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GLOBAL FOOD POLICY REPORT 2017

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GLOBAL FOOD POLICY REPORT 2017

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A Peer-Reviewed Publication

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Preface

The *2017 Global Food Policy Report* provides a comprehensive overview of major food policy developments and events. In this sixth annual report, leading researchers, policy makers, and practitioners review what happened in food policy, and why, in 2016 and look forward to 2017. This year's report has a special focus on the challenges and opportunities created by rapid urbanization, especially in low- and middle-income countries, for food security and nutrition.

In 2016, the world embarked on implementing the 2030 Agenda for Sustainable Development, with the goal of eliminating extreme poverty and hunger. The Paris Agreement on Climate Change also entered into force. Other major international developments included UN endorsement of the Framework for Action that emerged from the Second International Conference on Nutrition, the launch of the UN Decade of Action on Nutrition (2016–2025), and the New Urban Agenda adopted at the Habitat III summit in Quito, Ecuador. Also of note were the G7's commitment to prioritizing nutrition, the G20's emphasis on agricultural innovation for sustainable development, and the record replenishment for the International Development Association (IDA).

Progress in many places on reducing poverty and malnutrition has been notable, with extreme poverty at the lowest level ever. Hunger rates have fallen substantially in recent years, even dramatically in some countries, accompanied by falling levels of child stunting and other indicators of malnutrition. Agricultural production was up in 2016, and as a result, food prices were down, with benefits for consumers.

Political and economic uncertainties also marked the year. Continuing conflicts and record numbers of refugees in the Middle East increased the need for humanitarian aid. El Niño and other environmental shocks reduced harvests in Latin America, parts of Asia, and eastern and southern Africa, increasing food insecurity. Political events in 2016, including the British vote to leave the European Union and the US elections, along with continuing economic stagnation and recession in major economies leave the prospects for 2017 more uncertain than in previous years.

In 2017, the world must move forward with its commitments on the Sustainable Development Goals. Working to improve food systems and strengthening the ties between rural and urban areas offer great promise for meeting those goals and ending hunger and malnutrition.

Topics covered in the *2017 Global Food Policy Report* were the result of consultations with experts in the field. For inclusion in this report, a topic must represent a new development in food policy or a new way of looking at an important food issue; the topic has to be international in scope; and assessments and recommendations must be backed by evidence based on high-quality research results or expert judgment. Supplemented by data tables and visualizations illustrating trends in key food policy indicators at the country level, the report paints a full picture of food policy.

I hope this report is met with interest not only by policy makers who shape the food policy agenda, but also by business, civil society, and media, who all have a stake in food policies that benefit the world's poorest and most vulnerable people.

Shenggen Fan
Director General

Acknowledgments

The *2017 Global Food Policy Report* was prepared under the overall leadership of Shenggen Fan and a core team comprising Jamed Falik, Rajul Pandya-Lorch, Katrin Park, Pamela Stedman-Edwards, Klaus von Grebmer, Sivan Yosef, and Laura Zseleczky.

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Production of the report was led by Jamed Falik, David Popham, and Pamela Stedman-Edwards. Team members include Aliana Bailey, Melissa Cooperman, Michael Go, James Sample, and Caroline Smith. Editorial assistance was provided by Amy Gautam and Tracy Brown.

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CHAPTER 1

FOOD POLICY IN 2016–2017

Food Security and Nutrition in an Urbanizing World

SHENGGEN FAN

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The year 2016 saw important signs of resolve and commitments to sustainable development and food security. Yet the year also witnessed growing uncertainties linked to stagnant growth in the global economy, growing income inequalities everywhere, worsening refugee crises, increased polarization and populism among major donor countries, and rapid changes in the political landscape. These uncertainties and persistent challenges will prove to be a major test of whether the momentum created will propel the new sustainable development agenda forward and whether action will be taken to improve the lives of millions of people who continue to lack the most basic necessities—namely, food, shelter, and security.

LOOKING BACK AT 2016: A GLIMMER OF HOPE

Despite experiencing a sixth year of global economic stagnation in 2016, some positive signs emerged of better things to come. Take poverty, for example. World Bank projections suggest that for the first time in history, the number of people living in extreme poverty fell below 10 percent of the global population.[1] While the rates may have fallen, the numbers of extremely poor people in the world remain too high—hundreds of millions of people still live on less than US$1.90 a day (the current benchmark for extreme poverty).

Global hunger rates are also expected to have fallen in 2016, with less than 11 percent of the world suffering from undernourishment—a drop from 19 percent in 1990.[2] Advancements were made in countries such as Bangladesh, which cut hunger from 33 percent to 16 percent between the periods 1990–1992 and 2014–2016. Ethiopia made even more dramatic progress, reducing hunger from 75 percent to 32 percent over the same time frame. Among other broad strategies and programs to reduce hunger and malnutrition, efforts to improve crop production and diversification coincided with the improvements seen in these countries.[3] Along with Bangladesh and Ethiopia, many other countries also witnessed significant reductions in undernutrition, particularly in child stunting—a condition of low height-for-age that is irreversible and associated with impaired physical and cognitive ability. To take one research result released in 2016, Peru rapidly reduced child stunting from 28 percent to 18 percent in just four years (2008–2012), a remarkable sign of progress that included the poor and reached all of Peru's diverse regions.[4]

Global food prices fell for the fifth straight year in 2016 due to increased supply, according to the Food and Agriculture Organization of the United Nations (FAO). The FAO's December 2016 *Crop Prospects and Food Situation* report forecast world cereal production of 2,578 million metric tons for 2016, 1.7 percent above 2015 cereal output.[5]

This gain is driven mainly by maize and wheat. Global rice production for 2016 could reach an all-time high of 498.5 million metric tons, marking the first expansion in global rice production since 2013. Rice production in Asia recovered toward the end of 2016 following the dissipation of the El Niño cycle, with yields increasing to 450.7 million metric tons. These gains imply that many of the poorest, who spend a larger share of their income on food purchases, were able to experience some improvement in their food security and poverty status.

Along with improvements in poverty and hunger reduction, major global policy developments in 2016 helped to maintain or build momentum toward improving human and environmental well-being. In 2016, implementation of the United Nations' 2030 Agenda for Sustainable Development—anchored by the Sustainable Development Goals (SDGs)—began with a number of key actions taken as the world geared up to deliver on the ambitious agenda for eliminating hunger and poverty worldwide. Among these, a coalition of more than 60 governments, representing both developed and developing countries, committed to a record US$75 billion replenishment for the International Development Association, the World Bank's fund for the poorest countries.

The United Nations endorsed the Second International Conference on Nutrition (ICN2) Framework for Action and declared 2016 to 2025 a Decade of Action on Nutrition to reduce hunger and malnutrition and meet the SDGs. The Decade of Action aims to provide an umbrella for a wide group of actors to work together to make progress toward SDG 2 to end hunger and malnutrition in all its forms. While nutrition continues to be an important development issue at the global level, the challenge of translating commitment into action for accelerated progress remains.

A critical global development in 2016 emerged from the 2015 United Nations Climate Change Conference (COP21). The Paris Agreement—which addresses greenhouse gas emissions mitigation, adaptation, and finance beginning in the year 2020—was ratified by 126 countries and entered into force in November 2016.[6] These commitments to climate action are critical for food security and nutrition, given the ways in which agriculture is both affected by and contributes to climate change. Furthermore, COP22 in 2016 galvanized the launch of related

This chapter benefited from research and writing assistance from Michael Johnson and Christopher Rue.

efforts such as the initiative for the Adaptation of African Agriculture, which aims to reduce the vulnerability of Africa and its agriculture to climate change.

Urbanization was elevated in the global development policy agenda in 2016, most prominently through 167 countries' adoption of the New Urban Agenda at the Habitat III summit. The agenda sets a standard for sustainable urban development, including the provision of basic services for all, strengthened resilience in cities, reductions in greenhouse gas emissions, and promotion of greener cities. Also in 2016, 132 mayors around the world signed the Milan Urban Food Policy Pact, committing to developing sustainable, inclusive, and resilient food systems. Moreover, the Open Cities initiative in South Asia, one of the most rapidly urbanizing regions of the world, began operating in three cities (Colombo, Dhaka, and Kathmandu) to leverage community mapping and open data to promote sustainable development and disaster preparedness and resilience.

Other developments emerging from international forums and regional development groups in 2016 were also encouraging. For example, the Group of Seven (G7) reaffirmed its commitment to prioritizing nutrition and helping 500 million people in developing countries move out of hunger and malnutrition by 2030. The larger Group of Twenty (G20) highlighted the importance of agricultural innovation—in institutions, policies, science, and technology—to achieve sustainable development. Among regional development groups, the African Development Bank Group launched its 2016–2025 Strategy for Agricultural Transformation, committing to end extreme poverty, hunger, and malnutrition by 2025. And at the African Green Revolution Forum, African leaders, businesses, and major donors pledged more than US$30 billion for African agriculture to increase production, income, and employment for smallholder farmers and local African agriculture businesses over the next 10 years.

Along with global and regional policy developments, individual countries initiated significant food security and nutrition policy changes in 2016. The US Global Food Security Act was passed by Congress, which will help support the SDGs. France enacted anti–food waste actions and passed a law requiring supermarkets to donate unsold food. China announced investments in agriculture of about US$450 billion in an effort to increase farm productivity and improve rural incomes, and also outlined plans to reduce its citizens' meat consumption by 50 percent by 2030. Malawi launched a new National Agricultural Policy to improve incomes, food security, and nutrition. The Philippines finalized long-term development plans that include efforts to reduce poverty and to reach self-sufficiency in rice—the latter a policy with potential drawbacks.[7] India continued to expand implementation of its 2013 Food Security Law, aiming to allocate subsidized food grains to 800 million people across India's 36 states.

Behind these positive signs, concerning developments in 2016 revealed the persistence of hunger and malnutrition in some parts of the world. In West Africa, 10 million people experienced critical levels of food insecurity in 2016.[8] The 2015–2016 El Niño weather event caused poor harvests in many countries around the world, affecting a projected 41 million people in southern Africa, of whom 28 million were in need of immediate humanitarian assistance.[9] In Yemen, almost half the population (14 million of 27.4 million) faced high levels of food insecurity driven primarily by conflict, and in war-torn Syria roughly 4 to 5 million displaced people required urgent food aid throughout the year.[10] While it is encouraging that humanitarian aid supports many people in acute critical need, vulnerability to chronic food insecurity remains a concern.

LOOKING FORWARD TO 2017: GREAT UNCERTAINTIES DESPITE A STRONG RESOLVE

The resolve and commitments to sustainable development and food security that marked 2016 are being tested as we look forward to 2017. Of particular concern are the uncertain prospects for economic growth and changing political paradigms in developed and developing countries alike, which are creating an uncertain outlook for the global development landscape.

Current forecasts of global economic growth for 2017 are slightly positive: after low growth of 2.3 percent in 2016, growth in 2017 is expected to rise to 2.7 percent.[11] Prospects for growth differ sharply across countries and regions, with emerging economies in Asia showing robust growth, while Africa south of the Sahara experiences a slowdown.[12] The projected slowdown threatens to reverse the gains achieved in reducing poverty and food insecurity in Africa. In Nigeria, lower oil prices combined

with the effects of currency depreciation and conflict elevate the risk of severe food insecurity. Relatedly, staple food prices in Nigeria were expected to have risen above both 2015 prices and the five-year average by September 2016.[13]

Expected political changes around the world in 2017 contribute to the uncertain economic outlook. For example, several countries in Africa south of the Sahara will transition to new political leadership. A new administration in Ghana will transition into power and is expected to address the country's slowing economic growth. In the Democratic Republic of the Congo, a transitional government is supposed to be formed in advance of elections slated to be held by the end of 2017. In Latin America, political uncertainties in countries such as Brazil and Venezuela put a question mark on economic and social stability going forward, with implications for development and foreign direct investment. New political regimes in Asia, such as in the Philippines, have bucked convention with new or different approaches to trade and development. Political changes in the more advanced economies are also adding to the growing uncertainties. Threats of greater isolationism could further slow global trade and economic growth. As a result, the subdued economic outlooks for 2017 may further support the uptick in anti-integration movements among other advanced economies. Overall, the implications of these political changes for domestic and global growth, food policy, trade, and investments in food security and nutrition are unclear.

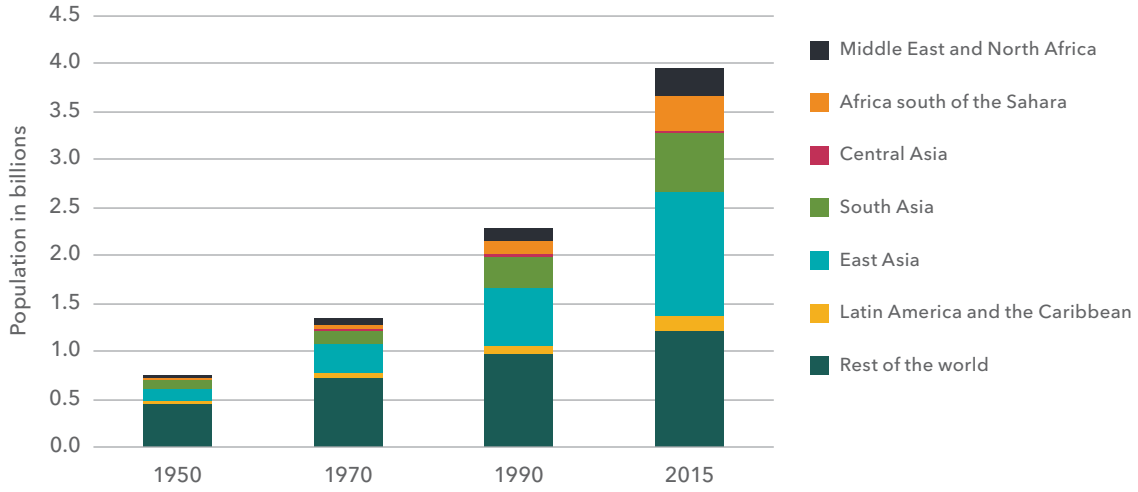
Rising within-country income inequality during the period of rapid globalization, as well as stagnant real median wages, fuels policy uncertainty around global trade and immigration in advanced economies.[14] Indeed, within-country inequality is higher now than it was 25 years ago, and the share of income going to the top 1 percent has increased in many countries over the last few decades. The issue of inequality will likely remain a focus in 2017 given its political and social implications.

Together with economic and political changes, ongoing conflicts will continue to exacerbate hunger and malnutrition in affected regions. Conflict displaced up to 65.3 million people in 2015 alone, and forced displacement has been on the rise since the mid-1990s.[15] It appears unlikely that these figures will drastically diminish in 2017.

URBANIZATION IN THE SPOTLIGHT

Rapid urbanization, particularly in developing countries, is a critical ongoing trend shaping food security and nutrition that will continue in 2017 and beyond (Figure 1). Nearly 90 percent of the projected urban population increase is concentrated in Africa and Asia, with China, India, and Nigeria alone expected to add 900 million urban residents by 2050.[16] How the expansion of urban areas is

FIGURE 1 Growth of urban population in major developing regions



Source: Food and Agriculture Organization of the United Nations, FAOSTAT (2016), www.fao.org/faostat/.

2016 FOOD POLICY TIMELINE

JAN FEB MAR APR MAY JUN JUL

PULSES CELEBRATED GLOBALLY

The UN declares 2016 the "International Year of Pulses" to highlight the nutrition and sustainability benefits of the hearty, high-protein crops.

UN DECLARES DECADE OF ACTION ON NUTRITION

The UN declares a Decade of Action on Nutrition from 2016 to 2025 to support efforts to eliminate hunger and malnutrition and meet Agenda 2030 goals.

WORST DROUGHT IN DECADES IN AFRICA

An unusually strong El Niño causes the worst drought in decades, leaving over 36 million people in southern and eastern Africa facing hunger.

BRITAIN VOTES TO LEAVE THE EUROPEAN UNION

"Brexit" could affect Britain's food security and spending on official development assistance, as well as the global economy and trade.

RECORD NUMBERS OF REFUGEES

UNHCR reports that 65 million people were displaced in 2015, exceeding the 60 million mark for the first time in history.

US GLOBAL FOOD SECURITY ACT SIGNED

The United States passes a law to promote global food security, resilience, and nutrition.

UN ADOPTS COMMITMENT ON REFUGEES

UN General Assembly member states adopt the New York declaration, a set of nonbinding commitments to address the refugee and migrant crisis.

GLOBAL NUTRITION SUMMIT MEETS

On the eve of the Summer Olympic Games in Rio, the Nutrition for Growth summit calls for world leaders to increase investments in nutrition and scale up successful strategies.

HURRICANE HITS HAITI

Hurricane Matthew wipes out large agricultural areas on the island, leaving 1.4 million people in need of food assistance.

NEW URBAN AGENDA ADOPTED

Agenda adopted at Habitat III in Quito, Ecuador, aims to improve how cities are planned, managed, and inhabited to set the world on a course toward sustainable urban development.

AUG SEP OCT NOV DEC

OPEN DATA FOR AGRICULTURE AND NUTRITION

The first-ever GODAN (Global Open Data for Agriculture and Nutrition) Summit launches a data revolution, calling on public and private organizations to open their data on agricultural research.

POSSIBLE MERGERS

Proposed mergers of major seed and agrochemical companies face scrutiny—if approved, 80 percent of the US corn-seed market and 70 percent of the world's pesticide market would be controlled by three companies.

US PRESIDENTIAL ELECTION

President-elect Donald Trump's policies expected to have implications for global development issues including trade, refugees, climate change, and US foreign aid.

COP22 IN MARRAKECH

Marrakech Climate Change Conference (COP 22) marks the Paris Agreement's entry into force.

FOOD SYSTEMS FOR HEALTHY DIETS

International Symposium on Sustainable Food Systems for Healthy Diets and Improved Nutrition focuses on concrete country experiences and challenges shaping food systems to deliver healthy diets.

GLOBAL FOOD POLICY REPORT 2017 SURVEY

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Over **1,300 individuals representing more than 100 countries** responded to the *2017 Global Food Policy Report* survey on perceptions about food policy and food security now and for the future, and on the impacts of urbanization.

FOOD POLICIES

60% are **dissatisfied** with **global food policies**

73% are **dissatisfied** with **food policies in their own countries**

60% are **dissatisfied** with **progress in global food and nutrition security**

66% are **dissatisfied** with **progress in food and nutrition security in their own countries**

HUNGER & UNDERNUTRITION

36% of respondents think global hunger and undernutrition **can** be eliminated by 2025.

8% think global hunger and undernutrition **will** be eliminated by 2025.

46% of respondents think hunger and undernutrition **can** be eliminated by 2025 in their own countries.

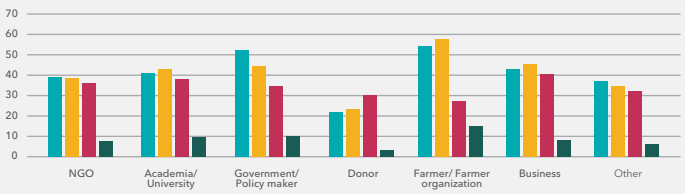
20% think hunger and undernutrition **will** be eliminated by 2025 in their own countries.

URBANIZATION & FOOD SECURITY

73% of respondents think **the expansion of cities and urban populations will make it harder to ensure that everyone gets enough nutritious food to eat.**

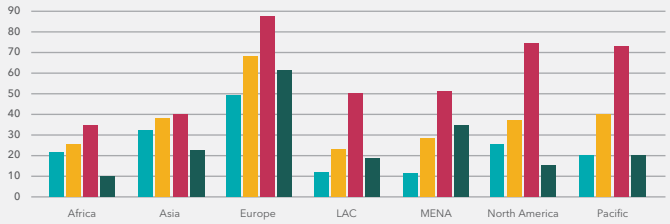
61% of respondents think **policies and investments are supporting development of links that bring food products from rural producers to urban consumers.**

STAKEHOLDER PERSPECTIVES



- Satisfied with global food policies
- Satisfied with progress in global food and nutrition security
- Think hunger and undernutrition **can** be eliminated globally by 2025
- Think hunger and undernutrition **will** be eliminated globally by 2025

REGIONAL PERSPECTIVES



- Satisfied with food policies in their country
- Satisfied with progress in food and nutrition security in their country
- Think hunger and undernutrition **can** be eliminated in their country by 2025
- Think hunger and undernutrition **will** be eliminated in their country by 2025

Source: The survey was conducted online, from January 12–26, 2017.

managed in future years will be critical for ensuring agricultural growth and global food security.

Rapid urbanization and population growth are expected to put growing pressure on the global food system as agricultural production comes under stress from environmental degradation, climate change, extreme weather conditions, and limited virgin lands for expansion. Furthermore, as urbanization has accelerated in some developing countries, so has the triple burden of malnutrition—the coexistence of hunger (insufficient caloric intake to meet dietary energy requirements), undernutrition (prolonged inadequate intake of macro- and micronutrients), and overnutrition in the form of overweight and obesity.[17]

The good news is that the world is paying attention. By building momentum through global initiatives such as the Habitat III summit and the Milan Urban Food Policy Pact, the global development community appears ready to take action.

Difficulty in improving food security and nutrition in both rural and urban areas in developing countries can be traced to weak linkages between agricultural producers, and particularly smallholders, in rural areas and urban consumers. Urbanization can be a boon to rural producers who could more effectively supply urban areas with nutritious foods while benefiting from larger, generally more wealthy urban markets. Chapter 2 discusses how enhancing rural-urban linkages—through improving policy coordination, strengthening value chains, leveraging intermediate cities, making critical investments in non-urban areas, and promoting productive social protection—can help end hunger and malnutrition for rural and urban dwellers.

As urban populations grow, poverty, food insecurity, and malnutrition are increasingly becoming urban problems in all regions of the world. The state of food security and nutrition in the world's growing cities is discussed in Chapter 3. Poor urban dwellers face unique nutritional challenges around accessing nutritious food, adequate employment, social protection, and adequate water, sanitation, and hygiene facilities, all of which affect food security and nutrition. The chapter highlights the need for more data and research to better understand and characterize the challenges and opportunities faced by the urban poor and to guide the design of effective policies and programs to support them.

Urbanization is playing a role in a larger global trend—whereby consumption of coarse grains, staple cereals, and pulses is replaced by increased consumption of animal-source foods, sugar, fats and oils, refined grains, and processed foods. This "nutrition transition" is causing increases in overweight and obesity and diet-related diseases such as diabetes and heart disease. Chapter 4 unpacks the nutrition transition, and considers how to use policy to create an enabling environment for good nutrition.

In many developing countries, a "quiet revolution" is affecting staple food value chains. Increased commercial flows of agricultural goods, diet transformation, and the large role of commercial markets in meeting urban food demand all contribute to these evolving value chains. The growing use of modern inputs, information and communication technologies, and midstream sections of the value chain figure in this transformation. Chapter 5 discusses lessons learned and opportunities for cities to continue to serve as engines of growth for agricultural and food system transformation.

While urbanization is happening almost everywhere, the ongoing process in Africa south of the Sahara comes with unique implications for governance and food security. In particular, large urban poor populations in the region rely heavily on the informal economy for accessible, affordable food. Informal markets find themselves at odds with government interventions that typically focus on control, regulation, and often violent eradication of the urban informal food economy. Chapter 6 discusses the unique institutional, administrative, and political challenges for achieving food security in the region, and offers policy suggestions for a way forward.

The review of Regional Developments in food policy takes a brief look at the particular challenges of urbanization and the food and agricultural economy in each of the developing regions.

Together these chapters provide an overview of what we know about urbanization, food security, and nutrition and point to some of the most urgent research and data needs. They also point to promising policy directions that could begin to strengthen linkages between rural and urban areas and contribute to food security and access to nutritious foods in the world's expanding urban areas. Addressing the needs of growing ranks of urban dwellers and improving the livelihoods of smallholder producers while promoting agricultural productivity will be essential to global food security and nutrition and to moving ahead with the new sustainable development agenda.

CHAPTER 2

SMALLHOLDERS AND URBANIZATION

Strengthening Rural-Urban Linkages to End Hunger and Malnutrition

JOSÉ GRAZIANO DA SILVA AND SHENGGEN FAN

José Graziano da Silva is director-general of the Food and Agriculture Organization of the United Nations, Rome, Italy. **Shenggen Fan** is director general of the International Food Policy Research Institute, Washington, DC, USA.

KEY MESSAGES

- Rural-urban linkages—including physical, economic, social, and political connections—are crucial for ending hunger and malnutrition (SDG 2) sustainably in both rural and urban areas. Rural-urban linkages also support other Sustainable Development Goals.
- Urban growth increases food demand and spurs dietary changes in urban areas—new demand can create opportunities for rural producers to improve their livelihoods.
- Broken value chains and poor coordination weaken rural-urban links and hold back progress on food security and nutrition.
- Investment in rural infrastructure and intermediate towns—quality rural and feeder roads, electricity, storage facilities, communications and information—can build connections and create hubs of economic activity benefiting smallholders and cities.

POLICY AND RESEARCH NEEDS

- What policies and investments can best develop rural-urban linkages that benefit both smallholders and other rural residents and support rural and urban food security and nutrition?
- How can policy coordination between rural and urban areas help create efficient and inclusive value chains and governance of natural resources needed for agricultural production?
- How can small- and medium-sized towns best be leveraged to link rural and urban areas?
- How can public investment best be targeted to develop rural farm and nonfarm sectors and thus reduce rural and urban poverty, increase productivity, and improve resilience?
- What policies and programs on social protection can improve household-level resilience in rural and urban areas?

The world is increasingly urban. Over half the global population lives in cities, and many more will join them: by 2050, 66 percent of the population is projected to live in urban areas. Nearly all of the increase will occur in developing countries, where some of the world's largest cities are already found.

Urbanization is reshaping the landscape within which we must pursue the Sustainable Development Goals (SDGs) of ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture. For both rural and urban areas, rapid urbanization brings profound challenges and opportunities for meeting these goals.

ENHANCED RURAL-URBAN LINKAGES TO ACHIEVE SDGS

Enhancing linkages between rural and urban areas is one of the keys to achieving the SDGs. Rural-urban linkages are the physical, economic, social, and political connections that link the most remote areas to the densest megacities, often through smaller towns and cities in between. These connections allow for flows of goods, people, social relations, information, finance, and waste across space, and also promote links across sectors, such as agriculture, services, and manufacturing.

Strong rural-urban linkages help propel economic development and improvements in food security and nutrition. When linkages are strengthened, farmers sell increasing shares of their produce in urban markets. Laborers commute or migrate to nearby towns for seasonal work, but may keep strong ties with their family networks in rural areas through remittances. Businesses in towns, intermediate cities, and large urban areas benefit from demand for food and nonfood items and from the supply of agricultural raw materials from rural areas.[1] And urban businesses provide technical assistance, credit, and consumer demand information to small-scale farms in rural areas (Figure 1). However, where links between rural and urban spaces are broken or weak, both rural and urban areas suffer.

While the majority of the world's poor and hungry currently live in rural spaces, hundreds of millions of poor and hungry people live in cities. With

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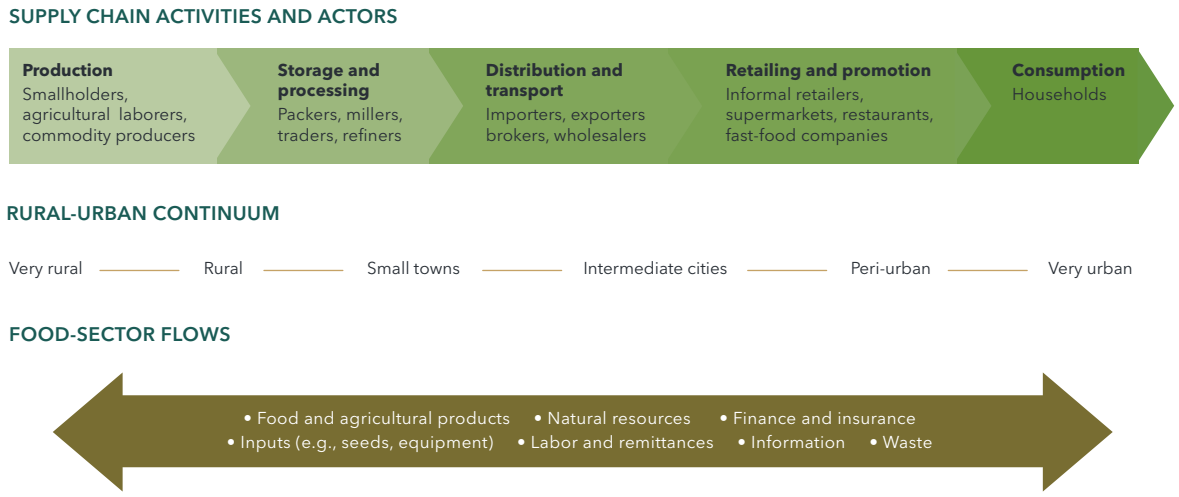
FIGURE 1 Food from small farms to big cities



Source: Adapted from J. von Braun, "Rural-Urban Linkages for Growth, Employment, and Poverty Reduction," presented at the Fifth International Conference on the Ethiopian Economy, Ethiopian Economics Association, Addis Ababa, June 7–9, 2007.

accelerating urbanization, particularly in low-income countries, these numbers may increase if left unaddressed. At the same time, changing dietary and lifestyle patterns associated with income growth and urbanization lead to malnutrition in the form of overweight and obesity.[2] In rapidly urbanizing developing countries, multiple burdens of malnutrition—overweight and obesity alongside persistent hunger and undernutrition—are becoming increasingly prevalent.[3]

Urbanization is transforming rural landscapes. Rising urban demand for more and better food can provide opportunities to increase and diversify food production in rural areas, thus improving farmers' livelihoods.[4] However, rapid urbanization can also add stress to agricultural systems through resource allocation away from agriculture, environmental degradation, migration of young farmers, and other challenges.[5] For these reasons, urbanization has major implications for food policy and needs greater attention from policy makers, practitioners, and researchers.

Enhancing rural-urban linkages will be critical for making food systems more effective and inclusive. Doing so would also contribute to achieving multiple SDGs—especially ending poverty, hunger, and all forms of malnutrition (Table 1).[6] The New Urban Agenda, agreed on by UN member states at the 2016 Habitat III conference in Quito, Ecuador, provides a framework for addressing the challenges of urbanization while contributing to the eradication of hunger and malnutrition and achieving other SDGs. This will not be possible, however, if we focus strictly on urban areas. It will require harnessing the synergies between rural and urban spaces through strong physical, political, and market linkages.

WEAK LINKS BETWEEN RURAL AND URBAN AREAS

Urbanization poses challenges to sustainably achieving food security and nutrition. Weak rural-urban linkages and unsustainable use of natural resources exacerbate these challenges, and can hold back progress.

BROKEN VALUE CHAINS

Food value chains encompass all actors and activities involved in the food supply chain, and include inputs and production, storage, processing, distribution, transport, retail, and consumption.[7] For example, value chains can bring food produced by rural smallholders to urban consumers and inputs produced in cities or towns to smallholders. However, weak links along the value chain may disrupt this flow. A lack of inputs—such as seeds and fertilizers—or physical and financial impediments to accessing inputs faced by smallholders can weaken the value chain upstream. A lack of processing, milling, cold

TABLE 1 How strengthening rural-urban linkages can help to achieve improved food systems and multiple SDGs

Activities for enhancing rural-urban linkages	Benefits to food systems and residents in		SDGs supported*											
	Rural areas	Urban areas	1	2	3	8	9	10	11	12	13	15	16	17
Investing in rural feeder roads and cooled transportation[1]	Connects smallholders to input and output markets, generates employment, improves incomes and value-added, and diversifies food production and diets	Improves availability and accessibility of staples, high-value foods, and other agricultural products, and generates non-farm employment and incomes	●	●	●	●								
Establishing processing centers and storage facilities[2]	Increases value-added of agricultural products and incomes, spurs employment, and reduces food losses	Improves availability of diverse foods and increases incomes	●	●		●	●		●		●	●		
Using information and communications technologies (such as mobile phones) to link farmers to processors, retailers, and consumers[3]	Improves market participation, incomes, and livelihoods of smallholders	Improves availability of diverse foods	●	●			●	●						
Facilitating in-country movement of people while providing assistance to people who move to cities[4]	Allows rural workers to mitigate income risk through migrant work and remittances, improving income and livelihoods	Improves food security and nutrition through social safety nets and rural-to-urban food and cash transfers	●	●		●		●					●	
Improving coordination and planning between rural and urban areas, especially as related to food and agriculture[5]	Opens labor opportunities and markets for smallholders	Helps manage land use and reduces food insecurity and malnutrition	●	●	●	●	●	●	●	●	●	●		●
Leveraging small- and medium-sized cities as key nodes to link smallholders to big cities[6]	Allows for growth in scale of markets (such as processing, cold storage) and improves access to input, output, and credit markets and can dynamize employment generation	Increases food access, consistency, and quality and dynamizes employment generation	●	●	●	●	●							

*SDGs supported by enhancing rural urban linkages

storage, and transportation can sever value chains midstream. Poor transportation infrastructure can make it too costly for smallholders to sell their produce downstream to urban consumers and can contribute to greater food losses and waste. Strong value chains are important for improving livelihoods, food security, and nutrition.[8]

Weak links in the rice value chain in Nigeria provide an example. Rice has become one of Nigeria's most-consumed staples, and the country has made boosting rice production a priority.[9] Yet 60 percent of rice purchased in urban areas is imported because of consumer concerns about locally produced rice. These concerns include inconsistencies in quality, labeling, and taste—problems that arise from poor vertical integration in the domestic rice value chain.[10] For rice, postharvest processing (milling, parboiling, and cleaning) and marketing (weighing, bagging, and branding) play key roles. Yet with a highly fragmented domestic value chain, the many small- and medium-sized rice millers that process 80 percent of Nigerian rice have varied skills and degrees of access to services and information, and little scope for upgrading varieties or technologies.

The result is wide variation in the quality of the final product in Nigeria, including unfavorable properties such as discoloration and the presence of stones. Lack of traceability along the value chain leads to inconsistencies between variety names and the final product, preventing a link between production and consumer preferences. That consumers prefer the quality, taste, and texture of imported rice over domestic rice—in large part due to the broken rice value chain—is not surprising.

POOR COORDINATION ACROSS LOCALES

Although rural and urban areas are interdependent, they are often governed by distinct local entities. When faced with problems of achieving food security and nutrition for their constituents, policy makers may look for solutions solely within their own locales, without recognizing the potential of rural-urban linkages. For example, urban policy makers often turn to urban agriculture to address food insecurity, despite little evidence that urban agriculture alone can substantially reduce urban food insecurity or malnutrition.[11] Rural policy makers may not consider how rural households benefit from connections to urban areas as a means of diversifying income sources, such as the potential of remittances from seasonal or permanent migrants to urban areas.[12]

Lack of shared governance of natural resources tends to weaken links between rural and urban areas. With existing predominant production methods, rising food demand will increase pressures on natural resources and the environment. These pressures will be exacerbated by shifts in land use for livestock production (including in peri-urban areas) that are associated with changing dietary patterns.[13] Lack of land use planning and proper regulation of land tenure will also affect development of urban and peri-urban agriculture. Urban sprawl will affect food security and natural resource availability in places where it causes significant loss of productive peri-urban agricultural land and contributes to degradation of environmental resources.[14] The expected increases in the urban population in the developing world will be accompanied by a tripling in the built-up area of cities—from 200,000 to 600,000 square kilometers between 2000 and 2030.[15] The way in which cities are built up will have major implications for establishing connectivity and securing adequate rural-urban linkages.

A lack of shared governance of food security and nutrition and shared management of natural resources may arise from misperceptions about rural and urban areas. Urban food insecurity and malnutrition have been overlooked in low- and middle-income countries—hunger and malnutrition have typically been considered rural problems.[16] On the other hand, a disproportionate focus on urban areas can bring about an "urban bias" against agriculture and the rural economy in the allocation of development resources and prioritization of policies to address poverty.[17]

LACK OF INVESTMENT IN RURAL AND NON-URBAN INFRASTRUCTURE

Rural infrastructure, including quality rural and feeder roads, electricity, and storage facilities, is essential for pro-poor growth, agricultural development, and improved livelihoods.[18] Inadequate rural infrastructure leads to isolation of communities and is significantly associated with poverty and poor nutrition.[19] Weak transport infrastructure is a major constraint in many countries in Africa south of the Sahara, despite the potential for rural roads to pave the way for other investments that can improve

nutrition—such as schools, health services, and security services.[20] Lack of paved roads and electricity also contributes to postharvest food losses along the value chain.[21]

The Democratic Republic of the Congo (DRC) illustrates the importance of infrastructure for economic and agricultural development. The economic potential of agriculture in the DRC is handicapped by dilapidated transport systems.[22] Access to markets there is among the weakest in Africa. Poor market access raises costs and reduces the scope for profitable trade and on-farm investments. Long travel times related to poor infrastructure contribute substantially to Congolese poverty. Investment in infrastructure is clearly needed, but it is important to note that the type of infrastructure matters. Research suggests that city access combined with access to ports is more beneficial than city access alone.[23]

Investments along the continuum between rural and urban—in small towns and medium-sized cities that constitute the hidden (and sometimes nonexistent) geographic middle—can play a key role. Rural townships and medium-sized cities can serve as important intermediary points to connect hinterlands to urban centers while providing social and economic benefits.[24] They can act as service delivery nodes for rural areas and link the rural economy to markets, thereby reducing transaction and transportation costs. Towns and intermediate cities can also foster nonfarm rural growth, affording smallholders access to employment in agroprocessing or other commercial or industrial activities.

UNDESIRABLE CHANGES IN FOOD CONSUMPTION PATTERNS

Urbanization and higher urban incomes are associated with a broad dietary transition marked by increased demand for animal-sourced food, fats and oils, refined grains, and fruits and vegetables. Production of these foods is more intensive in the use of land, water, inputs, and energy, tends to generate more greenhouse gas emissions, and increases pressures on natural resources. Consumers with higher urban wages and urban lifestyles also tend to favor processed and prepared food products, such as fast food, store-bought convenience foods, and foods prepared and marketed by street vendors. With these changes, the nutrient content of diets is changing. Typically, diets are becoming more energy-dense and are characterized by higher intake of salt, fats and oils, and sugar, a pattern that leads to an increase in overweight and obesity as well as diet-related diseases.[25]

Despite these trends, strong rural-urban linkages can help to achieve food security and improved nutrition in the context of rapid urbanization. They can reduce the price of healthy foods, such as fresh fruit and vegetables, in urban markets through improved transport or storage.[26] This can contribute to a healthier diet in urban populations, particularly for the poor, who are often limited to cheaper, unhealthy, and less nutritious diet options. Greater affordability and availability of healthy food options can also help address the challenge of rising obesity in rapidly urbanizing areas. The existence and quality of these linkages, as well as the extent to which they are inclusive of poor and vulnerable populations, are key for all rural and urban residents to benefit from rapid urbanization.

DO EXPERIENCES SO FAR PROVIDE INSIGHTS FOR PROGRESS?

Three case studies illustrate how enhanced rural-urban linkages can play a critical role in helping countries improve food security and nutrition.

CASE 1: IMPROVED INFRASTRUCTURE IN THE RED RIVER DELTA IN VIET NAM

Rising food demand and dietary shifts resulting from rapid urbanization provide well-linked rural producers with opportunities to enhance their livelihoods and contribute to better diets in both rural and urban areas. In Nhat, an agricultural village in the Red River Delta in Viet Nam, strong rural-urban linkages—an improved road and transport system, good communications infrastructure, and strong connections to agricultural service suppliers—spurred agricultural intensification and diversification.[27] With increased access to nearby urban markets and export markets, farm households successfully diversified agricultural activities beyond subsistence rice production toward intensive, high-value production of fruits and vegetables.[28] The growth of high-value agricultural production was boosted by income diversification in most households from nonfarm employment sources, such as handicrafts, trade and services, and wage labor. The returns from these nonfarm activities in large part allowed for investments in

farm expansion, thus helping to reduce poverty and improve food security and nutrition.

CASE 2: THE ROLE OF SMALL- AND MEDIUM-SIZED TOWNS AND CITIES IN ETHIOPIA

Small- and medium-sized towns and cities can act as economic hubs that create strong synergistic and mutually beneficial links between the farm sector in rural areas and the nonfarm sector in large urban centers.[29] Isolation of rural areas or absence of transport infrastructure connecting rural areas to nearby towns and intermediate cities has been shown to negatively affect agricultural productivity and nutrition.[30]

A major element in Ethiopia's urban development policy was development of small towns as key entry points. The country's Plan for Accelerated and Sustained Development to End Poverty for (2005–2009) prioritized improvement of rural access roads, telecommunications access, and market infrastructure as central components of its strategy to maximize synergistic growth and opportunities for towns and surrounding rural areas.[31]

Empirical findings from Ethiopia point to the importance of local market towns.[32] These urban centers account for about 50 percent of agricultural input purchases and up to 75 percent of agricultural produce sales. Over half of household food and nonfood spending and the bulk of artisanal product sales, especially by women, occur in these towns. Additionally, proximity to local market towns influences rural economic activities, and better access to these towns, for example through improved roads, had positive impacts on household welfare.

CASE 3: GLOBAL VALUE CHAIN DEVELOPMENT AND URBAN GROWTH IN GHANA

Growing demand for higher value-added food, processed through integrated global value chains, is fueling Ghana's process of accelerated urbanization and structural transformation. For instance, cocoa production increasingly contributed to average farm incomes over the last two decades. Expansion of cocoa production, processing, and trade from the traditional areas in the eastern coastal region to the western parts of Ghana increased revenue. The expanding cocoa business also stimulated urban economic activity, especially through increased trade and business services and greater demand for consumer goods and services. This expansion gave rise to what have been labeled "consumption cities"—where wealth created in non-urban sectors is spent in urban sectors—as seen elsewhere in Africa.[33]

This structural transformation occurred in only some parts of the country. The more isolated north still lags behind, largely as a result of poor infrastructure and social services, low education and agribusiness skills development, and lack of access to technology.[34] These factors hamper value chain development and keep rural-urban linkages weak in northern Ghana.

IMPROVING RURAL-URBAN LINKAGES

As the world continues to urbanize, achieving food security and nutrition for all depends on interventions and approaches that build, strengthen, or transform rural-urban linkages.

IMPROVE POLICY COORDINATION BETWEEN RURAL AND URBAN AREAS

Working together effectively across rural, peri-urban, and urban spaces—typically governed by different local entities—requires policy coordination. Policies that cut across rural and urban areas should account for each area's contribution in order to leverage their different strengths. Urban policy makers should look beyond urban agriculture to meet their food security and nutrition needs, and coordinate with their rural counterparts to facilitate the flow of agricultural products into cities. Rural policy makers should recognize the opportunities provided by urbanization and promote market opportunities for smallholders, traders, processors, and other actors in the food value chain.

Political entities should work together to enhance linkages that span politically distinct locales as a means to facilitate sustainable production, storage, transport, and marketing of safe and nutritious food to urban consumers while reducing food loss and waste. Establishing policy coordination in planning and regulating the use of land, water, and other resources critical to food production in urban, peri-urban, and rural areas is also important for efficiency and win-win outcomes. Doing so is not easy, as pointed out by a recent review of territorial approaches to the governance of food security and nutrition.[35] In addition to political

will, effective allocation of financial resources and decision-making power are required to secure better horizontal and vertical coordination across central and local governments and policy domains.

Rural-urban partnerships have the potential to create effective frameworks for cooperation and joint governance.[36] But such partnerships are a new approach, and other governance models for policy coordination should also be explored. The development community should continue to support the implementation plan for the New Urban Agenda, which commits to enhancing coordination of urban and rural development strategies and programs.

SUPPORT EFFICIENT AND INCLUSIVE RURAL-URBAN VALUE CHAINS

Increasing demand for food and increasing scarcity of land near urban areas can lengthen food value chains. Moreover, changing consumption patterns can shift employment within the food system from agriculture to midstream segments such as transport, wholesaling, retailing, food processing, and vending. All this has implications for the burgeoning youth population that will increasingly seek employment, especially in Africa south of the Sahara.[37]

To take advantage of these changes, support should be provided to make rural-urban value chains more efficient and inclusive and to improve vertical coordination. For example, vertical cooperatives—such as the coffee unions of Ethiopia that provide marketing and input-supply services and connect producers to export markets—improve vertical coordination. Establishing mechanisms such as commodity exchanges and warehouse receipts should be considered, though strategies to mitigate the costs of the necessary services for a commodity exchange—warehousing, operations, and communications—as well as potential barriers to adoption by smallholders, such as high minimum deposit quantities, require more study.[38]

LEVERAGE TOWNS AND INTERMEDIATE CITIES

Strategies to better connect rural and urban areas should address the specific challenges facing those living in different places along the rural-urban continuum. Each area has a role to play in addressing rapid urbanization and finding synergies to strengthen food systems. Rural townships and medium-sized cities can facilitate economic and social connections between rural and urban areas.[39] Decentralization can play a key role in allowing local governments and other local actors to identify needs and priorities and to respond appropriately.[40] Local decision making should be supported by adequate resources, and local development strategies should be well-integrated in national planning. Some areas—including isolated regions, mountainous areas, degraded environments, and indigenous settlements—may require greater attention and tailored strategies and policies to link them to urban areas.

IMPROVE TARGETING OF PUBLIC INVESTMENT

Investing to develop rural areas—for both farm and nonfarm sectors—can strengthen rural economies and reduce poverty in rural and urban areas. Investments in rural physical infrastructure (such as feeder roads, electricity, transportation, communications, and cold storage) as well as in education and health are crucial for small farms to increase incomes and for rural residents to access rural nonfarm jobs. Along with investments in information and communications infrastructure, investments should be made in providing producers with reliable agronomic information, including prices and information on production technologies.[41] For urban dwellers, the impact of rural investment extends to reducing urban poverty through growth in the national economy and reduced food prices.[42] Investments in rural areas and less-favored areas can provide win-win outcomes for both the rural and urban poor.

Investments in rural infrastructure will also enhance resilience at the household level. For farmers and those working further down the food value chain, investments in cold storage, transportation, and energy infrastructure for processing help smooth income shocks from seasonality, market volatility, and weather variability.

MITIGATE RISKS BY PROMOTING SOCIAL PROTECTION IN RURAL AND URBAN AREAS

Rapid urbanization can bring about economic and social dislocations that leave some people behind. Social protection measures for both rural and urban contexts can ease these risks by reducing social and economic inequalities, promoting decent work, and fostering inclusive and sustainable growth.

