17 Agricultural Development: Technology, Policies, and Institutions

The previous chapter discussed the role of agriculture in economic development, highlighting the sector's potential contributions to both economic growth and poverty alleviation. We turn now to the question of what policies and institutions are needed to maximize those contributions. Addressing that question requires a more detailed focus on the agricultural sector itself. What kinds of policies should governments adopt to promote agricultural development? Which kinds of investments are most effective? And, what kinds of institutions and rules are necessary to make the most of the policies and investments that are chosen? In short, what is required to get agriculture moving?

This chapter approaches that question by addressing the broad constraints that have limited agricultural development in general, and food production in particular, in many parts of the developing world. These constraints take many forms, and their severity varies widely across regions and countries. Some of the constraints to increasing agricultural productivity may be technological. Before the 1950s, agriculture in nearly all developing countries relied on traditional technologies and crop varieties. Traditional agriculture, while stable and well-suited to its environment, was typically characterized by low levels of productivity. Growth in agricultural output relied almost entirely on expansion of the areas under cultivation. By the 1960s, large public investments in crop science had begun to pay off in the form of seeds for improved crop varieties and packages of complementary inputs, the combination of which led to substantial increases in agricultural productivity. Yet, the benefits of this **green revolution** have been concentrated in Asia and Latin America, with comparatively little impact on agricultural development in sub-Saharan Africa.

Other constraints on agricultural development arise from unfavorable government policies (relating in particular to food prices) or from inadequate institutional support for agriculture. Both of these categories of potential constraints relate to the incentives faced by farmers. If food prices are too low, farmers may have limited incentive to expand production. In the long run, low food prices might also be a disincentive for investments in agriculture. Governments in developing countries face a fundamental dilemma in this respect: while higher food prices might provide an important incentive for farmers to increase their output, higher food prices might simultaneously increase the problems of hunger and malnutrition that are endemic in many developing countries. Farmers' incentives are also determined by institutions (that is, by the rules of the game that govern economic relations in society). Institutions governing land rights are of particular concern because farmers who own their land may have greater incentive to invest in maintaining its quality. Before exploring these issues in greater detail, we first set the scene for agriculture in developing countries by characterizing traditional agriculture and farming systems.

CHARACTERISTICS OF TRADITIONAL AGRICULTURE AND AGRICULTURAL SYSTEMS

Farms and farmers in developing countries differ widely from one another, both within and between countries. They differ in size, technology, environmental conditions, crop mix, and degree of commercialization to name but a few categories. Many farmers in poor, densely populated, countries such as Bangladesh might own no land at all and work as day laborers on other people's farms. A farmer in sub-Saharan Africa, most likely a woman, may own and cultivate several small plots totaling one to two hectares,[1] grow five or six different crops, and keep a few chickens. The current model of agricultural development in Brazil involves commercial farms of thousands of hectares, often growing soybeans for sale, coexisting with a multitude of small family farms. Given such diversity, generalizations about **traditional agriculture** are necessarily stylized. Most farms in developing countries are small-scale family farms. They consume a large portion of their own food production, though few farmers are purely subsistence farmers.[2] The livelihood, health, and productivity of farm families depend directly on the efficiency with which they allocate their scarce resources.

Traditional farms tend to be small in area, typically less than three hectares, but intensively cultivated. The demand for labor fluctuates with the agricultural seasons.

[1]One hectare equals 2.47 acres.

[2]This section draws on the discussion in chapters 7 and 8 in George W. Norton, Jeffrey Alwang, and William A. Masters, *Economics of Agricultural Development, World Food Systems and Resource Use*, 2nd ed. (New York: Routledge, 2010).

Labor may be in short supply during planting and harvesting time, but underemployed in other seasons. Seasonality may also bring with it wide fluctuations in food prices, as prices are at their lowest point immediately after the harvest but increase continually from that time until the next harvest. This seasonal fluctuation arises in part because traditional farms often lack adequate facilities to store their crops and must sell them shortly after harvest. The months preceding the next harvest, when prices reach their seasonal high, are often referred to as *the lean season*.

Traditional farms use traditional technologies, which typically rely on few purchased inputs (such as fertilizer, insecticides, and pesticides), grow locally indigenous crop varieties, and operate at low levels of productivity. It is widely accepted that traditional farmers allocate their resources rationally (as defined by economists) and thus do the best that they can with the few resources at their disposal. Hence the famous description by economist Theodore W. Schultz that traditional farmers are "poor but efficient."[3] Traditional farmers may also earn a significant portion of their livelihood by engaging in nonfarm rural activities, such as providing services and engaging in petty trade.

AGRICULTURAL SYSTEMS

Farming systems, characterized by technology, mix of crops and livestock, and the physical environment, vary widely across the developing world. Farming systems tend to be dominated by a small number of crops—typically a staple cereal such as rice, wheat, or corn—and many minor crops or livestock. The major types of farming systems (each of which includes a variety of subsystems) are **shifting cultivation**, **pastoral nomadism**, and **settled agriculture**. Shifting cultivation describes a system in which producers cultivate one area until its fertility is exhausted and then migrate to another plot of land. If the new areas must first be cleared of brush and the remaining brush then burned to clear the fields and increase the nutrient content of the soil, it is termed **slash and burn** agriculture. Economists George Norton, Jeffrey Alwang, and William Masters estimate that shifting cultivation is still practiced on about 15 percent of the world's cultivated area, mostly in Latin America and sub-Saharan Africa.[4] They note that shifting cultivation has been linked to soil erosion.

Pastoral nomadism, as the name implies, describes a farming system in which producers travel more or less continuously. This mobility requires that their production system be based on livestock, which the nomads shepherd across grazing areas. This system can function only in areas of low population density and is thus most frequently found in arid and semiarid agroecological zones, such as in much of the Sahel region of Africa or in the Indian state of Rajasthan. Nomadic groups typically

[3]Theodore W. Schultz, *Transforming Traditional Agriculture* (Chicago: University of Chicago Press, 1964), p. 38.

