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Progress and Challenges in Global Food Security

Sharad Tandon, Maurice Landes, Cheryl Christensen, Steven LeGrand, Nzinga Broussard, Katie Farrin, and Karen Thome

United States Department of Agriculture

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Abstract

The United States leads efforts to improve global food security, providing about half of global food aid and supporting agricultural development. Global food security has improved over the past 15 years, but challenges and opportunities remain. This report analyzes the roles of trade, agricultural productivity, safety nets, and better data and measurement in achieving these gains. It also identifies emerging challenges. Global population growth, rapid urbanization, and weather and climate variability increase the need for agricultural productivity growth and new risk management tools. More emphasis on nutrition calls for new food security measures; heightens the importance of developing nutritionally sound, cost-effective safety nets; and highlights the role trade can play in supporting safe and diverse diets.

Keywords: Global food security, food security measurement, agricultural productivity, food aid, agricultural trade, nutrition, safety nets, agricultural development, urbanization, risk management, Global Food Security Act of 2016.

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Progress and Challenges in Global Food Security

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What Is the Issue?

For almost six decades, the United States has led global efforts to alleviate food insecurity, providing about half of global food aid and bilateral and multilateral support for agricultural development and trade. Global food security has improved over the past 15 years, but challenges and opportunities persist as U.S. food security decisionmakers continue to prioritize and refine the global food security agenda. The Global Food Security Act of 2016 (GFSA) provides for continued U.S. commitment to reducing food insecurity and poverty through agricultural-led growth, increased resilience, and a broad commitment to improved nutrition. In order to feed a world that will have over 9 billion people by 2050, it is necessary to investigate the drivers of global food security and options for improving it. In this report, we analyze factors contributing to improvements in food security and highlight emerging issues and challenges.

What Did the Study Find?

There have been some improvements in food security measurement, agricultural productivity, food trade, food security safety net programs, and nutrition; however, some challenges persist:

Food Security Measurement

- Better data and ways of measuring progress are key for evaluating evidence-based programs, including those under GFSA. To identify food-insecure populations, researchers must rely on multiple indicators to measure the four dimensions of food security—availability, access, utilization, and stability. Available measures include national-level indicators of availability and access, household-level indicators of access and utilization, physical measures of nutritional and health outcomes, and newer experiential measures of food security. Results differ across measurement techniques, and further development is underway to improve their accuracy and reliability.

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Agricultural Productivity

- In most of the low-income countries studied, domestic production supplies the bulk of those countries' food staples. Production and yield growth have greatly improved food security in the majority of countries over the past few decades. In many developing countries, increased agricultural productivity—producing the same or more output with fewer inputs—has significantly improved food security.

- On average, the faster the growth in agricultural productivity, the larger the reductions in food insecurity. Gains through productivity research and technology adoption—via extension, market access, and risk-management tools—have contributed to improvements in food security in many countries.

Food Trade

- In countries where climate or a lack of land or water resources limits the potential for local production, food imports have played a primary role in improvements in food insecurity. In other countries, food imports have played an important complementary role.

- Some countries limit their reliance on imports because of concerns about the effect on local food production and employment, as well as inadequate foreign currency reserves and insufficient infrastructure. Over the long term, however, a number of developing countries have found effective food security strategies by competing in world markets for goods and services and opening food markets to international trade.

Food Security Safety Net Programs

- Countries implement different types of domestic food safety net programs, ranging from in-kind food assistance to newer methods that provide conditional and unconditional cash transfers.

- Cash transfer programs can be more cost effective than older methods, but not all countries have sufficient food markets and administrative capacity to broadly implement them. However, advances in information technology, personal identification, banking, and mobile phones support the expansion of targeted cash transfer programs. These innovations can make the programs more effective, as well as reduce the market distortions associated with acquiring, distributing, and storing commodities found in traditional in-kind programs.

Nutrition

- Nutrition is a major focus of GFSA. Nutrition challenges persist even when food availability and access have improved. Dietary diversity is key to improved nutrition, and while average diets have become more diverse, this is not broadly the case for lower income groups or vulnerable subgroups, such as mothers and young children. Non-food factors, such as clean water and effective sanitation, are also key factors in improving food utilization and nutrition among these groups.

How Was the Study Conducted?

The report focused on the 76 low- and middle-income countries regularly tracked by USDA in its annual International Food Security Assessments (IFSA). ERS researchers compared and analyzed alternative indicators of food security using ERS databases on international food security and international agricultural productivity and data available from international organizations, such as the Food and Agriculture Organization and the World Health Organization. ERS researchers also examined linkages among agricultural productivity, agricultural trade, food safety net programs, and food security.

Progress and Challenges in Global Food Security

Introduction

The most widely used definition of food security originates from the 1996 Food Summit at the Food and Agriculture Organization of the United Nations (FAO):

> *Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.*

The definition encompasses issues of food *availability*, economic and social *access*, individuals' ability to translate the food they eat into good health outcomes (commonly referred to as the *utilization* dimension), and their ability to maintain *stability* in each of these dimensions over time (Coates, 2013). This is also the definition used by the U.S. Global Food Security Act of 2016 (GFSA). Both transitory and chronic food insecurity can have lasting effects on health and economic outcomes. Food insecurity can adversely affect physical development and mental capacity (Jyoti et al., 2005) and can also have lasting physical and economic effects over the course of a lifetime (Glewwe and Miguel, 2008). For society as a whole, food insecurity can contribute to political and social unrest (Bellemare, 2015), and economic losses are estimated at 2-3 percent of global gross domestic product (GDP) or $1.4-2.1 trillion annually (FAO, 2013). The United States has played a leading role in global efforts to alleviate food insecurity through international food aid, development programs, and bilateral and multilateral trade agreements. Most assistance has taken the form of direct donations of U.S. agricultural commodities through the Food for Peace, Food for Progress, and McGovern-Dole programs (table 1), as well as additional contributions through support of the World Food Program.

The U.S. share of global food aid has averaged roughly 50 percent since 2010. In addition to food assistance, prior to the GFSA, the U.S. Government enacted the Feed the Future initiative in 2010, which aimed to reduce hunger and poverty in 19 developing countries. The United States also contributes to international food security through programs and institutions such as the Millennium Challenge Corporation, Consultative Group on International Agricultural Research (CGIAR), Global Agriculture and Food Security Program, International Fund for Agricultural Development, United Nations' (UN) Food and Agriculture Organization (FAO), and World Bank.

Table 1

Selected U.S. Government outlays for programs related to international food security

	Outlays										
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
	$ million										
USDA	366	239	541	430	385	432	448	344	481	341	375
Food for Peace	60	10	10	13	13	13	10	10	15	na	na
Title I	50	ne	ne	ne	ne	ne	ne	ne	ne	ne	ne
Title V (Farmer-to-farmer)	10	10	10	13	13	13	10	10	15	na	na
Food for Progress	220	130	166	238	166	190	246	150	127	149	153
McGovern-Dole IFECN[1]	86	99	99	168	174	206	192	184	165	192	202
Local and Regional Procurement (LRP)	ne	ne	0	5	24	23	0	0	0	0	0
Section 416 (b)	0	0	0	0	0	0	0	0	0	0	0
BEHT[2]	0	0	266	6	8	0	0	0	174	0	20
USAID	1,839	1,870	2,351	2,552	3,803	3,829	3,929	3,847	4,146	4,436	3,697
Food for Peace	1,839	1,870	2,351	2,552	2,746	2,628	2,583	2,312	2,302	2,446	2,697
Title II	1,839	1,870	2,351	2,552	1,933	1,660	1,610	1,355	1,324	1,466	1,696
Title III	0	0	0	0	0	0	0	0	0	0	0
Feed the Future[3]	ne	ne	ne	ne	813	968	973	957	978	980	1,001
Emergency Food Security Program	ne	ne	ne	ne	244	232	374	578	866	1,009	na
World Food Program (WFP)											
U.S. contribution	1,123	1,184	2,070	1,767	1,553	1,243	1,460	1,494	2,227	2,006	1,778
International Fund for Agricultural Development (IFAD)											
U.S. contribution	na	na	na	na	90	29	30	28	30	30	32
Consultative Group on International Agricultural Research (CGIAR)											
U.S. contribution	61	60	58	79	86	34	123	52	132	164	na
Global Agriculture and Food Security Program (GAFSP)											
U.S. contribution	ne	ne	ne	ne	67	100	135	143	0	123	0
Total	3,389	3,353	5,020	4,827	5,984	5,666	6,126	5,908	7,016	7,099	5,882

na = not available. ne = not available because the program was nonexistent.

[1]IFECN = International Food for Education and Child Nutrition.

[2]Bill Emerson Humanitarian Trust.

[3]Omits Feed the Future funding provided through the Millenium Challenge Corporation, U.S. African Development Fund, Global Agriculture and Food Security Program, and Peace Corps.

Sources: Schnepf, R. (2016), *U.S. International Food Aid Programs: Background and Issues*, Congressional Research Service, R41072, 45pp; U.S. Agency for International Development (USAID); World Food Program; Global Agriculture and Food Security Program; International Fund for Agricultural Development; and Consultative Group on International Agricultural Research.

The United States has made commitments to end global food insecurity by 2030 as part of the 2015 global Sustainable Development Goals.[1] In 2016, the United States enacted the Global Food Security Act (GFSA), which provides for reducing food insecurity and poverty through agricultural-led growth, increased resilience, and a broad commitment to improved nutrition. (See box 1, "The Global Food Security Act of 2016.") Because both past and current initiatives to address international food insecurity are evidence driven, advances in measuring food security remain critical to monitoring and evaluating progress.

Box 1

The Global Food Security Act of 2016

In 2016, Congress passed and the President signed the Global Food Security Act (GFSA). The legislation creates a comprehensive approach to sustainable food and nutrition security that addresses both emergency food shortages and factors affecting long-term improvements in food security. The legislation mandates the creation of a "whole-of-government" global food security strategy that will set specific and measurable goals, with benchmarks, timetables, performance metrics, and monitoring and evaluation that reflect international best practices.

The GFSA also amends the Foreign Assistance Act of 1961 to make emergency assistance available through a wider range of mechanisms than those used in previous food aid programs. These mechanisms—including funds, transfers, vouchers, agricultural commodities, and products derived from agricultural commodities—are procured locally or regionally to meet emergency food needs arising from manmade and natural disasters.

A comprehensive U.S. Government Global Food Security Strategy (GFSS) organizes the specific mandates of the GFSA into an overarching goal—to sustainably reduce global hunger, malnutrition, and poverty—through three interrelated objectives:

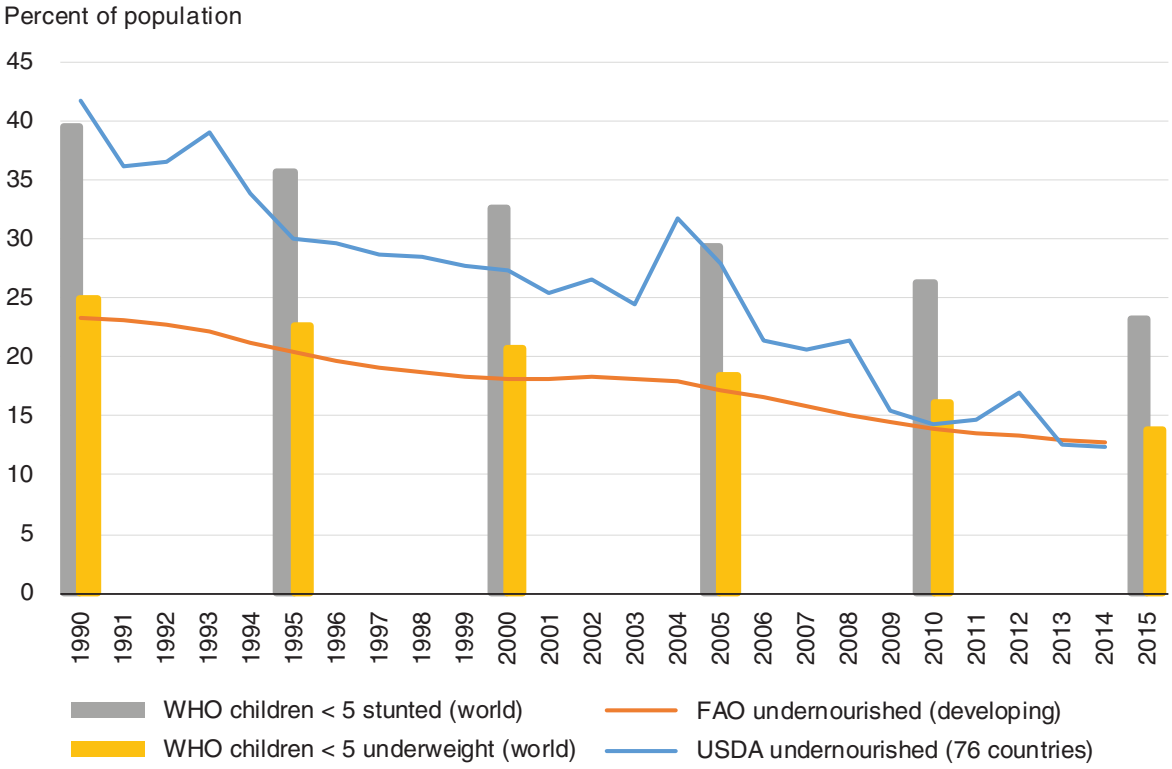
- Inclusive and sustainable agricultural-led economic growth
  - Strengthen inclusive agricultural systems that are productive and profitable
  - Strengthen and expand access to markets and trade
  - Increase employment and entrepreneurship
- Strengthened resilience among people and systems
  - Increased sustainable productivity particularly through climate-smart approaches
  - Improved proactive risk reduction, mitigation, and management
  - Improved adaptation to and recovery from shocks and stresses
- A well-nourished population, especially among women and children
  - Increased consumption of nutritious and safe diets
  - Increased use of direct nutrition interventions and services
  - More hygienic household and community environments

[1]The UN Sustainable Development Goals established in 2015 are intended as a "universal call to action to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity." A number of the 17 goals are related to food security, including those calling for no poverty, zero hunger, and good health and well-being.

Food Security Progress

Assessments using metrics that primarily capture availability and access dimensions of food security confirm significant improvements in global food security over the past few decades (fig. 1). According to FAO, the prevalence of undernourished people in the developing world declined from 23.3 percent to 12.9 percent between 1990 and 2015 (UN, 2015). The USDA international food security assessment finds that the prevalence of undernourishment has more than halved between 1990 and 2015 for the 76 low- and middle-income countries USDA regularly tracks (Rosen et al., 2015).[2]

Figure 1
Global food security/undernourishment indicators



Note: WHO Children < 5 stunted = children under 5 years old who have low height for their ages, per the World Health Organization (WHO). WHO children < 5 underweight = children under 5 years old who have low weight for their ages, per WHO. FAO undernourished (developing) = general population in developing countries at risk of undernourishment, per United Nations, Food and Agriculture Organization (FAO). USDA undernourished (76 countries) = general population in 76 low-andSS middle-income countries consuming food staples below levels needed to reach minimum a daily caloric target, per USDA, Economic Research Service (ERS).

Sources: ERS, FAO, WHO.

[2]The 76 countries tracked by USDA are divided into regions as follows: Latin America and Caribbean (Bolivia, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Nicaragua, Peru); North Africa (Algeria, Egypt, Morocco, Tunisia); Other Asia (Armenia, Azerbaijan, Georgia, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Uzbekistan); South and Southeast Asia (Afghanistan, Bangladesh, Cambodia, India, Indonesia, Laos, Mongolia, Nepal, Democratic People's Republic of Korea, Pakistan, Philippines, Sri Lanka, Vietnam, Yemen); Sub-Saharan Africa (Angola, Benin, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Congo, Côte d'Ivoire, Eritrea, Ethiopia, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, Sudan, Swaziland, Tanzania, Togo, Uganda, Zaire/Democratic Republic of the Congo, Zambia, Zimbabwe).

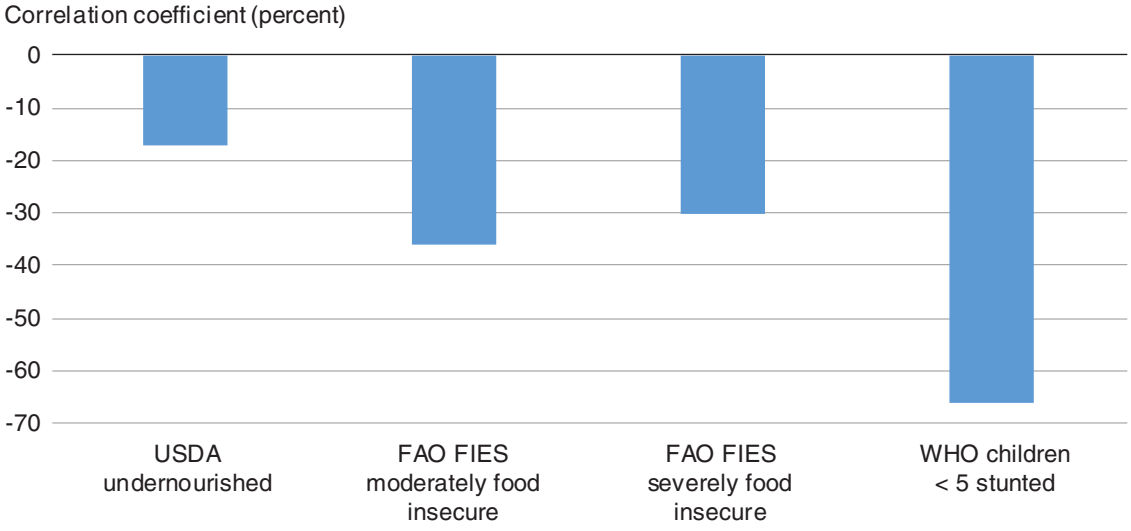
Metrics that are able to assess progress in the food utilization dimension of food security, as reflected in nutritional and health outcomes, likewise indicate significant progress, but also suggest that progress in nutritional and health outcomes has been more difficult to achieve. While the World Health Organization's (WHO) estimated share of children under 5 years old who are underweight (by more than 2 standard deviations from the WHO Child Growth Standard) has closely paralleled FAO's share of the population who are undernourished, WHO's estimated share of children under 5 years old who are stunted (height-for-age less than 2 standard deviations of the WHO Child Growth Standard) has remained relatively high. This, and other evidence, suggests the rationale for emphasizing improvement of nutritional outcomes in the GFSA.

Improvements in food security metrics have varied significantly across global regions, with progress particularly strong in Asia and Latin America. Although Sub-Saharan Africa has also made significant progress, its gains have generally been slower, and food insecurity remains more prevalent there (UN, 2015; Rosen et al., 2015). Regional differences in food insecurity will be discussed more in the following chapters.

Although national achievements in improving food security are associated with economic growth and improvements in per capita incomes, evidence suggests that higher incomes do not necessarily suffice to ensure high levels of food security. A number of metrics of "food access"—defined as access to a diet that can make an active and healthy lifestyle possible—by themselves, only weakly correlate with per capita income levels (fig. 2). In contrast, indicators of "food utilization"— the ability to convert adequate access to food into good health outcomes—correlate much more highly with per capita income. However, the correlations between food security indicators and per capita income suggest that other factors aside from income help determine both short- and long-term food security outcomes.

Figure 2

Correlation coefficients between 2012-14 average GDP per capita and food security indicators



Note: USDA undernourished = general population consuming food staples below the levels needed to reach minimum daily caloric target in 76 low- and middle-income countries, per 2015 USDA estimates. FAO FIES moderately food insecure = population who have compromised food quality or reduced food quantity in the United Nations, Food and Agriculture Organization (FAO) Food Insecurity Experience Scale (FIES) survey of developing countries. FAO FIES severely food insecure = population who have hunger in the FAO FIES survey of developing countries. WHO children < 5 stunted = children under 5 years old who have low height for their ages, per the World Health Organization (WHO).

Sources: USDA, Economic Research Service (ERS) calculations using the 2015 ERS International Food Security Database, 2015 FAO data, and WHO data from the most recent year available for each country, which ranged from 2007 to 2014.

Five Key Global Food Security Issues

Despite the improvement in food security over the past two decades, significant challenges and opportunities confront U.S. food security decisionmakers. We face the challenge of feeding a world that will have over 9 billion people by 2050, building on what has currently been accomplished to develop new options for achieving global food security. This report highlights the current state of food security research, focusing on five core topics: the measurement of food security, the role of agricultural productivity growth in combating food insecurity, the role of trade in improving food security, advances in the design of domestic and international safety net programs to strengthen food security, and the increased focus on nutrition outcomes in advancing food security. Emerging issues are identified in each chapter and in accompanying boxes. (For helpful terminology that is used throughout, see box 2, "Food Security Terminology.")

Box 2

Food Security Terminology

Food security: The most commonly used definition is the one adopted by the 1996 FAO World Food Summit: "Food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." (FAO)

Undernourishment: An inability to acquire enough food to meet the daily minimum dietary energy requirements over a period of one year. (FAO)

Malnutrition: Refers to deficiencies, excesses, or imbalances in a person's intake of energy and/or nutrients. It includes "undernutrition," arising from nutrient or micronutrient deficiencies, as well as overweight and obesity, which may contribute to diet-related noncommunicable diseases (such as heart disease, stroke, diabetes and cancer). (WHO)

Stunting: Low height for age—an indicator of malnutrition measured as a percentage of children under 5 whose height for age is more than 2 standard deviations below the median for the WHO Child Growth Standards. (WHO)

Wasting: Low weight for height—an indicator of malnutrition measured as the proportion of children under 5 whose weight for height is more than 2 standard deviations below the median for the international reference population for the WHO Child Growth Standards. (WHO)

Underweight: Low weight for age—an indicator of malnutrition measured as the percentage of children under 5 whose weight for age is more than 2 standard deviations below the median for WHO Child Growth Standards. (WHO)

FAO Food Insecurity Experience Scale: An experience-based metric of the severity of food insecurity based on people's direct responses developed by the FAO Voices of the Hungry project. These responses are collected through an eight-question survey regarding people's access to adequate food. (FAO)

continued—

Box 2

Food Security Terminology—continued

USDA Prevalence of Undernourishment: Food insecurity is estimated based on the gap between projected domestic food consumption (domestic production plus imports minus nonfood uses) converted to calorie terms and a daily per capita consumption target of 2,100 calories. Available calories are allocated across the population based on income distribution data. (USDA, ERS)

FAO Prevalence of Undernourishment: Food insecurity is estimated based on the gap between projected domestic food consumption (domestic production plus imports minus nonfood uses) converted to calorie terms and a country-specific daily per capita consumption target. Available calories are allocated across the population based on coefficients derived from available household survey data. (FAO)

IFPRI Global Hunger Index: Country indices constructed from the most recent available data on undernourishment, child wasting, child stunting, and child mortality in each country. (IFPRI)

Household expenditure survey: Estimates of household food consumption derived from data collected in consumer expenditure surveys that are then used to calculate food-insecurity indicators. In some countries, these surveys are typically conducted only occasionally.

Resilience: In the context of food security, this refers to the ability of households, communities, and agricultural and economic systems to anticipate, absorb, and recover from the negative effects of the human-made and natural changes and events.

Measurement. The multiple dimensions of food security—availability, access, utilization, and stability—increase the *complexity of accurately measuring food security status*. Indicators for each of the four dimensions of food security typically challenge available data and require a number of assumptions. As a result, policymakers and researchers need to understand a number of metrics and their limitations to fully characterize the food-insecure population (Coates, 2013; Tandon and Landes, 2011a). "Macro-level" indicators, such as those released in the annual USDA Global Food Assessment, rely on national-level data and forecasts to provide current indicators that pertain primarily to availability and access. "Micro-level" measures draw on available household-level survey data to provide more information on temporal and cross-section differences in availability, access, utilization, and stability, but are generally slower and more costly to implement. Recently, a number of researchers and policymakers have placed more emphasis on experiential measures of food security—a micro-level indicator that relies on a battery of survey questions that is quicker and cheaper to implement than more traditional household expenditure surveys (Ballard et al., 2013; Upton et al., 2016). Still, there are substantial differences between the experiential indicators and other measures that are currently not fully understood or reconciled (Coates, 2013; Broussard and Tandon, 2016). For example, an ERS comparison of intake-based and experiential measures for Ethiopia, India, and Bangladesh found that between 65 and 83 percent of individuals who reported food-intake levels qualifying them as undernourished in calories did not report experiencing food insecurity (Broussard and Tandon, 2016).

Agricultural productivity. For the 76 low-income countries USDA regularly tracks, gains in domestic food production have been the most common contributor to changes in food security status.

On average, in low-income countries where strong growth in agricultural productivity has occurred, it has led to reduced prevalence of food insecurity, as has agricultural development (Minten and Barrett, 2008). Evidence indicates that agricultural productivity growth can lead to growth in agricultural labor and rural and urban nonfarm employment (McCorriston et al., 2013). However, evidence also suggests that migrants do not necessarily obtain better opportunities in urban areas, and food insecurity is higher in some places where there have been larger increases in urbanization.

Although investments in agricultural productivity do not necessarily result in improved food security in all cases, the evidence suggests that policy can enable productivity growth. Investments in agricultural research and technology development, as well as improvements in infrastructure, market access, and governance to enhance technology adoption are likely key to continued improvements in food security in many countries. More recent efforts to design and implement new index-based crop insurance programs suitable for implementing in developing country contexts may likewise prove valuable to strengthen resilience and promote adoption of new technologies.

Food trade. In addition to agricultural productivity gains, increased food trade has also contributed to food security gains in the past few decades. Food imports have complemented productivity gains in many countries, and served a more primary role in countries where climate and resources limit the potential for efficient gains in domestic production. Although food imports often contribute significantly to improved food availability, access, and stability, concerns with the effect of imports on local production and employment are often used to attenuate strategies involving heavy reliance on food imports. Practical limitations—such as insufficient infrastructure and (in the context of declining supplies of international food aid) constraints on financial capacities to import food commercially—can also limit reliance on trade by low-income countries. Concerns that increased trade may expose domestic producers and consumers to volatility in world markets also figure into decisions about how much to rely on food trade. However, although many countries felt effects from recent spikes in world food prices, evidence examined here suggests that world and domestic prices have not become significantly more volatile in recent years.

Domestic and international safety nets. Despite significant improvements in global food security, due in part to increased agricultural productivity and increased agricultural trade, the estimated size of the food-insecure population in 2015 was still about 800 million individuals (FAO, 2015a). Some programs designed to improve food security, such as those aimed at improving domestic agricultural productivity and increasing trade in food, do not necessarily improve access to affordable food and nutritionally adequate diets for all population segments (Minten and Barrett, 2008; McCorriston et al., 2013; Tandon and Landes, 2011b). As a result, many countries operate safety net programs, often with international support, to strengthen resilience to food security threats by improving food availability and access for populations not served adequately by food markets. Traditionally, in low-income countries, the most common types of programs have been in-kind assistance, such as subsidized food grains, while more recent program designs have involved cash transfers.

Nutrition. Nutrition is a major focus of GFSA, whose overarching goal is to reduce not only hunger and poverty but also malnutrition. Nutrition challenges persist even when food availability and access have improved. Dietary diversity improves availability of essential macro- and micro-nutrients, and our analysis finds that diets have become somewhat more diverse over the past 20 years. Although most regions meet minimum nutritional requirements for calories, fat, and protein, results differ by income groups. Vulnerable subgroups of the population, such as mothers and young children, face special challenges, which have become a major focus of the GFSA. Some nonfood factors, such as clean water and effective sanitation, affect food utilization and have strong consequences for childhood nutrition.

