Agriculture has been transformed in the past three decades. Output has increased at nearly twice the rate of earlier periods, fueled partly by the developing world's greatly increased capacity to produce food and partly by changes in the developed countries. Above all else, there has been unprecedented technical change in agriculture throughout the world.

Alongside this remarkable and sometimes underestimated achievement stands the "world food problem." Hundreds of millions of people in the developing world are still without enough food. Population growth, the effects of which are often exacerbated by a highly unequal income distribution, has sharply reduced both the per capita benefits of increased food production and the associated increases in income per capita.

This paradox—of poverty in the midst of plenty—has long plagued popular understanding of the role of agriculture in economic development. On the one hand, it has led to a sense of hopelessness about the world's malnourished; on the other, to technological overconfidence. Overanxiety about food crises has alternated with taking agriculture for granted, even neglecting it.

None of these extreme reactions is appropriate or helpful. Agriculture does indeed face special problems, of which two in particular stand out. The first is biological—the close dependence on the natural environment. This results in output levels that fluctuate unpredictably from season to season, and growth that varies greatly from one region to another depending on natural resources and the extent to which their potential has already been developed. The second is economic—the problem of the radical adjustments farmers face in the process of agricultural development. While its output may continue to grow, agriculture's share of both GDP and employment invariably decreases as economies develop and industrialize. Indeed, at later stages of development, the absolute size of the labor force in agriculture declines, ultimately to a very small fraction of the total.

In most ways, though, agriculture is not unique. Farmers, like other workers, respond to incentives. In buying food, consumers are influenced by relative prices and available income, as they are when they buy other things. Agriculture's success or failure therefore owes much to factors that influence all economic activity. If it lags, it is because of inadequate investment, lack of incentives, and inappropriate policies, as well as problems of technology, climate, and soil.

This chapter describes some key elements in the worldwide expansion and transformation of agriculture. It discusses where growth has taken place, where it has not, and the problems which patterns of growth have produced or failed to solve. In particular it highlights the following features of agricultural development:

- Progress has been slowest in the low-income countries. These countries account for most of the world's poor, the vast majority of whom work on the land.
- There are strong links between agriculture and overall economic growth. Few countries have achieved sustained economic growth without first, or simultaneously, developing their agriculture.
- As it proceeds, development dictates a declining role for agriculture. Initially dominant, it eventually accounts for only a small fraction of net output, employment, and income. Successful adjustment to agriculture's changing role determines not only the pace and pattern of development as a whole, but also the severity of the problems rural people face in the development process.
- The international economic environment—trade, technology, commercial capital, and development assistance—has contributed to major changes in world agriculture. Most changes have been beneficial, but some serious problems remain: notably the agricultural protection policies of the developed countries, which limit the market access of developing-country producers, at high cost both to governments and to consumers in the developed world.

The pattern of recent growth

While the rate of growth of agricultural output over the past three decades was about double that of earlier years, it was decelerating during the period. Worldwide, output rose at 3.1 percent a year in the 1950s, 2.6 percent in the 1960s, and 2.2 percent in the 1970s. The broad pattern was one of declining growth rates in the non-market industrial economies, while rapid growth was maintained in developing countries and
industrial market economies. (Table 5.1 and Figure 5.1 show the pattern for the 1960s and 1970s.)

In the industrial market economies agricultural growth has been led by rising demand for high-value products such as meat, poultry, dairy produce, fruit, and vegetables. This stimulated rapid growth in the production of cereals, especially in North America and Australia, because changes in animal husbandry led to heavy demand for feed grains. Today, grain fed to livestock accounts for 70 percent of their grain consumption. Between them, livestock and feed grain account for over 65 percent of gross agricultural output (see Box 5.1 and Chapter 6).

Rapid economic growth has drawn people away from agriculture. Agriculture's share of the labor force in most developed countries is now only one-third of what it was in 1960, averaging only 6 percent in the developed market economies in 1980. As a result of a major shift toward labor-saving technology, labor productivity (output per worker) has
Box 5.1 Food versus feed?

"Sheep eat men" was the seventeenth-century slogan of English peasants dispossessed when common land was enclosed for private pastures. Today, some 600 million tons of cereals are fed to animals every year. This amount could feed 2.5 billion people, more than twice the number in poverty. Moreover, grain converted to meat loses 75 to 90 percent of its calories and 65 to 90 percent of its protein. Accordingly, a lively school of thought maintains that feeding grain to cattle, pigs, and chickens takes food away from the hungry.

The issue is not a simple one, however. The main use of cereals for feed occurs in developed countries, where over two-thirds of the grain consumption is accounted for by animals. This pattern of grain use reflects the high incomes of consumers in the developed countries. If cereals were not fed to livestock, cereal production in these countries would decline sharply.

A massive transfer of purchasing power from rich countries to poor ones would be needed to shift consumption from animals to people. Even if this unlikely prospect were realized, the longer-term consequences are problematic. Most of the world's hungry are farmers or live in farm areas where basic cereals are grown. It would be difficult if not impossible to inject large amounts of cereals into these areas without reducing incomes and production in the very regions where increased income is most needed. Direct food assistance has an important role to play, but it needs to be carefully balanced with other forms of assistance that stimulate food production and incomes.

As development proceeds, the interaction between livestock producers and grain farmers plays an increasingly important part in sustaining agricultural growth. The rapid growth in demand for feed is one factor responsible for the dramatic increase in cereal yields in the industrial countries—to nearly 3.5 tons an hectare. In the 1930s cereal yields were almost identical in developed and developing countries, about 1.1 tons per hectare. Rapidly developing middle-income countries are already following the pattern established by agriculture in the developed world; about 25 percent of the grain they consume is used for livestock feed.

frequently risen faster in agriculture than in other sectors. Agriculture has greatly increased its use of other inputs such as fertilizer and machinery, which now represent nearly half the value of gross output. Agricultural value added has therefore risen less rapidly than gross output—at least 1 percent a year during the 1970s in many countries.