[4]Norton et al. *Economics of Agricultural Development*," p. 150.

include five or six families traveling together with medium-size herds of livestock, perhaps 25 to 60 sheep and goats or a smaller number of camels or cattle. Increasing population densities and global climate change are particular threats to this type of farming system, which is also associated with environmental damage, resulting from overgrazing.

Settled agriculture includes a variety of systems, which as a group represent the best potential for productivity growth. Some settled agricultural systems are the following:

- *Intensive annual crops*, the most dominant system in terms of total cultivated area, typically concentrating on production of staple cereal crops (wheat, rice, and corn)
- *Mixed farming*, which builds on the interactions of crops and livestock production to manage risk and maintain soil fertility
- *Perennial crops*, generally tree crops such as bananas, coffee, cocoa, along with sugarcane, that produce for a period of years (often in combination with annual food crops)
- *Livestock systems*, producing both dairy and meat products, either through grain feeding (intensive production) or exclusively by grazing (extensive production)

Settled agriculture forms the core of efforts to modernize agriculture. The challenges are numerous, complex, and ever evolving. With cereals demand in developing countries projected to increase by nearly 50 percent between 1997 and 2020, the challenge of getting agriculture moving is urgent.[5] The starting point is a framework for diagnosing the constraints to increased productivity.

DIAGNOSING THE CONSTRAINTS TO AGRICULTURAL DEVELOPMENT

Increasing agricultural output is a high priority for most developing countries. In addition to the obvious benefit of providing greater access to food for domestic consumers, increasing agricultural output also enhances the livelihoods of those working in agriculture and related industries. In many developing countries, the agricultural

[5]Projections of future demand for food take into consideration not only projections of how many people will need to be fed but also projected income levels, which shape both the quantity and the type of food demanded. It is widely documented that demand for meat increases with income, and meat production implies additional demand for grain as feed. Much of this demand will be in China. Mark Rosegrant, Michael Paisner, Siet Meijer, and Julie Witcover, *Global Food Projections to 2020, Emerging Trends and Alternative Futures* (Washington, DC: International Food Policy Research Institute, 2001), p. 58.

THE GREEN REVOLUTION[11]

The term **green revolution** refers broadly to the science-based innovations in crop breeding and farming practices, with roots dating from the 1940s, that transformed global agriculture during the second half of the last century. Agronomist Norman Borlaug is often referred to as the Father of the Green Revolution for his early scientific work in Mexico on developing **semidwarf disease resistant wheat** varieties. These new wheat varieties were an early example of **modern crop varieties (MVs)**, or **high-yielding crop varieties**, that were to become the centerpiece of the green revolution. Plants are vulnerable to a wide range of pests, diseases, and parasitic weeds that can severely reduce yields. By cross-breeding appropriate strains of wheat, Borlaug and colleagues were able to fortify the wheat then grown in Mexico against major diseases. In addition, existing wheat varieties tended to grow tall and thin as each plant competed with its neighbors for sunlight. Efforts to increase wheat yields through the application of chemical fertilizers increased the grain production of plants, but the tall thin wheat varieties tended to fall over under the added weight of grain. The creation of semidwarf wheat varieties, which had shorter and thicker stems than the traditional varieties as well as improved responsiveness to fertilizers was a solution to that problem. By the mid-1960s, similarly improved varieties of rice had also been developed and released, along with MV wheat, to farmers in Latin America and Asia.

These research programs were housed at new international agricultural research centers (IARCs). The International Maize and Wheat Improvement Center (known by its Spanish acronym, CIMMYT) was established in Mexico in 1963 (with Borlaug as its founding director), and the International Rice Research Institute (IRRI) was established in the Philippines in 1960. Both centers were supported by large grants from the Rockefeller and Ford Foundations. These were the first two centers of what is now the Consultative Group on International Agricultural Research (CGIAR), a global network of 15 research institutes. While popular accounts of the green revolution tend to focus on the early advances with MVs in the 1960s, a comprehensive review by economists Robert Evenson and Douglas Gollin suggests the green revolution remained in full swing until at least the year 2000.[12]

Part of this extended history of the green revolution is the recognition that the early successes were largely limited to wheat and rice for use in Latin America and Asia. Green revolution advances ultimately included the release of more than 8,000 MVs for 11 major crops, yet progress was uneven across both commodities and countries. Advances for certain semiarid crops, such as sorghum, millet, barley, and root crops such as cassava, did not come until the 1980s. The adoption of modern

[11]This section draws on R. E. Evenson and D. Gollin, "Assessing the Impact of the Green Revolution, 1960 to 2000," *Science* 300 (2003); World Bank, *World Development Report, 2008*.

[12]Evenson and Gollin, "Assessing the Impact of the Green Revolution."