Well-targeted, productive safety nets can help recipients mitigate risk while building productive assets.[43] In particular, policies to help rural small-scale farmers increase productivity and move up to commercially oriented systems or to participate in nonfarm economic activities are important. Integrating nutrition education into social safety net programs can boost nutritional outcomes.[44] Brazil's flagship program, Bolsa Família, which was focused on poverty reduction and food security, used cash transfers to promote improved education and healthcare for beneficiaries. Bolsa Família successfully incorporated education and health components through integration with other social programs and policies for food security and nutrition.[45] The program contributed substantially to decreases in childhood mortality, and in particular lowered deaths attributable to malnutrition.

Remittances from migrant workers can increase incomes of rural residents, diversify incomes, and provide investment capital for the rural nonfarm economy and small towns.[46] To help realize the potential of remittances, formal and informal institutional and policy barriers that restrict in-country movement of people should be removed. Key barriers include poor infrastructure and lack of education and access to information.

STRENGTHENING LINKS FOR WIN-WIN OUTCOMES

Rapid urbanization brings new challenges for achieving food security and nutrition for all: it increases pressure on the food system to produce resource-intensive foods and can contribute to undernutrition through a lack of access to crucial water, sanitation, and hygiene services. At the same time, urban lifestyles and dietary preferences are associated with increased prevalence of overweight and obesity and diet-related disease. Developing rural-urban linkages can help to address those challenges while promoting the benefits of rapid urbanization for food security and nutrition. These include more diverse diets and greater income for rural residents, greater food access and availability for urban residents, and greater national economic growth.

To strengthen rural-urban linkages, policy coordination between rural and urban spaces must be improved; food value chains strengthened with due attention to the role of small towns and intermediate cities; rural infrastructure investments better targeted; and productive social safety nets promoted. Taking these steps is crucial to help end hunger and malnutrition, and to achieve multiple SDGs in a time of rapid urbanization.

"Urbanization is reshaping the landscape within which we must pursue the Sustainable Development Goals of ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture."

CHAPTER 3

FOOD SECURITY AND NUTRITION

Growing Cities, New Challenges

MARIE RUEL, JAMES GARRETT, AND SIVAN YOSEF

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KEY MESSAGES

- Poverty, food insecurity, and malnutrition become increasingly urban problems as urban populations expand everywhere.
- Persistent child undernutrition, stubborn micronutrient deficiencies, and an alarming rise in overweight and obesity in urban areas mark the shift of the burden of malnutrition from rural areas to cities:
  - One in three stunted children now lives in an urban area.
  - Rapid increases in overweight and obesity have been concentrated in urban areas.
- The urban poor face a challenging food environment.
  - Food security in the city depends on access to cash. Extremely poor urban households in many developing countries spend more than 50 percent of their budget on food.
  - Dependence on purchased food and employment in the informal sector—especially for women—leave the urban poor vulnerable to income and food price shocks.
  - Formal and informal safety nets often fail to protect the poorest of the urban poor.
  - Limited access to healthcare, safe water, and sanitation in cities leads to severe health and nutrition inequalities for the urban poor—especially slum dwellers.

POLICY AND RESEARCH NEEDS

- What is the extent of poverty, food insecurity, and malnutrition in urban areas?
- What is the quality of urban diets, what are the nutrient gaps, and what are the dietary patterns that increase health risks?
- What are the effects of the urban food environment on food access and food choices?
- How can we best tailor programs and policies to support the urban poor in tackling the distinct challenges of urban life?

For the first time in history, more than half of the world's population lives in urban areas.[1] By 2050, two-thirds of the world's population is projected to be urbanized, as 2.5 billion additional people are born in or migrate to urban areas.[2] Africa and Asia, which currently have 40 percent and 47 percent, respectively, of their populations living in urban areas, are expected to account for 90 percent of this growth.[3] Just three countries—China, India, and Nigeria—are projected to add 900 million urban residents by 2050.[4] In North America, Europe, and Latin America and the Caribbean, between 73 and 82 percent of the population currently lives in urban centers, but urbanization in these regions is expected to slow or stagnate between now and 2050. Globally, the growth of cities, large and small, and peri-urban areas is creating a new set of challenges and opportunities for addressing poverty, food security, and nutrition.

POVERTY, FOOD INSECURITY, AND MALNUTRITION MOVE TO THE CITY

Poverty, food insecurity, and malnutrition are moving to the cities, as the world's population becomes more urbanized. Between 1993 and 2002, the global rate of poverty—those living on less than a dollar a day—declined from 28 to 22 percent, largely reflecting a drop in rural poverty rates in developing countries from 37 to 30 percent. Urban poverty remained unchanged at approximately 13 percent. During the same period, the *absolute number* of poor people residing in urban areas rose by 50 million (from 242 to 292 million), while the number of rural poor declined by 148 million (from 1,031 to 890 million).[5] As a result, the urban share of the poor in developing countries rose from 19 to 25 percent in one decade.[6] By 2020, up to 85 percent of the poor in Latin America are expected to live in towns and cities, as will close to half (45 percent) of the poor in Africa and Asia.[7]

The Multidimensional Poverty Index, another measure of poverty, includes 10 indicators reflecting three dimensions of poverty (health, education, and standard of living) for 105 countries.[8] This index estimates the urban share of poverty as ranging from

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38 percent in Europe and Central Asia, to roughly 30 percent in Latin America and East Asia and the Pacific, to 16 percent in South Asia, and 14 percent in Africa south of the Sahara.[9] Using the same index for a smaller set of countries, the annual rate of decline in poverty is also faster in rural compared to urban areas (1.3 percentage points versus 1 percentage point).

Food insecurity and malnutrition are likely to follow these trends, given their close links with poverty. A study of 12 African countries found that in all but one, at least 40 percent of the urban population was energy deficient (lacking in calories), with the prevalence of hunger reaching nearly 90 percent in urban Ethiopia.[10] Another study of countries in Africa, Asia, and Latin America found that the urban incidence of hunger equaled or exceeded rural levels in 12 of the 18 countries studied.[11]

Childhood undernutrition reflected in stunting (low height-for-age) has declined rapidly in the developing world, with the number of stunted children dropping from 239 million in 1985 to 163 million in 2011.[12] The bulk of this decline occurred in rural areas, not urban ones.[13] Like poverty, stunting has moved to the cities: the proportion of stunted children living in urban areas rose from 23 to 31 percent—meaning that approximately one in three stunted children now lives in an urban area. Although, on average, child undernutrition is still less common in urban than in rural areas, undernutrition among poor urban children often rivals the levels found among the rural poor.[14] Deficiencies of essential minerals and vitamins such as iron, zinc, iodine, and vitamin A also persist globally and are estimated to affect half of all preschool children and 2 billion people worldwide. No global estimates are available for urban and rural areas, and country-specific studies are far from conclusive.[15] In China, deficiencies of micronutrients such as vitamin A, vitamin B12, iron, and zinc were higher among rural compared to urban children.[16] In Venezuela, adolescents living in rural areas had higher rates of anemia and iron deficiency than those living in urban areas.[17]

Overweight and obesity at the global level have also risen rapidly in both children and adults. Among children, the number of overweight rose by more than 50 percent in 20 years (1990–2011).[18] Overweight in children is most prevalent in high-income countries, but by 2011 as many as 32 million overweight children lived in low- and middle-income countries. The prevalence of overweight in children is often, although not always, higher in urban than in rural areas. A comparison of low- and middle-income countries found a higher prevalence of overweight in rural compared to urban areas in 25 of the 80 countries studied.[19] Among adults, the global rise in overweight and obesity since 1975 has been dramatic—more than doubling in women and more than tripling in men. The increase accelerated in the past decade, and was more concentrated in urban than in rural areas.[20] In a study of 38 countries, mean body mass index and the prevalence of overweight was higher among urban than rural women in most countries in both time periods studied (1991–2004 and 1998–2010).[21] The rise of overweight and obesity in urban areas and its health impacts are described in greater detail in Chapter 4.

Overall, persistent child undernutrition, combined with the stubborn problem of micronutrient deficiencies and the alarmingly rapid rise in overweight and obesity, signals a shift toward a greater overall burden of malnutrition (in all its forms) in urban compared to rural areas.[22] This transfer of poverty, food insecurity, and malnutrition to urban areas demands a new understanding of the drivers of these problems and of the policies, programs, and interventions needed to tackle them. In the following pages, we review the unique features and conditions found in urban areas that shape food security and nutrition, and highlight the opportunities and challenges created by urbanization, especially for the poorest segments of the population. We conclude with recommendations for immediate program and policy actions to help urban residents achieve food security and good nutrition, as well as recommendations for intensifying research efforts.

A DIVERSE AND PLENTIFUL FOOD SUPPLY

Urban food supplies are strikingly diverse. Urban residents enjoy a greater variety of foods and food sources (such as supermarkets, convenience stores, restaurants, and street foods) than their rural counterparts. Infrastructure and population densities in urban centers facilitate distribution, transportation, and technology use, allowing suppliers to reach more consumers at lower cost and encouraging the rapid spread of information.[23] Greater

availability of electricity and often higher incomes allow urban households and businesses to use refrigeration to store foods, and therefore shop less often, particularly for perishable foods such as produce, dairy, and meat products. With more women engaged in the labor force in urban areas, demand for convenience in buying and preparing food is increasing.[24] Technologies provide a range of convenient processed goods, including canned and frozen items, snacks, and prepared meals, as well as ultra-processed foods with extended shelf-life.[25]

Supermarkets have expanded rapidly in many developing countries, especially in urban areas of emerging economies. By the mid-2000s, supermarkets controlled 30 to 50 percent of the food market in Southeast Asia, Central America, and Argentina, Chile, and Mexico.[26] Supermarkets can offer a wide range of fresh produce, dairy products, animal-source foods, and a host of processed foods.[27] Also available to urban citizens are more traditional food outlets, such as local grocery stores, fruit and vegetable markets, and street vendors. These still account for a large proportion of food purchases, especially in Africa and Asia and most especially for the urban poor.[28] (Governance of informal food markets to support poor urban consumers and small producers in Africa is discussed in detail in Chapter 6.) As of the mid-2000s, supermarkets in Africa south of the Sahara still accounted for less than 5 percent of urban food expenditures, and they are expected to remain a minority food supplier in the future, especially for the urban poor.[29] In Zambia and Kenya, for example, supermarkets still cater primarily to households in the top 20 percent of income distribution.[30] Urban food retail systems are thus two-pronged, comprising modern retailers, which control a large share of the nonstaple and processed food markets, and traditional retailers, which dominate sales of fruits, vegetables, and usually meat.[31]

Street foods are also available in many cities, and can provide a low-cost, convenient, and attractive source of ready-made food for urban residents, especially among smaller and poorer urban families.[32] Street foods can make up a significant part of the diet of select groups; in Nairobi, Kenya, for example, 51 percent of men in one low-income neighborhood and 72 percent in another regularly purchased street food for lunch, which contributed 23 and 70 percent of their daily energy intake, respectively.[33] In Nigeria, adolescents obtain 40 to 70 percent of their food from street vendors, supplying 20 to 30 percent of their daily energy intake.[34]

On a more negative note, mass media and marketing have greater presence in urban areas, influencing consumers' tastes and preferences, often toward energy-dense and micronutrient-poor processed foods and low-quality diets.[35] Foreign direct investment has contributed to the rise of fast-food restaurants and to the processing and marketing of global junk food brands in developing countries.[36]

Urban agriculture—growing crops or raising livestock in urban or peri-urban areas—can offer another source of food as well as employment and income for urban dwellers. A recent analysis of 15 developing and transitional countries shows enormous variation in the share of urban households that participate in agriculture, ranging from 11 percent in Indonesia to 70 percent in Nicaragua and Viet Nam.[37] Still, urban agriculture accounts for only 5 to 15 percent of total agricultural production in the studied countries, and most households consume the food they produce rather than sell it. Although the contribution of urban agriculture to income is generally low (less than 10 percent in 10 of the 15 countries), urban farming is linked with improved dietary diversity in two-thirds of the countries. But despite its demonstrated benefits, the contribution of urban agriculture may be limited by production and legal constraints related to the availability of key inputs such as water, safe handling of agrochemicals, and disposal of animal or crop waste.

HEALTHY DIETS ARE BEYOND REACH FOR THE URBAN POOR

While the food environment in urban areas offers tremendous diversity and opportunities for consumers, the urban poor face a set of challenges that may jeopardize their access to high-quality, diverse, safe, and affordable diets and increase their risk of poor health and nutrition. Urban dwellers are more likely to meet their protein and energy requirements than rural dwellers. But urban consumers, especially as their incomes increase, are also more likely to consume imbalanced diets heavy on processed foods, too high in calories, saturated fats, refined sugars, and salt, and low in fiber.[38] In addition, although urban residents tend to consume more fruits and vegetables, urban diets can remain low in

micronutrients such as iron, zinc, and vitamin A. In urban areas of Benin, Kenya, and Mali, for example, women were found to have inadequate intake of several vitamins and minerals.[39] Micronutrient-fortified processed foods such as cereals, oils, bouillon cubes, milk, and noodles are more easily available in urban areas, but high prices for these products may be prohibitive for the poor.[40]

Poor diets among city residents result from a combination of forces. These include food-environment factors such as the availability and aggressive marketing of energy-rich and nutrient-poor processed foods and fast-food outlets; changes in food habits and demand that come with higher incomes; changes in types of employment, particularly for women, which increase demand for convenience and ready-to-eat foods and meals; and changing norms and attitudes toward foods associated with urban living, such as pressures to move away from traditional diets. Chapter 4 further investigates the causes and implications of this dietary transition. Together with more sedentary lifestyles, these factors put the population at increased risk of overweight and obesity and related noncommunicable diseases. An additional concern is the food-safety risk associated with eating out, specifically with street foods.[41]

NAVIGATING THE URBAN CASH ECONOMY

The urban economy is cash-based. Urban households generally purchase most of their food, making employment and a stable income vital for food access. For the poor, food often accounts for a large share of total expenditure, especially in urban areas. Their livelihoods and food security depend heavily on informal-sector employment, including women's employment, on formal and informal safety nets, and on coping mechanisms for dealing with income or food price shocks.

THE CHALLENGES OF RELYING ON INFORMAL JOBS

Although urban areas can offer a wide range of employment possibilities for men and women, for the less-educated and less-skilled, employment is often in the informal sector. Most urbanites work in sectors such as petty trade, construction, or manufacturing, where wages are low and jobs are formidably insecure.[42] Across developing countries, employment in the informal sector accounts for more than 50 percent of all nonagricultural employment.[43] In India, for example, 78 percent of the workforce is employed in the informal sector (excluding agriculture), which is mostly based in urban and semi-urban areas.[44] Women are more likely to be self-employed in the informal economy, and in Africa south of the Sahara, women outnumber men in the informal economy as a whole.[45] Although informal jobs and self-employment may help to diversify income and provide more flexibility in terms of hours worked (which may be particularly useful for women with children), formal-sector employment is generally a more stable and consistent source of income. However, formal employment is less accessible for the poorer and less-educated segments of the population.

For women, working outside the home may require trade-offs related to the cost or quality of childcare. Although it is often assumed that urban women are more likely to work outside the home, empirical evidence shows no difference between urban and rural women, except in Latin America. When they work, however, urban women are less likely than rural women to take their children to their place of work, perhaps because their workplaces—such as markets, offices, factories, and private homes—are less suitable for children. They are also more likely to use hired help or institutional care for their children than rural women.[46] Whether this puts their children at an advantage or a disadvantage depends on the nature, stability, and remuneration of the job, as well as the quality of childcare substitutes used. The few studies on the topic have found little evidence that maternal employment affects child feeding, psychosocial care, health-seeking practices, child health, or nutritional status in low- and middle-income countries.[47] This may reflect the fact that working mothers use adaptive strategies to balance their dual role as income earner and childcare giver—for example, stopping work around the perinatal period (even if unpaid), working fewer hours, or taking their young child along to their workplace. These adaptive strategies may reduce the negative effects of employment on childcare and well-being. But they may also jeopardize the mother's ability to generate the income needed to sustain her household's well-being and food security, especially if she is the sole income earner.

INCOMES AND FOOD PRICES SHAPE ACCESS TO FOOD

Incomes and food prices play a critical role in food access, given that most food consumed in urban areas is purchased. Extremely poor urban households in 20 low- and middle-income countries were found, on average, to spend more than 50 percent of their budget on food. Food budget shares ranged from 48 percent in Guatemala to 74 percent in Tajikistan.[48] Budget shares for urban dwellers' spending on food appear to be consistently lower than those for rural dwellers, even at the same level of nominal income. This may be due to relatively greater expenditures on other essential items in urban areas, such as transport and rent. Economic factors, along with the influences of marketing and related tastes and preferences, are key drivers of city residents' choices regarding where to eat (at home or away from home) and what to eat (home-prepared food, street food, or fast food).[49]

Dependence on purchased food also means that the urban poor are vulnerable to income and food price shocks. For a household, the impact of a food price shock depends on a number of factors, including whether the household is a net food buyer, and whether it is able to cope by shifting from internationally traded staples to less expensive, less traded goods such as roots and tubers, or if it has land that can be used to grow crops.[50] The urban poor are disadvantaged on most of these counts: 97 percent of urban households are net food buyers, the majority spend a large proportion of their income on traded staples,[51] and most do not have access to land for agricultural production. Nevertheless, analyses of the recent food price crisis suggest that contrary to expectations, poverty—rather than urban or rural location—determined who was most affected.[52] No evidence was found of an urban disadvantage, with the poorest populations in both urban and rural areas suffering the most from food price increases.[53]

SAFETY NETS ARE LESS ACCESSIBLE TO THE URBAN POOR

For urban dwellers, formal safety nets are not as widely accessible as often perceived. A 2014 survey of more than 100 countries challenged assumptions about access to formal safety nets, showing that on average, only 21 percent of urban compared to 28 percent of rural dwellers are covered by social safety nets.[54] This rural-urban difference may reflect effective targeting—globally, the majority of the poor still reside in rural areas. It may also reflect the challenges of targeting programs to the urban poor, many of whom live transient lives, either moving frequently or migrating. A recent review of urban social safety net programs in low- and middle-income countries emphasizes the need for an "urban adaptation" of successful rural models and a greater emphasis on evidence generation and learning to provide the urban poor with better-tailored and more effective income and livelihood support.[55]

Informal safety nets, such as immediate and extended family members, trusted friends, and community or neighborhood networks built on social trust, cooperation, and reciprocity, are another possible source of support in times of hardship. Although data are unavailable to document the nature and strength of informal safety nets in urban areas, they may be less sturdy than in rural areas because of weaker identification with the community (especially when residence is temporary); higher levels of violence in urban areas, which can diminish the trust necessary for nonfamily collective action; and the fact that family members may live apart from one another, reducing the ability to undertake activities that do not rely on immediate reciprocity.[56] These limited possibilities for external help in times of trouble, when combined with the need to use cash for food, contribute to substantial insecurity and uncertainty for the livelihoods and food security of the urban poor.

ENVIRONMENTAL HAZARDS THREATEN HEALTH AND NUTRITION

To live healthy and productive lives, people need more than food. To absorb and use the nutrients they need for growth, physical activity, reproduction, maintenance of bodily functions, and healthy aging, people need to be free of diseases. And for that, they need access to safe water, sanitation, and hygiene services, to high-quality healthcare services, and to safe food. Life in urban areas is often characterized by high population density, air pollution, insects and rodents, other contaminants, and weak infrastructure, especially in informal settlements or slums where most of the poor live (Box 1). Urban populations are exposed to this unique set of environmental and health risks, which can affect not only their health and nutrition, but also their livelihoods, income, and food security.

BOX 1 THE PLIGHT OF SLUMS

Slums are settlements characterized by inadequate access to safe water, sanitation, and infrastructure; nondurable and overcrowded housing; and insecure residential status.[1] Slums are often set up on dangerous and unclaimed land, and residents do not pay property taxes that would cover public services such as electricity, water and sanitation, and waste disposal.[2] Given the threat of eviction, slum dwellers often lack incentive to invest personally in housing quality improvements or sanitation and waste and sewage disposal infrastructure, which in turn may have devastating consequences for their health.[3]

In 2014, 881 million people lived in slums in the developing world, an increase from 689 million in 1990.[4] In India, 17 percent of urban dwellers, or 65 million people, live in slums.[5] In Peru, 34 percent of the urban population lives in slums. In Uganda, the proportion skyrockets to 54 percent.[6] By 2030, the number of slum residents in low- and middle-income countries is projected to reach 2 billion, with most living in Africa and Asia and in smaller cities.[7] This extraordinary growth prompted the United Nations to devote a target of Sustainable Development Goal 11, which focuses on improving cities, to upgrading slums.[8]

Life in slums is characterized by overcrowding, indoor and outdoor air pollution, dusty roads, and lack of water, sanitation, and sewage infrastructure, all of which expose residents to a plethora of environmental health risks. Water and food contamination and related infections are particularly common, and affect children disproportionately.[9] Young children living in slums have a greater incidence of diarrheal illnesses and a higher risk of mortality than their non-slum urban peers.[10] Systematic reviews of cholera outbreaks in Africa have sourced them to slum neighborhoods.[11] Exclusive breastfeeding, which offers protection from infections in young infants, was found to be low in slums in India, due to myths and low utilization of health services.[12] Childhood undernutrition is also higher in slums compared with other urban areas, fueling the vicious cycle of poverty and infection and increasing the risks of long-term consequences for cognitive development, economic productivity, overweight and obesity, and related noncommunicable diseases.[13] Respiratory health—affected by overcrowding, indoor and outdoor air pollution, and secondhand smoke—is also greatly compromised among slum dwellers. Pneumonia and asthma are prevalent among children, as are tuberculosis and chronic obstructive pulmonary and lung diseases in adulthood. Other health hazards affecting slum dwellers include injury due to violence and traffic accidents; flooding and landslides due to lack of infrastructure; industrial pollution and hazardous waste; fire; and stress associated with overcrowding and sharing a physical and social environment.[14]

Despite the growing awareness of slums, there is a dearth of government policies and interventions directed at regularizing tenure and improving slum dwellers' health.[15] Slum health should be accorded policy and research attention in its own right, distinct from the areas of urban health and poverty and health.

Source: A. Ezeh, O. Oyebode, D. Satterthwaite, Y-F. Chen, R. Ndugwa, J. Sartori, B. Mberu, et al., "The History, Geography, and Sociology of Slums and the Health Problems of People Who Live in Slums," *Lancet* online (October 16, 2016), https://doi.org/10.1016/S0140-6736(16)31650-6.

Access to healthcare, clean water, and proper sanitation services is generally greater in urban than rural areas.[57] Access to these basic services appears to range across a continuum—rural dwellers have the least access, followed by the urban poor, with the urban non-poor enjoying the best access.[58] Urban dwellers are also more likely than their rural counterparts to use health services for both curative and preventive services.[59] Socioeconomic disparities in cities and towns, however, have tremendous effects on access to and use of these services.[60] Poor urban dwellers tend to live in crowded, often unplanned environments with limited access to high-quality water sources, sanitation facilities, water drainage, and waste disposal services. These conditions make it almost impossible to prevent contamination of water and food, maintain adequate levels of hygiene, prevent respiratory infections through improved air quality, or control rodent contamination or insect vectors of diseases such as dengue and malaria.[61] Not surprisingly, the prevalence of child diarrhea among urban residents is often as high as, or higher than, among rural children.[62] A recent analysis covering 73 countries showed that children in smaller towns or slums are at higher than average risk for diarrhea than are children living in either urban or rural areas.[63] In India, where the slum population is estimated at 65 million, nearly half of slum residents have respiratory diseases and spend more than

10 percent of their household income on associated treatment.[64]

Access to and use of health services is also lower among slum dwellers, compared to other urban residents. In India, for example, 83 percent of urban pregnant women in the top three income quartiles attended the recommended number of prenatal healthcare visits, compared to 54 percent among the lowest quartile, who were mostly slum residents.[65] Similarly, 62 percent of wealthier households had access to piped water, compared to 19 percent among the poorest. In Mombasa, Kenya, less than 20 percent of people living in informal settlements had access to improved water sources compared to 60 percent of those living in formal settlements; and large socioeconomic differences existed even across informal areas.[66] Slum dwellers often have to pay for even low-quality water, which comes with increased risks of child morbidity, undernutrition, and mortality; this is the case, for example, in Indonesia.[67]

Food safety is another major concern in urban areas, where supply chains are long or originate in polluted urban areas and where traceability and accountability measures for food are lacking. Fresh fruits and vegetables are particularly vulnerable to contamination with unsafe heavy metals and pathogens related to fecal contamination (E. coli), the latter often the result of bacterial contaminants in the wastewater used to irrigate crops.[68] Street foods are also often contaminated in urban slums due to the absence of regulatory inspection and enforcement, and the health risks they pose are often disproportionately borne by the poorest urban residents, who are more likely to consume them.[69] Food safety concerns have been amplified following highly publicized food scares, such as those in China involving dangerous food additives, counterfeit products, and the sale of expired food.[70] Urban consumers are willing to pay for food quality assurance—as much as an additional 60 percent in Viet Nam—although the urban poor may not be able to exercise this option.[71] A recent review also suggests that the health risks associated with high consumption of street foods are not limited to foodborne diseases. These foods may also increase risks of noncommunicable chronic diseases due to the often high content of energy, saturated fats, salt, and added sugars and low micronutrient content.[72]

URBAN-TAILORED PROGRAMS AND POLICIES FOR BETTER LIVES

Economic growth alone is unlikely to solve the nutrition- and health-related challenges faced by the urban poor. As the economies of developing countries grow and urbanization intensifies, childhood stunting rates decrease but at a slower rate than the concurrent rises in adult overweight and obesity, and deficiencies of micronutrients persist.[73] Rural dwellers move to cities in the hope that the promise of employment, education, and better lives will materialize, but they confront a number of environmental, health, and livelihood constraints that affect their well-being and that of their family. Because of the unique features of urban poverty, food security, and nutrition—and the socioeconomic and gender disparities within urban areas—tailored programs and policies targeted to the urban poor and vulnerable are critical. Actions are needed to:

- Increase access of the urban poor to healthy, nutritious, and safe foods and stimulate demand for high-quality diets through targeted interventions and policies to create a more enabling environment for healthy choices (see Chapter 4);
- Promote and support urban agriculture to increase food access and allow urban dwellers to cope with price and income shocks, where space and conditions allow;
- Regulate the production of safe, affordable, and nutritious street foods; and provide regular food-safety trainings for informal food retailers and street food vendors (see Chapter 6);
- Support and manage the informal sector economy and harness its potential to protect the livelihoods of the poor and help them move out of poverty (see Chapter 6);
- Ease the trade-offs for working mothers by providing safe, affordable, and accessible child-care options;
- Design cost-effective, well-targeted social protection instruments to help the urban poor cope with income or price shocks and build assets;
- Address the severe inequalities in access of poor urban (and especially slum) dwellers to healthcare, water, sanitation, waste removal, and electricity services, and lift the access and utilization barriers faced by urban dwellers where services are available;

- Review policy options and adopt context-specific policies to regularize tenure in squatter settlements (that is, slums);[75]
- Provide opportunities for physical activity (to prevent overweight, obesity, and noncommunicable diseases) through smart urban development that eases access, affordability, and safety constraints related to recreational facilities and public transport (see Chapter 4).

ADDRESSING DATA GAPS AND RESEARCH NEEDS

The challenges and opportunities facing the urban poor, many arising from the nature of employment, the availability of—but limited access to—services, the urban environment, and urban food systems, deserve significantly more study. Comprehensive, high-quality research is urgently needed to provide guidance on the design and targeting of urban programs and expansion of services to those who need it most. For almost every topic addressed in this chapter, the data and evidence are outdated or incomplete. In particular, updated and accurate data collected over time to obtain trends and disaggregated information by city size, gender, age, and income group are needed to answer:

- What is the extent of poverty, food insecurity, and malnutrition in urban areas?
- Where and how do urban dwellers obtain their food and what factors shape their food choices and the quality of their diets? What are the effects of the urban food environment, including mass media, incomes, prices, market availability, and the built environment, including electricity and water, on their diets?
- What is the quality of the diet of urban dwellers, what are the nutrient gaps, and what are the dietary patterns that increase their health risks (including food safety and noncommunicable disease risks)?
- What are the patterns of employment for women, men, and youth, and how do these affect childcare and household food security?
- What childcare options are available for working mothers (considering cost, affordability, and quality of alternative childcare)?
- How can programs and policies be better tailored to address the special challenges faced by urban dwellers and support their coping and adaptive strategies to achieve food security and nutrition?

In today's urbanizing world, the numbers of urban poor, food insecure, and malnourished are likely to increase dramatically. Poverty is already shifting from rural to urban areas in some regions. Inclusive public sector action targeted at urban poverty and malnutrition is needed. Governments, program implementers, and researchers can no longer ignore the unique features and needs of urban populations if they are to effectively address poverty, food insecurity, and malnutrition globally.

"The transfer of poverty, food insecurity, and malnutrition to urban areas demands a new understanding of the drivers of these problems and of the policies, programs, and interventions needed to tackle them."

CHAPTER 4
CHANGING DIETS

Urbanization and the Nutrition Transition

CORINNA HAWKES, JODY HARRIS, AND STUART GILLESPIE

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KEY MESSAGES

- Diets are changing with rising incomes and urbanization—people are consuming more animal-source foods, sugar, fats and oils, refined grains, and processed foods.
- This "nutrition transition" is causing increases in overweight and obesity and diet-related diseases such as diabetes and heart disease.
- Urban residents are making the nutrition transition fastest—but it is occurring in rural areas too.
- Urban food environments—with supermarkets, food vendors, and restaurants—facilitate access to unhealthy diets, although they can also improve access to nutritious foods for people who can afford them.
- For the urban poor, the most easily available and affordable diets are often unhealthy.

POLICY AND RESEARCH NEEDS

- What are people eating and how is the urban food environment shaping their food choices?
- Which national and municipal level policies—such as food-labeling requirements to provide consumers with more information, taxes on less healthy foods, school meal programs, and affordable "popular" restaurants—have improved nutrition for urban residents?
- How can food retailers and food services make a greater contribution toward creating an enabling environment for good nutrition?
- What positive experiences with policies to address the nutrition transition can point policy makers in a promising direction?

Diets are changing everywhere. Widespread trends include a decrease in consumption of coarse grains, staple cereals, and pulses; an increase in consumption of animal foods, sugar, salt, fats and oils, refined grains, and processed foods; and depending on where you look, either an increase or decrease in consumption of fruits and vegetables.[1] These changes are occurring at different rates in different regions and populations, but the most rapid change is taking place in the developing world. For example, sugar, salt, and particularly fat consumption from processed foods has plateaued in high-income countries, but is rapidly increasing in middle-income countries.[2] The Global Panel on Agriculture and Food Systems for Nutrition concluded that "over time, people are consuming more recommended components of high-quality diets. However, despite dietary improvements, the net result is still a prevalence of low-quality diets in most countries."[3] Poor-quality diets—lacking in essential nutrients and with an excess of harmful components—are now estimated to be the number-one risk factor in the global burden of disease.[4]

Dietary changes and their nutrition impacts—together known as the "nutrition transition"[5]—are strongly linked with increasing burdens of overweight and obesity[6] and diet-related noncommunicable diseases, such as diabetes and heart disease. The World Health Organization estimates that 1.9 billion people are now overweight or obese, and 1 in 12 people throughout the world has diabetes.[7] These diseases are proving very costly: noncommunicable diseases are expected to cost the global economy as much as US$47 trillion in lost earnings and health bills over the coming two decades, representing 75 percent of global gross domestic product in 2010, with the potential to push millions of people below the poverty line.[8]

Drivers of these dietary changes work at many scales, and involve changes in supply and demand in the food system that are mutually reinforcing. The policies and processes of globalization; the growth of the large-scale food industry, including supermarkets and expansion of mass marketing; and increasing income and changing employment pressures that lead to changes in eating and activity behaviors are all significantly implicated in changing dietary patterns and associated health conditions.[9] All of these factors are closely linked with the processes of urbanization, as changing environments and preferences interact to influence diets and nutrition. We explore the data available on urban diets, nutrition,

and related health outcomes, and then look in more detail at some of the drivers of urban diet and nutritional change and the implications for policy and research.

DIFFERENCES BETWEEN RURAL AND URBAN AREAS

DIET

How are diets changing as a result of urbanization? Early work on the nutrition transition showed that the shift toward greater availability of fats and sugars and reductions in reliance on starchy carbohydrates as dietary staples was occurring faster in cities than in rural areas.[10] Urban populations tend to consume more calories, yet a lower proportion of these calories comes from cereals or carbohydrates and more comes from fat.[11] Urban populations consume more meat and other protein, or consume different animal protein sources than rural counterparts, but less dairy.[12] They also consume more fruits and vegetables overall, though consumption of these food groups differs greatly between richer and poorer urban populations.[13] And finally, urban dwellers consume more non-basic foods, including sugary snacks among children, food away from home, and processed foods.[14]

WEIGHT

The global prevalence of overweight and obesity rose rapidly in both adults and children in recent years. The number of overweight children rocketed worldwide, from 28 million in 1990 to 43 million in 2011.[15] And if current trends among adults continue, global obesity prevalence is expected to reach 18 percent in men and surpass 21 percent in women by 2025.[16] Further details on these trends in overweight and obesity are provided in Chapter 3.

Dietary changes are a major driver of these disturbing weight trends. Although urban and rural divisions are far from the only factor explaining subnational differences, associations exist between city residence and overweight.[17] Large multicountry studies find a particularly strong link between urban residence and overweight among adult women in countries at all levels of economic development; women living in urban areas are more likely—by about 7–12 percentage points—to be overweight than are rural women, even after controlling for education.[18] National-level studies have shown that the problem of overweight among both men and women is overwhelmingly higher in urban than rural areas, and the prevalence of overweight increases in urban areas over time.[19] A similar picture exists for children, as shown by two recent studies: in one, overweight prevalence among children was found to be higher in urban than in rural areas in 55 of 80 low- and middle-income countries; in the other study, a similar share (43 out of 55 countries) showed a higher risk of overweight among urban children.[20]

Weight gain is related not only to diet but also to low levels of physical activity. In 2003, a multicountry analysis showed that one out of five adults around the world was physically inactive, with physical inactivity more prevalent among wealthier and more urbanized countries, and among women and elderly individuals.[21] Adults living in cities tend to expend less energy at work (more sedentary jobs), in domestic chores (more readily available water and electricity), and in getting around (greater use of motorized transport). With regard to leisure, however, urban areas may offer either more opportunities for increased physical activity (such as sports and gyms) or fewer (more access to television, computers, and video games). Overall, not enough is known about the aggregate effects of the shift from rural to urban life on physical activity.[22]

DIET-RELATED DISEASES

Along with dietary changes and an increase in overweight, diet-related diseases are also on the rise in low- and middle-income countries, and are clearly linked with urban residence. A study of 173 countries found that a country's level of urbanization is significantly associated with diabetes prevalence, through the mediator of increased sugar access.[23] In most countries of West Africa, obesity, hypertension, and diabetes have all increased and are generally higher in urban areas across all socioeconomic groups.[24] Studies in India show that urbanization is associated with high blood pressure in men and with cardiovascular disease and higher cholesterol in other populations studied.[25] In China, people who migrate to cities are found to have higher blood pressure.[26] In Benin, city residence is associated with more adverse cholesterol profiles, and in Sri Lanka with diabetes in men and women.[27] Notably, noncommunicable, nutrition-related diseases have emerged in Africa south of the Sahara at a faster

rate and at a lower economic level than in industrialized countries.[28] Overall, adult overweight, obesity, and raised blood glucose increased in every region of the world between 2010 and 2014, and heart disease is the leading cause of mortality worldwide, with three-quarters of deaths occurring in low- and middle-income countries.[29]

DRIVERS OF THE NUTRITION TRANSITION IN CITIES

What aspects of urban living promote food choices that lead to these largely detrimental changes in nutrition and health outcomes? A combination of drivers is likely, underpinned by the need for cash to access food and changes to "food environments." Income influences what foods people buy in cash economies, while urban food environments circumscribe how income can be spent on food and shape people's food preferences, attitudes, and therefore food choices more broadly.[30] Likewise, income and environments affect people's time and ability to exercise. The term "obesogenic environment" is used to describe an environment within the home, workplace, or society that promotes weight gain.[31]

INCOME TO PURCHASE FOODS ASSOCIATED WITH THE NUTRITION TRANSITION

Most food in urban areas is purchased, so people's ability to generate income is key to their diet and nutrition. Urban residents tend to differ from their rural counterparts with regard to levels (and form) of income, as well as in their social and cultural attributes.[32] Many studies assessing differences in diets and health outcomes across populations find interactions between urbanization and income.[33] Urban-rural differences in body mass index, for instance, have been found to narrow when community and individual socioeconomic status are controlled for.[34] In other words, the association between higher body mass and urban residence may well be driven by city dwellers with higher socioeconomic status—although there are also large numbers of urban poor.

Income growth enables households to access more food, but this can be either nutrient-dense food that contributes to a high-quality diet or calorie-dense, salty or sugary food that can undermine diet quality.[35] Many of the negative dietary changes are occurring in both higher- and lower-income groups. A study in an urban slum in India, for instance, found that 66 percent of households consume packaged snacks high in fat, with two-thirds consuming these daily.[36] In urban Malawi, the food insecure are more likely to consume ready-made and processed foods from street vendors.[37] In comparison, the price of nutrient-dense foods such as fruits, vegetables, and animal foods is often significantly higher than that of calorie-dense foods, making cost a barrier to the urban poor.[38] Thus both healthy and unhealthy choices are increasing for the rich, but largely unhealthy choices are accessible for the poor.[39] With the number of urban poor growing in many countries, more people are increasingly pushed toward unhealthy dietary choices as a result of the nexus of urbanization, food prices, and globalized markets.[40]

PHYSICAL ACCESS TO FOODS ASSOCIATED WITH THE NUTRITION TRANSITION

While income is critical in shaping economic access to food, physical access to food shapes what is available to buy. In the urban food landscape, the modern retail sector—including convenience stores, supermarkets, and hypermarkets—is growing rapidly, generally first in large cities and towns and then small towns.[41] As a result, urban populations have access to different types of food outlets. Modern food retail climbed from around 5 percent of market share in 1990 to 60 percent by the end of that decade in some developing countries with more global market linkages; it has grown in all other regions since the 1990s, though less rapidly.[42] For example, in Thailand, 85 percent of the population had access to a supermarket as of 2014, up from 47 percent a decade earlier.[43] Residents in more urbanized areas of China are more likely to have supermarkets and fresh markets within 30 minutes' drive, as well as fast-food restaurants and other indoor restaurants.[44] While fresh "wet" markets are under pressure as a result of modern retail growth, they still remain a critically important source of food for the urban poor, especially in Asia and Africa (see Chapter 6).[45]

The foods stocked by modern retail outlets are important to dietary change. These outlets initially tend to specialize in selling processed food and then, in the case of supermarkets, turn also to semi-processed foods and fresh

produce.[46] Globally, nearly 60 percent of processed food is distributed through supermarkets; in upper-middle-income countries, modern retail dominates processed food distribution, while in lower-middle-income and low-income countries, traditional retail outlets are the main source of processed foods and soft drinks.[47] Recent country-level studies found evidence that in Kenya supermarket use is associated with increased purchase of processed foods at the expense of unprocessed foods, and that in Thailand frequent shopping at supermarkets is associated with consumption of six "problem foods" (soft drinks, snack foods, processed meats, western-style bakery items, instant foods, and deep-fried foods).[48]

The share of fresh foods available in supermarkets, by country income level, was relatively constant over the past 15 years, which suggests that the expansion of supermarkets had little impact on retail patterns for these commodities.[49] Traditional fresh market shopping has been associated with increased vegetable intake in Thailand, while on the other hand, a small study of schoolchildren in China found the density of wet markets, rather than that of supermarkets, to be associated with children's higher consumption of calories, carbohydrates, protein, and fat.[50] In São Paulo, Brazil, living in a neighborhood with access to fresh produce—whether from a supermarket or fresh food market—is associated with higher consumption of fruits and vegetables. Access within cities is also relevant: again in São Paulo, supermarkets are more likely to be found in wealthier neighborhoods while fast-food restaurants are more likely to be located in less wealthy neighborhoods. This suggests that the links between diets and shopping venues are complex and likely context-specific, and require further investigation.

Food eaten away from home such as that purchased from street vendors, modern fast-food chains, and restaurants—often high in fat, salt, and sugar—is also an increasingly important food source in urban diets.[51] An estimated 20 to 25 percent of household food expenditure in low- and middle-income countries is on food prepared outside the home, and some segments of urban populations in these countries depend entirely on street food.[52] Many country studies have found that people of all ages frequently consume meals away from home, including street food and fast food, from several times per week to multiple times per day.[53]

ENVIRONMENTS AFFECTING FOOD CHOICE

Food choices are affected not only by affordability and availability of foods but also by other aspects of the food environment, including the desirability and convenience of particular foods.[54] Marketing significantly influences the desire to purchase certain foods. Companies selling value-added snacks, fast foods, and sugary drinks invest substantially in making their products available as widely as possible, including near schools and other places where people gather.[55] Arguably, marketing has a stronger influence in urban areas where media outlets and large retail stores are more accessible; urban residence, for example, has been found to be associated with fast-food preferences and consumption norms.[56] Households in cities tend to have high rates of television ownership, and evidence from a wide range of countries, including Argentina, China, Mexico, Peru, and Sri Lanka, shows that commercials for sugary snacks, confectionery, and drinks—especially those targeting children—are frequent.[57]

POLICY OPTIONS

What are the policy options available to address this problem? If changing diets are the result of changes in behavior, food environments, and the food systems that underpin them, then improving diets requires policies that can address these drivers. Potential policy actions in each of these three areas—food environments, food systems, and behavior change—are brought together by the NOURISHING Framework (Figure 1), which sets out 10 core actions.

Policies at the national level to change food environments are particularly relevant to cities. Governments around the world have implemented approaches to improve food environments in six main areas highlighted in the NOURISHING Framework.[58] One such approach is nutrition labeling for packaged foods. Chile, for example, introduced new "warning" labels on packaged foods high in fats, sugars, and salt in 2016, and Ecuador has a system of stoplight labels, with red indicating high levels of fats, sugars, and salt. Economic incentives provide another option—a growing number of middle-income countries (including Mexico and some Caribbean and Pacific island nations) have taxed certain foods, particularly sugary drinks and, less commonly, confectionery and fats. Another promising approach is through schools,

FIGURE 1 The NOURISHING policy framework

POLICY AREA		
FOOD ENVIRONMENT	FOOD SYSTEMS	BEHAVIOR CHANGE
N	Nutrition label standards and regulations on the use of claims and implied claims on food	
O	Offer healthy foods and set standards in public institutions and other specific settings	
U	Use economic tools to address food affordability and purchase incentives	
R	Restrict food advertising and other forms of commercial promotion	
I	Improve nutritional quality of the whole food supply	
S	Set incentives and rules to create a healthy retail and food service environment	
H	Harness food supply chain and actions across sectors and ensure coherence with health	
I	Inform people about food and nutrition through public awareness	
N	Nutrition advice and counseling in health care settings	
G	Give nutrition education and skills	

Source: This material has been reproduced from the World Cancer Research Fund International NOURISHING Framework and Policy Database, www.wcrf.org/NOURISHING.

which provide a setting in which changes that target both behavior and food environments can be linked. Some middle-income countries—Brazil is the largest example—regulate foods available in schools, including through mandatory or voluntary guidelines for school meals and, less commonly, by restricting other foods available for purchase, such as in vending machines. A small number of countries, including Mexico, the Republic of Korea, and Taiwan, China, implemented specific restrictions on unhealthy food marketing to children. Promoting "reformulation" of processed foods to reduce levels of salt and trans fats through law or government-industry engagement is an approach

taken in several upper-middle-income countries, including Argentina and South Africa. Far less has been done at the retail end to shift food environments toward encouraging healthier food choices. This gap is surprising given the key role played by food-provisioning environments in shaping physical access to foods, as reviewed above. Food retailing is thus an area ripe for policy innovation and entrepreneurship to orient it toward healthier diets in cities.

Action in all these policy areas has been minimal in low- and lower-middle-income countries, even those where the nutrition transition is most rapid. An analysis of the implementation of five policy actions specific to soft drinks (taxation of sugar-sweetened beverages; mandatory restrictions and official voluntary guidelines on sugar-sweetened beverages in schools; restrictions or warnings on advertising of sugar-sweetened beverages; public awareness campaigns on or including sugar-sweetened beverages; mandatory or official voluntary guidelines on front-of-package labeling) found that these measures had been applied in no low-income countries and in only one lower-middle-income country.[59] Nevertheless, 33 percent of the countries included in the analysis were upper-middle-income countries, showing that progress is being made beyond high-income countries and providing a model for lower-income countries to follow.

It is well established that while changes to food environments are critical to shaping healthier choices and preferences, they are likely to be more successful if reinforced by behavior change communication. Programs in schools that take this type of multilevel approach—for example, the ACTIVITAL program in urban Ecuador (Box 1)—have been found to be successful in improving diets and reducing overweight.