Measurement of Food Security

- Accurately measuring each dimension of food security—availability, access, utilization, and stability—remains a challenge, and it is necessary to employ different types of metrics to fully characterize the food-insecure population.
- New experiential measures of food security help to cost-effectively estimate more dimensions of food security, but often differ from traditional indicators in ways that are not yet fully understood.
- Traditional measures of food security—including "macro-level" indicators of availability and "micro-level" household consumption and anthropometric surveys—will continue to have a role in informing policymakers.

According to the 1996 Food Summit at the Food and Agriculture Organization (FAO), food security exists if and only if "all people at all times have physical, social, and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." Based on the outcomes of the 1996 and 2009 World Food Summits, policymakers and researchers have focused on achieving the four dimensions of food security:

- Availability: there is a sufficient quantity of food available for the entire population.
- Access: each person has economic and physical access to these available calories.
- Utilization: each person is able to translate a proper diet into healthy outcomes, which further requires adequate sanitation and proper food preparation.
- Stability: each of these conditions are met at each point in time.

These dimensions build on each other, where food availability is necessary for food access, and food access is necessary for food utilization. Stability is the ability to sustain each of the other dimensions over time (Webb et al., 2006; Upton et al., 2016). Given all these dimensions, the concept of food security is not easy to measure or describe in a single indicator. Rather, a number of different metrics that help to describe the prevalence of food insecurity can combine to provide a more complete assessment of food security (Coates, 2013).

Table 2 presents a list of common food security metrics, as well as the dimension of food security that the metric directly measures. For example, the prevalence of undernourishment and the prevalence of child stunting are indicators of two dimensions of food security (access and utilization). It is possible that a country could have a lower prevalence of undernourishment but a higher prevalence of child wasting and stunting, or vice versa, depending on the intra-household distribution of calories and the prevalence of proper sanitation practices.

Table 2
Commonly cited metrics of food security

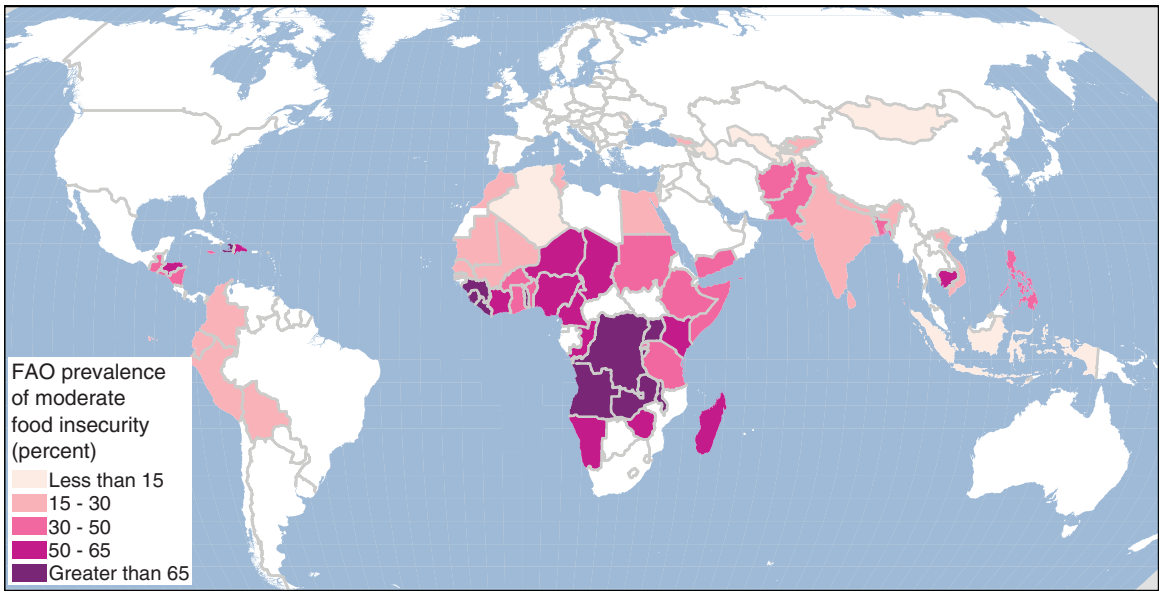
Type of metric	Metric list	Construction	Dimensions addressed
Macro-level metrics	Prevalence of undernourishment reported annually in FAO's *State of Food Insecurity*	Calculates total food availability for the country—total production less net imports—and then allocates these calories across the population to calculate the share of the population consuming below their minimum daily energy requirement	Availability and access
	Prevalence of undernourishment reported annually in USDA's *International Food Security Assessment*	Prior to 2016, calculated total food availability for the country—total production less net imports—and then allocated these calories across the population based on income distribution data to calculate the share of the population consuming below their daily energy requirement. Since 2016, demand is estimated for the whole income distribution, incorporating changes in both incomes and food prices.	Availability and access
	Global Hunger Index reported annually by the International Food Policy Research Institute	Creates an index based on weighting separate available indicators of food security—the prevalence of undernourishment, child wasting, child stunting, and child mortality. Uses a mix of current and lagged indicators, depending on data availability.	Availability, access, and utilization
Micro-level metrics	Food consumption indicators derived from household consumer expenditure survey estimates of calorie consumption, micro- and macronutrient consumption, diet diversity, coping strategies index, etc.	Estimates of household (and sometimes intra-household) consumption are obtained from consumer expenditure surveys. These data are used to calculate household or intra-household macro- and micro-nutrient consumption, the number of times a particular food group is consumed, the number of times a household is forced to exhibit a coping behavior, etc. These indicators can be used to construct metrics of prevalence of undernourishment and micronutrient consumption.	Access
	Anthropometric—body mass index (BMI), stunting, wasting, etc.	Simple measurements based on age, height, weight, and other readily measurable individual characteristics are compared to the distribution of scores from a geographically representative sample.	Utilization
	Experiential measures of food security	Households respond to yes-no questions on whether the household or individuals experienced a problem with food access. A number of different types of experiential measures can be constructed from these questions. Responses to individual questions may not be robust indicators of food access, but responses to the group of questions can be used to construct a scale such as the one used in ERS's U.S. domestic food security assessment (Coleman-Jensen et al., 2016).	Can address all dimensions

Notes: FAO = United Nations, Food and Agriculture Organization. ERS = USDA, Economic Research Service.
Source: The definitions of each metric and the dimension of food security each metric identifies are based on ERS researchers' interpretation of each individual measure.

It is also important to note possible differences between similar indicators of food security based on the method used to derive the estimates. For example, estimates of the undernourished population based on "macro-level" national food availability balances (FAO and USDA estimates) capture food availability based on supply and use balances and then make assumptions regarding the access to food across the population; whereas "micro-level" estimates of undernourishment based on household expenditure and consumption surveys directly measure each household's access to food. Thus, if improved national food availability is not accompanied by improved food access by vulnerable groups, then macro-level indicators that rely on a formula to estimate food distribution may indicate improved food security status while those derived from household surveys might not significantly change (Barrett, 2007).

Only a few metrics are able to provide comparable cross-national estimates of food security over time. Three such metrics are the USDA and FAO prevalence of undernourishment estimates and the WHO estimates of anthropometric indicators of children under age 5. Figure 3 shows the prevalence of undernourishment and stunting in the most recent years available (2015 for undernourishment, 2007-14 for stunting) for the 65 countries for which all estimates exist. Based on these metrics, Sub-Saharan Africa tends to have the highest prevalence of food insecurity of all the developing regions.

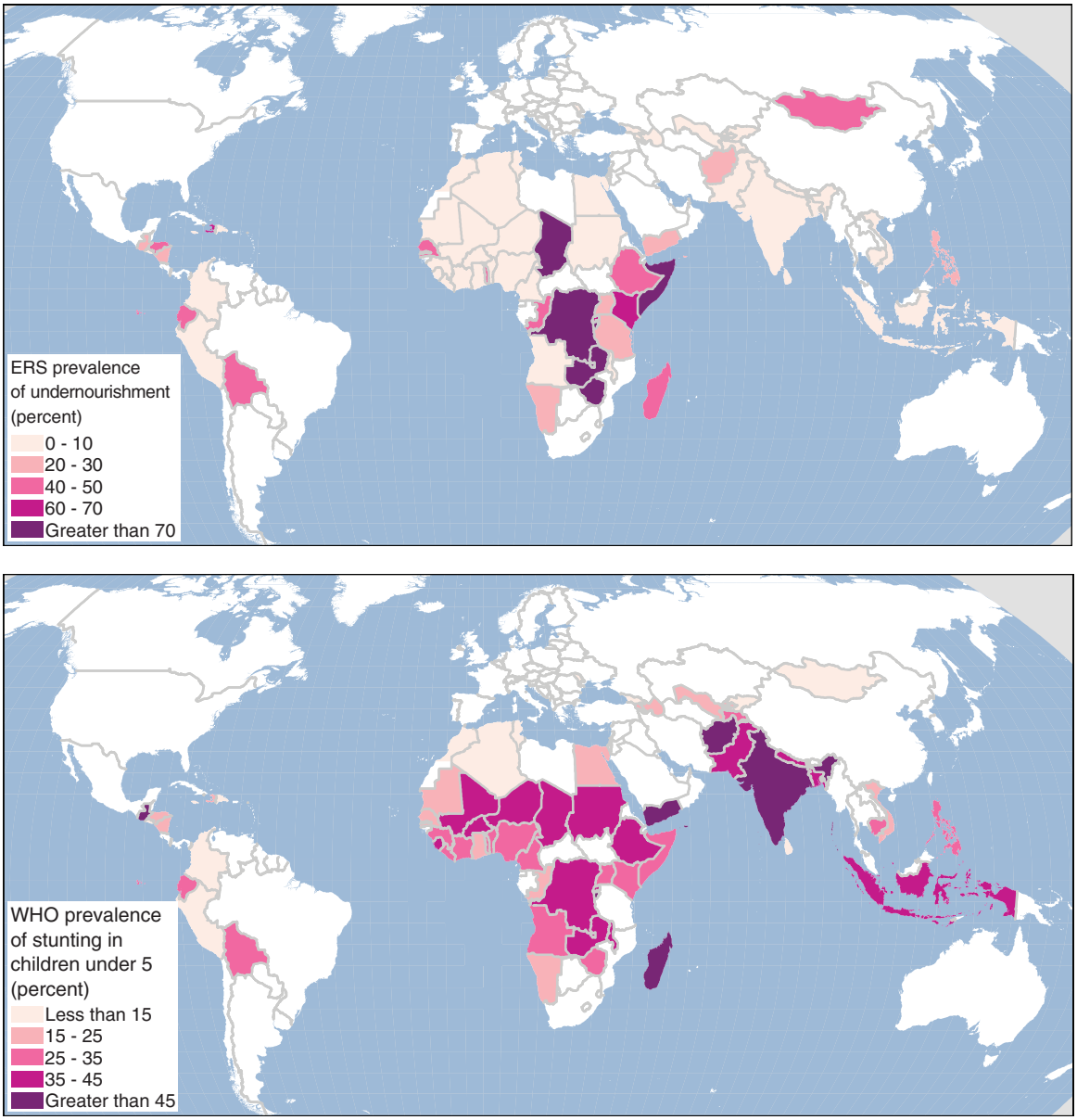
Figure 3
Selected food insecurity indicators for the 76 low- and middle-income countries tracked by USDA, FAO, and WHO



continued—

Figure 3

Selected food insecurity indicators for the 76 low- and middle-income countries tracked by USDA, FAO, and WHO—continued



Note: The figure plots the three indicators in the 65 countries for which there are estimates of all three indicators. All indicators are expressed as shares of the total population. The regions that are not shaded (i.e., white) are countries USDA does not track or for which at least one of the measures does not exist. The FAO and WHO measures are continuous, while the ERS prevalence rate is measured in deciles.

FAO prevalence of moderate food insecurity = shares of population who have compromised food quality or reduced food quantity in United Nations, Food and Agriculture Organization (FAO) Food Insecurity Experience Scale survey of developing countries. ERS prevalence of undernourishment = shares of population consuming food staples below the levels needed to reach minimum daily caloric target in 76 low- and middle-income countries, per USDA, Economic Research Service (ERS) estimates. WHO prevalence of stunting in children under 5 = shares of children under 5 years old who have low height for their ages, according to the World Health Organization (WHO).

Source: Compiled by ERS from 2015 ERS data, 2015 FAO data, and WHO data from the most recent year available for each country (which ranged from 2007 to 2014).

However, it is important to note that even metrics measuring the same dimensions of food security—such as USDA's and FAO's measures for prevalence of undernourishment—show significant differences. (Using similar data, the USDA estimates of undernourishment are lower than FAO's on average and for 53 of the 65 countries displayed.[3]) For a number of countries, the difference between the two measures is pronounced—24 of the 65 countries have over a 30-percentage-point difference in the prevalence of undernourishment. However, these differences arise in part because FAO uses UN sources for population and GDP growth, and the ERS assessment uses USDA estimates of macroeconomic conditions and census data from each individual country.

Additionally, significant differences exist among regions in the prevalence of undernourishment and children-under-5 stunting (fig. 3). For example, rates of stunting are higher in South Asia than in Sub-Saharan Africa, even though a smaller share of South Asia's population is undernourished, according to both USDA and FAO estimates.

The Sensitivity of Individual Metrics to Changes in Methodology

Policymakers and researchers face the difficult task of combining a number of different metrics to better understand the size and the characteristics of the food-insecure population. However, a potentially important rationale for using so many metrics is to corroborate estimates using multiple methods. Each individual indicator contains measurement error, making it undesirable to rely on any individual metric without corroboration of others.

Looking at the macro-level indicators, for example, both FAO's and USDA's estimates of the prevalence of undernourishment face the challenge of estimating how available calories are split across the population. However, continually improving metrics and methodological revisions have led to significant changes in the estimates of prevalence of undernourishment. When utilizing the same underlying data, FAO estimates of the undernourished population for a given year have changed over time; current estimates of the undernourished population in 1990 have been adjusted upward with each methodological review and data update (Caparros, 2014). Likewise, when USDA changed its methodology to allocate available calories across the population in 2016, the number of undernourished people changed from 12 percent of the population to 17 percent in 2016 (Rosen et al., 2016).

Similarly, using household-level surveys to estimate household consumption also requires strong assumptions to estimate the number of undernourished individuals. In particular, the results are quite sensitive to the assumptions made in estimating the nutritional content of food consumed outside the house and the nutritional content of processed foods. ERS research has demonstrated that adjusting these estimates slightly can result in a significant change in the assessment of the undernourished population by 173 million individuals (or 16 percent of the population) in India alone in 2004 (Tandon and Landes, 2011a; Tandon and Landes, 2012). Furthermore, these sources of calories are becoming more prevalent as incomes grow, and better methods of estimating calories from processed foods and food taken outside the home will be increasingly important to improve the precision of undernourishment estimates using Household Consumer Expenditure Surveys (Tandon and Landes, 2014).

Another significant measurement issue is that, while food insecurity occurs at the individual level, most surveys collect data at a higher level—either at the household- or an even more aggregated

[3]We cannot compare the raw numbers of undernourished individuals in each estimate because the FAO estimates cover more countries than the ERS estimates.

level. ERS research has demonstrated that when survey data permit estimates at the individual level, both the number of food-insecure individuals change, and the identity of the food-insecure population changes significantly because of inequities in food consumption within households (D'Souza and Tandon, 2015; D'Souza and Tandon, 2016). When collecting consumption data, the method most preferred by nutritionists is to create a food diary in which participants weigh and record consumption on 2 nonconsecutive days, but this method is more time-consuming and expensive than traditional household consumer expenditure surveys (Fiedler et al., 2012).

Additionally, a growing body of literature demonstrates that other aspects of household survey design—such as the length of the food menu list in the survey instrument and the definition of the household—significantly influence estimates of food consumption and insecurity (Beaman and Dillon, 2012; Beegle et al., 2012b; Caeyers et al., 2012; Ravallion et al., 2016). Overall, the differences between assessments resulting from use of different methodologies can be significant, with variations in the incidence of food insecurity of nearly 20 percent of the population (Beegle et al., 2012a).

Although all of the measurement issues discussed so far have focused on the estimation of food consumption, additional measurement issues exist in estimating individual caloric and nutrient requirements. Recommended daily allowances (RDAs) vary based on the age, gender, and activity level of the individual (FAO, 2001). Unfortunately, activity levels are not directly observed in most cases, and are crudely estimated, often based on whether individuals live in rural or urban areas (India National Sample Survey, 2007).

Combined, these findings demonstrate that each estimate of food security is only one of a range of possible values. These findings further demonstrate the importance of using a range of metrics of the same dimension of food security to help identify estimates of particular dimensions of food security.

Interpreting a Range of Food Security Metrics

Comparing commonly used food security indicators for three large countries with significant rates of food insecurity—Bangladesh, Ethiopia, and India—demonstrates how a suite of metrics helps to paint a more complete picture of food insecurity in each country (table 3). Based on these estimates, each country has a significant share of population who do not have sufficient access to food. Despite FAO's and USDA's differing methods, both organizations' metrics rank food insecurity being most prevalent in Ethiopia and the least prevalent in India. This ranking continues to hold in the IFPRI Global Hunger Index when child health outcomes are explicitly brought into the comparison.

However, the picture regarding the share of the population that lacks sufficient access to food across the countries varies significantly between micro-level and macro-level indicators. Micro-level indicators can add more detail and precision on the characteristics of the food-insecure populations in each country. Based on the prevalence of severe food insecurity as measured by FAO's Food Insecurity Experience Scale, each country has approximately equal shares of individuals who resort to extreme behaviors such as skipping meals or going entire days without food. (See "prevalence of severe food insecurity" under "Micro-level metrics, table 3.) Based on prevalence moderate food insecurity using the same FAO scale, however, we see that Ethiopia has roughly twice as large a share of the population with problems accessing a healthy diet as India.

Table 3
Comparing measures of food security

Food security measure		Prevalence in Bangladesh	Prevalence in Ethiopia	Prevalence in India
		Percent		
Macro-level metrics	United Nations, Food and Agriculture Organization's (FAO) prevalence of undernourishment (2014)	16.7	35.0	15.2
	USDA, Economic Research Service (ERS) prevalence of undernourishment (2014)	29.5	40.3	10.1
	International Food Policy Research Institute's (IFPRI) Global Hunger Index prevalence of undernourishment (2014)	19.1	24.4	17.8
Micro-level metrics	FAO's Food Insecurity Experience Scale (FIES)—prevalence of severe food insecurity (2014)	10.8	12.1	12.4
	FAO's Food Insecurity Experience Scale—prevalence of moderate food insecurity (2014)	33.5	48.4	24.8
	Prevalence of undernourishment in rural households derived from household consumer expenditure surveys (2010-12)	22.0	32.6	63.8
	World Health Organization (WHO) share of children under 5 who are stunted (Global Nutrition Report, 2015)	36.0	40.4	39.0
	WHO share of children under 5 who are wasted (Global Nutrition Report, 2015)	14.0	8.7	20.1

Source: FAO's *The State of Food Insecurity in the World, 2014*; ERS's International Food Security Database; IFPRI's *2014 Global Hunger Index: the Challenge of Hidden Hunger*; ERS researchers' calculations using the FAO FIES; ERS researchers' calculations using the Bangladesh Integrated Household Survey 2012; 2011/2012 Ethiopian Rural Socioeconomic Survey; and ERS researchers' calculations using the 66th Round (2009/2010) of the National Sample Survey Organization Consumer Expenditure Survey for India; the 2015 Global Nutrition Report.

In contrast to the USDA and FAO macro indicators, the estimates of undernourishment based on household expenditure survey data in table 3 are reported for only the rural population. The estimates suggest that food security is a larger problem in rural India than in rural Bangladesh or Ethiopia.[4] However, these household-level estimates of access to food in India do not appear to be consistent with the other macro- and micro-level estimates, highlighting the importance of measurement issues.

[4]Survey data for urban households are available only for India and indicate that the prevalence of undernourishment in India is lower in urban areas than in rural areas. FAO reports that urban areas of India, Bangladesh, and Ethiopia have less food insecurity than rural areas. (FAO, 2013).

Lastly, the measures of stunting and wasting further help to describe the food-insecure population of each country by indicating the extent to which constrained food availability, access, and utilization affect the development of children. The share of the child population that is stunted (low height for age) in each country is essentially equal, but there is significantly more wasting (low weight for height) in the South Asian countries than in Ethiopia.

There are a number of possible explanations for the relatively poor anthropometric outcomes in South Asia, despite indications that South Asia has better access to food than a number of other food-insecure regions. Lack of diet diversity may limit availability of some nutrients, or sanitary food preparation or health conditions may lead to differences in nutrient absorption (Schmidt, 2014). Stunting is also associated with the effects of open defecation, leading to diarrhea and environmental enteropathy (Spears et al., 2013). Also, cultural behaviors, such as parents in South Asia favoring male children, particularly first-born sons, may limit food access for other children (Dickinson et al., 2015; IFPRI, 2015; Jayachandran and Pandhi, 2015).

Thus, while the macro-level indicators suggest that undernourishment and access to food is a bigger problem in Ethiopia than in Bangladesh or India, the micro-level metrics expose other factors present in South Asia that alter food security outcomes in that region. Taken together, the different metrics suggest the possible need for different approaches for food security policy in each country. For example, while it may be important to continue to improve food access in Ethiopia through additional food assistance programs, more concerted efforts may be needed to improve sanitation and other aspects of utilization and nutrition in Bangladesh and India (IFPRI, 2015).

Emerging Issues in Food Security Measurement

- New experiential measures of food security are growing in popularity, in no small part due to their low cost and ease of collection over time. However, more research is needed to better understand the relationship of these metrics to other metrics that are better understood. (See box 3, "New Experiential Metrics of Food Security.")

- Many measures of food security are not particularly robust to small changes in methodology. Some of the sources of measurement error are relatively easy to address, such as through smaller occasional surveys to better measure food consumed outside the household, consumption of processed foods, and intra-household distribution of food.

- Some seemingly benign problems with survey-based indicators are harder to address, such as changes to the menu list of food expenditure items between survey years or across different surveys. More research needs to be done to better understand best practices, and then more effort needs to be taken to better standardize data collection.

Box 3

New Experiential Metrics of Food Security

One of the recent developments in the measurement of food insecurity is the genesis of experiential measures based on surveys that inquire about people's individual experiences with food insecurity by using a battery of questions designed to capture the use of coping strategies. One example of such a measure is the Food Insecurity Experiential Scale (FIES), developed by FAO as a complement to its traditional estimate of the prevalence of undernourishment reported in the *State of Food Insecurity* report. In its current form, the scale is based on eight separate yes-no questions designed to measure food access, beginning with the most severe forms of food insecurity (going an entire day without food) to the mildest form of food insecurity (worrying about having enough food to eat). The answers to these questions are used to estimate the probability that the individual faced moderate or severe food insecurity over the past year.

A benefit of this approach is that it can be easily adapted to capture each of the four dimensions of food insecurity. Although the FIES focuses primarily on access to food, other questions can be designed to better understand each of the other dimensions of food security as well. Furthermore, the surveys are faster and less costly to implement than household consumer expenditure surveys and, particularly, individual-level consumption surveys (Ballard et al., 2013). Gallup has included the food security module in its existing worldwide surveys, which are conducted both in person and by phone, depending on the country.

While experiential surveys are relatively adaptable, fast, and inexpensive, the indicators derived from them can differ significantly from other metrics, raising questions about their reliability. Although statistical models can help assess the consistency of the responses, the way individuals report their experiences in response to sometimes subjective questions can be affected by a number of factors that have little to do with the respondents' actual welfare. These factors include the ordering and wording of questions, the implicit scales used in the questions (i.e., defining what is normal consumption, etc.), and different interpretations of the questions by respondents (Bertrand and Mullainathan, 2001). Some studies have investigated the significance of biases in responses to similar subjective welfare questions in other contexts (Beegle et al., 2012b; Ravallion et al., 2016). Less research has been done on how experiential measures of food security compare with other measures (Maxwell et al., 2014). More research is needed to investigate how far these findings can be generalized to better understand the reliability of food security assessments that use these types of measures. ERS research has demonstrated that, in three large surveys conducted in Bangladesh, Ethiopia, and India, a large number of individuals are classified as undernourished based on their reported consumption from household consumer expenditure surveys, but some of these same people do not respond affirmatively to any of the food-insecurity questions in the experiential surveys conducted in the same survey (Broussard and Tandon, 2016).

Agricultural Productivity and Food Security

- Productivity growth in agriculture—producing the same or more output with fewer inputs—can improve food security directly by increasing the food availability and indirectly by improving food access, utilization, and stability.
- On average, countries that have achieved higher growth in agricultural productivity have also experienced larger reductions in the prevalence of food insecurity.
- Investments in agricultural research and technology development, paired with improvements in the broader "enabling environment" (e.g., infrastructure, market access, institutions, and risk-management measures), are key to sustaining long-term productivity growth.

By allowing more food to be produced from a given set of inputs, increased agricultural total factor productivity (TFP) facilitates the expansion of food output at declining real costs. TFP is defined as the ratio of total output to total aggregate inputs, and growth in TFP reflects gains from new technologies and improvements in the efficiency of the production process.

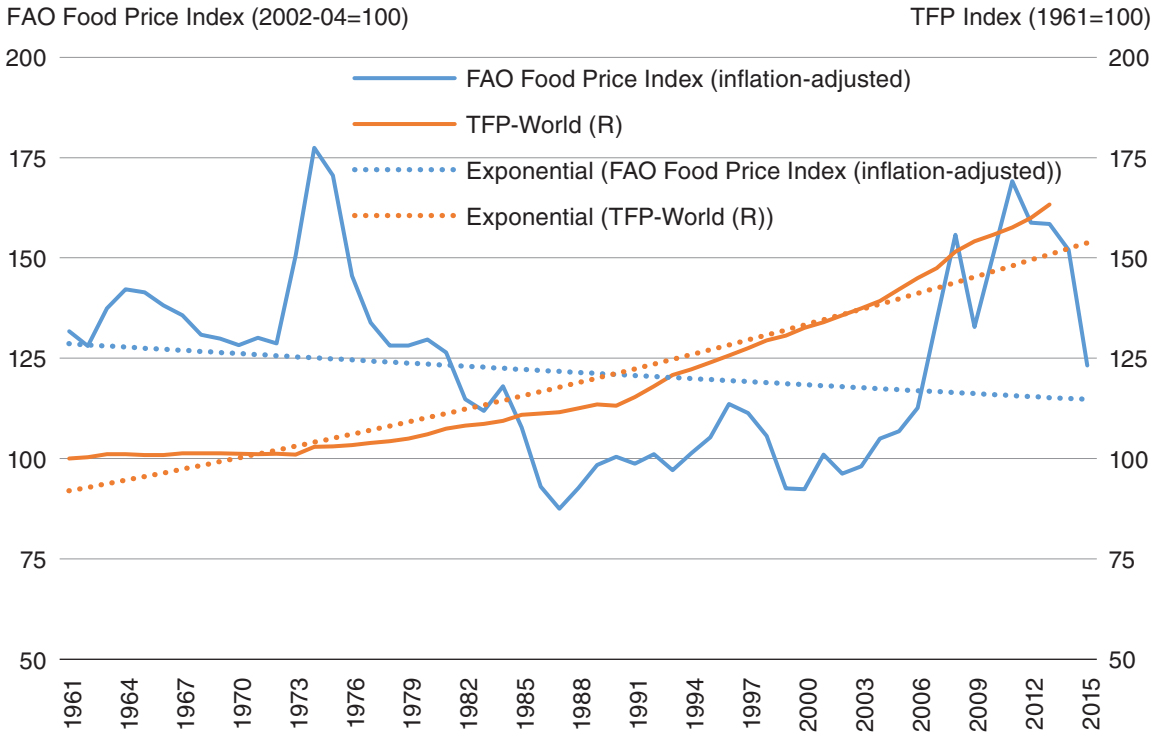
By plotting average global TFP growth and an aggregate index of real food prices and each series' trendline (fig. 4), we see the long-term relationship between agricultural productivity and food prices. From the 1960s through the early 2000s, prior to the surge in world food prices during 2008-12, an overall pattern showed rising TFP to be associated with falling real food prices, even as growing population and rising incomes increased food demand (Alexandratos and Bruinsma, 2012; Garnett et al., 2013; Godfray et al., 2010). Although the 2008-12 spike in world prices interrupted this pattern, current projections call for a return of more stable real prices under current policies, anticipated macroeconomic conditions, and assuming normal weather (USDA, 2016).