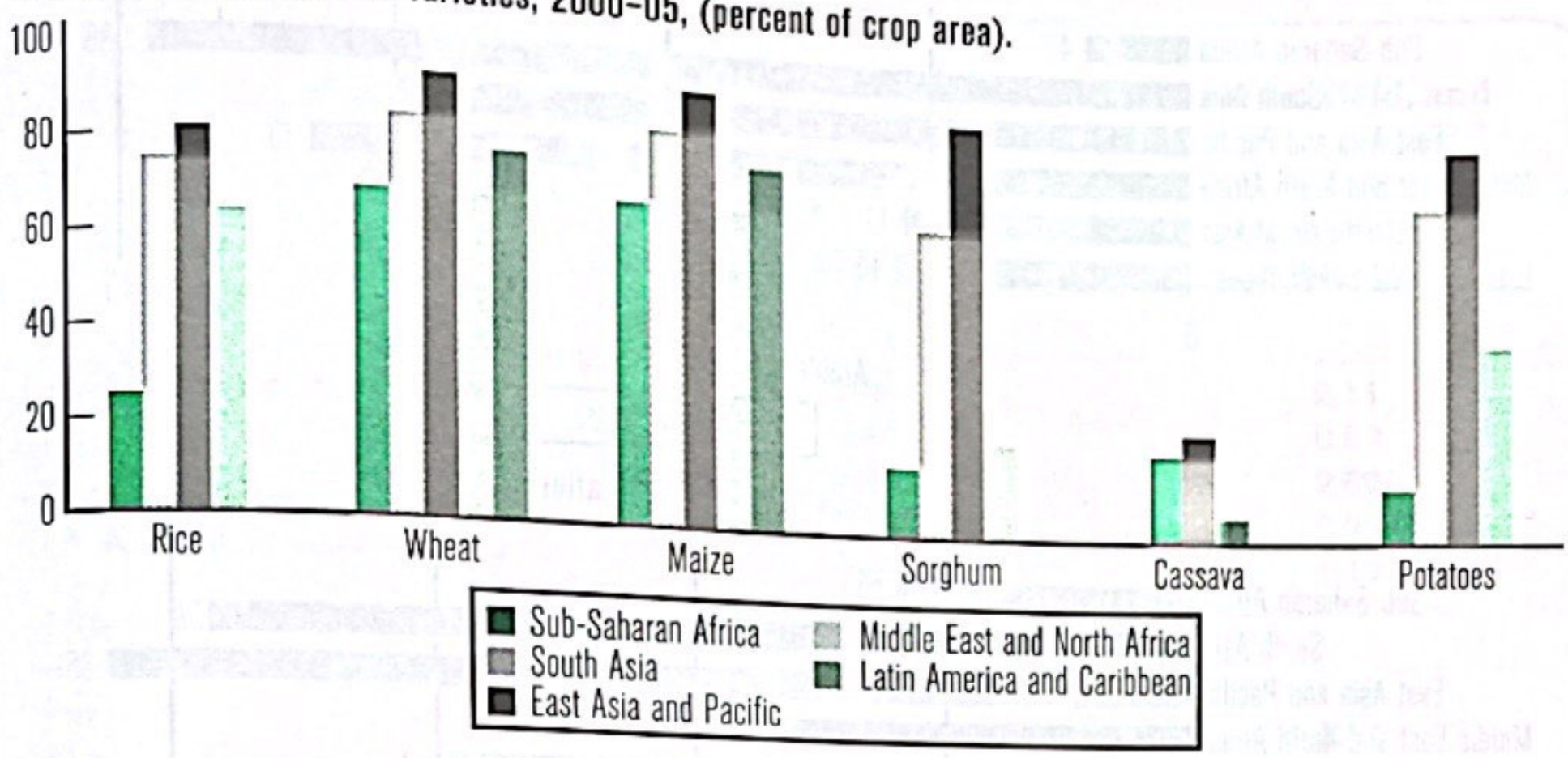

FIGURE 17–3 Modern Variety Diffusion by Crop and Region

Note: Data are provided for the period 2000–05, except for maize in some Sub-Saharan African countries where data are from 1997.

Source: Figure 7.1 from The International Bank for Reconstruction and Development. The World Bank: *Agriculture for Development,* 2008. Reprinted with permission.

varieties was widespread but unevenly distributed over time and space. Figure 17–3 illustrates the diffusion of MVs by crop and region. By the early 2000s, adoption rates across commodities in East Asia were uniformly high (exceeding 80 percent, with the exception of cassava, a root crop that plays only a small role in Asian diets). MVs for major commodities had also diffused widely through South Asia and Latin America. Yet, with the exception of wheat, adoption of MVs in sub-Saharan Africa by the early 2000s lagged far behind other developing regions. Adoption of modern varieties for rice and sorghum in sub-Saharan Africa are particularly low in comparison with other regions, even though these two crops are widely grown in the region.

Lagging adoption of MVs in sub-Saharan Africa has several explanations. One problem has been that agroecological conditions in Africa are extremely diverse—sometimes even within a single country. Another problem, particularly before the 1980s, was that the new varieties were engineered to be highly responsive to purchased inputs, such as chemical fertilizers, or (especially in the case of rice) thrived best in irrigated fields. These complementary inputs have been less common in Africa than in Asia or Latin America, limiting the ability of African farmers to benefit from green revolution innovations. Figure 17–4 demonstrates the stark disparities in input intensity across regions. By the year 2002, nearly 40 percent of cropland in South Asia was irrigated, compared to only 4 percent of the cropland in sub-Saharan Africa. Similarly, fertilizer application per hectare in sub-Saharan Africa remained but a small fraction of average fertilizer applications in other regions.

Most of the MVs were the result of genetic research performed at the international research centers. Yet the real measure of success in agricultural research is not the number of varietal releases, but their impact in farmers' fields. In the language of

INSTITUTIONS FOR AGRICULTURAL DEVELOPMENT

Economic historian and Nobel laureate Douglass North famously defined institutions as "the humanly devised constraints that structure human interaction. They are made up of formal constraints (rules, laws, constitutions), informal constraints (norms of behavior, conventions, and self-imposed codes of conduct), and their enforcement characteristics. Together they define the incentive structure of society and specifically economies."[23] Institutions thus define the rules of the game by which individuals in society interact with one another. In the context of agricultural development, institutions governing the ownership and transfer of land are of particular importance.

In most countries, land ownership is a key determinant of power and social status, making land allocation a highly political concern. Land (like income, wealth, and political power) is unevenly distributed. For selected countries, Table 17–2 provides data on the size of an average land holding as well as an indicator of the equity with which land is distributed within the country. The equity of land distribution is summarized in Table 17–2 by a Gini coefficient for land ownership. Recall from Chapter 6 that a Gini coefficient summarizes relative distributional equity with a number ranging between 0 and 1. The closer the Gini coefficient is to 1, the more unequal is the distribution. Several points stand out in these data. There is great variation in the size of average land holdings and the equity of land ownership across regions and countries, reflecting large differences in population density, culture, and history. Average farm sizes in Africa and Asia tend to be quite small relative to some of the larger countries in South America. In Ethiopia, the average farm size is 0.8 hectare, as compared with 469 hectares in Argentina and 740 hectares in the United States.

