ECONOMICS OF AGRICULTURAL DEVELOPMENT

WORLD FOOD SYSTEMS AND RESOURCE USE

2ND EDITION

GEORGE W. NORTON, JEFFREY ALWANG
AND WILLIAM A. MASTERS

Economics of Agricultural Development

Economics of Agricultural Development examines the causes, severity, and effects of persistent poverty, rapid population growth, and malnutrition in developing countries. It discusses potential solutions to these problems, and considers the implications of globalization for agriculture, poverty, and the environment.

Areas covered in the book include:

- The sustainability of the natural resource environment
- Gender roles in relation to agriculture and resource use
- The contribution of agricultural technologies
- The importance of agricultural and macroeconomic policies as related to development and trade, and the successes and failures of such policies
- The implications for what might be done in the future to encourage more rapid agricultural and economic development

The globalization of goods, services, and capital for agriculture is fundamental to the future of developing countries and has major implications for the fight against poverty and sustainability of the environment. In recent years, agriculture has once again returned to a position of centre stage as food price volatility has led countries to re-examine their development strategies.

This new edition of the essential textbook in the field builds on the 2006 original and reflects the following developments:

- The increased impact of climate change
- Issues affecting agricultural markets such as bio-fuels, the rise in farm prices, and energy costs
- The move to higher valued agricultural products

This book will be essential reading for undergraduate students seeking to understand the economics of agricultural development and the world food system, including environmental and human consequences of agricultural development, international trade and capital flows.

This book contains a wealth of real world case studies and is now accompanied by a website that includes powerpoint lectures, a photo bank, and a large set of discussion and exam questions.

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Contents

Preface

Persistent poverty, rapid population growth, and malnutrition in developing countries are among the most serious issues facing the world today. *Economics of Agricultural Development* examines the causes, severity, and effects of these problems. It identifies potential solutions, and considers the implications of globalization for agriculture, poverty, and the environment. It identifies linkages in the world food system, and stresses how agricultural and economic situations in poor countries affect industrialized nations and vice versa. It focuses on the role that agriculture can play in improving economic and nutritional well-being and how that role might be enhanced. It explores causes and implications of agricultural commodity price volatility.

Much has been learned about the roles of technology, education, international trade and capital flows, agricultural and macroeconomic policies, and rural infrastructure in stimulating agricultural and economic development. In some cases, the same factors can contribute to economic growth and lead to price and income instability or environmental risk. These lessons and other issues are examined in the book using basic tools of economic analysis. The need is stressed for improved information flows to help guide institutional change in light of social, cultural, and political disruptions that occur in the development process.

The challenge in studying the economics of agricultural development is to build a broad view of the problem, and to bring economic theory to bear on specific challenges faced by the rural sector and on means for utilizing agricultural surpluses to further overall economic development. The goal of this book is to help students and other interested practitioners gain an understanding of the agricultural development problem, including the environmental and human consequences of different development paths, and the influence of international trade and capital flows. It is designed to help students develop skills that will enhance their capability to analyze world food and development problems.

This book interprets for undergraduates the economics of development and trade, including the importance of extending economic theory to account for institutions, imperfect information, and the willingness of people to exploit others and to act collectively. This extension provides important insights for development policy and helps explain why some countries develop while others are left behind. The role of the government in promoting broad-based development is explored. The book also covers topics related to sustainability of the environment, gender roles in relation to agriculture and resource use, and the importance of macroeconomic policies as related to development and trade.

This new edition of the book addresses the causes and implications of recent sharp commodity price increases. It contains added discussion of economic issues related to biofuels and climate change and how they affect agriculture in developing countries.

INTENDED AUDIENCE

Economics of Agricultural Development is designed as a comprehensive text for the first course on the economics of world food issues and agricultural development. The book is aimed at undergraduate students, with the only prerequisite a course in introductory economics. Students in undergraduate courses that address world food and agricultural development represent a wide variety of majors. Economic jargon is kept to a minimum and explained where necessary, and the book sequentially builds a base of economic concepts that are used in later chapters to analyze specific development problems. A second audience for the book is those who work for public and private international development organizations.

ORGANIZATION of the BOOK

Agricultural development is important for rural welfare and for overall economic development. Part One of the book considers the many dimensions of the world food – income – population problem in both a human and an economic context. After the severity and dimensions of the problem have been established, Part Two examines the economic transformation experienced by countries as they develop, sources of economic growth, and theories of economic development, including the role of agriculture in those theories. Part Three provides students with an overview of traditional agriculture, agricultural systems and their determinants in developing countries, with particular attention to issues such as environmental sustainability and gender roles. Part Four then identifies agricultural development theories and the technical and

institutional elements required for improving the agricultural sector. It stresses the need to build on and modify current agricultural development theories. Finally, Part Five considers the importance of the international environment, including trade and trade policies, macroeconomic policies, capital flows, and foreign assistance, including food aid. The concluding chapter integrates various development components addressed in the book and discusses future prospects for agricultural development.

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Dimensions of World Food and Development Problems

Rural family in Colombia.

Introduction

> Most hunger is caused by a failure to gain access to the locally available food or to the means to produce food directly.
> — C. Peter Timmer, Walter P. Falcon, and Scott R. Pearson[1]

This Chapter

1 Examines the basic dimensions of the world food situation
2 Discusses the meaning of economic development
3 Considers changes that occur during agricultural and economic development

OVERVIEW of the WORLD FOOD PROBLEM

One of the most urgent needs in the world today is to reduce the pervasive problems of hunger and poverty in developing countries. Despite many efforts and some successes, millions of people remain ill-fed, poorly housed, under-employed, and afflicted by a variety of illnesses. These people regularly suffer the pain of watching loved ones die prematurely, often from preventable causes. In many countries, the natural resource base is also being degraded, with potentially serious implications for the livelihoods of future generations.

Why do these problems persist, how severe are they, and what are their causes? What does the globalization of goods, services, and capital mean for agriculture, poverty, and environment around the world? And, how does the situation in poor countries feed back on industrialized nations, and vice versa? An understanding of the fundamental causes of the many problems in poorer countries is essential if solutions are to be recognized and implemented. What role does agriculture play and how might it be enhanced? What can rich countries do to help? How do the policies in developed countries affect developing

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[1] C. Peter Timmer, Walter P. Falcon, and Scott R. Pearson, *Food Policy Analysis* (Baltimore: Johns Hopkins University Press, 1983), p. 7.

countries? These are some of the questions addressed in this book. Globalization will continue, and a key issue is how to manage it to the betterment of developing and developed countries alike.

Much has been learned over the past several years about the roles of technology, education, international trade and capital flows, agricultural and macroeconomic policies, and rural infrastructure in stimulating agricultural and economic development. In some cases, these same factors can be a two-edged sword: they contribute to economic growth on the one hand, but lead to price and income instability or environmental risk on the other. These lessons and other potential solutions to development problems are examined herein from an economic perspective. The need is stressed for improved information flows to help guide institutional change in light of social, cultural, and political disruptions that occur in the development process.