Policy actions can also be taken at the municipal level. Over the last decade, there has been a significant growth in response to urban food problems by municipal governments, several of which have potential to address the nutrition transition. In 2015, over 100 countries signed the Milan Urban Food Policy Pact, which calls for actions to "address non-communicable diseases associated with poor diets and obesity, giving specific attention where appropriate to reducing intake of sugar, salt, trans fats, meat and dairy products and increasing consumption of fruits and vegetables and non-processed foods."[60] Examples of city-level action to date include Medellín, Colombia, and Belo Horizonte and Curitiba in Brazil, which all introduced lower-cost "popular" restaurants to increase access to healthier food; Quito, Ecuador, and Nairobi, Kenya, with urban agriculture programs; and Dakar, Senegal, with microgardens.[61] While research evidence is inadequate to show if there is a direct cause-and-effect relationship, some positive signs are emerging. Obesity prevalence among children has started to decline in Curitiba, for example.[62] Obesity rates are also declining among children in a handful of cities and states in high-income countries, including Amsterdam, which has a municipal-level program to decrease overweight, and a range of cities and states in the United States

BOX 1 A SCHOOL-BASED ANTI-OBESITY PROGRAM IN URBAN ECUADOR

ACTIVITAL was a participatory, school-based program aimed at improving dietary and physical activity behaviors among Ecuadorian adolescents in the urban area of Cuenca, Ecuador, over three years (2009–2012).[1] Twin approaches were used—an individual classroom-based strategy comprising an interactive toolkit to assist teaching on healthy eating and healthy physical activity, and an environmental strategy that included participatory workshops with parents and food-shop staff (on topics such as healthy eating, activity, and portion sizes), along with social events such as the preparation of healthy breakfasts, motivational talks by famous local athletes, and the development of walking trails for the schools. These strategies were implemented in 10 intervention schools, while the normal curriculum was maintained in 10 other schools. Primary outcomes of the program were the nutritional value of dietary intake, physical activity, physical fitness, and screen time. Body mass index, waist circumference, and blood pressure were among the secondary outcomes. Results showed that the intervention decreased added sugar and processed snack food intake, waist circumference, and blood pressure across all socioeconomic groups, while slowing the deterioration in fruit and vegetable intake and in physical activity.[2]

that have taken concerted actions to address the problem.[63]

Actions can also be taken to improve physical activity in cities; a systematic review of factors in the built environment that shape physical activity and obesity risk found that five "smart growth factors" (diverse housing types, mixed land use, housing density, compact development patterns, and open space) were associated with increased levels of physical activity, primarily walking.[64]

A key question is how to generate political commitment for these types of actions. Experience suggests there will be significant pushback on policies designed to reduce consumption from the businesses producing the foods being consumed in excess.[65] Experiences from high-income countries—where the majority of obesity-prevention policies have been implemented—can provide insights. New York City, for example, successfully implemented a series of reforms to its food environment, which evidence suggests was due to a range of factors including a high-level champion, empowerment for bold action among city staff, use of data to drive policy proposals, and coalitions across government.[66]

RESEARCH NEEDS

Urban environments are becoming increasingly obesogenic, and not enough is known about approaches for transforming such environments into *enabling environments* for improved nutrition. Past research has identified three key components of enabling environments for nutrition, relating to: (1) knowledge, data, evidence, and their effective framing and communication; (2) political commitment, effective governance, and sound policy; and (3) leadership, capacity, and financing.[67] Enabling environments operate from the individual to the national level, and they encompass social, policy, institutional, and spatial conditions.[68]

With regard to knowledge, first, more and better information is needed on people's diets, appropriately disaggregated. This means disaggregating urban data by socioeconomic status, given the extreme income inequalities in many urban contexts. Few national governments collect the data required to inform decision makers about what people actually eat, and the United Nations has no functioning global dietary database.[69] Second, better information is needed on drivers of unhealthy diets—for example, how and to what extent shopping venues and marketing affect dietary choices. In terms of action, more must be learned about potential policy options under different urban scenarios, and monitoring and evaluation systems developed to track their effects and impacts. This applies to both diet and activity, and to their environmental and behavioral drivers. Research should go beyond the public sector to shine a light on the role of the private sector in cities. Promising approaches to generating incentives for effective partnerships to improve the accessibility and affordability of healthy diets should be investigated, as well as the role of private companies in driving the current nutrition transition. Much is context-specific, so it will be important to progressively build a library of evidence in different contexts that also focuses on the replicability, scalability, and sustainability of programs.

The power of looking at cities is that while no country has yet managed to reverse a rising obesity trend, individual municipalities are now gaining traction with different approaches.[70] A range of policy options are being implemented in different countries and cities from which lessons can be learned. Urgent attention is needed to evaluate the impact of these policies on diets. Given that knowledge derives from experience as well as from research evidence, "stories of change" need to be rigorously documented as they emerge to highlight the processes and pathways of change.[71] Experiential learning about the ways in which decision makers effectively navigate barriers and constraints to address the nutrition transition will be a crucial complement to evidence from effectiveness studies.

The nutrition transition is well established, particularly in urban areas of low- and middle-income countries, with clear differences in diets, nutrition, and health outcomes for urban residents compared to their rural counterparts. These changes are shaped by socioeconomic status and by the food environments and broader urban environments within which people make their everyday decisions. Multiple policy options are becoming better defined and are being more rigorously tested. But to head off the worst of the nutrition transition in countries increasingly affected by the forces of urbanization, more information is needed on what people in cities are eating and how they are influenced in making their decisions, as well as what policies work, where, and for whom.

CHAPTER 5

AGRICULTURAL VALUE CHAINS

How Cities Reshape Food Systems

BART MINTEN, THOMAS REARDON, AND KEVIN CHEN

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KEY MESSAGES

- Rapid growth of cities is driving change in agricultural value chains—key factors include increased commercial flows of agricultural goods, diet transformation, and the large role of commercial markets in meeting urban food needs.
- Megacities in developing countries are transforming value chains for high-value crops and for traditional staple food crops.
- The "quiet revolution" affecting staple-food value chains is increasing productivity through:
  - Increased investment in technology and modern inputs, including fertilizers and improved seeds, by farmers close to cities.
  - Use of mobile phones by farmers to better position themselves in markets.
  - Greater vertical integration resulting from the growing scale of midstream and retail sections of the value chain—such as cold storage, rice mills, and supermarkets.

POLICY AND RESEARCH NEEDS

- What is the impact of the food value chain segments beyond the farmgate on employment, prices, and food security for both rural and urban populations?
- What role are urban markets playing in shaping agricultural value chains?
- How are evolving agricultural value chains affecting opportunities for small producers?
- How can governments best kick-start changes in agricultural value chains, including through investment in road and communications infrastructure, reliable electricity grids, and agricultural research and development?

Food systems are changing rapidly in developed and developing countries alike.[1] Explosive growth of cities along with the rapid emergence of an urban middle class are driving this transformation of food systems in developing countries.[2] Urban growth leads to larger flows of agricultural produce from rural to urban areas as well as changes in the types of food marketed and consumed. Most urban residents rely on food markets, which provide a significantly higher share of food for urban populations than for rural populations.[3] For many farmers in developing countries, urban food markets are becoming the most important end destination for their produce.

Urban and rural populations in developing countries have significantly different diets—on average, urban populations are both willing and able to spend more money on food. Branded and packaged foods are expanding rapidly in these urban markets. Annual growth rates of retail sales of packaged food products in developing countries are estimated to be much higher than in developed countries.[4] Urban residents also eat increasingly more food away from home (that is, in restaurants).[5] Moreover, in a number of developing countries, richer urban consumers are shifting consumption away from staples toward so-called high-value crops such as vegetables, fruits, dairy, meat, and fish.

The growing population eating "urban diets" combined with increases in rural-urban market flows in recent decades have led to changes in the food supply chains that link producers to urban consumers. First, modern retail—supermarkets run by cooperatives or by the private sector—has emerged rapidly in developing countries. A large body of research explores the impact of modern retail on both consumers and producers.[6] In many developing countries, traditional markets are still the predominant outlet, however. Second, the increasing importance of high-value crops has produced new marketing system structures—such as modern cold storage facilities—that reflect the particular characteristics of these products, as compared to staples, such as perishability.[7] Third, vertically coordinated agrifood chains have improved and expanded, leading to changes in mechanisms for input supply and output procurement.[8]

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Traditional value chains for major crops and staples are changing too. Despite the importance of staple crops, few researchers have looked at the evolution of domestic rural-urban supply chains for these crops as societies become increasingly urban. For example, there are no integrated and cross-country studies of the various segments of the supply chain; nor good estimates of the share of final prices received by farmers as compared to the shares of the other components of the value chain; nor evidence on levels of wastage.

A STUDY OF TRADITIONAL VALUE CHAINS

To better understand how these traditional value chains are responding to urbanization and other drivers, our research team studied the rural-urban value chains that bring two major crops, potato and rice, to the capitals—all megacities—of three Asian countries (Bangladesh, China, and India), as well as teff, a major cereal, to the capital of Ethiopia. Surveys were carried out in the four study countries for each segment of the value chain for these crops to begin to answer questions about the value chain's changing structure, technology adoption, prices, margins, quality, and wastage.[9]

These crops are essential to diets in these countries. Rice is by far the most important staple in each of the Asian countries studied, although the annual quantities consumed per capita range from 160 kg in Bangladesh to 77 kg and 70 kg in China and India, respectively. The consumption of potatoes is much lower than rice, but it is still a major crop in these three countries, with annual consumption at 33 kg per capita in China and 18 kg in India.[10] In Ethiopia, teff is by far the most important cash crop by value and the most important crop in terms of area planted.[11] Teff production was valued at US$2.5 billion in 2013/2014, accounting for 32 percent of the total value of Ethiopia's cereal sector. The value of the commercial surplus alone—that part of production that is sold—was estimated at US$750 million, equal to the commercial surplus of all other cereals combined in the country.

TRANSFORMATION OF VALUE CHAINS

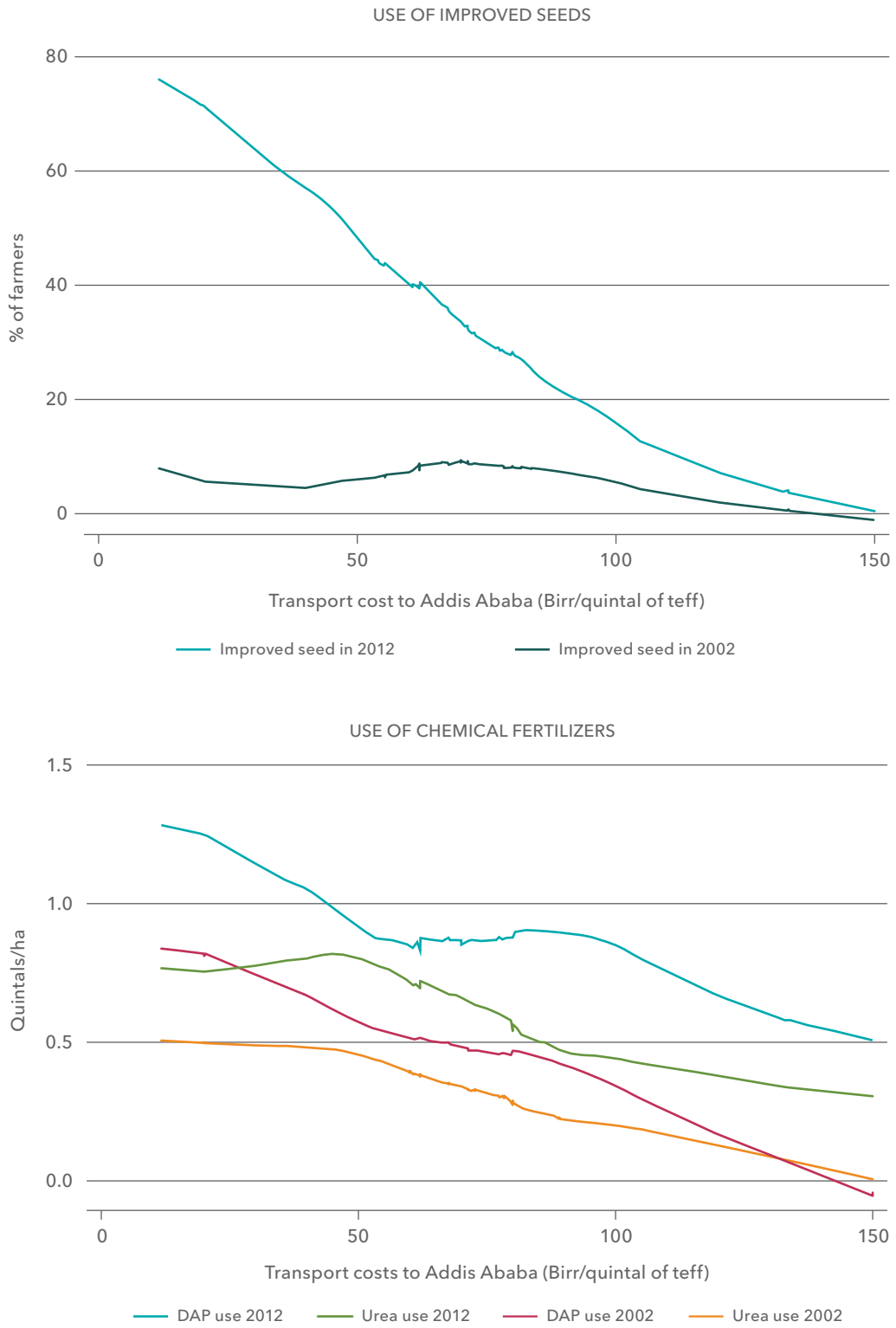
A number of transformations are occurring in commercial value chains that link farms to the city for these three crops, according to the surveys' findings. Many common assumptions about these value chains may no longer hold true as they evolve in an increasingly urban world. How are traditional food value chains changing?

URBAN PROXIMITY MATTERS. Since the burst of change in production of staple crops during the Green Revolution, uptake in agricultural technologies seems to have slowed. Productivity growth in a number of countries is widely thought to have reached a plateau and stalled. Today, there is call for renewed investments in technology development to address the global food crisis.[12] However, looking at the supply zones of the four capital cities reveals substantial change in both technology use and in farming inputs in the last decade.[13] Surprisingly, despite these changes, yields have changed little except for rice in China. This is partially explained by the fact that some farmers have switched to lower-yielding but higher-quality varieties to benefit from higher prices in the marketplace.

Cities have played a key role in technology adoption (Figure 1). In Ethiopia, farmers located closer to the capital, Addis Ababa, where transport costs are lower, are reported in a preliminary study to have adopted modern inputs more frequently.[14] Fertilizer use is more prevalent in areas closer to the city, and most agricultural intensification—as measured through the increasing use of chemical fertilizers—is occurring in these well-connected areas. Increasing fertilizer use seems to be driven by better availability of fertilizers, improved incentives closer to cities because of higher output prices in relation to fertilizer prices, and better knowledge of best practices disseminated by extension agents. Improved seeds have spread quickly as well. Few farmers indicated that they used improved seeds 10 years prior to the survey in 2012. But by the time of the survey, use of improved seeds had increased dramatically to almost 80 percent of the farmers who live close to Addis Ababa. People in more remote areas did not adopt improved seeds.

MOBILE PHONES SHAPE MARKETS. When farmers in developing countries sell their crops, it is widely thought that they may face low prices because they are poorly informed about the market, or find themselves at the mercy of a field broker or constrained by tied credit.[15] However, the surveys found that a significant number of farmers engage

FIGURE 1 Transport costs and adoption of modern technologies in Ethiopia



Source: Adapted from B. Minten, S. Tamru, E. Engida, and K. Tadesse, "Transforming Staple Food Value Chains in Africa: The Case of Teff in Ethiopia," *Journal of Development Studies* 52, no. 5 (2016): 627–645. Reprinted with permission.

Note: DAP = diammonium phosphate fertilizer. Birr is the currency of Ethiopia. A quintal is equal to 100 kg.

knowledgeably in the market and the role of brokers is limited. Most transactions are in cash, with advances and credit playing little role at the farm level. Moreover, access to information has increased significantly with the widespread availability of mobile phones.[16] A large share of farmers interviewed in commercial zones near large cities own mobile phones, ranging from a high of 97 percent in China to a low of 27 percent in Ethiopia (Table 1). In the three Asian countries, almost one-quarter of farmers in commercial zones had reached a price agreement by phone in their last transaction.[17] For rice and potato supply chains in Dhaka, rice chains in Beijing, and potato chains in Delhi, almost all farmers who used phones contacted multiple traders before engaging in a transaction. Overall, 40 percent of staple suppliers in these rural-urban supply chains had contacted multiple buyers by phone in the context of their last transaction. Access to phones is clearly empowering farmers and changing marketing systems in developing countries. The low number of phone users in Ethiopia illustrates the large variation across countries in farmers' access to phones, which is still in an early phase in that country.[18]

THE GROWING SCALE OF MARKETS IS CHANGING VALUE CHAINS. The post-farmgate segments of the value chain—after the product leaves the farm—are often thought to be stagnant and dominated by small traditional processors and traders. However, in India and Bangladesh, large-scale operations, notably large cold storage operations run by private companies, are playing an important role in potato value chains, and are widely used by traders and small- and large-scale farmers. These cold storage operations are increasingly involved in markets for inputs (such as providing improved seeds), outputs (such as linking farmers with traders), and credit.[19] In all three Asian countries studied, the rice milling industry is undergoing restructuring and modernization. In Bangladesh, the milling segment is becoming more concentrated: the share of small mills is declining in the trade of both farmers and rice wholesalers.[20] Rice mills in all countries—especially the medium

TABLE 1 Mobile phone use by commercial farmers near major cities

	Unit	Production areas in commercial zone of			
		Dhaka	Beijing	Delhi	Addis Ababa
STAPLE CROP		RICE	RICE	RICE	TEFF
% of farmers who own a cell phone	%	80	97	73	27
Use of phone in last transaction					
Farmers who were in contact with buyer by phone	% Yes	71	47	19	12
If used...					
Farmers agreed upon price on the phone	% Yes	58	34	51	71
Other buyers contacted	% Yes	90	95	50	-
Average number of phone calls concerning this transaction		2.5	2.5	2.5	-
VEGETABLE CROP		POTATO	POTATO	POTATO	
% of farmers who own a cellphone	%	82	92	97	
Use of phone in last transaction					
Farmers who were in contact with buyer by phone	% Yes	31	19	78	
If used...					
Farmer agreed upon price on the phone	% Yes	66	18	60	
Other buyers contacted	% Yes	98	51	99	
Average number of phone calls concerning this transaction		4.8	3.7	7.6	

Source: E. Nakasone, M. Torero, and B. Minten, "The Power of Information: The ICT Revolution in Agricultural Development," *Annual Review of Resource Economics* 6 (2014): 533–550. Reprinted with permission.

and large mills—have made substantial investments in upgrading their equipment. In China, large mills are becoming increasingly vertically integrated with large retailers and large wholesalers.[21] In Bangladesh and India, a shift is underway from loose to packaged rice, but packaging includes only mill information and no branding. In China, the rapid emergence of packaged and branded rice, especially from medium and large mills, is changing markets.[22]

QUALITY COMMANDS HIGHER PRICES, EVEN FOR STAPLES. Undifferentiated commodities are usually thought to dominate the staples market, with little role for differentiation based on product quality because people are not willing or able to pay for higher-quality food. Most studies looking at the effect of quality in marketing systems have focused on the emergence of high-value products—fruits and vegetables, dairy, meat, and fish—and different marketing requirements for these products.[23] However, our study revealed increasing demand for quality in staple products—average urban consumers are willing to pay substantial price premiums for better-quality staple foods.

SUPPLY CHAINS ARE SHORT AND MARGINS ARE SMALL. Food supply chains are often thought to be long, and longer chains are expected to lead to inefficiencies that increase the margin between the market price and the farmgate price—what the farmer receives. For example, a case study of India argues that most agricultural trade is mediated by a large number of intermediaries, which not only inflates prices but also slows the movement of products from farmers to consumers, leading to large transit costs.[24] However, we find that supply chains for crops are much shorter than commonly assumed. In the case of Ethiopia, usually just two intermediaries exist between agricultural producers and urban retailers.[25] The margins between producers and consumers for the most common variety of rice vary from US$80 per ton in China to US$120 per ton in Delhi (Table 2). Despite the fact that rice has to be transported over a much longer distance in China compared to the other countries, rice margins are still significantly lower. For this common variety of rice, farmers obtain 69 percent, 74 percent, and 87 percent of the final retail price in India, Bangladesh, and China, respectively. In the case of teff in Ethiopia, the share to the farmer reaches 79 percent. These are high shares in final retail prices, especially when compared to developed countries. For example, in the United States, potato farmers are estimated to receive only 15 percent of the final retail price.[26]

MARGINS INCREASE WITH QUALITY, BUT FARMERS SEE LITTLE BENEFIT. Interestingly, the share of the final retail price accruing to the post-farmgate segments of the value chain is larger, both in relative and absolute terms, for higher-quality products (which command a higher retail price) (Table 2).[27] Given increasing demand for these higher-quality products, the importance of the post-farmgate segments of value chains is expected to grow. The difference between the value of the post-farmgate segments for common variety and high-quality rice, as measured by the margin between producers and consumers, is significant—a difference of US$40 per ton in Bangladesh, US$120 per ton in China, and US$130 per ton in India. The farmgate price is only slightly higher for high-quality rice than for low-quality rice in India and Bangladesh, so for the farmer, the labor rewards for growing high- and low-quality rice are not significantly different. However, in Ethiopia, where the margins for higher-quality and lower-quality teff are similar, farmers do receive a higher price for the higher-quality variety. In the case of rice, farmers do not currently benefit from the relatively higher retail prices or the increased willingness to pay for quality staples. This is to be expected when farmers can easily switch from one variety to another. Most of the rewards as well as extra costs of producing a higher-quality product (related, for example, to storage, branding, packing, grading, milling, and polishing) are captured by the post-farmgate segment, not the farmer.

WASTE IS LIMITED. Traditional supply chains for staples are thought to be burdened by high rates of food wastage. For example, a study in India found that average losses in horticulture value chains reach 12 percent and in potato value chains, 11 percent.[28] In Bangladesh, an earlier study valued the annual loss due to wastage in the potato value chain at about US$70 million, using an estimate of 25 percent loss.[29] In contrast, our study found that wastage rates are significantly lower than previously assumed. In Bangladesh, the share of potatoes wasted in the value chain or not used for consumption was found to be 5.2 percent in the harvest period and

6.4 percent in the off-season (that is, after storage) of the total quantity entering the value chain (Table 3). Even lower rates of wastage were found in India. Waste is higher in China, possibly because of the significantly longer distances that potatoes are shipped. While some have argued that electricity cuts in Bangladesh and India might lead to major losses of potato in cold storage, all cold stores surveyed had access to diesel generators that kept them functioning during cuts, although at a higher cost. Waste during storage was quite low, estimated at 1.2 percent in Bangladesh and 0.1 percent in India. The lower than expected wastage might be due to bad measurements in previous studies of total wastage. But it is also possible that the diffusion of mobile phones and improved roads have reduced wastage along traditional value chains.[30] In addition, postharvest handling is important to waste rates, but it appears that many improved practices and investments have already been put in place, reducing waste from this stage to modest levels.

IMPLICATIONS FOR FOOD SECURITY

Although the food security debate has largely focused on the farm sector, midstream actors (traders, processors) and downstream actors (retailers) also play an important role in the formation of food prices. Driven by urbanization, the increasing demand for quality and convenience, and the availability of better technologies for cold storage and milling, the role of midstream and downstream agents is likely to continue growing. These post-farmgate segments are often neglected in discussions of food security, however. An obvious policy question is how to best facilitate this "quiet revolution" in traditional agricultural value chains. Interestingly, we found that the government played an important role in kick-starting changes in all four surveyed countries. Governments invested heavily in infrastructure, subsidies (such as for cold storage operations in India), or agricultural research and development (especially in China and India).[31] Although these governments were previously heavily involved in the distribution of agricultural inputs, Bangladesh and China have increasingly moved out of input supply, except for seeds. At the same time, the changing demands of consumers and the resulting expansion of market opportunities are creating incentives for the private sector to step in and restructure the functioning of value chains.

FIVE KEYS TO STRENGTHENING AGRICULTURAL VALUE CHAINS

Five findings are clearly important to the policy debate on food system transformation, food security, and agricultural value chains:

TABLE 2 Average price structure for commercial farmers for common and better-quality crop varieties

Sales price	Unit	Value chain to consumers in			
		Dhaka	Beijing	Delhi	Addis Ababa
		RICE			TEFF
		Most common variety[a]			
Farmer price[c]	USD/kg	0.28	0.54	0.27	0.67
Margin	USD/kg	0.10	0.08	0.12	0.18
Retailer price	USD/kg	0.38	0.62	0.39	0.85
		Better-quality variety[b]			
Farmer price[c]	USD/kg	0.30	0.57	0.31	0.77
Margin	USD/kg	0.14	0.20	0.25	0.15
Retailer price	USD/kg	0.44	0.77	0.56	0.92

Source: Authors' calculations.

Note: [a] common variety: Bangladesh—coarse; India/China—common rice; Ethiopia—mixed teff

[b] better-quality variety: Bangladesh—medium rice; India/China—fine/non-aromatic rice; Ethiopia—white teff

[c] assuming a conversion ratio of 65 percent (no value attached to byproducts), rice equivalent

TABLE 3 Wastage in the potato value chains

	Unit	Wastage rates		
		Dhaka	Beijing	Delhi
WASTAGE IN VALUE CHAIN TO CONSUMER				
Farmer	%	1.2	2.2	0.0
Cold storage	%	1.2	-	0.1
Rural wholesaler	%	1.7	3.1	0.0
Urban wholesaler	%	0.3	1.5	0.2
Urban retailer	%	2.0	3.2	3.0
Total wastage in harvest period	%	5.2	9.9	3.2
Total wastage in off-season	%	6.4	-	3.3
WASTAGE AT RETAIL LEVEL				
Size of last transaction	kgs	220.0	476.6	50.7
Total wastage in last transaction	kgs	4.4	15.1	1.5
Wastage:				
Thrown away immediately after purchase	kgs	1.1	-	0.7
Thrown away because unable to sell in time	kgs	3.1	-	0.8

Source: Authors' calculations.

1. As developing countries' economies grow and urbanization takes off, greater attention on the part of policy makers to the post-farmgate segment of staple-food value chains is required. Post-farmgate activities have important impacts on employment and prices, and therefore on food security for urban as well as rural populations. Rapidly emerging small- and medium-sized agribusinesses in the post-farmgate segment are rising in importance, but are often neglected in policy discussions.[32]
2. Urban markets are rapidly growing and will continue to shape agricultural and food economies in these countries. These markets should be taken into consideration as cities are increasingly becoming engines of agricultural and food system transformation.
3. While much policy debate centers on direct government operations in food value chains, such operations were generally quite small in the staple value chains studied. The implication is that the bulk of activity in agricultural value chains is private sector (traditional or modern) activity. Thus, emphasis should be placed on enabling the private sector's involvement and providing incentives for the sector to support national food security objectives.
4. The indirect role of the governments in the four countries studied was important in enabling and at times providing incentives for the food system transformation:
   - Major investments in the 1990s and 2000s in rural areas, through research and development, distribution of seed, and infrastructure, including in irrigation canal systems, road and railway systems, rural wholesale markets, power grids, and mobile phone communication grids, were essential to the transformation in the midstream of value chains observed by the study.
   - Investing in agricultural extension was important overall, although the data suggest a limited impact and availability of extension services in some areas, particularly in Bangladesh, China, and India.
5. As food and agricultural markets develop, quality and food safety standards will become increasingly important in these growing domestic markets of developing countries. More attention to these concerns is needed.

CHAPTER 6
GOVERNANCE

Informal Food Markets in Africa's Cities

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KEY MESSAGES

- Urbanization is moving fastest in Africa south of the Sahara, with major implications for food security and other governance challenges.
- Large urban poor populations rely heavily on the informal economy for accessible, affordable food. Most eggs, meat, fish, and milk sold to the urban poor are from informal markets.
- Food security policies in urban Africa face institutional, administrative, and political challenges:
  - Lack of local mandate for food security under decentralization policies.
  - Lack of cross-sectoral, cross-ministerial policy integration.
  - Political contest over cities that occasionally leads to violence.
- Government interventions have focused on control, regulation, and often violent eradication of the urban informal food economy.

POLICY AND RESEARCH NEEDS

- What tools can institutionalize regular engagement between local governments and informal workers?
- How can the informal economy be actively incorporated into discussions of urban food security?
- How can vertical and horizontal cooperation across sectors and ministries be promoted to improve governance of the informal sector?
- What approaches, such as training informal sector workers, can improve food safety and support the benefits provided by the sector?

Urbanization is a global phenomenon, but in Africa south of the Sahara[1] its pace and impact are particularly notable. Africa's urban population is the fastest growing in the world. By 2030, the continent is expected to reach a tipping point, when for the first time the majority of the region's population will live in urban areas.[2] These broad trends capture a tremendous degree of variation across urban Africa, ranging from the megacities of Kinshasa and Lagos, which are home to more than 10 million people, to secondary cities like Tema in Ghana and Ndola in Zambia, with populations of fewer than 750,000 people.[3] While these demographic shifts contribute to a number of urban policy challenges, including limited housing supplies, infrastructure bottlenecks, pressure on scarce public services, and environmental degradation, the implications for food security in urban Africa are equally significant.

The urban poor are more vulnerable than their rural counterparts are to fluctuations in food prices and exchange rates. Urban residents in Africa are less likely to produce food for their own consumption and they devote a higher share of their household budgets to food purchases than rural populations.[4] This vulnerability was evident during the 2008 and 2011 global food price spikes, when Africa experienced the highest incidence of urban food price riots.[5] Africa's urban centers are characterized by both a growing middle class and growing urban poverty.[6] Significant pockets of food insecure populations can be found in even the wealthiest countries in the region. For example, food insecurity is endemic in the poorest neighborhoods of Gaborone, Botswana, and Windhoek, Namibia.[7] More broadly, diets in African cities rely heavily on starchy staples, and this lack of diversity contributes to malnutrition.[8]

The governance challenges to enhancing food security in urban Africa span institutional, administrative, and political dimensions. Institutionally, food security policies involve intersectoral coordination across multiple ministries, which typically occurs under the leadership of ministries of agriculture or health. When the focus is explicitly on the urban dimensions of food security, greater engagement is needed with ministries of urban and local development. National food security strategies, however, are often created parallel to, rather than in concert with, urban development strategies. This hinders full integration of urban food security into national planning. For example, Uganda's recent national urban policy focused on water, housing, and waste management but neglected food security.[9]

Administratively, many African countries are pursuing varying degrees of decentralization, which implies that a growing number of government actors are engaged in different dimensions of urban food security. But food security policy formulation is rarely devolved entirely to local or municipal governments, precisely because food security commitments require sustained financing and intersectoral capacity that is often even weaker at the subnational than at the national level. Moreover, local autonomy over food security could result in uneven progress across communities within the same country. In South Africa for instance, arguably one of the region's most decentralized countries, local governments have no clear mandate over food security.[10] Local governments are, however, often granted administrative authority to regulate urban markets, particularly when it comes to monitoring adherence to food safety regulations. Yet this authority is often shared between urban councils and national ministries, which muddles accountability.

Politically, as cities become more economically important and home to a sizable share of voters, they can become a focal point for power disputes between mayors and presidents and between ruling and opposition parties.[11] At its most extreme, this culminates in political violence that disproportionately affects the urban poor, including their food security. For example, intense fighting during the 2000s in Côte d'Ivoire's commercial capital of Abidjan severely reduced dietary diversity among the city's population.[12]

This chapter explores the linkages between these governance dimensions and urban food security through the lens of the informal economy.[13] Oversight of the informal economy rarely falls to any one particular ministry, and its regulation is typically shared between local and national governments. As an important source of votes, the sector is also sometimes politicized by presidents and mayors, especially around elections. While most of the urban poor rely heavily on the informal sector, including street traders and marketers, for access to affordable food, adherence to food safety standards is much less constrained than for those operating in the formal food sector. Concerns over food safety partially explain the difficult relationship between African governments and the informal sector, which is characterized by alternating periods of harassment and appeasement. This chapter reviews these dynamics and highlights approaches that have enabled governments to protect the health of low-income urban consumers while allowing the informal economy to thrive and contribute to food security and nutrition.

THE INFORMAL ECONOMY AND FOOD SECURITY

In many African cities, the informal economy has long been the linchpin of food security for the urban poor.[14] Despite the trend of supermarket expansion in the region, the urban poor continue to depend heavily on informal markets and street vendors for daily purchases and use supermarkets only periodically for bulk purchases of staples.[15] Most of the eggs, fish, meat, and milk sold to the poor in urban Africa are from informal markets. In countries such as Côte d'Ivoire, Kenya, Mali, and Uganda, 80 to 90 percent of raw milk is purchased from vendors or small-scale retailers.[16] More broadly, a survey of over 6,000 households in low-income neighborhoods in 11 African cities found that 70 percent of urban households regularly purchase their foods from the informal market or street vendors.[17] Notably, reliance on the informal sector varies depending on how wealthy a country is: 90 percent of households in the South African cities of Cape Town and Johannesburg buy their food from supermarkets compared with only 23 percent in Maputo, Mozambique.[18]

Indeed, many observers contend that supermarkets in Africa are still largely a niche element of food retail and will continue to be so in the near future.[19] A study focused on Kenya predicts that supermarket chains will continue to capture only a fraction of the urban fresh fruit and vegetable market.[20] Similarly, despite the presence of supermarkets in Zambia for more than 20 years, they still serve only a small share of the population.[21]

The informal economy is critical to urban food security for several reasons. First, informal markets tend to be located closer to low-income housing settlements than are supermarkets, making informal markets the main source of food for many of the urban poor. Itinerant traders offer a convenient source of foodstuffs for busy urbanites. Physical proximity is especially important because in many African cities irregular provision of electricity makes long-term refrigeration difficult, requiring almost daily food purchases.

Second, the informal economy improves food affordability through both incomes and prices. Informal vendors can sell in smaller quantities, at lower prices, and on credit.[22] Moreover, the informal economy is a critical source of income for the urban poor, accounting for approximately 72 percent of nonagricultural employment in Africa.[23] Street vending and informal trade are especially important sources of livelihoods and financial independence for women, who are the primary sellers of street foods and perishable goods, such as fruits and vegetables.[24] In addition, informal trade is often the entry point into urban employment for newly arrived rural migrants.[25]

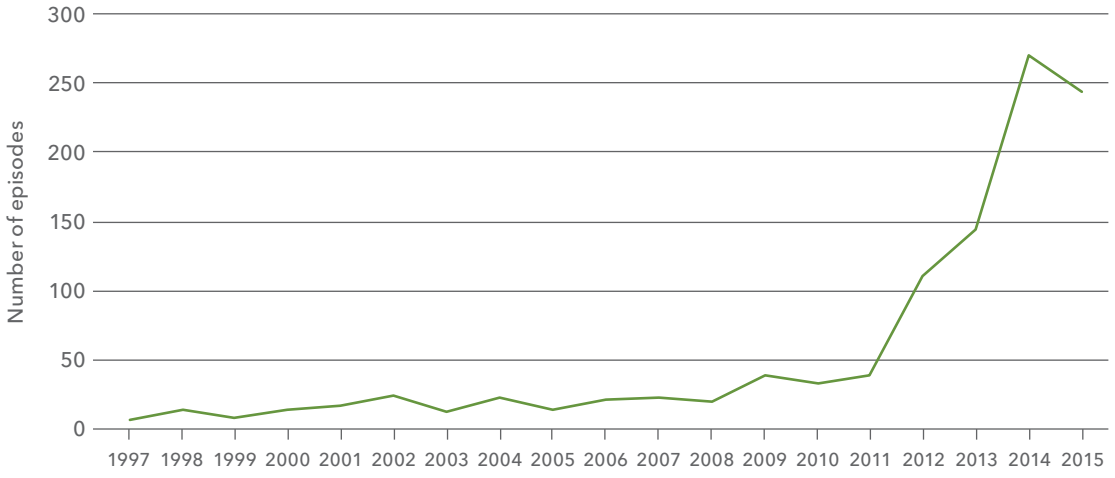
Third, the informal economy plays a critical role in the agricultural value chain. Many value chains have two tracks, with formal value chains serving middle- and upper-class consumers and export markets and informal ones serving low-income consumers in domestic markets.[26] Poor rural smallholders face lower barriers to entry when selling to informal traders and markets than to more formal and regulated markets. Yet even some large-scale agribusiness companies expand their markets by segmenting their consumers via the informal sector. In the dairy sector, for example, companies sell single-serving milk sachets to vendors who lack refrigeration and who in turn sell them to the poor.[27]

GOVERNANCE OF THE INFORMAL ECONOMY

Despite the importance of informal markets to the food security of the urban poor, African governments have a difficult relationship with the sector. In fact, many African countries still retain colonial-era legislation on street vending that penalizes both sellers and buyers.[28] Unpredictable "decongestion" exercises by governments often involve arresting and fining informal vendors, confiscating their merchandise, and demolishing market stalls. The Accra Metropolitan Assembly in Ghana even established a Fast Track Court in the mid-2000s for trials of street hawkers who had been arrested.[29]

Violence toward members of the informal sector, as reported in the media, has increased in the region over the last two decades (Figure 1). These episodes include Zimbabwe's Operation Restore Order (2005), Malawi's Operation Order (2006, 2015), Nigeria's Zero Tolerance Campaign in Lagos (2009), South Africa's Operation Clean Sweep (2013), and the Keep Zambia Clean and Healthy campaign (2007, 2015). This violence not only hurts a vulnerable sector of society that is already food insecure but also reduces access for others who depend on the sector for many of their fresh and nutrient-dense foods. For instance, in the wake of Operation Order in the Malawian cities of Blantyre, Lilongwe, and

FIGURE 1 Episodes of violence against informal workers in Africa



Source: Author's calculations based on the Armed Conflict Local and Event Data Project (ACLED), www.acleddata.com.

Notes: "Informal" refers here to street hawkers, vendors, marketers, and traders. "Africa" refers to countries south of the Sahara. The events are gathered from media reports in cities and secondary towns.

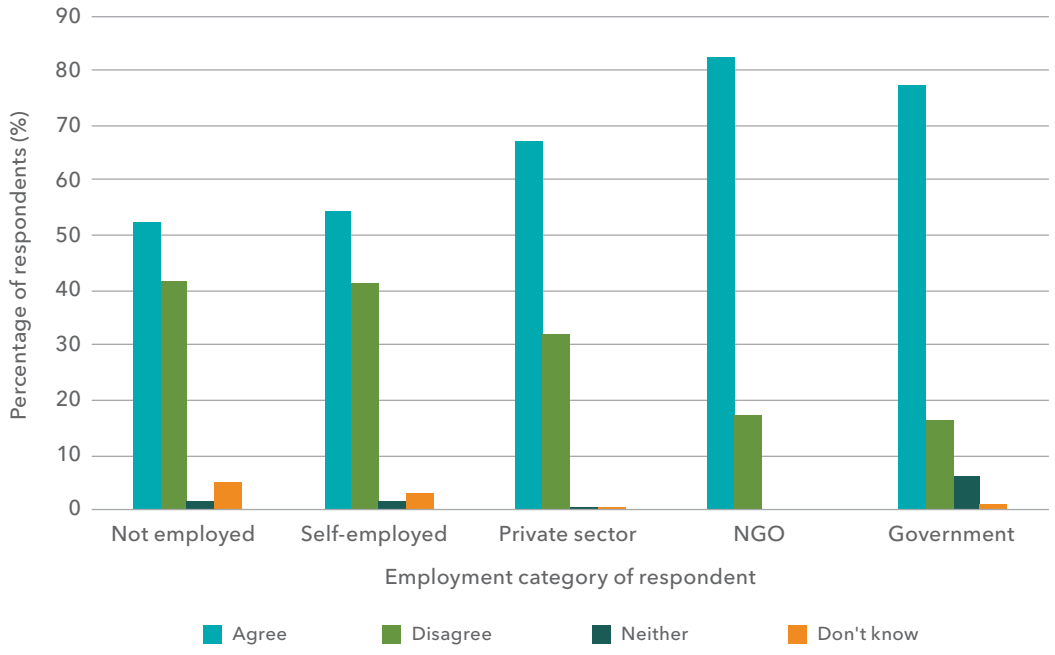
Zomba, higher food insecurity was observed among the poor when vendors were forced to the cities' outskirts.[30] While harassment of informal vendors is not unique to Africa and is also present in Southeast Asia and Latin America, the scale of the informal economy and its importance to urban livelihoods is much greater in Africa than it is in those regions.[31] Violent crackdowns on the sector can have serious consequences for Africa's urban food security.

This behavior toward the informal sector reflects many of the region's urban governance challenges. Institutionally, it is rare to find high-level government ministries that explicitly promote the interests of informal workers. In the absence of such support, a vibrant set of informal sector workers' associations emerged in the region over the last decade to address government harassment.[32] Yet many of these associations are too fragmented or underfunded to affect the policy process.[33] Administratively, authority over regulating informal sector activities can be extremely confusing. Higher levels of government may contravene the actions of lower tiers. For instance, in 2009, Zambia's Ministry of Local Government and Housing paid the Zambian police service to remove street vendors in Lusaka's central business district, thereby directly intervening in an area of responsibility delegated to the Lusaka City Council.[34] Politically, informal markets can become infiltrated by partisanship, and informal workers heavily influenced by party politics, which can affect how both markets and vendors are treated by governments.[35] Zimbabwe's Operation Restore Order, for example, was launched by the ruling party in all major urban areas after the party lost the 2005 parliamentary elections in these constituencies. The violent demolition campaign caused over 700,000 urban poor to lose their homes and informal businesses and exacerbated already insufficient food access for this population.[36] As seen in Figure 2 with reference to public opinion in Zambia, such draconian policies toward informal workers enjoy relatively high levels of support from middle-class constituents who work in the private and government sector.

INFORMALITY AND FOOD SAFETY

While politics plays an important role, governments justify their harsh treatment of informal sector workers by pointing to concerns about tax evasion, trespassing on private land, traffic congestion, and food safety. Certainly informal markets are less likely to

FIGURE 2 Should street vendors be banned? Views in Zambia



Source: Afrobarometer, Round 6 Data (2015), http://afrobarometer.org/data/zambia-round-6-data-2015.

Note: N = 1,199. Statistics are weighted by population survey weights. NGO = nongovernmental organization.

take measures to assure food safety. Many vendors and marketers operate in settings without access to electricity, waste disposal, clean water, or appropriate sanitation practices, meaning that foods are often not handled hygienically.[37] This increases the risk of foodborne illness for the urban poor, with its own set of problems, but also contributes to micronutrient deficiencies.[38] While the informal food sector can offer consumers low prices, the trade-off is less regulation of quality control and labeling than is found in formal food value chains, leaving poor consumers more vulnerable to contaminated, adulterated, and spoiled foods.[39] Crackdowns and harassment do not necessarily improve these circumstances, though. In fact, research in developing countries such as Brazil suggests that frequent crackdowns reduce the incentives for those in the informal food economy to invest in the practices or equipment that would improve food safety.[40]

LESSONS FROM POLICY INTERVENTIONS

One common policy intervention in Africa is to upgrade or build new marketplaces with proper sanitation and lighting in order to move informal vendors off the streets while also addressing food safety concerns. Yet these efforts rarely succeed in permanently discouraging traders from returning to the streets. Rising land costs in major cities, overlapping land claims in city centers, and a dearth of suitable land under public ownership often result in new markets being built on less expensive peri-urban land—often located far from informal workers' regular customers.[41] Moreover, fees for stalls in upgraded markets are often expensive, so stalls go to more affluent vendors or foreigners rather than the poorest traders.[42] Politics also plays a role in these processes, as seen in Dakar, Senegal, where a popular opposition-party mayor attempted to raise money for a new market for street vendors through a municipal bond, an initiative ultimately thwarted by the national government.[43]

In addition to market improvements, governments could protect the interests and health of low-income urban consumers and still allow the informal economy to thrive by focusing more on education and training. In Kenya, where informal milk trading accounts for about 86 percent of milk sold, Kenya's Dairy Board established a Dairy Traders Association in 2009 that provides informal traders with training on the basics of milk hygiene and simple quality tests. Upon completion of the short training course, traders receive a certificate to obtain a milk vending license and therefore avoid receiving a fine from the Dairy Board.[44] Similarly, in Nigeria, the International Livestock Research Institute designed a training course for butchers' associations in informal markets to improve hygienic behavior and develop best practices. In return, butchers can display their completion certificates to customers, and they often disseminate their learning to colleagues within their associations.[45] In Dakar, where women comprise a majority of those selling prepared food in the streets, illiteracy and poor education often contribute to a lack of awareness about sanitation standards. After a community was trained in food hygiene by a local nongovernmental organization, the participating women successfully lobbied for canteens where they could safely prepare foods.[46] Scaling up such interventions with street-vending and marketing associations, and capitalizing on mobile technology, could significantly contribute to the transfer of knowledge on hygienic food preparation practices and change behaviors accordingly (Box 1).

More broadly, a variety of options exist for improving the governance of the informal economy beyond addressing food safety concerns. These include institutionalizing regular engagement between local governments and informal workers within management units of city councils and marketplaces.[47] One attempt at this is Zambia's 2007 Markets and Bus Station Act, which aimed to place the control of markets and bus stations under management boards. In the case of markets, these boards include representatives of local authorities, vendors, and consumers who decide jointly how markets operate. This transparency and engagement in turn encourage many vendors to pay the requisite stall fees that cover investments in sanitation and other infrastructure.[48] Relatedly, improved transparency in the use of stall fees and other taxes enhances accountability between informal workers and the government. Fiscal earmarking of such payments explicitly for improved infrastructure in markets could build trust between authorities and informal workers while also increasing local government revenue.[49]

Approaches in other regions are instructive and feasible in the African context. In Hanoi, Viet Nam, vendors and the government arrived at a

BOX 1 THE POWER OF PARTICIPATION: WHAT ROLE FOR INFORMAL SECTOR ASSOCIATIONS?

Informal sector associations representing the urban poor have grown tremendously over the last decade, facilitated by international umbrella organizations such as Shack/Slum Dwellers International and Women in Informal Employment: Globalizing and Organizing. While growth of these associations resulted in fragmentation and competition in some cases, useful examples show where they have played a key role in advancing informal sector interests.[1]

For instance, Kenya's Federation of the Urban Poor (Muungano wa Wanavijiji) worked to establish a Food Vendors Association within some of Nairobi's informal settlements to map vending locations and their proximity to environmental hazards, such as flooding, sewage, and garbage heaps. Leaders of the association are all women and they undertake routine clean-ups of hazardous areas in their settlements.[2] Such practices could be replicated elsewhere with engagement of informal associations and support from local governments, donors, and the private sector. The resulting information could be communicated via text message to both consumers and food vendors so that such areas could be avoided and targeted for drainage and garbage collection by municipal authorities.

compromise approach known as "restricted tolerance"– street vendors can work freely during certain times of the day if they clean up any street litter at the end of their allotted time.[50] In Peru, informal workers are participating in developing a law on self-employment and working with Lima's city government to revise street-vending bylaws.[51] In Africa, participatory engagement of street vendors and marketers in reforming anachronistic legislation that legitimizes arbitrary harassment of informal workers offers a likely first step in improving governance.