Depending on the farm output mix chosen, growth in agricultural productivity can also improve the income of agricultural producers, which improves food access (FAO, 2015b; IFAD, 2015, WFP, 2015; Schneider and Gugerty, 2011). Additionally, agricultural productivity growth can improve economic access to food through its effects on labor markets. For example, improvements in the supply chain might lead farmers to invest in hiring more labor, which would provide more work opportunities for agricultural laborers (OECD, 2006; Schneider and Gugerty, 2011). Productivity gains on the farm can make more time available to farmers, allowing them to pursue off-farm work that provides another, often higher paying source of income (Barrett et al., 2010). Alternatively, it is possible that the source of agricultural productivity growth actually reduces the amount of agricultural labor needed and the drop in wages outweighs any positive effect that lower food prices may have on food access for a segment of the population (Gollin, 2003).

In addition to its effects on real food prices, producer income, and agricultural labor market outcomes, productivity growth can have additional indirect effects, such as reducing the impact that agricultural production has on the environment. TFP growth means fewer inputs are required to achieve the same output over time. TFP gains that result, for example, from greater efficiency in fertilizer or pesticide use can reduce the runoff of fertilizers and pesticides that pollute water supplies (FAO, 2012). Also, gains in water use efficiency can conserve groundwater for other uses and, in some cases, reduce saltwater intrusion that renders groundwater unfit for irrigation or household use (Williams, 2010). Each of these effects can potentially lead to improved water quality and food utilization.

Figure 4

Agricultural Total Factor Productivity (TFP) and inflation-adjusted food prices



Note: R = right-hand axis.

Sources: USDA, Economic Research Service, International Agricultural Productivity database and United Nations, Food and Agriculture Organization (FAO), Food Price Index.

Aside from the beneficial effects agricultural productivity growth has on current food security outcomes, research suggests that nonagricultural sectors and off-farm labor outcomes can improve along with agricultural productivity growth over time. These activities tend to be in segments of the commercial, manufacturing, or service sectors that are related in some way to agriculture and are often informal (Reardon, 1997). As an economy undergoes a structural transformation away from agriculture and toward secondary and tertiary sectors—a process that is often driven by growth in agricultural productivity—people tend to engage in increasingly formal work outside of agriculture (Johnston and Mellor, 1961). These opportunities can further improve food access, utilization, and stability. However, growth in rural farm and nonfarm employment is not necessarily sufficient to prevent significant rural to urban migration that can expose migrants to urban food security problems associated with food access and purchasing power. Identifying new opportunities to extend agricultural productivity growth to the wider agri-food system is an important emphasis of GFSA. So is finding ways to address the challenge urbanization poses to food security, particularly in Sub-Saharan Africa.

Sources of Productivity Growth in Agriculture

TFP growth comes in many forms—new technology (e.g., new varieties or tools), new processes, new institutions (e.g., new forms of contracts or policy mechanisms), and new markets (e.g., creating a market for a value-added product) (Wang et al., 2015). An innovation can come as part of a "package" of several innovations that need to be adopted by multiple actors in conjunction with each other (Feder et al., 1985). For example, the semi-dwarf, high-yielding rice and wheat varieties from the Green Revolution depended on fertilizer inputs and irrigation, which in turn were contingent on farmer access to credit and markets (Hounkonnou et al., 2012).

It is well established that productivity growth depends on long-term investments in agricultural research, which accrue into a stock of "knowledge capital" (Alston et al., 2000; Alston et al., 2009). Countries that have research and extension systems that are effectively able to develop and transfer new technologies tend to experience greater advances in productivity over the long run (Rada and Schimmelpfennig, 2015; Rada and Valdes, 2012; Fuglie et al., 2012). National research systems often work with international researchers, such as CGIAR centers, to translate and adapt externally produced research products to domestic production systems (Fuglie et al., 2012). Many advancements in TFP in Sub-Saharan Africa (SSA) since the 1980s are partly due to collaboration between CGIAR centers and national agricultural research systems, which have a return of $6 for every $1 invested in CGIAR research (Fuglie and Rada, 2013b).

Beyond agricultural research, there is increasing recognition of how enabling environments contribute to fostering productivity growth in agriculture (Diaz-Bonilla et al., 2014; Fuglie et al., 2012; FAO, 2012). Ultimately, the adoption of productivity-enhancing innovations is a matter of individuals making the decision to adopt new technologies. The factors that affect innovation decisions can be broadly split into individual characteristics and the wider external enabling environment (Diaz-Bonilla et al., 2014; Konig et al., 2013). Individual characteristics include the willingness to take risks, actions of peers, and human capital such as health and education (Benhabib and Spiegel, 2005). Factors in the external enabling environment that affect innovation decisions include prices, macroeconomic stability, governance, the rule of law, access to financial services, and the consequences of taking risks (e.g., social and legal consequences of bankruptcy) (Pinstrup-Andersen et al., 2008). There is evidence that countries that enacted economic reforms and removed market distortions have experienced improved productivity growth (Fuglie and Rada, 2013b; Rada and Fuglie, 2012; Rada et al., 2011). Public investment in infrastructure has also been key. New or improved roads and electricity boost farm productivity by enhancing access to inputs (Ahemed and Hossain, 1990) and also make it easier, faster, and cheaper for food products to reach market (OECD, 2006). Increased efficiency across the food value chain has the potential to decrease the real price of food paid by consumers and directly contribute to improvements in food access (Pinstrup-Anderson et al., 2008).

Changes in Agricultural Total Factor Productivity (TFP)

Global agricultural TFP grew by an annual average of 1.7 percent a year between 2001 and 2013 (table 4). However, that growth was generally uneven across time and regions (Fuglie and Rada, 2013a). For developing countries, TFP grew by an average of 1.9 percent annually between 2001 and 2013, which is about the same as it grew during 1991-2000, but faster than during 1981-90. Among developing regions in recent years, annual TFP growth has been fastest in Asia, Central America, North Africa, and Southern Africa. TFP growth has generally been slowest in the Caribbean and in most regions of Sub-Saharan Africa.

Based on data for the 76 low- and middle-income countries tracked by USDA, a significant positive correlation exists between changes in productivity and changes in the share of the population estimated to be food secure. On average, those countries with improved TFP growth also experienced improved food security (fig. 5). However, it is not possible to establish causation. Other determinants of food security, besides TFP, could be changing at the same time; events may be causing both food security and agricultural productivity to move together; and some TFP improvements could actually be driven by improvements in food security—where, for example, better nourished agricultural laborers could be more efficient.

The cases of Vietnam, Chad, and Zambia illustrate the linkages between food security and changes in agricultural productivity in more detail. Vietnam has increased TFP by 61 percent while raising its food-secure population share by 87 percent since 1990 (fig. 5). A number of programs that helped improve TFP were instituted during this time period, such as programs that invested in research and extension systems and in irrigation infrastructure (World Bank, 2003). Other measures also contributed to agricultural productivity, such as redistributing and securing land rights, reforming the procedures for starting businesses, increasing access to credit, decentralizing local decisionmaking, and integrating agriculture into the market economy in an environment of sound macroeconomic management (World Bank, 2003). Nonagricultural policies played an important role in creating off-farm employment and improving living standards and household food security (World Bank, 2003), but gains in agricultural productivity were also likely an important factor.

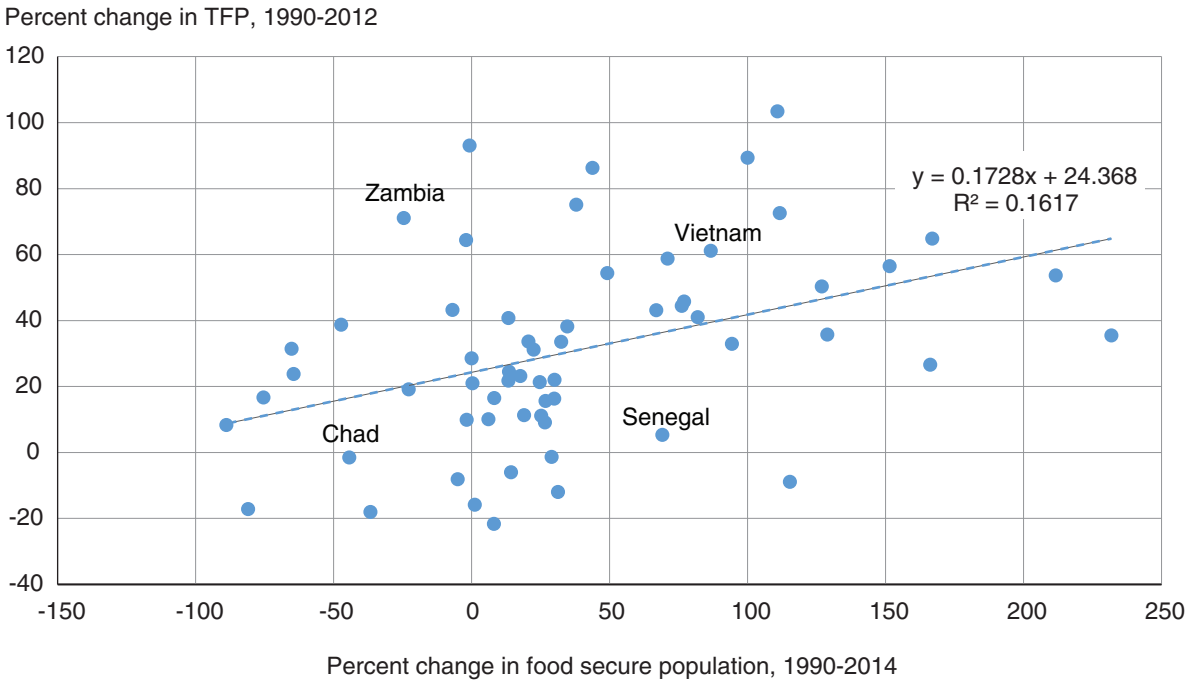
Table 4
Average annual percent changes in Total Factor Productivity by region

Region	1981-90	1991-2000	2001-13
	Average annual percent change		
World	0.6	1.5	1.7
Developing countries	1.1	2.0	1.9
Asia			
South Asia	1.2	1.0	1.9
Southeast Asia	0.5	1.3	2.4
West Asia	0.7	1.5	1.9
Latin America and Caribbean			
Caribbean	-0.6	-0.3	0.8
Central America	-1.7	2.7	2.0
Andes region	0.5	1.7	1.6
Africa			
North Africa	2.5	1.6	2.6
Sub-Saharan Africa	0.9	1.1	0.6
Central	0.6	-1.0	1.6
Eastern	0.5	0.1	0.2
Horn	-0.5	1.0	0.6
Southern	0.2	1.1	2.5
Sahel	0.9	1.2	0.6
Western	1.6	1.1	0.6

Source: USDA, Economic Research Service, International Agricultural Productivity database.

Figure 5

Changes in food security and Total Factor Productivity (TFP) for selected low- and middle-income countries[1]



[1]Changes in food security are based on USDA estimates of the shares of population who were undernourished.

Source: USDA, Economic Research Service (ERS), International Food Security database; USDA/ERS, International Agricultural Productivity Database.

Chad, on the other hand, has had a different experience. TFP is nearly unchanged since 1990, while the share of the population that is food secure has shrunk by 44 percent. There are a number of factors that contribute to this situation. Agricultural productivity is impeded by natural resource degradation, particularly desertification and soil loss, combined with highly variable rainfall in the central Sahel region. These problems are exacerbated by ongoing strife and conflict between ethnic groups, as well as between pastoralists and settled farmers as people migrate and compete over ever scarcer natural resources (IFAD, 2015; World Bank, 2016). The country's severe lack of marketing infrastructure is reflected in the large discrepancy between the relatively low prices received by farmers and high food prices paid by consumers—an implicit tax on both producers and consumers that dampens technology investment and food consumption (World Bank, 1997). There is also a dearth of financial services and research and extension support for agriculture (World Bank, 2016). In Chad, the lack of improvement in productivity in the agricultural supply chain is associated with relatively high food prices and a decrease in the share of the population that is food secure.

In Zambia, the food-secure population decreased by an estimated 25 percent since 1990 despite a 71-percent increase in TFP, highlighting a case where productivity gains alone are not sufficient to strengthen food security. Nearly all of the productivity gains have been due to increased use of inputs by the small share (3.8 percent) of farms that are larger than 5 hectares (Siegel, 2008; Tembo and Sitko, 2013). Overall food availability and access is limited by the fact that 72 percent of farms are 2 hectares or less, with most producing at a subsistence level with minimal inputs (Tembo and Sitko, 2013). As a result, both output and income gains are confined to a small segment of the rural population. Food availability and access are also limited by poor infrastructure that increases marketing costs and limits access to and utilization of nutritious foods (Siegel, 2008). There is a

relatively high prevalence of malnutrition in children, with 53 percent of children having vitamin A deficiencies and 47 percent being stunted (WFP, 2016). Also, 12.7 percent of the population is HIV positive, one of the highest rates in the world, which also impedes broader gains in productivity growth and food security (Fuglie and Rada, 2013a; WFP, 2016).

Emerging Issues in Agricultural Productivity and Food Security

The role of agricultural research. There is strong evidence that agricultural productivity growth over the long run depends on well-funded and effective research systems that can supply research products that fit the needs of local production systems (Fuglie et al., 2012). In recent years, a slowdown in public agricultural research and development (R&D) investments has raised concern about a corresponding slowdown in agricultural productivity growth (Wang et al., 2015). So far, there has been little indication of productivity growth slowing, but this could be due to the long lag between R&D expenditures and TFP growth (Wang et al., 2015).

For small countries, especially in Sub-Saharan Africa, it can be difficult to fund effective research and extension systems because of the fixed costs associated with setting up research facilities relative to the size of the population served. This can make it difficult for national research and extension systems in small countries to take advantage of economies of scale, making well-functioning systems prohibitively costly (Fuglie and Rada, 2013b). Yet there are examples of small countries that achieved returns on agricultural research investments sufficiently high to justify the investments. Critical to those accomplishments seems to be tying into regional and international research networks and maintaining a policy environment that is receptive to technologies developed elsewhere (Fuglie and Rada, 2016).

Productivity for the wider agri-food system. Much of the research on agricultural productivity has focused on the farm level. Under the new GFSA and the associated U.S. Government Global Food Security Strategy, there is a new emphasis on the importance of increasing the productivity of the wider agri-food system. In addition, there is increased interest in examining the potential for enhanced productivity to support employment growth in rural areas through meeting the growing demand for food in urban areas.

The productivity-resilience link. The productivity gains from agricultural research at all levels require the ideas produced to be actually adopted and brought into use, which is aided by a conducive enabling environment that creates incentives for technology adoption (Hall et al., 2007). In some instances, the technology already exists, but it has not been widely or fully adopted because socioeconomic conditions, including marketing institutions and policies, do not make adoption feasible (Gollin et al., 2016). Support mechanisms can be important policy tools for innovation and productivity growth in agriculture, given that adopting a new tool or practice can add significant risk (Fleisher, 1990). Safety nets—such as new weather-index-based crop insurance programs suited to implementation in developing country markets—hold promise for protecting growers from risks associated with adoption of new technology. Other safety nets, such as food or income assistance, can also provide the support and backstopping needed for adoption (FAO, 2014; FAO, 2015b; Kuyvenhoven, 2004).

Risks associated with climate change. Climate change assessments indicate that many of the low-income, food-insecure countries in Sub-Saharan Africa, Asia, and Latin America and the Caribbean will be faced with challenges to each of the four dimensions of food security policy. Based on the critical role of productivity gains in achieving past improvements in food security of many countries, successful development and adoption of new technologies for adequate and stable food production is likely to remain important in the context of climate change. (See box 4, "Climate Change and Food Security.")

Box 4

Climate Change and Food Security[1]

Climate change refers to the long-term change in the average level and variability of rainfall, temperature, and humidity. The Agricultural Model Intercomparison Improvement Project, supported by the USDA's Agricultural Research Service, takes an integrated approach to modeling the effects that climate change will have on agriculture. Using 50-to-70-year yield forecasts (box 4, fig. 1) derived from biophysical crop and livestock production models, the project links climate models with socioeconomic models to explore how a changing climate may affect food security. Climate change is expected to affect all four pillars of food security and to have the greatest global effects on the poor, especially in tropical regions.

Climate change will likely affect food availability by disrupting production and processing. Temperature and precipitation changes—as well as shifts in the timing of rains, such as the Asian monsoon—can have consequences for crop and livestock production. USDA estimates that climate change will lower crop yields by 2.5 percent per decade, in contrast to the 9-percent growth seen over last decade. Heat stress can also have negative effects on livestock health and reduce feed conversion efficiency, putting downward pressure on milk, meat, and egg production. Higher temperatures are expected to lead to more spoilage along the supply chain, requiring improvements to storage, processing, and packaging and creating additional costs. Extremes in temperatures and rainfall, as well as sea-level rise, could affect transportation infrastructure. Depending on the severity and spread of the disruptions to production, local availability, and transport, increased trade between regions may compensate for intra-regional disruptions.

Climate-change disruptions to production are expected to affect food access. Lower and more variable production, coupled with disruptions to distribution and degraded transport infrastructure, will likely mean higher and more variable prices. Higher or more volatile prices and marketing costs will likely have the largest effect on lower income households because they spend relatively high income shares on food. In a low-emissions scenario, the estimated costs add up to a 5- to 10-percent increase in food prices, with a high-emissions scenario resulting in a 20- to 30-percent increase. In each scenario, more open trade keeps price increases in the

continued—

[1]All findings reported in this box are drawn from *Climate Change, Global Food Security, and the U.S. Food System*, published by USDA in 2015 (Brown et al., 2015).

Box 4

Climate Change and Food Security—continued

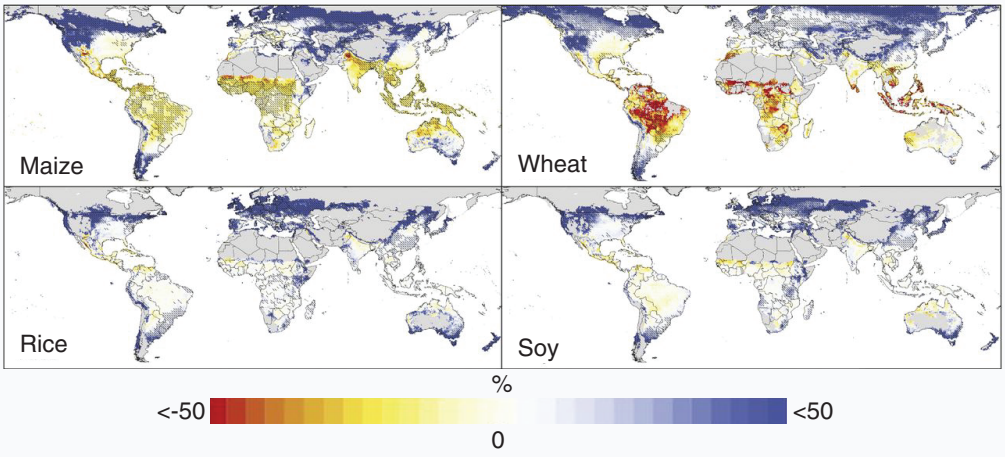
lower bound of the estimates. The extent to which open trade can affect food access depends on whether transportation infrastructure and markets in both exporting and importing regions can deliver food at affordable prices.

Climate change is expected to negatively affect food utilization in several ways. Food safety issues will be a concern as higher temperatures and humidity lead to a greater incidence of food-borne diseases and fungal toxins such as aflatoxin. Researchers anticipate increased human disease pressure that is likely to adversely affect the utilization of nutrients, leading, for example, to higher incidence of diarrheal diseases and mosquito-borne diseases such as malaria. Also, global or regional shifts in production zones can mean that traditional or culturally acceptable foods may not be locally available or affordable. Climate change is also likely to affect the nutritional content of food. For example, higher atmospheric concentrations of CO_2 reduce the iron and zinc in staple foods, and higher temperatures and humidity reduce the protein content of milk.

Maintaining the stability of food availability and prices is expected to be a focus of adaptation to climate change. Effective risk management mechanisms (see box 5, "New Risk Management Support Programs and Agricultural Productivity"), including food aid, can help people contend with the instability associated with producing and accessing food. Insurance schemes, such as weather-indexed crop insurance, can help producers manage weather risk. Information and communication technology can be used to share crop or market information and link people and services together. Trade can help make food available and accessible to regions affected by weather disruptions, but can also expose the importing country to the risks and variability in production and prices in exporting regions. Research and development can adapt culturally preferred varieties to a changing local production zone, as well as develop varieties with improved nutritional content. Research efforts can focus on improving yields because regions that are currently producing below potential yields will be further challenged as the climate changes.

Box 4 figure 1

Median yield changes (percent) between 1980-2010 baseline and 2070-2099 for four major cereal crops



Note: Composite results from all seven (six for rice) Global Gridded Crop Models (GGCMs) that are part of the Agricultural Model Intercomparison Improvement Project (Ag-MIP). Simulations assume representative concentration path 8.5 (RCP8.5) with CO_2 effects.

Source: USDA, Economic Research Service. Adapted from Rosenzweig et al. (2014), "Assessing Agricultural Risks of Climate Change in the 21st Century in a Global Gridded Crop Model Intercomparison," Proceedings of the National Academy of Sciences 111(9): 3,268-73.

Box 5

New Risk Management Support Programs and Agricultural Productivity

In addition to improving the "enabling environment," further specific innovations help both to improve agricultural productivity growth and enhance resilience in developing countries. Smallholder farmers are largely responsible for crop production that feeds them and others in the region, but because of the risk of catastrophic loss, many farmers are unwilling to fully invest in farming inputs, even if more investment will increase their average production and income (Hazell et al., 1986). Index insurance—agricultural insurance based on a transparent and independent measure of weather that is highly correlated with farm-level losses, such as rainfall in regions where agriculture is rain fed—is a possible solution to help increase agricultural investments, as it can potentially offer coverage against catastrophic loss in places where traditional insurance might not be offered (Karlan et al., 2014). The increased agricultural production from higher levels of agricultural investments can improve food availability, and the potential increases in income from more agricultural investments can then lead to improvements in food access.

In a developing country context, relatively successful agricultural insurance programs have included insurance as just one part of a holistic approach to farm risk management (box 5, table 1). One example is the R4 program, a World Food Program (WFP) and Oxfam America initiative that began in Ethiopia and Senegal and has recently expanded to Malawi and Zambia. R4 combines savings, insurance, risk mitigation, and risk-taking activities as a means to make farmers more resilient. Agriculture and Climate Risk Enterprise (ACRE Africa) has also seen growth in its insurance programs in Rwanda, Tanzania, and Kenya (box 5, fig. 1). ACRE—a for-profit company that evolved from the 2009 "Kilimo Salama" project funded by the Syngenta Foundation and the World Bank Global Index Insurance Facility (GIIF)—bundles insurance with agricultural advisory services, weather data, and local access to high-quality inputs and input credit. The program also uses mobile technology to quickly and cost-effectively provide information and transmit payments to farmers.

There is evidence that index insurance is improving farmer productivity and well-being in some developing country cases. An impact evaluation of the Horn of Africa Risk Transfer for Adaptation(HARITA) project in Ethiopia (the precursor to R4) finds that farmers insured through the program increased their savings and the number of oxen they owned, as well as increased productive investments in agriculture. The program also had a larger effect on insured women than on insured men and the uninsured (Oxfam, 2014). In Senegal, insured R4 study participants increased rice production at 10 times the rate of uninsured control group farmers from 2013-15. While both insured and uninsured farmers saw a decrease in food security during a drought, insured farmers experienced a much smaller decrease (-8.1 percent) than the uninsured (-49.1 percent) (WFP, 2015).[1] Farmers enrolled in the ACRE insurance program earned 16 percent more and invested 19 percent more than the uninsured in their communities (IFC, 2014). In Kenya, livestock index insurance is expected to reduce vulnerability and poverty over time (Janzen et al., 2012).

continued—

[1]In this study, "food security" is defined by a WFP measure known as the Food Consumption Score (FCS). The FCS scores are a weighted frequency of consumption of eight different food types; scores reflect both the quality and quantity aspects of food security, and can be broadly categorized into three groups: poor, limited/borderline, and acceptable food consumption.

Box 5

New Risk Management Support Programs and Agricultural Productivity—continued

Box 5 table 1

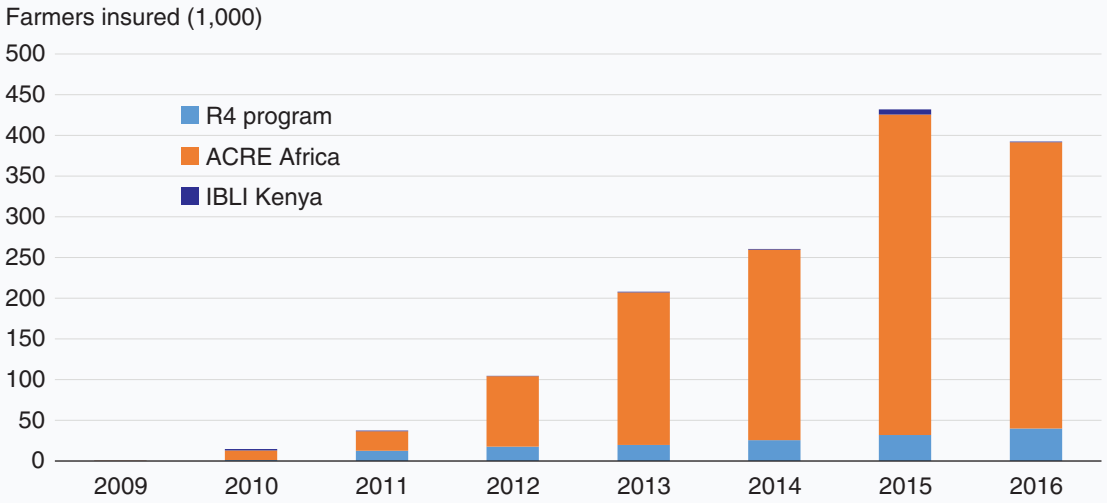
Sub-Saharan African index insurance programs and potential outcomes

Program	Countries affected	Program aims
ACRE Africa	Rwanda, Kenya, Tanzania	Increase farm income Increase farm investment
R4 Rural Resilience Initiative (WFP/Oxfam)	Ethiopia, Senegal, Malawi, Zambia	Mitigate food insecurity after a shock Increase agricultural investment Increase stock of oxen (form of savings/asset holding)
IBLI (Index-based Livestock Insurance)	Kenya, Ethiopia	Reduce poverty Increase average asset levels
African Risk Capacity (African Union)	Kenya, Mauritania, Niger, Senegal, Burkina, The Gambia, Malawi, Mali, Zimbabwe	Improve capacity of government response to extreme weather events and natural disasters

Notes: Agriculture and Climate Risk Enterprise (ACRE Africa) a for-profit company that evolved from the 2009 "Kilimo Salama" project funded by the Syngenta Foundation and the World Bank Global Index Insurance Facility (GIIF).
R4 Rural Resilience Initiative was launched by the World Food Program (WFP) and Oxfam.
Sources: USDA, Economic Research Service using information from ACRE Africa, R4, IBLI, and African Risk Capacity.