In the nonmarket industrial economies of eastern Europe and the USSR, output grew rapidly in the 1950s and 1960s because virgin land was opened up and the use of fertilizer and machinery increased. Between 1970 and 1980, however, agricultural growth slowed sharply in the two largest countries, the USSR (averaging 1.9 percent a year) and Poland (1.3 percent a year). This slowdown came at a time when the demand for meat and other livestock products was rising rapidly. Despite greatly increased imports of feed grains, agriculture has been slow to adapt to this changing pattern of demand. Some of the reasons for this failure lie in history—Soviet agriculture suffered heavily from war and neglect for thirty-five years after the Revolution of 1917—while others lie in the difficulties of an overly centralized system.

Agricultural output in the developing countries considered as a group grew at historically high rates, with growth of just under 3 percent a year during both the 1960s and the 1970s (see Table 5.1). But the rate of growth of population was also unprecedentedly high. The outcome was a modest (0.3 and 0.4 percent a year) increase in agricultural and food output per capita.

As is usually the case, these aggregates conceal substantial differences. In particular, there was an acceleration of growth of agricultural output in Southeast Asia; from being near the average for developing countries (0.3 percent per capita a year) in the 1960s, it rose to 1.4 percent a year in the 1970s. The Latin American countries also increased their growth of agricultural output per capita, up to 0.6 percent a year in the 1970s from 0.1 percent in the 1960s.

By contrast, the yearly rate of growth of agricultural output in Africa declined (from 2.7 percent in the 1960s to 1.3 percent in the 1970s)—and the rate of population growth accelerated. These changes meant that output per capita grew at 0.2 percent a year during the 1960s, but then fell by 1.4 percent a year in the 1970s. Part of the decline was associated with a slowdown in the production of nonfood crops (tropical beverages and fibers); but the growth of food output per capita was also transformed from a modest increase in the 1960s to a decline (−1.1 percent) in the 1970s.

In South Asia, the balance between population growth and agricultural growth remained essentially unchanged over the two decades. In spite of growth rates of agricultural output which averaged 2.5 and 2.2 percent, respectively, output per capita grew at only 0.1 percent in the 1960s and about zero percent in the 1970s. This performance—disappointing, since South Asia had been one of the major beneficiaries of the Green Revolution and of massive investments in irrigation and fertilizer—is a salutary reminder of the consequences of
high and sustained rates of population growth.

Of course, these growth rates were not uniform within each region, nor were they uniform within countries. In India, for example, not all regions are endowed with the fertile soil, effective flood control, and irrigation and drainage systems that have permitted some areas to show spectacular increases in agricultural production by adopting the new crop technologies. In the 1960s, agricultural growth exceeded 5 percent a year in about a third of the country’s 281 districts, but output actually fell in a fifth of the districts and rose at less than 1 percent a year in another fifth.

Such regional differences in agricultural growth rates are a common phenomenon in most countries, both developed and developing. Within each of the EEC countries, for example, there are regions of increasing and decreasing agricultural income during the 1960–80 period. These regional disparities tend to be accentuated during early development stages, however, because of the proportionately greater impact of natural conditions, the variable effect of technology, and the limited capacity of governments to support agricultural growth in less favored regions. In the United States, for example, which provides both national and state support for agriculture, agricultural output increased in every state between 1930 and 1970, although growth rates still varied significantly between 1.7 and 6 percent.

Low or negative growth in agricultural production per capita in South Asia and Africa presents a major challenge to domestic policymakers and the international community alike. The unprecedented advances in plant breeding, in the use of fertilizer, and in investment in irrigation over the past twenty years have resulted in a tie in the race between population growth and agricultural production in South Asia. In Africa, where no comparable advances in agricultural technology have been realized, the race is at present being lost. The challenge is to accelerate the pace of biological innovation, to provide the policy environment and the complementary resources that make the new technologies effective in increasing output and incomes, and to reduce the rapid rate of growth of population.

The role of agriculture in development

Economic growth is invariably accompanied by a declining share of agriculture in total output, income, and employment. At advanced stages of development, the labor force in agriculture starts to decline absolutely. Two main forces, which together produce the major structural transformations shown in Figure 5.2, are at the heart of the development process. First, the pace of agricultural growth is limited by the growth of demand for its output, 90 percent of which is food in all but a handful of countries (see Chapter 6). In turn, the growth of demand is limited by the tendency for the proportion of household spending on food to decline as incomes rise. In India, with a per capita income of $240, for example, households spend 60 to 70 percent of their income on food; in a $10,000 per capita economy such as Canada, they spend less than 20 percent on food and are able to enjoy variety and quality to a greater extent.

This tendency, known as Engel’s Law, is observed in all economies as they grow. The limits to agricultural growth imposed by the growth in domestic demand can, however, be raised if income growth is broadly diffused in the economy and countries export their surplus produc-

![Figure 5.2 Cross-country share of employment and output in agriculture, 1980](image)

**Note:** Excludes high-income oil exporters.
tion. (This option is available only to a limited extent, because Engel's Law operates on a global scale, as well as for individual countries.)

In the case of nonfood agriculture, competition from industrial substitutes grows as investment and innovation lower the price of industrial goods and services relative to agricultural raw materials. Common examples are the use of synthetics instead of natural fibers (cotton, wool, jute) for clothing, the substitution of oil or coal for wood, and the switch from timber to steel and cement in construction. Substitution is seldom total, however, so demand for natural products usually continues to grow. To benefit, producers have to concentrate on marketing as well as on efficient production.

With development, farmers become increasingly removed from consumers. As subsistence farming gives way to marketed production, the scope for specialized marketing, transport, processing, and packaging is enlarged. In the industrialized economies, these activities produce much more value added and employment than does agriculture itself; the farm-gate value of food is now only one-third of the price consumers pay for it.

The second main force accounting for the structural change in agriculture is increased agricultural productivity, made possible by technological innovations and accumulated public and private investment. Employment expands and diversifies as a consequence of the relative decline in the agricultural work force. In the early stages of development, almost everybody works in agriculture. Most of the activities later classified as "industrial" and "service" are initially carried out, if not within agriculture, at least in rural areas—the manufacture of clothing, furniture, and tools; construction of housing and other buildings; transport, processing, and marketing; education, medicine, social and cultural activities. As development progresses, these activities become differentiated and separated from agriculture, until only core agricultural production functions remain. While some nonagricultural activities are still carried out in rural areas, modern industry and services open up new and qualitatively different opportunities, many of which require relatively high skills and education. Although this process is one of the most desirable benefits of growth, it is also the most difficult to handle in human terms (see Chapter 7).