BRINGING URBAN FOOD SECURITY INTO POLICY

Urban spaces are not just characterized by demography and geography but also by a distinct set of legal, institutional, and governance dimensions that should be taken into account by any policy recommendations to tackle food security. Common policy efforts thus far to address urban food security include urban agriculture and biofortification programs. An equally important component should be more proactive incorporation of the informal economy into policy discussions on urban food security combined with less harassment of those whose livelihoods depend on the sector.

This is particularly important because Africa's urban expansion has occurred largely in the context of low per capita economic growth and only negligible shifts in the economic structure of most countries toward more formal sector employment.[52] Without sufficient formal sector jobs, the informal sector will continue to be a key source of employment and food access for the urban poor. Tellingly, the particular importance of food safety within the informal economy is a major issue in East and Southeast Asia as their growing middle classes become increasingly concerned with tracing the origin of their food.[53] This further suggests that food safety and urban informality will continue to dominate the agenda of African policy makers for the foreseeable future, as the middle class is only just beginning to expand in the region.

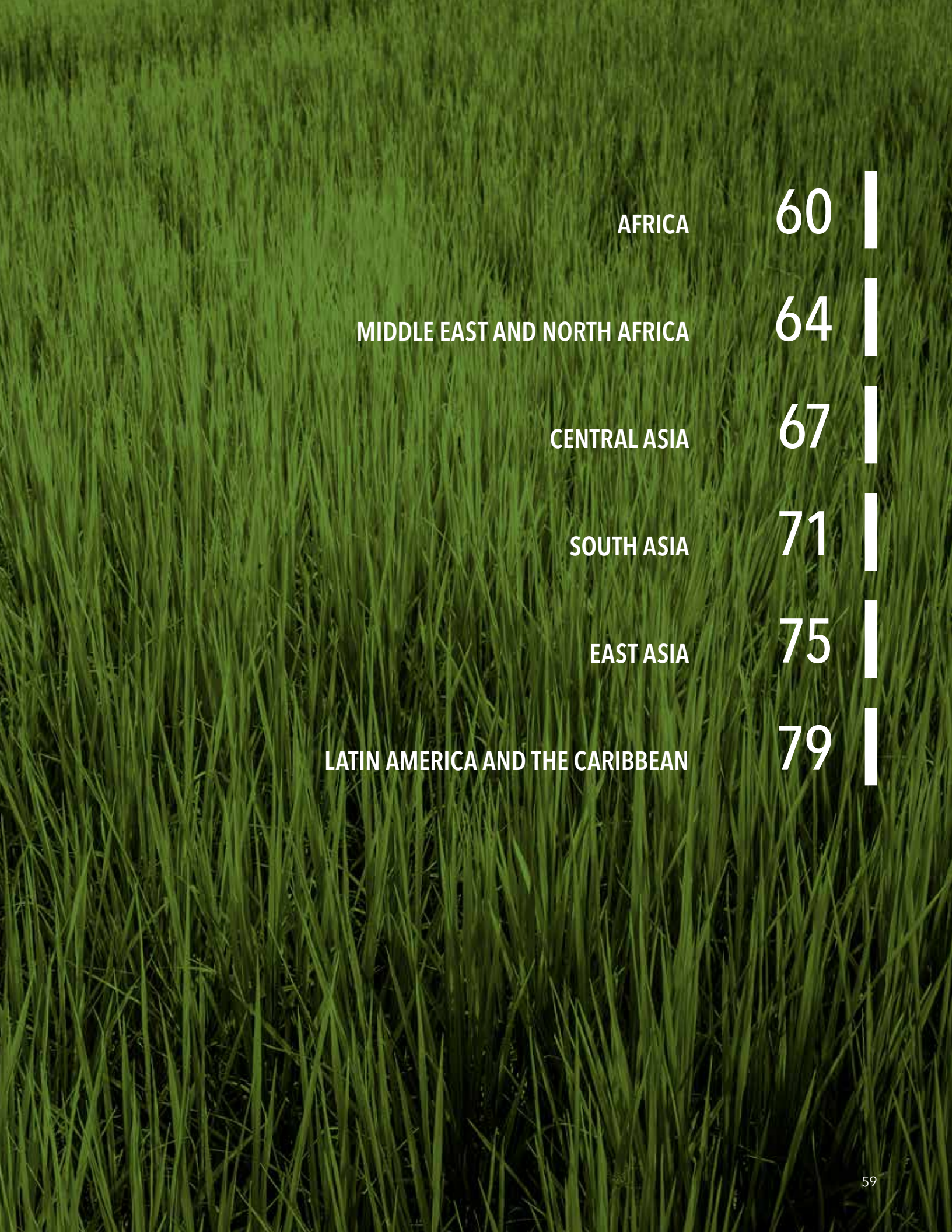
More broadly, in an era of decentralization and rapid urbanization in Africa, addressing urban food security requires horizontal cooperation across sectors and ministries as well as vertical coordination across tiers of government. Additionally, it requires novel approaches, including many of those discussed here, for addressing longstanding dilemmas for urban planners and local governments, including how to humanely manage the informal sector and harness its potential to improve food security. As policy interest grows in secondary cities and towns, which do not yet face such intense service delivery pressures and high land values, an opportunity exists to plan the design of markets to best accommodate informal workers as these cities grow.[54] Moreover, with the Sustainable Development Goal on inclusive cities (SDG 11) and the launch of the United Nations' New Urban Agenda, the possibility is greater than ever before to better integrate a focus on food security and management of the informal economy into urban planning processes.

"Street vending and informal trade are especially important sources of livelihoods and financial independence for women, who are the primary sellers of street foods and perishable goods, such as fruits and vegetables."

REGIONAL DEVELOPMENTS

2016 saw important developments with potentially wide repercussions for food security and nutrition in individual countries and regions. This section offers perspectives on food policy developments across the major regions: Africa, the Middle East and North Africa, Central Asia, South Asia, East Asia, and Latin America and the Caribbean. Urbanization trends and related impacts on food security and nutrition are presented for each region. The individual regional sections cover many other critical topics:

- Acceleration of cooperation and investment in Africa to improve food security in the face of climate challenges and low commodity prices
- Continuing conflict in the Middle East and North Africa, while some countries begin to face policy reform needs and realities of low oil prices
- Central Asia's promotion of agricultural diversification and regional integration to increase economic resilience
- South Asia's rapid growth and new investments and policies in the agriculture sector
- Urbanization, changing diets, and regional growth in East Asia
- Recession in major economies of Latin America and the Caribbean along with El Niño's effects on regional prospects



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Africa

TSITSI MAKOMBE, JULIA COLLINS, AND OUSMANE BADIANE

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The year 2016 was challenging for many African countries as they continued to adjust to lower commodity prices and more limited external finance. Overall gross domestic product (GDP) growth for Africa south of the Sahara was expected to reach only 1.4 percent in 2016, representing a sharp break from the high growth rates the region had enjoyed since the 2000s. The low growth was concentrated in the half of African countries that are major exporters of oil and mineral resources; most non-resource-exporting countries continued to grow at strong rates in 2016 (Figure 1).[1] In some resource-exporting countries, slow adjustment to changing conditions led to shortages of foreign exchange and rising government debt.[2]

Measures of poverty, hunger, and malnutrition improved steadily but slowly throughout the faster growth period of the 2000s and the recent economic deceleration. The share of the population that is malnourished dropped from 22.2 percent in 2003 to 16.3 percent in 2015.[3] Measures of child malnutrition declined but levels remain high, with the rate of stunting (low height-for-age) in children under five years at 33.7 percent in 2015. Africa south of the Sahara remained the region with the most serious levels of hunger, as measured by the Global Hunger Index (GHI), although its GHI score improved significantly over the past decade.[4] Poverty, measured by the headcount ratio at US$1.90 per day, dropped from 46.5 to 40.1 percent between 2003 and 2015.

Africa continued to show steady growth in agricultural value added, although annual average growth during the 2008–2015 period (3.35 percent) was lower than in the 2003–2008 period (4.67 percent). The continent as a whole did not reach the Maputo Declaration target of 6 percent annual agricultural growth, although 11 individual countries met the target during 2008–2015.

Similarly, Africa as a continent did not meet the Maputo Declaration target of allocating 10 percent of public expenditure to agriculture. The average share of agricultural expenditure declined from 3.6 percent in 2003 to 2.6 percent in 2014. Absolute levels of agricultural expenditure did increase over the period, however. This increase occurred despite the impacts of the global financial crisis of 2008–2009, the decline in official development assistance received, and more limited fiscal resources in general, as well as the high demand for public spending on other social services. Five countries met the target during the 2003–2008 and 2008–2014 periods, and several more came close.

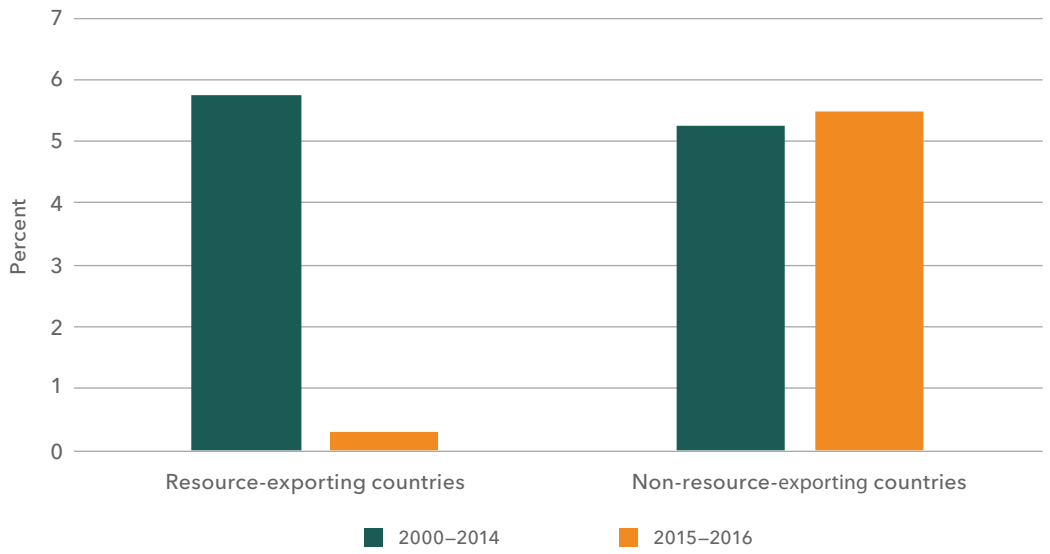
CONTINENT-WIDE EFFORTS TO ACCELERATE CAADP

The year 2016 kicked off with a continent-wide campaign called "Seize the Moment" to accelerate implementation of the Comprehensive Africa Agriculture Development Programme (CAADP) and help ensure impact at the grassroots level. Led by African governments, the African Union Commission, the New Partnership for Africa's Development (NEPAD) Planning and Coordinating Agency, the African Development Bank, and the Alliance for a Green Revolution in Africa, the campaign seeks to keep agriculture as a priority and secure necessary political, policy, and financial commitments to achieve goals outlined in various national, continental, and global agreements, including national agriculture and food security investment plans.

The Seize the Moment campaign also seeks to enhance progress toward mutual accountability, under which stakeholders track their commitments and hold each other accountable for results and impact on the ground. The campaign has increased momentum for planning the first CAADP Biennial Review.

In addition to putting systems in place to support countries planning their second-generation agriculture and food security investments, the

FIGURE 1 Annual average GDP growth, 2000–2014 and 2015–2016



Source: Authors, based on data from IMF World Economic Outlook database, accessed October 31, 2016, www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx.

Notes: Includes projected and estimated data from 44 countries in Africa south of the Sahara (excluding South Sudan), grouped as resource-exporting or non-resource-exporting. Country growth rates are weighted by each country's share in overall group GDP. GDP =gross domestic product.

African Union Commission and the NEPAD Planning and Coordinating Agency laid out a roadmap for the Biennial Review process. The International Food Policy Research Institute (IFPRI) and Regional Strategic Analysis and Knowledge Support Systems (ReSAKSS) are providing technical support to countries and regional economic communities in the preparation of Biennial Review reports and second-generation investment plans. A task force comprising leading experts from IFPRI and other institutions will provide training, backstopping, and quality assurance for local and regional experts to support country-level analytical work.

DROUGHT IN EASTERN AND SOUTHERN AFRICA

The 2015–2016 El Niño event, one of the strongest on record, caused severe drought in southern and eastern Africa as well as flooding in parts of eastern Africa. Although the event ended in early 2016, its impacts on global weather patterns continue to affect agricultural production and food security. Countries across eastern and southern Africa experienced poor harvests in 2016, leading to rising food prices. Several governments declared national emergencies and issued appeals for humanitarian aid. For example, the Ethiopian government and development partners called for aid in August 2016 for 9.7 million people in need of food and other assistance.[5] As of November 2016, the Southern African Development Community (SADC) projected that 41 million people in southern Africa would be affected by the drought in 2016–2017, of whom 28 million were already in need of immediate humanitarian assistance.[6] Although millions of people across the region were reached by humanitarian aid, large funding gaps remained, and the Famine Early Warning Systems Network (FEWS NET) projected that crisis conditions would persist in a number of countries throughout 2016.[7]

The drought highlighted the urgent need to increase the resilience of communities and countries, given the increasing frequency of climate shocks. SADC's Regional Humanitarian Appeal described progress made in establishing national resilience strategies in Malawi, Lesotho, and Zimbabwe, and called for further efforts to enhance resilience. These could include agricultural and financial innovations such as climate-smart agriculture, weather insurance,

and collective group savings, as well as strengthened social services and social protection systems.[8]

URBANIZATION, FOOD SECURITY, AND NUTRITION

Africa has been urbanizing rapidly for several decades, and the trend is expected to continue. The number of people living in cities nearly doubled between 1995 and 2015, and the urban population is expected to nearly double again over the next two decades.[9] Cities offer potential impetus to economic growth, but careful policy action is needed to ensure that benefits are realized. Urbanization in Africa appears to differ in some ways from that seen in other regions. City growth in Africa has been less concentrated, with small- and medium-sized cities growing faster than large cities.[10] For example, in rapidly urbanizing western Africa, 40 percent of the region's urban population lives in metropolitan areas, while the other 60 percent lives in secondary cities, often found near large cities and along highways and transport corridors.[11] A 2007 World Bank study found that urbanization is associated with falling poverty in most developing regions, but to a much lesser extent in Africa south of the Sahara.[12] Urbanization is often driven by rising agricultural productivity in rural areas and increasing industrial activity in urban areas, but neither of these trends has been as pronounced in Africa as in other regions.[13] Also, capital investments in Africa remain low compared to other developing regions, some of which increased infrastructure investments during periods of rapid urbanization and experienced greater poverty reduction.[14] Nonetheless, recent findings indicating that migration into smaller towns may be associated with more inclusive growth bode well for Africa. For example, a study from Tanzania and another study looking across developing countries found that migration to secondary towns or the rural nonfarm economy has a much larger effect on poverty reduction than does migration to metropolitan areas.[15]

One important potential benefit of urbanization in Africa, alongside the growth of a middle class, is the increasing demand from urban food markets for agricultural products. Urban areas account for a disproportionate share of food demand.[16] Demand for processed and nonperishable foods increases sharply as incomes rise, which presents opportunities for the expansion of value added and employment in post-farmgate segments of food value chains, such as processing.[17] Evidence exists that domestic small and medium agribusiness firms are increasingly active in storage, processing, transport, and wholesale and retail activities catering to urban markets.[18] To realize the employment and income benefits of growing urban food demand, though, domestic producers and firms must be able to respond to that demand rather than lose the opportunity to imports.[19] Necessary policy responses include urbanization strategies and urban planning to ensure the adequacy of infrastructure and services, as well as measures to enhance agricultural productivity, both on-farm and in processing and other downstream segments of value chains, to enable domestic producers to meet growing food demand.[20] Moreover, increased investments in basic market and road infrastructure services in small- and medium-sized cities that are more closely tied to the rural nonfarm economy are key for more inclusive growth, employment opportunities, and poverty reduction.

Urbanization and a growing middle class are associated with a dietary transition toward increased consumption of processed and animal-based foods, which can lead to serious nutritional challenges in the form of overweight and obesity. Over a dozen African countries already face the double burden of malnutrition characterized by the coexistence of undernutrition with overweight and obesity.[21] Although the double burden of malnutrition typically emerges as countries achieve middle-income status, evidence is growing that the problem is now emerging at earlier stages of countries' economic development.[22] African countries need to formulate food and agriculture policies that address food security without exacerbating the potential for overweight and obesity.

KEY CHALLENGES AND THE WAY FORWARD

Sustaining CAADP's momentum and realizing the ambitious 2014 Malabo Declaration commitments will require countries to intensify their implementation efforts and meet funding targets.[23] Countries will need to address challenges arising from limited technical and institutional capacities in planning and implementation as well as weak interministerial

coordination, and also strengthen mutual accountability platforms.[24]

Moderately higher growth is expected for Africa in 2017, but with commodity prices expected to remain low in the medium term, countries will need to adjust to a long period with a markedly different external environment than that of the 2000s. Countries that have been hardest hit, particularly oil exporters, will need strategies to restore macroeconomic stability, while countries still showing strong growth will need to be wary of their own rising debt and consider building buffers to guard against future crises.[25]

The severe drought in eastern and southern Africa and the scale of humanitarian need underline the urgency of strengthening the resilience of communities in the face of climate shocks. Efforts are underway at the continental and national levels to meet the Malabo Declaration commitment of enhancing resilience of livelihoods and production systems. The Africa Climate-Smart Agriculture Alliance, launched by the NEPAD Planning and Coordination Agency in 2014 in partnership with international research institutions and nongovernmental organizations, is working to develop national plans to scale up adoption of climate-smart technologies and practices in a number of countries. The African Union Commission and NEPAD Planning and Coordination Agency are coordinating technical support to help countries incorporate climate-smart agriculture into the next round of national agriculture and food security investment plans.

In light of urbanization, the rise of a middle class, and growing demand for processed and perishable foods, the private sector can play a key role in the food supply chain, operating in the processing, wholesale, retail, and transport segments. Governments must continue to improve the environment for private sector investments in agriculture and agribusiness through policy reforms that, for example, provide secure land tenure and favorable terms to access credit, or reduce barriers to licensing and input importation. Investments in infrastructure, such as roads and electricity, in cities of all sizes are critical. Policy reforms that encourage the consumption of healthier foods are also needed to address the double burden of malnutrition, in view of changing dietary patterns.

Middle East and North Africa

CLEMENS BREISINGER, FATMA ABDELAZIZ, AND NADIM KHOURI

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In the Middle East and North Africa (MENA) region, conflict and insecurity remained the key barriers to development progress in 2016. Although the world as a whole is reportedly a safer, less conflict-ridden place than at any other time in history, the MENA region suffers from continuing and increasing warfare.[1] Conflict remains most intense in Iraq, Libya, Syria, and Yemen, where the World Food Programme estimates that 40 million people (or about half of the population) are in need of humanitarian assistance.[2] Most other MENA countries are also directly or indirectly affected by conflict. The ranks of internally displaced persons as well as refugees fleeing conflict and its consequences have swelled to more than 25.5 million in the region.[3] Jordan and Lebanon shelter most of these refugees, at significant economic cost and with associated social tensions, despite some positive externalities created by refugees—including increases in local demand for goods that trigger production and jobs and an influx of international assistance.[4] Heightened regional security threats have also reduced the confidence of national and international investors and hampered the vital tourism sector in several countries, including Egypt and Tunisia. And there are signs of possible weakening of international support for relief and refugee assistance.[5]

LIMITED BENEFITS FROM LOW GLOBAL OIL AND FOOD PRICES

Continued low oil prices presented both a challenge and an opportunity for the region. Oil exporters such as the Gulf Cooperation Council countries and Algeria made steep spending cuts as their ample surpluses turned into significant deficits; these cuts may provide a starting point for reforms to promote sustainable economic transformation.[6] This need for economic transformation impelled 15 MENA countries to implement a total of 35 domestic reforms to facilitate the ease of doing business, a substantial increase over the annual average of 19 reforms over the past five years.[7] Oil-importing countries, on the other hand, had difficulty ensuring net overall gains from the prevailing low oil prices. Some countries, such as Egypt, seized the opportunity and reduced fuel subsidies, but these gains for the budget and people were largely offset by slowing remittance and foreign aid inflows from the oil-exporting Gulf countries.[8] In addition to reductions in fuel subsidies, Egypt implemented a courageous and comprehensive macroeconomic reform program that included introduction of a value-added tax and a floating exchange rate regime.

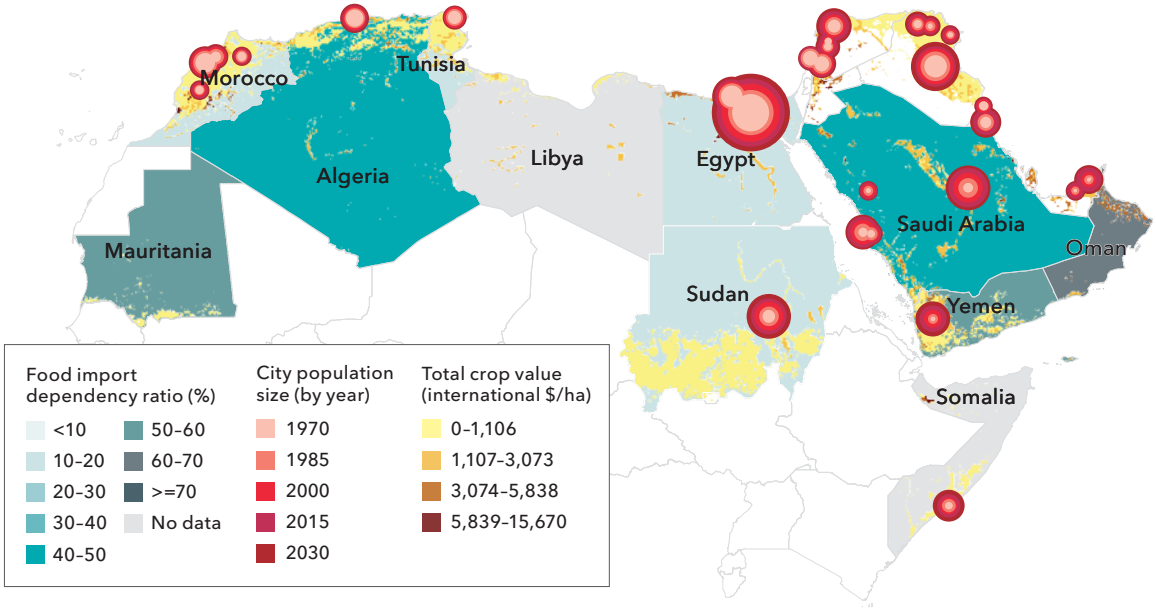
Continued low global food prices should benefit MENA countries, which are all net food importers (Figure 1). In countries experiencing conflict, however, reduced agricultural productive capacity and disrupted trade routes drove up the prices of both locally produced and imported staples.[9] Other developments also limited the impact of low global food prices. Morocco and Somalia experienced drought conditions that had serious effects on crop output, grazing resources, and livestock.[10] In Egypt, partly as a result of the macroeconomic reforms mentioned above, consumer price inflation reached 16.4 percent year-on-year in August 2016.[11] Some of the effects of rising prices were buffered by the Egyptian government's increased food subsidy allocation and its new cash transfer program, Takaful and Karama (Solidarity and Dignity).[12] While these measures are important to protect the poor in the short run, better targeting of food subsidies and, potentially, a move toward targeted cash transfers in the medium run would make Egypt's social safety net spending more effective and efficient.

POPULATION GROWTH, URBANIZATION, AND FOOD SECURITY

Rapidly growing populations and the related increase in food consumption are likely to increase MENA countries' dependence on food imports. Countries with sizable agriculture sectors, such as Egypt, Morocco, Sudan, and Tunisia, generally have a low food import dependency ratio of between 10 and 20 percent—that is, food imports account for 10 to 20 percent of food consumption (Figure 1).[13] The import dependency ratio of all other MENA countries exceeds 30 percent, with Iraq, Mauritania, Oman, and Yemen reaching about 50 percent, and Gulf countries such as Djibouti, Kuwait, and the United Arab Emirates reaching up to 70 percent. Over the past 40 years, the import dependency ratio remained relatively constant in most MENA countries, largely due to rapid increases in crop yields and, in some cases, policy changes that allowed market forces to trigger the production of higher-value crops. Scope still remains for increasing agricultural output in the region—but additional land and water resources for crop production are limited; climate change is expected to reduce crop yields; and fast-growing cities are encroaching on (often fertile) agricultural land.[14] To ensure future food security, MENA countries should be prepared to import more food from international markets in the near future.

The share of people living in urban areas is projected to overtake the share living in rural areas in most MENA countries by 2030—with the notable exceptions of Egypt, Somalia, Sudan, and Yemen. In combination with population growth and rising incomes, urbanization can be expected to increase the demand for processed foods. This likely trend provides an opportunity for agroindustry-led economic transformation in the MENA region to generate employment opportunities, improve food security, and reduce poverty.[15] To support such a transformation process, the business climate will need to be improved. Providing a conducive legal

FIGURE 1 Food import dependency, agricultural value added, and city growth in MENA



Source: Arab Spatial 2016. Prepared by Ecker and Guo (2016) based on data from UN-DESA (United Nations Department of Economic and Social Affairs, Population Division), World Urbanization Prospects: The 2014 Revision (2016), https://esa.un.org/unpd/wup/CD-ROM/; FAOSTAT (Food and Agriculture Organization of the United Nations, Statistics Division), Food Balance Sheets, http://faostat3.fao.org/download/FB/*/E, both accessed on September 14, 2016; L. You, U. Wood-Sichra, S. Fritz, Z. Guo, L. See, and J. Koo, Spatial Production Allocation Model (SPAM) 2005 v2.0., October 27, 2016, http://mapspam.info.

Notes: Cities are defined here as urban agglomerations with more than 1 million inhabitants in 2015. For more information on calculation of the food import dependency ratio, see endnote 13.

framework, adequate infrastructure, and an attractive tax environment can create incentives for the private sector to invest in agroindustries. Establishing one-stop shops for property registration and investment advisory services can accelerate the process of starting a business. And empowering local governments can promote development of local agroindustrial clusters and industrial parks.[16] In the case of food processing industries, increased enforcement of food safety regulations and consumer protection should be encouraged.

From a political economy point of view, the growing importance of agroindustries may increase the "weight" of urban areas in the MENA region in influencing national food security strategies—furthering the rural-urban synergy and balancing the impact of national and local actions. This would be consistent with the global trend in urban food security. In an effort to promote more sustainable city growth and expansion of food supplies, a number of MENA cities (including Algiers, Dubai, and Tunis) joined the Milan Urban Food Policy Pact, which links more than 125 cities worldwide—with a total population of more than 460 million—in pursuit of new urban development principles.[17] The pact follows on UN-Habitat's call for increased devolution of powers to cities and better linkages and integration of cities with their regional environments and economies. Such initiatives, along with continued and longer-term efforts for effective family planning, offer some hope for better urban dynamics in the MENA region.

OUTLOOK FOR 2017

Whether through the intensification of war operations or the success of fledgling peace-building efforts, 2017 can be expected to be a decisive year for at least some of the countries most affected by war—Iraq, Libya, Syria, and Yemen. The international community should stand ready to support post-conflict reconstruction plans and increase its support to those MENA countries hosting refugees. Tackling the root causes of conflict (and thus a major source of refugees) must be a key part of a comprehensive strategy for the MENA region. Such development collaboration should focus on policies and investments that address poverty, unemployment, and food and nutrition insecurity as economic causes of conflict and discontent. In addition, those countries suffering from spillover effects of regional security threats and related macroeconomic challenges should be encouraged and supported in implementing their domestic reform agendas.

The ongoing economic challenges are a reminder of the high food import dependency of all MENA countries. Assuming that the global prospects for food commodities continue to be positive into 2017, the MENA region should have no problem—on average—producing and importing sufficient food, especially in countries and areas with no conflict. But the region should start preparing strategies to deal with growing food import dependence, especially in view of rapid urbanization and population growth. Such strategies should include: reconsideration of unsustainable production support policies favoring the production of staple foods at all costs; improved targeting of subsidies toward food and nutrition security of the poor; investment in grain reserves, hedging, and diversified food import portfolios; export-led growth to earn foreign exchange for food imports; and economic transformation that creates opportunities for rural (and increasingly urban) households to earn income from nonagricultural sources.

Today's challenges are not new, but the region has not yet found ways of addressing them. Perhaps some new thinking can emerge from the dialogue between the region and the "outside" world. To that end, three thought-provoking questions may offer some ways forward for the region: (1) Can the international fatigue with respect to external donations to refugees in the region be compensated—or perhaps averted—by an increase in the level of support from the region itself? (2) Can MENA countries and the European Union, as neighboring regions, revive and strengthen their longstanding links—especially in the areas of investment, tourism, food trade, and development cooperation? (3) Can MENA countries—especially the non-oil-exporting countries—use the current respite from high commodity prices and the challenges posed by fundamental macroeconomic problems to engage in long overdue structural reforms? Many countries in the MENA region are at a critical crossroads, and 2017 may be a decisive year for determining the long-term direction these countries take.

Central Asia

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Since late 2014, the Central Asian countries—Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan—have been adjusting to severe external shocks, particularly declining commodity prices (oil, natural gas, and gold) and economic slowdowns in the region's key trading partners (Russia and, to a lesser extent, China). While slight recoveries in commodity prices provided some economic stability in 2016, policy makers continue to deal with the impact of the shocks on the region's households, which have been directly affected through remittances and exchange rates.

This has had clear implications for food security, especially in rural areas. While urbanization rates vary across the five countries, ranging from 27 percent in Tajikistan to 53 percent in Kazakhstan, roughly three-fifths of all Central Asians live in rural settlements.[1] The rural population also accounts for the majority of labor migrants from Central Asia, who have encountered fewer job opportunities and greater legal restrictions since the beginning of the economic slowdown in Russia. This could have exacerbated the prevalence of undernourishment among women and children living in rural households, who were already at greater risk than their urban counterparts. For example, more than 27 percent of Tajikistan's rural children were found to be stunted, compared to 21 percent for urban children.[2] On the other hand, the effects of overweight, an increasingly common form of malnutrition in Central Asia, are more likely to be felt in urban areas. For example, 38 percent of urban women in Tajikistan were found to be overweight, compared to 28 percent in rural areas.[3]

ADJUSTING TO EXTERNAL SHOCKS

The economies of Central Asia showed some signs of stabilization in 2016, despite continuing challenges created by the external environment. Partial recoveries of oil and metals prices provided some support to the economies of Russia and Kazakhstan. Other Central Asian countries, such as Kyrgyzstan, Tajikistan, and Uzbekistan, benefited not only from recovering commodity prices but also from a less volatile environment for trade and remittances.

Likewise, exchange rates for regional currencies generally became more stable in 2016 after undergoing significant depreciation in 2015. The Russian ruble appreciated relative to the US dollar, reflecting the recovery in the price of oil.[4] The national currencies of Kazakhstan and Kyrgyzstan each appreciated by more than 10 percent during the first three quarters of 2016, while the nominal exchange rate of the Tajik somoni showed little change relative to the US dollar throughout most of the year. Relatively steady exchange rates and subdued demand were largely responsible for stable consumer prices, including food prices.

Demand for migrant labor from Central Asia also stabilized somewhat, although data suggest this has been experienced unevenly. According to the Federal Migration Service of the Russian Federation, the number of registered labor migrants from Tajikistan and Uzbekistan continued to decline, albeit at slower rates than in previous years, as a result of tightened rules and procedures for labor migration. The number of officially registered labor migrants from Kyrgyzstan increased in 2016 on the other hand, possibly because they faced fewer legal and procedural hurdles after Kyrgyzstan became an official member of the Eurasian Economic Union in August 2015.

The combination of rebounding labor migration and a stronger ruble led to a 21 percent increase in remittance flows in nominal US dollar terms from Russia to Kyrgyzstan in the first three quarters of 2016 compared to the same period in 2015 (Figure 1). Appreciation of the ruble also mitigated the decline in the total value of remittances from the Russian Federation to Tajikistan and Uzbekistan. Despite this, official data indicate that remittance

flows from Russia to Tajikistan and Uzbekistan continued to decline, falling by 14.5 percent and 14.3 percent in US dollar terms, respectively, in the first three quarters of 2016 compared to the same period in 2015.[5] However, remittances—accounted in the national currencies of these countries—began recovering to some extent. For instance, inflows of labor remittances to Tajikistan accounted in real somoni terms increased by 2.4 percent in the first half of 2016 over the same period in 2015.[6] Household-level data from the World Bank's *Listening to Tajikistan* survey also suggest that remittances began to recover in 2016 in real somoni terms. But the data also indicate that remittance income of households in the bottom two quintiles declined by about 9 percent, while that of the top three quintiles increased by about 16 percent, suggesting that poorer households were harder hit by the crisis.[7]

Continuing external shocks have left the region with weaker growth prospects. After growing by 5 percent on average in 2015, the region's economy was expected to grow by 3.8 percent in 2016 as a result of uneven growth rates across countries in the region. For example, the Kazakh economy was expected to contract by nearly 1 percent after growing by 1.2 percent in 2015. Economic growth in other Central Asian countries was also expected to be considerably slower in 2016, despite expansionary fiscal policies.[8] Slower economic growth and uneven recovery in remittance income may have reduced household food security, especially for poor households, in Central Asia.

AGRICULTURAL DIVERSIFICATION AND NUTRITION

Amid rising risks from external factors such as commodity price shocks, Central Asian countries are increasing their focus on agricultural diversification as a means of addressing multiple issues related to agricultural development and food security.[9] Given the sizable share of agriculture in national economies, governments in Central Asia generally recognize that agricultural diversification and the development of horticulture, particularly fruit and vegetable production, could benefit from export opportunities created by Russian countersanctions.[10] The countersanctions banning agricultural imports from Western countries came into force in August 2014 and are expected to remain in place through 2017.[11] Central Asian countries are increasingly shifting from traditional agricultural crops to intensive horticulture to boost export earnings and increase market share in the vital Russian market.

The Uzbek government established the joint-stock company Uzagroexport, which specializes in exporting horticultural products.[12] Similar initiatives are being implemented in Kazakhstan, Kyrgyzstan, and Tajikistan. Moreover, Uzbekistan has increased cooperation with international development agencies to improve farming practices, provision of seeds and seedlings, storage, and marketing. Development partners, including the World Bank, the Asian Development Bank, and the US Agency for International Development, have increased their support for intensive horticulture to increase yields and improve farmers' skills and knowledge.[13]

In addition to agricultural diversification, some Central Asian countries have embraced the need to address malnutrition.[14] National governments are beginning to pay attention to the double burden of malnutrition, under which a population paradoxically suffers from both insufficient caloric intake and overweight and obesity. Uzbekistan approved a national program and action plan for healthy nutrition for 2015–2020 and established a national education and clinical center to address nutrition.[15] In this regard, the diversification of agricultural production could further national nutrition goals by providing greater diversity and more nutritious foods.

REGIONAL INTEGRATION

Poor integration and regional cooperation have been serious obstacles to development in the region. The World Bank's *Doing Business* survey indicates that the five Central Asian countries rank well below the global average in terms of speed and cost of cross-border trade.[16] Some Central Asian countries have recently taken steps to improve institutions and infrastructure to facilitate regional integration and trade. This is important for food security, because these countries rely on food imports to make up for shortfalls in domestic production. An annual report by the Central Asia Regional Economic Cooperation Program suggests an overall trend toward harmonization of border-crossing procedures in recent years.[17] In July 2016, Uzbekistan lifted a ban on exports of fruits and vegetables by truck, which it

had imposed in September 2015 in an attempt to limit Kazakh re-exports of Uzbek fruits and vegetables to Russia.[18] Following the death of Uzbek president Islam Karimov in September 2016, the successor administration tentatively signaled an easing of travel and trade restrictions with neighboring countries.

Some of the movement toward greater integration has been spurred by initiatives led by foreign partners, such as China's "One Belt, One Road" project. Under this initiative, Central Asian countries would serve as nodes in a transcontinental infrastructure corridor, facilitating trade between Western Europe and East Asia. China has already invested heavily in logistics and road construction projects in Tajikistan and Kyrgyzstan. In May 2016, Chinese companies pledged a total of US$1.9 billion in investments to develop Kazakhstan's food processing capacity, including US$1.2 billion for oilseed processing alone.[19] However, China's growing involvement in Central Asian agriculture has also sparked debate: protests against a proposed land leasing program in Kazakhstan in early 2016 were reportedly stoked by fears that land would be leased to Chinese tenants at the expense of local farmers.[20]

Kyrgyzstan's accession in 2015 to the Eurasian Economic Union (EAEU)—which also includes Armenia, Belarus, Kazakhstan, and Russia—is another example of regional integration, though it raises questions about the country's economic niche and relations with neighboring nonmember countries. Preliminary results from a joint International Food Policy Research Institute–University of Central Asia study suggest mixed benefits for Kyrgyzstan, which will reportedly benefit from generous provisions in terms of shared customs duties while suffering a short-term decrease in national gross domestic product growth.[21] The decline of the Kyrgyz re-export industry, which has leveraged low national tariff rates to redirect Chinese and other foreign goods throughout Central Asia, has been directly attributed by some analysts to EAEU accession.[22]

FIGURE 1 Total remittance inflows from Russia (2010–2016, quarters 1–3)

Source: Central Bank of Russia.

The same study suggests that lower-income households may benefit from Kyrgyz membership in the EAEU in part because of remittances. Kyrgyzstan has fared better in terms of migration and remittances than other major migrant-sending countries in the region. As citizens of an EAEU member state, Kyrgyz migrants are not subject to the strict visa and labor market regulations that were imposed by Russia as a response to its economic crisis.

However, Kyrgyzstan continues to face significant challenges in terms of upgrading its sanitary and phytosanitary practices to comply with EAEU standards and regulations. Other member countries demanded an audit of Kyrgyzstan's safety standards in the run-up to its accession. While most sanitary and phytosanitary controls on the Kazakh border were officially removed after Kyrgyzstan joined the EAEU, veterinary controls remained in place so that Kyrgyz authorities could finish implementing the remaining provisions.[23] Nevertheless, the Kyrgyz transition to the common market has faced some resistance from authorities in other member states. In May 2016, the Kazakh agricultural ministry banned the import of Kyrgyz potatoes, citing the discovery of parasites. The ban was lifted the following month after a meeting of the two countries' presidents, but the episode highlighted weaknesses in the EAEU's governance mechanisms and Kyrgyzstan's difficulty in fully benefiting from its access to the common market.[24] Kyrgyzstan's experience can be instructive for neighboring countries, particularly Tajikistan, where speculation persists over whether it will join the EAEU in the future.

LOOKING FORWARD

The modest improvement in the region's growth outlook primarily reflects the partial recovery of commodity prices. Relatively stable commodity export revenues are expected to further bolster the Russian economy and other commodity-exporting countries such as Kazakhstan. The slight, but noticeable, improvement in the economies of these countries is expected to boost growth prospects, household welfare, and food security elsewhere in the region through trade, investment, and remittances.

Central Asian countries will nonetheless remain vulnerable to external shocks, given longstanding institutional and structural constraints and their impact on productivity and investment.[25] Another decline in commodity prices or the emergence of new problems in the Russian economy may produce further setbacks to economic growth, household welfare, and food security in the region. To reduce this risk, the Central Asian countries need to lessen their dependence on commodity exports and remittance inflows, diversify their economies, and improve domestic employment opportunities. The development of the horticulture sector and allocation of land for high-value crops have potential to address these needs.

Despite some recent steps toward addressing malnutrition in the region, Central Asian countries do not have well-established monitoring and evaluation frameworks to support evidence-based policy making in this area. Establishing such frameworks and systematic data collection efforts are necessary to measure progress in achieving nutrition goals.

South Asia

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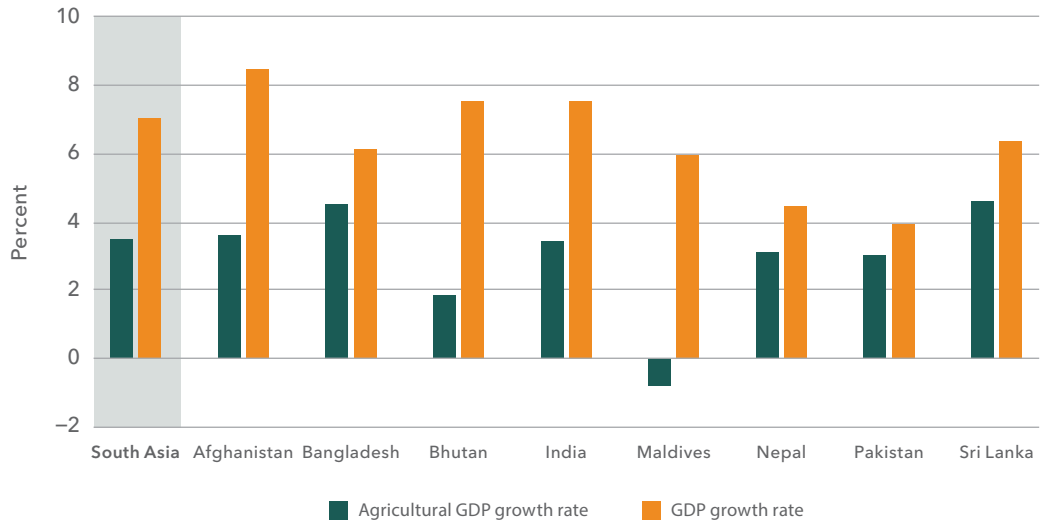
Led by robust economic growth in India, South Asia remains the fastest growing region in the world. Regional economic growth is projected to reach 7.1 percent in 2016 and 7.3 percent in 2017.[1] The region's limited exposure to global turbulence, combined with increasing investment in agriculture and food systems, is keeping growth prospects strong (Figure 1).[2] All South Asian countries achieved the Millennium Development Goal of reducing poverty by half well ahead of the 2015 deadline and have shown consistent improvement in human development and nutrition indicators. The Global Hunger Index (GHI) for South Asia declined from 47.7 in 1990 to 29.0 in 2016, moving from the "alarming" to "serious" category.[3] Poverty and undernourishment are still causes for concern, however—about one-fourth of the population is poor, and the region is home to more than 35 percent of the world's poor (more than 300 million people). Some 63 million children in South Asia are stunted and 26 million are wasted, and 208 million women are anemic.[4]

URBANIZATION AND FOOD SECURITY

South Asia's urban population grew by 186 million between 2001 and 2015—more than the entire population of Japan—and is expected to expand by almost 250 million more in the next 10 years.[5] The benefits of urbanization, including economic growth and structural transformation, are evident in the region. Manufacturing and services now account for more than 80 percent of gross domestic product (GDP). Despite the mammoth increase in absolute urban population, the pace of urbanization in South Asia

FIGURE 1 Growth rates in GDP and agricultural GDP in South Asia, 2003–2015



Source: World Bank, World Bank Open Data, accessed on November 1, 2016, http://data.worldbank.org/.

Notes: For India and South Asia, the agricultural growth rate is for 2003–2014. GDP = gross domestic product.

is slow compared to that of both the East Asia and Pacific region and the historical experience of developed countries. Urbanization levels are lowest in Nepal (19 percent) and Sri Lanka (18 percent), while Bhutan (39 percent), the Maldives (46 percent), and Pakistan (39 percent) are the most urbanized countries in the region (Figure 2).

Urbanization poses a considerable challenge to South Asian food security. Most urban dwellers are net food buyers and spend a significant portion of their disposable income on food. The 2007/2008 food crisis demonstrated the vulnerability of urban populations, especially slum dwellers, to shocks in agricultural markets.[6] Large urban settlements in South Asia are marked by widespread slums, and the share of the urban population living in slums is high (with the exception of Bhutan and Sri Lanka), ranging from 17.1 percent in India to 88.6 percent in Afghanistan.[7] At least 130 million people—more than the entire population of Mexico—live in informal urban settlements in South Asia.[8] Slum populations often do not have access to water and sanitation facilities, making residents more likely to suffer from disease and malnutrition. Developing strategies to address the food security risks faced by these vulnerable urban residents should be a policy priority.

Urban food consumption patterns are not uniform across South Asia, but some common trends emerge. Food accounts for a smaller share of consumption expenditure in urban areas than in rural areas, and urban households have more diverse diets than do rural households.[9] Food consumption patterns are changing across the region, with consumption of noncereals growing in both rural and urban areas.

INITIATIVES TO IMPROVE FOOD AND NUTRITION SECURITY

Bangladesh's record in addressing food and nutrition insecurity has been remarkable, including one of the fastest prolonged reductions in child stunting in the world—stunting dropped from 55 percent in 1997 to 36 percent in 2015. The government's dedication to improving food and nutrition security is reflected in its commitments at the Nutrition for Growth Summit, engagement in Compact 2025, enactment of a National Nutrition Policy, and its planned nutrition-focused health program.

India faces a paradoxical situation—its rapid economic growth is coupled with a much slower decline in undernutrition. The country continued implementing its National Food Security Act, Mid Day Meal Scheme, and Anganwadi Centres to tackle food and nutrition insecurity.[10] India also launched a new health protection scheme for the poor and an initiative to ensure that below-poverty-line families

FIGURE 2 Urban population as percentage of total population in South Asia, 2001–2015

Source: World Bank, accessed November 1, 2016, http://data.worldbank.org/.

are provided with government-subsidized cooking gas connections.

Nepal's new constitution, promulgated in 2015, established a fundamental right to food. This change, together with the possibility of a food crisis resulting from natural disasters and external shocks, brought the issue of food and nutrition security to the forefront of the policy agenda. Nepal set ambitious targets for reducing food and nutrition insecurity, putting emphasis on basic foodstuffs in 2016.[11] Initiatives include strengthening the food supply system, especially in remote areas, introduction of identity cards for poor families in order to better target poverty alleviation and safety net programs, programs promoting dietary change, and incentives to increase food production.

Along with Bangladesh and Nepal, Pakistan is a member of the global Scaling Up Nutrition (SUN) movement and various networks associated with SUN designed to improve nutrition. An Academia and Research Network for SUN activities was launched in May 2016 in Islamabad. Pakistan's provinces have taken steps to improve their food and nutrition situation following devolution of power beginning in 2010, and with support from UNICEF and other partners, developed a multisectoral strategy to help reduce malnutrition.