The Gini coefficients for land ownership in Africa tend to be on the low side, such as 0.37 in the Democratic Republic of the Congo and 0.38 in Namibia. These low Gini coefficients reflect highly equitable distributions of land ownership. Conversely, the distribution of land in South American countries is highly skewed. Gini coefficients on the order of 0.85 for Brazil and 0.93 in Paraguay indicate that a large portion of land is owned by a small number of large landowners, while the large majority of rural dwellers in those countries must divide up whatever land is left over. The highly unequal distribution of land in Latin America has such deep historical roots that special terms have evolved to describe it: **latifundia** (the term for the large estates that dominate the distribution) and **minifundia** (the small family farms on which peasant farmers struggle to feed their families).

Institutions governing land rights play a large role in shaping incentives for agricultural producers, both in terms of their level of effort and their willingness to invest in maintaining the quality of their land. Insecure land rights can undermine

[23]Douglass North, "Economic Performance through Time," in Torsten Persson, ed., *Nobel Lectures, Economics 1991–1995* (Singapore: World Scientific, 1997).

TABLE 17-2 Farm Size and Equity of Land Holdings in Selected Countries

REGION/COUNTRY	CENSUS YEAR	AVERAGE FARM SIZE (HECTARES)	GINI COEFFICIENT FOR LAND HOLDINGS
Africa			
Burkina Faso	1993	3.92	0.42
Congo	1990	0.53	0.37
Egypt	1990	0.95	0.65
Ethiopia	1989–92	0.80	0.47
Guinea	1995	2.03	0.48
Malawi	1993	0.75	0.52
Namibia	1995	2.64	0.38
Uganda	1991	4.70	0.59
North and Central America			
Bahamas	1994	11.5	0.87
Barbados	1989	190.0	0.94
Canada	1991	349.1	0.64
Honduras	1993	11.17	0.66
Panama	1990	110.0	0.87
Puerto Rico	1987	100.0	0.77
United States	1987	740.0	0.74
South America			
Argentina	1988	469.0	0.83
Brazil	1985	64.64	0.85
Colombia	1988	120.0	0.79
Paraguay	1991	77.53	0.93
Peru	1994	20.15	0.86
Asia			
India	1991	1.55	0.58
Indonesia	1993	0.87	0.46
Japan	1995	1.20	0.59
South Korea	1990	1.05	0.34
Nepal	1992	0.95	0.45
Pakistan	1990	3.78	0.57
Philippines	1991	2.16	0.55
Thailand	1993	3.36	0.47
Turkey	1991	5.76	0.61
Vietnam	1994	0.52	0.53

Source: FAO, *World Census of Agriculture* (Rome: Food and Agriculture Organization of the United Nations, 2000).

producers' incentives and limit productivity. Secure land rights can enhance agricultural productivity by creating access to credit markets through which farmers can purchase improved inputs. The rules governing land sales can influence agricultural productivity by facilitating the transfer of ownership rights to the most efficient producers.

Land rights take a variety of forms in developing countries, ranging from purely individual rights to purely collective forms of land ownership, with numerous forms

in between these polar extremes. Thus at one end of the spectrum, owners have full control over who uses their land and what they produce; at the other extreme, all members of a community are entitled to use the land and benefit from the output. The most common intermediate forms of land rights are **fixed-rent tenancy** and **share cropping**. Share cropping is the dominant contractual arrangement in South Asia, while other regions of the developing world more typically rely on fixed-rent tenancy. Under tenancy, a family might rent land from a large landlord and pay a fixed cash rent. Under share cropping, the farm family rents a plot of land from the landlord, with whom the family shares a fixed portion of their output. A key difference between these systems lies in how the risks inherent in farming are divided between the landlord and the tenant. Under a fixed rent scheme, the tenant farmers bear all of the risk; their rent due on the land does not depend on the level of their output. In contrast, under share tenancy, the landlord and the tenants share the risk more evenly because the in-kind payments to the landlord depend on the tenant's level of output. Incentives for producers may also differ across types of tenancy. On large commercial farms worked by hired wage labor, owners face a complicated problem of monitoring the level of effort of their workers. In contrast, on purely communal farms, on which everyone shares the communal output, workers' incentives might be limited because an individual's rewards may not reflect that individual's efforts to maximize collective output. In terms of producer incentives, a key distinction across types of tenancy arrangements is whether the producers are **residual claimants** to the output of the farm—that is, whether their individual benefits increase with their level of effort.

Another critical distinction between different land institutions is the security and stability of producers' rights to farm particular parcels of land. A rental contract written for one or two years is certainly less secure than clear title to a given parcel. Economists Klaus Deininger and Gershon Feder summarize the costs and benefits of secure individual property rights.[24] The main benefits include (1) improved incentives to conserve and invest in the land itself; (2) the ability to transfer land ownership, possibly to those able to make the best use of the land (for instance by taking advantage of economies of scale); and (3) the ability to use land as collateral, providing farmers access to credit markets (and the potential to adopt modern varieties and inputs). The main costs are the administrative costs of actually defining land boundaries and enforcing land rights and the risk that the poorest farmers, who often depend on access to **common property resources** (such as open pastures for grazing their livestock), could be deprived of their sources of livelihood.

There is substantial evidence to support the idea that secure land rights increase both agricultural productivity and investments in land conservation (which enhance future productivity). In China, the transition from collective to private cultivation has been associated with significant increases in productivity, as individual farmers

[24]Klaus Deininger and Gershon Feder, "*Land institutions and land markets*," in B. L. Gardner and G. C. Rausser, eds., *Handbook of Agricultural Economics*, 1st ed. (Amsterdam: Elsevier, 2001) vol. 1, pp. 288–331.

stand to retain more of the benefits of increased effort. Longer-term investments in land conservation are also evident. In Ghana, studies have found farmers with greater tenure security are more likely to plant trees and to invest in drainage and irrigation. In Niger, farmers who owned their land applied larger quantities of manure to maintain their soil fertility than did tenant farmers. In addition, there is evidence that secure tenure rights not only induce investment in land conservation but also facilitate access to the formal credit markets necessary to finance those investments. In Thailand, land ownership titles not only increased the value of land and boosted productivity but also increased the supply of credit. Another study in Paraguay found that the benefits of land titling were roughly equivalent to 10 percent of farm income. Yet, that study also found that those benefits were strongly concentrated among the larger land owners, whereas producers with less than 20 hectares received no benefits of increased credit supply.[25]

Improving systems of **land titling** is one approach to securing tenure rights. Land titling involves providing legal documentation of land ownership. Plans to improve tenure security through titling must also consider the costs of implementation. These costs are largely administrative and include measurement and demarcation of areas, adjudication of conflicting land claims, and the cost of documentation. Land titling can also facilitate the operation of land markets, which are often underdeveloped in poor countries. Land markets, however, may not facilitate access to land by the poor if the poor lack access to credit markets. When land titling alone is insufficient to achieve social goals in regard to land rights, various forms of land reform have been attempted.