World Food and Income Situation

Are people hungry because the world does not produce enough food? No. In the aggregate, the world produces a surplus of food. If the world's food supply were evenly divided among the world's population, each person would receive substantially more than the minimum amount of nutrients required for survival. The world is not on the brink of starvation. Population has roughly doubled over the past 40 years, and food production has grown even faster.

If total food supplies are plentiful, why do people die every day from hunger-related causes? At its most basic level, hunger is a poverty problem. Only the poor go hungry. They go hungry because they cannot afford food or cannot produce enough of it themselves. The very poorest groups tend to include: families of the unemployed or underemployed landless laborers; the elderly, handicapped, and orphans; and persons experiencing temporary misfortune due to weather, agricultural pests, or political upheaval. Thus, hunger is for some people a chronic problem and for others a periodic or temporary problem. Many of the poorest live in rural areas.

Hunger is an individual problem related to the distribution of food and income within countries and a national and international problem related to the geographic distribution of food, income, and population. Roughly one-fifth of the world's population (about one billion people) lives on less than $1 per day (about one-half lives on less than $2 per day). These people are found primarily in Asia and Africa. The largest number of poor and hungry live in Asia, although severe hunger and poverty are found in Sub-Saharan Africa and in parts of Latin America. Good strides have been made in reducing global poverty; over the

Many farm workers in Asia earn between one and two dollars per workday.

past 30 years, the proportion of the world's population living on less than $1 per day has been cut by more than half and is now less than 20 percent. However, more remains to be done to alleviate poverty-related problems.

While hunger and poverty are found in every region of the world, Sub-Saharan Africa is the only major region where per-capita food production has failed to at least trend upward for the past 30 years. As Figure 1-1 shows, per capita food production in Africa has stagnated since 1980 and had experienced a downward trend for several years before that time. Latin America and particularly Asia have experienced relatively steady increases. The result has been significant progress in reducing hunger and poverty in the latter two regions, while per-capita calorie availability remains below minimum nutritional standards in many Sub-Saharan countries. Low agricultural productivity (farm output divided by farm inputs), wide variations in yields due to natural, economic, and political causes, and rapid population growth have combined to create a precarious food situation in these countries.

Annual variation in food production is a serious problem, particularly in Sub-Saharan Africa (see Figure 1-1). This variation has caused periodic famines in individual countries, particularly when production problems have been compounded by political upheaval or wars that
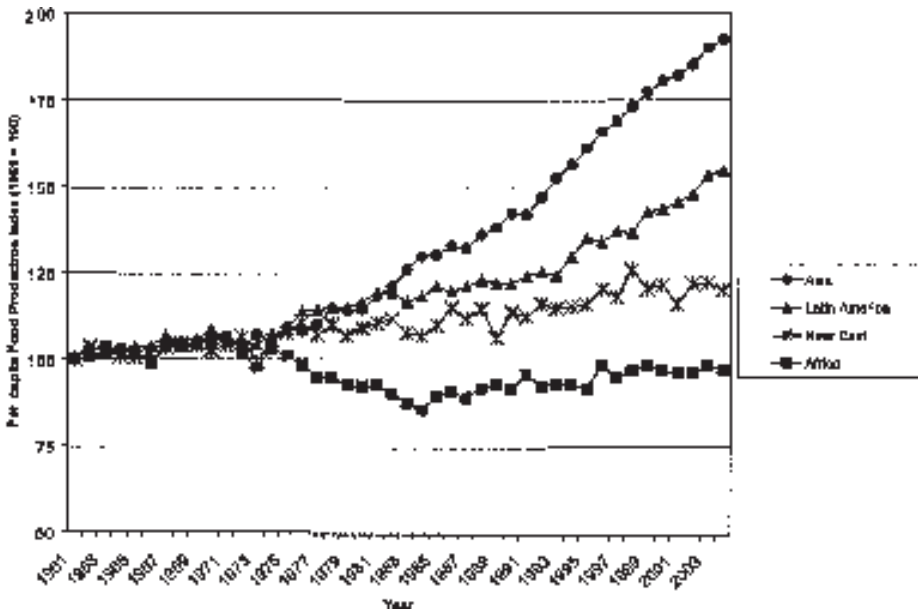
Figure 1-1. Index of per capita food production.
(*Source*: FAOSTAT data, 2005.)

have hindered international relief efforts. Production variability causes wide price swings that reduce food security for millions who are on the margin of being able to purchase food. If the world is to eliminate hunger, it must distinguish among solutions needed for short-term famine relief, those needed to reduce commodity price instability (or its effects), and those needed to reduce long-term or chronic poverty problems.

Food Prices

For many years, for most people in the world, the real price of food fell relative to the prices of other things. The international prices (in nominal or "current" dollars) of maize, rice, and wheat — the world's major food grains — are shown in Figure 1-2. Despite peaks in 1974, 1981, 1996, and 2008, the average prices of all three grains have fluctuated without strong trends for several years. The prices of most other things have risen much more steadily with inflation, so for most people the *relative* (or "constant") price of food has slightly fallen, with exceptions during the peak years. This reduction in the real price of food is both good and bad, because prices affect economic growth and social welfare in a contradictory fashion. Lower food prices benefit consumers and stimulate industrial growth but can lower agricultural producer

incomes and reduce employment of landless workers. To the extent that lower prices reflect lower production costs, impacts on producers may be mitigated. Future food-price trends will depend on the relative importance of *demand* shifts, resulting primarily from changes in population, income, and non-food uses for farm products (such as bio-fuels) compared to *supply* shifts, resulting from a variety of forces, particularly new technologies and climate changes.

Instability in local and world food prices, however, is a serious problem affecting food security and hunger in developing countries. The three grains shown in Figure 1-2 have exhibited sizable year-to-year price variations. This instability was most severe during the 1970s and most recently. Food price fluctuations directly affect the well being of the poor, who spend a high proportion of their income on food. Governments are finding that food price instability increases human suffering and also threatens political stability.

As shown in Figure 1-2, grain prices were higher than normal in 2007–2008. The higher prices were due to a combination of factors that shifted supply and demand, as well as actions by market speculators. Supply factors included such items as adverse weather conditions
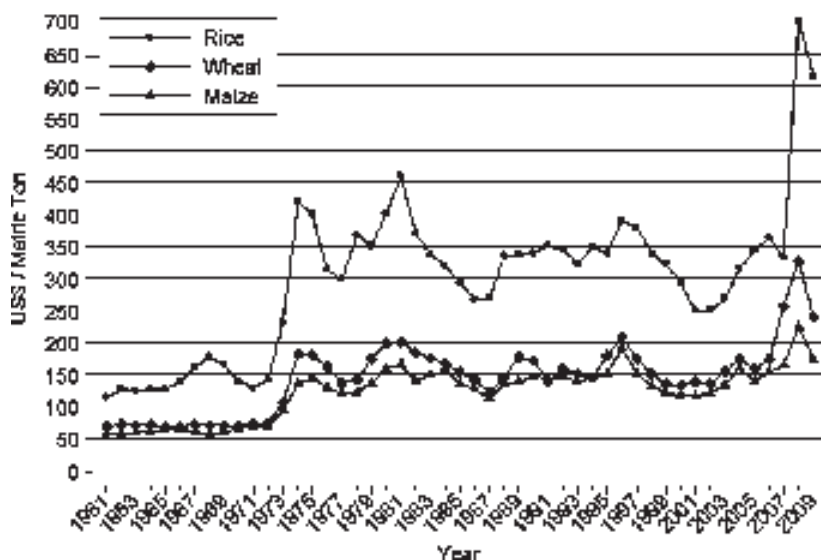
Figure 1-2. World prices of major grains in current dollars. (*Source*: FAOSTAT 2009, for years through 2006 and IMF International Financial Statistics 2009, for years 2007–09.)

and higher fuel and fertilizer costs, while demand factors included items such as increased demand for grains for bio-fuel use, continued population and income growth in many developing countries, changes in currency values, and policy changes in countries that increased their demand for imported food. Also, speculative investments in commodity markets increased, driving up commodity prices more than basic supply and demand factors alone would have dictated. As the global economy turned down in 2008, speculators eventually reduced these investments, fuel prices dropped, and income growth slowed. Grain supplies also increased, and food prices retreated substantially from their highs of early 2008.