INITIATIVES FOR AGRICULTURAL GROWTH

Several programs and policies were introduced in South Asia in 2015 and 2016 to boost agricultural productivity through sustainable, diversified, and climate-smart agriculture. Across the region, a renewed focus on the farm sector was reflected in increased investments.

Nepal increased its agricultural budget by about 40 percent. The government announced an ambitious agriculture modernization program aimed at attaining self-sufficiency in staple crops, fruits, and vegetables and designated Specialized Agriculture Production Areas for strengthening value chains. Other new policies include an Agricultural Mechanization Promotion Policy, a National Food Safety Policy, an Agribusiness Promotion Policy, seed regulations, establishment of a technical school for agriculture entrepreneurs, and grants and subsidies in specialized agricultural areas such as construction of tissue-culture laboratories for bananas and potatoes and fish production ponds.

Bangladesh is committed to diversifying toward more nutritious and high-value crops. The government is emphasizing seed production activities including biotechnology and facilities and infrastructure for hybrid and biofortified high-zinc rice seed and Bt eggplant seed production, marketing, and development. A new national seed policy is being developed to support the establishment of a commercially oriented seed industry capable of meeting domestic needs and competing in regional and global seed markets. Timely supply of fertilizers to meet increasing demand and pragmatic measures to encourage farmers to use fertilizers to maintain soil fertility are also being given priority. Irrigation using surface and rainwater will be encouraged along with cultivation of water-efficient crops in drought-susceptible zones.

Bangladesh also plans to promote smallholder dairy development through supply chain development and integration with crop and fish culture. Policies under the seventh Five Year Plan (2016–2020) will include better access to credit and subsidies for marginal farmers. In the context of fisheries, the government plans to enhance productivity, livelihood security, and equitable distribution of benefits, while promoting conservation of fisheries and aquatic biodiversity. Further, a public-private collaboration for technology development and diffusion, particularly for mechanization based on traditional devices and solar power, is being promoted.

In India, the government prioritized agriculture in 2016 with a pledge to double farmers' income by 2022 and an annual budget supportive of the agriculture sector.[12] New initiatives include a crop-insurance scheme that is path-breaking in terms of coverage and use of technology, and a dedicated long-term irrigation fund with an initial endowment of US$3 billion. The government launched a Unified Agricultural Marketing e-Platform in April 2016, a big milestone in improving farmers' access to markets. The tax structure was reformed under the concept of "one nation, one tax" with a new tax on goods and services; the new tax regime is expected to contribute to higher economic growth by reducing tax liabilities and leakage. In November 2016, the Government of India moved to curb the "black money" economy and reduce tax evasion, abruptly announcing that the largest rupee notes (Rs. 500 and Rs. 1000) would no longer be legal tender. The impact

of demonetization on agricultural production and incomes, demand, and credit in rural areas in 2017 bears watching.

Pakistan's Ministry of National Food Security and Research drafted an agriculture and food security policy to promote long-term agricultural growth.[13] Responsibility for agricultural policy lies primarily with the provincial governments, however. The Punjab government earmarked US$956 million for fiscal year 2016/2017, beyond its routine allocation to the sector, to address farm community issues and food security.[14] The provinces of Punjab, Sindh, and Khyber Pakhtunkhwa announced a 50 percent subsidy for agricultural machinery.[15] Pakistan's provincial governments also drafted separate agriculture and food policies, and the Federally Administered Tribal Areas drafted policies on sanitation, drinking water, and agriculture.[16]

Afghanistan's National Agricultural Development Framework has four key programs: Natural Resource Management, Agriculture Production and Productivity, Economic Regeneration, and Programme Support and Change Management.[17] Major recent priorities include wheat seed distribution, land-lease reform, efficient use of government lands, enhancement of farmers' productivity, access to credit, and the Comprehensive Agriculture and Rural Development Facility to identify development gaps.

Sri Lanka launched an ambitious National Food Programme (2016–2018) that aims for self-sufficiency in five major food crops—potatoes, onions, chilies, maize, and soy. (It should be noted that policies striving for food self-sufficiency can be costly and inefficient.) In another major initiative to promote agricultural growth, Sri Lanka will support contract farming, based on a "small producer–large purchaser" model, as a means to strengthen integrated value chains. Other new measures for agricultural growth include a 50 percent interest subsidy to farmers, farmers' organizations, and agroprocessing establishments to increase use of agricultural machinery and equipment; removal of import duties on agricultural machinery and equipment; development of an automated commodity exchange; plans to import 15,000 high-producing dairy cattle and establish dairy development zones to boost local milk production; a proposal to establish 100 Integrated Inland Fishery Villages; and a rebate on chicken exports.

CHALLENGES AND OPPORTUNITIES

South Asian agricultural and food systems are at a crossroads. Climate variability and extreme weather events (such as droughts, floods, and temperature change) that threaten food and nutrition security are becoming serious challenges in South Asian countries. Unplanned urbanization is progressing rapidly and without critical civic amenities such as safe drinking water, drainage, housing, and hygiene facilities. The Government of India recognizes these problems and is ambitiously planning to create 100 "smart" cities by 2022—cities that are sustainable and citizen-friendly to improve urban living conditions.[18]

Food and nutrition security can be enhanced in South Asia by improving food and agricultural systems through increasing efficiencies, reducing postharvest losses, and developing the agroprocessing sector. Intraregional trade has considerable scope for growth: despite regional cooperation agreements, regional trade accounts for just 5 percent of South Asian trade compared to 25 percent in Southeast Asia.[19]

In 2017, South Asian countries are expected to reform their agriculture sectors, increase openness to trade, and take appropriate measures to adapt to climate change and weather uncertainties.

East Asia

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Food security and nutrition remain a top priority for East Asian countries, which are home to about 17 percent of the world's poor and 24 percent of the world's undernourished.[1] The strongest El Niño event of the past two decades made food security particularly challenging to achieve in 2016. Prolonged drought in the region led to declines in rice production, but high stock levels in place at the onset of El Niño kept world market prices largely in check. Over the longer term, increasing urbanization, economic growth accompanied by the rise of a middle class, and resultant changes in diets will pose challenges for food policy. East Asian countries will need to develop new policies to adequately deal with the changing structure of consumer demand and increasing market integration.

REGIONAL RICE ECONOMY

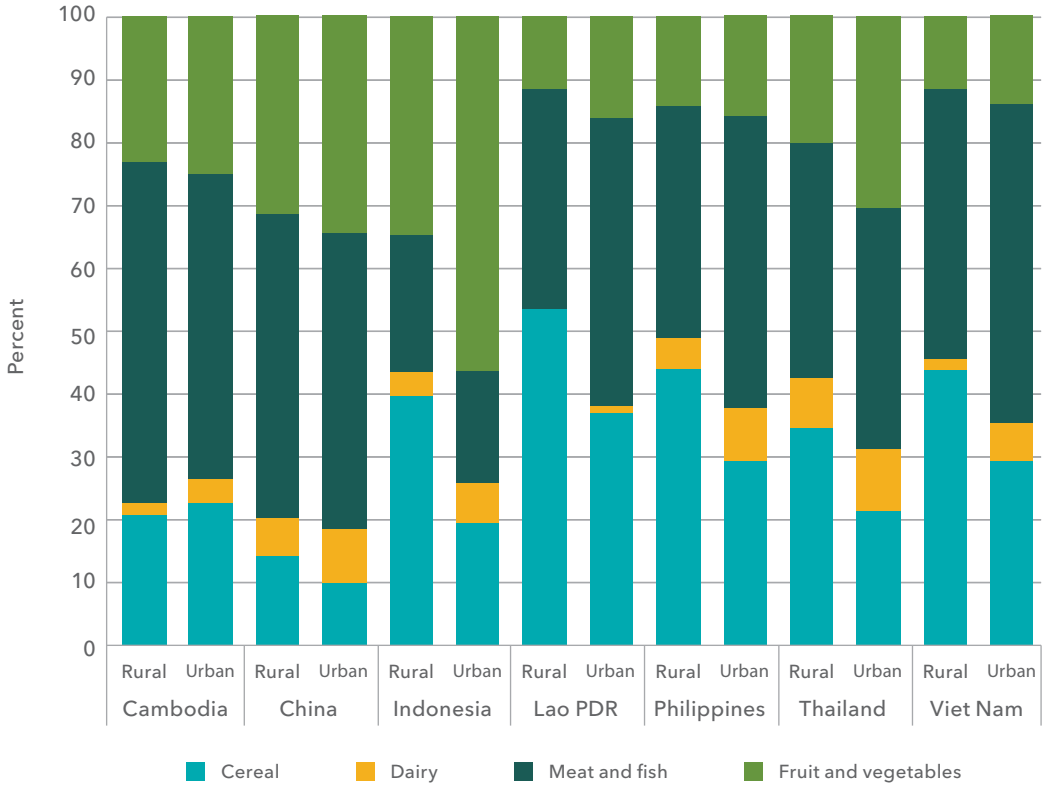
Although structural transformation has altered the role of rice in the agriculture sectors and overall economies of East Asia, rice remains a primary focus of the region's food policy. Despite its falling share, rice still provided about 43 percent of daily caloric intake in the region in 2013, and the share was even higher for the poor.[2] Rice is also the most important agricultural product in terms of domestic production value.[3] Thus for both poor consumers and farmers, a stable rice economy is critical to food security. With economic growth, however, governments have an increasing tendency to manipulate prices in favor of farmers, as evidenced in China, Indonesia, the Philippines, and Thailand in recent years.[4]

In the 2015/2016 season, rice production in the region declined by 0.9 percent, and exports from the region were forecast to decline by 0.5 percent in 2016, following a 4.1 percent decline the previous year. Global rice inventories at the end of 2015/2016 fell to 169.5 million metric tons, a decline of 2.6 percent.[5] While the global end-of-season stock-to-use ratio declined for the second straight year, it is still at a high level, well above that seen before, during, and immediately after the 2008–2009 global financial crisis. These high stocks helped to buffer the impact of the strong El Niño and moderate price increases. Some East Asian governments, including Indonesia and the Philippines, took action to meet demand and stabilized domestic prices through imports.[6] Thailand and Viet Nam remained the number two and three global exporters after India, while Myanmar, a re-emerging exporter (it was the world's leading exporter in the 1950s), is pursuing opportunities to open up the Association of Southeast Asian Nations (ASEAN) and other markets to absorb its domestic surplus and reduce its heavy reliance on the Chinese market.[7]

URBANIZATION AND FOOD VALUE CHAINS

Spurred by economic growth and urbanization, dietary diversity is increasing in China and Southeast Asia, and food value chains are changing both on-farm and beyond the farmgate. Data from the International Food Policy Research Institute (IFPRI) show that the share of cereal demand (in terms of quantity) declined by 12 percent from 2005 to 2015; in contrast, the share of meat and fish demand increased by 8 percent; the share of dairy and eggs rose by 30 percent; and the share of fruits and vegetables stayed steady during that period.[8] Furthermore, the consumption shares of various foods in terms of expenditure for rural and urban areas vary substantially (Figure 1). The consumption of cereals is typically much lower in urban areas, suggesting that room exists for substantial

FIGURE 1 Consumption share in terms of expenditure by product in rural and urban areas of East Asian countries, 2010



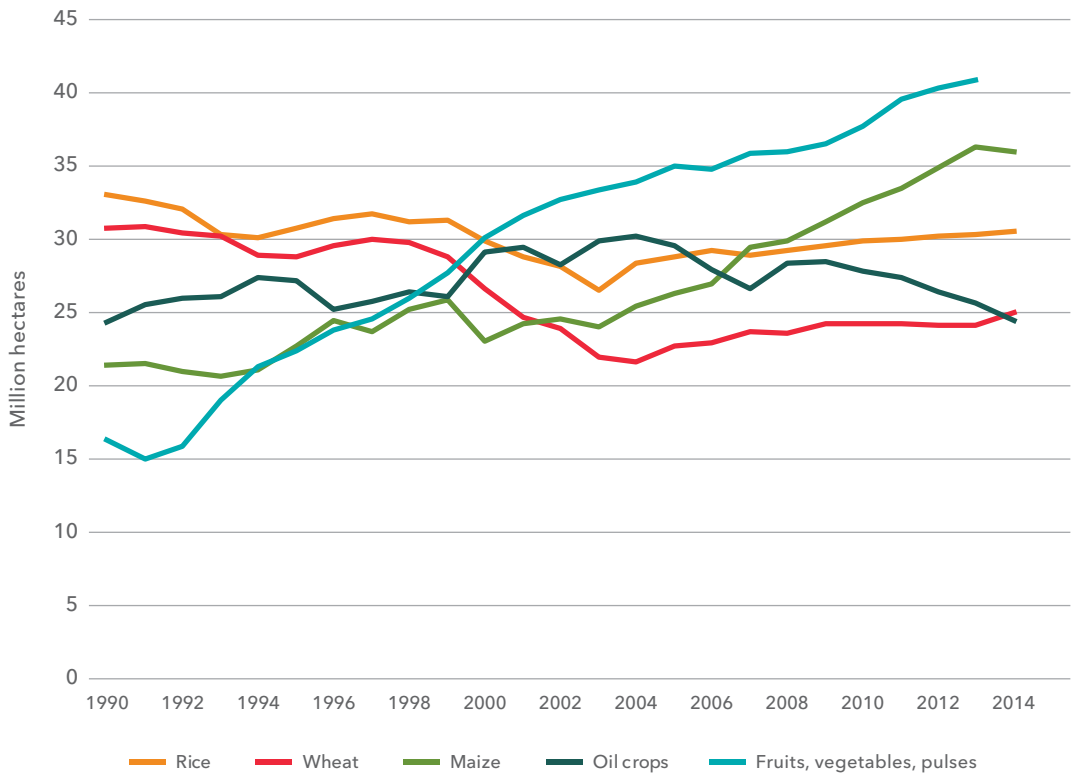
Source: World Bank, World Development Indicators, accessed September 29, 2016, http://data.worldbank.org.

expansion of demand for nongrains if economic growth and urbanization continue.

Government policies have not always kept pace with changing consumption patterns, often because they are focused on cereal self-sufficiency. Indonesia and the Philippines kept domestic rice prices well above world prices over the past 10 years, discouraging farmers from diversifying into higher-value crops. In recent years, China also maintained domestic rice prices at high levels, which, among other effects, increased informal border trade with Viet Nam and Myanmar. China's 2016 Number One Central Document, however, emphasizes that the country's production structure must meet diverse consumption demands, with enterprises encouraged to "go overseas" to trade and invest.[9] China also initiated a supply-side reform in agriculture under the 13th Five Year Plan, establishing a market-oriented pricing system targeted at eliminating oversupply of some grains.[10] The area harvested of fruits and vegetables in China has tripled since 1990, while the area harvested of both rice and wheat has declined (Figure 2). Viet Nam recently instituted a subsidy for farmers who shift from growing rice to maize, due to concerns over rising imports of animal feed.[11]

Beyond the farmgate, while traditional "wet" markets remain important, the number of supermarkets has expanded rapidly. The modern food value chains associated with supermarkets often impose new demands on smallholders that make it difficult for them to connect to dynamic markets. East Asia will need to more effectively link smallholders to changing markets. One possibility is e-commerce, which directly links farmers and consumers and gives producers better market access and greater bargaining power. The Chinese government considers agricultural e-commerce a key to bridging the urban-rural gap, promising to "encourage the introduction of e-commerce into rural areas," and has earmarked hundreds of billions of yuan for construction of broadband Internet and e-commerce bases in rural areas.[12]

FIGURE 2 Crop area harvested in China, 1990–2014



Source: FAO (Food and Agriculture Organization of the United Nations), FAOSTAT, accessed October 24, 2016, www.fao.org/faostat.

BUILDING RESILIENCE

The strong El Niño of 2016 brought a reminder of the importance of infrastructure and preparedness for dealing with natural disasters and climate change. In response to the drought caused by El Niño, Malaysia, the Philippines, and Thailand took a series of short-term measures, including construction of temporary irrigation infrastructure, a ban on off-season cultivation, and subsidies to compensate affected farmers.[13] In the future, climate change is expected to increase the frequency of severe weather events (droughts, typhoons, and floods), threatening past food security gains. In view of this, China issued a new emergency plan for natural disasters and is seeking to increase the resilience of agriculture to natural disasters by scaling up agricultural insurance.[14] Modern technology can also improve disaster response—the Philippines, working with the Food and Agriculture Organization of the United Nations (FAO), used drones to assess damage from El Niño.[15]

Water and soil management will be critical to building climate change resilience, and East Asian countries are taking measures for adaptation. Thailand issued a mandate to investigate new water sources.[16] Both Thailand and the Philippines set up national plans for crop zoning, which matches appropriate crops to soil conditions and water supply.[17]

CONTINUED FOCUS ON FOOD SAFETY

In 2016, China revised its 2015 Food Safety Law, increasing administrative, civil, and criminal penalties for regulatory violations and calling for greater accountability for county governors.[18] China also launched pilot projects on the safety certification of edible agricultural products, and Walmart established a Food Safety Collaboration Center in Beijing in October 2016.[19] In Southeast Asia, the ASEAN Risk Assessment Centre for Food Safety was established to provide independent scientific opinion on food safety issues of common interest. It will promote adoption of common positions on food safety

measures and facilitate safe trade.[20] A number of capacity-building events were held, including the World Trade Organization's first workshop on food safety and an ASEAN workshop for representatives of ASEAN Food Reference Laboratories and national Food Reference Laboratories to harmonize food safety surveillance and assure reliable food testing.[21]

2017 AND BEYOND

The outlook for the region's economy and agricultural performance is positive. China's economic growth rate is expected to slow only slightly from 6.5 percent in 2016 to 6.3 percent in 2017.[22] Despite spillover from China's slowdown, the annual average growth rate of ASEAN countries is projected to increase to 5.2 percent over 2016–2020.[23] In the face of global economic headwinds, China and Southeast Asia will continue to be the engine of the world's growth.[24] With the transition to neutral El Niño conditions or a mild La Niña, the FAO predicts that rice production and exports will recover in the 2016/2017 season.[25] Although the European Union may restrict its duty-free rice imports from Cambodia and Myanmar over concerns about the actual origin of the rice, demand from China may pick up the slack.[26]

Two remaining challenges for East Asia's food security and nutrition situation are particularly worth noting. In light of Agenda 2030 and the Sustainable Development Goals, the first challenge is how to achieve sustainable growth when economic development, population growth, and climate change will likely exacerbate existing resource scarcity, environmental stress, and economic inequality. Needed will be more investment in resource-saving and environment-friendly technologies, a shift from costly self-sufficiency to deeper involvement in global food value chains, and more attention to inclusive growth. The second challenge is how to address the obesity problem, which is likely to be exacerbated by changing food value chains and increasing reliance on processed food.[27] Developing countries in East Asia should increase public awareness of healthy diets by designing appropriate regulatory frameworks and rolling out educational efforts, and should learn from positive experiences in Japan and Korea, developed countries that have managed to avoid an obesity epidemic.[28]

Despite the challenges, regional integration is expected to deepen. The potential failure of the Trans-Pacific Partnership as a result of domestic political considerations in the United States is likely to have significant implications in East Asia, including likely greater dominance of China in the regional economy and trade.[29] The new Asian Infrastructure Investment Bank has taken its first steps, announcing four development projects in Bangladesh, Indonesia, Pakistan, and Tajikistan.[30] In September 2016, the first China ASEAN Agriculture Forum was held in Nanning, China, signaling increasing emphasis on China-ASEAN agricultural relations.[31]

Integration of agricultural markets within ASEAN is high on the organization's policy agenda, reflecting its blueprint for establishing a common market. A major concern is that supply chains in key crops, operated by the private sector, are increasingly crossing borders, raising fears among producing countries of a loss of sovereignty and of missed opportunities for domestic industrialization and value addition.[32] Integration may prove unachievable unless appropriate policies and strategies are designed to defuse concerns over food security and rural poverty among policy makers and stakeholders. Given these concerns, it is not surprising that little progress has been made toward implementation of the common ASEAN market.[33] In particular, coordination of national food security policies and agreements on roadmaps for the development of regional food value chains lag behind.[34] Going forward, it will be important to monitor and evaluate the benefits and costs of agricultural market integration among the ASEAN countries and to observe whether progress toward integration is being made.

Latin America and the Caribbean

EUGENIO DÍAZ-BONILLA AND MÁXIMO TORERO

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The situation in the Latin America and Caribbean (LAC) region in 2016 reflected economic and political difficulties in several of the larger countries, climate-related impacts including drought associated with El Niño, and ongoing changes related to the region's high level of urbanization.

The LAC region produces an important share of the world's food. Regional production accounts for about 13 percent of the global total value of production (measured in purchasing power parity dollars) and 15 percent of total exports (measured in current US dollars).[1] The evolution of agricultural policies and production in most of the large LAC countries can be expected to strengthen the region's position as a food supplier.

The new Argentinian administration that took office in December 2015 allowed the peso to float, removing most currency controls and restrictions, which led to a devaluation of over 40 percent. In addition, export restrictions and permits were eliminated, as were export taxes for a variety of cereals, oilseeds, and fruits. For soybeans and byproducts, export taxes were reduced from 32–35 percent to 27–30 percent. Since then, high inflation has partially eroded the real devaluation. Argentina—along with other countries in the region—has suffered climatic problems. However, the country's exports of wheat, coarse grains, oilseed meals and oils, beef, and poultry are expected to show important increases for the 2015/2016 and 2016/2017 seasons (particularly wheat and maize).[2]

In Brazil, political turmoil and economic uncertainty related to the impeachment of President Dilma Rousseff combined with other shocks led to the worst recession in several decades. The economy declined for a second year, with gross domestic product (GDP) per capita down almost 5 percent in 2015. Brazil made important advances in reducing stunting and malnutrition over the last 10 years, but the country faces important fiscal challenges (budget issues were at the core of Rousseff's impeachment), with uncertain impacts on funding of the social programs that led to those advances. Within that complex context, however, Brazil's agriculture sector continues to grow, cushioned in part by depreciation of the Brazilian currency. At around 2 percent growth per year, though, this performance remains somewhat below the historical average.

Mexico's economy has grown at a modest but continuous rate, about 1.0–1.2 percent growth in annual GDP per capita. The country's agriculture sector grew by about 4 percent in 2015, also boosted by a two-year decline in the exchange rate of the Mexican peso against the US dollar. More recently, potential policy changes under a new US administration have opened a period of uncertainty, further depressing the Mexican currency.

In Colombia, the economy and the agriculture sector have both grown at a steady pace of about 2–3 percent annually. The government's accord with the largest guerrilla group (the FARC, using the Spanish acronym) was narrowly rejected in October, but a revised agreement was approved by the Colombian Congress in November 2016. As a result of the peace process, Colombia's agricultural area could expand, with the prospect of rural development and private investment in areas controlled by the rebels.

The collapse of the Venezuelan economy, which saw a fall of about 5 percent in GDP per capita in 2014 and 7 percent in 2015, creates a particularly worrisome situation. The decline in the price of oil, serious macroeconomic imbalances, and political confrontations are all contributing to acute shortages of food, medicine, and other basic necessities.

Other countries in South America were also affected by declines in the price of their primary exports, including oil, copper, and several agricultural products. Countries in Central America and the

Caribbean, on the other hand, benefited from the decline in energy prices and from the resumption of remittances (mainly associated with steadier growth in the United States), which reached US$25.5 billion—an average of 15 percent of GDP for the countries most reliant on remittances—according to estimates for 2015.[3]

The agreement to ban export subsidies reached at the World Trade Organization Ministerial Conference in Nairobi (December 2015) is a positive development both for the many LAC countries that are agricultural exporters and for food-importing countries that do not want their domestic markets disrupted by subsidized products. At the same time, MERCOSUR (a subregional trading bloc) negotiations with the European Union have stalled on long-standing issues related to market access (agriculture for Europe and manufactures for MERCOSUR), while the Trans-Pacific Partnership Agreement, concluded at the level of the executive branches for the countries involved (three of which are from LAC), faced an uncertain process of ratification as a result of US domestic politics, and was recently suspended by the new US administration.

At the bilateral level, Brazil and the United States agreed on mutual market access for beef, and the United States completed the technical steps to lift its phytosanitary restrictions on beef and lemons from Argentina.

CLIMATE AND ENVIRONMENT

Climatic developments related to El Niño led to the continuation of drought in Central America in 2015 and early 2016, particularly in the Dry Corridor, a semi-arid region covering nearly one-third of Central America, primarily in El Salvador, Guatemala, Honduras, and Nicaragua. The drought had negative impacts on the production of export crops (such as coffee), as well as staple crops (maize and pulses). About 3.5 million people were affected. For subsistence farmers in El Salvador, Honduras, and Nicaragua, below-average rainfall is estimated to have reduced production of red beans and maize. Honduras may lose 80 percent of its maize crop.[4] As El Niño tapers off, concerns have been turning to La Niña, which brings the possibility of excess rain, floods, and hurricanes.[5] On a separate note, the international prices of key staple foods for these countries have been low; this has helped to limit the negative effects of El Niño by keeping food imports more affordable.

Haiti, the poorest country in the region, also experienced extreme drought conditions, with more than half a million people out of its population of about 10 million estimated to be suffering from food scarcity due to decreased production.[6] In October 2016, the country was directly hit by the massive Hurricane Matthew, creating Haiti's worst humanitarian crisis since the 2010 earthquake. As of late 2016, the population in the southern part of the country was in dire need of medicine, clean water, and food to avoid an even worse humanitarian catastrophe.

El Niño also led to drought conditions in parts of Colombia, Mexico, Venezuela, northern Brazil, and the southern regions of Argentina and Chile, while generating excess rain in parts of Brazil, Peru, and eastern areas of Argentina, with negative impacts on a variety of crops and livestock production.

The increasing frequency of extreme weather events will require substantial investment in agricultural research and development (R&D) and in infrastructure to cope with this changing environment. In addition, while the advance of deforestation in the LAC region does not seem to have accelerated, it continues to require monitoring.[7]

URBANIZATION

LAC is the most urbanized developing region, with close to 80 percent of the population living in urban areas (Table 1).[8] The LAC region also has the highest average income per capita and the lowest share of the population in poverty (at US$3.10 per day, 2011 purchasing power parity) among developing regions.[9] Closely related to urbanization and relatively higher incomes, the region also saw an expansion of supermarkets before other developing regions.[10] Supermarkets make a greater variety of food available year-round, but they are also linked to consumption of more processed foods. The latter means that although levels of hunger in LAC are among the lowest based on the Global Hunger Index, the region also experiences more problems of obesity and related health problems than do other developing regions.[11]

The LAC region has a number of megacities, but rural migrants have also settled in smaller urban centers. Almost 60 percent of the region's urban

TABLE 1 Urban populations by region and city size

	Urban population (% of total population)	Urban population in cities of more than 1 million (% of total population)	Urban population in cities of 1 million or fewer (% of total population)	Non-urban population (% of total population)
East Asia and Pacific	52.9	na	na	47.1
Europe and Central Asia	65.1	19.2	45.8	34.9
Latin America and the Caribbean	**78.7**	**35.4**	**43.3**	**21.3**
Middle East and North Africa	60.5	23.0	37.6	39.5
South Asia	33.0	14.5	18.6	67.0
Africa south of the Sahara	37.7	15.0	22.8	62.3
High income	81.1	na	na	18.9
Low and middle income	48.4	19.2	29.2	51.6
World	53.9	22.0	31.8	46.1

Source: World Development Indicators database, accessed on September 30, 2016, http://data.worldbank.org.

Note: All the individual regions exclude high-income countries.

population live in intermediate and small towns of fewer than a million inhabitants.[12] The large percentage of the population living in intermediate and small towns distinguishes LAC from other developing regions, with the exception of the developing countries in Europe and Central Asia. Agricultural value chains and the structure of food production, employment, and consumption may differ for these two types of urban areas. Various hypotheses are being debated about the potentially different development patterns—including different impacts on poverty and growth—that arise from migration from rural areas to megacities as opposed to migration to smaller urban centers in the LAC region.[13] For instance, in some cases, aging populations may remain in areas characterized by subsistence production while younger populations move to larger urban areas. In other cases, including perhaps in some LAC countries, commercial agriculture may be keeping younger farmers in rural areas, in part supported by small and intermediate towns. These processes are also related to differing patterns of land atomization (that is, increasingly small parcels) or reconcentration driven by migration dynamics.

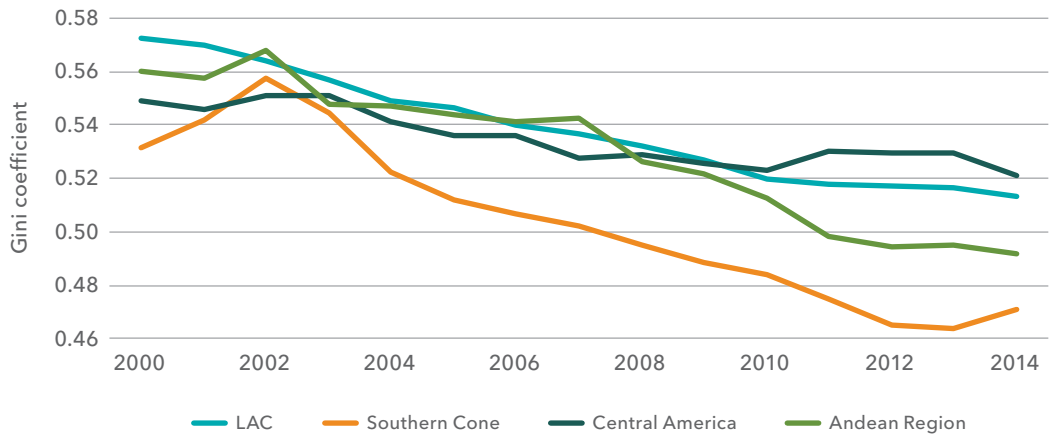
Despite improvements in incomes and declines in poverty, LAC remains the most unequal region in the world (with an average Gini coefficient—the standard measure of inequality—of about 0.51 for the countries with data), closely followed by Africa south of the Sahara (Gini of 0.47) (Figure 1). Moreover, important differences arise within the region, with a recent increase in inequality in the Southern Cone countries. In addition, and in contrast to other developing regions, most of LAC's poor are concentrated in urban areas, although the incidence of poverty is still greater in rural areas in many countries in the region.[14]

Urban centers in LAC are among those most affected by violence and crime, apart from countries at war. In fact, measured by the number of homicides per 100,000 people, the 8 most dangerous cities in the world and 42 of the top 50 are in LAC.[15] Violence and crime vary across countries, subregions, and neighborhoods, but poor urban and rural populations are both notably affected.[16]

LOOKING AHEAD

Global economic and financial uncertainties point to continuing economic difficulties for the LAC region in 2017 and beyond. These uncertainties will continue to hobble a region still burdened by economic recession in Brazil and Venezuela. LAC faces unique dynamics and challenges in relation to its food and nutrition security and poverty, in part related to the pattern of urbanization. LAC countries need to devise a coherent set of macroeconomic and sectoral policies to face the difficult times ahead, while stepping up medium- and long-term investments in education, infrastructure, R&D, and governance of

FIGURE 1 Inequality trends in LAC subregions, 2000–2014



Source: LAC Equity Lab tabulations of SEDLAC (CEDLAS and the World Bank) and World Development Indicators (WDI), www.worldbank.org/en/topic/poverty/lac-equity-lab1/income-inequality/inequality-trends. Updated April 2016.

Note: The Gini coefficient measures inequality, in this case of incomes, with values between 1 (completely unequal) and 0 (completely equal). Since the numbers presented here are based on SEDLAC, a regional data harmonization effort that increases cross-country comparability, they may differ from official statistics reported by governments and national statistical offices. The LAC aggregate is based on 17 countries in the region for which microdata are available; it does not include Haiti. In cases where data are unavailable for a given country in a given year, values were interpolated using WDI data to calculate regional measures.

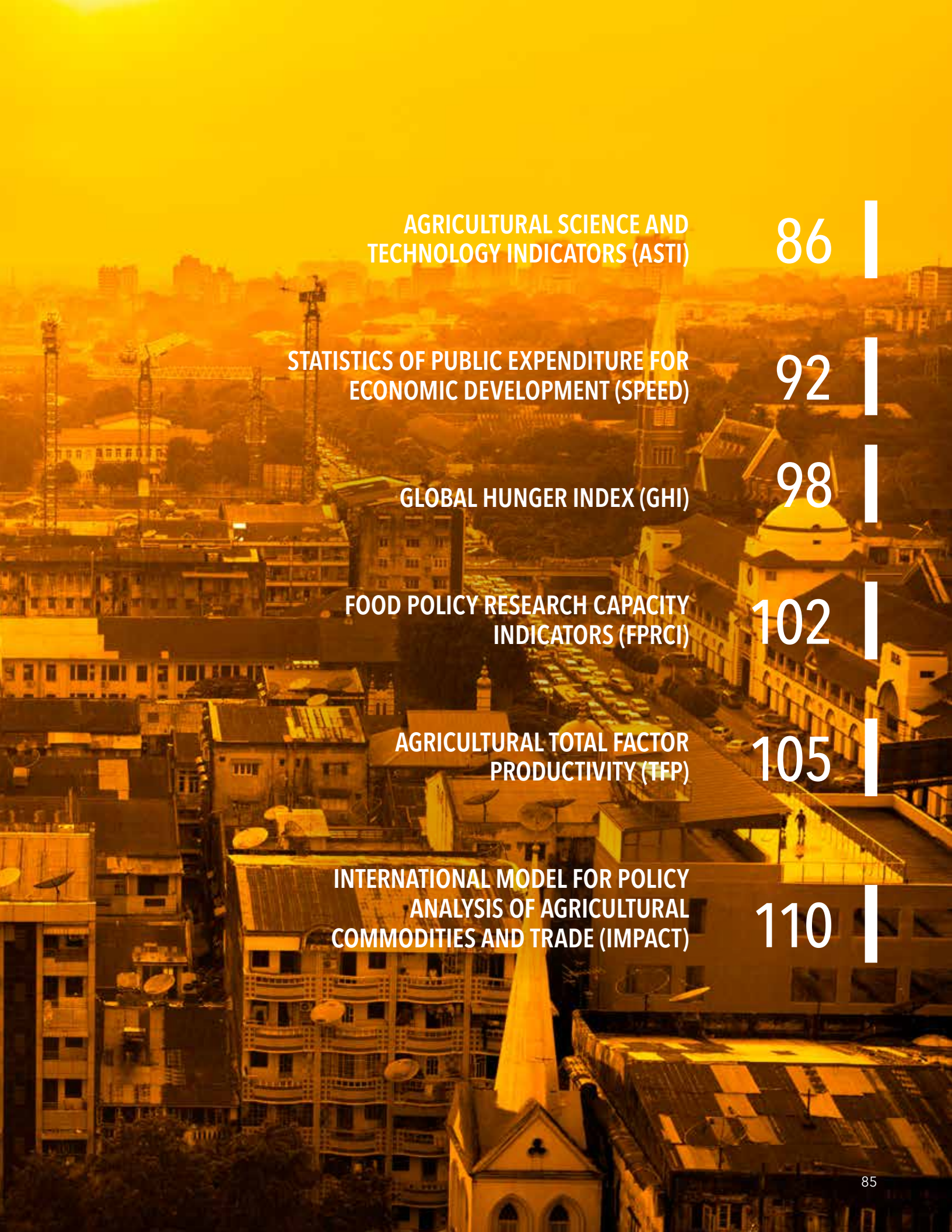
natural resources to achieve sustainable and inclusive growth. Considering the importance of intermediate urban centers in the LAC region, and the fact that a development pattern based on these centers seems to be associated with relatively large declines in poverty (compared to populations moving to larger cities), it will be necessary to maintain a balanced geographic pattern of public investments and services across rural areas and the intermediate urban centers that support them.[17]

"Addressing the needs of growing ranks of urban dwellers and improving the livelihoods of smallholder producers while promoting agricultural productivity will be essential to global food security and nutrition and to moving ahead with the new sustainable development agenda."

FOOD POLICY INDICATORS: TRACKING CHANGE

Decision makers and policy analysts need solid evidence and timely information to develop and implement effective food policies. The International Food Policy Research Institute (IFPRI) develops and shares global public goods—including datasets, indicators, and indexes—as part of its mission to provide research-based policy solutions that sustainably reduce poverty and end hunger and malnutrition. This information can be used to gauge the impact of policy changes and the progress made on specific aspects of development.

This section provides updates on data generated by IFPRI research in 2016 and illustrations of key trends. Indicators include investments in agricultural research, public spending on agriculture, capacity for food policy research, and agricultural total factor productivity, as well as a hunger index at the country level. Results of IFPRI's International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT), which projects agricultural production, food consumption, and risk of hunger to 2030 and 2050, are included for the first time. All indicators are available online with an interactive display of the data.



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Agricultural Science and Technology Indicators (ASTI)

Policy makers recognize that increased investment in agricultural research and development (R&D) is key to increasing agricultural productivity. Despite this, many low- and middle-income countries struggle with capacity and funding constraints in their agricultural R&D systems.

Working with a large network of country-level collaborators, Agricultural Science and Technology Indicators (ASTI), led by the International Food Policy Research Institute (IFPRI) within the portfolio of the CGIAR Research Program on Policies, Institutions, and Markets, conducts surveys to collect primary data and analysis on agricultural R&D investments, human capacities, and institutional structures. After analyzing the data, ASTI publishes quantitative and qualitative information and identifies trends in funding sources, spending levels and allocations, and human resource capacities, at both country and regional levels.

Indicators derived from this information allow the performance, inputs, and outcomes of national agricultural R&D systems to be measured, monitored, and benchmarked, with the ultimate goal of informing and improving decision making.

TRENDS IN CAPACITY AND INVESTMENT

Global investment in agricultural R&D, once heavily weighted toward the developed world, shifted dramatically in recent years toward the developing world. Whereas spending growth in high-income countries as a group has stalled since the turn of the millennium, the developing world has accelerated its agricultural R&D investments at a rapid pace, driven by high growth rates in China and India (Table 1).

Agricultural research spending and capacity in Latin America and the Caribbean and Asia have grown rapidly since 2000, but considerable differences remain across countries. Brazil's world-class research infrastructure and outputs contrast sharply with the lagging infrastructure, investment levels, and capacity in many Central American and Caribbean island nations. China accounts for most of the agricultural research spending growth in Asia, with India and Indonesia close behind. But underinvestment in countries such as Cambodia, Lao PDR, and Pakistan impedes their ability to respond to the threats to food security associated with widespread poverty, rapid population growth, climate change, and environmental degradation.

Although agricultural R&D spending and human resource capacity in Africa south of the Sahara have grown considerably, this growth has been uneven and trends are driven by large countries such as Ethiopia, Nigeria, and South Africa. Furthermore, many countries are overly dependent on volatile and unsustainable donor funds. The region is dealing with serious challenges on the human capacity side: long-term recruitment restrictions have left many research agencies with aging pools of researchers. In addition, female scientists remain severely underrepresented in research, despite their unique position to address the pressing challenges of African farmers, the majority of whom are women.

The West Asia and North Africa region has made valuable progress in agricultural research investment since the 2008 global food crisis, but inadequate systems, funding, and human resource capacity—coupled with a lack of political stability—hamper food security. Many national agricultural research institutes need to improve pay, working conditions, and incentives to compete with universities and attract, retain, and motivate well-qualified researchers.

In all regions, the imminent retirement of highly experienced agricultural researchers without adequate plans for their replacement creates concern about the quality of future research outputs.

INDICATORS

Agricultural research includes government, higher education, and nonprofit agencies, but excludes the private for-profit sector. Total agricultural R&D spending includes salaries, operating and program costs, as well as capital investments for all government, nonprofit, and higher education agencies involved in agricultural research in a country. Expenditures are adjusted for inflation and expressed in 2011 prices. Purchasing power parities (PPPs) measure the relative purchasing power of currencies across countries by eliminating national

differences in pricing levels for a wide range of goods. PPPs are relatively stable over time, whereas exchange rates fluctuate considerably. In addition to looking at absolute levels of agricultural R&D investment and capacity, another way of comparing commitment to agricultural R&D is to measure research intensity—that is, total agricultural R&D spending as a percentage of agricultural output (AgGDP).

Total agricultural researchers includes all researchers employed at government, nonprofit, and higher education institutions in a country. Totals are reported in full-time equivalents (FTEs) to account for the proportion of time scientists actually spend on R&D activities. A critical mass of qualified researchers is crucial for implementing a viable research agenda, for effectively communicating with stakeholders, and for securing external funding. Therefore, it is important to look at the share of PhD-qualified researchers. Gender balance in agricultural R&D is important, given that women researchers offer different insights and perspectives that can help research agencies more effectively address the unique and pressing challenges of female farmers. Age imbalances among research staff should be minimized. Having too many PhD-qualified researchers approaching retirement age can jeopardize the continuity of future research.

Research involves unavoidable time lags from the point when investments are made until tangible benefits are attained; in the interim, long-term stable funding is required. The volatility coefficient measures the volatility of agricultural research spending by applying the standard deviation formula to average one-year logarithmic growth of agricultural R&D spending over a certain period. A value of 0 indicates "no volatility"; countries with values between 0 and 0.1 are classified as having "low volatility"; countries with values between 0.1 and 0.2 are considered to have "moderate volatility"; and countries with values above 0.2 fall into the "high volatility" category.

MORE INFORMATION

Only a fraction of the available ASTI indicators are presented here. The ASTI website offers additional indicators, including national-level time series data on researcher capacity by qualification level, age bracket, and commodity, as well as a detailed breakdown of agricultural R&D investment. Interactive pages on the ASTI website allow users to access country-level time series data, make cross-country comparisons, create graphs, and download country datasets. The country pages also feature recent ASTI factsheets, other country-level publications, and institutional information on agencies involved in agricultural R&D. The interactive benchmarking tool on the ASTI website is a convenient map-based instrument allowing users to make cross-country comparisons and rankings based on a wide set of financial and human resource indicators. The ASTI datasets are available in an easy-to-use data download tool. Spending and human-capacity data for CGIAR centers are also available, along with more detailed information on definitions, methodology, and calculation procedures, at www.asti.cgiar.org.