Box 5 figure 1

Growth of index insurance programs in Sub-Saharan Africa



Note: The R4 program is an initiative of the World Food Program (WFP) and Oxfam America. Agriculture and Climate Risk Enterprise (ACRE Africa) is a for-profit company that evolved from the 2009 Kilimo Salama project funded by the Syngenta Foundation and the World Bank Global Index Insurance Facility (GIIF). Index-Based Livestock Insurance (IBLI Kenya) is an index insurance research and implementation program run by the International Livestock Research Institute (ILRI). ACRE Africa program information for 2016 is approximate.

Source: USDA, Economic Research Service calculations using data from Oxfam, ACRE Africa, Kilimo Salama, and ILRI.

continued—

Box 5

New Risk Management Support Programs and Agricultural Productivity—continued

Despite the relative successes of some index insurance pilots and full-scale programs, challenges remain for both implementation and sustainability of these types of supply-side safety net projects. The lack of sufficiently detailed data on agricultural production and weather increases the chance that a farmer suffers a loss that is not covered under the insurance contract (basis risk), and thus impedes both the supply of and farm-level demand for innovative insurance products. In addition, farmer education on how insurance works is a critical component of uptake—but one that is costly.

Public-private partnerships (PPPs) are one channel for sharing expenses that would otherwise make private index insurance too costly for farmers in developing countries. For example, the Mongolian Government would cover only extremely large losses of an insurance product for its livestock herders. Similarly, India's National Agricultural Insurance Scheme subsidizes farmer premiums, and its State governments provide yield data from crop-cutting experiments. The Kenya National Agricultural Insurance Program was recently launched as a PPP that will insure livestock, maize, and wheat and ease the financial burden on the Kenyan Government after natural disasters. Index insurance PPPs can serve as de facto supply-side safety nets for farmers, even helping governments finance disaster aid.

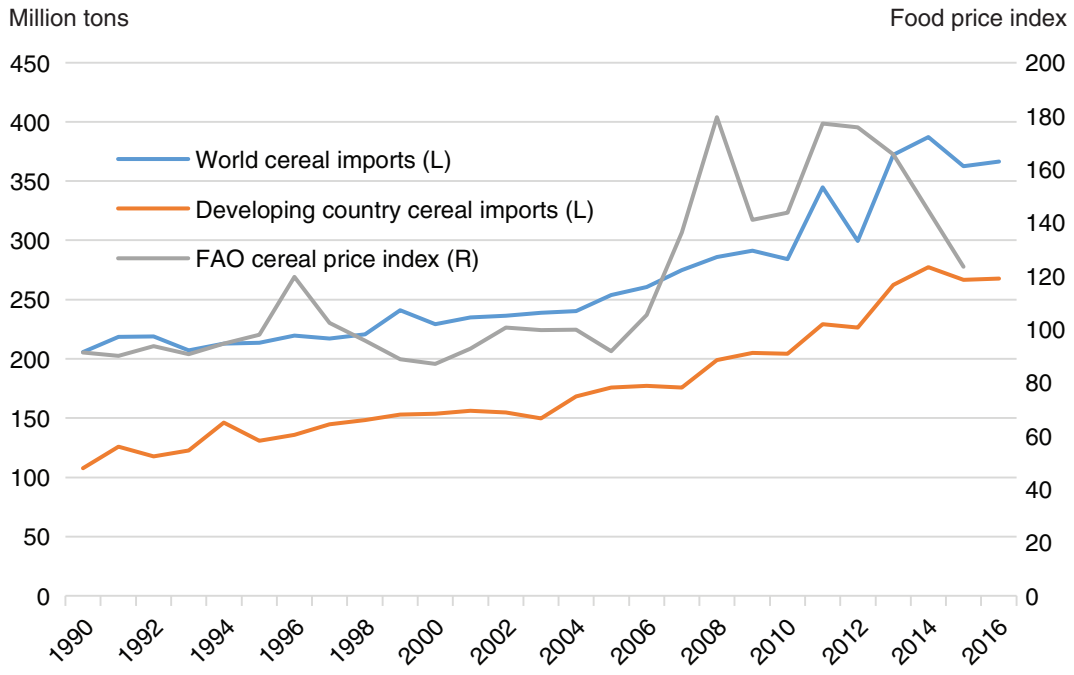
Trade in Agriculture and Its Contribution to Food Security

- Trade can contribute to multiple dimensions of food security, including food availability, access, utilization, and stability. Increased reliance on trade also presents potential challenges to developing domestic agriculture and, under some market conditions, may expose domestic markets to more price volatility.
- While many food-insecure countries export agricultural products, most are net food importers. Imports have been a major contributor to improved food security in countries with limited production potential. But, for most of the 76 low- and middle-income food-insecure countries regularly tracked by USDA, domestic production has been the primary source of gains in food security.
- Commercial imports, as opposed to food aid, have accounted for all of the growth in cereal and cereal-equivalent food imports by the 76 countries studied. The share of food aid in cereal imports has declined globally and in all lower income regions since the mid-1990s.
- For some countries, the abilities to generate the financial capacity to import food through export earnings and other foreign receipts and to make tradeoffs between imports of food and outlays for investments in areas such as agriculture and infrastructure are considerations for food import policy.

In addition to creating the potential for efficient domestic production, countries can also improve food availability through trade in agriculture. Overall, developing countries have increased their role in world markets for cereals and roots and tubers, which account for the bulk of food staple consumption in most developing countries (Trostle and Seeley, 2013). Cereal imports by developing countries have grown about 140 percent since 1990 and about 75 percent since 2000 (fig. 6). By 2013-15, developing countries accounted for about 75 percent of global cereal imports and had contributed about 87 percent of the expansion of global cereal import demand since 2000. Clearly, developing countries as a whole are taking advantage of world markets to meet some of their expanding demand for both food and feed (Trostle and Seeley, 2013).

For much of the period between 1990 and the mid-2000s, the growth in cereal imports was supported by relatively stable real prices in global markets. Since the mid-2000s, however, world prices have tended to be less stable, with significant spikes in 2008, 2011, and 2012, followed by a sharp downturn in 2014 and 2015 (fig. 6). Although other factors, including supply disruptions and demand for biofuel feed stocks, influenced the recent price instability, higher demand in developing country markets was a key underlying factor (Trostle et al., 2011; Cooke et al., 2016). Although low-cost cereal imports provided an opportunity for developing countries, including low-income, food-insecure countries, to boost consumption, an environment of higher or less-stable prices may increase the perceived costs and risks of increasing reliance on food trade (D'Souza and Joliffe, 2012; Tandon and Landes, 2014).

Figure 6
World cereal trade



Notes: L = left vertical axis. R = right vertical axis.
Source: USDA, Economic Research Service. United Nations, Food and Agriculture Organization (FAO), FAOSTAT database and FAO, Food Price Index.

In aggregate, for the 76 low- and middle-income, food-insecure countries regularly tracked by USDA, commercial imports of cereals and the cereal equivalent of roots and tubers increased 151 percent, from 53 million tons during 1990-92 to 134 million tons during 2012-14, while food aid imports of these commodities dropped 50 percent, from 11.9 million tons during 1990-92 to 5.9 million during 2010-12, the latest period of available data. The share of imports in total supplies of these food staples in these countries increased from about 12 percent during 1990-92 to about 16 percent in 2012-14. There is, however, wide dispersion in both import growth and import shares of food availability across regions and countries. In general, imports now account for relatively large shares of food availability in North Africa, Latin America and the Caribbean, and Other Asia, and smaller shares in South and Southeast Asia and Sub-Saharan Africa.

This chapter describes the roles food imports and food trade in general can play in improving food security. We then examine changes in food imports and food security indicators since 1990, focusing on developments in the 76 low- and middle-income, food-insecure countries tracked in the annual USDA International Food Security Assessment. Finally, we analyze the role of food imports, together with other factors, in driving changes in country-level food security indicators since 1990.

How Food Imports Affect Food Security

The most obvious way that imports can enhance food security is by increasing *food availability* above what is supplied from domestic production and stock adjustments, although these benefits can be diminished if imports have significant adverse effects on domestic production (FAO, 2015b). Imports can also improve physical and economic *access to food* and better nutrients, with this effect

dependent on whether domestic logistics, markets, and programs can distribute imports in a timely way to deficit areas and households at an affordable price. Imports can contribute to the utilization dimension of food security through the increased availability of food and access to higher quality diets (Smith and Haddad, 2000; Diaz-Bonilla, 2015). Finally, in cases where financial capacity and logistical and marketing systems are up to the task, food trade can contribute to food security by smoothing seasonal and climate-induced *variability* in domestic food supplies and food security.

Openness to trade in general, including food trade, can yield the potential longrun economic advantage of promoting specialization in production and exports of products in which a country has a comparative advantage, and consumers benefit from lower cost imports of products that can only be produced domestically at a relatively high price. Many developed and developing countries have achieved relatively high levels of income by pursuing more open trade policies (Yanikkaya, 2003), which also help to improve food security apart from trade in agriculture. While openness to trade exposes domestic producers and consumers to the price fluctuations and cycles of global markets, it also provides the mechanism for establishing competitive industries that generate sustainable employment and economic growth.

Low-income, food-insecure countries do, however, face potential economic tradeoffs when establishing food trade policies. Open food-import policies, while potentially increasing availability of lower cost food, may affect growth in the domestic agriculture sector and could create significant adjustment costs borne by the rural sector. In low-income countries, agriculture often accounts for larger shares of employment and income than in more developed economies, and a majority of those living in poverty reside in rural areas. In general, research indicates that growth in the farm sector tends to have more advantageous developmental and equity benefits than growth in many other sectors of the economy (World Bank, 2007; Christiaensen et al., 2010; FAO, 2015b). Also, even if there are positive longer term gains from liberalizing food imports, there might be significant adjustment costs borne by the rural sector (Topalova, 2010).

A second important economic consideration is that increased reliance on food imports hinges on the sustainability of a country's export earnings and import purchasing power in fluctuating international markets. There are also potential tradeoffs between using scarce financial resources for imports of food as opposed to investment goods that may have longer term payoffs (Diaz-Bonilla, 2015; FAO, 2015b).

In addition to possible developmental or financial concerns with increasing reliance on food imports, some countries face significant logistical, regulatory, and market constraints to expanding their participation in international food markets. These issues are most commonly noted in Sub-Saharan Africa, where the prevalence of informal, small-scale trading and relatively high logistical costs of cross-border movements raise costs and limit trade growth, particularly within the region (Keyser, 2015). Additionally, imbalances between supply and demand for traditional foods—such as white corn and roots and tuber crops in the case of Sub-Saharan Africa—in local and international markets can also impede reliance on food trade (Keyser, 2015).

In practice, when we look at the 76 low- and middle-income countries regularly tracked by USDA, no significant statistical relationship exists between changes in the share of the population that is food insecure (as measured by USDA) and changes in the degree of trade openness (represented by the share of cereal availability that is imported) (fig. 7).[5] The lack of a clear

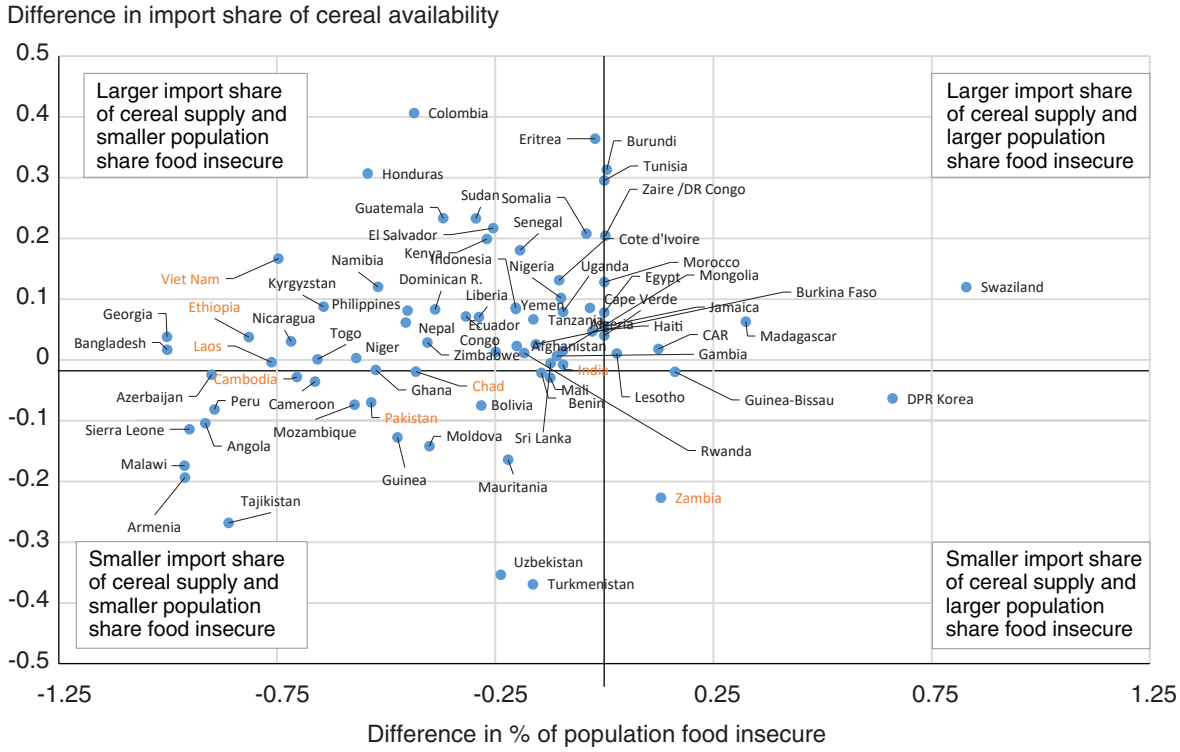
[5]There is little evidence of a robust relationship between openness to trade and ERS estimates of the prevalence of undernourishment, using a wide variety of measures of openness to trade.

relationship in part reflects the differences between countries in capacities to produce and import food, as well as the roles of other economic, social, and institutional factors that shape food access, utilization, and stability outcomes (Smith and Haddad, 2000; Magrini et al., 2014). Most of the 76 countries either remained food secure or reduced the food-insecure shares of their populations between 1990-92 and 2012-14. Within this group, the majority of countries increased the share of imports in their cereal supplies, suggesting the benefits of trade openness, but there are also many countries that reduced the import share. Also, among the countries where the food-insecure share of the population increased over the period, this adverse outcome correlated with an increased role for imports in some cases and a reduced role in others, suggesting the relevance of factors other than openness to trade.

While most of the 76 countries examined are net food importers, 8 were net cereal exporters during 2012-14: Cambodia, Chad, Ethiopia, India, Laos, Pakistan, Vietnam, and Zambia. Net exports signal a comparative productive advantage, supporting growth in employment and farm-sector income and associated improvements in economic access to food, as well as enhanced commercial food import capacity. In all but one of the net cereal-exporting countries (Zambia), the food-insecure share of the population declined between 1990-92 and 2012-14.

Figure 7

Change in food-insecure share of population vs. change in import share of cereal availability



Note: "Difference" (in axis label) refers to changes between the 1990-92 averages and 2012-14 averages. Changes in the food-insecure population shares are based on USDA estimates of undernourished population shares. Countries in orange were net exporters in 2012-14.

Source: USDA, Economic Research Service calculations from USDA/ERS International Food Security database.

Changes in Food Trade by Food-Insecure Countries

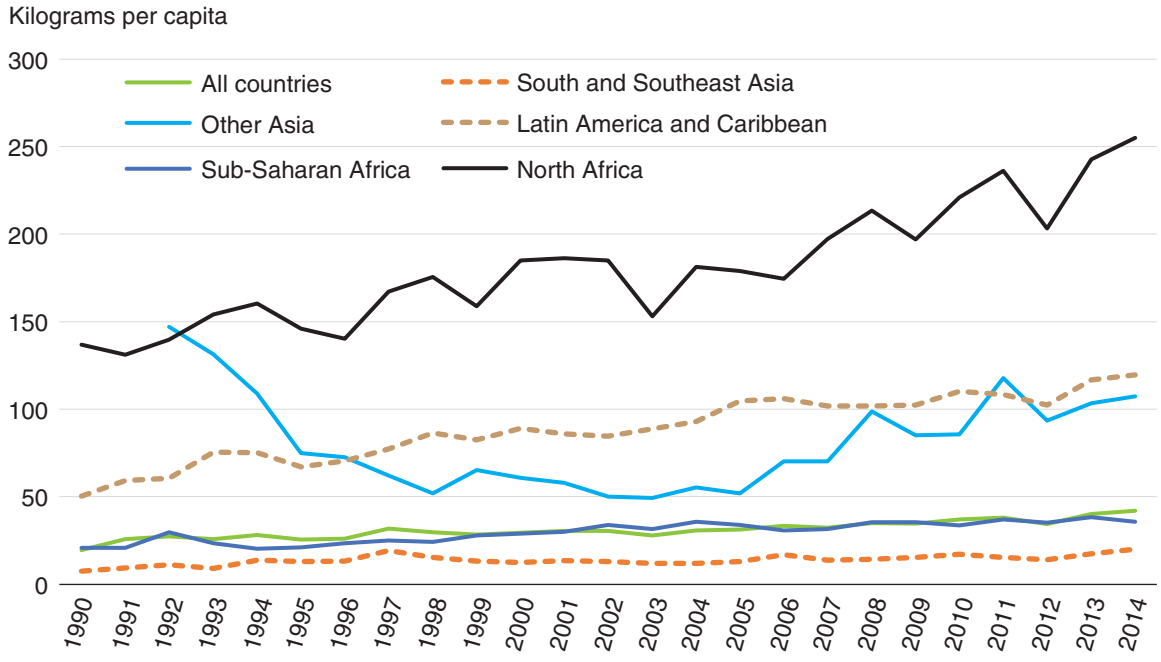
Since 1990, there has been an upward trend in per capita imports and import shares of availability for cereals (including the cereal equivalent of roots and tubers) by the 76 low- and middle-income countries USDA tracks, but with significant variation across regions (fig. 8). Imports and import shares have been relatively low in South and Southeast Asia and Sub-Saharan Africa, regions where many countries have significant agricultural sectors with the land and water resources to grow food.

Imports and import shares are higher in North Africa, where agricultural resources and erratic rainfall limit production potential (Nigatu and Motamed, 2015). Limited potential to produce food staples also contributes to high dependence on cereal imports in the low- and middle-income Latin America and Caribbean countries (Krivonos and De Paixao, 2015). The Other Asia region, composed of former Soviet republics, initially reduced imports during its economic and political transition in the 1990s, but production growth has slowed, and imports have trended upward since 2000.

A significant feature of the trend in cereal imports by lower income countries since 1990 has been the declining role of food aid and increasing role of commercial imports (fig. 9). Overall, the share of food aid in cereal imports by the 76 countries tracked by USDA declined from an average of 27 percent during 1990-92 to 5 percent during 2010-12. The Sub-Saharan Africa region now accounts for the bulk of concessional cereal imports (food sold at below market rates), but the share of concessional imports in total imports is also declining in that region. For the low-income countries in the North Africa, Other Asia, and Latin America and Caribbean regions, aid now accounts for negligible shares of cereal imports. The shrinking role of concessional cereal supplies in each region means that most countries rely increasingly on their own financial import capacity—export earnings and capital inflows—to purchase cereal imports.

Figure 8

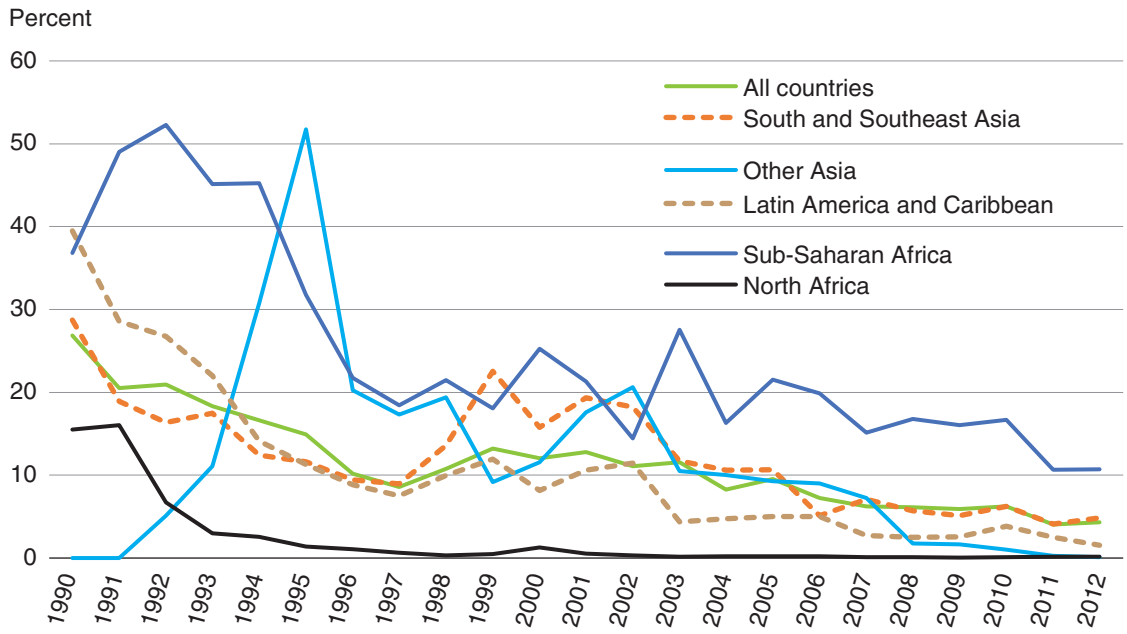
Total cereal imports[1] per capita in 76 low- and middle-income countries



[1]Includes the cereal equivalent of roots and tubers.

Source: USDA, Economic Research Service, International Food Security database.

Figure 9
Food aid share of total cereal imports for 76 low- and middle-income countries



Source: USDA, Economic Research Service, International Food Security database.

Evidence of Trade Contributions to Food Security

Most of the 76 low- and middle-income countries tracked by USDA have made significant progress in reducing their food-insecure populations since 2000, but with differing contributions from gains in trade and domestic production. Overall, for the 76 countries studied, domestic production has remained, by far, the primary source of per capita cereal supplies and of cereal-equivalent roots and tubers (table 5 and fig. 10). Per capita production has accelerated since 2000, growing at 1.3 percent (compared with a decline of 0.1 percent from 1990 to 2000). However, per capita production has grown less than per capita imports, which grew 2.2 percent from 1990 to 2000 and 2.1 percent after 2000. Since 2000, growth in imports has outpaced growth in production, both in aggregate and in each region. However, the data reveal significant differences in the roles of domestic production and trade across regions. The role of imports in cereal availability is substantially larger in North Africa, Latin America and Caribbean, and Other Asia, than in the two most populous regions, South and Southeast Asia and Sub-Saharan Africa.

Examining the country-level data for the 76 countries tracked by USDA (table 6), we see that countries vary considerably in the extent to which they emphasize production or import food security strategies. A total of 36 countries achieved reductions in their food-insecure populations primarily through gains in domestic production rather than gains in imports, and another 31 did so with gains in imports larger than gains in production. In general, the group of countries that expanded production more than imports are the countries that have achieved the largest reductions in their food-insecure populations. However, the 31 countries that reduced their food-insecure populations primarily by expanding imports include a number of countries that had low levels of food insecurity in the first period.

Table 5

Trends in food-insecure population and per capita production and imports in 76 low- and middle-income countries

				% change	% change
	1990-92	2000-02	2012-14	1991-2001	2001-13
Food-insecure share of the population					
	Percent				
76 countries	38	26	14	-3.6	-5.1
South and Southeast Asia	36	20	11	-5.9	-4.9
Other Asia[1]	62	66	9	0.8	-15.7
Latin America and Caribbean	69	43	24	-4.6	-4.8
Sub-Saharan Africa	47	45	24	-0.5	-5.2
North Africa	1	0	0	-100.0	0.0
Per capita production					
	Kilograms				
76 countries	189.2	188.1	219.4	-0.1	1.3
South and Southeast Asia	195.3	194.7	230.4	0.0	1.4
Other Asia[1]	154.6	237.4	281.4	4.4	1.4
Latin America and Caribbean	115.3	116.6	134.5	0.1	1.2
Sub-Saharan Africa	183.2	179.9	201.3	-0.2	0.9
North Africa	210.4	188.3	228.8	-1.1	1.6
Per capita imports					
	Kilograms				
76 countries	24.3	30.2	38.9	2.2	2.1
South and Southeast Asia	9.4	13.0	17.3	3.2	2.4
Other Asia[1]	129.2	56.3	101.4	-8.0	5.0
Latin America and Caribbean	56.8	86.6	112.8	4.3	2.2
Sub-Saharan Africa	23.9	31.1	36.7	2.7	1.4
North Africa	135.9	185.3	233.6	3.1	1.9

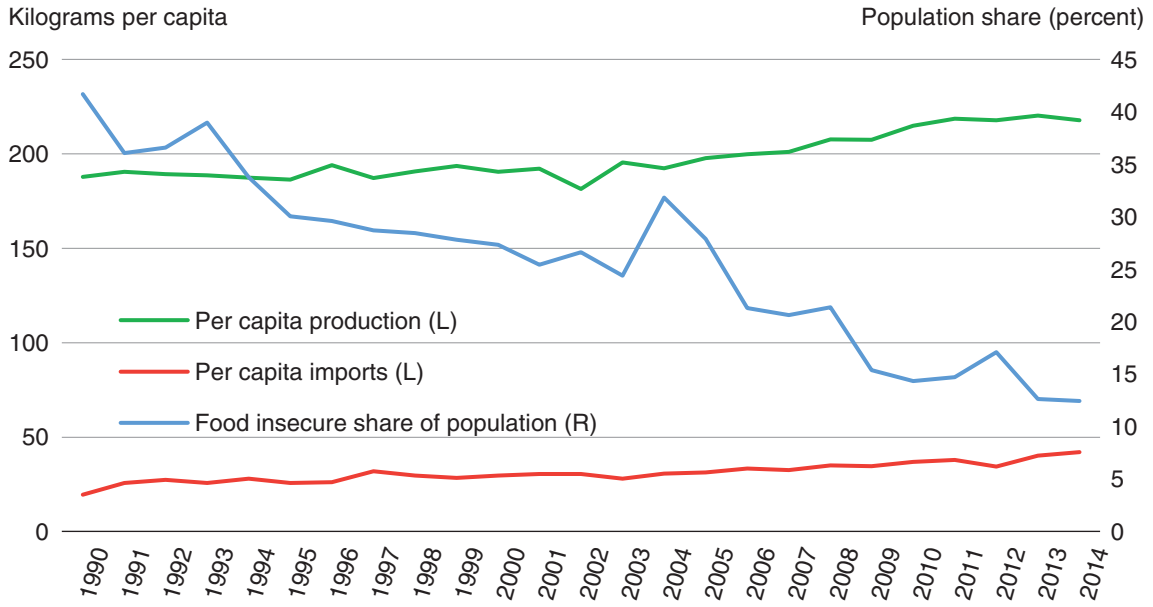
[1]Reported for 1992-94 in place of 1990-92.