The transfer of labor from agriculture (where the amount of capital per worker and average productivity is relatively low) to industry and services (where capital per worker and average productivity are relatively high) is the key to raising incomes and output. The higher average productivity of labor in the nonagricultural economy is reflected in income differences between it and agriculture. In most countries, incomes are lower in agriculture than elsewhere, as shown by the fact that farming's output share is consistently lower than its employment share (Figure 5.2). This income difference provides the incentive for people to move out of agriculture into nonagricultural activities in urban centers. The agricultural shares of output and employment are roughly equalized only at a comparatively late stage of development.

The process of change can be very rapid in historical terms: in Japan and the less developed parts of Europe, the agricultural labor force represented 40 to 50 percent of total employment as recently as 1950. Developed countries no longer depend heavily on agriculture: it accounts for only 4 percent of output and 6 percent of employment in industrial market economies, and 15 and 17 percent, respectively, in planned economies. In low-income countries, by contrast, agriculture still accounts for 30 to 50 percent of output and an average of 70 percent of employment. Even in most middle-income countries, 10 to 20 percent of output and over 40 percent of employment are derived from agriculture.

The continuing importance of agriculture in the economies of the developing countries is reflected in the association between the growth of agriculture and of the economy as a whole. Among countries where the agricultural share of GDP was greater than 20 percent in 1970, agricultural growth in the 1970s exceeded 3 percent a year in 17 of the 23 countries whose GDP growth was above 5 percent a year (Table 5.2). During the same period, 11 of the 17 countries with GDP growth below 3 percent a year managed agricultural growth of only 1 percent or less. Agricultural and GDP growth differed by less than two percentage points in 11 of 15 countries experiencing moderate growth. There have been exceptions, of course, but they prove the rule: fast GDP growth and sluggish agriculture was a feature of some of the oil- or mineral-based economies such as Algeria, Ecuador, Morocco, and Nigeria (see Box 5.2).

The parallels between agricultural and GDP growth suggest that the factors which affect agricultural performance may be linked to economy-wide social and economic policies. In the many low-income countries where agriculture predominates, effective policies, institutions, and investment
programs for agriculture are virtually synonymous with effective overall management. This is not surprising since there are many important growth linkages between agriculture and the rest of the economy. Expanding agricultural production through technological change and trade creates important demands for the outputs of other sectors, notably fertilizer, transportation, commercial services, and construction. At the same time, agricultural households are often the basic market for a wide range of consumer goods that loom large in the early stages of industrial development—textiles and clothing, processed foods, kerosene and vegetable oils, aluminum holloware, radios, bicycles, and construction materials for home improvements. In most middle-income economies, agricultural policies are only slightly less influential. Despite the similar resources and history of the countries, agricultural productivity has increased twice as fast in Cameroon and Liberia in recent years as it has in neighboring Guinea and Ghana—and four times as fast in Tunisia and Colombia as in Morocco and Peru.

**Managing agricultural development**

The process of transformation is well advanced in many middle-income countries, where agriculture’s contribution to output and employment has already declined to modest levels and the agricultural labor force is starting to shrink in absolute terms. In these circumstances, mechanization and other labor-saving techniques (such as the use of herbicides) play a major role in sustaining agricultural growth. Education and training are needed to help people move into industrial and service jobs—especially people from backward areas. In some of the advanced middle-income economies, marketed farm produce is increasing sharply, often several times faster than the overall rate of increase in agriculture. Heavy investment in roads, railways, ports, and other links in the marketing chain are required, together with policies and institutional arrangements to ensure efficient transport, processing, and storage. Similar considerations apply to the timely availability,
variety, and cost of industrial inputs such as chemical fertilizer. Finally, farmers and traders rely more on efficient (and increasingly complex) financial arrangements to provide credit for investment and working capital (see Chapter 6). Among the middle-income economies, rural poverty becomes a less severe, and hence more manageable, problem. In better-off rural communities, nonfarm employment is increasingly important; for many, farming itself becomes a part-time occupation. Where problems do persist, many countries have targeted investment toward rural health, nutrition, and infrastructure.

While middle-income countries expanded their agricultural output by 3.1 percent a year in the 1970s, low-income countries managed only 2.1 percent. As a consequence, agricultural output per capita increased by 0.7 percent a year in middle-income countries, while because of the poor performance of the African economies it actually declined in low-income countries by 0.4 percent a year.

The challenges of agricultural development are clearly much harder to meet in countries at earlier stages of development, when the economy itself is largely agricultural. Agriculture merits support and stimulus—yet it has to provide them itself, being the only real source of income, savings, and growth. At the same time, countries have other competing priorities, including industrial and urban development. Against this background, two sets of policy issues assume particular importance. The first is domestic: what incentives should be given to farmers and how should they change over time? The second set is international: how can governments in the developed countries assist agricultural progress in the developing countries?

Relative prices and other incentives are often biased against the farmer in developing countries. Overvalued exchange rates, taxation of agricultural exports, heavy protection of fledgling industry, and inefficient parastatal processing and marketing agencies—all contribute to this bias. Some of the issues involved in trying to measure the effects of these factors are discussed in Box 5.4.

The relatively low prices received by farmers have seriously hampered growth in many developing countries. Where prices have not been kept artificially low, and where other conditions for growth have been favorable, farmers have responded by increasing output. The responsiveness of farmers to incentives—in contrast to the outmoded and mistaken view that peasants are

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**Box 5.2 Oil and agriculture: The Nigerian experience**

Oil exports—about 2 million barrels a day in 1980—have become Nigeria's major foreign exchange earner. But oil has been a decidedly mixed blessing for agriculture.

In the early 1960s, agriculture was thriving. Small farmers, who made up more than 70 percent of the Nigerian work force, expanded their production of food and cash crops. Agricultural exports were booming and small farmers produced about 90 percent of them. Nigeria was the world's leading exporter of groundnuts, groundnut oil, palm kernels, and palm oil, and the second largest cocoa exporter (after Ghana). Income generated in the farming sector supported the development of many local manufacturing and service industries and provided most of the foreign exchange needed to build roads and other infrastructure.