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TABLE 1 Agricultural Science and Technology Indicators

Low- and middle-income countries by region	Year	Agricultural research spending			Volatility	Agricultural researchers (FTEs)			
		2011 PPP dollars (million)	2011 US dollars (million)	as a share of AgGDP		Total	Female share (%)	Share of PhD-qualified (% of total)	PhD-qualified older than 50 (as % of total PhDs)
AFRICA SOUTH OF THE SAHARA									
Benin	2014	23.2	10.5	0.38	0.16	170.4	13.3	48.1	56.0
Botswana	2014	21.3	11.7	2.92	0.14	137.8	33.0	22.5	65.8
Burkina Faso	2014	48.5	21.9	1.01	0.31	310.8	19.2	52.5	52.6
Burundi	2014	13.1	4.4	0.46	0.18	141.4	16.8	20.0	44.0
Cabo Verde	2014	2.3	1.4	0.95	na	22.3	38.2	11.2	--
Cameroon	2014	45.9	22.1	0.34	na	240.1	20.9	40.8	46.9
Central African Rep.	2011	3.4	1.9	0.16	na	134.0	19.4	14.0	50.0
Chad	2014	12.5	6.6	0.09	na	90.7	5.8	19.4	75.3
Congo, Dem. Rep.	2014	36.5	20.7	0.34	na	512.8	9.8	16.6	64.2
Congo, Rep.	2014	5.8	3.5	0.44	0.12	104.2	18.5	36.4	78.1
Côte d'Ivoire	2014	82.1	39.7	0.53	0.14	253.2	16.9	71.3	36.7
Eritrea	2011	2.9	1.1	0.30	na	116.8	6.8	10.8	74.6
Ethiopia	2014	127.3	37.1	0.24	0.18	2,768.5	10.2	7.2	41.4
Gabon	2011	1.2	0.8	0.11	0.43	48.8	23.0	22.1	43.5
Gambia	2014	5.1	1.7	0.80	0.25	60.4	6.8	13.1	47.5
Ghana	2014	197.4	91.3	0.99	0.14	575.0	21.9	40.8	61.6
Guinea	2014	7.7	2.9	0.30	0.29	258.7	7.4	15.3	94.0
Guinea-Bissau	2011	0.2	0.1	0.02	na	9.0	--	--	--
Kenya	2014	274.1	105.8	0.79	0.08	1,178.5	29.2	35.9	65.7
Lesotho	2014	2.4	1.3	0.94	na	45.6	48.0	12.1	49.1
Liberia	2011	6.7	3.5	0.51	na	45.1	20.4	10.6	na
Madagascar	2014	10.3	3.4	0.13	0.15	204.8	33.6	46.3	68.6
Malawi	2014	28.1	13.7	0.53	0.21	158.3	20.5	32.8	38.1[a]
Mali	2014	37.9	16.9	0.38	0.20	285.7	11.9	51.6	86.8
Mauritania	2014	15.6	6.4	0.49	0.33	86.0	13.8	17.2	8.4
Mauritius	2014	35.2	19.5	5.89	0.12	152.9	40.4	14.1	43.9
Mozambique	2014	29.3	16.2	0.36	na	308.4	35.1	11.2	50.3
Namibia	2014	38.8	24.9	3.09	0.23	99.7	44.0	13.8	100.0[b]
Niger	2014	14.5	6.8	0.23	0.12	182.2	14.9	40.1	47.4
Nigeria	2014	433.5	209.6	0.22	0.15	2,975.5	28.5[b]	23.7[b]	60.6[a]
Rwanda	2014	39.6	17.2	0.67	na	169.3	22.7	14.2	32.4
Senegal	2014	51.3	25.7	1.15	0.18	124.4	22.5[a]	71.7	36.4
Sierra Leone	2014	15.3	5.5	0.24	0.40	123.7	20.2[b]	13.7[b]	75.0
South Africa	2014	417.4	274.4	2.78	0.08	811.3	38.6	51.3	38.6
Swaziland	2014	6.9	3.7	0.93	na	27.4	29.8	46.6	78.8
Tanzania, United Rep.	2014	103.9	34.5	0.29	0.29	857.7	32.1	23.8	45.8
Togo	2014	6.9	3.1	0.17	0.28	125.1	6.4	36.7	38.6

Table 1 continued

Low- and middle-income countries by region	Year	Agricultural research spending			Volatility	Agricultural researchers (FTEs)			
		2011 PPP dollars (million)	2011 US dollars (million)	as a share of AgGDP		Total	Female share (%)	Share of PhD-qualified (% of total)	PhD-qualified older than 50 (as % of total PhDs)
Uganda	2014	152.5	50.4	0.97	0.17	477.9	25.8	34.1	40.0
Zambia	2014	26.9	13.2	0.51	0.17	245.6	28.3	14.1	41.5
Zimbabwe	2014	43.4	21.9	1.44	0.31	208.7	31.0	17.6	38.7
ASIA									
Bangladesh	2012	250.6	78.2	0.37	0.13	2,121.0	12.4	35.3	39.8
Cambodia	2010	22.4	7.4	0.18	na	284.4	21.9	5.9	10.5
China	2013	9,366.2	5,081.5	0.62	0.09	na	na	na	na
India	2014	3,298.4	1,067.8	0.30	0.05	12,746.6	18.3	73.2	38.3
Lao PDR	2010	na	na	na	0.23	227.2	na	6.5	38.0
Malaysia	2010	592.3	282.5	0.99	na	1,609.4	49.2	24.9	43.1
Nepal	2012	53.4	17.8	0.28	0.21	403.4	12.5	14.8	76.7
Pakistan	2012	332.5	93.7	0.18	0.09	3,678.3	10.8	20.7	34.5
Sri Lanka	2009	61.8	21.6	0.34	na	618.8	46.9	24.2	na
Viet Nam	2010	136.0	44.5	0.18	na	3,744.2	na	17.8	na
LATIN AMERICA AND THE CARIBBEAN									
Antigua and Barbuda	2012	1.0	0.7	2.98	na	7.5	27.2	31.6	41.7
Argentina	2013	732.1	474.7	1.29	0.13	5,824.5	45.2	20.8	46.1
Barbados	2012	1.3	1.3	2.01	na	9.9	na	na	na
Belize	2012	2.3	1.3	0.66	na	12.6	23.0	1.6	44.1
Bolivia	2013	58.9	25.0	0.93	na	190.3	17.7	11.0	36.0
Brazil	2013	2,704.0	2,377.9	1.82	0.06	5,869.4	37.1	72.5	11.8
Chile	2013	186.4	134.1	1.65	0.08	715.7	33.3	36.8	34.7
Colombia	2013	253.7	159.5	0.79	0.13	1,102.9	36.1	22.5	36.9
Costa Rica	2012	37.1	25.5	1.06	0.04	241.5	34.3	14.0	54.1
Dominica	2012	0.2	0.1	0.18	na	3.0	33.3	33.3	100.0
Dominican Rep.	2012	20.3	10.3	0.30	na	199.6	24.2	10.3	45.4
Ecuador	2013	27.3	14.4	0.18	na	149.4	17.3[c]	9.6	27.7
El Salvador	2006	6.6	0.4	0.15	na	76.9	na	na	na
Grenada	2012	0.4	0.3	0.71	na	1.8	na	na	na
Guatemala	2012	15.6	7.3	0.14	0.09	141.8	20.0	9.6	68.4
Honduras	2012	7.5	3.9	0.17	0.09	87.6	13.6	5.7	55.4
Jamaica	2012	11.8	7.4	0.89	na	62.1	47.2	21.6	11.9
Mexico	2013	710.4	438.8	1.05	0.05	3,967.4	25.3	47.5	61.0
Nicaragua	2012	17.5	7.0	0.38	na	131.5	29.7	8.8	46.7
Panama	2012	15.5	8.5	0.74	0.08	133.0	17.7	7.5	45.0
Paraguay	2013	26.8	14.2	0.26	0.28	209.5	37.2	5.4	8.9[a]
Peru	2013	83.4	46.1	0.35	na	339.1	31.9	13.1	49.2
St. Kitts and Nevis	2012	0.8	0.5	5.13	na	4.5	82.2	4.4	50.0

Table 1 continued

Low- and middle-income countries by region	Year	Agricultural research spending			Volatility	Agricultural researchers (FTEs)			
		2011 PPP dollars (million)	2011 US dollars (million)	as a share of AgGDP		Total	Female share (%)	Share of PhD-qualified (% of total)	PhD-qualified older than 50 (as % of total PhDs)
St. Lucia	2012	0.3	0.2	0.63	na	2.2	9.1	--	--
St. Vincent and Grenadines	2012	0.7	0.5	1.07	na	2.5	na	na	na
Trinidad and Tobago	2012	18.0	11.0	7.82	na	83.0	43.3	22.7	4.5
Uruguay	2013	77.4	61.3	1.40	0.11	371.9	48.2	26.1	27.8
Venezuela	2013	86.2	54.5	0.31	na	503.1	na	16.3	45.2
CENTRAL AND WEST ASIA AND NORTH AFRICA									
Algeria	2012	91.6	38.3	0.21	na	593.4	51.3	23.0	54.7
Egypt	2012	528.4	144.7	0.44	na	8,419.7	36.3	67.6	na
Jordan	2012	36.2	15.0	1.84	0.12	272.3	18.3	35.5	51.4
Lebanon	2012	38.2	21.3	0.95	na	209.2	48.2	44.6	21.8
Morocco	2012	147.0	442.0	0.49	na	556.3	23.3	40.0	62.0
Oman	2012	110.0	2.6	6.51	na	243.6	31.1	25.5	36.2
Sudan	2012	57.3	26.3	0.14	0.19	932.8	40.2	36.9	37.5
Tunisia	2012	63.0	97.1	0.64	0.05	541.6	32.7	61.8	50.4
Turkey	2012	537.3	376.7	0.51	na	3,009.4	32.5	41.6	20.0
Yemen	2012	38.7	13.7	0.56	na	526.7	7.1	28.7	54.6

Notes: na = not available. PPP = purchasing power parity. AgGDP = agricultural gross domestic product. (--) = zero. FTE = full-time equivalent.

Table only includes countries where ASTI has conducted survey rounds since 2002. Agricultural research includes government, higher education, and non-profit agencies, but excludes the private for-profit sector.

a = data exclude higher-education sector; b = data include only government agencies; c = data exclude the nonprofit sector.

ASTI

AGRICULTURAL SCIENCE AND TECHNOLOGY INDICATORS

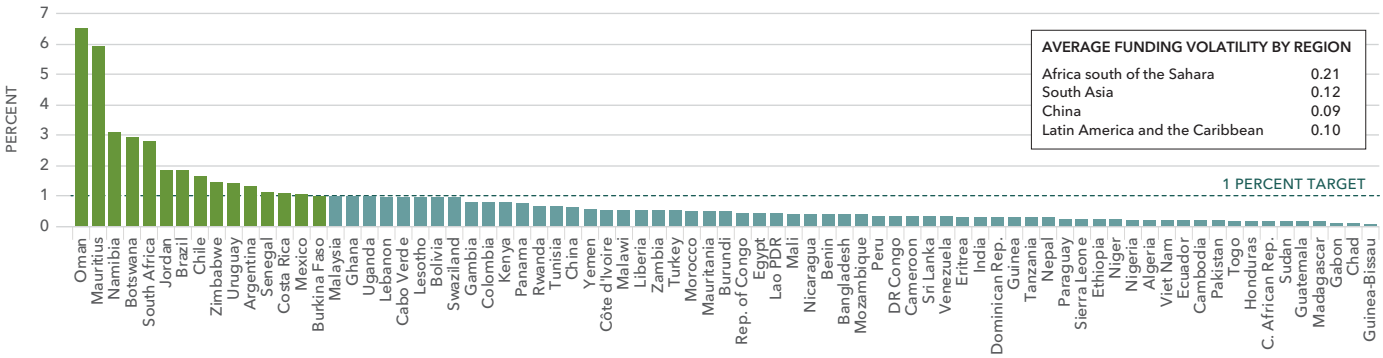
TREND 1
UNDERINVESTMENT AND FUNDING VOLATILITY ARE LIMITING RETURNS TO AGRICULTURAL RESEARCH

Agricultural research investment levels in most low- and middle-income countries still fall well below the minimum target of 1 percent of agricultural gross domestic product recommended by the United Nations. Higher levels of funding are needed to establish and maintain viable agricultural research programs that achieve tangible results. Agricultural research investment can command significant returns, but these returns take time—commonly decades. This inherent lag— from the inception of research to the adoption of a new technology or a new variety calls for sustained and stable research funding. Funding volatility makes it harder to realize long-term returns. Africa's agricultural research spending has exhibited considerably greater volatility than spending in other developing regions, driven by the short-term, project-oriented nature of donor and development bank funding in Africa.

TREND 2
A GENERATION GAP THREATENS FUTURE AGRICULTURAL RESEARCH

Many of the PhD-qualified agricultural researchers in low- and middle-income countries are in their 50s and 60s. This situation is most severe in Africa south of the Sahara. Given that the official retirement age in most countries is 60 or 65, many countries will be left without the critical mass of experienced, PhD-qualified researchers needed to lead research programs. This trend, combined with high shares of more recently recruited junior staff in need of experience and mentoring, has left many countries vulnerable. Without adequate succession strategies and training, significant knowledge gaps will emerge, raising concerns about the quality of future research outputs.

AGRICULTURAL R&D SPENDING AS A SHARE OF AGRICULTURAL GDP



AVERAGE FUNDING VOLATILITY BY REGION

Africa south of the Sahara	0.21
South Asia	0.12
China	0.09
Latin America and the Caribbean	0.10

SHARE OF PHD-QUALIFIED RESEARCHERS OVER 50

Statistics of Public Expenditure for Economic Development (SPEED)

Tracking public expenditure by national governments allows policy makers and analysts to examine (1) national policy priorities, as reflected in the allocation of funds, and (2) the cost-effectiveness of public spending both within and across countries. Public expenditure is expenditure incurred by public authorities—including central, state, and local governments, public corporations, and state enterprises—to provide public goods and services or to achieve national development goals. The Statistics of Public Expenditure for Economic Development (SPEED) database, a resource of the International Food Policy Research Institute (IFPRI), provides data that policy makers, researchers, and other stakeholders can use to examine both historical trends and the allocation of government resources across sectors.

INDICATORS

Information on agricultural and other sectoral public expenditures in 109 developing countries and 34 developed countries is collected for the SPEED database.[1] Indicators reported include total agricultural expenditure, agricultural spending per capita, and the ratio of agricultural spending to agricultural gross domestic product (GDP) for the period 1980 to 2014 (Table 2). IFPRI researchers compile these data from international organizations and national governments, and conduct extensive data checks and adjustments to ensure consistent spending measurements over time that are free of exchange-rate fluctuations and currency denomination changes.[2]

TRENDS IN AGRICULTURAL EXPENDITURE

At the global level, per capita agricultural expenditure increased at a rate of 1.9 percent per year between 1980 and 2014.[3] Much of the observed growth took place in the last two decades (1995–2014), reversing the decline observed between 1980 and 1994. Trends differ in different parts of the world and between developing and developed countries. For developed countries, despite their large volume of investments, agriculture represents only a marginal portion of the economy. Per capita agricultural expenditure for developed countries declined continuously from 1980 to 2014, but is still relatively high, averaging close to US$150 over the entire period.[4] The ratio of agricultural expenditure to agricultural GDP also remained high, at above 20 percent. In developing countries, on the other hand, although agriculture accounts for a larger share of the economy, per capita agricultural expenditure was considerably lower, at less than one-third the level of developed countries. In addition, per capita agricultural expenditure in developing countries remained flat until the early 1990s, although it showed an impressive recovery at a rate of 8.7 percent per year between 1995 and 2014.

Comparing performance across the world's developing regions, South Asia and Africa south of the Sahara lag behind in terms of both per capita agricultural expenditure and ratio of agricultural expenditure to agricultural GDP. Growth in per capita agricultural expenditure has been quite erratic. The strongest performance occurred between 1995 and 2014, with Latin America and the Caribbean and Africa south of the Sahara lagging behind the other regions.

For Africa south of the Sahara, the heads of state and government adopted the Comprehensive Africa Agriculture Development Programme (CAADP) in 2003 and committed to spend at least 10 percent of their national budgets on agriculture. Against this target, Africa as a whole has underperformed, with the region reaching an average of 2.9 percent per year between 2003 and 2014. The average share was higher (3.3 percent) prior to the 2009 global financial crisis. Several countries consistently surpassed the 10 percent target in recent years, however, including Burkina Faso, Ethiopia, Malawi, Mali, and Niger.

DOWNLOAD DATA
https://doi.org/10.7910/DVN/INZ3QK

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TABLE 2 Agricultural public expenditure for economic development, by country

Region/ country	Agricultural expenditure (billions 2011 constant US dollars)			Agricultural expenditure (billions 2011 PPP dollars)			Per capita agricultural expenditure (2011 constant US dollars)			Per capita agricultural expenditure (2011 PPP dollars)			Ratio of agricultural expenditure to agricultural GDP (%)			Share of agriculture in total expenditure (%)		
	1980	1995	2014	1980	1995	2014	1980	1995	2014	1980	1995	2014	1980	1995	2014	1980	1995	2014
EAST ASIA AND PACIFIC																		
China	12.62	15.56	204.86	23.26	28.68	377.61	12.90	12.67	149.60	23.78	23.36	275.74	10.93	4.74	23.56	12.20	8.43	9.34
Fiji[a]	0.03	0.03	0.01	0.06	0.05	0.02	55.05	40.01	15.24	94.70	68.83	26.22	8.90	6.86	3.31	7.24	4.01	1.24
Indonesia	3.72	5.76		9.04	14.01		25.12	29.12		61.08	70.82		9.98	8.36		10.27	9.43	
Malaysia	1.15	1.44	1.72	2.41	3.02	3.60	83.12	69.48	57.45	174.30	145.69	120.46	10.20	8.34	5.59	8.75	5.10	2.47
Mongolia[b]		0.02	0.08		0.04	0.18		6.78	26.74		15.97	63.01		1.26	5.71		2.12	1.76
Myanmar[d]	0.29	0.19	0.24	1.00	0.64	0.81	8.51	4.23	4.59	28.98	14.38	15.61	8.02	2.66	1.17	23.57	14.90	6.26
Papua New Guinea	0.11	0.08		0.15	0.11		35.73	17.58		45.57	22.42		7.97	3.26		8.46	3.97	
Philippines	0.63	1.27	2.42	1.54	3.09	5.86	13.36	18.23	24.36	32.41	44.23	59.10	3.34	5.93	7.84	6.06	6.90	5.69
Singapore	0.03	0.04	0.12	0.04	0.06	0.18	12.41	11.89	22.69	17.51	16.77	32.01	5.47	24.78	123.89	0.44	0.24	0.25
Thailand	1.24	4.01	5.33	3.06	9.88	13.13	26.17	67.60	78.64	64.51	166.62	193.85	7.56	19.49	12.32	9.67	11.30	6.50
Tonga	0.00	0.00	0.01	0.01	0.00	0.01	52.53	8.67	52.67	62.53	10.31	62.68	6.13	1.23	7.29	9.97	0.80	3.13
Vanuatu	0.00	0.00		0.00	0.00		14.97	22.79		13.33	20.29		2.55	2.67		2.96	3.13	
Viet Nam[b]		0.79	1.50		2.41	4.57		10.50	16.56		32.09	50.63		6.15	5.33		8.20	8.37
SOUTH ASIA																		
Afghanistan[a]			0.25			0.69			8.30			22.36			4.56			1.81
Bangladesh[a]	0.29	0.36	1.79	0.93	1.14	5.74	3.56	3.01	11.41	11.39	9.66	36.54	2.97	2.74	8.30	13.02	4.93	11.08
Bhutan	0.01	0.04	0.07	0.04	0.11	0.20	34.88	78.80	96.09	96.56	218.17	266.06	19.53	23.98	21.91	31.86	19.69	13.18
India[a]	2.57	5.07	20.95	7.93	15.65	64.71	3.68	5.27	16.37	11.37	16.29	50.58	2.63	3.14	5.94	7.18	5.26	5.97
Maldives[c]	0.00	0.02	0.01	0.00	0.04	0.01	14.76	91.06	18.88	25.28	155.94	32.33	6.99	46.24	7.17	8.84	12.07	0.74
Nepal	0.10	0.14	0.44	0.31	0.43	1.31	6.84	6.62	15.51	20.56	19.89	46.62	3.93	3.96	6.83	16.39	9.64	10.98
Pakistan	0.15	0.09	0.95	0.52	0.33	3.38	1.86	0.76	5.15	6.61	2.68	18.25	0.98	0.31	1.66	2.13	0.46	1.90
Sri Lanka	0.29	0.39	0.77	0.84	1.11	2.20	19.50	21.35	37.31	55.78	61.07	106.73	9.44	8.69	10.77	5.77	5.28	5.74
EUROPE AND CENTRAL ASIA																		
Albania		0.07	0.07		0.15	0.15		21.81	23.60		47.37	51.26		2.15	2.56		3.95	1.74
Azerbaijan		0.20	0.64		0.45	1.40		26.27	66.30		57.56	145.27		6.68	16.54		8.01	2.45
Belarus		0.41	1.54		1.07	4.04		39.88	161.63		105.00	425.57		12.56	31.59		5.96	6.04
Bulgaria[a]		0.03	0.51		0.05	1.03		3.16	70.84		6.36	142.61		0.55	19.28		0.25	2.37
Georgia			0.12			0.24			30.72			60.32			9.41			2.50
Kazakhstan			1.52			2.77			87.34			159.72			16.43			3.43
Kyrgyzstan		0.03			0.08			6.36			16.54			2.41			3.54	
Latvia[a]		0.14	0.15		0.20	0.21		58.16	74.97		82.09	105.82		12.76	16.41		2.83	1.35
Lithuania		1.45	0.43		2.27	0.67		398.62	147.31		625.40	231.11		68.61	28.68		29.69	2.56
Moldova		0.02	0.11		0.05	0.22		5.14	25.93		10.89	54.98		1.69	10.34		1.38	3.33
Russian Federation		0.43	14.29		0.73	24.21		2.92	99.64		4.95	168.79		0.62	20.26		0.15	1.08
Serbia[b]			0.50			0.97			68.97			134.98			14.33			2.30
Ukraine			0.59			1.37			13.16			30.52			4.57			0.76
MIDDLE EAST AND NORTH AFRICA																		
Algeria[c]		0.85	3.00		2.03	7.17		29.41	81.64		70.34	195.22		7.62	18.48		2.42	3.68
Bahrain[c]	0.02	0.02	0.02	0.03	0.03	0.04	41.71	29.88	18.18	74.41	53.31	32.43	18.58	17.04	28.36	0.63	0.54	0.31
Egypt	1.10	1.47		4.02	5.36		25.37	23.52		92.63	85.89		12.78	8.43		5.14	4.39	
Iran	2.27	2.43		5.17	5.55		58.61	40.37		133.61	92.02		10.17	6.67		3.36	4.22	

Table 2 continued

Region/ country	Agricultural expenditure (billions 2011 constant US dollars)			Agricultural expenditure (billions 2011 PPP dollars)			Per capita agricultural expenditure (2011 constant US dollars)			Per capita agricultural expenditure (2011 PPP dollars)			Ratio of agricultural expenditure to agricultural GDP (%)			Share of agriculture in total expenditure (%)		
	1980	1995	2014	1980	1995	2014	1980	1995	2014	1980	1995	2014	1980	1995	2014	1980	1995	2014
Jordan	0.03	0.18	0.07	0.08	0.44	0.16	13.85	41.99	9.07	33.52	101.62	21.94	8.08	37.73	6.45	0.98	4.46	0.69
Kuwait[a]	0.02	0.24	0.38	0.03	0.39	0.62	12.27	147.66	106.70	19.68	236.93	171.22	13.33	70.59	64.98	0.10	0.59	0.61
Lebanon[b]		0.03	0.03		0.05	0.05		9.36	5.68		16.82	10.21		2.58	1.83		0.40	0.24
Morocco	0.59	0.58		1.29	1.28		29.29	21.41		64.43	47.11		10.61	8.67		6.80	4.21	
Palestine, State of[b]			0.02			0.01			5.49			2.51			4.56			0.73
Oman[a]	0.10	0.25	0.19	0.19	0.49	0.39	84.01	112.43	49.75	168.63	225.65	99.86	24.24	20.17	20.83	1.85	1.56	0.57
Syrian Arab Republic	0.45	0.77		1.01	1.71		50.54	53.82		112.32	119.61		12.00	9.02		5.04	10.24	
Tunisia[b]	0.56	0.56	0.74	1.33	1.34	1.76	88.03	61.69	67.92	209.29	146.67	161.47	34.71	25.19	17.08	15.63	8.17	4.16
Turkey	0.58	0.68	10.25	0.98	1.15	17.31	13.25	11.63	132.26	22.38	19.63	223.35	1.52	1.52	16.95	2.08	1.03	3.22
United Arab Emirates[a]	0.09	0.08	0.09	0.13	0.12	0.13	87.88	35.01	9.98	126.85	50.53	14.41	14.01	2.78	3.40	0.83	0.67	0.09
Yemen		0.05			0.13			3.10			8.74			1.86			1.68	
LATIN AMERICA AND THE CARIBBEAN																		
Argentina	0.30	0.26		0.47	0.40		10.73	7.37		16.55	11.37		2.19	1.87		0.65	0.58	
Bahamas[d]	0.01	0.02	0.01	0.01	0.02	0.02	45.81	55.87	41.49	48.25	58.86	43.71	11.45	7.47	8.88	1.45	1.67	0.97
Barbados	0.03	0.03		0.03	0.03		106.40	113.90		105.52	112.95		12.77	28.30		3.20	2.80	
Belize	0.01	0.01		0.02	0.02		79.20	42.87		137.75	74.58		12.96	6.96			4.61	
Bolivia	0.05	0.01		0.12	0.01		9.28	0.83		21.84	1.95		2.61	0.32		3.33	0.35	
Brazil		16.41	11.30		18.66	12.85		100.81	54.82		114.63	62.34		21.12	8.68		5.70	1.71
Chile	0.29	0.27	1.08	0.40	0.37	1.50	25.62	18.71	60.95	35.61	26.00	84.70	9.16	4.26	12.65	1.77	1.18	1.65
Colombia[a]	0.22	0.40	0.00	0.35	0.64	0.00	7.93	10.70	0.03	12.62	17.02	0.04	1.40	2.21	0.01	2.00	1.77	2.10
Costa Rica	0.08	0.14	0.20	0.12	0.21	0.29	34.06	40.80	42.50	49.68	59.51	61.97	5.24	5.65	8.75	3.38	3.15	1.42
Dominican Rep.	0.28	0.22		0.55	0.43		48.50	27.65		95.34	54.35		11.93	8.66		16.71	7.83	
Ecuador[a]			0.32			0.61			20.44			38.85			4.23			1.40
El Salvador[a]	0.01	0.04	0.06	0.02	0.07	0.12	2.59	6.68	9.57	5.15	13.28	19.02	0.36	1.73	2.41	5.80	1.69	0.98
Grenada		0.01			0.02			126.82			192.04			31.37			9.65	
Guatemala	0.22	0.07	2.16	0.46	0.16	4.64	30.24	7.11	134.86	64.94	15.26	289.55	6.95	1.82	37.51	7.88	2.72	29.32
Jamaica		0.09	0.10		0.14	0.15		35.55	34.83		56.42	55.28		7.89	11.28		2.13	2.06
Mexico[d]	8.53	3.42	5.67	13.81	5.54	9.18	123.03	36.26	47.81	199.20	58.72	77.41	20.68	9.77	15.71	14.56	3.36	2.32
Panama[a]	0.13	0.05	0.12	0.23	0.09	0.21	64.62	18.07	30.49	118.07	33.02	55.71	17.62	5.04	9.62	5.29	1.64	1.35
Paraguay	0.04			0.07			11.46			21.56			1.56			3.47		
Peru			0.34			0.62			11.09			20.08			2.62			1.25
St. Vincent and Grenadines	0.00	0.00		0.00	0.01		22.05	35.42		35.20	56.54		9.38	8.74		3.81	3.46	
Trinidad and Tobago[b]	0.18	0.12	0.19	0.29	0.20	0.30	166.27	98.70	138.46	270.62	160.64	225.36	68.72	66.01	181.53	5.10	4.49	2.18
Uruguay	0.07	0.08		0.08	0.10		22.78	25.66		28.79	32.43		2.25	3.63		2.08	1.04	

Table 2 continued

Region/ country	Agricultural expenditure (billions 2011 constant US dollars)			Agricultural expenditure (billions 2011 PPP dollars)			Per capita agricultural expenditure (2011 constant US dollars)			Per capita agricultural expenditure (2011 PPP dollars)			Ratio of agricultural expenditure to agricultural GDP (%)			Share of agriculture in total expenditure (%)		
	1980	1995	2014	1980	1995	2014	1980	1995	2014	1980	1995	2014	1980	1995	2014	1980	1995	2014
AFRICA SOUTH OF THE SAHARA																		
Angola		0.14	0.46		0.19	0.63		10.37	18.93		14.26	26.03		5.34	6.70		1.74	0.86
Benin		0.06	0.15		0.12	0.32		9.21	13.80		20.30	30.42		6.33	7.57		7.26	7.97
Botswana	0.08	0.17	0.28	0.14	0.30	0.50	75.64	105.58	125.02	137.41	191.80	227.13	29.17	46.66	68.93	9.71	5.96	4.15
Burkina Faso	0.20	0.39	0.29	0.45	0.86	0.64	29.81	38.67	16.43	65.83	85.41	36.28	19.10	30.21	7.06	31.37	45.68	9.39
Burundi[a]		0.02	0.02		0.05	0.06		2.53	1.95		7.49	5.78		3.71	2.14		5.10	2.79
Cameroon	0.04	0.07		0.07	0.15		4.02	5.17		8.34	10.74		1.19	2.21		2.22	4.16	
Cabo Verde[b]		0.00	0.03		0.00	0.05		5.50	66.95		8.98	109.29		1.84	21.06			4.93
Central African Republic[b]	0.04	0.03	0.01	0.07	0.05	0.01	16.06	7.60	1.45	29.61	14.01	2.67	5.41	3.99	0.73		9.94	1.69
Congo, Rep.		0.01			0.01			3.31			5.40			1.07			0.34	
Côte d'Ivoire	0.17	0.17	0.35	0.35	0.35	0.73	20.69	11.79	15.89	42.78	24.38	32.86	3.76	3.46	4.64	2.60	3.56	4.79
Democratic Rep. of Congo		0.00			0.00			0.04			0.07			0.02			0.18	
Equatorial Guinea		0.01			0.01			16.16			25.89			2.31				
Ethiopia[c]		0.16	0.30		0.54	1.04		2.76	3.37		9.48	11.57		3.23	2.41		9.72	3.90
Gambia	0.01			0.02			12.94			38.36			9.25			17.13		
Ghana	0.09	0.03	0.06	0.19	0.06	0.13	8.11	1.53	2.24	17.52	3.32	4.84	1.76	0.51	0.59	12.21	0.73	2.08
Guinea-Bissau[a]		0.00	0.00		0.00	0.00		0.11	0.70		0.23	1.51		0.03	0.26		1.19	0.88
Kenya[a]	0.20	0.31	0.43	0.53	0.79	1.10	12.55	11.16	9.76	32.50	28.90	25.27	5.41	5.15	3.48	8.28	7.00	4.11
Lesotho[b]	0.02	0.09	0.05	0.04	0.17	0.10	17.39	51.25	25.93	32.18	94.86	47.99	12.29	54.22	30.30	8.02	12.41	3.15
Liberia[b]	0.02	0.00	0.01	0.04	0.01	0.02	11.25	1.91	2.20	21.77	3.69	4.26	10.62	3.35	0.85	5.02	2.76	1.97
Madagascar[c]		0.07	0.02		0.20	0.05		4.95	0.70		14.89	2.11		3.48	0.59		6.10	1.59
Malawi	0.06	0.06	0.00	0.13	0.12	0.01	10.27	5.98	0.19	21.08	12.28	0.39	3.75	4.94	0.13	10.15	8.85	15.66
Mali[a]	0.03	0.20	0.24	0.07	0.46	0.55	4.49	21.12	14.73	10.08	47.40	33.07	1.85	11.75	6.54	7.05	17.28	9.71
Mauritius	0.04	0.07	0.08	0.08	0.13	0.14	45.89	63.04	63.10	82.64	113.53	113.63	17.02	14.87	24.16	6.87	5.86	2.48
Mozambique[a]			0.37			0.67			13.99			25.37			10.20			6.85
Namibia[c]		0.12	0.33		0.19	0.51		74.03	145.76		115.26	226.97		16.00	31.96		6.04	6.92
Niger	0.08	0.07	0.36	0.17	0.16	0.76	13.42	7.92	18.70	28.64	16.90	39.90	5.46	6.35	12.15	14.17	13.17	12.30
Nigeria	0.44	0.28	0.20	0.92	0.58	0.41	6.02	2.56	1.10	12.53	5.34	2.30	2.66	0.79	0.20	2.92	3.60	0.80
Rwanda[b]			0.13			0.29			11.76			27.08			5.46			7.09
Senegal	0.05	0.07	0.41	0.11	0.14	0.82	9.52	8.03	28.12	19.02	16.04	56.16	6.31	5.34	18.98	4.04	5.23	8.52
Seychelles		0.01	0.01		0.01	0.01		68.69	65.97		127.12	122.08		17.50	23.03		1.99	1.62
Sierra Leone		0.00			0.01			0.99			2.77			0.42			1.57	
South Africa		0.35	0.78		0.53	1.18		8.36	14.43		12.72	21.95		3.91	7.90		0.51	1.05
Sudan																		
Swaziland[b]	0.04	0.03	0.06	0.07	0.06	0.10	66.73	36.08	45.33	124.22	67.17	84.39	15.11	10.66	18.24	12.98	5.68	4.23
Togo	0.06	0.03	0.07	0.14	0.07	0.16	23.18	7.46	10.05	50.85	16.37	22.05	10.50	3.66	4.03	6.99	6.13	5.84
Uganda	0.01	0.01	0.18	0.03	0.03	0.54	0.73	0.52	4.73	2.21	1.56	14.31	0.64	0.40	2.95	6.71	1.87	4.50
United Rep. of Tanzania	0.15	0.14		0.45	0.41		7.96	4.65		23.95	13.99		8.38	2.99		10.90	8.55	
Zambia[c]	0.63	0.06	0.29	1.29	0.12	0.59	106.70	6.11	20.15	218.07	12.48	41.18	73.83	4.40	12.65	22.81	2.80	7.27

Table 2 continued

Region/ country	Agricultural expenditure (billions 2011 constant US dollars)			Agricultural expenditure (billions 2011 PPP dollars)			Per capita agricultural expenditure (2011 constant US dollars)			Per capita agricultural expenditure (2011 PPP dollars)			Ratio of agricultural expenditure to agricultural GDP (%)			Share of agriculture in total expenditure (%)		
	1980	1995	2014	1980	1995	2014	1980	1995	2014	1980	1995	2014	1980	1995	2014	1980	1995	2014
HIGH-INCOME EUROPEAN COUNTRIES																		
Austria	4.90	3.94	1.79	4.22	3.39	1.54	645.19	494.19	210.50	555.54	425.52	181.25	50.86	58.78	32.98	2.51	2.32	0.78
Belgium	1.09	0.65	0.24	0.94	0.56	0.21	111.07	64.27	21.34	95.14	55.05	18.28	16.74	13.11	7.12	0.88	0.33	0.08
Croatia[c]		0.23	0.91		0.32	1.29		49.73	211.78		70.36	299.64		9.26	36.50		2.50	3.99
Cyprus	0.16	0.24	0.18	0.17	0.25	0.18	316.96	366.53	200.49	328.38	379.73	207.71	26.92	32.38	34.28	15.06	4.61	1.50
Czech Republic		4.08	0.95		5.39	1.26		394.53	90.54		521.09	119.58		68.61	17.07		5.27	0.98
Denmark	1.10	0.55	0.60	0.77	0.39	0.43	213.89	105.39	106.69	151.13	74.46	75.38	13.92	7.12	12.80	0.91	0.35	0.31
Estonia		0.07	0.12		0.10	0.17		48.87	94.43		67.07	129.59		11.95	16.26		1.47	1.28
Finland	7.74	8.33	2.28	6.13	6.60	1.81	1,619.33	1,630.69	416.59	1,283.31	1,292.32	330.14	68.35	124.67	35.18	10.74	7.75	1.48
France		10.35	5.92		8.82	5.04		172.70	89.20		147.13	76.00		19.62	13.63		0.89	0.36
Germany	3.53	17.93	7.30	3.24	16.45	6.70	45.22	219.74	90.55	41.48	201.58	83.07	8.79	62.86	30.93	0.49	1.09	0.43
Greece	3.71	3.05	0.44	3.81	3.13	0.45	385.55	286.29	39.92	396.11	294.13	41.02	18.49	18.56	4.98	5.30	3.11	0.34
Hungary		1.89	0.89		3.04	1.43		182.43	90.02		293.84	144.99		27.31	16.31		3.51	1.23
Iceland	0.27	0.21	0.14	0.23	0.18	0.12	1,179.75	774.04	434.90	1,015.17	666.06	374.23	40.70	25.19	17.14	12.44	7.22	1.99
Ireland		1.20	1.03		1.04	0.89		330.13	219.43		285.40	189.70		19.17	27.99		2.71	1.04
Italy	10.26	9.17	6.65	9.60	8.58	6.23	182.13	160.46	111.30	170.43	150.15	104.15	12.38	15.57	15.72	1.10	0.89	0.60
Luxembourg	0.15	0.18	0.21	0.12	0.15	0.17	402.60	447.66	379.95	323.78	360.01	305.56	49.06	59.54	125.85	2.16	1.44	0.79
Malta	0.01	0.01	0.04	0.02	0.02	0.05	45.92	33.30	103.55	57.90	41.99	130.57	13.66	8.35	35.84	3.77	0.53	0.94
Netherlands	2.80	2.02	1.41	2.43	1.75	1.22	198.51	130.46	83.48	171.99	113.04	72.33	18.39	10.52	9.60	1.05	0.60	0.34
Norway	7.83	5.28	3.02	4.88	3.30	1.89	1,917.85	1,211.61	587.34	1,196.32	755.78	366.37	94.68	57.67	38.18	7.16	2.99	1.25
Poland		2.69	2.19		4.37	3.55		69.79	56.63		113.14	91.81		21.02	14.94		2.68	0.92
Portugal		1.73	0.90		2.01	1.05		171.65	86.81		199.29	100.80		19.03	18.93		2.14	0.74
Romania	3.89	2.81	1.61	7.45	5.38	3.08	172.00	122.22	81.69	329.50	234.13	156.49	24.63	12.78	17.07	7.42	6.77	2.32
Slovakia			0.34			0.47			62.12			86.18			8.16			0.78
Slovenia		0.50	0.22		0.57	0.25		251.00	107.59		286.45	122.79		42.69	22.97		3.61	0.88
Spain	7.18	6.28	5.80	7.34	6.42	5.93	190.42	157.88	125.37	194.58	161.33	128.11	16.12	16.34	17.49	3.36	1.43	0.90
Sweden	4.74	2.51	0.93	3.48	1.84	0.68	570.68	284.08	96.20	418.57	208.36	70.56	41.83	27.39	13.15	2.87	1.06	0.31
Switzerland[a]	10.95	14.93	6.01	6.79	9.26	3.72	1,737.45	2,128.37	739.84	1,077.05	1,319.39	458.63	107.58	195.59	121.80	4.87	9.24	2.46
United Kingdom	6.71	1.66	3.66	5.99	1.48	3.27	119.37	28.69	56.94	106.48	25.60	50.79	32.40	6.50	21.82	1.19	0.22	0.30
OTHER HIGH-INCOME COUNTRIES																		
Australia	2.30	3.03	4.27	1.48	1.94	2.74	156.40	167.00	180.68	100.34	107.14	115.92	7.11	9.79	11.25	1.78	1.24	0.72
Canada	3.15	4.77		2.51	3.81		128.39	162.91		102.46	130.01		9.77	14.98		2.20	1.93	
Israel	0.90	0.86		0.81	0.78		239.87	161.84		217.57	146.80		26.53	35.89		1.97	1.49	
Japan	19.22	13.47	7.17	14.27	10.00	5.33	165.78	108.17	56.55	123.13	80.34	42.00	18.18	14.78	9.91	3.49	1.69	0.60
New Zealand[b]	1.57	0.37	1.03	1.34	0.31	0.88	498.75	100.48	231.90	424.87	85.59	197.55	19.88	5.14	10.71	5.42	1.06	1.32
Rep. of Korea[b]	1.39	8.39	14.60	1.80	10.88	18.94	37.11	187.82	294.36	48.12	243.58	381.74	4.99	27.28	53.14	5.59	10.02	3.53
United States	20.40	13.26	23.18	20.40	13.26	23.18	88.87	49.81	72.57	88.87	49.81	72.57	15.56	10.52	11.32	1.48	0.64	0.70

Note: PPP (purchasing power parity) dollars measure the relative purchasing power of currencies across countries by eliminating national differences in pricing levels for a wide range of goods and services.

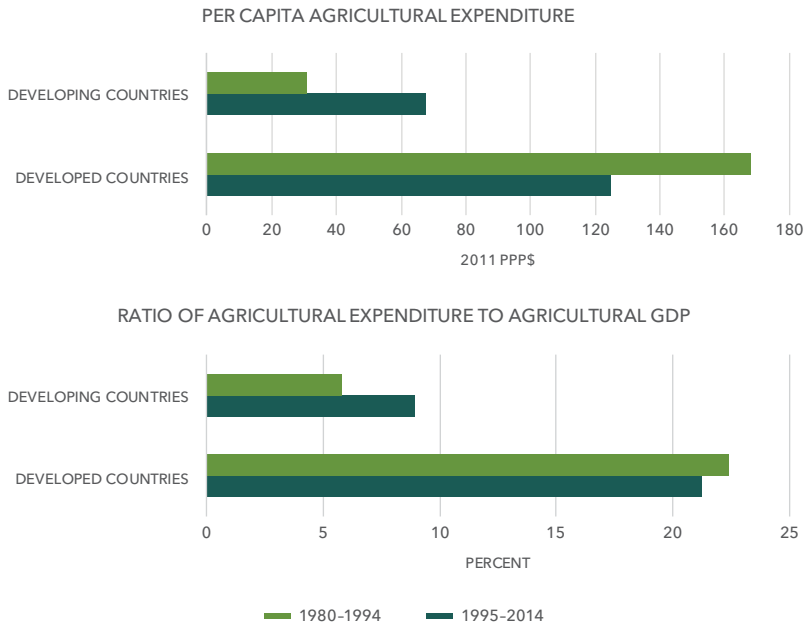
a = last year of data available is 2013; b = last year of data available is 2012; c = last year of data available is 2014; d = last year of data available is 2010.

SPEED

STATISTICS OF PUBLIC EXPENDITURE FOR ECONOMIC DEVELOPMENT

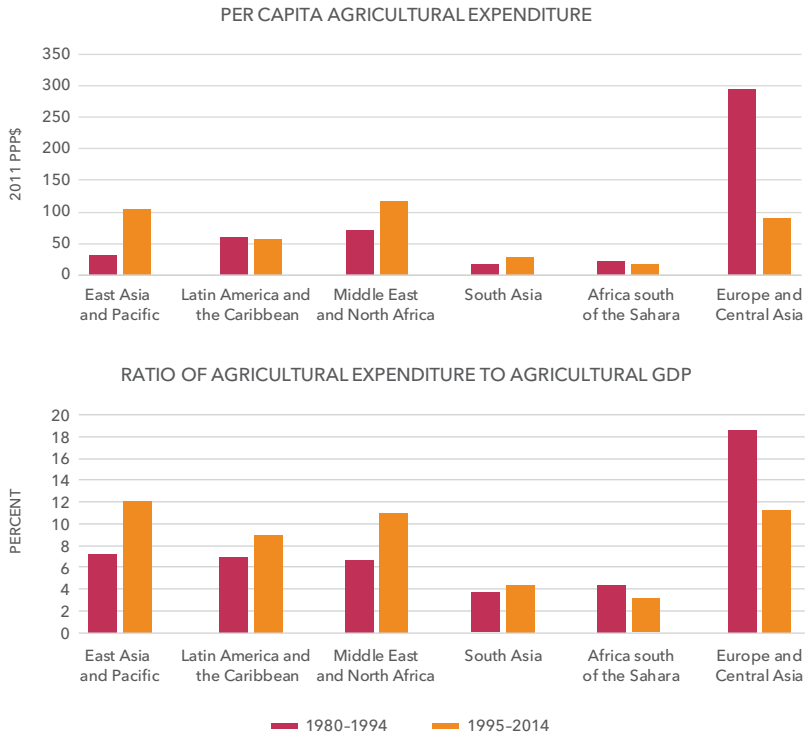
Trend 1
DEVELOPING COUNTRIES SPEND LESS ON AGRICULTURE, BUT THE GAP IS SHRINKING

By two measures, developing regions spend less than developed regions on agriculture. Both per capita spending and the ratio of public expenditure to agricultural GDP are lower across all developing regions. But the gap has shrunk over time. While developed country spending declined continuously from 1980 to 2014, spending in developing countries recovered after 1995. These changes reflect the evolution of international development policies. Structural adjustment programs implemented in the 1980s and 1990s in developing countries curtailed government spending on agriculture, but since the early 2000s, many developing country governments have increased allocations to the sector.



Trend 2
SPENDING PATTERNS DIFFER ACROSS DEVELOPING REGIONS

Several regions showed a strong recovery in the most recent period (1995–2014), while others experienced further declines in spending. This disparity reflects differences in levels of resources, economic performance, demographic shifts, and development priorities. For example, South Asia and Africa south of the Sahara, which have the lowest level of resources and overall economic performance in terms of GDP per capita, have lagged behind other developing regions in both per capita spending and the ratio of public expenditure to agricultural GDP.



Note: "Developing countries" includes East Asia and the Pacific, Europe and Central Asia (excluding high-income countries in Europe), Latin America and the Caribbean, Middle East and North Africa, South Asia, and Africa south of the Sahara. The developed region includes high-income Europe and other high-income countries not listed under the developing subregions. PPP$ = purchasing power parity dollars.

Global Hunger Index (GHI)

The Global Hunger Index (GHI) provides a comprehensive measure of hunger at the global level and by country. It allows for tracking progress and setbacks in addressing hunger and malnutrition over time and for assessing the drivers of these changes. The GHI is designed to raise awareness and understanding of regional and country differences in the struggle against hunger and to trigger action to reduce hunger around the world.

UNDERSTANDING GHI SCORES

GHI scores reflect the multidimensional nature of hunger by combining four standardized indicators into one index number that falls within the range 0–100 (Figure 1):

1. Percentage of the population that is undernourished
2. Percentage of children under five who suffer from wasting (low weight-for-height)
3. Percentage of children under five who suffer from stunting (low height-for-age)
4. Percentage of children who die before the age of five (child mortality)

Higher scores indicate greater hunger—the lower the score, the better a country's situation. GHI scores above 20 are considered "serious"; scores greater than 35 are "alarming"; and scores exceeding 50 are "extremely alarming."

TRENDS IN GLOBAL HUNGER

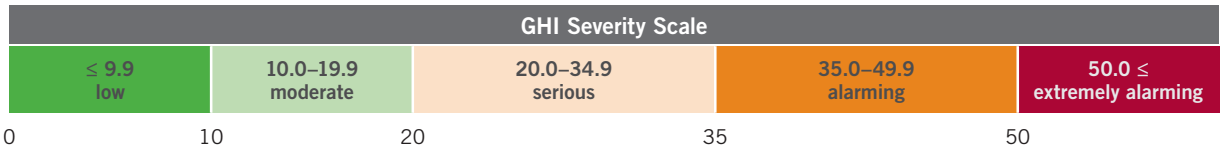
The 2016 GHI scores show substantial progress in hunger reduction for the developing world (Table 3). The GHI score for the developing world fell from 30.0 in 2000 to 21.3 in 2016, showing a reduction of 29 percent. Underlying this improvement are reductions since 2000 in each of the four GHI indicators. While the developing world has made progress in reducing hunger since 2000, this progress has been uneven, and great disparities in hunger continue to exist at the regional, national, and subnational levels.

In terms of the major regions of the developing world, Africa south of the Sahara and South Asia have the highest 2016 GHI scores, at 30.1 and 29.0, respectively. These scores reflect serious levels of hunger, and while the GHI scores for these regions have declined over time, the current levels are still on the upper end of the serious category.

The GHI scores for East and Southeast Asia, Near East and North Africa, Latin America and the Caribbean, and Eastern Europe and the Commonwealth of Independent States range between 7.8 and 12.8, and represent low or moderate levels of hunger. Yet disparities within each region are important to recognize. For example, Haiti has a 2016 GHI score of 36.9, which places it in the alarming category, although Latin America and the Caribbean as a whole is the developing region with the lowest GHI score. Also, the 2016 GHI score for East and Southeast Asia is 12.8, but this is strongly influenced by highly populous China, which has a low GHI score of just 7.7. Examination of the other countries in this grouping without China shows a GHI score of 19.9—very near the threshold between the moderate and serious categories.

From the 2000 GHI to the 2016 GHI, 22 countries made remarkable progress, reducing their GHI scores by 50.0 percent or more. Seventy countries saw a considerable reduction in their scores, dropping by between 25.0 percent and 49.9 percent, and 22 countries decreased their GHI scores by less than 25.0 percent. Despite this progress,

FIGURE 1 GHI severity scale according to GHI score



50 countries still suffer from serious or alarming levels of hunger.

Seven countries—Central African Republic, Chad, Haiti, Madagascar, Sierra Leone, Yemen, and Zambia—still suffer from levels of hunger that are alarming. Due to incomplete data, 2016 GHI scores could not be calculated for 13 countries. Ten of these—Burundi, Comoros, Democratic Republic of the Congo, Eritrea, Libya, Papua New Guinea, Somalia, South Sudan, Sudan, and Syria—are classified in the 2016 GHI report as "cause for significant concern" based on available data and reports from international organizations that specialize in hunger and malnutrition.