LAND REFORM

Efforts to reform land rights can take a variety of forms, including the following:

- *Reform of rent contracts* works to increase the security of tenure of the tenant farmer. Laws requiring long-term contracts that restrict the landlord's right to remove the tenant strengthen the tenant's property rights at the expense of those of the landlord without necessarily transferring income from owner to tenant.
- *Rent reduction* typically involves placing a ceiling on the percentage share of the crop that a landlord can demand as rent. If the percentage share is substantially below what prevailed in the past, the impact both on tenant welfare and the tenant family's surplus available for investment can be substantial.
- *Land to the tiller* (the former tenant) *with compensation* to landlord for loss of land is a measure that can take many different forms. Government

[25]These studies are summarized in Deininger and Feder, "Land Institutions and Land Markets."

might pass a law stating a ceiling on the number of acres an individual can own and so force individuals to sell all land over that limit. Or the reform law can state that only those who actually till land can own it, and all other land must be sold. A key issue in this kind of reform is whether the former landlord receives full or only partial compensation for the land that must be sold.

- *Land to the tiller without compensation* is the most radical transformation of land rights. All land not cultivated by its owner is confiscated, and the former landlord receives nothing in return. This type of reform is most commonly found in the aftermath of a major political upheaval, such as a revolution or losing a war.

The implementation of these types of land reforms becomes more complex as we move down the list, and the potential for harmful unintended consequences exists in each case. Placing ceilings on land rents is one of the least intrusive of these potential reforms. Yet rent ceilings may create incentives for landowners to evict their tenants. This was a common result in Latin America as well as in India, where similar reforms led to the loss of 30 percent of the total area operated by the poor. Conversely, Deininger and Feder report that tenancy reform in West Bengal was associated with productivity gains of 40 percent.[26] Efforts to limit the size of land holdings have generally failed. The major problem in these cases is that ceilings can be evaded, for instance, by subdividing large landholdings among family members.

Land to the tiller programs are examples of redistributive land reform. These programs involve transferring ownership of land and thus face increasing political obstacles. Experience has been mixed, with greater success under certain preexisting circumstance. In settings in which tenants already cultivate given parcels of land that are pieces of larger landlord estates, transferring ownership of the land is administratively simple and can increase productivity by improving producers' incentives. Successful examples of this type of reform have occurred in Bolivia, Ethiopia, India, Iran, Japan, Korea, and Taiwan. Yet, experience with land reform in **hacienda** systems, by which tenants typically work most of the time on a landlord's plot of land but have their own subsistence plots, has been less positive. A common experience in Latin America when faced with the prospect of redistributive land reform was for landlords to evict their tenants or to convert them into wage laborers. In addition, land compensation schemes can be extremely costly and the task of estimating a fair compensation price for confiscated land is complicated by the poor quality of land markets in many countries. When land redistribution creates new landowners who were not previously cultivating that land, the need for complementary types of support (such as infrastructure and farmer training programs) might add substantially to the costs.[27]

[26]Deininger and Feder, "Land Institutions and Land Markets."

[27]Deininger and Feder, review these issues in greater detail; see "Land Institutions and Land Markets."

If land redistribution with compensation is complicated, redistribution *without* compensation is virtually impossible in the absence of a social revolution, foreign invasion, or both. The successful examples of redistributive land reform in Japan, the Republic of Korea, and Taiwan were possible only as the result of defeat in war or foreign occupation. In China and the Soviet Union, foreign invasions preceded social revolutions that destroyed the old agrarian orders and paved the way for large-scale land reform. In other cases, revolution alone created the conditions necessary for redistributive land reform. Examples include Cuba, Egypt, Ethiopia, Nicaragua, and Vietnam.

Redistributive land reform continues to be a key and controversial issue in many countries. This is particularly true in countries with highly unequal distributions of land ownership, often the result of historical legacy or ethnic discrimination. The southern African states of Zimbabwe and South Africa, for example, were settler colonies in which white minorities owned much of the prime agricultural land. Redistributive land reform has been a dominant social issue in these countries. Forced expropriation of white-owned farms in Zimbabwe began in 1999 with the support of President Robert Mugabe. Land reform in Zimbabwe has been widely criticized, not only for its violence but also because political favoritism in distributing newly seized land has contributed the failure of Zimbabwe's program to benefit most of the rural poor. In South Africa, the collapse of the Apartheid regime and the transition to democracy in 1994 brought with it high expectations among the indigenous majority for restitution in the form of land. These expectations were fueled by events in Zimbabwe. Yet, in contrast to that example, the government of South Africa has taken a more cautious approach to land reform. A desire to avoid the economic chaos that befell Zimbabwe helps explain this caution. After its election in 1994, the government of the African National Congress announced plans to redistribute 30 percent of commercial farmland to blacks by 2014; yet as of 2010, progress was limited to only 6 percent, and tensions continued to surround this issue. Redistributive land reform is also a key issue in many postconflict settings. Mozambique and Liberia, after long periods of civil war, face serious challenges of resettling large displaced populations on land since occupied by others. Land reform has also been a central issue in South America, where indigenous Indian minorities have long suffered discrimination. In Bolivia, for example, the government planned to redistribute 400,000 acres of land in 2011, a substantial increase over the 2010 level.