Malnutrition

Hunger is most visible to people in developed countries when a drought or other disaster results in images in the news of children with bloated bellies and bony limbs enduring the pain of extreme hunger. Disturbing as such images are, in a sense they mislead. The less conspicuous but more pernicious problem, in terms of people suffering and dying, is chronic malnutrition. While accurate figures of the number of malnourished in the world are not available, and even good estimates depend on the definition used, a conservative estimate is that roughly 860 million people suffer from chronic or severe malnutrition associated with food deprivation. More than ten million people, many of them young children, die each year from causes related to inadequate food consumption. Increasing per-capita food production has allowed more of the world's population to eat better. But for those in the lower income groups, the situation remains difficult.

Health

People born in developing countries live, on average, 14 years less (in Sub-Saharan Africa, 27 years less) than those born in developed countries. Health problems, often associated with poverty, are responsible for most of the differences in life expectancies. Mortality rates for children under age five are particularly high, often 10–20 times higher than in developed countries (see Figure 1-3). Though countries with high rates of infant mortality are found in all regions, Sub-Saharan African countries are particularly afflicted. The band of high infant mortality stretching from the Atlantic coast across Africa to Somalia on the Indian Ocean covers some of the poorest and most undernourished populations in the world.
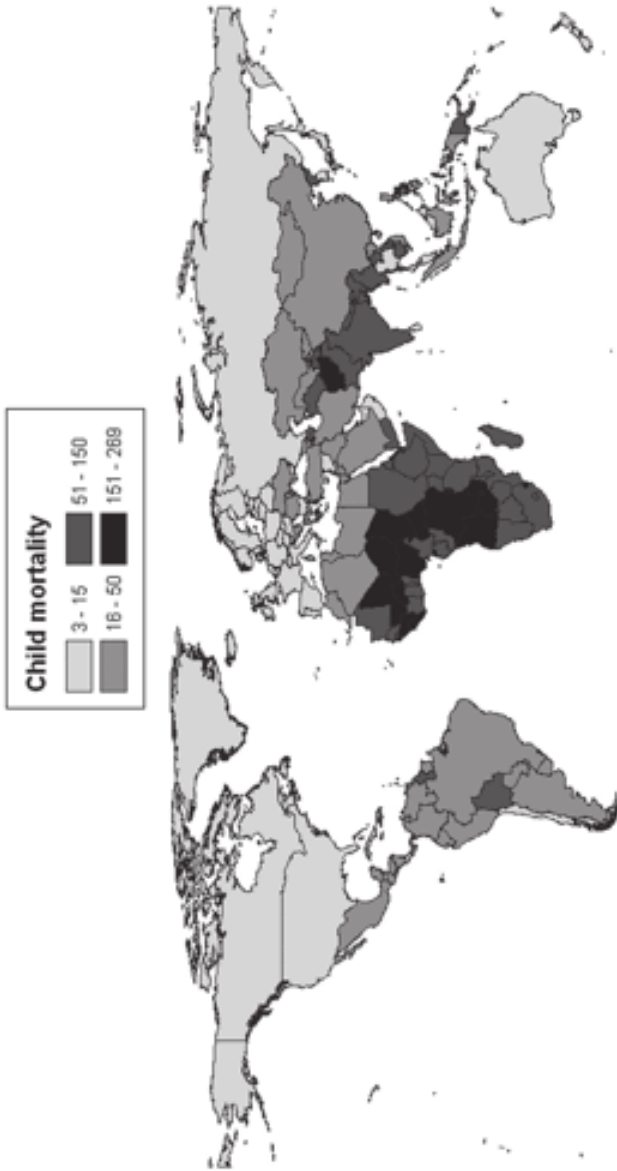
Fiigure 1-3. Under-five mortality rates (per 1000 live births).
(*Source*: World Health Organization Statistical Information System, 2006.)

Poverty affects health by limiting people's ability to purchase food, housing, medical services, and even soap and water. Inadequate public sanitation and high prevalence of communicable diseases are also closely linked with poverty. A major health problem, particularly among children, is diarrhea, usually caused by poor water quality. According to the World Bank, 5 to 10 million children die each year from causes related to diarrhea. Respiratory diseases account for an additional 4 to 5 million deaths, and malaria another million. Basic health services are almost totally lacking in many areas; on average, ten times as many people per doctor and per nurse are found in low-income countries as in developed countries.

A major health problem that continues to grow rapidly in the developing world is acquired auto-immune deficiency syndrome (AIDS). The disease is particularly difficult to contain in many African countries because of the ease of its heterosexual spread, lack of education about the disease, limited use of protective birth-control devices, and in some cases absence of government commitment to address the problem. Estimates are that roughly a quarter of the adult populations in certain countries, such as Botswana and Swaziland, are HIV positive. Effects are felt in lost productivity and increased poverty, in addition to its effects on direct human suffering. As serious as the problem currently is in Africa, the region likely to be devastated most by AIDS in the future is Asia. According to the World Health Organization, an estimated 33 million people worldwide were living with HIV/AIDS in 2007.

Population Growth

How important is population growth to the food-poverty-population problem? It is very important, and will continue to be so at least for the next 40–50 years. Population is growing less than 1 percent per year in developed economies, but 2 percent per year in developing countries excluding China, and 3 percent or more in many Sub-Saharan African countries. These higher growth rates place pressure on available food supplies and on the environment in many low-income countries. Population growth and food production are closely linked, and changing either in a major way takes time, as discussed in Chapter 4. It is clear that continual increases in food production are needed, because regardless of how successful are efforts to control population growth, world population will not stabilize for many years. Rapid urbanization is also occurring as populations continue to grow.

Children in Honduras.

Globalization

Food and economic systems in less-developed countries are affected by the international economic environment far more today than they were in years past. Trade and other economic policies abroad and at home, international capital flows, migration, and oil price shocks have combined to increase the instability of and opportunities for improving the food and economic security of developing countries.