Progress in agriculture was cut short by the oil boom in the mid-1960s and was further disrupted by the three-year civil war, which began in 1967. As a result, farming has yet to recover. Agricultural growth has been close to zero over the twenty years from 1960 to 1980, despite economy-wide growth of 4.8 percent a year. In the 1970s, the volume of agricultural imports quadrupled while agricultural exports were halved. By the late 1970s, Nigeria was a net importer of agricultural produce.

Oil income has depressed agriculture in the following ways:

- A substantial revaluation of the naira and high local inflation made exporting increasingly unprofitable, while food imports became increasingly competitive with local production. Higher incomes led urban Nigerians to change their eating habits in favor of imported foods.
- An immense urban boom attracted large numbers of young Nigerians into the towns. Because of rapid overall labor force growth, the number of farm workers may not have fallen absolutely, but the rate of increase was very slow and the proportion of older workers increased sharply.
- The considerable effort made to sustain agriculture through public investment and new development schemes was greatly hampered by the dearth of trained and experienced manpower, which was largely drawn into other, more buoyant sectors.

Oil clearly offers a major opportunity to accelerate the process of structural transformation. But the Nigerian experience suggests lessons for other countries in whose economies oil has a major potential role. Oil revenues must be used to support an efficient transformation process. This means that close attention must be paid to manpower constraints, that public sector financial discipline must be tight, and that the impact of oil on the exchange rate must be carefully monitored. Public investment needs to focus on expanding the economy's absorptive capacity—concentrating on removing bottlenecks in transport, power, and other infrastructure sectors. Expenditures on education and training need to expand to meet the human resource requirements of a more advanced and diversified post-oil economy.
set in traditional ways—has been observed in societies with diverse social systems and levels of development (see Box 5.3).

Pricing alone is neither a complete explanation of agricultural performance nor the sole key to progress, however. Other areas of government policy are important:

- **Comparative advantage.** Many countries have traditionally encouraged specialization in agriculture to exploit the comparative advantage given to them by nature. In recent years, countries such as the Ivory Coast, Malaysia, and the Philippines have achieved rapid agricultural growth by encouraging export crops while also expanding food output.

The importance of trade for the agricultural growth of developing countries is evident from the share of agricultural output which is exported. Based on the FAO’s production data (see Table 5.1), in 1979, out of ninety developing countries, exports accounted for 50 percent or more of total agricultural output in ten countries; more than 20 percent in thirty; and more than 10 percent in fifty. Among countries exporting more than half their total output, Jordan, Malaysia, Mauritius, and the Central American and Caribbean countries figure prominently. Among those exporting between a half and one-third of total output, nearly half are in sub-Saharan Africa. For developing countries in these two categories, the export market is a major factor determining agricultural growth. Since these are often countries where agriculture is a dominant sector, agricultural exports are an important factor in their overall economic growth as well.

Exporting is a rewarding but also a risky business. Between 1961 and 1978, African cocoa producers lost market share to Latin Americans; South Asian dominance in tea was eroded by competition with African and Chinese exporters and fell from 80 percent of world exports to under 50 percent; Latin American coffee producers supplied only 51 percent of the market in 1978, compared with 62 percent in 1961; and the small, sugar-producing islands of the Caribbean have been unable to expand into new sugar markets and have lost ground to East Asian and Latin American producers.

Specialization involves heavy investment and a commitment to research. Brazil’s exports of soybeans are a notable recent example of exploiting the comparative advantage of a crop that was already being grown in the country (see Box 5.5). But greater difficulties are posed for very small

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**Box 5.3 Improving incentives in Chinese agriculture**

As part of a general shift toward greater flexibility, agricultural policies in China started changing in 1977. The system of rigid production planning in collectivized agriculture was relaxed, and household and other private agricultural activities were encouraged. The approach still sets local sales targets for the main crops, but allows production teams more latitude in their decisions on crops, land, and input use. Deregulation of local markets helps promote the private sale and exchange of produce.

Incentives to promote the production of priority commodities have been increased. Between 1977 and 1979 state purchasing prices for all the important commodities were raised by 20 to 30 percent. In addition, farmers are being encouraged to sell crops and livestock products to state agencies via entitlements to special allocations of grain or fertilizer (at relatively favorable prices) along with normal sales proceeds. Extra production is particularly favored; grain sales above quota attract a premium of 50 percent over base prices.

Within the production cooperatives, incentives have also been sharpened. The changes involve improvements to “work point” systems so that less is apportioned to workers as basic rations and more as a return for the quality and quantity of individual work. Various types of contractual arrangements are being encouraged under which small groups of workers manage collective land and other assets under contract to the production team, with bonuses for above norm performance.

Although it is too early to assess the long-term impact of these changes, they have already resulted in a dramatic upsurge in agricultural output:

- Between 1977 and 1980, the growth of output averaged close to 7 percent a year.
- Food-grain output increased by some 37 million tons, with growth averaging close to 5 percent a year, though in both 1977 and particularly 1980 bad weather was responsible for poor wheat crops.
- More remarkable was the upsurge among some of the other major field crops. Cotton output increased 23 percent in 1979–80, and oilseeds by 92 percent from 1977 to 1980; in both cases there was a sizable expansion of cultivated area as well as yield increases. Large increases are also reported for sugar, silk-worm cultivation, and jute. There is evidence that these increases reflect substantial shifts in cropping patterns based on area specialization and local comparative advantage.

- Meat production (almost entirely pork) increased over 50 percent during the past three years—a response both to improved producer prices and to policies that give livestock producers greater freedom to use grain for animal feed.

China’s planners did not anticipate so big a response. Nor did they adjust consumer sales prices for the leading items; therefore subsidies, already quite a large item in the budget, have shot up to around $5 billion a year.
Box 5.4 Nominal protection and foreign exchange valuation

Determining the incentives or disincentives farmers face in different countries is a rough science. The protection measures shown in the figure compare the domestic prices that farmers are paid with prices they could expect to face if the country in question were freely trading on the world market. Too much significance should not be attached to individual crop and country data since year-to-year changes can be large. But the data confirm the high level of protection in many developed countries, where many producer prices are 50 to 100 percent above world market levels, in contrast to the situation of most developing countries, where prices are often well below the world market.