Source: USDA, Economic Research Service (ERS) calculations based on ERS's International Food Security database.

There are also eight countries, some of which relied primarily on domestic production and some primarily on imports, where the food-insecure share of the population increased between 1990-92 and 2012-14 (table 6). A number of these countries can be classified as highly food-insecure and politically unstable. In this set of countries, neither a production- nor import-led strategy was able to improve food security.

Figure 10

Food insecurity, production, and imports in 76 low- and middle-income countries



Note: Food-insecure population shares are based on USDA, Economic Research Service (ERS) estimates of undernourished population shares. L = left-hand vertical axis. R = right-hand vertical axis.

Source: USDA, Economic Research Service, International Food Security database.

Table 6

Country changes in food-insecure population, per capita cereal production, and per capita cereal imports between 1990-92 and 2012-14; 76 countries

Reduction in % food insecure	Production change > import change/ capita	Import change > production change/capita
75-100% decline	Laos, Malawi, Sierra Leone, Angola, Vietnam, Tajikistan, Ethiopia, Azerbaijan, Bangladesh, Peru (10)	Georgia (1)
50-74% decline	Cambodia, Ghana, Cameroon, Togo, Mozambique, Pakistan, Nicaragua, Niger (8)	Namibia, Kyrgyzstan, Honduras (3)
25-49% decline	Moldova, Guinea, Bolivia, Chad, Nepal, Ecuador (6)	Philippines, Congo, Liberia, Zimbabwe, Dominican Republic, Kenya, El Salvador, Guatemala, Sudan, Colombia (10)
0-24% decline	Uzbekistan, Turkmenistan, Mali, Rwanda, Benin, Cape Verde, Mauritania, Burkina Faso, Sri Lanka, India, Indonesia, *Eritrea* (12)	Afghanistan, Tanzania, *Haiti*, Gambia, Jamaica, *Zaire/Democratic Republic of the Congo*, *Somalia*, Yemen, Egypt, Cote d'Ivoire, Nigeria, Uganda, Senegal, Morocco, Mongolia, Algeria, Tunisia (17)
Increase	*Zambia*, *Lesotho* (2)	*Central African Republic*, Guinea-Bissau, *Burundi*, Madagascar, Democratic People's Republic of Korea, *Swaziland* (6)

Notes: 1. Changes in food-insecure population are based on USDA estimates of population shares that were undernourished.

2. Underlined countries were at least 95-percent food secure in both periods.

3. Italicized countries were at least 75-percent food insecure in 2012-14.

4. Each number in parentheses denotes the number of countries in each box.

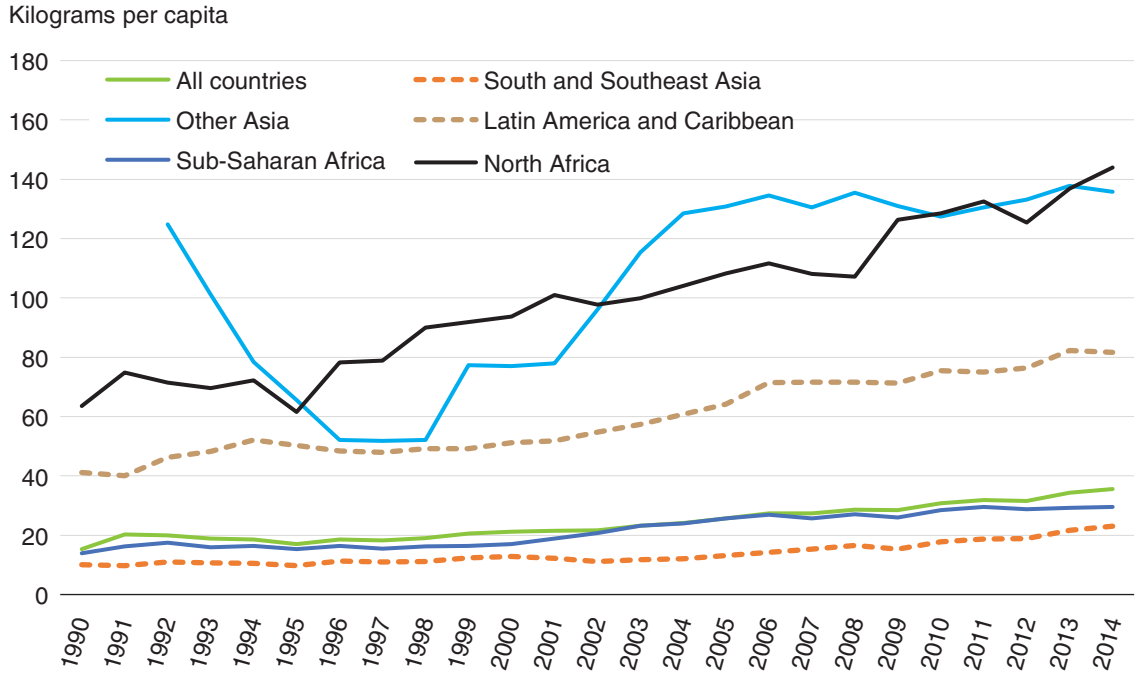
Source: USDA, Economic Research Service (ERS) calculations based on ERS's International Food Security database.

The Link Between Feed Demand, Cereal Trade, and Food Security

Among the 76 countries studied here, the data reveal a strong linkage between the levels of cereal imports and feed demand in the importing countries. The three regions with the most per capita cereal imports—North Africa, Latin America and Caribbean, and Other Asia—also have substantially higher per capita feed use, which signal greater demand for product and commercial feed (fig. 11). This pattern parallels the generally higher per capita incomes in these three regions, compared with South and Southeast Asia and Sub-Saharan Africa.[6] For many of the countries in North Africa, Latin America and Caribbean, and Other Asia, the link between increased cereal trade and improved food security relates to not only enhancing the availability of cereal for food use, but also to improving the availability of animal products to enhance diet diversity.

FAO food balance data confirm the strong relationship between the level of animal protein supply and the alternative food security indicators (fig. 12). Although the correlation is lower for the USDA measure, which only evaluates the adequacy of food staples, it is high for the FAO Food Insecurity Experience Scale (FIES) and WHO child-stunting indicators, which are better able to account for the effects of overall diet diversity and quality. This finding shows the importance of dietary diversity, and specifically animal product consumption, in improving food security.

Figure 11
Per capita feed use in 76 low- and middle-income countries

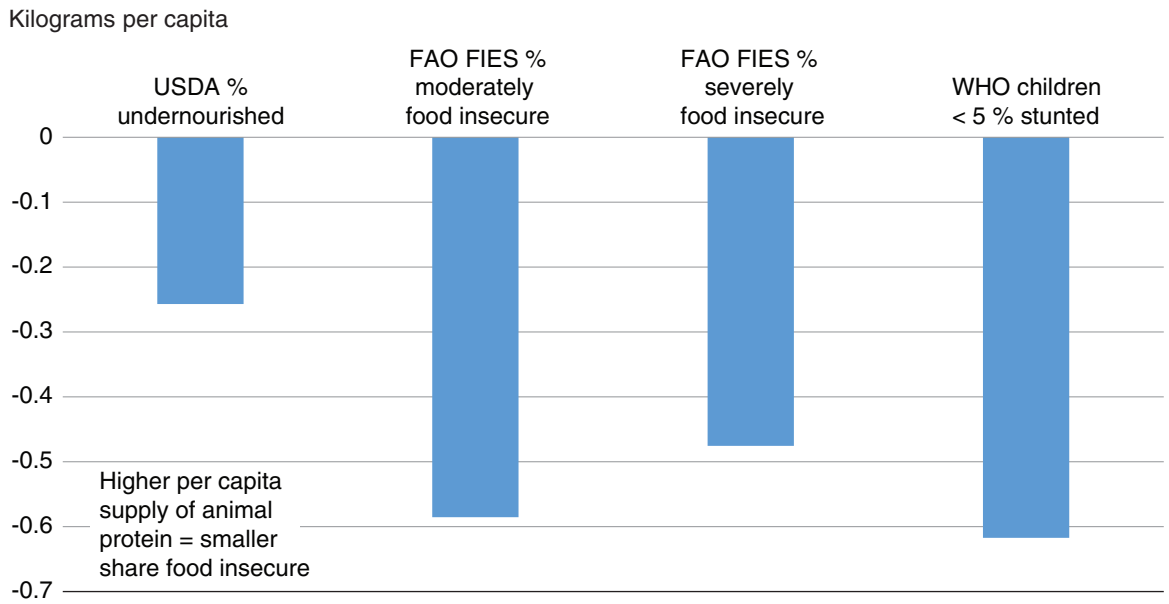


Source: USDA, Economic Research Service, International Food Security database.

[6]USDA ERS International Macroeconomic data set.

Figure 12

Correlation coefficients between per capita supply of animal protein and food security indicators[1]



[1]Per capita protein supply is 2009-11 average. USDA percent undernourished is 2012-14 averages. United Nations, Food and Agriculture Organization (FAO), Food Insecurity Experience Scale (FIES) indicators are for 2014. World Health Organization (WHO) child stunting indicators are most recent available since 2010.

Source: USDA, Economic Research Service calculations from ERS International Food Security database; UN/FAO; and WHO data.

Trade Policy and Cereal Imports

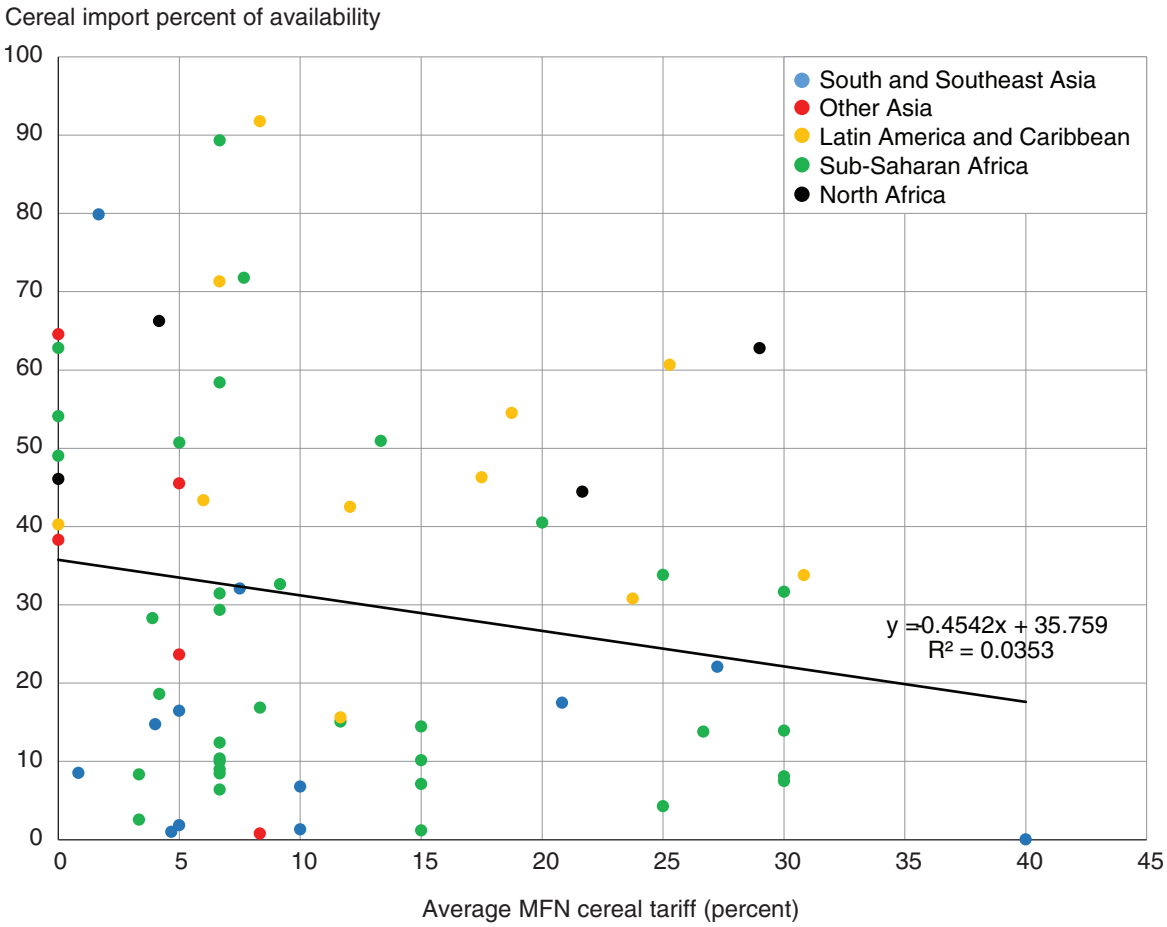
The role of imports in national food security strategies is partly evident in tariff and non-tariff policies that define how open the economy is to food trade. Data on Most Favored Nation (MFN) tariffs for wheat, rice, and corn—available for 67 of the 76 low- and middle-income countries followed by USDA—indicate a wide range of tariffs on cereal imports.[7] While average cereal tariffs are lowest (3.7 percent) in the Other Asia region, average tariffs for the other four regions are very similar, ranging from 11.4 percent to 14.6 percent. Examining MFN tariffs and import shares of cereal supplies does not reveal any strong relationship between the role of imports and trade openness, at least as captured in MFN tariffs (fig. 13).

The lack of a strong relationship between tariffs and the role of imports likely reflects an array of other policy and cost factors that influence the extent to which imports are feasible. Nontariff barriers—including phytosanitary measures or restrictions on imports of genetically modified crops—can be more restrictive than tariffs. Cost factors can include high logistical costs and limited availability of appropriate commodities in some regions (i.e., white corn in Sub-Saharan Africa), as well as financial constraints on national capacities to import food commercially.

[7]Simple average MFN tariffs for wheat, rice, and corn as reported by the World Trade Organization. MFN tariff data were not available from this source for Afghanistan, Azerbaijan, Eritrea, Ethiopia, Democratic People's Republic of Korea, Somalia, Sudan, Uzbekistan, and Turkmenistan.

Figure 13

Cereal tariffs versus cereal import shares of total cereal availability, 2010-14, in 76 low- and middle-income countries



Note: Each point represents one country. MFN = Most favored nation.

Sources: World Trade Organization and USDA, Economic Research Service, International Food Security database.

Commercial Import Capacity and Cereal Imports

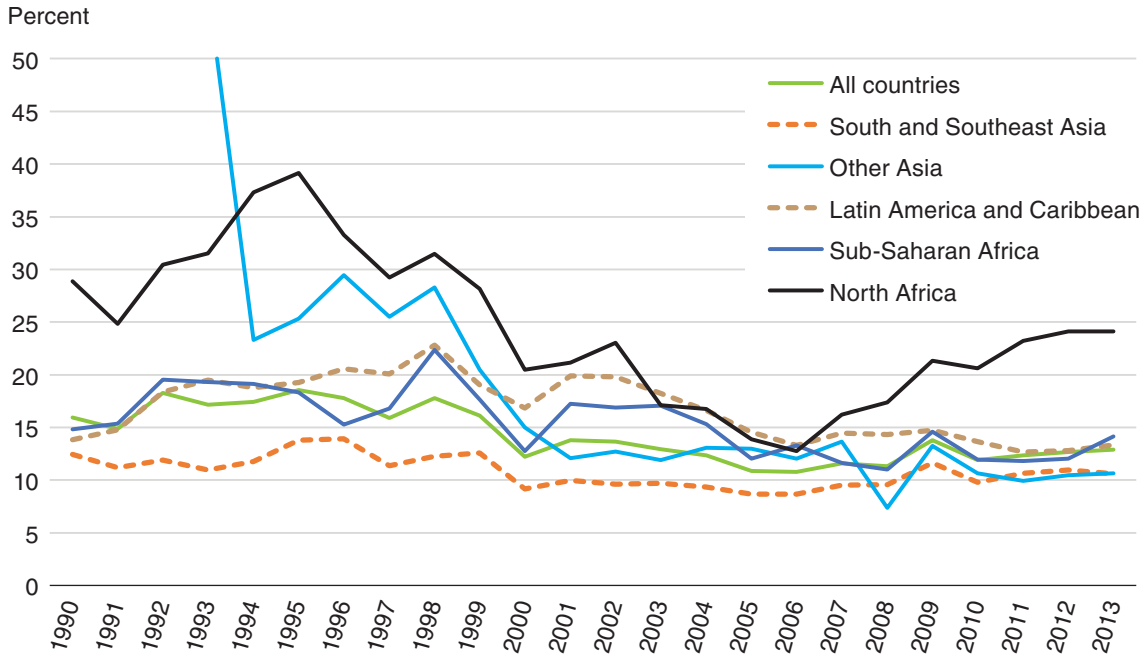
Commercial imports, rather than concessional supplies, account for all of the growth in the cereal and roots and tubers imports by the 76 low- and middle-income countries studied between 1990-92 and 2012-14. As a result, national capacities to expand and/or sustain food imports as an element of food security strategy for lower income countries hinges primarily on the adequacy of commercial import capacity. This capacity is determined largely by macroeconomic factors that affect economy-wide merchandise export earnings and import costs, as well as flows of capital, such as foreign direct investment and inward remittances, all of which are subject to domestic and global market conditions. In addition to the adequacy and stability of commercial import capacity, the use of such capacity to import food for current consumption may involve tradeoffs with imports of inputs and/or investment goods, including goods to support agricultural production, which may have longer term employment and income benefits (Christiaensen et al., 2010; Diaz-Bonilla, 2015).

One indicator of the level and sustainability of the cost of food imports is the ratio of the cost of agricultural imports to an economy's total export earnings. This ratio has the benefit of accounting for the sometimes offsetting effects of fluctuations in world commodity prices on merchandise export earnings, food import costs, and import capacity, but does not account for the sometimes significant effects of capital flows (Diaz-Bonilla, 2015).

Overall and for most of the regions under study, the food import shares of export earnings, while variable, have tended to decline since the early 1990s (fig. 14). Reflecting their low reliance on cereal imports, South and Southeast Asia, and Sub-Saharan Africa, and Other Asia use the lowest shares of export earnings on food imports. Latin America and Caribbean, despite increasing food imports, also uses a low and declining share of export earnings on cereal imports. North Africa, in contrast, applies a large share of its export earnings to food imports, a share that has now been rising since the mid-2000s. All of the regions, with a possible exception of South and Southeast Asia, show substantial year-to-year variability in the shares of export earnings used for food imports, suggesting likely variability in the foreign exchange available for imports of other consumption and investment goods.

Examination of country-level data on agricultural import shares of export earnings again reveals considerably more variation between countries than is seen in the regional aggregate data (table 7). While more than a third (28) of the 76 countries studied spend less than 20 percent of export earnings on agricultural imports, about 22 percent (17) spend more than 50 percent, and 41 percent (31) spend between 20 and 50 percent. However, the current food security status, represented by the share of the population assessed as food insecure by USDA, does not appear to relate strongly to the share of export earnings spent on agricultural imports.

Figure 14
Agricultural import share of merchandise export earnings, 76 low- and middle-income countries



Source: United Nations, Food and Agriculture Organization, FAOSTAT database.

Although there is a tendency for smaller food-insecure population shares to be associated with smaller (less than 50 percent) shares of export earnings spent on agricultural imports, a number of countries spending larger shares of export earnings on food imports are also relatively food secure. For the countries with the highest incidence of food insecurity, there is no clear pattern; for some, the share of agricultural imports in export earnings is fairly small and for others it is fairly large.

The findings suggest that countries can pursue food security with a mix of strategies for spending foreign exchange earnings. A significant number of the 76 countries studied spend large enough shares of export earnings on agricultural imports that there may be tradeoffs with other imports, including inputs and investment goods that might support gains in domestic food production or economic growth more broadly. Additionally, while overall ratios of agricultural imports costs to total export earnings have generally remained stable—indicating stability in the ability to pay for imports—the high ratios in a large number of countries, including those in North Africa, suggest vulnerability to price volatility. Additional discussion of the nature and effects of price volatility for food security is provided in Food Price Volatility and Food Security (See box, "Food Security and International Price Volatility.")

Table 7

Food-insecure population and agricultural import share of total export earnings, 2011-13

% food insecure	Agricultural imports share of total export earnings				
	<10%	10-20%	20-50%	50-100%	>100%
<10%	Turkmenistan, Angola, Nigeria, Indonesia, Peru (5)	Colombia, Vietnam, Algeria, Coete d'Ivoire, Tunisia, Sudan, Ghana, Cameroon (8)	Mali, Laos, Pakistan, Morocco, Mauritania, Bangladesh, Guinea, Malawi, Kyrgystan, Burkina Faso, Niger, El Salvador, Uganda, Moldova, Egypt, Benin, Nicaragua (17)	Jamaica, Georgia, Nepal, Senegal, Armenia, Sierra Leone (6)	Liberia, Cape Verde (2)
10-20%	Azerbaijan, India, Uzbekistan (3)	Philippines, Mongolia (2)	Tanzania, Sri Lanka, Togo, Dominican Republic, Mozambique, Tajikistan (6)	Ethiopia (1)	
20-50%	Congo, Namibia (2)	Cambodia, Honduras (2)	Guatemala, Kenya, Zimbabwe (3)	Guinea-Bissau (1)	Afghanistan, Gambia (2)
50-90%	Chad, Zambia, Bolivia, Ecuador, Swaziland (5)	Democratic People's Republic of Korea (1)	Lesotho, Madagascar, Yemen (3)	Rwanda (1)	Haiti (1)
90-100%			Democratic Republic of the Congo, Central African Republic (2)	Burundi (1)	Somalia, Eritrea (2)

Notes:

1. Underlined countries are at least 95 percent food secure in both periods.

2. Each number in parentheses denotes the number of countries in each box.

Source: USDA, Economic Research Service, International Food Security database and United Nations, Food and Agriculture Organization, FAOSTAT database.

Box 6

Food Security and International Price Volatility

The implications for food security of price volatility in domestic and international food markets has been an important topic of analysis, both in the context of recent global commodity price spikes (Trostle, 2008; Trostle et al., 2011) and longer term concerns with the effects expected to be associated with climate change (USDA, 2014). Price volatility, or large swings in prices over short periods of time, can limit food access, particularly for lower income consumers when prices rise, and can also dampen incentives for producers when their returns become too low or uncertain. While swings in food prices in both directions can have food security implications, analysts and policymakers focus primarily on the frequency and effects of food price spikes. The overall food security effects of food price spikes include the adverse impacts to rural and urban households that are net buyers of food, as well as the potential gains experienced by mostly rural households that are net sellers of food.

The evidence on the implications of high versus low prices for food security is mixed, and analysis of effects is complicated by country-specific differences in characteristics such as the shares of net food buyers and sellers and the degree to which world prices are transmitted into domestic markets. Policy advice has shifted from concern with the adverse effects of persistently low prices on rural incomes and welfare during historical periods to more recent concern with the effects of high prices on low-income households (Swinnen and Squicciarini, 2012). In general, the evidence tends to confirm that high food prices reduce food security in the short run (D'Souza and Joliffe, 2012, 2014; Daidone and Mane, 2013; Tandon and Landes, 2014), with effects varying across household types. There is less evidence about the long run, during which wages and production can adjust upward in response to higher prices. Here, somewhat thinner evidence suggests that higher prices can reduce poverty in the long run, although this may not be the case if persistent price volatility limits upward shifts in production and labor demand (Ivanic and Martin, 2015).

When we look at the volatility conditions facing the 76 low- and middle-income countries tracked by USDA, world production of major cereals was not significantly more variable during 2007-14 than during 1995-06, but world trade in wheat and corn did become more variable in the recent period (box 6, table 1). For the low- and middle-income countries, however, both production and net imports, while remaining more variable than for the world as a whole, generally became less volatile during 2007-14. The notable exception was the high and increasing variability of net imports in South and Southeast Asia, associated primarily with large changes in rice exports by India and Vietnam. Overall, although world cereal trade became somewhat more variable during 2007-14, food availability in the low- and middle-income countries, as represented by the cereal production and trade, tended to become less volatile during this recent period.

Changes in the variability of world and, particularly, domestic cereal prices are somewhat more difficult to evaluate with available data. Increases in world cereal prices faced by the low- and middle-income countries were higher during 2007-14, but price volatility was about the same in the two periods (box 6, table 2, and box 6, fig. 1). However, based on consumer price indices (proxy indicators that likely include heavily weighted food staple items), price increases declined in all low-income regions, and price volatility declined in all but one region during 2007-14. Between 1995-2006 and 2007-15, CPI inflation slowed in 64 (82 percent) of the 76 countries tracked by USDA, and CPI volatility (as measured by the coefficient of variation) declined in 59 (78 percent).

continued—

Box 6

Food Security and International Price Volatility—continued

Box 6 table 1

Coefficients of variation of cereal production and trade for the world and 76 low- and middle-income countries

	Production		Net imports[1]	
	1995-2006	2007-14	1995-2006	2007-14
	Percent			
World				
Wheat	4.1	5.2	5.1	10.1
Rice	3.7	3.6	14.8	13.8
Corn	9.4	8.9	10.1	14.3
Total	5.6	6.1	7.2	11.1
76 countries, total cereals				
South and Southeast Asia	6.5	6.6	39.6	200.0
Other Asia	21.9	5.9	19.8	16.1
Latin America and Caribbean	9.0	4.5	18.5	9.4
Sub-Saharan Africa	10.7	8.7	22.7	10.2
North Africa	18.2	10.4	11.4	12.9
Total	8.1	6.7	11.2	12.7

[1]Total imports for the world and net imports for the 76 low-income countries.

Source: USDA, Economic Research Service calculations based on USDA, Foreign Agricultural Service, Production, Supply, and Distribution online database and USDA, Economic Research Service data.

Box 6 table 2

Inflation and variability of world food prices and consumer prices for 76 low- and middle-income countries

	Average percent change		Coefficient of variation	
	1995-2006	2007-15	1995-2006	2007-15
FAO world price indices				
Food	1.6	4.4	13.4	12.4
Cereals	1.9	6.2	14.2	15.4
Domestic consumer price indices				
76 countries	11.4	6.7	22.6	14.8
South and Southeast Asia	10.0	8.2	22.6	17.2
Other Asia	21.1	7.2	27.3	15.0
Latin America and Caribbean	11.3	5.6	31.6	12.8
North Africa	4.5	5.4	10.9	13.1
Sub-Saharan Africa	10.2	7.1	20.8	16.1

Notes: Angola, Congo, and Zimbabwe were removed from the dataset because of hyperinflation.