International trade in agricultural products (as with other products) has grown rapidly since the 1970s, building on improvements in transportation and information systems. As exports and imports of farm products constitute a higher proportion of agricultural production and consumption, effects of domestic agricultural policies aimed at influencing the agricultural sector are altered. World prices become more important to farmers than they were previously, and possibilities for maintaining a nation's food security at the aggregate level are improved, although price volatility remains an issue. Production and policy changes abroad also tend to have a great effect on domestic agriculture as international trade grows. While the need for national food production self-sufficiency has been reduced, the need to be price competitive with other countries has grown, as has the need to participate in international negotiations to alter the policy environment.

International capital (money) markets, through which currencies flow from country to country in response to differences in interest rates and other factors, have become as important as trade to the food and

economic systems in less-developed countries. The volume of international financial transactions far exceeds the international flows of goods and services. Capital flows affect the values of national currencies in foreign exchange markets. The foreign exchange rate, or the value of one country's currency in terms of another country's currency, is an important determinant of the price a nation receives for exports or pays for imports. Speculation in financial markets has led to rapid inflows and outflows of capital in some countries, resulting sharp changes in asset values and incomes.

Many less-developed countries also have serious foreign debt problems. Many countries have reduced their rate of government spending in efforts to service this debt, and this decrease in turn has lowered the availability of pubic services, creating further hardships for the poor. The need for foreign exchange to repay external debts has also increased the importance of exports for less-developed countries, forcing some countries to reexamine their trade and exchange-rate policies. At the same time, new technologies have been changing the possibilities that countries have for producing and trading particular products.

Environmental Degradation

As populations grow, environmental problems become more severe. Deforestation, farming of marginal lands, overgrazing, and misuse of pesticides have contributed to soil erosion, desertification, poisoning of water supplies, and climate change. The global climate has become gradually warmer and less stable, while water has become scarcer. Environmental problems exist in every region of the world. Some degradation is intentional, but most is the unintended result of people and governments seeking means of solving immediate food and economic crises, often at the cost of long-term damage to the environment. Some of this damage may compromise the ability of a country to raise incomes in the long run. When people are hungry, it is hard to tell them to save their resources for the future, and environmental conservation represents a form of savings. However, many potential solutions exist that are consistent with both short-term increases in food production and long-term goals of simultaneously sustaining or improving environmental quality while raising incomes.

Risk and Uncertainty

Most of the factors mentioned above are associated with increased exposure to risk and uncertainty. Fluctuating prices, exchange rate instability, certain crop pests, and rapidly changing weather patterns
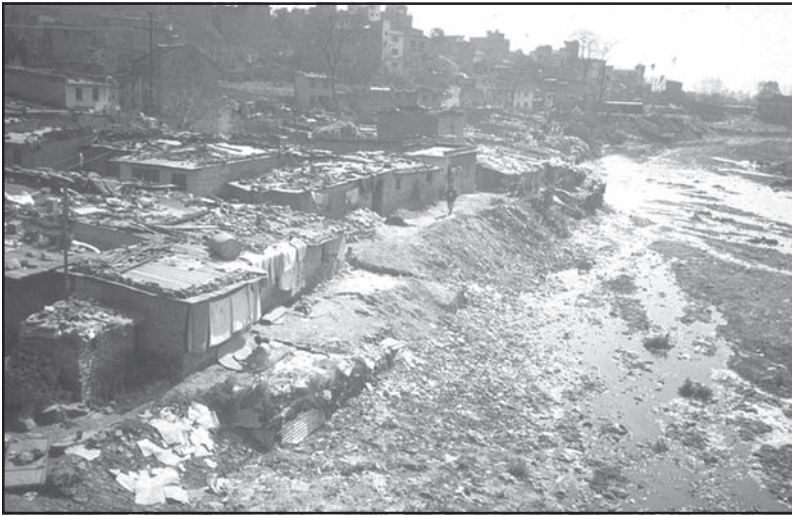
Slum close to riverbank in Katmandu, Nepal.

represent risk factors. Recent research has shown that risks and risk management imply real costs that may compromise long-run improvements in well being. Risk also lowers welfare in the short run. For example, Hurricane Mitch struck the Central American coastal region during October 1998, causing massive losses in productive capacity and washing out roads, houses, and entire villages. In Honduras alone, it killed more than 8,000 people and injured more than 12,000. Deforestation in hillside areas contributed to the hurricane's damage as landslides and flooding washed out low-lying areas. In December 2004, a large earthquake off the coast of Indonesia caused a tsunami that washed ashore in several countries, especially in Indonesia, Sri Lanka, India, and Thailand, killing more than 228,000 people.

Risk is not necessarily bad. Innovation and entrepreneurship are risky. It is the way that risks are managed that most influences economic growth. Risk management needs to be conducted in an efficient manner; the proper balance must be found between managing risks and pursuing other goals.

The preceding overview provides brief highlights of some of the dimensions of the food-income-population problem. These and other problems are discussed in more depth in subsequent chapters, and alternative solutions are suggested. First, however, it is important to consider what we mean when we talk about development.

MEANING of DEVELOPMENT

The term *development* means a change over time, typically involving growth or expansion. *Economic* development involves changes in people's standard of living. For most of human history there was little such change, but over the past 300 years there has been a rapid and (so far) sustained increase in almost every kind of human activity. Growth occurred first and has been sustained the longest in Northwest Europe and North America, but similar kinds of expansion have occurred all around the world.

Development is a process with many economic and social dimensions. For most observers, *successful* economic development requires, as a minimum, rising per-capita incomes, eradication of absolute poverty, and reduction in inequality over the long term. The process is a dynamic one, including not only changes in the structure and level of economic activity, but also increased opportunities for individual choice and for improved self-esteem.

Development is often a painful process. Adjusting to new circumstances is always difficult: as Mark Twain famously wrote, "I'm all for progress — it's change I can't stand." There is often dramatic social upheaval with traditional ways of life being displaced, existing social norms being challenged, and increasing pressures for institutional and political reform. The physical and cultural landscape of a country can change radically during economic development. And at the individual level, the standard of living for the poorest people in a society does sometimes decline, even as average real incomes increase. More often, the fruits of improvement are unequally distributed. By any measure, poverty and deprivation remain widespread, despite the astonishing improvements in living standards experienced by many all across the globe.

As economic activity continues to expand, there is continuous concern with the constraints imposed by natural resources and environmental factors. The World Commission on Environment and Development has defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[2] Thus, the term "development" encompasses not only an economic growth component, but distributional components, both for the current population and for future generations.

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[2] World Commission on Environment and Development, *Our Common Future* (New York: Oxford University Press, 1987), p. 43.

Measures of Development

Although development is difficult to measure, it is often necessary to do so in order to assess the impacts of particular programs, to establish criteria for foreign assistance, and for other purposes. Because of its several dimensions, single indicators of development can be misleading. Measures are needed that are consistent with the objective of raising the standard of living broadly across the population. Average per-capita income is frequently used as a measure (see Figure 1-4). Is it a good measure?

Average per capita income is not a perfect measure of living standards for several reasons, but finding an alternative indicator that can incorporate each dimension of development is impossible. Because development is multidimensional, collapsing it into a single index measure requires placing weights on different dimensions. Average per-capita income is an inadequate measure even of the economic dimensions because it misses the important distributional elements of development and is a crude measure of people's well-being.