Adjusted nominal agricultural protection coefficients, by country, late 1970s

Nominal protection coefficients (NPCs) take into account tariffs, quotas, and nontariff barriers that protect farmers as well as the impact of export taxes or restrictions that penalize farmers. Protection is also a function of the country's exchange rate as it is influenced by policy. Protecting domestic industries, for example, reduces industrial imports below

poor countries—for example, Burundi, Gambia, Guinea, and Uganda—that lack a research capability and are almost totally dependent (for 75 to 95 percent of their foreign exchange) on one or a few tropical export crops. Exceptional efforts will be required to achieve greater stability and diversity in the largely agricultural economies, including support from the international community to assist them in this difficult task.

- **Technological progress.** In the past, agricultural research relevant to developing countries' needs was confined largely to tropical export crops. Some, such as cane sugar, have been through several Green Revolutions over the past century. In general, though, research has become critical only in modern times; it has been applied to considerable effect in countries such as China, India, Indonesia, and the Philippines.
Much remains to be done for crops grown in semi-arid areas and for rain-fed annual crops generally (see Chapter 6). Although research is one of the cheaper investments that governments can make, it requires highly skilled people to direct it. Foreign assistance has played a major role in this area, especially through the establishment of international agricultural research centers and through the financing and initial staffing of national research efforts in poorer countries.

- Mobilization of rural resources. Motivating and organizing farm communities to help in collective works and infrastructure is widely recommended, though less often systematically practiced. China is the outstanding example of what can be done to improve roads, land, and irrigation through community efforts that use little public money. There and in some other countries, land reform has
provided an early stimulus for common action. This is not surprising, since collective action and individual benefit become more closely and more directly aligned as holdings of land and other assets become more nearly equal. Labor is the most plentiful and cheapest resource available in low-income countries, while capital is scarce and expensive. Using the rural work force for infrastructure improvement is an important means of converting labor into capital. Management is often the key constraint (see Chapter 7).

- Public sector investment and support. Agriculture attracts a surprisingly small share of government spending—between 5 and 10 percent of most developing countries’ central government budgets. Nevertheless, public sector outlays on critical bottlenecks have helped to stimulate and sustain growth by the development of large-scale irrigation, research, and rural infrastructure.

This approach has been particularly useful in areas where the potential for rapid growth already exists, and special programs often combine several elements into a development package. In some countries—Indonesia and the Republic of Korea, for example—fertilizer subsidies have been used to encourage growth. The effectiveness of such techniques should not disguise the fact that they can become very costly; removing them once they have achieved their objective can be difficult.

In some cases, however, the intervention of the public sector has been counterproductive. Instances of ineffective parasatal organizations involved in the marketing of agricultural products and the supply of inputs abound. Some governments have taken bold steps to improve the efficiency of distribution systems by opening up the sector to cooperatives and private traders (see Box 5.6).

- Foreign capital. Much early agricultural development in, for example, Argentina, Brazil, Malaysia, and East and West Africa was largely based on private investment, often involving foreign management and control. Private foreign investment and loans are still important in some middle-income economies. In the low-income economies, little external private investment or lending has recently gone into agriculture. Instead, foreign aid has become the main external source of foreign exchange and technical support, particularly after 1973 (see Table 5.3).

In the mid-1960s, while nearly a quarter of all official development assistance (ODA) was food aid ($1.4 billion out of $5.9 billion), project and technical assistance for agricultural programs was small. The food crisis of the early 1970s, coupled with a growing realization that poverty and malnutrition were persistent prob-

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**Box 5.5 Brazilian soybeans: Creating a comparative advantage**

Brazil's expansion of soybean production is a dramatic agricultural success story. Before 1960 production was insignificant, but by the end of the 1970s soybeans surpassed coffee as the principal Brazilian crop in value, covered some 17 percent of the cropped area, and constituted 14 percent of world soybean output. Over this period, Brazilian soybean production grew at 27 percent a year: in the 1960s entirely through expansion of the area planted, and in the 1970s boosted by yield improvements of more than 2 percent a year. Brazilian exports of soy and soy products (oil, meal, and cake) rose from $53 million in 1969 to $2.3 billion in 1980, a remarkable 42 percent a year rate of growth. Soybeans make up more than 10 percent of Brazil's annual exports. As soy oil was substituted for imported vegetable oils, domestic consumption grew almost 25 percent a year over the 1970s, and there was also growing demand for soy meal, mainly for chicken feed.

A number of factors helped to stimulate this impressive growth:

- Rapid expansion of world demand for protein for human and animal consumption; stagnation in the output of alternative protein sources (such as the Peruvian anchovy); the fact that Brazil's soybean crop comes to market during the US winter, when world supplies are seasonably low; and the US embargo on its soya exports in 1973 (which stimulated Japanese importers to find alternative sources).

- Farmers typically double-crop soybeans in the summer and wheat in the winter. New wheat varieties that mature earlier enabled soybean-wheat doublecropping to expand to other areas. Cultural practices for the two crops are similar, and soybeans benefited from support aimed at promoting wheat production (for example, the fivefold expansion of subsidized agricultural credit in the 1970s, about 20 percent of which was for soybeans).

- Research was a critical factor. More than sixty soybean cultivars brought to Brazil from the United States during the 1960s contributed to the development of domestic cultivars by the National Center for Soybean Research. Of the forty-eight cultivars distributed to farmers at the end of the 1970s, twenty-six had been developed in Brazil. It has been estimated by the Brazilian Agricultural Research Enterprise (EMBRAPA) that two-thirds of yield increases have come from genetic improvements. The other third has come from improving soil management practices—proper application of fertilizers, correctives, nitrogen-fixing bacteria, and herbicides—also derived from intensive and continuous research. That national yields grow apace with increases achieved at the research centers attests to the successful diffusion of the research results and their adoption by farmers.

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Box 5.6 Private complements public: The Bangladesh experiment

In the mid-1970s, Bangladesh planners estimated that fertilizer use had to expand by 15 percent a year to attain the targeted 4 percent yearly agricultural growth rate. At that time, the Bangladesh Agricultural Development Corporation (BADC), a public corporation under the Ministry of Agriculture, handled all marketing of farm supplies as well as all procurement of fertilizer. It had done well, but the strains had begun to tell.