FAO = United Nations, Food and Agriculture Organization.

Source: USDA, Economic Research Service (ERS) calculations based on USDA, Foreign Agricultural Service, Production, Supply, and Distribution online database and ERS data.

continued—

Box 6

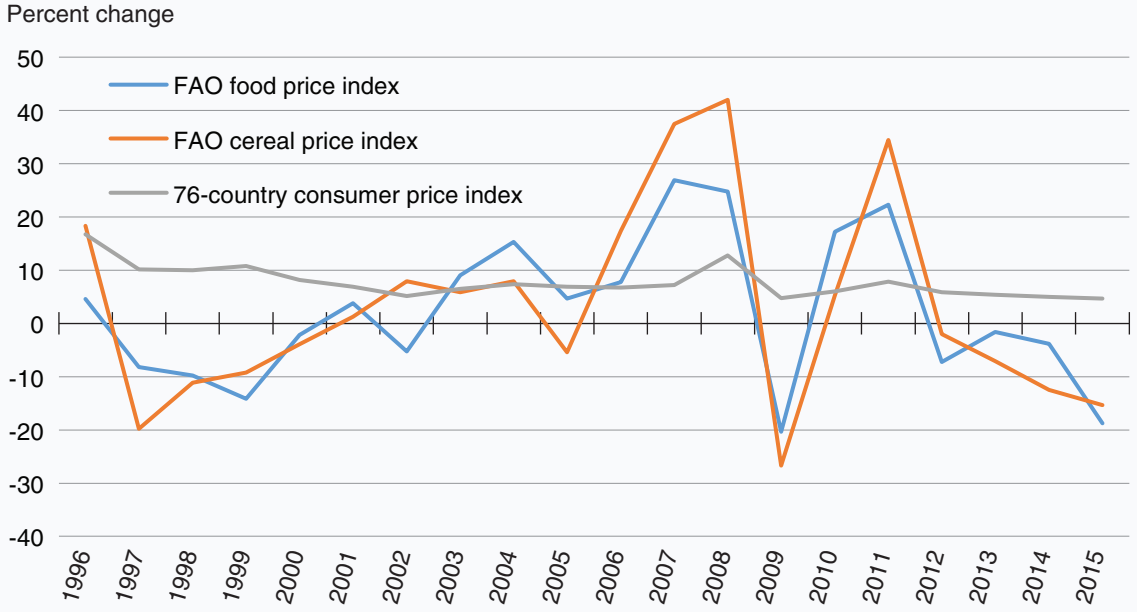
Food Security and International Price Volatility—continued

Although the lower volatility of consumer prices is an indicator of stability in food access, it may disguise upward price swings—particularly within-season swings—in key food staples that have significant food security implications. A study of domestic food staple price changes in 46 countries during 2006-10 (the period around the 2008 global food price spike) found peak increases in real prices from 40 to 60 percent for major cereals and roots and tubers (Dawe and Morales-Opazo, 2009). Another study focusing on Sub-Saharan Africa markets found that—while domestic food staple prices in the region were relatively volatile—there was little evidence that domestic prices became more volatile during 2007-10 (Minot, 2012).

Although the recent aggregate-level data for the 76 low- and middle-income countries tracked by USDA do not indicate an increase in volatility in domestic food staple supplies and prices since 2007, the 2008 and 2011-12 spikes in global cereal prices and the recent increased variability of global cereal trade potentially threaten food security for low-income food-importing countries.

Box 6 figure 1

Percent changes in world-food-price and consumer-price indexes in 76 low- and middle-income countries, 1996-2015[1]



[1]Angola, Congo, and Zimbabwe were removed from the data set because of hyperinflation.

Source: USDA, Economic Research Service calculations using United Nations, Food and Agriculture Organization and World Bank data.

Emerging Issues in Food Trade and Food Security

Trade policy responses to international market volatility. Global market conditions for major food commodities, along with the capacity for efficient local production, can be expected to shape policies regarding the role of trade in developing more efficient and resilient national agri-food systems. After global market prices spiked in the 2008-12 period, many countries sought to achieve greater self-sufficiency. Although the analysis of recent world food trade and price data does not indicate that either trade or prices have become more volatile (see box, "Food Security and International Price Volatility"), the recent spikes in world food prices in 2008 and 2011/12 were clearly felt in many low- and middle-income countries and households (D'Souza and Joliffe, 2012; Tandon and Landes, 2014). Further, the ensuing declines in world prices of food and nonfood commodities during 2014-16 have dealt setbacks to commodity production and export earnings by exporting countries, as well as to households dependent on these sectors. In the context of continued sharp market movements, policies designed to insulate sensitive domestic food markets from price fluctuations or macro-economic effects may continue to be important in addressing near-term food security imperatives, despite longer term effects of reducing gains from trade and contributing to price volatility in world markets.

Multilateral trade policies and food security. Domestic and trade policies used to achieve national food security goals may conflict with multilateral policies, as well as those of the Global Food Security Act, for reducing trade barriers and improving access to and participation in global and regional markets. Similarly, some national safety net programs have also raised food security issues to be addressed in global and regional trade negotiations. The ongoing Doha Round multilateral negotiations have raised issues regarding provisions that address food security policies in both developed and developing countries (Diaz-Bonilla, 2015). Similarly, food security policies can be important in regional trade agreements—including the Africa Growth and Opportunity Act (AGOA), the Central America Free Trade Agreement (CAFTA), and Asia-Pacific Cooperation (APEC)—that play major roles in achieving both income growth and food security in their respective regions.

Climate change effects on trade patterns. Climate change is projected to reduce food production potential in many low- and middle-income countries and potentially increase volatility in world market. (See box, "Climate Change and Food Security.") Mitigation and adaptation are key to the resilience of production systems, but less attention has been given to the role of markets and trade in addressing these issues. Trade could help countries adapt to reduced food production, but national and multilateral measures to expand food trade could be difficult to achieve if market volatility creates incentives for Governments to insulate their markets in an effort to avoid changes to domestic food security.

Consumer Safety Nets and Food Security

- Low-income countries use a number of different types of social support programs that are designed to help improve food access, utilization, and stability and develop more resilience to food security threats. The most common types of programs include conditional and unconditional cash transfers and in-kind assistance such as subsidized food grains.
- While it is difficult to estimate the effects support programs have on food security, evidence suggests that a number of social support programs across the world do, depending on design and context, improve various aspects of food security, including access, nutrition, and stability.
- International evidence suggests that conditional and unconditional cash transfers are less costly than in-kind food aid but that equivalent cash and in-kind transfers have similar positive effects on food security. These results suggest that cash transfers are preferable to in-kind food aid. However, it is unlikely that all countries can feasibly implement cash transfers, and in-kind food aid is still likely to play a role in domestic social support programs.

Background

Despite significant progress in improving food security in the past few decades, a significant share of the population of low-income countries remains food insecure (FAO, 2015a; Rosen et al., 2015). Given the continued prevalence of food insecurity, a number of countries implement domestic support programs designed to improve some or all dimensions of food security: availability, access, nutrition, and stability. India, for example, operates the world's largest domestic food safety net program and has recently ratified a National Food Security Act to expand eligibility for its food aid program (Krishnamurthy et al., 2014).

Safety nets generally respond to multiple needs. Long-term strategies to reduce the incidence of food insecurity might not affect the entire food-insecure population or might affect a portion of the population adversely (Tandon and Landes, 2011b). In many countries, the food-insecure population is generally very poor, socially or geographically isolated, or particularly vulnerable to structural or idiosyncratic economic changes. The needs of this population may be difficult to address through increases in agricultural productivity and greater openness to food trade. For example, trade can have potentially adverse effects on those employed in import-competing industries (Topalova, 2010; Edmonds et al., 2010). Price shocks, whether domestic or international, can affect food security of some households (D'Souza and Joliffe, 2014; Tandon and Landes, 2014). Similarly, increases in agricultural productivity can have either positive or negative effects on some agricultural laborers and some farm incomes, depending on whether labor use rises or falls and whether households are net sellers or buyers of agricultural goods (Datt and Ravallion, 1998; Foster and Rosenzweig, 2004; Minten and Barrett, 2008).

Safety net programs provide a way of responding to such food security challenges. This chapter details a number of different programs implemented by national governments that help to improve the food security of the most vulnerable populations.

Types of Safety Net Programs

Governments implement a number of different types of domestic safety net programs that address different dimensions of food security. Some programs—termed unconditional transfers—provide monetary assistance that recipients are allowed to use however they please. Others—termed conditional transfers—provide assistance in a way that requires recipients to use the funds to purchase certain types of goods or to engage in certain behaviors, such as schooling or health care. Alternatively, support programs can provide in-kind assistance by distributing food commodities, typically at a subsidized price, or they can provide cash. Each of these programs can be further tailored to affect particular dimensions of food security—for example, by targeting specific populations (e.g., those not earning a sufficient income or those not owning a certain threshold of assets). Programs might also provide different types of in-kind aid, such as certain foods or health care. In addition, many countries implement temporary emergency safety nets to provide either cash or food aid in droughts and other emergencies, which are aimed specifically at improving stability of food security. Table 8 provides examples of some common types of safety programs across the world, categorized by program type, and table 9 gives specific examples of each program type implemented in individual countries.

Table 8
Types of safety net programs

	Unconditional transfers	Conditional transfers
Cash	Recipients decide how to spend benefits.	Recipients must engage in specified behaviors, such as participation in health schemes, school attendance, or public works projects to receive cash.
Food	Recipients receive free or subsidized food.	School Feeding: students who attend school receive food. Public Works: Recipients receive food for participating in public works projects.

Source: World Bank (2014) *The State of Social Safety Nets: 2014*, World Bank, Washington, DC.

Table 9
Selected long-standing consumer safety net programs in low-income countries

Country	Program	Type	Description
Conditional transfer: cash			
Brazil	Bolsa Familia	Health and education	Cash is transferred to families if children go to school and get vaccinated.
Mexico	Oportunidades/Prospera	Health, nutrition, and education	Cash is transferred to incentivize improved education, health care and nutrition status of children.
Conditional transfer: in-kind			
Brazil	Program Nacional De Alimentacao Escola (PNAE)	School meals	Food is purchased from small farmers to supply school meals and provide a steady source of income for farmers. About 47.2 million children benefited in 2013.
India	Midday Meal	School meals	Food procured in price-support operations is provided to State governments for school meals. About 130 million children benefit.
Honduras	Vaso de Leche ("Glass of Milk")	School meals	The program reaches about 638,000 children in preschool and primary school with the aim of increasing protein and calcium intake. Products are sourced from local small-scale dairy producers.

continued—

Table 9

Selected long-standing consumer safety net programs in low-income countries—continued

Country	Program	Type	Description
Unconditional transfer: cash			
India	Mahatma Gandhi National Rural Employment Guarantee Scheme (NREGS)	Public works	The rural population is guaranteed 100 days per year of paid (unskilled, minimum wage) work on public works projects.
Bangladesh	Employment Generation Program for the Poorest (Food for Work)	Public works	The program combats seasonal undernutrition by employing people to build community assets and infrastructure in return for food (cash). Eligibility is limited to households that have less than half an acre of land and whose head of household is employed as a manual laborer. Wages are set below market rate, and men and women receive same wage.
Lesotho	Child Grant Program	Health, nutrition, and education	Aid is unconditional, but with strong messaging to spend the funds to improve health and nutrition outcomes and school enrollment for vulnerable children. As of March 2014, the program had reached 65,000 children.
Kenya	Cash Transfer for Orphans and Vulnerable Children (CT-OVC)	Food assistance	Transfers aimed at increasing food consumption are given to very poor families with vulnerable children.
Ethiopia	Productive Safety Net Program (PSNP)	Public works, food assistance	This program is part of the government's shift away from emergency food distribution and transfers food and cash to food-insecure households. It emphasizes "graduation" from the program when families can meet their own food needs.
Botswana	Multiple programs	Public works; health, nutrition, and education	Botswana's public works program scales up during drought years, providing cash and food transfers for the very poor. A school feeding program and vulnerable-group feeding program distribute food through health clinics to malnourished children under 6 years old and to pregnant and lactating women.

continued—

Table 9
Selected long-standing consumer safety net programs in low-income countries—continued

Country	Program	Type	Description
Unconditional transfer: in-kind			
India	Targeted Public Distribution Program	Unconditional transfer: in-kind	Cereals purchased and stored in price-support operations are distributed at subsidized prices, with the largest subsidies targeted to households below the poverty line.
Integrated programs			
Brazil	Fome Zero (Zero Hunger)	Food security	Launched in 2003, this comprehensive food security strategy incorporates programs in agricultural production, nutrition, health, and education. It includes Bolsa Familia cash transfer, food stamps, and school meals, as well as support for small holder agriculture.
Rwanda	Vision 2020 Umurenge Program	Food security	Direct Support provides cash to people who can't work. Public works provides cash wages to poor people who can work. Ubedehe Credit Scheme provides loans to poor farmers.

Source: Compiled by USDA, Economic Research Service from World Bank (2014) *The State of Social Safety Nets: 2014*, World Bank, Washington, DC, and United Nations, Food and Agriculture Organization (2015) *The State of Food and Agriculture: Social Protection and Agriculture: Breaking the Cycle of Rural Poverty*, Rome, Italy.

Each type of social support program can enhance food security. Cash transfers allow recipients to purchase a variety of goods, including food items, which may enhance dietary diversity and support local and regional markets. In-kind food aid, on the other hand, generally provides specific staple food items, but may lead indirectly to greater flexibility to divert budgets to other items, including improved diets. For example, an in-kind transfer of staple grains with limited nutritional quality aside from calories can improve diet diversity if households choose to take their savings on the amount of grains they would have bought at the market rate and spend them on more nutritious foods (Currie and Gahvari, 2008). Alternatively, an in-kind transfer providing food over the amount the household would have consumed without the transfer can promote more consumption of those goods, such as in-kind distribution of primary health care for all household members or an in-kind distribution of more healthy foods such as fruits and vegetables (Currie and Gahvari, 2008).

As can be seen by the array of programs described in table 9, each type of program also has potential effects beyond the direct contributions to food security. For example, public works programs that offer cash or food in return for labor can potentially improve local infrastructure and services. Examples of such programs include the Mahatma Gandhi National Rural Employment Guarantee in India or the Food for Work program in Ethiopia. Alternatively, conditional cash transfer programs, which offer cash in return for meeting certain conditions, can improve schooling and primary health care when those are conditions for receiving assistance. Examples of such programs include the Oportunidades/Prospera program in Mexico and the Bolsa programs in Brazil.

However, there are potential unintended consequences for social safety net programs as well. For example, unconditional cash transfers allow households to use some or all of the transfer to purchase goods that do not improve nutrition and have little public value. Furthermore, evidence indicates waste and misdirection of benefits in the case of public distribution of food that involves providing food for free or at subsidized rates. These programs can encounter significant costs in handling, distributing, and storing food and, if volumes are large enough, can have the unintended consequence of causing distortions in agricultural markets. For example, the Targeted Public Distribution System in India requires the Government to acquire a large amount of rice and wheat from farmers, which can distort planting decisions and potentially depress investments in the agricultural sector (Parikh et al., 2003). Furthermore, the system substantially increases transportation and storage costs (Rakshit, 2003).

Food Safety Net Programs in India

India, with the largest food-insecure population in the world, implements both in-kind and cash transfer programs aimed at improving the food security of low-income households. The country's largest support program, as well as the largest in-kind food distribution program in the world, is the Targeted Public Distribution System (TPDS), which provides aid to various categories of households. The TPDS distributes rations of a number of essential commodities—primarily rice, wheat, and kerosene—to households across India at significantly subsidized rates. The ration is less than the average household would purchase without the ration, and the largest subsidies and rations are targeted to households that are below the poverty line (BPL). In addition to the direct benefit, the program enables households to use the savings on the grain they would have purchased at market rates to purchase other goods, including more and better quality foods.

State governments are responsible for identifying BPL households and distributing subsidized commodities from Fair Price Shops (FPSs). The central Government procures rice and wheat through the Food Corporation of India (FCI), which pays a Government-mandated Minimum Support Price (MSP) to farmers, and these commodities are supplied to State governments for sale to beneficiaries at the centrally subsidized rates (Ministry of Consumer Affairs, 2002). State governments may provide TPDS commodities at below the centrally subsidized rates at their own cost. For example, the States of Andhra Pradesh and Chhattisgarh offer the larger subsidies to a larger share of households than is supported by the central government (Tarozzi, 2005; Dreze and Khera, 2011; Krishnamurthy et al., 2014). Under the National Food Security Act, enacted in 2013 and now implemented in most but not all States, the share of households receiving the largest subsidies will expand to nearly 75 percent of the rural population and 50 percent of the urban population (Krishnamurthy et al., 2014).

In addition to the TPDS, a number of other social support programs help maintain a minimum standard of living for the most vulnerable populations. The Midday Meal Scheme uses food staples provided from the central pool that supplies the TPDS to provide meals of sufficient nutrition to all school children in government-aided primary and upper primary schools (approximately ages 6-12). The Integrated Child Development Services (ICDS) provides food and primary health care to children under age 6 and their mothers (Ministry of Consumer Affairs, 2002). The Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) guarantees at least 100 days of wage employment in a year to every household whose adult members volunteer to work. Beneficiaries of the Midday Meal Scheme and ICDS can use money they would have spent on low-quality food to purchase a better quality diet (Singh et al., 2014), and beneficia-

ries of MNREGA can use the cash transfer for any purpose (without any restrictions), including purchasing a better quality diet for the household.

Together, these programs help improve food access, utilization, and stability of hundreds of millions of poor Indian households. However, there is vigorous debate about whether India should seek to replace its costly in-kind aid programs (like the TPDS) with conditional and unconditional cash transfer programs that might potentially cost less, better target vulnerable segments of the population, and distort domestic commodity markets less (Kapur et al., 2008). Pilot programs of cash transfers have begun in a number of States and union territories (e.g., Delhi and Chhattisgarh), and political parties have even campaigned on such programs. The central Government is currently making large investments in creating the technical and institutional capacity to effectively implement cash transfer programs. This initiative includes three interrelated programs that are issuing unique biometric ID cards to all Indians, providing all households with bank accounts, and exploiting the rapid penetration of mobile phone-based technologies in order to provide the capacity to effectively implement cash transfer-based safety nets. Although pilot programs are being implemented, there is still considerable debate about whether the technology will work effectively across the country, and whether the benefits will keep up with inflation or be diluted during times of rising local food and health care prices.[8]

Social Safety Nets in Zambia

Zambia, a country with a persistently high rates of poverty and food insecurity, implements a variety of targeted safety net programs to support food security in vulnerable populations, including in-kind assistance via school feeding, farming input provision, and unconditional cash transfers. The Home Grown School Feeding Program (HGSFP) provided daily meals to approximately 850,000 children in grades 1 through 9 in 2012. The HGSFP targets schools in high-poverty and low-enrollment districts, with aims to improve both school attendance and food security.

Administered by the Ministry of Community Development, the Food Security Pack (FSP) program began in 2000 to provide packages of seed and fertilizer to "vulnerable but able" households, including those with elderly- or child-heads, or with orphans or ill members (Mason et al., 2013). Unlike the much larger Fertilizer Input Subsidy Program (FISP) administered by the department of agriculture, which requires an outlay by the recipient, FSP is a grant and also reaches households with fewer assets than FISP (Mason et al., 2013). The FSP program had a large initial enrollment, but because of funding difficulties, the number of beneficiaries dropped to only about 15,000 households in 2012 (Tesliuc et al., 2013).

While FSP coverage is low, Zambia has cash transfer (CT) schemes that reach 151,000 households (per Zambian Government). As in much of Africa, the cash transfers are unconditional and arose in part as a response to the growing numbers of AIDS orphans (van Ufford et al., 2016). Zambia's current CT scheme began in the early 2000s with donor-funded pilots, and a shift to self-funded programming has solidified the CT role in development strategy and allowed rapid expansion of the program. The two largest targeting schemes are the Child Grant Program (CGP) and the Multiple Categorical Targeting Grant (MCTG). Both programs are geographically targeted—CGP

[8]For example, see Kotwal et al. (2011) for a summary of critiques of replacing TPDS with cash transfers.

operates in districts with the highest levels of child morbidity and stunting and provides benefits to households with children under age 5, and MCTG operates in the districts with the highest levels of extreme poverty, targeting households similar to those FSP targets. Evaluations have shown that the CGP has positive effects on consumption and food security, as well as on productive activities such as livestock ownership (Handa et al., 2015). Based on these results, the country began to increase the scale of the program (van Ufford et al., 2016).

Although the social safety net in Zambia is much less extensive than the variety of programs operating in India, the country is much further along in implementing a program of cash transfers. Based on the success of the pilot programs in Zambia and their subsequent scaling up, the case study offers a potential model for India to follow. Interestingly, the cash transfer program (as well as the school feeding program) in Zambia targets particular disadvantaged regions, unlike India's larger safety net programs, which operate across the entire country and base targeting on criteria set at the national and state levels (e.g., TPDS). Although there is significant debate about whether India should establish a national cash transfer program, continued implementation of smaller and geographically targeted programs at the state and sub-state level, such as those in Zambia, could reach a large share of the population.

Effects of Safety Net Programs on Food Security

Research findings indicate that each of the types of safety nets can have positive effects on measures of food security (Aker, 2015; Gilligan et al., 2016; Hidrobo et al., 2014; Hoddinott et al., 2015). A World Bank (2011) meta-review of evaluations of safety net programs found positive effects on food consumption in 17 of 20 conditional cash transfer programs (World Bank, 2011). Additionally, in summarizing the results of 12 separate evaluations of social safety net programs, Gentilini (2014) demonstrated that both in-kind food aid, conditional cash transfers, and unconditional cash transfers all improve at least one measure of food security (e.g., food consumption, calorie intake, dietary diversity, and anemia). The evidence of the effect of unconditional cash transfers on food security is beginning to build as well, with research indicating that unconditional cash transfers in seven countries in Sub-Saharan Africa positively affected at least one measure of food security (e.g., calories consumed, food expenditures, dietary quality, dietary diversity, coping strategies, seasonality, and production) (Hjelm, 2016).

However, the evidence is not all positive. Some studies find that, in certain contexts, in-kind food aid has limited effects on overall calorie consumption and on more severe problems with access to food (Tarozzi, 2005; Jensen and Miller, 2011). Similarly, a number of evaluations highlighted in World Bank (2011), Gentilini (2014) and Hjelm (2016) find positive food security outcomes for only one food security measure and not necessarily the same one across programs. Thus, because household behaviors in spending cash transfers vary with circumstances, it is possible that the programs' effects are context dependent and might vary by country or by the populations targeted (Hjelm, 2016).

Gentilini (2014) analyzes 12 evaluations that directly compare the effects of cash transfers and in-kind food aid on food security. Aided and control households were given a variety of cash transfers and in-kind aid, and food security outcomes were compared to better understand the effects of each on food security outcomes. The findings suggest that, in most cases, the effects of cash

and in-kind aid on food security may be identical. In the small number of cases where a difference between the effects of each type of program was certain, that difference was small. Although the results suggest variations across countries, cash transfers and in-kind aid programs potentially have similar effects on food security.

However, Gentilini (2014) found that in-kind aid was more expensive than cash transfers. The high cost of in-kind aid programs is corroborated by the experience of other national programs. For example, ignoring the possible undesirable distortion of India's agricultural markets, India spends nearly 1 percent of GDP on its TPDS despite some studies finding no significant effect on food-security outcomes in some areas (Kochar, 2005; Tarozzi, 2005) and only moderately positive effects in other areas. Given the lack of a significantly better outcome for in-kind aid and its higher cost, the evidence suggests that cash transfers might be a more cost-effective manner to maintain food security of the most vulnerable populations.

While the evidence suggests that cash transfers have similar effects and are cheaper to implement on average than in-kind aid, there may be circumstances when in-kind aid might be preferable to cash transfers. For example, cash transfers may be less effective in situations where rapidly rising food prices erode their purchasing power, in areas where food markets cannot efficiently deliver necessary supplies, or where the necessary banking and administrative systems are not present.

Emerging Issues in Food Safety Nets

Greater focus on nutrition and healthier diets. Most safety net programs have focused primarily on improving access to calories with little emphasis on the nutritional quality of those calories. For example, the TPDS in India provides a portion of a household's grains at a subsidized rate and does little to further incentivize choices that might have a stronger effect on healthy and successful household outcomes. However, improving nutrition and health is a major emerging policy and research focus. (See chapter, "Nutrition and Health: Broadening the Focus of Food Security.") As can be seen in table 9, many conditional in-kind aid programs and conditional cash transfer programs incentivize behaviors other than good nutrition, such as increased schooling and improved primary health care. However, using these programs to incentivize better nutrition, such as providing additional in-kind aid in the form of pulses, vegetables, and fruits can further improve dimensions of food security that many large-scale programs cannot influence in the same way.

New targeting challenges. Programs across the world are experimenting with different targeting schemes for domestic support programs. Targeting itself is difficult because determining who is eligible for aid is both costly and time consuming. Additionally, even after investing in identifying beneficiaries, it is possible that those who do not need the support receive benefits, and those who do need support do not receive adequate support. Some countries, such as India, are moving toward more universal targeting based on more readily observable characteristics, and some countries, such as Zambia, leave targeting to local communities that observe hard-to-measure characteristics of food-insecure households. Thoughtful targeting strategies can improve the efficacy of domestic support programs and further enhance food security. Additionally, designing social safety net programs that can effectively and efficiently target households undergoing sudden distress remains a problem. Given the suddenness of many adverse economic changes, and also given the potential rapid changes to food prices (to which the urban poor are especially susceptible), it is a challenge for existing targeting mechanisms to immediately identify and reach those who need the most assistance. (See box 7, "Urbanization and Food Insecurity.")

Box 7

Urbanization and Food Insecurity

In 2014, over 50 percent of the world's population resided in urban areas. By 2050, over 60 percent of the world's population is projected to reside in urban areas, with most of the growth occurring in Africa and Asia (United Nations, 2014). Historically, urbanization—such as that in Malaysia, China, and South Africa—has been explained by industrialization, which contributed to a strong positive relationship between urbanization and growth in income per capita (Gollin et al., 2016). Although urbanization is still positively associated with income growth, recent research has shown that many countries with high rates of urbanization have a relatively small industrial sector (e.g., Angola and Nigeria). Urbanization in these countries has been explained by lack of opportunity in the rural sector (Gollin et al., 2016) and by "urban natural increase," which is caused by high fertility combined with improved mortality rates due to medical advances (Jedwab et al., 2015).

More attention is now being given to the food needs of the urban poor and how the rapid urbanization that is taking place within many developing countries will affect global food insecurity. Although urban centers generally offer a greater variety of foods, limitations on food access (e.g., income and food prices) remain a main determinant of urban food insecurity (Maxwell, 1999). Unlike farmers and laborers in rural areas who may gain from higher food prices, urban residents tend to be net buyers whose food security is vulnerable to rising food prices. The combination of real price increases and low-wage employment can adversely affect the urban poor. In the wake of the global food crisis, a number of studies found that the urban poor were especially susceptible to real price changes (Alem and Soderbom, 2012; Avalos, 2015).