Alternative multidimensional development indicators have been suggested. One of the oldest is a level-of-living index proposed by M.K. Bennett that weights 19 indicators for which data were available in 1951.[3] Examples of indicators include caloric intake per capita, infant mortality rates, number of physicians per 1000 of total population, and years of schooling. A more recent index is the Human Development Index[4] (HDI), which weights life expectancy, education, and income. Weighting schemes are subjective, however, and average per-capita income is highly correlated with many of the indicators. Consequently, average per-capita income, measured as gross national product (GNP) or gross domestic product (GDP) per capita is often employed as a first approximation; then measures such as income distribution, literacy rates, life expectancy, and child mortality are examined separately or as part of an index. Even these supplementary indicators can be misleading due to regional disparities within countries.

Some studies have called for the GNP income measure itself to be modified to account for depreciation or appreciation of natural resource-based assets, particularly forests. This modification may be possible once natural resource accounting procedures are further refined.

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[3] See M. K. Bennett, "International Disposition in Consumption Levels," *American Economic Review*, vol. 41, September 1951, pp. 632–49.

[4] United Nations Development Program, *Human Development Report* (New York: Palgrave Macmillan, 2007), p. 356.

Figure 1-4. GNI per capita, 2004 (Atlas Method).
(*Source:* World Bank, *World Development Indicators* Online Database.)

BOX 1-1.
POVERTY and INEQUALITY

Poverty is generally defined as the failure to achieve certain minimum standards of living. By its very nature, poverty refers not just to *averages*, but to *distributions*. Poverty is not, however, synonymous with inequality; countries with perfect equality could contain all rich or all poor people. Measurement of poverty requires three steps: determining an appropriate measure or indicator, deciding on its minimum level, and counting the number or percentage of people falling below it. Alternatively, a measure of degree or intensity of poverty would indicate the amount by which people fall below the poverty line.

While poverty refers to some level or position with respect to a measure such as income, inequality refers to the distribution of that measure among a population. For example, evidence from 21 developing countries indicates that, on average, 6 percent of household income is received by the poorest 20 percent of the households, whereas 48 percent of household income is received by the richest 20 percent. In some countries the extremes are even more dramatic. It is possible for poverty to decrease in a country during the development process, but for inequality to increase, at least for a period of time.

Incomes and Development

Poverty and low incomes are most frequently associated with underdevelopment, while growing per-capita incomes should indicate increasing levels of development. As discussed above, increasing average incomes may not necessarily mean more development, because the distribution of this income often determines whether poverty and inequality are diminished as the mean grows. Some of the relationships between poverty and inequality are discussed in Box 1-1.

Numerous measures of inequality and the extent of poverty exist. For example, the Human Poverty Index (HPI) measures the extent of deprivation with respect to life expectancy, education, and income.[5] If, as is argued above, the meaning of development contains some element of poverty reduction or increased equality of income distribution, then clearly the incomes of the poor and destitute should be raised during the development process.

Policies undertaken to promote development have diverse effects on the incomes of the poor. Some people benefit, but often some do not,

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[5] United Nations Development Program, *Human Development Report* (New York: Palgrave Macmillan Press, 2007), p. 357.

and, at times, incomes fall for certain population groups. It is important to consider the winners and losers in the development process. Income distributions, and changes in them, are indicators of the impact of development policies on different groups in society.

Values and Development

Value judgments or premises about what is or is not desirable are inextricably related to development economics. Concerns for economic and social equality, poverty eradication, and the need to improve health and education all derive from subjective beliefs about what is good and what is not. Solutions to specific problems often involve tradeoffs, and decisions about public resource allocations always involve tradeoffs. Governments make such tradeoffs every day, as most government actions are costly to some people even as they benefit others. Economics can be a powerful tool for evaluating these tradeoffs, providing insights into the costs and benefits of different actions, winners and losers, and longer-run consequences of savings, investment, and consumption decisions. Economics is, however, less well-suited for making value decisions.

Even if people share the same set of beliefs and values, they may attach different weights to the individual beliefs and values within that set. Because there is no correct set of weights, people may not agree about appropriate solutions to development problems, even if the suggested solutions appear conceptually sound in terms of leading to their intended impacts.

Most policy suggestions would result in both gainers and losers. In some cases, the gainers could compensate the losers, but sometimes they could not, and often they do not. Because affected groups have differing political strengths within society, economic and social development policies cannot be separated from the political process. These realities must be considered if development policies are to succeed.

ROLE of AGRICULTURE

Many alternative development paths or strategies exist. The strategy followed by an individual country at a particular point in time is, or at least should be, influenced in part by its resource endowments and stage of development. Some countries with vast oil and mineral resources have generated capital for development by exporting those resources. Others have emphasized cash-crop exports such as coffee, cocoa, and tea. Some have focused on industrial exports, while others have stressed increases in basic food production. The optimal development path will

vary from country to country, but the choice of an inappropriate path, given the existing resource endowments and stage of development, can result in long-term stagnation of the economy.

Numerous examples can be found of countries choosing the wrong development path and paying the price. Argentina, a country well-endowed with land resources, pursued government policies in the 1940s and 1950s that stressed industrialization and virtually ignored agriculture. The result was that agricultural exports, previously an important component of economic growth, stagnated in the 1950s, and foreign exchange shortages prevented the imports of capital goods needed for industrialization. Economic growth slowed dramatically as a result. India is another country whose potential for agriculture-driven growth was subverted by a disproportionate emphasis on industrialization in the 1950s and 1960s.

Agriculture is not very productive in most low-income countries. Early in the development process much of the population is employed in agriculture, and a high percentage of the national income is derived from that sector[6] (see Table 1-1). As development proceeds, population grows and per-capita income increases. As incomes grow, more food is demanded; either agricultural production or imports must increase. Because agriculture commands so many of the resources in most low-income countries, few funds are available for importing food or anything else unless agricultural output grows.

The capacity of the agricultural sector to employ an expanding labor force is limited. As incomes continue to rise, the demand for non-food commodities grows as well. Therefore, economic development requires a structural transformation of the economy involving relative expansion of nonagricultural sectors. The agricultural sector must contribute food, labor, and capital to that expansion. It also provides a market for nonagricultural goods.

This economic transformation is illustrated in Table 1-1. Agriculture accounts for a large percentage of total income, and an even larger percentage of total employment for the lower-income countries. The contribution of agriculture to national incomes declines from 30 to 50 percent for the lower-income countries, to 15 to 20 percent for the

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[6]A warning about measurement is appropriate: in most countries it is difficult to measure the number of people employed in agriculture. Multiple job holdings, seasonal labor use in agriculture, and unpaid household labor all complicate the measurement problem. Often, data on the number employed in agriculture are obtained by (generally high-quality) census estimates of the rural population. Even in rural areas, many people are employed outside agriculture.

