	14.0	1.4
Georgia	4,304	-0.6	-1.7	30.1	-1.2	1.6
Kyrgyzstan	5,448	1.0	1.1	14.5	9.1	1.7
Moldova	3,519	-0.7	-0.5	25.8	-3.2	1.2
Tajikistan	7,079	1.5	8.8	45.4	12.7	2.0
Turkmenistan	5,170	1.3	4.3	43.5	17.1	1.8
Uzbekistan	28,077	1.1	7.0	36.4	7.5	1.9
Latin America and the Caribbean:						
Bolivia	10,248	1.6	4.6	31.4	0.5	2.2
Colombia	47,551	1.3	1.0	13.5	0.1	2.4
Dominican Republic	10,183	1.3	2.8	20.5	1.3	1.4
Ecuador	14,465	-1.3	1.8	16.1	-1.9	1.9
El Salvador	6,264	0.6	1.2	14.2	1.2	0.9
Guatemala	15,138	2.6	1.0	17.6	3.6	2.5
Haiti	10,256	1.3	0.7	10.8	1.5	2.5
Honduras	7,912	2.0	-0.8	11.8	3.6	1.1
Jamaica	2,761	0.4	-4.2	39.3	-3.2	1.1
Nicaragua	5,955	1.4	4.1	27.1	4.2	0.3
Peru	29,734	1.1	5.5	32.7	5.5	1.9

See footnotes at end of table.

Continued——

Appendix table 3

Country indicators—continued

Region and country	Macroeconomic indicators					
	Per capita GNI, 2010	Per capita GDP growth, 2010	GDP growth, 2010	Export earnings growth, 2010	Official development assistance as a share of GNI, 2010	External debt present value as a share of GNI, 2010
	U.S. dollars	*Percent*				
Southern Africa:						
Angola	3,960	3.0	5.9	--	0.3	24.6
Lesotho	1,090	4.5	5.6	2.4	9.6	28.4
Madagascar	430	-1.3	1.6	9.3 '09	5.5	26.6
Malawi	330	3.8	7.1	0.0	20.8	18.5
Mozambique	440	4.8	7.2	2.2	20.8	43.8
Namibia	4,510	2.9	4.8	-42.3	2.1	0.0
Swaziland	2,930	0.8	2.0	-4.6	2.6	17.2
Zambia	1,070	5.9	7.6	21.2 '07	6.4	25.8
Zimbabwe	460	8.2	9.0	60.0	10.6	71.8
South Asia:						
Afghanistan	410	5.2	8.2	-1.6	42.0	19.6 '08
Bangladesh	700	4.9	6.1	0.9	1.3	22.8
India	1,270	7.3	8.8	17.9	0.2	16.9
Nepal	490	2.7	4.6	-13.7	5.2	23.4
Pakistan	1,050	2.3	4.1	15.8	1.6	31.3
Sri Lanka	2,240	7.0	8.0	5.8	1.2	41.8
Yemen	1,170	4.8	8.0	15.8	2.3	0.0
East/Southeast Asia:						
Cambodia	750	4.8	6.0	20.6	6.9	43.4
Indonesia	2,500	5.0	6.1	14.9	0.2	26.1
Korea, Dem. Rep.	..	..	..	..	..	..
Laos	1,040	6.9	8.5	29.3	6.0	79.0
Mongolia	1,870	4.7	6.4	6.8	5.4	44.3
Philippines	2,060	5.8	7.6	21.0	0.3	36.2
Vietnam	1,160	5.7	6.8	14.7	2.9	36.5
Central Asia:[2]						
Armenia	3,200	1.9	2.1	21.7	3.5	64.8
Azerbaijan	5,330	3.8	5.0	24.2	0.3	14.9
Georgia	2,690	5.4	6.4	..	5.5	80.4
Kyrgyzstan	830	-2.5	-1.4	-4.2	8.7	89.2
Moldova	1,810	7.1	6.9	12.8	7.5	73.5
Tajikistan	800	2.4	3.8	6.6	7.7	53.1
Turkmenistan	3,790	7.9	9.2	42.5 '06	0.2	2.1
Uzbekistan	1,280	6.7	8.5	5.2 '05	0.6	19.0
Latin America and the Caribbean:						
Bolivia	1,810	2.5	4.1	9.9	3.6	27.8
Colombia	5,510	2.6	4.0	1.2	0.3	22.8
Dominican Republic	5,030	6.3	7.8	11.6	0.4	26.2
Ecuador	3,850	2.1	3.6	2.3	0.3	23.1
El Salvador	3,380	0.9	1.4	12.3	1.4	53.2
Guatemala	2,740	0.2	2.8	4.4	1.0	35.9
Haiti	670	1.6	2.9	9.9	17.2	20.4
Honduras	1,870	0.7	2.8	6.0	3.9	28.2
Jamaica	4,800	-0.8	-0.6	..	1.0	104.2
Nicaragua	1,110	6.1	7.6	13.2	10.0	76.9
Peru	4,700	7.6	8.8	2.5	-0.2	24.6

[1]= data start in 1993. [2]= data start in 1992.

GNI = gross national income.

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

Source: Population = FAOSTAT, UN 2010 revision (medium variant), Macroeconomic indicators = World Development Indicators online (as of May 2012), World Bank. http://databank.worldbank.org/