If urbanization is not accompanied by improvements in economic development, then urban dwellers may find themselves unemployed, making the urban poor particularly susceptible to food insecurity. Inequality in income growth can also contribute to an unequal distribution of food access. ERS research shows that per capita income in the capital city of Tanzania, Dar es Salaam, was twice that in rural parts of the country in 2011, resulting in a lower likelihood of households in Dar es Salaam being food insecure than in other parts of the country. However, the cost of the food basket was also 50 percent higher, implying that some households in the bottom income quintiles in Dar es Salaam were food insecure (Cochrane and D'Souza, 2015).

Box 7, figure 1 plots urban food insecurity in 2014 against the annual rate of urban population growth, 2010-15. The strong positive relationship between urban food insecurity and urban population growth suggests that much urbanization is not associated with growth in urban employment and incomes. The figure also highlights the differences in urban food insecurity and urban population growth across regions. The countries in Sub-Saharan Africa exhibit high rates of urban food insecurity and high rates of urban population growth, whereas the countries in Asia show relatively low rates of food insecurity along with modest rates of urban population growth. The countries of Latin America and Caribbean and North Africa exhibit modest rates of both urban food insecurity and urban population growth.

continued—

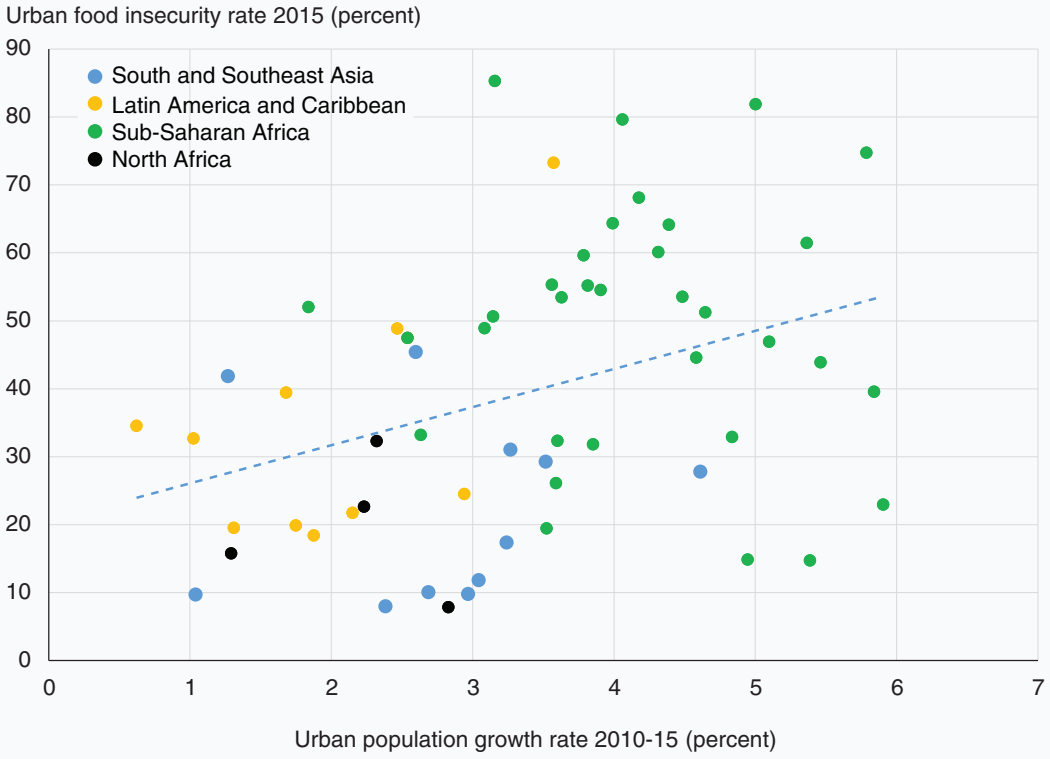
Box 7

Urbanization and Food Insecurity—continued

Although many of the countries in Sub-Saharan Africa have witnessed high-income growth over the past two decades, box 8 figure 1 suggests that that many African countries may have to confront urban food insecurity. Structural transformation and exports of natural resources have contributed to Africa's rapid and sustained income growth (Gollin et al., 2016), but demographic factors (like high urban fertility rates) and high rates of unemployment and underemployment may also play roles in the relatively high rates of urban food insecurity (Jedwab et al., 2015). Additional research is needed to understand the effect that urban population growth will have on urban food insecurity and the types of measures required to meet urban food security needs.

Box 7 figure 1

Urban food insecurity and rate of urbanization[1]



[1]Urban food insecurity is estimated based on United Nations, Food and Agriculture Organization, Food Insecurity Experience Scale indicators and includes regions with moderate and severe food insecurity. This chart includes 59 low- and middle-income countries for which urbanization and urban food insecurity data are available. Two overlapping dots result an apparent total count of 58 dots.

Source: World Bank Development Indicators and United Nations, Food and Agriculture Organization.

Using technology to achieve greater efficiency and effectiveness. Technological innovations can help to improve the delivery of domestic aid programs. For example, in India, technology has already helped reduce corruption of the existing TPDS system of individual States by increasing transparency of deliveries of food, computerizing records of beneficiaries, and using electronic weighing machines to ensure individuals receive the proper rations (Khera, 2011). Further technology changes increase access to bank accounts and enable aid recipients to receive cash transfers across the country (Mathew and Goswami, 2016). The degree to which technology can improve the delivery of aid in the next few years remains to be seen.

National and international coordination. Domestic safety net programs sometimes operate in addition to international assistance being provided by the United States and other foreign governments. (See box 8, "International Food Aid.") Both types of assistance are currently evolving. Finding effective mechanisms for coordinating between them and integrating both domestic and international safety net programs into evolving international markets is an emerging challenge.

Box 8

International Food Aid

The United States and other countries contribute significant resources to global food aid through many programs, with a wide variety of purposes and strategies (box 8, table 1). Additionally, box 8, figure 1 presents the amount of in-kind assistance of cereals donated by the United States and other donor countries to the 76 countries tracked by USDA's International Food Security Assessment, broken down by region. The United States supplies about half of this in-kind assistance, primarily through the Food for Peace, the McGovern-Dole International Food for Education and Child Nutrition Program, and Food for Progress programs.

Food for Peace provides emergency assistance to regions affected by conflict and natural disasters, as well as nonemergency food aid to address underlying causes of food insecurity. Emergency food assistance can take the form of in-kind food aid, locally or regionally procured food, cash transfers, or food vouchers, depending on which of those interventions might be more effective. In addition to direct food assistance, the program also institutes nonemergency food aid, which primarily takes the form of in-kind food aid shipped from the United States.

Additionally, USDA, Foreign Agricultural Service (FAS) implements two large programs aimed at supporting food-insecure countries: the McGovern-Dole International Food for Education and Child Nutrition Program and Food for Progress. McGovern-Dole provides donations of U.S. agricultural commodities for use in school feeding programs, as well as other sorts of assistance to improve literacy and provide education. Food for Progress also provides assistance to food-insecure countries by donating U.S. agricultural commodities to recipient countries to be sold on the open market. The proceeds from these sales are then used to support a wide variety of development programs aimed at improving agricultural productivity in recipient countries. For each program, FAS announces a list of priority countries, and then selects proposed projects submitted by nonprofit organizations, the World Food Program, and other international organizations, which then implement the projects.

In addition to programs that involve food aid, the U.S. Government also contributes significant resources to better understand how to improve global food security. Most prominently, the Global Food Security Act is designed to help alleviate food insecurity and poverty through improving agricultural productivity, boosting rural incomes, improving agricultural research and development, empowering women, improving the resilience of households and communities to economic and agricultural changes, and maximizing cost-effective results such that U.S. assistance is no longer needed.

continued—

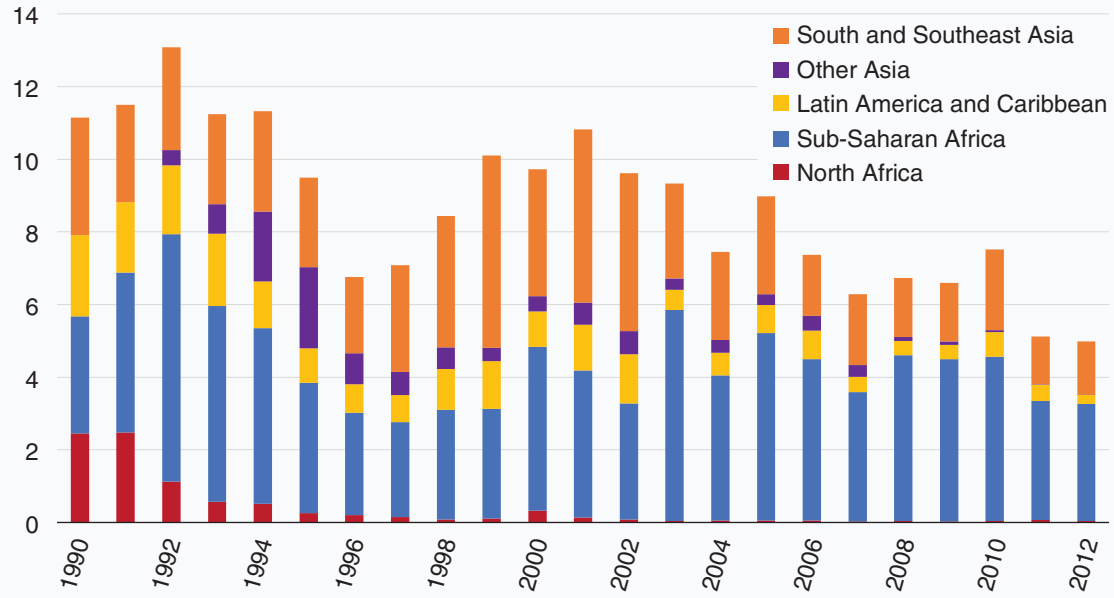
Box 8

International Food Aid—continued

Box 8 figure 1

Cereal food aid imports by 76 low- and middle-income countries

Million of tons



Source: USDA, Economic Research Service, International Food Security database.

Box 8 table 1

Selected international food aid programs

Program name	Type/target	Description
United States		
Food for Peace	Emergency	Title 2-Emergency and Private Assistance Programs provide in-kind food aid managed by USAID and implemented by nongovernmental organizations and World Food Program. Commodities address emergency needs and development programs that aim to reduce vulnerability to crises and improve food and nutrition security. Title 1-Economic Assistance and Food Security and Title 3-Food for Development are not currently funded. Funding for Title 2 in FY 2015 was $1.5 billion.
Bill Emerson Humanitarian Trust	Emergency	This special authority in the Agricultural Act of 2014 allows USAID Office of Food for Peace to respond to unanticipated food crises abroad—when Food for Peace-Title 2 funding is not available—from an all-cash fund to purchase commodities for food assistance. Funding for FY 2014 was $180 million. There was no funding for FY 2015.

continued—

Box 8

International Food Aid—continued

Box 8 table 1

Selected international food aid programs

Program name	Type/target	Description
Emergency Food Security Program	Emergency	This USAID-administered program provides grants for local and regional procurement of food commodities and cash/vouchers for food in cases of emergency. It is intended to complement Food For Peace-Title 2 in responding to highest priority food emergencies. Funding for FY 2015 was $1 billion.
McGovern-Dole International Food for Education and Child Nutrition Program	Child nutrition	This USDA-administered program was authorized in 2002 to support child nutrition and education by donating U.S. commodities and providing technical and financial assistance for school feeding programs. FY 2015 funding was $244 million.
Food for Progress	Food assistance and agricultural development	This USDA-administered program helps emerging democracies expand free enterprise in the agricultural sector. Commodities are donated and then sold on local markets, with the proceeds used to support development programs. FY 2015 funding was $197 million.
International Food Relief Partnership	Nutrition	This subprogram of Food for Peace-Title 2 provides small grants to primarily faith-based groups to support nutritional programs that distribute ready-to-use supplementary foods. (Funding of $10.4 million for FY 2015 was included in the Food for Peace Title 2 funding above.)
European Union		
General EU Budget	Food assistance	The EU budget allocates funds (EUR 349 million in 2014) for food assistance. Most funding supports cash transfers and vouchers, so recipients can purchase food on local markets supporting local economic development and timely distribution rather than food deliveries. The EU also funds the World Food Program (which brings total annual spending to about EUR 1 billion) and holds an annual Food Assistance Convention.
Emergency Aid Reserve	Emergency	This funding for emergency humanitarian assistance includes food aid beyond what was included in the budget.
Development Cooperation Instrument	Poverty reduction	This program allocated over EUR 19 billion for 2014-20 for development assistance—including for agricultural and rural development and food security—to combat poverty in developing countries.
Food Security Thematic Program	Food security	With an allocated budget for 2011-14 of EUR 749 million, this program addresses structural causes of food insecurity.

continued—

Box 8

International Food Aid—continued

Box 8 table 1

Selected international food aid programs

Program name	Type/target	Description
Canada		
Emergency food assistance	Emergency	This program, focused on short-term response to meeting immediate dietary and nutritional needs, contributed $383 million to the World Food Program in 2012. The program focuses on increasing use of cash transfers and vouchers. It holds an annual Food Assistance Convention.
Food assistance in development contexts	Food security	This program, focused on medium- to long-term response, helps vulnerable people develop and enhance their livelihoods and self-reliance.
Food security strategy	Food security	This strategy focuses on: (1) sustainable agricultural development (C$ 1.18 billion allocated over 3 years); (2) food assistance and nutrition (C$ 330 million over 2009-10 for 70 projects in 78 countries); and (3) research and development funded by the Canadian International Food Security Research Centre; contributes to the CGIAR, Forum for Agricultural Research in Africa, Pan-Africa Bean Research Alliance, and Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA).
Japan		
Grant Assistance for the Food Aid Project	Emergency	The program awards grants to developing countries with food shortages to purchase grains, with recipient countries setting aside local currency for economic and social development projects in consultation with the Japanese Government. Allocation was Yen 13.1 billion ($120 million) in 2010, with Japan also providing $156.3 million to the World Food Program in 2016.
China		
An overview	Food assistance/ emergency	In 2005, China stopped receiving World Food Program food aid and became the world's third-largest donor in the same year. In 2016, $156 million in Chinese grain was given as emergency food aid to African countries affected by El Niño. In 2015, China gave $10.5 million to WFP, with $1 million earmarked for Democratic People's Republic of Korea and $5 million for South Sudan.

continued—

Box 8

International Food Aid—continued

Box 8 table 1

Selected international food aid programs

Program name	Type/target	Description
World Food Program		
Food Assistance for Assets	Food assistance	This program pays people with food, cash, or vouchers to build assets such as wells, irrigation trenches, roads, and schools. Recipients get immediate food assistance, and they benefit from the infrastructure that is constructed.
Purchase for Progress	Production assistance	Through this program, grains are purchased from farmers, and assistance is provided to help farmers and other parts of the value chain to meet standards.
Cash transfers	Food assistance	Programming supports cash transfers to enable more dietary choice and variety and support local economies. Programs use new technologies, such as scratch cards and mobile payments.

Notes: FY = fiscal year. WFP = World Food Program. EUR = euros. C$ = Canadian dollars.
Source: U.S. Department of Agriculture and U.S. Agency for International Development, *U.S. International Food Assistance. F.Y. 15*. USDA Foreign Agriculture Service, World Food Program, Global Affairs Canada, Japan International Cooperation System, Ministry of Foreign Affairs of Japan, European Commission, Food Aid International.

Nutrition and Health: Broadening the Focus of Food Security

- Nutrition and its relationship to food security and health are receiving more attention. The Global Food Security Act's (GFSA) overarching goal is to reduce global hunger, malnutrition, and poverty.

- Dietary diversity supports more nutritionally adequate diets for both macro- and micro-nutrients. Over the past 20 years, diets in the 76 countries covered in our research have become somewhat more diverse, and all regions now meet, on average, minimal nutritional levels for per capita calories, fats, and protein. This is not true for all income groups, however.

- Despite progress, significant nutritional challenges remain, including improved nutrition for vulnerable subpopulations (such as pregnant women and young children).

- Emerging issues include better understanding of how nonfood factors (such as clean water and adequate sanitation) affect nutrient utilization and health, as well as the emerging "triple burden" of undernutrition, micro-nutrient deficiencies, and overnutrition even in developing, food-insecure countries.

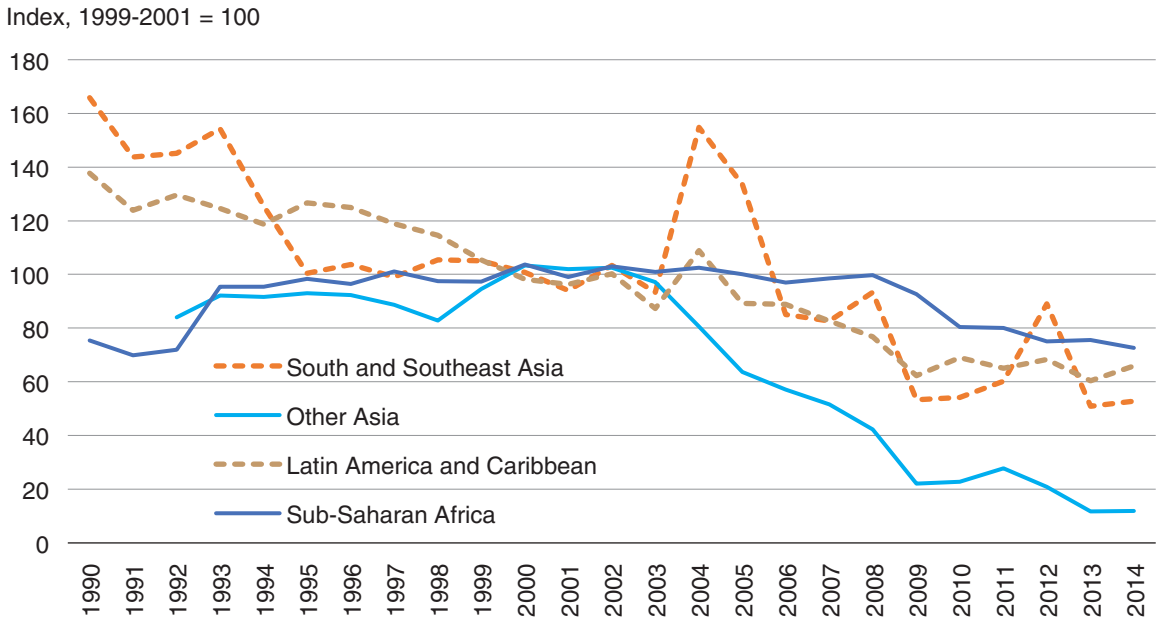
A prominent feature of the comprehensive U.S. Government Global Food Security Strategy (GFSS) developed in accordance with GFSA is the inclusion of a focus on nutrition and health issues to meet GFSA's overarching goal to sustainably reduce global hunger, malnutrition, and poverty. Underlining the priority given to broadening the focus beyond the traditional emphasis on food availability and access issues, the GFSS includes a specific objective to achieve a well-nourished population, with particular emphasis on women and children. The strategy targets increased consumption of nutritious diets, direct nutrition interventions and services, and achievement of more hygienic household and community environments.

Many countries across all regions achieved the 1996 World Food Summit goal of reducing the number of undernourished people by half by the year 2015, using total calorie availability as the measure. Analysis of the 20-year period found major reductions, and the 50-percent-reduction goal was achieved by 15 of the 19 Asian countries, 6 of the 10 Latin America and Caribbean countries, and 18 of 38 countries in Sub-Saharan Africa regularly tracked by USDA during this period (ERS/IFSA, 2015). The four North African countries included in this study were considered food secure during the entire study period. When we base food-insecurity assessment on estimated caloric intake, we find these achievements led to substantial reductions in the number of food-insecure people across the 76 low- and middle-income countries studied by USDA (fig. 15).

While improvements in calorie availability are certainly key, more information about diets themselves is needed to evaluate improvements in overall nutrition embodied in the utilization dimension of food security. Dietary diversity has been demonstrated to link to a wider supply of essential nutrients and better nutrition (Ruel, 2003; Airmond and Ruel, 2004). An important series of analyses in the medical journal *The Lancet* provided empirical evidence for nutrition's role in maternal and child health, and stimulated new programs to address maternal and child nutrition as a key component of food security (Black et al., 2008). A followup *Lancet* study in 2013 furthered the evidence base in this area (Black et al., 2013; Black, 2013).

Figure 15

Index of number of undernourished people by region, 76 low- and middle-income countries[1]



[1]Based on USDA estimate of the number of people consuming below the targeted level of total calories. According to this estimate, North Africa had no food-insecure population during this period.

Source: USDA, Economic Research Service, International Food Security database.

Although a thorough analysis of improvements in diet diversity and nutrition would include assessment of micronutrient intake and other factors, ERS has analyzed changes in the availability of macro-nutrients—including protein, fat, and sugar in addition to calories—for the 76 low- and middle-income countries regularly tracked by USDA over the period 2000-13 (table 10; ERS, 2017, with updates from the FAO food balance sheet 2016).

An analysis of macronutrient availability suggests improvements in the nutritional quality of diets as well in calorie availability over much of this period. In terms of regional aggregates, most regions significantly exceeded 2,100 calories per capita by 2013, with North Africa exceeding that target by a large margin. In addition, per capita consumption of proteins and fats increased faster than total calorie consumption, and by 2013, all regions had essentially met per capita protein and fat requirements.

Diet Diversity Varies by Region

The macro-nutrients in table 10, in turn, reflect diversity in the consumption of major food groups. Increasing income generally leads to the consumption of more animal source proteins, as well as other high-value products such as fruits and vegetables and processed products. Different food preferences also affect regional patterns, as do the presence and structure of food safety net programs. For most of the low- and middle-income countries studied by USDA, cereals and roots and tubers remain the major food staples and dominant source of dietary calories (fig. 16). Cereals account for 55-60 percent of available calories in all regions except Latin America and the Caribbean, where average diets tend to be somewhat more diverse than in the other regions. On average, across the regions, sugar and sweeteners and vegetable oils, followed by fruits and vegetables tend to be the key sources of diet diversity, while pulses and meats tend to be relatively minor sources.

Table 10
Diet composition and ratios to nutritional target, 2000, 2009, and 2013

	Consumption per capita per day[1]				Ratio of consumption to requirement (per capita daily)		
	Energy	Protein	Fat	Sugar	2,100 cal energy	10 percent protein[2]	20 percent fat[3]
2000							
76-country average	2,210	55	46	46	1.05	1	0.93
Sub-Saharan Africa	2,137	52	41	32	1.02	0.97	0.86
South and Southeast Asia	2,251	54	43	42	1.07	0.96	0.86
Latin America and Caribbean	2,316	58	60	95	1.1	1	1.16
North Africa	3,133	86	69	84	1.49	1.1	0.99
2009							
76-country average	2,393	62	55	49	1.11	1.04	1.03
Sub-Saharan Africa	2,297	57	50	35	1.09	0.99	0.98
South and Southeast Asia	2,420	64	52	40	1.15	1.06	0.97
Latin America and Caribbean	2,457	64	64	95	1.17	1.04	1.17
North Africa	3,292	94	68	92	1.57	1.14	0.93
2013							
76-country average	2,532	67	58	57	1.21	1.05	1.03
Sub-Saharan Africa	2,402	61	52	48	1.14	1.01	0.98
South and Southeast Asia	2,581	71	60	49	1.23	1.09	1.03
Latin America and Caribbean	2,530	65	68	92	1.2	1.03	1.22
North Africa	3,393	98	75	90	1.62	1.15	1

Note: cal = calories.
[1]Calculated based on United Nations, Food and Agriculture Organization Food Balance Sheet.
[2]Based on U.S. Food and Drug Administration's recommended threshold target—consuming at least 10 percent of caloric intake as protein.
[3]Based on American Heart Association's recommended threshold target—consuming 20 percent of caloric intake as fat.
Source: USDA, Economic Research Service.

Changes in diet composition between 2000 and 2013 have been relatively gradual. The share of calories coming from cereals, roots, and tubers remained essentially unchanged for both Sub-Saharan Africa, despite higher income growth in the last decade. Consumption of cereals, roots, and tubers declined modestly for South and Southeast Asia, despite substantial growth for a number of countries in this region. Consumption of cereals, roots, and tubers declined most significantly for Other Asia, which includes countries of the Former Soviet Union. North Africa has seen a slight decline in the share of cereals in the diet, despite food security safety nets that have traditionally subsidized cereal products, especially bread.

Over the same period, diet shares of other food groups have tended to increase, albeit slowly, in most regions. For example, vegetable oil increased as a share of calories in all regions. Vegetable oil now accounts for a significant share of calories: about 8 percent in Sub-Saharan Africa and 9 percent or more in Latin America and Caribbean and North Africa. The exception is South and Southeast Asia, where this growth has been very modest, and vegetable oil provides less than 6 percent of calories.

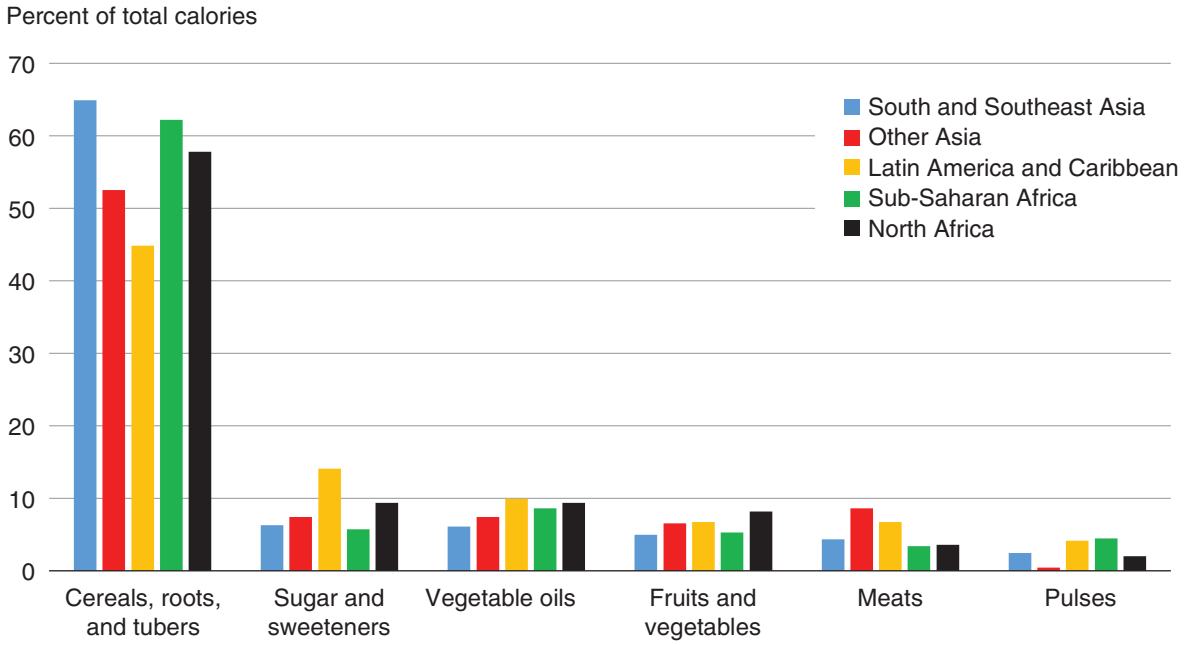
Consumption of meat—an important potential source of protein and fat as well as calories—has increased slowly across most regions, but remains a minor dietary component in most low- and middle-income countries studied (fig. 17). Gains in meat consumption have been slowest in North and Sub-Saharan Africa and somewhat faster in the other regions. Other Asia experienced the most significant change, driven in part by increases in meat production. Dietary shares for fruits, vegetables, and pulses have grown in each region, becoming relatively large shares of the diet in Sub-Saharan Africa and Latin America and the Caribbean (fig. 18).