In 1978 BADC established the New Marketing System (NMS) to reduce restrictions on private traders and thus move toward a more open system for distributing fertilizer. BADC would gradually withdraw from retailing and, except in remote areas, sell mainly to wholesalers at "primary distribution points." Private dealers and cooperatives would be permitted to buy from all BADC warehouses. Private movement of fertilizer would be unrestricted except in the border zones.

With bilateral assistance from the United States, BADC began the NMS in the Chittagong Division, which covers one-fourth of the area of the country and accounts for a third of total fertilizer consumption. It increased official dealers' margins, permitted farmers to buy from any trader, and made it easier to become a trader. It developed a private dealer credit system from commercial banks. BADC set up a monitoring system for the NMS and took steps to cut down its internal transport and storage problems.

The NMS enjoyed reasonable success. Fertilizer sales increased, and forty-five government warehouses were put out of business, leaving the government active mainly in remote areas which did not attract wholesalers. Retail prices dropped below official prices around the primary distribution points. The new fertilizer wholesalers showed they could move fertilizer cheaply and effectively from surplus to deficit areas, selling to both farmers and retailers.

On the basis of this pilot experience, the NMS was adopted nationwide. As of mid-1980, major accomplishments of the NMS included:

- BADC's fertilizer points of sale were reduced by 55 to 60 percent, about one-third of the original 130 warehouses were closed.
- Farmer access to fertilizer points of sale greatly increased in the Chittagong Division.
- Farmers paid less for fertilizer under the NMS.
- A new class of entrepreneurs had emerged.

The net results of the program have been almost entirely positive. The private distribution system is more flexible and can supply farmers at lower costs, and much of BADC's managerial and labor force can be released for other tasks. The costs of constructing and maintaining the marketing and storage infrastructure have been substantially reduced. The government is now collaborating more actively with the private sector in other areas.

Table 5.3 Official assistance (commitments) to agriculture, 1973–80

<table>
<thead>
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<td>DAC*</td>
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<td>640</td>
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<td>Total ODA</td>
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<td>4,529</td>
<td>4,438</td>
<td>5,879</td>
<td>6,701</td>
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<td>-6</td>
<td>-2</td>
<td>+32</td>
<td>+14</td>
<td>+5</td>
<td>-2</td>
<td></td>
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<tr>
<td>Other official flows (OOF)</td>
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<td></td>
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<td>403</td>
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<td>Multilateral agencies</td>
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<td>2,621</td>
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<tr>
<td>OPEC (bilat and multilateral)</td>
<td>63</td>
<td>90</td>
<td>333</td>
<td>221</td>
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<td>49</td>
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<td>Total OOF</td>
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<td>+10</td>
<td>+22</td>
<td>-26</td>
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<td>Grand total (all donors)</td>
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<td>7,943</td>
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<td>8,934</td>
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<tr>
<td>Percentage change</td>
<td>+62</td>
<td>+16</td>
<td>-9</td>
<td>+24</td>
<td>+17</td>
<td>-6</td>
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</table>

Source: OECD.

a. Includes EEC.

Problems in large parts of the world, produced a major shift toward agriculture. Flows of ODA and other official assistance for agriculture more than doubled in real terms between 1973 and 1980. The share of agriculture and rural development in the lending of the multilateral institutions rose to nearly 30 percent.

The share of aid in agricultural investment varies widely from country to country. In China, by far the largest country, virtually no external assistance was received during the past twenty-five years. Similarly, in India, though large amounts of aid have been received, it represents only 3 to 5 percent of total spending on agriculture. Its use is concentrated on selected areas such as irrigation, and its effectiveness is largely determined by overall agricul-
tural investment. Elsewhere, especially in the poorer African countries, aid accounts for 20 percent of public investment in agriculture. There too, the effectiveness of aid still depends on the government's interest in, and commitment to, agriculture.

The need for policy and investment changes is not uniform among developing countries. Many have been quite successful in managing their agriculture and adapting to structural changes. They need little advice, although they may need continued financial support to sustain well-designed policies and programs. Others need to make major changes. They are not alone. The developed countries have found it extremely difficult to manage the last stages of structural change in agriculture; their capacity to deal more effectively with these challenges will be an important factor in developing countries' success or failure.

The international environment

The international environment can support or restrict agricultural development in developing countries in two main ways. First, through the mechanisms described in Part I of this Report, the international economy powerfully conditions the overall growth prospects of developing countries. In turn, more buoyant overall growth simultaneously provides both strong support for agricultural growth and the resources to permit an expansion of productive capacity.

Second, trading opportunities for agricultural products permit agricultural growth beyond the limits set by the expansion of domestic demand alone. Agricultural exports remain a major source of foreign exchange for many developing countries, and therefore an important determinant of overall economic growth. Patterns of agricultural trade have varied markedly over the past three decades, reflecting in part the growth of the world economy and in part the differential agricultural growth performance described earlier in this chapter.

During the period of fastest growth in the world economy—roughly, from 1955 to 1973—the expansion of international trade was dominated by manufactured goods, fuel, and minerals. World trade grew at 8 percent a year, trade in agricultural goods by less than half that. By 1973, developing countries' agricultural exports had fallen from 60 percent of the value of their total exports in 1955 to only 30 percent. Nevertheless, agricultural goods remained the single most important category of exports for more than two-thirds of the low- and middle-income economies.

The early 1970s proved a turning point in the agricultural trade of developing countries. Since 1973, the growth of world trade has declined to 4.7 percent a year, in line with the slowdown of the world economy. But the growth of agricultural trade has accelerated to 4.8 percent a year, largely because the demand for food has increased rapidly (see Figure 5.3). The extra purchasing power of the oil-exporting countries boosted their share of world food imports from less than 6 percent in 1973 to 10 percent in 1978. Over the same period, strong demand for meat and poultry in eastern Europe, coupled with a poor supply response from domestic agriculture, boosted the region's maize and wheat imports from 3 to 14 percent of its total food imports. Eastern Europe now accounts for about one-third of world imports of maize and wheat. China has also become a major grain importer. In total, the world grain trade has expanded from about 30 million tons in the mid-1950s to average 130 million tons a year in the 1976-80 period—nearly one-half because of rising imports by developing countries (including China) and one third because of import growth by the USSR and eastern Europe.