Table 1-1. Relationship among Per-Capita National Income, the Proportion of National Income in Agriculture, and the Proportion of the Labor Force in Agriculture, Selected Countries, 2006

Country	Per capita income (in PPP dollars)[1]	Agriculture GDP as a percentage of total GDP	Percentage of active labor force in agriculture	
			Male	Female
Ethiopia	581	47	84	76
Uganda	848	32	60	77
Mali	1004	37	50	30
Bangladesh	1068	20	50	59
Moldova	2,190	18	41	40
Philippines	2,956	14	45	25
Indonesia	3,209	13	43	41
Colombia	5,867	12	32	8
Ecuador	6,737	7	11	4
Thailand	7,061	11	44	41
Brazil	8,474	5	25	16
Argentina	10,815	8	2	1
Mexico	11,387	4	21	5
South Korea	21,273	3	7	9
Italy	27,750	2	5	3
Greece	29,261	3	12	14
Japan	30,290	2	4	5
France	30,591	2	5	2
Australia	34,160	3	5	3
Canada	34,972	2	4	2
United States	41,812	2	2	1

Source: World Bank, World Development Indicators, 2008.

[1] PPP stands for purchasing power parity and means that the incomes are converted to dollars, taking into account cost-of-living differences between the countries.

middle-income range, and down to 5 percent or below for the highest income countries.

The initial size and low productivity of agriculture in most developing countries suggests an opportunity for raising national income through agricultural development. Because of the initial size of, and low per-capita income in the agricultural sector, there is real scope for improving the distribution of income and enhancing the welfare of a major segment of the population through agricultural development.

One of the keys to agricultural development is to improve information flows. In primitive societies, economic activities are local and information is basically available to all. Inappropriate activities are constrained by social and cultural norms. As development begins to proceed and economies become more complex, information needs increase but traditional forms of information transmission are incapable of meeting these needs. Modern information systems are slow to develop, creating inequalities in access to new information. Those with greater access than others can take advantage of this situation to further their own welfare, often at the expense of overall agricultural and economic development.

Some changes required to foster broad-based and sustainable development require institutional changes and capital investments. Capital investments necessitate savings. Such savings are channeled into private and public investment, the latter to build the infrastructure needed for development. Saving requires striking a balance between present and future levels of living because it requires abstention from current consumption. Means must be sought to reduce this potential short-run versus long-run conflict during the development process. However, certain types of investments necessary for development, such as education, provide both short- and long-run benefits, as do investments in technologies and employment-intensive industries.

Improving Agriculture

How can agriculture be improved to facilitate its role in providing food and contributing to overall development? There are still areas of the world, particularly in parts of Latin America and Africa, where land suited for agricultural production is not being farmed. Most increases in agricultural production will have to come, however, from more intensive use of land currently being farmed. Such intensive use will require improved technologies generated through research as well as improved irrigation systems, roads, market infrastructure, and other investments. It will require education and incentives created through changes in institutions such as land tenure systems, input and credit policies, and pricing policies (see Box 1-2).

Agriculture and Employment Interactions

Agricultural development can provide food, labor, and capital to support increased employment in industry and can stimulate demand in rural areas for employment-intensive consumer goods. Because of their comparative advantage in labor-intensive production, many developing countries will need to import capital-intensive goods, such as steel

BOX 1-2.
HISTORICAL PERSPECTIVE on AGRICULTURAL DEVELOPMENT

The historical progression of agricultural development can be broadly broken into four distinct periods, marked by three "revolutions" in production technology and social institutions.

First, from the time that we first appeared on earth, human beings hunted and gathered their food. Hunter-gatherer societies typically lived in small groups, experienced little population growth.

Then, more than 10,000 years ago, a combination of climate changes and other factors created conditions for the development of settled agriculture. In the Middle East and elsewhere, people began to collect and cultivate the seeds of plants that eventually became modern barley, wheat, and rye. This development is known as the *first agricultural revolution*, and permitted a slow but significant increase in human population density.

More recently, a few hundred years ago, rising population density and opportunities for trade led to a *second agricultural revolution*. In Northwestern Europe and elsewhere, farmers developed crop rotations and livestock management systems that permitted rapid growth in output per person, fueling the *industrial revolution* and the eventual mechanization of many important tasks.

Finally, in the late nineteenth and early twentieth centuries, scientific breeding, chemical fertilizer, and other innovations allowed rapid increases in output per unit of area. The spread of these biological technologies to developing countries, known as the *green revolution*, has been a powerful engine of economic growth and poverty alleviation, allowing low-income people to produce more food at lower cost than ever before.

These historical trends played out at different speeds and in different ways across the globe. A few people in the poorest countries still devote substantial energy to hunter-gatherer activities, and many millions of farmers still cultivate the same seeds in the same ways as their ancestors. Because of population growth, these techniques and institutional arrangements yield less and less output over time. The development and spread of higher-productivity systems to suit these people's needs is among the major humanitarian challenges of our time.

and fertilizer, and export labor-intensive consumer goods and certain types of agricultural goods. Countries that do not match an employment-oriented industrial policy with their agricultural development policy will fail to realize the potential income and employment benefits of agricultural development.

SUMMARY

Some of the basic dimensions of the world food-poverty-population problem were examined. The aggregate world food situation was reviewed, and questions such as who the hungry are, and why they are hungry even though the world produces a surplus of food, were addressed. The significance of population growth and a series of forces in the global economy that influence developing countries were stressed.

The meaning and measures of development were discussed and importance of development problems. The desirability of suggested solutions depends on value judgments. While alternative development strategies can be followed, agriculture has an important role to play in overall development in most developing countries. Development will require a complex set of improved technologies, education, and institutions, and an employment-oriented industrial policy.

IMPORTANT TERMS and CONCEPTS

Agricultural productivity	Institutions
Development	International capital markets
Enhanced information flows	International trade
Environmental degradation	Measures of development
Food-poverty-population problem	Population growth
Food price instability	Structural transformation
Foreign exchange rates	of the economy
Globalization	Sustainability
Health problems	Technology

Looking Ahead

In order to visualize more clearly the relationships among food supplies, food demand, population growth, and nutrition, it is important to examine facts, scientific opinion, and economic theory. We make this examination in the remaining chapters of Part One in this book. We turn first in Chapter 2 to the causes and potential solutions to hunger and malnutrition problems.

QUESTIONS for DISCUSSION

1 Are people hungry because the world does not produce enough food?
2 Has food production in developing countries kept pace with population growth there?
3 Is malnutrition more widespread today than in the past?
4 Why did food prices rise so dramatically in 2008?

5 What are some factors that will influence the price of food over the next 10 to 20 years?

6 Is there any hope of bringing more land into production to help increase food production?

7 Why is agricultural development particularly important in less-developed countries?

8 Approximately what proportion of the world's population lives on per-capita incomes of less than $2 per day?

9 What is development? To what extent are values important when discussing development issues?

10 Is average per-capita income a good measure of level of living?

11 Why is most of the labor force engaged in agriculture in many less-developed countries?

12 Does economic development require expansion of the nonagricultural sector in low-income countries?

13 What is the conflict between increasing near- versus long-term levels of living in developing countries?

14 What are the major health problems in developing countries and what are their primary causes?

15 How fast is population growing in developing countries?

16 Why has international agricultural trade become more important over the past 30 years?

17 Why have international capital markets become more important to developing countries over the past 30 years?

18 Why might low food prices be both good and bad?

19 Why has environmental degradation become an increasing problem in developing countries?

RECOMMENDED READINGS

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Todaro, Michael P. *Economic Development* (New York: Addison Wesley, 2008), especially Chapters 1, 2, and 3.