VISIT ONLINE
Download data: https://doi.org/10.7910/DVN/LU8KRU
Download the 2016 Global Hunger Index report: https://doi.org/10.2499/9780896292260

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TABLE 3 Global Hunger Index scores (various years), ranked by 2016 country scores

Rank[a]	Country	1992	2000	2008	2016
2016 GHI scores less than 5, collectively ranked 1–16[b]	Argentina	5.8	5.3	<5	<5
	Belarus	--	<5	<5	<5
	Bosnia and Herzegovina	--	9.6	6.7	<5
	Brazil	16.1	11.8	5.4	<5
	Chile	6.2	<5	<5	<5
	Costa Rica	7.6	6.3	5.0	<5
	Croatia	--	6.2	<5	<5
	Cuba	8.7	6.1	<5	<5
	Estonia	--	5.3	<5	<5
	Kuwait	26.0	<5	<5	<5
	Latvia	--	6.6	<5	<5
	Lithuania	--	5.2	<5	<5
	Montenegro	--	--	5.1	<5
	Saudi Arabia	11.8	10.4	9.1	<5
	Turkey	14.3	10.4	5.6	<5
	Ukraine	--	13.5	<5	<5
17	Slovakia	--	7.7	6.0	5.3
18	Tunisia	13.6	9.0	6.2	5.5
18	Romania	9.0	8.6	5.9	5.5
20	Uruguay	10.0	7.6	6.7	5.6
21	Jordan	12.6	9.8	5.9	5.7
22	Macedonia, FYR	--	7.9	6.2	5.8
23	Iran	17.5	13.7	8.8	6.7
24	Russian Federation	--	10.5	6.8	6.8
25	Venezuela	14.9	15.3	8.7	7.0
26	Lebanon	11.4	9.0	8.3	7.1
26	Serbia	--	--	7.8	7.1
28	Mexico	14.6	10.8	8.4	7.2
29	China	26.4	15.9	11.5	7.7
30	Kazakhstan	--	10.7	10.7	7.8
31	Jamaica	12.4	8.6	7.4	7.9
32	Georgia	--	15.2	8.2	8.2
33	Bulgaria	9.3	9.5	8.8	8.3
34	Fiji	11.7	10.2	8.7	8.5
34	Trinidad and Tobago	13.9	12.3	10.5	8.5
34	Colombia	15.1	11.4	9.3	8.5
37	Peru	28.4	20.8	15.8	8.6
38	Armenia	--	17.4	11.7	8.7
38	Algeria	16.8	14.8	10.8	8.7
40	Kyrgyzstan	--	19.4	13.1	9.1
41	Moldova, Rep.	--	15.1	11.9	9.2
42	Panama	21.1	19.9	14.9	9.3
42	Morocco	18.3	15.6	12.0	9.3
44	Malaysia	20.1	15.5	13.4	9.7
45	Azerbaijan	--	27.2	15.7	9.8
46	Suriname	17.5	16.5	11.7	10.1
47	Oman	21.1	14.2	10.7	10.4
47	Paraguay	17.1	14.2	11.7	10.4
49	Dominican Rep.	25.0	19.4	15.6	11.1
50	El Salvador	19.1	16.8	12.6	11.2
51	South Africa	18.5	18.7	16.3	11.8
51	Thailand	26.1	18.3	11.9	11.8
53	Albania	20.4	21.1	16.9	11.9
54	Gabon	21.1	18.5	15.6	12.0
55	Turkmenistan	--	22.2	16.6	12.3
56	Uzbekistan	--	21.8	15.8	13.1
57	Mauritius	17.5	16.2	14.8	13.2
57	Honduras	25.8	20.3	16.8	13.2
59	Nicaragua	36.1	25.6	17.9	13.3
60	Egypt	19.3	15.3	16.1	13.7

Table 3 continued

Rank[a]	Country	1992	2000	2008	2016
61	Mongolia	34.0	33.0	20.5	13.8
62	Ghana	42.7	29.9	22.7	13.9
62	Ecuador	23.6	20.2	17.5	13.9
64	Guyana	24.1	18.8	16.9	14.5
64	Viet Nam	41.5	30.2	22.1	14.5
66	Bolivia	36.7	30.8	23.9	15.4
67	Senegal	37.1	37.7	24.4	16.5
68	Philippines	30.8	26.2	20.4	19.9
69	Guatemala	28.4	28.0	21.9	20.7
70	Gambia	33.5	27.9	24.5	20.9
71	Cambodia	45.3	44.7	26.6	21.7
72	Nepal	43.1	36.8	29.2	21.9
72	Kenya	38.5	37.6	29.6	21.9
72	Indonesia	35.8	25.3	28.6	21.9
75	Myanmar	55.8	45.3	32.0	22.0
75	Iraq	19.6	24.9	24.5	22.0
77	Mauritania	39.7	33.6	23.6	22.1
78	Togo	45.2	38.5	28.2	22.4
79	Lesotho	25.9	32.9	28.0	22.7
80	Cameroon	40.4	40.3	30.5	22.9
81	Botswana	32.4	33.0	30.9	23.0
82	Benin	44.6	38.1	31.8	23.2
83	Swaziland	24.8	30.9	30.0	24.2
84	Nigeria	49.5	40.9	33.6	25.5
84	Sri Lanka	31.8	27.0	24.4	25.5
86	Côte d'Ivoire	31.8	31.4	34.1	25.7
87	Uganda	41.3	39.4	31.2	26.4
88	Congo, Rep.	37.6	37.2	31.9	26.6
89	Malawi	57.6	45.3	31.8	26.9
90	Bangladesh	52.4	38.5	32.4	27.1
91	Rwanda	54.6	58.7	37.9	27.4
91	Guinea-Bissau	45.2	43.9	31.9	27.4
93	Mali	50.2	43.9	34.4	28.1
93	Lao PDR	52.2	48.8	33.9	28.1
93	Guinea	46.1	44.4	33.9	28.1
96	Tanzania, United Rep.	42.1	42.4	32.9	28.4
97	India	46.4	38.2	36.0	28.5
98	Korea, DPR	30.9	40.4	30.1	28.6
99	Zimbabwe	36.1	41.0	35.1	28.8
100	Tajikistan	--	40.3	32.4	30.0
101	Liberia	49.7	47.4	38.6	30.7
102	Burkina Faso	47.7	48.4	37.1	31.0
103	Namibia	35.8	32.5	29.6	31.4
104	Mozambique	65.6	49.4	38.2	31.7
105	Djibouti	61.1	48.5	35.9	32.7
106	Angola	65.9	57.8	40.5	32.8
107	Ethiopia	70.9	58.5	43.0	33.4
107	Pakistan	43.4	37.8	35.1	33.4
109	Niger	64.8	53.0	37.1	33.7
110	Timor-Leste	--	--	46.9	34.3
111	Afghanistan	49.3	52.4	39.2	34.8
112	Sierra Leone	57.8	53.9	45.3	35.0
112	Yemen	43.8	43.2	36.5	35.0
114	Madagascar	44.6	44.2	37.1	35.4
115	Haiti	51.6	42.8	43.4	36.9
116	Zambia	47.1	50.4	45.2	39.0
117	Chad	62.5	51.9	50.9	44.3
118	Central African Republic	52.2	51.5	48.0	46.1

Notes: (--) = data are not available or not presented. Some countries, such as post-Soviet states prior to 1991, did not exist in their present borders in the given year or reference period.

a = ranked according to 2016 GHI scores. Countries that have identical 2016 scores are given the same ranking (for example, Tunisia and Romania both are ranked eighteenth). The following countries could not be included because of lack of data: Bahrain, Bhutan, Burundi, Comoros, Democratic Republic of the Congo, Eritrea, Libya, Papua New Guinea, Qatar, Somalia, South Sudan, Sudan, and Syrian Arab Republic.

b = differences between these scores are minimal. The 16 countries with 2016 GHI scores of less than 5 are not assigned individual ranks, but rather are collectively ranked 1–16.

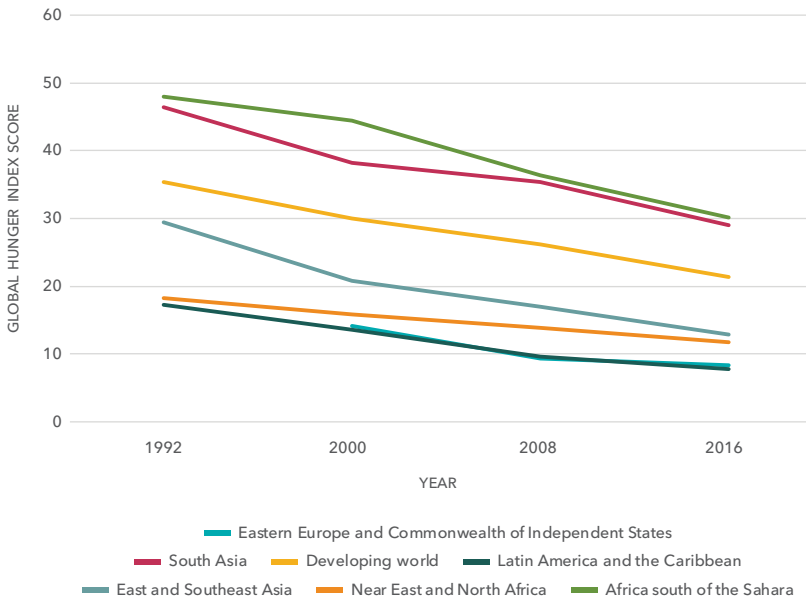
GHI

GLOBAL HUNGER INDEX

Trend 1
HUNGER IS DECLINING BUT STILL SERIOUS IN SOME REGIONS

GHI scores reflect declining hunger for all regions of the developing world in recent decades, yet Africa south of the Sahara and South Asia stand out for having hunger levels that are substantially higher than those of the other regions. South Asia's and Africa south of the Sahara's 2016 GHI scores are considered "serious," whereas the scores for the other regions are categorized as "moderate" or "low." Regional scores, moreover, may conceal important disparities within regions and within countries.

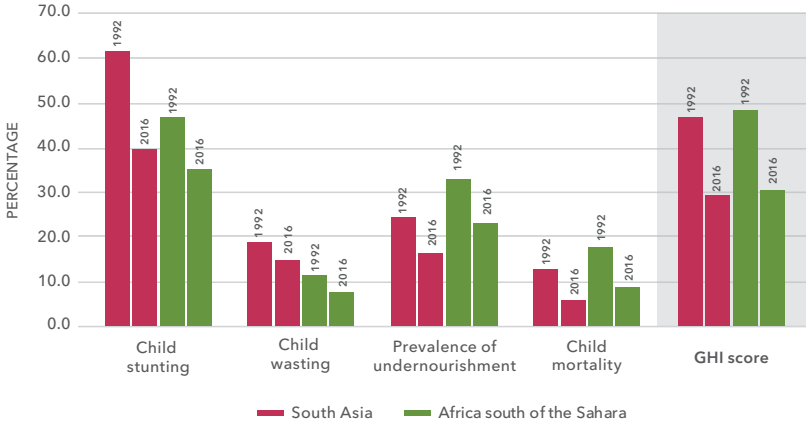
REGIONAL GLOBAL HUNGER INDEX SCORES



Trend 2
SIMILAR SCORES REFLECT DIFFERENT CHALLENGES

Although Africa south of the Sahara and South Asia have very similar GHI scores overall, they reflect different regional challenges. The indicator values that comprise the GHI scores vary considerably between regions. In South Asia, child undernutrition, including both child stunting and child wasting values, is higher than in Africa south of the Sahara, while Africa south of the Sahara has higher undernourishment values—reflecting overall calorie deficiency for the population—and higher child mortality rates. There is no "one size fits all" solution to ending hunger and malnutrition.

SOUTH ASIA AND AFRICA SOUTH OF THE SAHARA: COMPOSITION OF GHI SCORES



Food Policy Research Capacity Indicators (FPRCI)

Food policy research plays an important role in guiding the agricultural development of countries. To achieve food security goals, countries need to strengthen their capacity to conduct food policy research. Strong local policy research institutions help in shaping an evidence-based policy-making process. Measuring national capacity for food policy research is important for identifying capacity gaps in food policy research and guiding allocation of resources to fill those gaps.

Food policy research capacity is defined as any socioeconomic or policy-related research capacity in the areas of food, agriculture, or natural resources. To measure this capacity, the International Food Policy Research Institute (IFPRI) developed a set of indicators of the quantity and quality of policy research at the country level.

INDICATORS

IFPRI created a database for food policy research capacity in 2010, and has continued to expand and refine it. The data presented in Table 4 are currently collected for 33 countries; data for Myanmar were added this year. A consistent methodology is followed to enable comparison of values across time and countries. The database was most recently updated with numbers for 2015.

Analysts/researchers is a head count of professionals employed at local organizations whose work involves food policy research or analysis. To introduce some uniformity, IFPRI also presents a modified quantification of the head count: full-time equivalent analysts/researchers with a PhD equivalent. To obtain an indicator of per capita food policy research capacity, this research capacity is then divided by the country's rural population (full-time equivalent researchers per million rural residents). This helps to illustrate the impact of local food policy research in a particular country.

The quality of a country's food policy research capacity is estimated by tallying the number of relevant international publications in peer-reviewed journals over a five-year period. IFPRI views this as a reflection of the local enabling environment for food policy research. This indicator allows for comparison across countries, as it ensures an internationally accepted standard of quality for publications. The final indicator is derived by dividing the number of international publications by the number of full-time equivalent researchers with a PhD, providing a measure of productivity.

TRENDS IN FOOD POLICY RESEARCH

Overall food policy research capacity across all countries did not change from last year's level, but countries and regions had different experiences. For instance, Colombia has seen a steady decline in the number of food policy research publications since 2011, while Nepal has seen an increase. A number of East African countries, with the exception of Tanzania and Mozambique, showed a slight decline in food policy research capacity. Asian countries did not show any dramatic changes in numbers. Afghanistan has seen an increase in research capacity since 2014. In Latin America, with the exception of Colombia and Honduras, all countries experienced either a slight increase or no change in the number of publications.

IFPRI will continue to update and expand this database to include additional countries to better facilitate cross-country comparisons. This will also facilitate identification of the minimum food policy research capacity threshold for a country. It is hoped that such data will aid in informing national policy makers of the importance of investing in local food policy research capacity. Lastly, this data will provide donors with a framework for prioritizing investments to strengthen food policy research capacity across as well as within countries.

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TABLE 4 Food policy research capacity indicators, 2011–2015

Country	Analysts/ researchers (head count) in 2013-2017	FTE analysts/ researchers with PhD in 2013-2017	International publications produced from 2011-2015	FTE analysts/ researchers with PhD per million rural population in 2015	Publications per FTE researcher with PhD 2011-2015
Afghanistan	43	3.0	2	0.131	0.672
Bangladesh	66	22.9	45	0.217	1.965
Benin	38	4.3	23	0.732	5.349
Burundi	39	5.1	2	0.570	0.390
China	2,000	1,332.5	1,326[a]	2.096	0.995
Colombia	85	6.5	29	0.553	4.496
Ethiopia	141	30.4	16	0.397	0.526
Ghana	153	23.3	52	1.903	2.232
Guatemala	45	11.9	3	1.559	0.252
Honduras	33	6.1	4	1.628	0.653
Indonesia	146	42.4	13	0.355	0.307
Kenya	155	31.6	51	0.947	1.614
Lao PDR	9	1.8	5	0.407	2.857
Liberia	34	3.1	1	1.402	0.325
Madagascar	187	11.5	10	0.760	0.868
Malawi	68	18.2	22	1.321	1.210
Mali	60	10.1	1	1.066	0.100
Mozambique	37	3.3	12	0.188	3.609
Myanmar	97	46.5	5	1.309	0.108
Nepal	27	3.7	4	0.160	1.096
Niger	29	8.8	2	0.605	0.227
Nigeria	349	77.4	35	0.827	0.452
Peru	54	7.2	18	1.068	2.517
Rwanda	64	5.5	5	0.639	0.909
Senegal	71	9.3	13	1.156	1.398
South Africa	198	50.3	210	2.623	4.173
Swaziland	32	2.9	1	2.900	0.351
Tanzania, United Rep.	91	20.8	26	0.604	1.253
Togo	81	6.8	4	1.641	0.586
Uganda	34	10.9	19	0.344	1.739
Viet Nam	175	32.5	6	0.536	0.184
Zambia	29	5.3	9	0.608	1.698
Zimbabwe	42	8.9	9	0.931	1.014

Notes: Data on the number of analysts/researchers are collected every five years. For most countries, data were last collected in 2013. FTE = full-time equivalent.

a = the number of international publications for China is for 2009–2013.

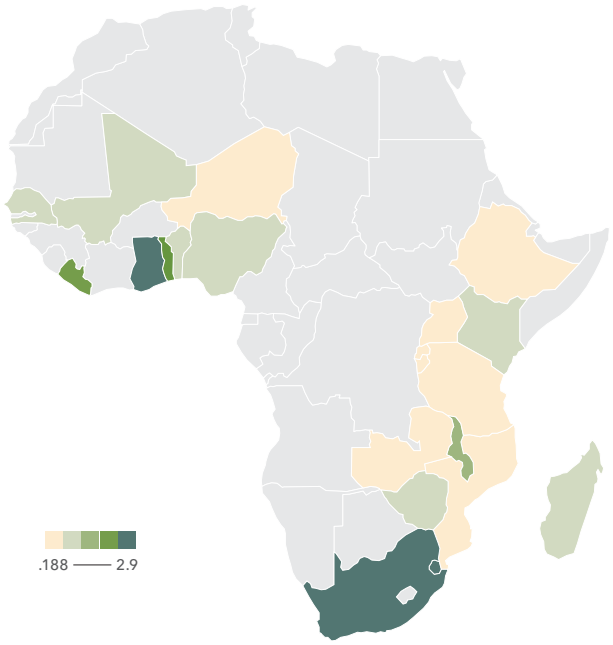
FPRCI

FOOD POLICY RESEARCH CAPACITY INDICATORS

Trend 1
RESEARCH CAPACITY VARIES—EVEN WITHIN DEVELOPING REGIONS

Food policy research capacity—measured in terms of full-time equivalent researchers with a PhD per million rural population—varies greatly across and within developing regions. In Africa south of the Sahara, Swaziland, South Africa, and Ghana all have a relatively high ratio of food policy researchers to rural people. Many other African countries, including much of East Africa except Malawi, Kenya, and Zimbabwe, show relatively low capacity in this regard. Economic development levels explain capacity differences in part.

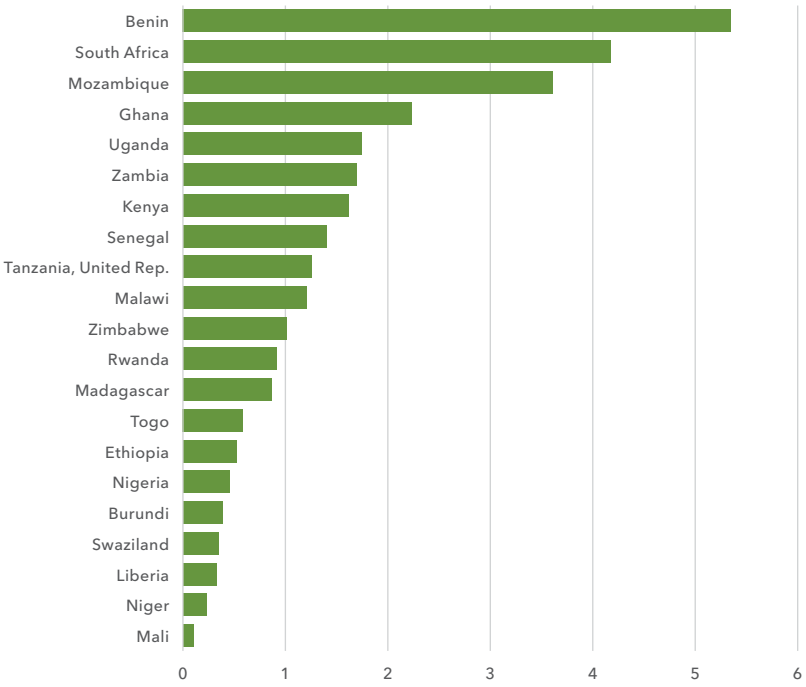
FULL-TIME EQUIVALENT ANALYSTS/RESEACHERS WITH PHD PER MILLION RURAL POPULATION (2015)



Trend 2
NUMBER OF PUBLICATIONS PRODUCED BY DEVELOPING COUNTRY RESEARCHERS RANGES WIDELY

The number of international publications produced per researcher shows wide variation across countries. For some African countries, this measure correlates with the number of researchers per million rural population—South Africa and Ghana score high on both measures of food policy research capacity. Other countries produce relatively more publications despite low ratios of researchers to rural population.

PUBLICATIONS PER FTE RESEARCHER WITH PHD 2011–2015: AFRICA



Note: Both indicators—full-time equivalent (FTE) researchers per million rural population and publications per FTE researcher with PhD—are based on a five-year average. The actual numbers may differ from year to year. The relative position of countries may change when data on more countries are added.

Agricultural Total Factor Productivity (TFP)

Increasing the efficiency of agricultural production—getting more output from the same amount of resources—is critical for improving food security. To measure the efficiency of agricultural systems, we use total factor productivity (TFP). TFP is an indicator of how efficiently agricultural land, labor, capital, and materials (agricultural inputs) are used to produce a country's crops and livestock (agricultural output)—it is calculated as the ratio of total agricultural output to total production inputs. When more output is produced from a constant amount of resources, meaning that resources are being used more efficiently, TFP increases. Various policies and investments, such as agricultural research that develops higher-yielding varieties or more cost-effective pest management methods, can increase TFP. Measures of land and labor productivity—partial factor productivity (PFP) measures—are calculated as the ratio of total output to total agricultural area (land productivity) and to the number of economically active persons in agriculture (labor productivity). Because PFP measures are easy to estimate, they are often used to measure agricultural production performance. PFP measures normally show higher rates of growth than TFP, because growth in land and labor productivity can result not only from increases in TFP but also from a more intensive use of other inputs (such as fertilizer or machinery). Indicators of both TFP and PFP contribute to the understanding of agricultural systems needed for policy and investment decisions by allowing for comparisons across time and across countries and regions.

TRENDS IN PRODUCTIVITY

Table 5 presents estimates of TFP for three periods between 1991 and 2013 and land and labor productivity measures for developing countries and regions using the most recent data on outputs and inputs from the Food and Agricultural Organization of the United Nations (FAO).

Data on TFP for 2001–2013 reflect the strong performance of developing regions during the 2000s, with the peak occurring between 2001 and 2007. TFP growth in Africa south of the Sahara and in the Middle East and North Africa remained strong between 2008 and 2013, while growth in Latin America appears to be slowing to the levels observed in the 1990s. In contrast with results from earlier data (reported in the *2014–2015 Global Food Policy Report*), current TFP estimates for Asia show slower growth between 2008 and 2013, largely explained by slower growth in China. The data also show a significant increase in the use of feed in China, while output continued to grow at an average of 3 percent as in previous years.

DATA

The output values used to estimate TFP are FAO-constructed gross agricultural outputs, each of which is a composite of 190 crop and livestock commodities aggregated using a constant set of global average prices from 2004–2006. Inputs are agricultural land, measured in hectares of cropland and permanent pasture; labor, measured by the number of economically active persons in agriculture; and fertilizer, measured by tons of fertilizer nutrients used. The dataset uses FAO's capital stock series that aggregates quantity of physical assets at 2005 constant prices.[1]

Land and labor productivity measures for the regions (such as Africa south of the Sahara) reflect a weighted average of individual country productivity measures using average outputs (1991–2013) of each country as weights. TFP is calculated using a growth accounting approach. This approach defines TFP as the ratio of an output index and an input index.[2]

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http://hdl.handle.net/1902.1/20518

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TABLE 5 Average annual growth of agricultural output and total factor productivity (TFP), and levels of land and labor productivity, various years

Region/country	Land productivity				Labor productivity				Output growth (%)			TFP growth (%)		
	1990	2000	2007	2013	1990	2000	2007	2013	1991–2000	2001–2007	2008–2013	1991–2000	2001–2007	2008–2013
AFRICA SOUTH OF THE SAHARA	180	243	334	439	1133	1418	1761	2225	3.5	4.5	4.3	1.5	2.2	2.4
Angola	15	24	44	78	252	314	467	701	5.0	9.3	10.4	1.4	5.0	6.7
Benin	395	511	531	720	780	1,105	1,066	1,505	6.2	1.2	7.0	1.5	0.0	2.4
Botswana	8	8	9	11	1,071	724	752	916	−0.8	1.5	4.6	−2.2	−0.7	3.6
Burkina Faso	110	147	171	223	297	305	317	374	3.2	3.9	6.2	1.0	0.5	4.0
Burundi	490	528	620	764	406	342	288	333	−0.5	1.2	5.4	0.2	−2.3	3.6
Cameroon	238	325	468	597	713	842	1,169	1,531	3.2	5.4	5.1	0.6	2.9	2.8
Central African Republic	108	152	170	200	526	669	735	798	3.7	1.8	2.3	2.1	0.5	1.2
Chad	17	23	28	33	446	456	464	506	2.9	2.9	3.1	0.1	−0.1	2.2
Congo, Rep.	20	26	35	43	466	547	706	832	2.8	4.3	3.6	−0.3	4.5	1.1
Congo, Dem. Rep.	172	150	148	169	493	346	300	311	−1.5	−0.1	2.4	−1.2	−1.4	1.0
Côte d'Ivoire	209	289	277	342	1,520	1,975	2,094	2,596	3.7	0.1	3.6	1.9	−0.5	2.1
Ethiopia	82	144	196	255	255	217	261	296	1.8	6.1	5.1	1.1	2.7	1.4
Gabon	39	49	51	60	949	1,227	1,345	1,586	2.3	0.6	2.9	0.6	0.8	1.5
Gambia	132	227	189	208	233	288	175	194	4.9	−4.1	5.1	1.8	−5.8	4.7
Ghana	160	294	352	494	567	902	974	1,196	7.7	3.6	6.1	4.6	0.4	3.3
Guinea	73	111	132	152	415	430	481	490	3.8	3.3	2.6	−0.8	−0.6	1.7
Guinea-Bissau	105	130	157	209	450	527	568	684	3.4	2.6	5.1	1.1	1.8	3.2
Kenya	150	168	245	273	513	417	525	527	1.1	5.7	2.1	0.0	3.6	0.4
Liberia	103	152	165	148	457	548	521	419	4.4	1.3	−1.3	−3.7	0.3	2.3
Madagascar	69	65	79	86	612	491	480	441	0.4	2.9	1.8	−0.6	0.5	0.2
Malawi	244	409	524	641	302	491	574	684	6.5	4.4	5.9	2.8	1.1	2.4
Mali	46	47	70	87	822	837	1,101	1,207	2.1	6.7	4.0	−0.3	3.7	1.8
Mauritania	9	10	11	13	767	672	635	628	1.5	2.1	2.5	−0.9	−0.7	0.7
Mauritius	2,144	2,437	2,601	2,795	3,174	3,970	4,693	5,930	0.3	−0.4	0.3	−0.8	0.1	0.4
Mozambique	24	34	45	63	221	230	266	332	3.5	4.4	6.1	0.6	2.6	3.1
Namibia	10	10	12	11	1,689	1,528	1,848	1,580	0.4	2.6	−1.9	−1.4	5.9	−1.1
Niger	34	46	63	70	500	544	703	647	4.3	7.2	2.2	1.0	4.0	−0.1
Nigeria	275	393	631	869	968	1,312	1,891	2,259	5.2	7.5	5.1	2.8	4.8	3.6
Rwanda	590	742	870	1,379	387	369	393	531	1.1	3.7	8.1	1.8	−2.1	4.3
Senegal	101	139	113	158	378	400	268	326	3.1	−3.1	6.5	1.4	−4.1	2.6
Sierra Leone	155	117	202	303	400	317	582	929	−2.8	12.1	9.2	−2.1	4.6	6.8
Somalia	33	33	36	43	816	707	674	695	−0.1	1.4	2.9	−0.1	0.9	1.8
South Africa	96	111	119	142	5,713	7,316	8,863	12,289	1.6	0.8	3.0	1.6	0.9	3.4
Sudan	31	55	68	76	773	1,151	1,315	1,394	6.4	3.7	1.9	3.7	1.5	−0.9
Swaziland	220	204	225	258	1,958	1,686	1,979	2,286	−0.9	1.4	2.3	−1.6	1.4	1.9
Tanzania, United Rep.	116	129	186	234	374	325	422	518	1.1	6.0	6.2	−0.2	1.8	3.9
Togo	151	176	211	223	512	571	580	601	2.9	2.1	2.6	1.0	1.3	0.1
Uganda	322	395	427	442	584	585	564	516	2.5	2.3	1.4	−0.6	0.2	−0.5

Table 5 continued

Region/country	Land productivity				Labor productivity				Output growth (%)			TFP growth (%)		
	1990	2000	2007	2013	1990	2000	2007	2013	1991–2000	2001–2007	2008–2013	1991–2000	2001–2007	2008–2013
Zambia	36	39	52	84	339	330	396	565	1.6	4.5	9.0	0.8	3.2	3.1
Zimbabwe	121	138	95	104	551	636	486	487	2.8	−4.1	1.5	1.3	−2.3	0.5
LATIN AMERICA AND THE CARIBBEAN	260	343	439	505	5,759	7,918	11,205	14,033	3.2	4.0	2.5	2.0	2.9	2.0
Argentina	192	252	297	302	16,822	22,219	30,008	32,629	2.8	4.1	0.8	2.2	2.5	0.4
Bahamas	1,656	1,776	2,238	2,593	3,312	4,618	5,819	7,259	1.5	3.4	3.8	−0.4	6.8	−3.4
Barbados	2,847	2,778	3,095	3,393	6,011	7,144	9,903	11,876	−0.8	−0.1	−0.7	−0.0	2.6	0.2
Belize	725	1,043	1,131	1,176	5,076	6,474	5,926	5,701	5.5	1.4	1.5	2.5	0.0	−1.8
Bolivia	48	65	87	103	1,388	1,507	1,711	1,796	3.6	4.3	3.0	0.9	0.7	3.0
Brazil	253	341	467	562	4,341	6,685	10,647	15,172	3.9	5.2	3.4	2.4	4.2	2.8
Chile	279	411	485	556	4,747	6,444	7,833	9,196	3.4	3.0	2.4	1.4	1.7	2.9
Colombia	216	255	329	349	2,907	3,186	3,897	4,295	1.6	2.9	1.1	0.4	1.3	0.5
Costa Rica	707	1,236	1,516	1,641	5,292	6,956	8,344	9,822	3.4	2.6	2.1	2.7	1.8	2.1
Dominican Rep.	629	753	1,004	1,189	2,563	3,439	5,064	6,873	1.7	3.9	3.1	0.7	2.9	3.7
Ecuador	479	732	887	969	3,412	4,808	5,164	5,737	4.6	1.5	1.7	3.4	1.2	−0.2
El Salvador	599	676	745	739	1,287	1,529	1,829	2,014	1.8	1.4	0.5	0.1	0.1	0.6
Guatemala	469	635	899	1,111	1,355	1,906	2,060	2,249	3.5	5.1	3.5	1.7	1.0	3.8
Guyana	105	186	195	255	3,138	5,671	6,168	8,219	5.7	0.4	4.6	6.1	−0.2	5.0
Haiti	582	568	605	661	521	486	505	504	0.3	2.0	1.0	−2.0	0.2	1.2
Honduras	355	442	613	670	1,747	1,762	2,865	3,268	1.0	5.9	1.9	0.6	2.6	1.1
Jamaica	1,031	1,118	1,204	1,287	1,785	2,158	2,504	2,777	0.9	0.6	0.6	0.6	0.8	0.6
Mexico	216	278	330	364	2,640	3,346	4,210	4,963	2.7	2.5	1.6	2.0	2.1	1.5
Nicaragua	162	201	258	338	1,667	2,640	3,658	5,020	4.7	3.7	4.2	1.9	2.6	4.8
Panama	383	373	418	442	3,202	3,101	3,552	3,938	0.2	1.8	1.0	−1.5	0.7	0.6
Paraguay	156	143	218	279	4,638	4,061	5,603	6,952	0.8	6.4	5.0	−1.0	4.0	2.9
Peru	156	256	322	410	1,223	1,760	2,083	2,637	5.7	3.6	4.6	2.8	2.2	3.4
Suriname	1,343	1,073	1,606	1,745	4,076	3,147	3,513	4,388	−2.2	2.5	4.3	−2.2	4.6	0.1
Trinidad and Tobago	1,743	2,189	2,910	2,672	2,632	2,993	3,274	3,206	0.9	1.0	−1.4	2.1	2.3	−0.8
Uruguay	147	191	237	293	11,776	14,499	18,477	24,306	2.7	2.8	4.3	1.3	1.4	2.7
Venezuela	196	263	312	362	4,914	6,986	8,886	11,367	2.9	2.4	2.5	1.7	1.8	1.2
ASIA	653	930	1,169	1,368	762	974	1,247	1,505	3.9	3.6	3.0	2.4	2.5	1.5
Afghanistan	54	67	86	95	823	631	642	618	2.0	3.6	1.7	1.2	−0.4	1.0
Armenia	495	466	620	699	4,355	3,546	6,869	8,173	−0.3	8.4	1.4	1.4	5.6	1.8
Azerbaijan	509	334	474	613	2,536	1,628	2,144	2,716	−3.0	5.2	4.4	−2.7	1.5	2.9
Bangladesh	1,073	1,633	2,072	2,558	355	473	582	726	3.3	3.3	3.3	2.1	1.6	2.6
Bhutan	229	195	297	280	650	611	603	434	−0.1	7.1	−2.3	−0.0	4.9	−2.8
Cambodia	275	397	555	779	411	479	636	844	4.5	6.9	6.8	1.7	3.6	2.6
China	457	737	947	1,148	472	756	957	1,178	5.2	3.4	3.3	3.4	3.0	1.1
India	719	930	1,192	1,451	624	709	831	951	2.6	3.5	3.3	1.2	2.2	2.3
Indonesia	670	808	1,004	1,181	726	804	1,082	1,334	2.4	4.9	3.8	0.6	2.9	1.6
Kazakhstan	51	27	40	44	7,864	4,402	6,874	8,003	−6.8	5.7	1.6	−1.8	3.5	5.3

Table 5 continued

Region/country	Land productivity				Labor productivity				Output growth (%)			TFP growth (%)		
	1990	2000	2007	2013	1990	2000	2007	2013	1991–2000	2001–2007	2008–2013	1991–2000	2001–2007	2008–2013
Korea, DPR	1,532	1,287	1,383	1,533	1,065	989	1,134	1,355	–1.6	1.3	1.9	2.1	0.1	3.0
Kyrgyzstan	157	161	169	189	3,568	3,183	3,543	3,978	0.5	0.7	1.6	2.3	0.0	2.5
Lao PDR	428	627	703	877	472	613	690	815	5.0	4.1	5.9	2.3	–0.1	1.2
Malaysia	1,100	1,405	1,828	1,979	3,894	5,333	8,003	10,323	2.7	4.2	2.6	1.7	3.0	2.3
Mongolia	7	7	6	8	3,827	3,990	3,135	4,516	0.1	–4.2	5.3	2.6	–3.7	1.9
Myanmar	596	976	1,508	1,624	401	572	914	977	5.4	8.0	2.1	3.0	4.2	1.1
Nepal	704	910	1,086	1,431	463	469	448	511	2.9	2.3	4.5	1.5	0.9	0.8
Pakistan	808	1,098	1,330	1,182	1,398	1,584	1,561	1,234	3.5	2.7	–1.8	1.4	0.5	–2.9
Philippines	1,146	1,389	1,713	1,778	1,172	1,252	1,525	1,615	2.0	3.7	1.5	0.3	2.5	0.9
Sri Lanka	900	992	1,054	1,233	589	641	636	827	1.0	1.1	4.7	0.6	0.6	3.8
Tajikistan	251	173	275	390	1,655	1,292	1,640	2,119	–3.5	7.4	6.6	–1.3	1.1	4.8
Thailand	844	1,268	1,536	1,617	856	1,268	1,574	1,988	3.4	2.8	2.5	2.8	2.1	1.4
Turkmenistan	26	54	91	85	2,586	3,052	4,643	3,938	4.4	7.4	–1.5	3.7	3.6	0.4
Uzbekistan	201	255	369	514	2,557	2,645	3,632	5,065	2.0	5.1	5.7	3.1	1.1	4.3
Viet Nam	1,590	2,138	2,614	3,018	459	704	904	1,063	5.8	4.9	3.7	1.5	1.0	2.1
MIDDLE EAST AND NORTH AFRICA	1,066	1,325	1,584	1,733	2,698	3,693	4,372	5,302	2.7	2.7	2.6	1.7	1.8	2.1
Algeria	74	94	123	208	1,438	1,334	1,581	2,541	2.9	4.3	9.2	1.6	2.1	6.6
Bahrain	2,424	2,855	2,907	5,143	4,849	8,755	6,104	11,058	3.1	–1.0	10.4	2.1	0.2	6.8
Egypt	4,179	5,234	6,304	6,603	1,719	2,780	3,487	3,800	4.5	3.8	1.1	2.1	1.9	–0.4
Iran	217	303	542	563	2,568	3,269	4,028	4,170	3.6	4.6	1.0	2.4	3.8	–0.1
Iraq	332	318	302	460	4,833	4,931	6,054	8,634	–1.5	0.7	4.1	1.1	–2.6	5.8
Israel	3,504	4,122	5,362	5,622	31,214	38,248	51,448	61,284	1.4	2.5	1.0	0.8	3.2	1.3
Jordan	554	741	1,056	1,283	5,760	6,768	8,920	11,241	3.2	3.6	4.7	1.4	2.6	3.5
Kuwait	643	971	1,272	2,021	10,072	13,068	13,715	18,073	4.7	4.2	8.1	1.6	2.3	7.4
Lebanon	1,762	2,082	1,845	1,658	16,654	30,209	36,751	45,014	1.5	0.1	–0.5	1.0	0.2	–1.6
Libya	53	66	75	78	6,557	10,024	14,911	20,980	2.2	1.7	0.7	2.8	1.2	2.1
Morocco	167	170	225	320	1,557	1,551	2,190	3,346	0.3	3.7	6.3	–0.6	3.3	5.2
Oman	173	265	231	287	749	1,097	1,147	1,005	5.3	1.2	3.8	3.2	–1.8	–1.4
Qatar	448	708	737	861	3,902	11,682	7,988	6,288	5.5	0.4	2.8	3.0	0.4	–0.6
Saudi Arabia	20	16	20	21	2,491	4,110	5,797	7,843	1.2	3.5	0.7	–0.3	2.6	0.5
Syrian Arab Rep.	272	408	466	397	3,803	4,888	4,901	4,035	4.3	2.1	–2.6	2.3	–1.0	–3.3
Tunisia	282	303	366	402	3,771	3,783	4,492	4,939	1.7	3.2	2.0	–0.2	1.9	1.6
Turkey	677	784	839	1,092	2,600	3,504	3,978	5,439	1.7	0.6	4.0	1.6	1.3	4.8
Yemen	33	48	67	80	583	604	745	848	3.8	5.0	2.8	1.4	2.6	1.1

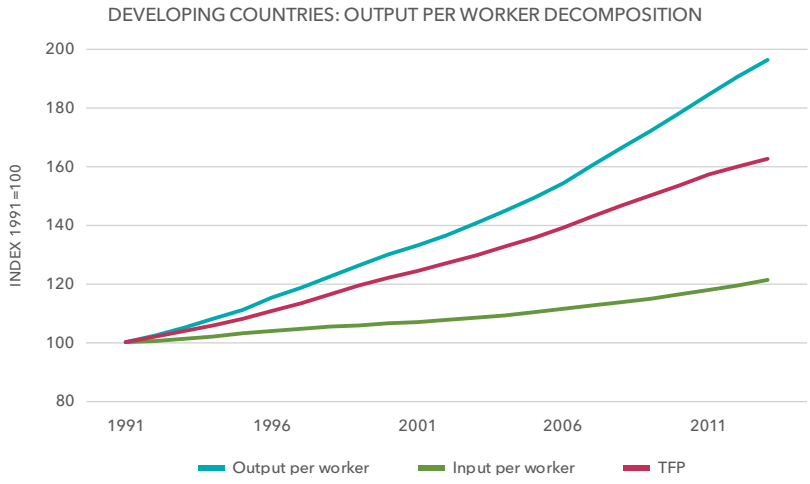
Note: Land productivity is agricultural gross production per hectare of agricultural land; labor productivity is agricultural gross production per economically active person in agriculture. Both types of agricultural gross production are measured in constant 2004–2006 US dollars.

TFP

AGRICULTURAL TOTAL FACTOR PRODUCTIVITY

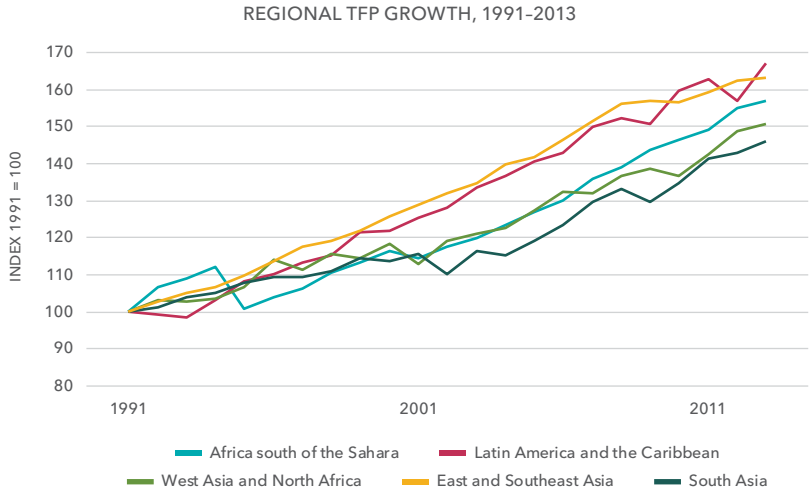
Trend 1
DOUBLING OF OUTPUT PER WORKER

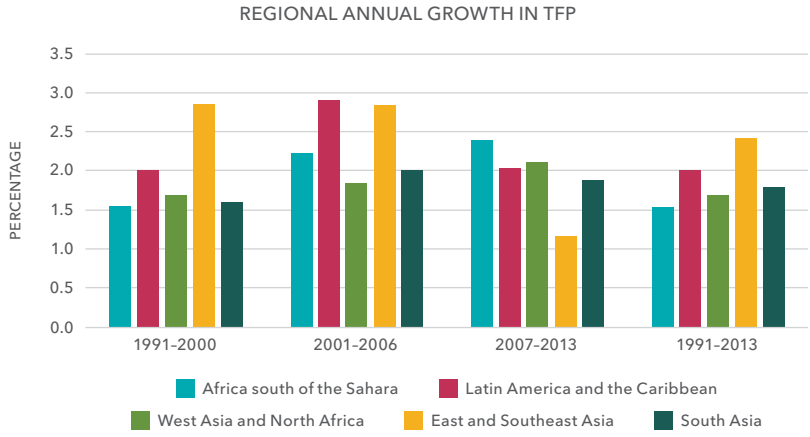
Between 1991 and 2013, output per worker in developing countries doubled, growing at an average annual rate of 3.1 percent. About 70 percent of this growth is explained by total factor productivity (TFP), while the remaining 30 percent reflects growth in input per worker. Growth in Asia, mainly driven by China and India, drove the sustained growth since 1991 in TFP. Post-2000, policy changes in Latin America, West Asia and North Africa, and Africa south of the Sahara favored agriculture and gave a major boost to productivity.



Trend 2
TFP GROWTH RATES DIFFER ACROSS REGIONS

Rates of TFP increase differ across developing regions, reflecting differences in economic environments and past investment in research and development. East and Southeast Asia and Latin America and the Caribbean were the fastest growing regions, both increasing TFP by more than 60 percent. South Asia experienced the slowest growth. East and Southeast Asia performed well until 2006, when TFP growth in China slowed. TFP growth accelerated after 2001 in Latin America and the Caribbean and Africa south of the Sahara, and a bit later in West Asia and North Africa and South Asia. Policy changes in the 1990s in these regions created a more favorable macroeconomic environment, and high commodity prices accelerated improvements in agricultural production efficiency and technical change. Differences in institutional arrangements and policies for agriculture, in addition to relatively earlier reforms in China, underlie differences in TFP growth between China and India.





International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT)

Policy makers, analysts, and civil society face increasing challenges to reducing hunger and improving food security in a sustainable way. Modeling alternative future scenarios and assessing their outcomes can help inform their choices. The International Food Policy Research Institute's IMPACT model is an integrated system of linked economic, climate, water, and crop models that allows for exploration of such scenarios.

METHODOLOGY

At IMPACT's core is a partial equilibrium, multi-market economic model that simulates national and international agricultural markets. Links to climate, water, and crop models support the integrated study of changing environmental, biophysical, and socio-economic trends, allowing for in-depth analysis of a variety of critical issues of interest to policy makers at national, regional, and global levels. IMPACT benefits from close interactions with scientists at all 15 CGIAR research centers through the Global Futures and Strategic Foresight (GFSF) program, and with other leading global economic modeling efforts around the world through the Agricultural Model Intercomparison and Improvement Project (AgMIP).

The tables on the following pages summarize results from the latest IMPACT projections to 2030 and 2050. Results are shown for production, consumption, and trade of major food commodity groups, as well as for the population at risk of hunger, by region and for selected countries. Results are shown for two "baseline" scenarios—one considers the impacts of climate change, while the other assumes no climate change (for comparison). Results for additional countries can be found at the IMPACT website.

KEY FINDINGS FROM THE LATEST IMPACT PROJECTIONS

The latest baseline projections from IMPACT indicate that global food production will grow by about 60 percent over 2010 levels by 2050 in the context of climate change—10 percentage points less than would be the case without climate change (Table 6). Production will grow more rapidly in developing countries, particularly in Africa. Even with population growth and climate change, per capita consumption is projected to increase by 9 percent globally to more than 3,000 kilocalories per day. But differences in access to food within and between countries mean that nearly 500 million people will remain at risk of hunger. In Africa south of the Sahara, an additional 38 million people are projected to be at risk of hunger in 2050 as a result of climate change—25 percent more than would be at risk in the absence of climate change.

Despite the impacts of climate change, meat production is projected to grow by 66 percent globally by 2050, and by 78 percent in developing countries. Per capita consumption levels in developing countries, however, will remain under half of those in developed countries (Table 7). Production of fruits and vegetables, pulses, and oilseeds will grow even more rapidly, by more than 80 percent globally and more than doubling in some regions. Per capita consumption of fruits and vegetables in developing countries is projected to surpass that of developed countries by 2050, with important benefits for nutrition and health. Production of cereals and roots and tubers will grow more slowly, by around 40 percent globally but roughly doubling in Africa south of the Sahara. Developing countries as a group will become larger net importers of food from developed countries.