THE WORLD FOOD CRISIS OF 2005–08

During the years 2005–08, the world suffered its most severe food crisis since the early 1970s. The key indicator of this crisis was the rapid increase in the prices of a range of basic foods. As Figure 17–12 shows, the prices of rice, maize, and wheat increased

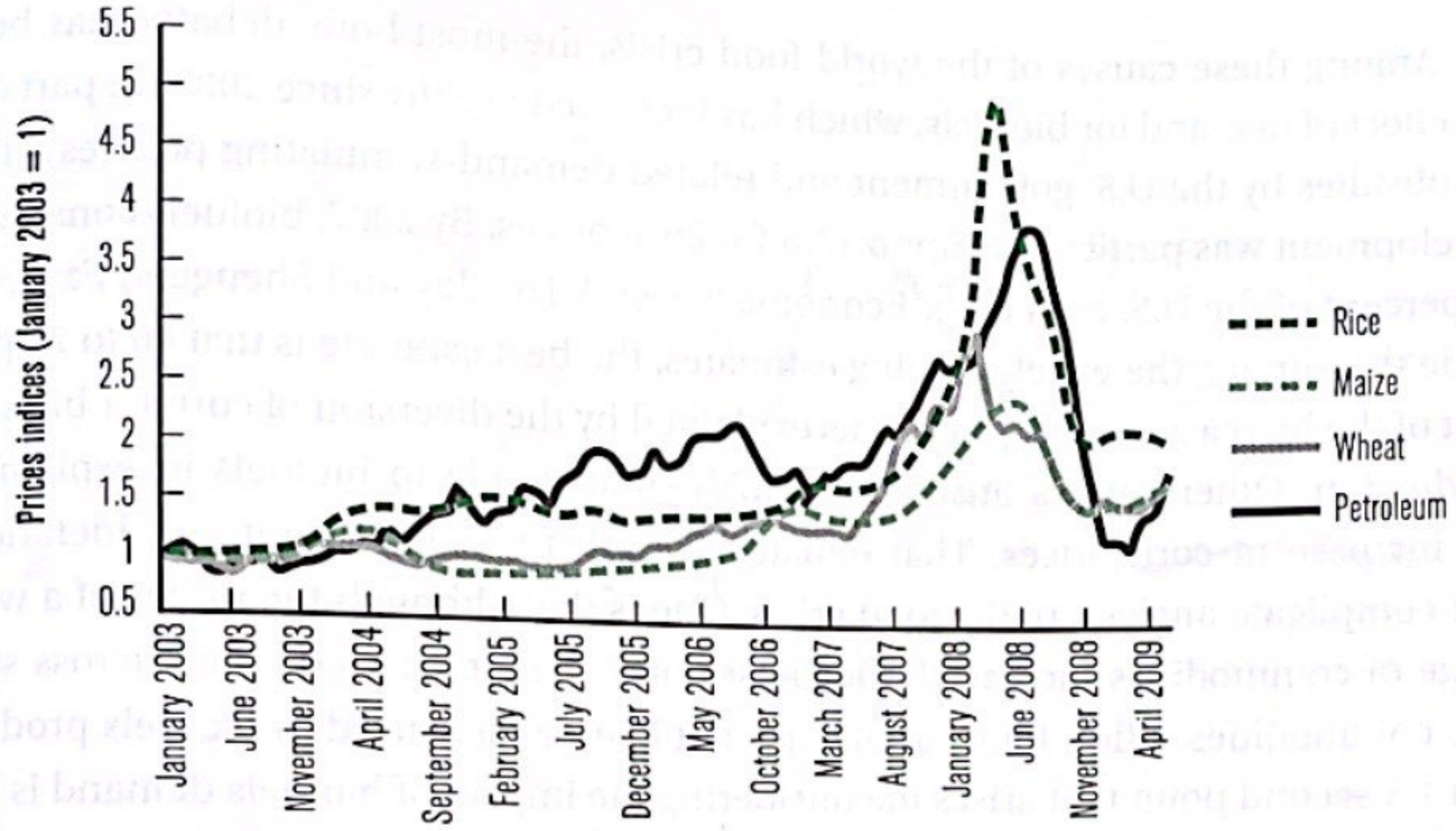

FIGURE 17-12 Trends in the Nominal Prices of Cereals and Oil, January 2003 to May 2009

Source: Headey, D., S. Malaiyandi, and S. Fan. 2009. "Navigating the Perfect Storm: Reflections on the Food, Energy, and Financial Crises." IFPRI Discussion Paper 00889, Figure 1. Washington, DC: International Food Policy Research Institute.

dramatically between early 2007 and mid-2008, following more gradual increases beginning in 2004. The price of maize showed the least increase, yet still reached a level by June 2008 that was two and a half times greater than it had been just two years earlier. The run up in wheat prices was even more severe, but both were outpaced by the skyrocketing price of rice during 2007–08. From October 2007 to April 2008, the world price of rice tripled (increasing from $335 to over $1,000 per ton).

CAUSES OF THE CRISIS

Explanations for the crisis include a wide range of possibilities and are the subject of continuing debate. The list of potential culprits includes both supply shocks and demand shocks: growth in demand from China and India, speculation on financial markets, hoarding and export restrictions, weather shocks, decreased productivity, low interest rates, a depreciation of the U.S. dollar, rising oil prices, declining food stockpiles, and demand for biofuels.[28] There is no definitive consensus regarding the relative contributions of these potential causes. Notably, some of these potential causes are common to all commodities (such as the effect of oil price increases and the depreciation of the U.S. dollar), whereas other causes are commodity-specific (such as supply shocks and the effect of biofuels demand).

[28]See D. Headey and S. Fan, "Anatomy of a Crisis: The Causes and Consequences of Surging Food Prices," *Agricultural Economics* 39 (suppl., 2008), 375–91.