United Nations Development Programme, *Human Development Report 2007/2008* (New York: Palgrave Macmillan, 2007).

World Bank, *World Development Report* 2008 (New York: Oxford University Press); see earlier volumes as well.

Poverty, Hunger, and Malnutrition

For hunger is a curious thing: at first it is with you all the time, waking and sleeping and in your dreams, and your belly cries out insistently, and there is a gnawing and a pain as if your very vitals were being devoured, and you must stop it at any cost, and you buy a moment's respite even while you know and fear the sequel. Then the pain is no longer sharp but dull, and this too is with you always, so that you think of food many times a day and each time a terrible sickness assails you, and because you know this you try to avoid the thought, but you cannot, it is with you. Then that too is gone, all pain, all desire, only a great emptiness is left, like the sky, like a well in drought, and it is now that the strength drains from your limbs, and you try to rise and find that you cannot, or to swallow water and your throat is powerless, and both the swallow and the effort of retaining the liquid taxes you to the uttermost.

— Kamala Markandaya[1]

This Chapter

1 Describes the world food situation

2 Examines different forms of poverty, hunger and malnutrition: their magnitudes and consequences, and how they are measured

3 Identifies principal causes of and potential solutions to problems with poverty, hunger, and malnutrition in developing countries

THE WORLD FOOD SITUATION
World Food Demand and Supply

World food consumption and production have each grown about 2.2 percent per annum since 1970, while in developing countries consumption has grown about 3.7 percent and production 3.5 percent. Cereals

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[1] Kamala Markandaya, *Nectar in a Sieve* (New York: New American Library, 1954), p. 91.

are the most important sources of food and, since the mid-1960s, world cereal production has risen by roughly one billion tons per year. It is likely that an additional billion tons in production per year will be needed by 2030 to meet food needs of a world population expanding in numbers and in income. It is also likely that cereal imports by developing countries will increase from about 10 percent of consumption to about 15 percent.

While the overall numbers and projections suggest gradual improvement in reducing malnutrition in the world, there are still several countries in which per-capita food consumption has declined and is not likely to increase enough to significantly reduce the number of undernourished. Even in countries with growing average food consumption, some groups may not see their consumption levels increase: household food consumption is closely related to household incomes, and the most disadvantaged are afflicted by low and uncertain levels of income. In addition, the rate of growth in agricultural output for the world as a whole has slowed since the 1980s, and the use of cereals and sugar to produce bio-fuel products has created competition for these products for food. When food supplies are short, prices rise, creating severe problems for those who spend a high proportion of their limited income on food. The effects of the food price increase in 2007–2008 are a good example, as they are estimated to have caused an increase in the number of people malnourished in the world from 800 million to 860 million. A best-case scenario for the world over the next 30 years would seem to point to a reduction in severely malnourished to about 400–500 million people, but for populations in many countries the struggle for food will continue. Therefore we turn now to how poverty and access to food manifest themselves in terms of hunger, malnutrition, and, in some cases, famine.

POVERTY

Poverty has many faces and is one of the major challenges facing the development community. Poverty is widely understood to be an inability to meet basic needs, and the poor tend to be hungry, are without adequate shelter, and have limited access to health care. The poor lack opportunity, and their powerlessness often lead to hopelessness and despair. To most people reading this book, poverty is an invisible and abstract problem, somewhere out there. We seldom think about it, and when we do we often don't know what to think or how to take action against it. Trends since the early 1980s point to a decrease in global poverty, but stark challenges remain; in 2005, an estimated 1.4 billion

people — about one fourth of the world's population — lived in extreme poverty and efforts to reduce poverty must be constantly refined.

Measuring Poverty

Since poverty is multidimensional, efforts to measure it can be complicated by attention to its different dimensions. Two broad types of measurement schemes exist: monetary and non-monetary. Monetary measures consolidate the different dimensions into a single unit of measure — money. Their strengths include the ability to make comparisons in a common unit, a non-arbitrary measurement scheme, and ability to quantify the extent, depth and severity of poverty (see box 2-1). However, monetary approaches often fail to capture dimensions of poverty that may be especially important and intractable, such as social exclusion and political powerlessness.

Non-monetary measures include qualitative assessments and indices that combine different dimensions such as the Human Development Index (HDI) and Human Poverty Index (HPI) described in Chapter 1. These indices often face the criticism that the weights used are arbitrary and measures vary significantly when the weights are changed.

The different approaches complement each other, and their combination has allowed a deeper understanding of poverty. For example, participatory poverty assessments that engage in discussions with groups of poor people about their conditions and the unique challenges they face often accompany monetary assessments, and the combination can help in understanding how policies can be formulated to reduce poverty.

Vulnerability: Transitory and Chronic Poverty

Poverty is not a constant state for many developing-country households. Weather, pests, diseases, and policies cause fluctuations in income that translate into movement in and out of poverty — households are vulnerable to becoming poor. This in-and-out-of poverty situation is important because separate policies may be needed to address transitory compared to chronic poverty. Evidence shows that transitory poverty — households who move in and out of poverty over time — accounts for a substantial portion of overall poverty. As a result, means of protecting people from transitory income shortfalls may substantially improve the global poverty picture. Formal and informal insurance schemes, social safety nets, and other means of reducing or managing risks can help achieve this aim. Rural public work programs — such as

BOX 2-1.
MONETARY MEASUREMENT of POVERTY[1]

Three primary challenges in measuring poverty are: (i) deciding what to measure, (ii) identifying a value, below which a household is deemed to be poor, and (iii) adding it up for the population. Poverty involves an inability to control sufficient resources to meet a minimum level of well being, and analysts use household income or consumption expenditure to measure it. Consumption is generally preferred because income, particularly in rural areas, is seasonal and variable, while consumption is smoother and often easier to measure. The poverty line is the value of income or expenditures on a daily, monthly or annual basis below which a person is deemed to be poor. This poverty line can be determined many ways. In the United States, the poverty line was created in 1963 using the minimum cost of achieving an adequate diet based on U.S. Department of Agriculture food plans. Non-food expenditures were accounted for by observing that poor households generally spend about a third of their total budget on food: the food poverty line was multiplied by 3 to obtain the total poverty line. This line has been updated over time by adjusting for changes in the cost of living. A commonly used international poverty line is the World Bank's use of $1 per person per day (in 1993 prices) to reflect extreme poverty (this number was recently revised to be $1.25 in 2005 prices) and $2 per day (2005 prices) to reflect moderate poverty.

With a household survey, incomes or expenditures can be compared to the poverty line: households with values below the line are poor. Policy makers are interested not only in which households are poor, but also in where the poor are located, what they do, and how poverty has changed over time. Monetary indices of poverty are used to address these concerns, and the most commonly used poverty index, called the Foster, Greer, Thorbecke (FGT) Index,[2] is one that reflects the prevalence (proportion of the total population that is poor), depth (the degree of shortfall below the poverty line) and severity of poverty (the degree of inequality among the poor). This index gives policy makers a nuanced view of the total poverty picture: for example, a policy may increase the depth of poverty among some while reducing the total proportion of the population that is poor. According to the most recent estimates, 40 percent of the population in South Asia was poor in 2005 compared to 51 percent in Sub-Saharan Africa. In contrast, the poverty severity measures were 3 percent for South Asia compared to over 10 percent for Sub-Saharan Africa, indicating a far more serious problem in poverty severity in Sub-Saharan Africa than in South Asia.