In addition to the indicators presented here, IMPACT allows changes in prices, land and water use, greenhouse gas emissions, and other socio-economic and environmental indicators to be explored. For example, prices are projected to rise by about 50 percent for most food commodity groups by 2050 when the impacts of climate change are considered—about double the increase projected in the absence of climate change.

MORE INFORMATION

More information on these results, and on the results of alternative scenarios exploring different population, income, policy, investment, and technology pathways, can be found online (see box). Results for all 158 countries and regions modeled are available, as well as information on IMPACT, the Global Futures and Strategic Foresight program, and recent publications.

VISIT ONLINE
IFPRI IMPACT: https://www.ifpri.org/program/impact-model
Global Futures and Strategic Foresight: http://globalfutures.cgiar.org/
IMPACT documentation: http://www.ifpri.org/publication/international-model-policy-analysis-agricultural-commodities-and-trade-impact-model-0

CONTACT
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TABLE 6 IMPACT projections of food production, consumption, and hunger to 2050, with and without climate change

	Aggregate food production (index, 2010 = 1.00)					Per capita food consumption (KCAL per capita per day)					Hunger (millions of people at risk)				
		Without climate change		With climate change			Without climate change		With climate change			Without climate change		With climate change	
	2010	2030	2050	2030	2050	2010	2030	2050	2030	2050	2010	2030	2050	2030	2050
WORLD	**1.00**	**1.37**	**1.69**	**1.33**	**1.60**	**2795**	**3032**	**3191**	**2982**	**3079**	**838.1**	**528.2**	**405.8**	**592.3**	**476.9**
Developing countries	**1.00**	**1.42**	**1.76**	**1.39**	**1.71**	**2683**	**2961**	**3137**	**2909**	**3020**	**823.3**	**513.3**	**392.2**	**576.7**	**461.1**
Developed countries	**1.00**	**1.24**	**1.47**	**1.15**	**1.29**	**3384**	**3439**	**3513**	**3406**	**3435**	**14.8**	**14.9**	**13.6**	**15.7**	**15.8**
ASIA AND PACIFIC	**1.00**	**1.37**	**1.64**	**1.36**	**1.63**	**2656**	**3003**	**3185**	**2954**	**3072**	**539.8**	**249.8**	**181.8**	**280.9**	**204.6**
East Asia	**1.00**	**1.23**	**1.35**	**1.26**	**1.41**	**3009**	**3509**	**3628**	**3459**	**3516**	**187.2**	**59.2**	**54.7**	**60.3**	**56.8**
China	1.00	1.23	1.34	1.26	1.40	3044	3604	3733	3552	3616	173.4	44.8	41.0	44.7	41.0
Japan	1.00	1.24	1.52	1.31	1.69	2770	2787	2842	2757	2773	2.3	2.0	1.2	2.3	1.9
Korea, Rep.	1.00	1.25	1.43	1.26	1.44	3139	3347	3429	3310	3347	0.6	0.4	0.4	0.4	0.4
South Asia	**1.00**	**1.57**	**2.05**	**1.50**	**1.91**	**2361**	**2669**	**2959**	**2623**	**2848**	**268.5**	**138.3**	**87.7**	**161.6**	**97.0**
Afghanistan	1.00	1.33	1.73	1.35	1.77	2149	2239	2452	2206	2349	7.0	9.4	7.9	10.1	10.4
Bangladesh	1.00	1.41	1.63	1.33	1.46	2426	2714	2911	2653	2781	26.0	11.3	6.9	14.8	8.7
India	1.00	1.63	2.16	1.56	2.01	2354	2697	2998	2651	2883	189.7	73.9	45.0	90.5	44.9
Nepal	1.00	1.33	1.60	1.37	1.71	2425	2695	3186	2625	3028	2.7	2.0	0.8	2.4	1.5
Pakistan	1.00	1.33	1.63	1.27	1.50	2379	2540	2862	2514	2787	37.6	38.0	24.4	39.9	28.0
Southeast Asia and Pacific	**1.00**	**1.48**	**1.89**	**1.46**	**1.84**	**2551**	**2852**	**3051**	**2796**	**2931**	**84.1**	**52.3**	**39.4**	**58.9**	**50.8**
Indonesia	1.00	1.62	2.02	1.63	2.05	2540	2990	3281	2910	3110	32.4	12.9	7.2	15.3	11.1
Malaysia	1.00	1.83	2.95	1.79	2.84	2838	3173	3462	3143	3384	0.9	0.8	0.9	0.8	0.9
Myanmar	1.00	1.35	1.55	1.34	1.53	2169	2473	2592	2420	2487	10.5	6.5	4.8	7.2	6.0
Philippines	1.00	1.33	1.68	1.31	1.65	2503	2641	2777	2602	2691	12.1	12.2	11.0	13.2	13.1
Thailand	1.00	1.18	1.26	1.12	1.14	2742	3012	3183	2975	3103	6.2	3.1	1.8	3.5	2.3
Viet Nam	1.00	1.25	1.36	1.20	1.24	2512	2710	2828	2654	2712	12.9	9.5	7.2	10.8	9.7
AFRICA AND MIDDLE EAST	**1.00**	**1.60**	**2.24**	**1.55**	**2.11**	**2623**	**2795**	**3002**	**2735**	**2873**	**238.7**	**229.8**	**185.0**	**258.7**	**227.1**
Africa south of the Sahara	**1.00**	**1.65**	**2.37**	**1.57**	**2.17**	**2358**	**2587**	**2853**	**2518**	**2713**	**209.5**	**195.7**	**150.5**	**223.0**	**188.7**
Congo, Dem. Rep.	1.00	1.72	2.49	1.67	2.38	1943	2392	2998	2325	2848	37.6	20.3	6.6	25.2	6.6
Ethiopia	1.00	1.65	2.45	1.66	2.48	2066	2307	2614	2266	2533	32.7	32.3	22.5	34.7	26.5
Kenya	1.00	1.76	3.12	1.79	3.14	2133	2395	2708	2300	2524	10.2	8.9	5.0	10.8	8.2
Nigeria	1.00	1.62	2.31	1.56	2.16	2751	2943	3136	2866	2984	9.7	8.5	11.6	10.6	11.6

Table 6 continued

	Aggregate food production (index, 2010 = 1.00)					Per capita food consumption (KCAL per capita per day)					Hunger (millions of people at risk)				
		Without climate change		With climate change			Without climate change		With climate change			Without climate change		With climate change	
	2010	2030	2050	2030	2050	2010	2030	2050	2030	2050	2010	2030	2050	2030	2050
South Africa	1.00	1.50	1.87	1.49	1.80	2962	3229	3397	3157	3258	1.9	1.5	1.6	1.5	1.6
Sudan	1.00	1.74	2.47	1.44	1.76	2329	2465	2714	2431	2635	11.4	12.7	9.0	13.7	10.9
Tanzania, United Rep.	1.00	1.64	2.42	1.56	2.22	2178	2396	2602	2309	2439	15.6	17.8	17.8	20.4	23.0
Uganda	1.00	1.89	3.05	1.77	2.71	2391	2585	2796	2520	2667	8.5	10.4	11.3	11.8	13.8
Middle East and North Africa	**1.00**	**1.51**	**2.01**	**1.50**	**2.00**	**3125**	**3250**	**3377**	**3208**	**3275**	**29.3**	**34.2**	**34.5**	**35.7**	**38.4**
Algeria	1.00	1.54	2.02	1.42	1.71	2977	3098	3163	3061	3071	1.9	1.9	1.9	2.0	2.2
Egypt	1.00	1.47	1.96	1.43	1.91	3395	3580	3783	3520	3645	1.6	2.2	2.5	2.2	2.5
Iran	1.00	1.48	1.96	1.52	2.06	3079	3109	3228	3067	3126	4.7	5.2	4.4	5.7	5.3
Iraq	1.00	1.77	3.16	1.75	3.09	2342	2651	2773	2618	2685	7.8	7.5	8.5	7.9	9.6
Morocco	1.00	1.61	2.27	1.42	1.82	3287	3592	3856	3553	3755	1.7	1.9	2.0	1.9	2.0
Saudi Arabia	1.00	1.76	2.74	1.76	2.71	2936	3055	3128	3020	3046	1.3	1.4	1.5	1.5	1.8
Turkey	1.00	1.40	1.60	1.44	1.70	3596	3661	3698	3620	3597	1.8	2.2	2.4	2.2	2.4
THE AMERICAS	**1.00**	**1.37**	**1.69**	**1.27**	**1.48**	**3188**	**3290**	**3392**	**3244**	**3297**	**42.5**	**35.7**	**27.7**	**39.3**	**32.7**
Latin America and the Caribbean	**1.00**	**1.46**	**1.83**	**1.42**	**1.72**	**2878**	**3036**	**3184**	**2985**	**3081**	**39.5**	**32.1**	**24.0**	**35.8**	**28.7**
Argentina	1.00	1.42	1.75	1.42	1.74	3171	3327	3426	3297	3354	0.7	0.6	0.7	0.6	0.7
Brazil	1.00	1.52	1.95	1.41	1.66	3142	3336	3492	3292	3398	3.7	3.2	3.1	3.2	3.1
Colombia	1.00	1.44	1.75	1.52	1.96	2645	2804	2957	2759	2868	5.0	3.9	2.7	4.5	3.6
Mexico	1.00	1.35	1.62	1.31	1.54	3040	3134	3240	3054	3096	5.3	5.4	5.3	6.1	6.1
Peru	1.00	1.46	1.78	1.71	2.44	2472	2752	2886	2700	2782	3.6	2.0	1.4	2.3	1.8
Venezuela	1.00	1.41	1.76	1.30	1.50	2536	2626	2763	2579	2669	1.4	1.3	0.7	1.6	1.2
North America	**1.00**	**1.29**	**1.58**	**1.15**	**1.29**	**3714**	**3725**	**3735**	**3689**	**3654**	**3.0**	**3.6**	**3.7**	**3.6**	**4.0**
EUROPE AND FORMER SOVIET UNION	**1.00**	**1.18**	**1.33**	**1.14**	**1.26**	**3275**	**3390**	**3491**	**3359**	**3414**	**17.1**	**13.0**	**11.4**	**13.4**	**12.5**
Former Soviet Union	**1.00**	**1.26**	**1.42**	**1.20**	**1.36**	**3092**	**3321**	**3423**	**3288**	**3338**	**9.7**	**5.9**	**5.2**	**6.2**	**5.5**
Russia	1.00	1.26	1.44	1.23	1.44	3227	3450	3532	3417	3452	1.8	1.2	1.1	1.2	1.2
Ukraine	1.00	1.21	1.31	1.11	1.18	3201	3434	3581	3400	3499	0.6	0.4	0.3	0.4	0.3
Uzbekistan	1.00	1.28	1.49	1.27	1.45	2563	2849	3024	2820	2935	2.4	0.8	0.8	0.9	0.8
Europe	**1.00**	**1.15**	**1.28**	**1.11**	**1.21**	**3370**	**3424**	**3523**	**3395**	**3450**	**7.4**	**7.0**	**6.2**	**7.3**	**6.9**

Notes: World and regional figures include other regions and countries not reported separately. Aggregate food production is an index, by weight, of cereals, meats, fruits and vegetables, oilseeds, pulses, and roots and tubers (which are reported separately in Table 7). Per capita food consumption is a projection of daily dietary energy supply. Estimates of the number of people at risk of hunger are based on a quadratic specification of the relationship between national-level calorie supply and the share of population that is undernourished as defined by the FAO. Values reported for 2010 are calibrated model results. Projections for 2030 and 2050 assume changes in population and income as reflected in the Intergovernmental Panel on Climate Change's (IPCC) Shared Socioeconomic Pathway 2. Climate change impacts are simulated using the IPCC's Representative Concentration Pathway 8.5 and the HadGEM general circulation model. Further documentation is available at www.ifpri.org/program/impact-model.

Source: IFPRI (International Food Policy Research Institute), IMPACT Model version 3.3, October 2016.

TABLE 7 IMPACT projections of production, consumption, and net trade to 2050 by commodity group with and without climate change

	Total production (million metric tons)					Per capita food consumption (kg per capita per year)					Net trade (million metric tons)				
		Without climate change		With climate change			Without climate change		With climate change			Without climate change		With climate change	
	2010	2030	2050	2030	2050	2010	2030	2050	2030	2050	2010	2030	2050	2030	2050
CEREALS															
World	**2,155**	**2,746**	**3,235**	**2,621**	**2,990**	**143.5**	**146.7**	**148.3**	**143.4**	**140.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Developing countries	1,390	1,826	2,154	1,802	2,109	148.7	151.6	153.0	148.0	144.5	−86.6	−124.0	−224.3	−61.5	−96.2
Developed countries	765	920	1,081	819	882	116.3	118.3	120.4	116.7	115.3	86.6	124.0	224.3	61.5	96.2
Asia and Pacific	**859**	**1,067**	**1,195**	**1,047**	**1,165**	**148.7**	**152.1**	**154.3**	**148.9**	**146.0**	**−39.7**	**−69.7**	**−129.4**	**−28.8**	**−6.4**
East Asia	393	451	479	464	511	145.2	148.2	147.3	145.4	140.0	−43.3	−63.3	−74.5	−6.4	65.6
South Asia	279	384	454	362	415	148.5	150.7	154.1	147.5	145.8	−5.1	−8.3	−52.7	−22.1	−67.0
Southeast Asia and Pacific	187	232	262	221	239	158.1	164.6	167.6	159.9	157.4	8.6	1.9	−2.2	−0.3	−5.0
Africa and Middle East	**229**	**337**	**428**	**328**	**409**	**149.3**	**151.0**	**151.5**	**146.7**	**142.4**	**−91.5**	**−157.6**	**−261.3**	**−153.1**	**−239.2**
Africa south of the Sahara	114	184	254	179	239	121.8	129.3	134.4	124.2	124.6	−32.2	−63.5	−119.9	−58.0	−103.0
West	49	79	110	75	99	143.5	152.4	155.3	146.9	144.8	−13.7	−29.8	−60.3	−29.1	−56.9
Central	7	12	18	12	17	59.3	65.4	68.9	62.4	63.0	−3.1	−6.3	−11.8	−5.9	−10.5
East	39	65	91	64	91	115.7	125.6	134.1	119.7	123.1	−8.7	−17.1	−31.9	−13.7	−21.8
Southern	13	18	21	19	23	182.8	194.8	201.5	187.5	187.3	−3.5	−7.1	−12.5	−4.6	−7.2
Middle East and North Africa	114	153	174	149	170	201.4	198.3	194.4	195.8	187.2	−59.3	−94.1	−141.4	−95.2	−136.2
North Africa	42	55	62	49	50	204.7	202.5	198.7	199.6	191.0	−30.6	−46.4	−68.5	−49.9	−72.8
Middle East	56	73	77	73	78	183.0	179.3	176.2	177.3	169.7	−33.5	−59.1	−93.5	−59.3	−91.8
The Americas	**600**	**817**	**1,033**	**713**	**806**	**120.6**	**121.7**	**121.5**	**118.8**	**115.1**	**100.8**	**189.9**	**312.3**	**132.9**	**128.1**
Latin America and the Caribbean	164	245	322	236	294	128.0	129.6	129.8	126.0	122.7	−23.4	−18.4	−5.8	−18.1	−64.2
Caribbean	2	2	3	2	3	103.7	104.9	105.3	102.4	99.9	−5.6	−7.3	−9.1	−6.9	−8.0
Central America	38	52	66	51	64	156.9	156.6	155.2	150.2	143.9	−23.4	−28.3	−29.0	−25.0	−25.5
South America	125	191	254	182	227	118.7	120.5	120.9	118.1	115.5	5.6	17.2	32.3	13.8	−30.7
North America	436	572	711	478	511	108.2	108.3	107.8	106.5	102.6	124.3	208.3	318.1	151.0	192.2
Europe and former Soviet Union	**467**	**525**	**579**	**532**	**611**	**135.9**	**140.6**	**144.2**	**139.1**	**138.8**	**30.4**	**37.4**	**78.4**	**49.0**	**117.5**
Former Soviet Union	156	206	244	217	272	162.1	170.8	174.5	169.3	168.7	21.5	62.3	101.5	77.4	137.9
Europe	311	319	334	315	339	122.3	125.5	129.6	124.1	124.5	8.9	−24.9	−23.1	−28.4	−20.4
MEATS															
World	**274**	**381**	**460**	**380**	**455**	**39.4**	**45.6**	**49.5**	**45.4**	**49.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Developing countries	174	254	312	253	309	30.5	37.7	41.9	37.5	41.5	−3.6	−14.4	−21.5	−14.4	−20.7
Developed countries	100	127	148	127	146	86.5	91.1	95.8	90.7	95.0	3.6	14.4	21.5	14.4	20.7
Asia and Pacific	**109**	**150**	**166**	**149**	**165**	**30.3**	**39.6**	**43.3**	**39.4**	**42.9**	**−7.0**	**−25.3**	**−34.7**	**−25.6**	**−34.5**
East Asia	79	99	93	98	91	56.5	76.3	81.3	75.9	80.6	−9.2	−22.5	−25.6	−22.9	−26.1
South Asia	10	19	31	19	31	6.0	10.7	17.8	10.6	17.6	0.2	−2.9	−11.4	−2.8	−11.0

Table 7 continued

	Total production (million metric tons)					Per capita food consumption (kg per capita per year)					Net trade (million metric tons)				
		Without climate change		With climate change			Without climate change		With climate change			Without climate change		With climate change	
	2010	2030	2050	2030	2050	2010	2030	2050	2030	2050	2010	2030	2050	2030	2050
Southeast Asia and Pacific	20	32	43	32	43	28.8	41.6	49.6	41.5	49.4	2.0	0.1	2.3	0.2	2.5
Africa and Middle East	**22**	**40**	**66**	**40**	**65**	**18.3**	**23.7**	**31.3**	**23.6**	**31.0**	**−2.7**	**−6.1**	**−12.9**	**−6.0**	**−12.5**
Africa south of the Sahara	11	20	35	20	35	13.0	18.1	26.8	18.1	26.6	−0.4	−3.6	−13.5	−3.5	−13.1
West	3	6	11	6	11	10.2	16.2	26.6	16.1	26.3	−0.3	−1.9	−7.3	−1.9	−7.1
Central	1	1	2	1	2	9.1	12.2	17.0	12.1	16.8	−0.4	−1.0	−2.1	−1.0	−2.0
East	3	6	10	6	10	10.3	14.4	22.5	14.3	22.2	−0.0	−1.1	−4.9	−1.1	−4.7
Southern	2	4	5	4	5	45.2	61.0	73.3	60.8	72.7	−0.2	−0.1	−0.1	−0.1	−0.1
Middle East and North Africa	11	20	31	19	31	28.3	36.0	42.4	35.8	42.0	−2.3	−2.5	0.7	−2.5	0.5
North Africa	5	10	17	10	17	22.6	32.0	42.9	31.9	42.7	0.0	0.3	2.0	0.3	2.0
Middle East	5	10	15	10	15	31.0	38.4	43.4	38.3	43.1	−2.0	−3.0	−2.3	−3.0	−2.4
The Americas	**89**	**127**	**158**	**127**	**156**	**82.2**	**88.0**	**93.0**	**87.5**	**92.1**	**11.5**	**29.1**	**44.5**	**29.0**	**43.8**
Latin America and the Caribbean	44	67	85	66	84	61.4	69.9	76.6	69.4	75.6	7.2	16.7	25.9	16.7	26.0
Caribbean	1	2	2	2	2	34.5	43.3	52.4	43.0	51.6	−0.1	−0.2	−0.0	−0.1	0.0
Central America	7	10	13	10	13	51.0	58.4	65.8	58.0	64.9	−0.9	−0.9	−0.8	−0.8	−0.6
South America	36	55	69	54	69	68.1	76.9	83.2	76.5	82.2	8.2	17.7	26.7	17.7	26.6
North America	45	61	73	60	72	117.6	119.0	120.2	118.6	119.3	4.4	12.5	18.7	12.3	17.8
Europe and former Soviet Union	**54**	**64**	**69**	**64**	**69**	**67.5**	**72.0**	**76.3**	**71.6**	**75.5**	**−1.8**	**2.3**	**3.0**	**2.6**	**3.3**
Former Soviet Union	10	12	14	12	13	46.0	55.3	59.5	55.0	59.0	−3.0	−3.3	−3.2	−3.3	−3.2
Europe	44	52	56	52	56	78.6	80.3	84.4	79.8	83.5	1.2	5.6	6.2	5.9	6.4
FRUITS AND VEGETABLES															
World	**1,592**	**2,334**	**3,044**	**2,297**	**2,945**	**196.2**	**240.0**	**284.7**	**236.2**	**275.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Developing countries	1,304	1,952	2,554	1,925	2,476	191.2	239.7	290.6	235.9	281.2	15.1	−20.1	−90.5	−15.5	−81.8
Developed countries	288	383	490	373	470	222.8	241.4	248.6	237.8	241.2	−15.1	20.1	90.5	15.5	81.8
Asia and Pacific	**868**	**1,259**	**1,586**	**1,262**	**1,583**	**209.7**	**278.7**	**358.7**	**274.4**	**347.4**	**−44.8**	**−141.4**	**−279.9**	**−116.1**	**−222.7**
East Asia	609	800	938	823	992	351.0	432.7	430.1	427.1	419.4	−20.4	−5.4	192.7	28.1	265.6
South Asia	158	318	467	302	417	104.7	197.7	366.8	194.1	354.2	−29.7	−127.5	−466.1	−136.1	−483.4
Southeast Asia and Pacific	101	141	181	138	174	134.0	176.0	205.1	172.4	196.5	5.3	−8.5	−6.6	−8.2	−4.9
Africa and Middle East	**251**	**436**	**661**	**423**	**623**	**155.9**	**171.4**	**190.1**	**168.5**	**183.5**	**1.9**	**33.1**	**77.8**	**26.4**	**60.3**
Africa south of the Sahara	101	188	301	174	261	95.4	119.7	150.0	117.2	143.9	−1.0	−9.3	−34.1	−19.2	−60.1
West	40	74	118	70	106	117.2	145.3	174.4	142.4	167.9	0.3	−3.5	−14.8	−6.0	−22.1
Central	10	17	27	16	22	66.0	82.4	103.1	80.2	97.7	0.1	−1.3	−4.4	−2.5	−7.5
East	36	70	121	65	107	82.2	105.5	138.5	103.2	132.4	−1.2	−5.4	−12.9	−8.1	−20.3
Southern	9	15	21	14	17	76.2	89.2	98.3	87.4	94.3	2.9	6.4	10.1	5.2	7.2

Table 7 continued

	Total production (million metric tons)					Per capita food consumption (kg per capita per year)					Net trade (million metric tons)				
		Without climate change		With climate change			Without climate change		With climate change			Without climate change		With climate change	
	2010	2030	2050	2030	2050	2010	2030	2050	2030	2050	2010	2030	2050	2030	2050
Middle East and North Africa	150	248	361	249	362	270.2	284.3	290.5	280.6	282.9	3.0	42.4	111.9	45.6	120.4
North Africa	57	99	149	90	126	228.9	250.1	270.3	246.7	262.9	0.0	16.5	44.1	8.3	24.4
Middle East	73	121	176	126	189	246.8	263.1	269.3	259.7	262.2	−0.1	12.0	39.2	18.4	56.3
The Americas	**255**	**351**	**447**	**338**	**422**	**187.0**	**212.1**	**226.7**	**208.4**	**218.7**	**49.2**	**74.6**	**123.8**	**67.4**	**110.9**
Latin America and the Caribbean	164	236	299	225	273	159.6	182.9	202.9	179.7	195.7	46.3	76.3	108.3	67.4	88.7
Caribbean	12	15	18	14	15	192.6	218.7	245.0	216.2	239.1	2.3	3.4	4.6	2.0	1.9
Central America	46	59	67	55	59	165.5	180.0	196.8	176.7	189.5	15.4	18.6	18.1	15.2	11.5
South America	107	162	214	156	199	154.2	181.0	202.0	177.8	194.8	28.7	54.3	85.7	50.2	75.3
North America	91	114	147	114	149	233.6	262.4	265.9	257.7	256.7	2.9	−1.7	15.4	0.0	22.2
Europe and former Soviet Union	**218**	**289**	**351**	**274**	**317**	**209.2**	**230.9**	**241.8**	**227.8**	**235.3**	**−6.3**	**33.7**	**78.4**	**22.3**	**51.5**
Former Soviet Union	62	81	95	79	90	181.6	223.0	239.5	219.9	232.6	0.1	5.0	14.0	3.9	11.1
Europe	156	208	255	195	227	223.5	234.8	242.9	231.7	236.7	−6.4	28.7	64.4	18.3	40.4
OILSEEDS															
World	**673**	**1,033**	**1,293**	**1,017**	**1,257**	**6.8**	**8.2**	**7.8**	**7.9**	**7.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Developing countries	525	842	1,079	833	1,057	7.0	8.6	8.2	8.3	7.6	−3.0	−8.5	−11.5	−7.4	−9.6
Developed countries	148	191	214	184	200	5.6	5.9	5.9	5.6	5.5	3.0	8.5	11.5	7.4	9.6
Asia and Pacific	**322**	**536**	**713**	**534**	**707**	**8.1**	**10.4**	**9.5**	**10.0**	**9.0**	**−35.4**	**−59.6**	**−69.9**	**−56.0**	**−62.1**
East Asia	49	63	68	64	70	10.9	15.9	15.1	15.4	14.4	−44.3	−62.8	−66.7	−59.2	−59.5
South Asia	41	52	57	51	52	3.6	4.5	4.3	4.4	4.0	0.5	−4.5	−9.7	−4.7	−9.9
Southeast Asia and Pacific	231	421	589	420	586	13.1	14.7	14.6	14.3	13.9	8.4	7.7	6.4	8.0	7.2
Africa and Middle East	**61**	**101**	**126**	**98**	**119**	**5.5**	**6.4**	**7.2**	**6.1**	**6.5**	**−6.1**	**−8.8**	**−13.5**	**−8.1**	**−11.5**
Africa south of the Sahara	53	90	113	87	105	5.9	6.8	7.7	6.5	7.0	0.2	−1.2	−4.6	−1.0	−3.9
West	43	74	94	72	88	8.1	9.3	10.1	8.8	9.2	0.3	−0.5	−2.7	−0.4	−2.5
Central	4	6	8	6	7	9.0	10.0	10.6	9.4	9.5	0.1	0.1	0.1	0.2	0.4
East	4	6	7	6	7	3.7	4.4	5.3	4.2	4.8	0.1	−0.3	−1.3	−0.2	−0.9
Southern	1	1	2	1	1	1.9	2.1	2.1	2.0	2.0	−0.2	−0.3	−0.3	−0.2	−0.2
Middle East and North Africa	9	12	14	12	14	4.7	5.5	6.0	5.3	5.5	−6.3	−7.6	−8.8	−7.0	−7.6
North Africa	4	6	7	5	6	4.6	5.3	5.7	5.1	5.3	−1.5	−1.8	−2.2	−1.7	−2.1
Middle East	5	7	8	7	8	5.4	6.1	6.4	5.9	5.9	−3.9	−5.0	−6.0	−4.6	−5.1
The Americas	**235**	**323**	**371**	**314**	**350**	**6.8**	**6.7**	**6.5**	**6.4**	**6.0**	**58.7**	**83.7**	**97.5**	**78.1**	**85.2**
Latin America and the Caribbean	126	184	215	180	206	6.6	6.4	6.0	6.1	5.5	27.2	46.3	56.6	43.5	49.6
Caribbean	1	1	1	1	1	7.8	8.0	7.8	7.7	7.3	−0.3	−0.3	−0.4	−0.3	−0.4
Central America	6	9	10	8	9	3.2	3.1	3.1	3.0	2.9	−5.5	−6.0	−6.5	−5.7	−5.9
South America	119	174	204	170	196	7.9	7.7	7.1	7.3	6.4	33.0	52.6	63.5	49.5	55.8

Table 7 continued

	Total production (million metric tons)					Per capita food consumption (kg per capita per year)					Net trade (million metric tons)				
		Without climate change		With climate change			Without climate change		With climate change			Without climate change		With climate change	
	2010	2030	2050	2030	2050	2010	2030	2050	2030	2050	2010	2030	2050	2030	2050
North America	110	139	155	134	144	7.1	7.2	7.2	7.0	6.7	31.5	37.3	40.8	34.6	35.6
Europe and former Soviet Union	**55**	**72**	**83**	**71**	**81**	**2.6**	**2.7**	**2.9**	**2.6**	**2.7**	**−17.2**	**−15.3**	**−14.1**	**−14.0**	**−11.6**
Former Soviet Union	14	19	22	19	23	1.1	1.2	1.2	1.2	1.2	−0.4	0.5	1.4	0.7	1.8
Europe	40	53	60	52	58	3.3	3.5	3.6	3.3	3.4	−16.8	−15.8	−15.4	−14.7	−13.4
PULSES															
World	**66**	**94**	**121**	**92**	**118**	**6.2**	**7.5**	**8.9**	**7.5**	**8.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Developing countries	52	74	97	72	91	6.7	8.2	9.8	8.1	9.6	−2.8	−6.5	−9.9	−7.6	−12.8
Developed countries	14	19	24	20	26	3.5	3.8	4.0	3.8	4.0	2.8	6.5	9.9	7.6	12.8
Asia and Pacific	**28**	**37**	**44**	**36**	**42**	**5.2**	**6.2**	**7.3**	**6.2**	**7.2**	**−0.5**	**−3.3**	**−5.2**	**−3.1**	**−5.2**
East Asia	6	8	11	8	12	1.5	1.9	2.1	1.9	2.1	0.5	1.8	4.7	2.3	5.6
South Asia	16	21	24	20	23	9.4	10.6	11.7	10.5	11.5	−2.9	−6.1	−10.1	−6.2	−10.6
Southeast Asia and Pacific	7	8	8	8	8	3.1	3.6	3.9	3.5	3.8	1.9	1.0	0.2	0.8	−0.3
Africa and Middle East	**16**	**25**	**35**	**23**	**32**	**9.7**	**11.3**	**13.4**	**11.2**	**13.1**	**−1.9**	**−5.6**	**−11.6**	**−6.5**	**−13.5**
Africa south of the Sahara	12	19	28	19	27	10.4	12.3	14.7	12.1	14.4	−0.9	−4.0	−9.4	−4.0	−9.2
West	5	9	16	9	14	8.5	9.8	11.6	9.6	11.1	0.3	0.1	−0.3	0.0	−0.6
Central	1	2	2	2	2	6.7	7.4	8.7	7.3	8.4	−0.1	−0.2	−0.3	−0.2	−0.2
East	5	7	9	7	10	15.3	18.2	22.0	18.0	21.6	−0.7	−3.3	−7.9	−3.2	−7.5
Southern	0	0	0	0	0	3.8	4.2	4.5	4.1	4.4	−0.1	−0.1	−0.0	−0.1	0.0
Middle East and North Africa	4	6	7	5	5	8.2	9.2	10.0	9.2	10.0	−1.0	−1.7	−2.3	−2.5	−4.3
North Africa	1	2	2	1	2	8.2	9.7	11.4	9.8	11.5	−1.1	−1.8	−2.6	−2.1	−3.2
Middle East	2	3	4	3	3	7.9	8.5	8.9	8.6	9.0	−0.2	−0.5	−0.8	−0.9	−1.7
The Americas	**14**	**21**	**28**	**21**	**30**	**8.9**	**9.7**	**10.4**	**9.7**	**10.3**	**3.2**	**7.2**	**12.5**	**8.0**	**14.4**
Latin America and the Caribbean	7	11	16	11	15	11.4	12.6	13.8	12.5	13.6	−0.7	1.1	4.4	0.7	3.1
Caribbean	0	0	1	0	1	12.4	13.4	14.8	13.3	14.6	−0.2	−0.2	−0.0	−0.2	−0.1
Central America	2	3	4	3	3	12.5	13.6	15.2	13.6	15.0	−0.4	−0.2	0.0	−0.4	−0.4
South America	5	8	12	7	11	10.8	12.1	13.1	12.0	12.9	−0.0	1.5	4.4	1.2	3.6
North America	7	10	12	11	15	4.6	4.8	4.9	4.8	4.9	3.8	6.0	8.0	7.3	11.4
Europe and former Soviet Union	**8**	**11**	**14**	**11**	**14**	**2.6**	**2.7**	**2.8**	**2.7**	**2.8**	**−0.8**	**1.7**	**4.4**	**1.6**	**4.3**
Former Soviet Union	3	4	5	4	5	1.5	1.6	1.6	1.6	1.6	0.4	1.3	2.4	1.3	2.5
Europe	5	7	9	7	8	3.1	3.3	3.4	3.3	3.4	−1.2	0.5	2.0	0.3	1.8
ROOTS AND TUBERS															
World	**780**	**1,006**	**1,185**	**963**	**1,103**	**65.0**	**70.5**	**73.4**	**67.8**	**69.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Developing countries	682	897	1,068	858	997	65.8	72.4	75.7	69.5	71.1	5.6	−0.6	−5.4	−0.8	−1.0
Developed countries	97	109	118	105	106	61.2	59.8	59.3	57.5	56.0	−5.6	0.6	5.4	0.8	1.0

Table 7 continued

	Total production (million metric tons)					Per capita food consumption (kg per capita per year)					Net trade (million metric tons)				
		Without climate change		With climate change			Without climate change		With climate change			Without climate change		With climate change	
	2010	2030	2050	2030	2050	2010	2030	2050	2030	2050	2010	2030	2050	2030	2050
Asia and Pacific	**298**	**351**	**365**	**356**	**380**	**46.9**	**50.9**	**49.5**	**48.4**	**45.8**	**−4.9**	**−23.4**	**−18.8**	**1.2**	**28.2**
East Asia	181	201	185	201	182	71.4	76.3	73.5	72.9	68.7	−18.5	−14.2	−0.1	−3.3	12.2
South Asia	50	75	103	79	120	27.3	35.7	38.0	33.1	34.1	−6.2	−24.2	−30.6	−12.4	1.2
Southeast Asia and Pacific	67	76	77	76	78	37.5	39.4	39.9	38.6	38.6	19.9	15.0	11.9	16.9	14.8
Africa and Middle East	**245**	**377**	**524**	**362**	**486**	**109.3**	**117.3**	**123.1**	**113.9**	**117.0**	**−1.8**	**−13.0**	**−31.6**	**−16.6**	**−39.8**
Africa south of the Sahara	224	349	490	333	450	146.4	152.7	156.1	149.1	149.2	−1.1	−11.0	−29.0	−17.9	−43.3
West	133	207	297	201	281	197.5	199.0	198.8	194.9	191.1	1.5	−4.3	−11.7	−4.2	−10.2
Central	37	59	80	56	72	172.5	170.6	166.7	167.1	159.9	1.0	2.6	−2.2	0.1	−8.2
East	50	78	107	71	91	129.6	138.5	142.0	134.6	134.4	−3.2	−9.4	−15.3	−13.9	−24.6
Southern	3	4	5	4	5	36.8	37.7	38.7	36.6	37.1	−0.0	0.7	1.3	0.9	1.3
Middle East and North Africa	21	28	34	29	36	39.0	39.9	40.5	37.0	36.3	−0.8	−2.1	−2.6	1.3	3.5
North Africa	9	14	18	15	20	33.7	38.3	42.1	35.7	37.9	−0.1	0.2	−0.3	2.0	4.0
Middle East	10	13	15	14	15	35.8	32.6	30.9	30.4	27.8	−0.7	−0.7	−1.4	0.7	0.5
The Americas	**86**	**112**	**130**	**110**	**127**	**55.7**	**54.5**	**53.0**	**52.3**	**49.9**	**−0.3**	**10.2**	**19.1**	**14.3**	**26.6**
Latin America and the Caribbean	60	82	97	83	99	51.1	49.9	47.9	48.3	45.6	0.2	11.5	20.4	16.2	29.8
Caribbean	3	5	7	5	6	61.4	59.0	56.6	58.2	55.1	0.1	1.7	3.5	1.3	2.6
Central America	3	5	7	5	6	17.4	18.5	19.9	17.5	18.2	−0.2	0.2	0.8	0.2	0.4
South America	53	72	83	74	87	63.6	62.1	59.3	60.2	56.6	0.3	9.6	16.1	14.7	26.8
North America	26	29	33	27	28	63.3	62.5	61.5	59.3	56.9	−0.4	−1.4	−1.3	−1.9	−3.2
Europe and former Soviet Union	**150**	**166**	**166**	**134**	**111**	**89.0**	**86.5**	**85.3**	**83.4**	**80.8**	**7.0**	**26.3**	**31.3**	**1.1**	**−15.1**
Former Soviet Union	82	89	84	63	42	115.3	112.1	109.6	107.2	102.7	8.5	18.7	18.3	−4.1	−19.5
Europe	68	77	82	72	69	75.3	73.8	73.6	71.5	70.3	−1.5	7.7	13.0	5.2	4.4

Notes: World and regional figures include other regions and countries not reported separately. Total production is aggregated across irrigated and rain-fed systems at the national level and aligned with years as reported in FAOSTAT. Per capita food consumption is based on food availability at the national level. Net trade includes negative and positive numbers indicating that a region is a net importer or exporter, respectively, and balances to zero at the global level. Cereals include barley, millet, rice, sorghum, wheat, and aggregated other cereals. Meats include beef, pork, poultry, and sheep and goats. Fruits and vegetables include banana, plantain, aggregated temperate fruits, aggregated tropical fruits, and aggregated vegetables. Oilseeds include groundnuts, rapeseed, soybean, sunflower, and aggregated other oilseeds. Pulses include beans, chickpeas, cowpeas, lentils, pigeonpeas, and aggregated other pulses. Roots and tubers include cassava, potato, sweet potato, yams, and aggregated other roots and tubers. Values reported for 2010 are calibrated model results. Projections for 2030 and 2050 assume changes in population and income as reflected in the IPCC's Shared Socioeconomic Pathway 2. Climate change impacts are simulated using the Intergovernmental Panel on Climate Change's Representative Concentration Pathway 8.5 and the HadGEM general circulation model. Further documentation is available at www.ifpri.org/program/impact-model.

Source: IFPRI (International Food Policy Research Institute), IMPACT Model version 3.3, October 2016.

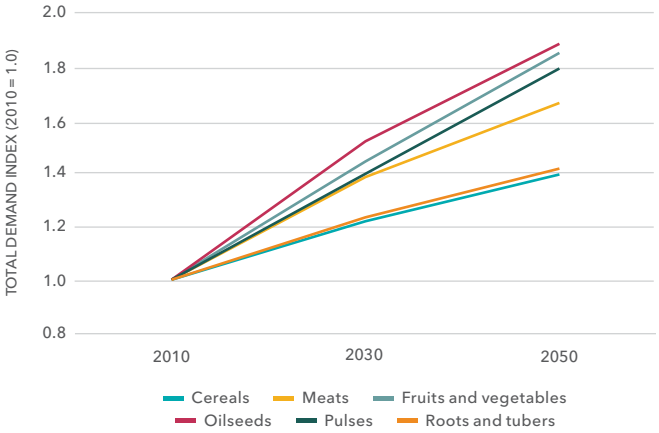
IMPACT

INTERNATIONAL MODEL FOR POLICY ANALYSIS OF AGRICULTURAL COMMODITIES AND TRADE

Trend 1
GROWING DEMAND AND CHANGING DIETS

Total demand for food will continue to grow in the coming decades and the composition of diets will change with incomes and preferences. Demand for staple foods like cereals and roots and tubers will grow by about 40 percent and for meat over 60 percent. Demand for fruits and vegetables will grow even faster (though starting from a lower level).

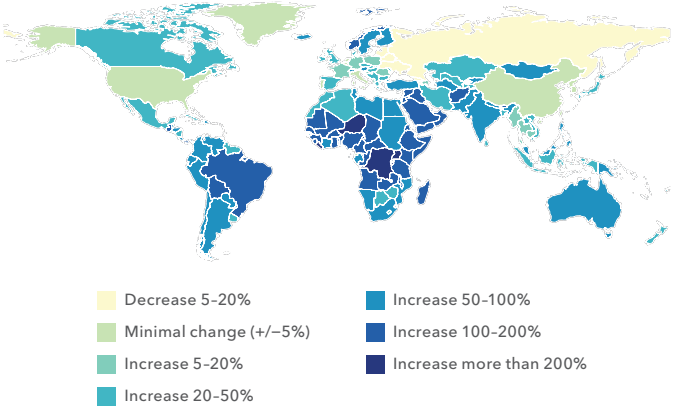
DEMAND FOR AGRICULTURAL PRODUCTS



Trend 2
SHIFTING DEMAND FOR CEREALS ACROSS REGIONS

Demand for cereals will grow most rapidly in Africa south of the Sahara, reflecting continued population growth in that region and implying increased reliance on imports. By contrast, cereal demand growth will slow in East Asia, which is projected to become a net exporter by mid-century.

CHANGE IN TOTAL AGGREGATE CEREAL DEMAND, 2010–2050

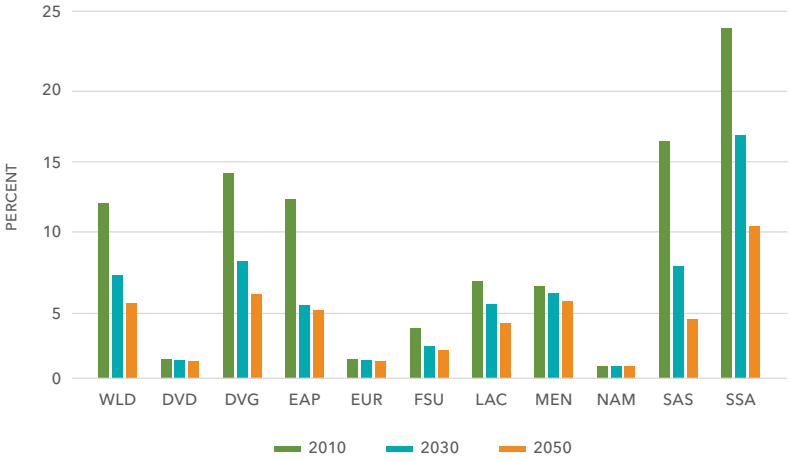


Trend 3
DECLINING RISK OF HUNGER

The share of population at risk of hunger is projected to decline from 12 to 5 percent globally by 2050 and from 14 to 6 percent in developing countries. The highest share will remain in Africa south of the Sahara, where 11 percent are still projected to be at risk of hunger in 2050.

Note on graph: WLD = World; DVD = Developed countries; DVG = Developing countries; EAP = East Asia and Pacific; EUR = Europe; FSU = Former Soviet Union; LAC = Latin America and the Caribbean; MENA = Middle East and North Africa; NAM = North America; SAS = South Asia; SSA = Africa south of the Sahara.

SHARE OF POPULATION AT RISK OF HUNGER



Note: Results presented are modeled projections from IMPACT that assume changes in population and income as reflected in the IPCC's Shared Socioeconomic Pathway 2. Climate change impacts are simulated using the IPCC's Representative Concentration Pathway 8.5 and the HadGEM general circulation model.

Notes

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CHAPTER 3

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CHAPTER 4

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FOOD POLICY INDICATORS: TRACKING CHANGE

STATISTICS OF PUBLIC EXPENDITURE FOR ECONOMIC DEVELOPMENT (SPEED)

1 Two countries were removed from last year's report. Zimbabwe was removed because of data inaccuracies that resulted from the hyperinflation of the early 1990s. Venezuela was removed because data were lacking for the years of interest.

2 As was the case for the 2016 report, the United Nations Statistical database was used to obtain a more complete time-series of both the GDP deflator and the purchasing power parity (PPP) converter. Differences from the data reported in the *2016 Global Food Policy Report* may arise from revisions of the public expenditure data as well as other variables such as population, deflators, exchange rates, and total and agricultural GDP.

3 The significant change in the magnitude of the growth rates for agricultural expenditure compared to last year's report is due mostly to revisions in the data made by the IMF and Eurostat and in data obtained from countries.

4 The significant increase in this number over last year's report reflects a change in the base year used for deflation and currency conversions. Previous years used 2005 as the base. Starting this year, 2011 is used. All currency values are in 2011 PPP dollars.

AGRICULTURAL TOTAL FACTOR PRODUCTIVITY (TFP)

1 Capital used in crop production from this series (land development and equipment, plantation crops, and machinery and equipment) is now included as an input. Similarly, livestock capital (animal stock, livestock structures, and milking machines) is now used instead of animal stock. Animal feed is also included as an input, measured as the amount of edible commodities (from FAOSTAT food balance sheets) fed to livestock during the reference period. Quantities of the different types of feed are transformed into metric tons of maize-equivalents using information regarding energy content for each commodity.

2 As input prices are not available, econometric estimations of the parameters of a global agricultural production function are used as weights to calculate the index of aggregate inputs. Newly available and improved econometric methods were used to estimate the global production function. The weighted average of individual country output and TFP growth rates of individual countries was used to calculate regional averages, using output as weights.

2017 GLOBAL FOOD POLICY REPORT

IFPRI's flagship report reviews the major food policy issues, developments, and decisions of 2016, and highlights challenges and opportunities for 2017 at the global and regional levels. This year's report looks at the impact of rapid urban growth on food security and nutrition, and considers how food systems can be reshaped to benefit both urban and rural populations. Drawing on recent research, IFPRI researchers and other distinguished food policy experts consider a range of timely questions:

- What do we know about the impacts of urbanization on hunger and nutrition?
- What are our greatest research and data needs for better policy making that will ensure food security and improve diets for growing urban populations?
- How can we better connect rural smallholders to urban food consumers to ensure that smallholders benefit from expanding urban food markets?
- Why do city environments drive a nutrition transition toward poorer diets, and what policies can improve the nutrition environment?
- How are urban areas reshaping agricultural value chains for staple crops and benefiting small farmers?
- What role do informal markets play in feeding cities, and how can they be better governed to increase urban food security?

The *2017 Global Food Policy Report* also presents data tables and visualizations for several key food policy indicators, including country-level data on hunger, agricultural spending and research investment, and projections for future agricultural production and consumption. In addition to illustrative figures, tables, and a timeline of food policy events in 2016, the report includes the results of a global opinion poll on urbanization and the current state of food policy.

For more information about the *2017 Global Food Policy Report*:

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