Among these causes of the world food crisis, the most hotly debated has been the effect of demand for biofuels, which has increased rapidly since 2003 (in part due to subsidies by the U.S. government and related demand-stimulating policies). This development was particularly important for corn prices. By 2007, biofuels consumed 25 percent of the U.S. corn crop. Economists Derek Headey and Shenggen Fan conclude that among the widely varying estimates, the best estimate is that 60 to 70 percent of the increase in corn prices was explained by the diversion of corn for biofuels production. Other studies attribute a much smaller role to biofuels in explaining the increase in corn prices. That debate illustrates two important considerations that complicate analysis of the food crisis. One is that although the prices of a wide range of commodities increased, the causes of these increases differed across specific commodities. (Rice, for example, has not been widely used in biofuels production.) A second point that arises in considering the impact of biofuels demand is the need to consider interactions between crops. In the case of biofuels, the increased demand for corn is thought to have explained up to 40 percent of the increase in soybean prices. What's the connection? The 23 percent increase in acreage in the United States devoted to corn came at the expense of a 16 percent reduction in soybean acreage in 2007. In addition, to the extent that consumers substitute between staple gains, increased corn prices have contributed to increased demand for wheat and rice, adding to price increases for those commodities.

The explanation for the tripling of world rice prices relates more to the combustible mixture of distortionary trade interventions and panic buying. Historically, world rice markets are thin compared with those for other grains. That is, only 5 to 7 percent of global rice production is traded internationally (compared with 20 percent of wheat). This makes world rice prices relatively volatile. In addition, global rice exports are dominated by a small number of countries: Thailand, India, Vietnam, and Pakistan alone account for about 70 percent of global rice exports. So conditions in the world rice market were ripe for an implosion in November 2007, when India reacted to rising rice prices by banning exports. India's ban on rice exports set off a chain reaction in world rice markets. Importing nations, the Philippines in particular, accelerated their import orders, fearing further price increases. These orders, themselves, helped drive up prices, in response to which Vietnam, China, Cambodia, and Egypt also intervened to restrict rice exports. Figure 17–13 places these and related events on a chart of world rice prices.[29]

Commodity-specific factors also affected world wheat prices. In this case, the main culprit was a weather-induced supply shock. Australia, one of the world's leading exporters of wheat, suffered its worst drought in a thousand years in 2006, cut-

[29]D. Headey, S. Malaiyandi, and S. Fan, "Navigating the Perfect Storm: Reflections on the Food, Energy, and Financial Crises," Discussion Paper No. 00889, International food Policy Research Institute, Washington, DC, August 2009. For a comprehensive review of the rice crisis, see D. Dawe, ed., *The Rice Crisis: Markets, Policies and Food Security* (London: Earthscan, 2010).

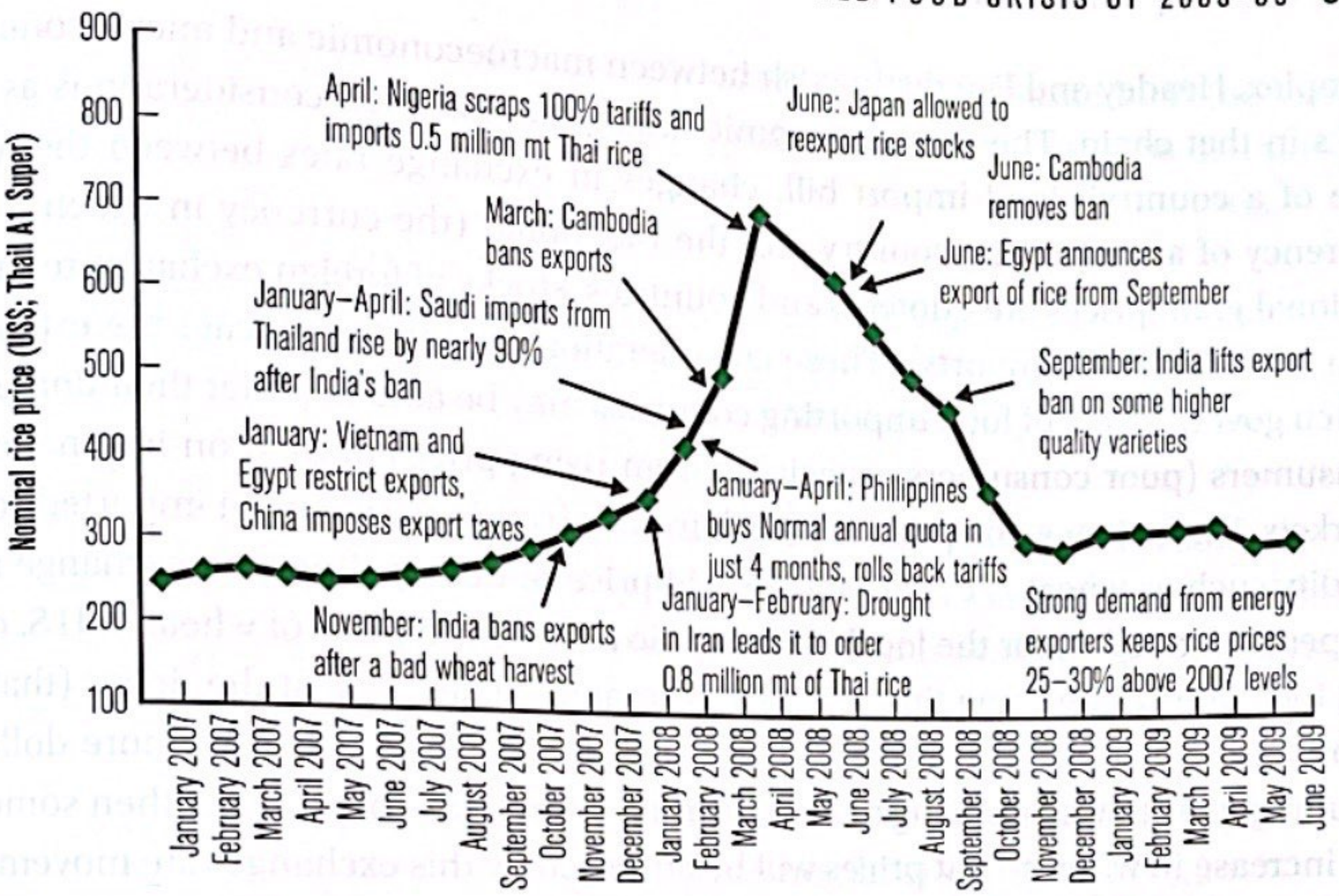

FIGURE 17-13 Events in World Rice Market

mt, metric tons.