Gains in Nutrition Also Vary by Income

An aggregate analysis that indicates a gradual increase in the diversification of the macro-nutrient content of average diets masks significant differences across income groups that are evident in all regions studied. Calorie consumption remains markedly lower among the lowest income consumers, and this disparity is more pronounced in the case of protein (fig. 19, fig 20).

Disparities in consumption between the lowest and highest income deciles becomes more pronounced in consumption by individual food groups. The disparity between the highest and lowest deciles is most pronounced for fruits and vegetables, a food group containing a wide range of nutrients that can contribute to improved nutritional status (fig. 21). There are also significant differences between the lowest and highest deciles in the consumption of sugar and sweeteners and vegetable oils—two food groups that are high in calorie content but with fewer non-caloric nutrients (fig. 22, fig. 23).

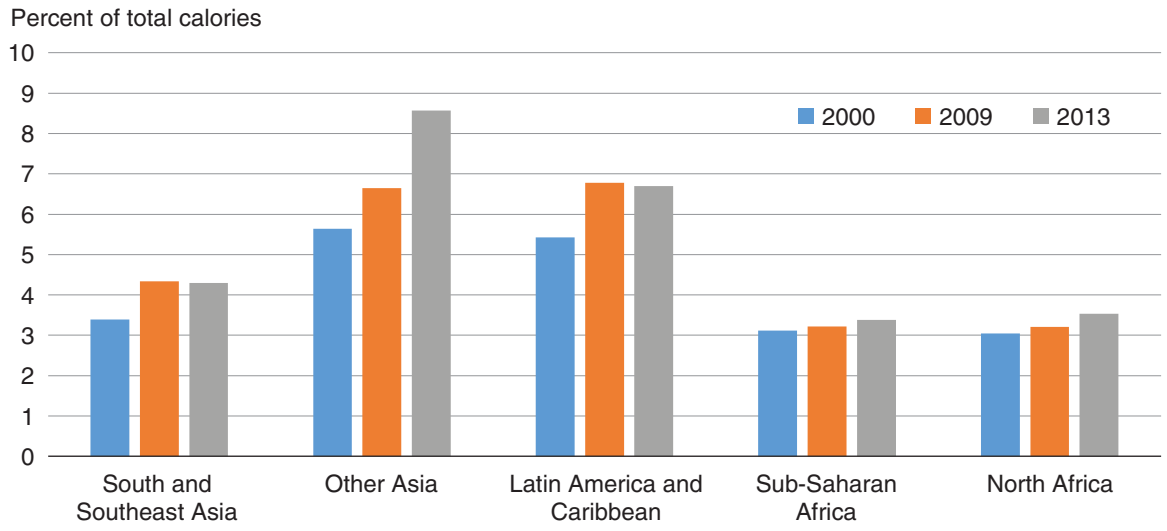
Figure 16
Average calorie composition of diets by region in 2013, 76 low- and middle-income countries



Source: USDA, Economic Research Service calculations based on United Nations, Food and Agriculture Organization FAOSTAT data.

Figure 17

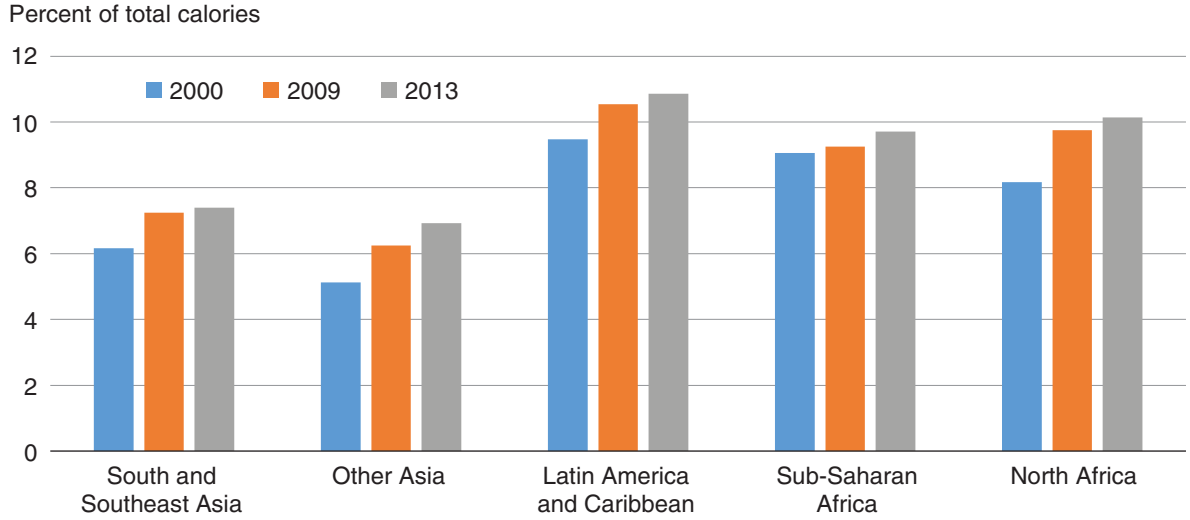
Changes in calories from meat in average diets by region, 76 low- and middle-income countries



Source: USDA, Economic Research Service calculations based on United Nations, Food and Agriculture Organization FAOSTAT data.

Figure 18

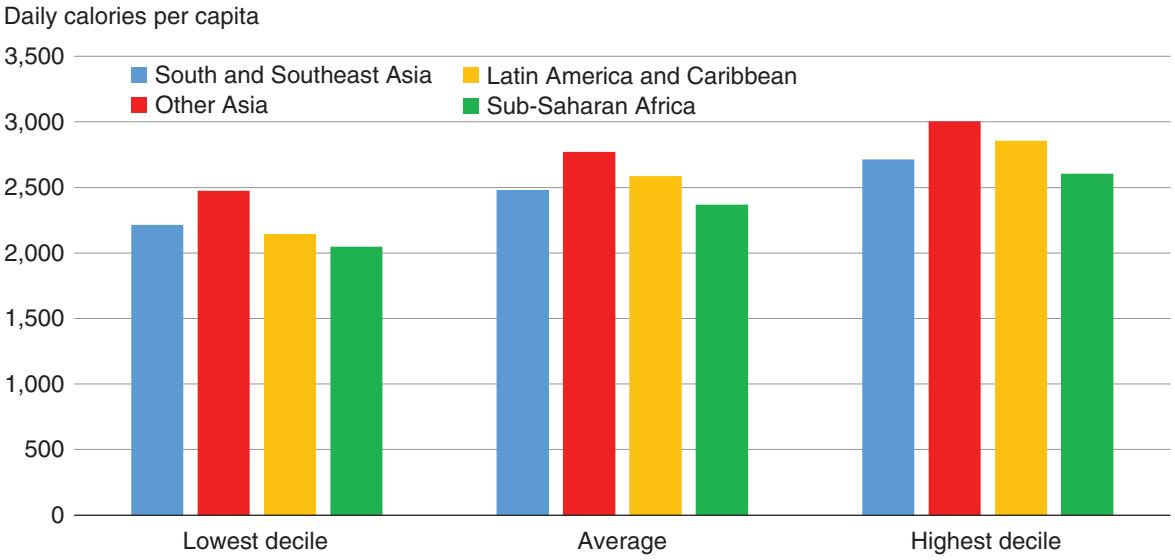
Changes in calories from fruit, vegetables, and pulses in average diets by region, 76 low- and middle-income countries



Source: USDA, Economic Research Service calculations based on United Nations, Food and Agriculture Organization FAOSTAT data.

Figure 19

Average calorie consumption by income decile and region in 2013, 72 low- and middle-income countries

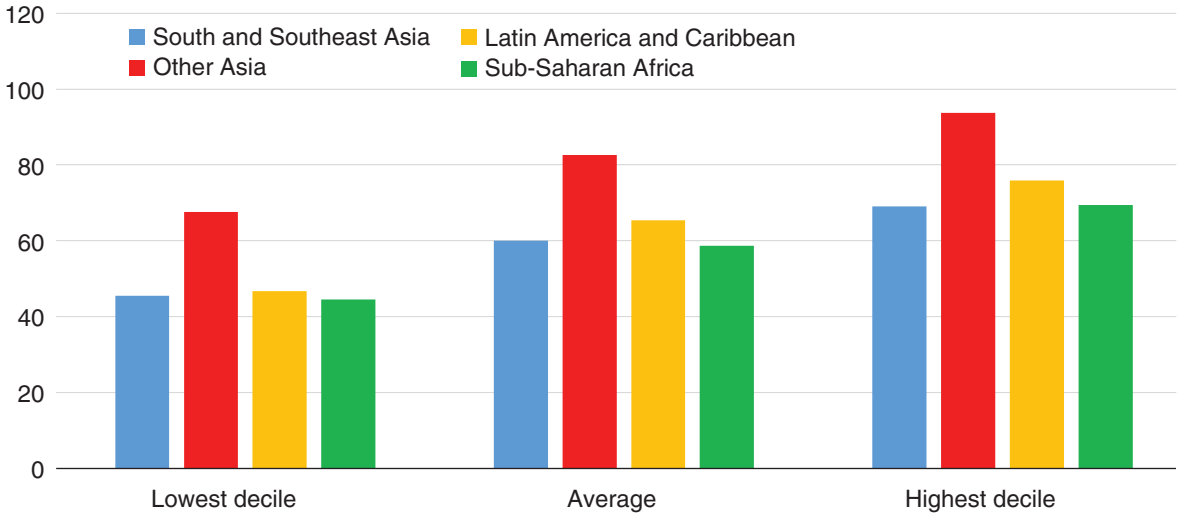


Note: The four North African countries were not included.

Source: USDA, Economic Research Service calculations based on United Nations, Food and Agriculture Organization FAOSTAT data.

Figure 20

Average protein consumption by income decile and region in 2013, 72 low- and middle-income countries

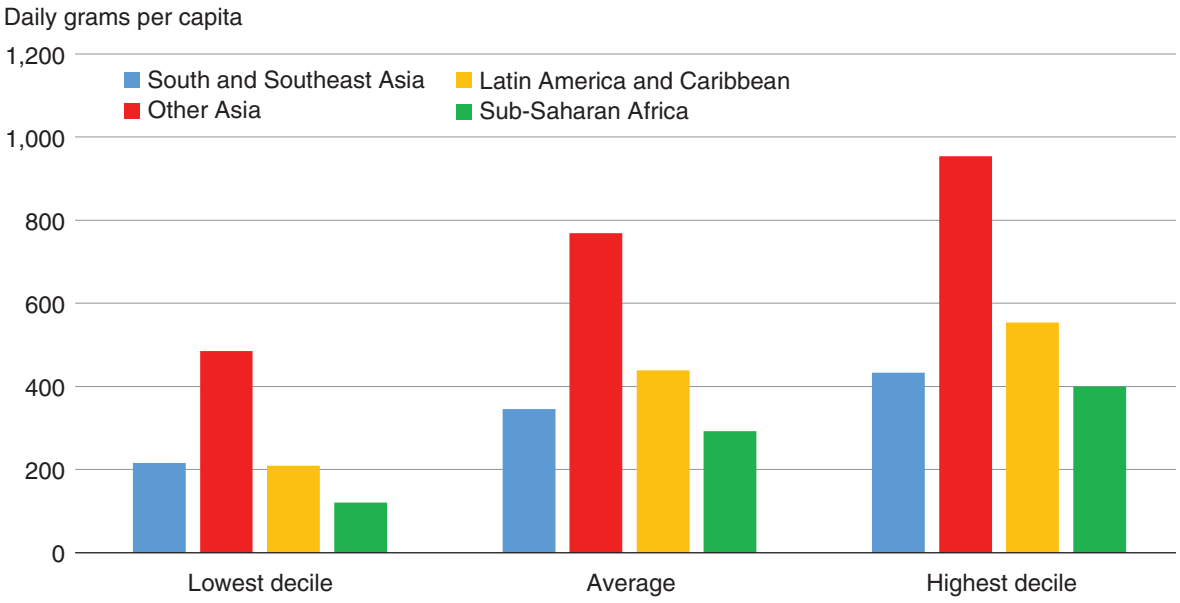


Note: The four North African countries were not included.

Source: USDA, Economic Research Service calculations based on United Nations, Food and Agriculture Organization FAOSTAT data.

Figure 21

Average fruit and vegetable consumption by income decile and region in 2013, 72 low- and middle-income countries

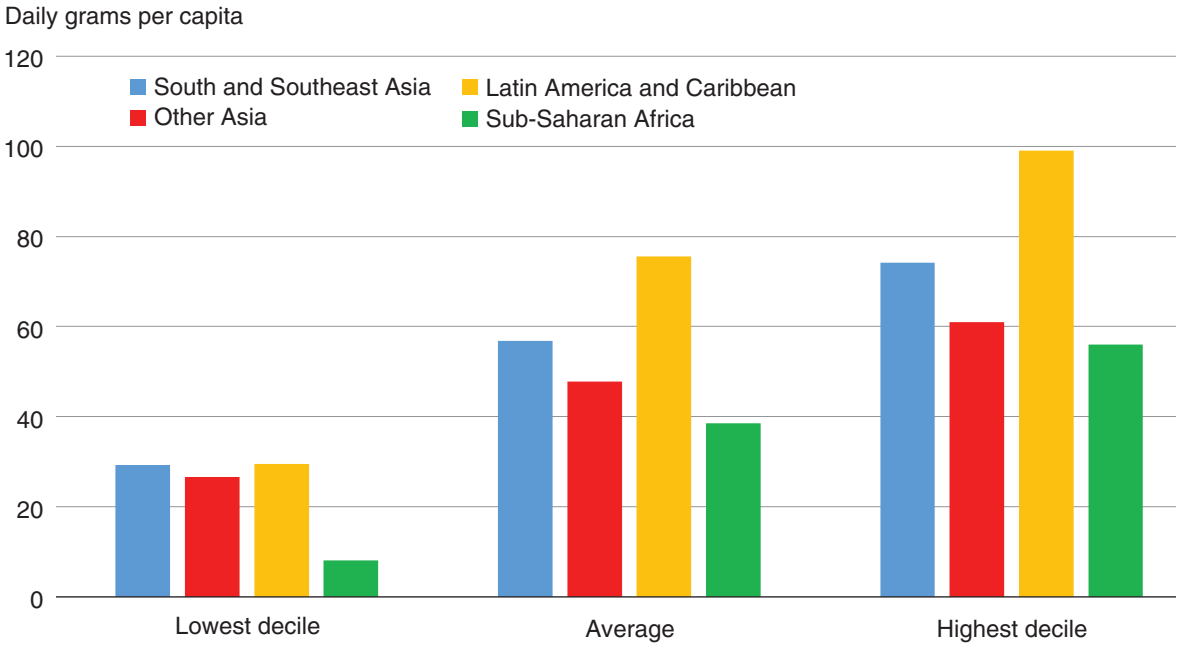


Note: The four North African countries were not included.

Source: USDA, Economic Research Service calculations based on United Nations, Food and Agriculture Organization FAOSTAT data.

Figure 22

Average sugar and sweetener consumption by income decile and region in 2013, 72 low- and middle-income countries

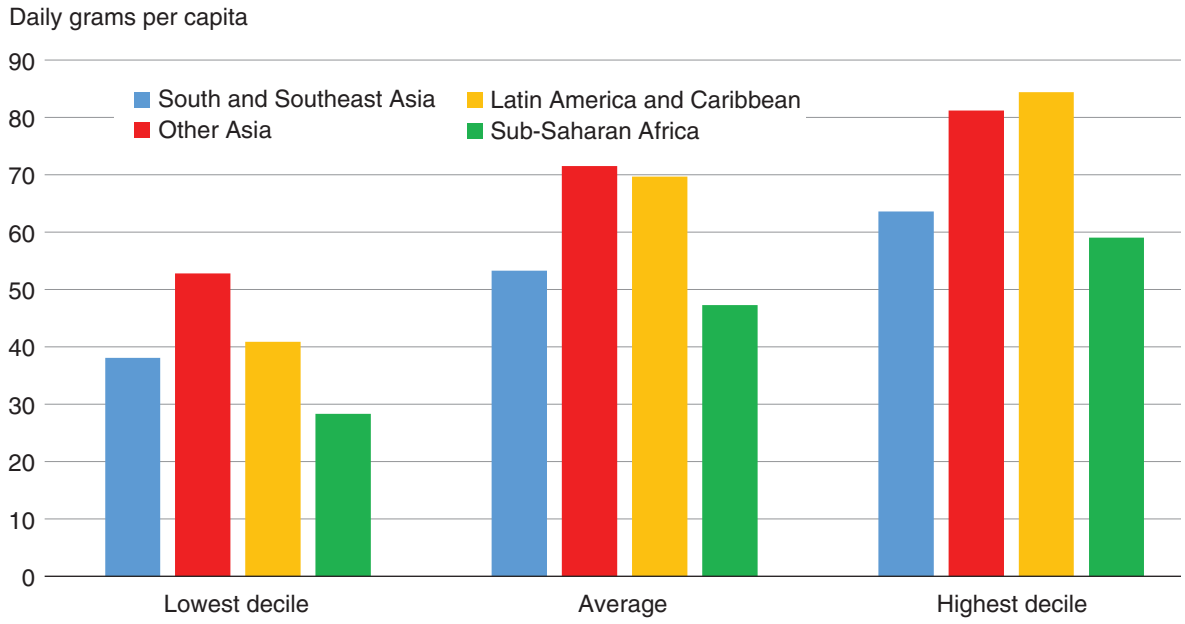


Note: The four North African countries were not included.

Source: USDA, Economic Research Service calculations based on United Nations, Food and Agriculture Organization FAOSTAT data.

Figure 23

Average vegetable oil consumption by income decile and region in 2013, 72 low- and middle-income countries



Note: The four North African countries were not included.

Source: USDA, Economic Research Service calculations based on United Nations, Food and Agriculture Organization FAOSTAT data.

Measures to Improve Nutrition and Health

While macro-nutrient trends are an important aspect of nutrition, they capture only part of nutrition's role in food security. There is a robust literature on international nutrition issues, often associated with international health programs. USAID's longstanding Demographic and Health Survey (DHS) has provided data to allow for monitoring of progress on some of its key health programs, including maternal and child health and nutrition. Nutrition objectives targeting pregnant women and young children are a key focus in GFSA. The United States developed the 1,000 Days program to highlight the importance of nutrition during the first 1,000 days of a child's life, including time in utero (Black, 2013; USAID, 2014). A variety of U.S. Government programs have worked to translate new research findings on nutrition into making better nutritional interventions, as well as into providing more nutritionally adequate foods as food aid (USAID, 2015). The U.S. Government also developed a global nutrition coordination plan to better align the work of 11 agencies and programs dealing with international nutrition (USG, 2016a).

Although access to adequate nutrients is necessary, these nutrients often do not suffice to reduce measures of chronic childhood undernutrition such as stunting. As the earlier discussion of food security measurement demonstrates, food security assessments based on food availability and access can differ considerably from those based on anthropometric measures such as stunting. Research indicates that environmental factors, such as safe water and sanitation, affect nutrient utilization, which is reflected in anthropometric outcomes. USAID's most recent nutrition strategy, as well as the GFSS, incorporates the increased integration of the WASH perspective—water, *s*anitation, and hygiene—which recognizes these inter-relationships (USAID, 2014; USAID, 2015).

The literature on nutrition security also highlights the triple burden of malnutrition—the co-existence of both overnutrition and undernutrition in both developing and developed countries, often accompanied by micro-nutrient deficiencies. Diets are now identified as a major contributor to, and risk factor for, a range of noncommunicable diseases, which pose significant challenges to both individual health and health institutions (Popkin, 2006). The GFSA explicitly references the broader challenge of malnutrition, defining it as poor nutritional status caused by nutritional deficiency or excess (GFSA, Sec 4(6)).

Each of these dimensions of nutrition are significant emerging challenges for global food security. Recent assessments found that despite progress in many countries, the world is not on track to meet goals for reducing stunting, reducing micro-nutrient deficiencies (so-called hidden hunger), and avoiding increases in the prevalence of overnutrition (IFPRI, 2015; USG, 2016). Developing measures to track nutritional progress is also challenging. Commonly used indicators for childhood nutrition—stunting and underweight—are complicated by environmental influences such as water, sanitation, and hygiene. It will require additional work to untangle these relationships and their effects on nutritional outcomes and measures. Collecting data on micro-nutrients is often invasive and requires direct access to individuals, which can sometimes be accomplished through better coordination with medical clinics.

Emerging Issues in Nutrition and Food Security

- Nutritional outcomes and health are affected by a range of environmental and social elements—such as water, sanitation, and hygiene. Attention to these nonfood factors adds additional complexity to the utilization dimension of food security.

- Effective programs to improve health for vulnerable subpopulations (such as pregnant women and young children) are necessary but there is still much to be done to define programs to avoid life-long-impact nutritional inadequacy which impose high personal and social costs. (Bhutta et. al, 2013; Black, 2013, Pinstrup-Anderson, 2013).

- The "triple burden" of malnutrition—undernutrition, micro-nutrient deficiency, and overnutrition—now occurs in many food-insecure developing countries. Underconsumption in the lowest income deciles can coincide with significant overnutrition in upper income deciles. Micro-nutrient deficiencies can exist across the income spectrum. Targeting appropriate responses to relevant income groups poses a new challenge for food security programs.

Findings and Emerging Issues

An analysis of the 76 low- and middle-income countries regularly tracked by USDA and review of recent food security research indicate that each of our five focus areas—food security measurement, agricultural productivity, food trade, domestic and international food safety net programs, and nutrition—are vital to effectively monitoring food security, understanding past gains in food security, and unlocking future gains. Improving food security is a complex problem that requires addressing constraints to food availability, access, utilization, and stability. However, research and experience help to identify strategies and methods that can further extend the gains of the past 15 years, as well as address emerging issues likely to be important topics of future food security research and strategy. Some emerging issues tie back to the core issues of productivity, trade, and safety nets. Others, however, will point in different directions and mark a sharper divergence between what we have done in the past and the issues that arise for the future.

The multiple dimensions of food security create a challenge in developing a single metric of food security status and require the use of multiple indicators to identify and fully characterize food-insecure populations. Aggregate, national-level indicators, such as those published in USDA's annual International Food Security Assessment, are timely and low cost, but are less valuable for assessing food access or nutritional status within populations. Household consumption surveys can provide important food access and utilization detail, but are relatively costly and require new methods to accurately account for all foods consumed. Survey-based anthropometric indicators supply unique and valuable data on nutritional and health outcomes, but only address utilization problems and do not necessarily identify recent or emerging problems with food access.

Newer experiential measures of food security offer the potential for timely and cost-effective measurement of all dimensions of food security, but they often do not align with other, traditional indicators, suggesting that additional work is needed to assess their accuracy. Important emerging issues in food security measurement include continuing to evolve metrics that can address the multiple dimensions of food security; evaluating the accuracy of new, relatively fast and low-cost experiential measures of food security; and reconciling the differences between new and traditional measures. The issue of evaluating experiential measures is especially high priority given the interest in using these measures to monitor progress toward the sustainable development goals.

Domestic production accounts for the bulk of food staple supplies in most of the low- and middle-income countries studied, and gains in food grain yields and production have been a primary contributor to improved food security in the majority of these countries over the past few decades. Research shows that focusing on productivity-based agricultural output gains can be an effective approach to improving food security in many low-income countries. On average, countries with faster growth in agricultural productivity have also had larger reductions in food insecurity. Although the potential for cost-effective growth in agricultural productivity is not equal in all cases, achieving productivity gains through research and establishing enabling environments for technology adoption—including extension, markets, and risk-management tools—are likely key to continued food security improvements in many countries.

Important emerging issues in the relationship between agricultural productivity and food security include the funding for public agricultural research to support agricultural innovation, particularly in smaller countries unable to fund adequate national research systems. The use of index insurance and other tools to reduce the risk of adopting new technology can help support further growth in

on-farm investment and productivity. Achieving efficiency gains in marketing and other components of agricultural value chains can help boost incentives that can provide benefits for both producers and consumers.

Food imports have played an important complementary role in improving food security in some countries and a more primary role in countries where climate or a lack of resources limit the potential for local production. Concerns with the effect of imports on local food production and related employment—as well as practical limitations, such as inadequate foreign currency reserves and insufficient infrastructure—limit the extent to which many food-insecure countries rely on food trade. Exposure to potential world market price volatility is a common concern of low-income food-importing countries, although current evidence does not indicate an increase in the volatility of world food staple trade or prices.

Over the longer term, developing the capacity to compete in world markets for goods and services and opening food markets to international trade have been an effective food security strategy for a number of developing countries. A key emerging issue is the interface among the domestic food security policies of low-income countries, multilateral trade disciplines and global markets. Uncertain world market conditions, including exposure to potential world market price volatility is a key concern for low-income food-importing countries. Continued research on how best to help food-insecure households cope with food price increases and help small farmers cope with food price declines, is vital to global food security.

Food-insecure countries implement a number of types of domestic food safety net programs, ranging from traditional in-kind food assistance, to more recent program designs that provide conditional and unconditional cash transfers, rural employment, and school meals. Available evidence suggests that the newer cash transfer programs are more cost effective at improving food security, but in-kind aid can be valuable to promoting certain types of consumption (i.e., more healthy and diversified diets) and may be preferable to cash transfers during times of rapidly rising food prices. It is unlikely, however, that all countries have sufficiently developed food markets and administrative capacity to broadly implement cash transfers.

Advances in information technology and capacities in personal identification, banking, and mobile phones are supporting the expansion of targeted, cash-transfer programs, with the potential to improve their efficacy, lower costs, and reduce the market distortions associated with acquiring, distributing, and storing commodities for traditional in-kind programs. Key emerging issues in the development of effective food safety nets include the need for more research on the relative benefits and costs of each type of program in various settings, greater program emphasis on nutrition and health outcomes, response to increased urbanization, answers to the challenge of improved targeting of vulnerable groups, and better use of technology to improve the efficacy of safety net programs.

Nutrition challenges persist even when food availability and access have improved. Adequate levels of calorie consumption can co-exist with deficiencies in both macro- and micro-nutrients. These deficiencies, in turn, weaken nutritional well-being and affect overall health status. Research shows that more diverse diets provide better availability of essential nutrients, including both macro- and micro-nutrients. Our analysis finds that diets have become somewhat more diverse over the past 20 years, with most regions, on average, meeting minimum nutritional requirements for calories, fat, and protein, but that results differ by income groups. In addition, there are challenges to meeting the nutritional needs of vulnerable subpopulations, such as mothers and young children, who are a major focus of the Global Food Security Act of 2016 (GFSA). Other nonfood factors, such as clean water

and effective sanitation, affect food utilization. This is particularly true for key measures of childhood nutrition such as stunting and underweight. Growing recognition of the role of nutrition to food security is reflected in GFSA, whose overarching goal is to reduce not only hunger and poverty, but also malnutrition. It deals explicitly with maternal-childhood nutrition, the role of non-food factors (water, sanitation, hygiene) in nutritional outcomes, and the "triple burden" of malnutrition—that is, the co-existence of undernutrition, micro-nutrient deficiencies, and overnutrition within food-insecure developing countries.

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