The extra demand has been met mainly by developed countries. The biggest relative increases in exports have come from the EEC, which produced trade surpluses in a number of commodities as a result of continued agricultural growth and stagnant demand in the home market. By contrast, the large rise in North American grain exports only slightly increased their importance in world food trade. Overall, the net food deficit
of the industrial market economies narrowed from 16 percent of world food trade in 1965 to less than 5 percent in 1978.

The oil-importing developing countries gave greater emphasis to agricultural exports during the 1970s. By 1978, their trade surplus on food amounted to $21 billion, sharply up from $6 billion in 1973. Performance has varied widely by region and country. Some countries have been able to penetrate expanding markets; examples include Brazil's successful soybean exports and Thailand's new trade in cassava chips for livestock feed. A number of low-income countries sharply increased their food exports to Middle Eastern markets after 1973 (see Figure 5.4). These markets now account for more than 20 percent of low-income countries' food exports, compared with 4 percent in 1973.

These were the successes. In other cases, however, especially where exports were based on traditional tropical crops, inelastic demand limited increases in foreign exchange earnings. Although volume expanded in the 1970s, the terms of trade deteriorated considerably. Had agricultural prices been moving in line with prices of manufactured goods, this higher volume of exports would have given low-income oil importers an additional $1.2 billion of foreign exchange in 1978 and middle-income ones an extra $5.7 billion—enough to finance 15 percent and 27 percent of their respective current account deficits (see Table 5.4).

Slow ing demand in protected developed-country markets has altered the shape of developing countries' agricultural trade. When trade was limited to a few commodities consumed almost exclusively in the developed world, export volume and prices were determined by fluctuations in industrial countries' growth and by production changes in the developing countries. Today, developed countries remain the major markets for food exports, taking about 70 percent of middle-income countries' exports and 50 percent of low-income countries' exports. But developing countries' food exports to these markets grew much more slowly between 1965 and 1978 (1.1 percent a year) than their exports to oil-exporting developing countries (6.3 percent a year), to high-income oil exporters (8.9 percent a year), and to centrally planned economies (4.9 percent a year). These three groups now represent the most dynamic and open markets for the agricultural exports of developing countries, weakening the historical link between commodity trade and the growth of industrial countries.

The trade and agricultural policies of developed countries influence the options open to the developing countries in important ways. In contrast to the situation in most developing countries, agriculture in the developed world is heavily protected and supported. The aim has been to support farm incomes in the face of rapid growth of earnings elsewhere in the economy. In some instances, governments have also sought to retain a farm economy capable of supplying most of their countries' food. Countries in the
EEC have protection levels between 30 and 80 percent above the commodity prices in world trade (see Box 5.4). The United States has less explicit protection, but its budgetary expenditures as a percentage of agricultural value added (38 percent) are similar to those of the EEC (39 percent). Japan has the most heavily protected farmers, largely because of import restrictions (the domestic price of rice, for example, is twice its import price, and wheat and barley are protected even more). Developed countries also subsidize their agriculture through programs of research, technical assistance, credit, and income-maintenance schemes. By 1980, public spending on agriculture by the EEC countries, Japan, and the United States was about $80 billion; the EEC accounts for close to half the total.

These protectionist policies have had mixed consequences for the developing countries. An important positive feature is that these policies have stimulated research and technical development in agriculture, which benefit developing countries through the international transfer of technology. More controversial are the lower international prices for some commodities associated with developed-country disposal of agricultural surplus, notably grains and milk products. While clearly benefiting importing developing countries in the short run, in the longer term the lower prices may depress farm incentives for local food production and stimulate permanent changes in preferences for foods which cannot be locally produced. The benefits tend to accrue largely to a relatively affluent urban minority of consumers, while adverse effects are felt by the poor rural majority.

For developing-country exporters, the impact of agricultural protection is clearly negative in several respects (see Box 5.7). Developing-country exporters have been hard hit by this legislated inability to expand into traditional industrial-country markets. For example, the share of developing-country sugar exports going to the developed world has fallen from 88 percent in 1970 to 64 percent in 1978. Although they have been able to expand their share in other developing-country sugar import markets, this has not been sufficient to maintain the value of sugar exports in real dollar terms, relative to 1970. Moreover, strong competition from the industrial countries' surplus has captured increasingly large shares of the growing market in those developing countries that import sugar; 46 percent in 1978 compared with 24 percent in 1970.

By comparison with trade in manufactures, little progress was made in reducing agricultural protection in the most recent (1975–78) Tokyo Round of multilateral trade negotiations. That lack of progress is compounded by the fact that nontariff measures are often used to exclude developing countries' agricultural exports.

Governments in industrial countries are sensitive to the protectionist demands of their own farmers, and this factor exacerbates the uncertainties and risks of agricultural trade. For example, the EEC is considering ways to reduce the budgetary costs of the common agricultural policy—not by reducing protection, but by extending tariff barriers to imported vegetable oils. Such measures, particularly if they lead to higher domestic production, as they have done with sugar, are bound to harm efficient producers in the developing world and to force consumers in developed countries to pay even higher prices for food.

Protection also creates substantial volatility in world prices. By insulating domestic producers and consumers from external market realities, governments are placing the burden of balancing global

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**Box 5.7 Measuring the impact of agricultural protection**

The International Food Policy Research Institute (IFPRI) has completed the most recent study of the impact of protection on agricultural trade. Based on data of the mid-1970s, their study concluded that a 50 percent reduction in OECD developed-country trade barriers (affecting some 99 agricultural commodities) would increase agricultural exports from some fifty-six developing countries by about 11 percent, equivalent to $3 billion of extra sales at 1977 prices. Long-term benefits might considerably exceed these estimates, if a more liberal trade environment (that exporters had confidence would be sustained) encouraged new investment and expanded specialized production over a longer period.

The distribution of benefits from trade liberalization reflects the uneven pattern of protection, the patterns of comparative advantage of the various developing-country producers, and their export policies. Roughly a third of extra export revenues would accrue to sugar producers; beverages, tobacco, and meat products account for another third. Close to 60 percent of the additional revenues would accrue to Latin American producers, over 20 percent to countries in Asia, and 10 percent each to sub-Saharan Africa and the North Africa and Middle East region. Benefits would also be considerable for smaller exporting countries not included in the sample of fifty-six (which were selected on the basis of a population of 4 million or more in mid-1975), for example, Cuba, Jamaica, and Mauritius (as sugar producers), Cyprus (wine), Zimbabwe (tobacco), and Costa Rica (meat, coffee).
supply and demand on a relatively small part of the market. Since it is disproportionately the developing countries who participate in the open world market, they have to bear the bulk of this burden. Fluctuating commodity prices make planning more difficult and wrong investment decisions more likely. One legacy of record sugar prices in 1974 was a proliferation of costly import-substituting schemes for growing sugar. They continue to act as a drain on budgets and, as heavy debt-service payments fall due, on foreign exchange.