Source: Headey, D., S. Malaiyandi, and S. Fan. 2009. "Navigating the Perfect Storm: Reflections on the Food, Energy, and Financial Crises." IFPRI Discussion Paper 00889, Figure 2. Washington, DC: International Food Policy Research Institute.

ting in half that country's wheat exports. That year's harvest in other major producing countries, including the United States, Russia, and Ukraine, were also smaller than usual.

A more general factor was the price of oil. The price of oil surged just in advance of the prices of wheat, maize, and rice. Oil prices are relevant for several reasons. For instance, chemical fertilizers are largely petroleum-based products, and most farm machinery runs on gasoline or diesel fuel. In addition, higher oil prices also increased the cost of transporting agricultural output, both within and between countries. Here too we see an interaction effect with other potential causes of the crisis: biofuels production becomes more profitable when oil prices are high. In addition, the ability of markets to respond to price increases in a range of commodities by releasing stockpiles of those grains into the market was severely constrained by the historically low levels of grain reserves at that time. Ironically, one cause of the low levels of grain reserves was the secular decline in prices before the crisis.

CONSEQUENCES OF THE CRISIS

The consequences of the world food crisis of 2005–08 are even more difficult to sort out. While our ultimate concern may be the welfare of poor households, the causal chain running from global cereals price shocks to household welfare is long and

complex. Headey and Fan distinguish between macroeconomic and microeconomic links in that chain. The macroeconomic linkages entail such considerations as the size of a country's food import bill, changes in exchange rates between the local currency of an importing country and the U.S. dollar (the currency in which international grain prices are quoted), and countries' stocks of foreign exchange reserves (the funds used for imports). These considerations generally indicate the extent to which governments of food importing countries may be able to buffer their domestic consumers (poor consumers especially) from rising prices of food on international markets. For instance, the price in local currency (say, in pesos) of an imported commodity such as wheat is equal to the world price in dollars times the exchange rate (in pesos per dollar) for the local currency. So if the world price of wheat in U.S. dollars increases at the same time that the peso appreciates against the dollar (that is, if the peso–dollar exchange rate changes such that a peso purchases more dollars, resulting in a "lower" exchange rate indicating fewer pesos per dollar), then some of the increase in world wheat prices will be absorbed by this exchange rate movement and not passed along to domestic (local currency-denominated) food prices. Over the period 2003–07 countries' experiences in this regard varied widely.

Yet the welfare impacts also depend on a set of microeconomic factors that come into play once world market events have been translated into domestic food prices. At that point, changes in the relative prices of foods may motivate consumers to substitute among commodities (in favor of those that have become relatively cheaper). Opportunities for substitution away from suddenly more expensive commodities can help dampen the potential adverse effects on consumers. But these opportunities also depend on consumer preferences and the patterns of food consumption for households at different levels of income. In particular, the effect of rising food prices on household welfare depends on whether the household is a net buyer or net seller of food (as discussed earlier).

Estimates of the welfare impact of the world food crisis have also varied widely. Studies have tended to conclude that poverty (even rural poverty) tends to increase with rising food prices. This is not surprising, given that nearly all urban dwellers and a substantial proportion of rural dwellers (especially the poor) are net buyers of food (though net sellers, many of whom are still relatively poor, have benefited). While countries varied widely in the impact of the food crisis on poverty, effects also varied widely within individual countries. Economists Maros Ivanic and Will Martin concluded that on average (over the nine countries they studied) poverty rates increased by 4.5 percentage points in the short run.[30] Projecting this result to all low-income countries, they suggest that the food crisis could have increased the global poverty head count by 105 million. Their estimate is thus substantially higher than that of the Food and Agricultural Organization, which found that the food crisis increased the

[30]M. Ivanic and W. Martin, "Implications of Higher Global Food Prices for Poverty in Low-Income Countries," *Agricultural Economics* 39 (suppl. 2008): 405–16.

poverty head count by 40 million. These examples demonstrate both the variation in estimates of the magnitude of the impact and the broad consensus that the world food crisis hurt the poor.

SUMMARY

- A variety of characteristics distinguish agriculture from other sectors in a typical developing economy. These unique features of agriculture include its large share of GDP and employment, several technical characteristics of the agricultural production function, that much of the sector's output is directly consumed by its producers, and agriculture's role as a resource reservoir.
- Farms and farmers in developing countries differ widely from one another, both within and between countries. These differences include wide variations in farm size, technology, environmental conditions, crop mix, and degree of integration in markets. Nonetheless, it is possible to characterize traditional agriculture at a broad level of generalization as consisting of small-scale family farms producing food primarily for their own consumption, using traditional crop varieties and techniques and few purchased inputs, with low levels of productivity.
- Agricultural systems can take a variety of forms, with the major types being systems of shifting cultivation, pastoral nomadism, and settled agriculture. Most of the progress made in promoting agricultural development in recent decades has concentrated on systems of settled agriculture.
- Growth in agricultural productivity (commonly defined as the level of output per unit of land) is a central component of agricultural development. The growth rate of yields for cereal crops has been consistently high in East Asia, but quite low in sub-Saharan Africa (with the performance of other developing regions ranging between these extremes).
- Productivity growth in agriculture may be constrained by a variety of factors, including a lack of improved technology, unfavorable economic incentives, and poor-quality institutions.
- The green revolution produced new agricultural technologies and contributed significantly to agricultural productivity growth in Asia and Latin America. The benefits to farmers in sub-Saharan Africa have been more limited.
- Government policies that influence food prices play a critical role in shaping the incentives for farmers as they decide what to produce, how to produce it, and how much to produce. Meeting the goal of increasing agricultural output and productivity requires positive incentives for

farmers, typically in the form of higher food prices. Yet government efforts toward that end may be severely constrained by the negative impact of high food prices on poor consumers, many of whom may be at severe risk of undernutrition and hunger.

- Institutions governing land rights are of particular importance in shaping incentives and opportunities for farmers. Secure tenure arrangements encourage both greater levels of effort in current farm production and greater levels of investment in conserving soil resources for future production. Efforts to improve tenure security through land reform are often appealing in theory, but difficult to implement.