A considerable degree of instability of agricultural commodity prices is, however, inherent in their underlying demand and supply relationships. Neither demand nor supply are very sensitive to short-run price changes; on the other hand, the demand for agricultural raw materials in particular varies significantly with fluctuations in industrial country growth, and the supply of these products is often quite variable too. It can be affected by weather conditions, disease, and pests in major producing areas, and by the long gestation period which separates plantings of new tree crops from the period of maximum yield. Commodity prices therefore often rise and fall dramatically and impart a high degree of instability to the economies of countries heavily dependent on these commodities for their export earnings.

In addition to various protection measures taken by the consuming countries to insulate themselves from price fluctuations, efforts to deal with unstable commodity prices have taken the form of long-term bilateral trade agreements and multilateral commodity agreements. The latter have met with limited success for a variety of reasons—

Box 5.8 The "food crisis" and its food security aftermath

Between 1972 and 1974 the world price of wheat and rice roughly trebled from $60 to $200 a ton and from $130 to $500 a ton, respectively; fertilizer prices shot up still faster from $50–75 to $300 a ton. These unprecedented increases in the prices of the world’s most basic foods and of a critical input needed to increase food production were dramatic manifestations of the “world food crisis.” They were seen—along with anxieties about land availability and reports of hunger and famine—as harbingers of an impending collapse of the world food system, and of a future beset by dramatically higher and more unstable food prices.

By 1976, however, the prices of wheat, rice, maize, and fertilizer had fallen as dramatically as they had risen. Wheat prices in particular were below their pre-1972 level. It was clear that a fundamental shortage of food was not in the offing. Prices of cereals and most agricultural commodities are now not expected to be much above present levels until well into the 1990s.

In retrospect, the factors causing the food crisis were avoidable. Over the period from 1955 to 1972, large publicly held grain stocks in the developed countries and heavy food aid shipments had created an environment in which some developing countries had little incentive to produce food and fertilizer. At the same time, developed-country domestic policies led to the atrophy of efficient grain-marketing mechanisms. The sharp rise in grain stocks in 1968 led to an abrupt reduction of wheat production by the grain-exporting countries between 1969 and 1971. In 1972, world grain production declined; simultaneously, large grain purchases were made by the USSR.

Domestic markets in a number of importers, notably those in western Europe and the planned economies, were insulated by governments from the effect of world prices. Consequently, the burden of adjustment fell most heavily on those who were not protected, including many developing economies and the grain-exporting countries (where high grain prices dramatically reduced the feeding of grain to livestock). Grain stocks were not sufficient to contain prices, which rose rapidly. Fearing a shortage, many countries bought more grain than they needed, driving prices still higher.

The food crisis taught some painful but important lessons. A repeat of the 1972–74 situation seems unlikely owing to the following responses to it:

- Much greater emphasis has been given to increasing food production, the essential long-term source of food security.
- More widely held and carefully monitored stocks have been established.
- Grain markets are now functioning more effectively than in the past. The feeding of grain to livestock and decisions to buy, to sell, to store, and to trade grain are more responsive to price changes.
- Countries have imposed limits on the amounts of grain they will export before reviewing the grain market.
- Countries are giving more thought to the broader impact on food security of production and acreage adjustments previously considered to be of purely domestic concern.
- Governments have also reached a number of international agreements that improve world food security:
  - An International Emergency Food Reserve of 500,000 tons was established in 1976, and contributions of 588,000 tons were made to it in 1981.
  - A new Food Aid Convention was negotiated in 1980 which raised the minimum annual contribution of food aid from 4.2 to 7.6 million tons.
  - The IMF Food Facility was established in 1981 as an extension of the IMF Commodity Fund Facility to provide financial assistance to offset fluctuations in countries’ food import bills either because of shortfalls in domestic production or higher world food prices.

Whether these changes, together with increases in world stocks, provide “adequate world food security” is still being argued; further mechanisms to promote stability and security may emerge. But the food crisis had the additional effect of increasing awareness among planners and policymakers that a properly functioning international world food market also contributes substantially to improved world food security.
incomplete participation by all producing and consuming countries, lack of agreement on target prices, limited financial support for buffer stocks, or lack of commitment by participants to the actions required in the face of price changes. These problems are further complicated by the tendency of most commodity prices to rise and fall together. Efforts to diversify production within tropical products as a means of achieving greater stability have therefore not been very successful. And only limited overall stability can be gained from a single commodity agreement. While more effective commodity agreements may be achieved, including a common fund to support such agreements, the long-term solutions are diversification into other exports, such as manufactures, and into agricultural products (including foods) for a more stable domestic market. In the short term, domestic economic management policies to reduce the internal impact of fluctuating external prices can contribute to longer-term diversification.

Volatile prices make governments more receptive to the idea of agricultural self-sufficiency and more prone to intervene in production and trade. The issue of food security provides another important example. To the extent that the 1972–74 world food crisis made governments more aware of the instability caused by insulated agricultural markets, its wider impact may have been favorable (see Box 5.8). Generally, though, governments tend to react to instability by further protecting their own markets or by creating or revamping international regulatory mechanisms. These do indeed mitigate some of the adverse effects of price cycles, but at substantial real costs, both economic and political. They do not tackle the roots of the problem, which lie in the distorted structure of trade.

To sum up, the challenge for policymakers in developing and developed countries alike is to break out of the web of restrictive measures that impede agriculture in some countries and overstimulate it in others; to create a trading system in which comparative advantage plays a more important role in production and trade decisions; and to encourage market mechanisms that reduce the risks of participating in the system. The restructuring of incentive policies at home and the creation of such a trading system would promote the effective long-run deployment of the world’s agricultural resources and help meet the developing economies’ pressing short-term needs for improved access to overseas markets for their agricultural exports.