[1] For more information, see Martin Ravallion, "Poverty comparisons: A guide to concepts and methods," Living Standards Measurement Study Working Paper, no. 88 (Washington, D.C.: World Bank, 1992).

[2] J. Foster, J. Greer, and E. Thorbecke, "A Class of Decomposable Poverty Measures", *Econometrica*, Volume 52 (1984), pp. 761–66.

dam-building, irrigation and water supply schemes, road construction and maintenance programs — are examples of social safety nets that may reduce vulnerability to poverty and build infrastructure for agricultural development.

Chronic poverty is often caused by very different factors: households do not have access to enough human, physical, natural, and other assets to earn sufficient incomes for minimum levels of well-being. Poverty traps caused by insufficient assets, severely degraded natural resources, and other factors, are difficult to escape and often require long-term investments in asset building, access to new factors of production, and improved institutions.

Agricultural Development and the Poor

One of the most common misconceptions about poverty is that it is largely an urban problem. Pictures of teeming slums with inadequate sanitation and rotting infrastructure help bolster this perception. In contrast, rural residents are thought to live in relatively spacious conditions and to be able to rely on own-production of foods in times of dire need. In fact, on a global level, the rural poor make up more than three-fourths of the total poor, and rural poverty is twice as prevalent as urban poverty.[2] Rural poverty is a major problem and, as we will see throughout this book, agricultural development can play a major role in its reduction, but agricultural development can also alleviate urban poverty.

Agricultural technology has direct impacts on the rural poor by increasing incomes of farmers, many of whom may be poor. Care must be taken during development and subsequent release of new technologies to ensure that they are accessible to poor producers, but evidence shows that in many cases poor producers benefit directly. Indirect benefits to the poor from growth in agriculture come from two primary sources: increased demand for labor and increased supply of food, causing food prices to drop. The latter benefit can be substantial and is an important reason why global poverty fell from the early 1980s until recently. Food price declines have led to higher levels of living even for

[2] The prevalence of global rural poverty was estimated in 2005 to be 29.7 percent compared to a 13.2 percent poverty rate in urban areas of developing countries. While rural poverty has declined relative to urban poverty due to urbanization, 75.4 percent of the developing world's poor are found in rural areas. Source: Martin Ravallion, Shaohua Chen, and Prem Sangraula, 2007, "New Evidence on the Urbanization of Global Poverty," Policy Research Working Paper forthcoming, World Bank.

people who do not depend directly on agriculture. When global food markets tighten as they did recently, poverty rises due to the indirect effect of higher food prices.

HUNGER, MALNUTRITION, and FAMINE

Hunger is a silent crisis in the world. In times of famine, it can tear at the heartstrings as media attention focuses on its dramatic effects. In fact, the most extreme type of hunger is severe calorie and protein undernutrition during a famine. However, more pervasive is chronic under-nutrition and malnutrition associated with poverty, illness, ignorance, maldistribution of food within the family, and seasonal fluctuations in access to food. We begin our discussion of hunger with the contrast between famines and chronic malnutrition.

Famines

Famine is marked by an acute decline in access to food that occurs in a definable area and has a finite duration. This lack of access to food usually results from crop failures, often in successive years, due to drought, flood, insect infestation, or war. During a famine, food may actually be present in the affected area, but its price is so high that only the wealthy can afford it. Food distribution systems may break down so that food cannot reach those who need it.

Famines have occurred throughout history. In recent years, their prevalence has been greatest in Sub-Saharan Africa, but famines also have occurred in North Korea periodically since 1995, in Kampuchea (formerly Cambodia) in 1979, Bangladesh in 1974, India in 1966 to 1967, and China in 1959 to 1961. The latter was the worst famine of the 20th century and resulted in an estimated mortality of at least 16 million people.

Famine is the extreme on the hunger scale because it causes extreme loss of life and concurrent social and economic chaos over a relatively short period of time. As access to food falls, people begin by borrowing money and then selling their assets to acquire money to purchase foods. Subsistence farmers sell their seed stocks, livestock, plows, and even land. Landless laborers and other poor groups lose their jobs, or face steeply higher prices for food at constant wages. As the famine intensifies, whole families and villages migrate in search of relief. The telltale signs of acute malnutrition and, eventually, sickness and death appear (see Box 2-2).

Fortunately, progress is being made against famine. Although large variations occur in annual food production in individual countries and world population continues to grow, the frequency and intensity

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BOX 2-2.
NATURAL DISASTER and FAMINE in BANGLADESH[1]

From June to September 1974, severe flooding in the Brahmaputra River in Bangladesh led to large-scale losses of the dry-season rice crop and created pessimism about the prospects for the transplanted spring crop. The price of rice doubled in fewer than three months during and after the floods. Two months after this sudden upturn in rice prices, unclaimed dead bodies began to be collected in increasing numbers from the streets of Dacca, the capital city. Similar collections were reported throughout the countryside. The government of Bangladesh officially declared a famine in September 1974. Estimates of the final death toll vary widely, but most agree that more than 1 million people died of starvation or related causes during and after the famine.

Insufficient food stocks clearly hindered the government's efforts to provide relief. Inadequate relief stocks should not, however, be confused as a cause of the famine; the evidence clearly shows that in 1974 adequate food grains were available in Bangladesh to avoid famine. This same evidence shows that the districts most affected by the famine even had increased availability of food per person compared to prior years.

What, then, caused the famine? Landless laborers and farmers with less than half an acre of land were most severely affected by the famine. These groups, whose only true asset was their labor power, found that the value of their labor declined greatly relative to the price of rice. Despite available food in local markets, they were unable to purchase it. The flood did not immediately affect food supply since the lost crop would not have been harvested until the next year anyway. It did, however, greatly lower employment opportunities. Lower wages combined with higher rice prices were the root causes of the 1974 Bangladesh famine.

[1] Most of this material is drawn from Amartya K. Sen, *Poverty and Famines: An Essay on Entitlement and Deprivation* (New York: Oxford University Press, 1981).

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of famines has decreased due to improved information and transportation networks, increased food production and reserves, and dedicated relief organizations. Much of the starvation we see during famines now occurs in areas where transportation systems are deficient and where political conflict thwarts relief efforts. The recent North Korean famine was due to a combination of natural disasters, economic collapse, and lack of political will to alleviate the problem.

Chronic Hunger and Malnutrition

As devastating as famines are, they account for only a small fraction of hunger-related deaths. Famines can be attacked in a relatively short period of time if political conflict in the affected country does not

hamper relief efforts. Chronic hunger and malnutrition affect a much greater number of people and are more difficult to combat.

Although no accurate figures on the prevalence of malnutrition exist, the World Health Organization (WHO) estimates that a half-billion people suffer from protein and calorie deficiencies and perhaps an equal number suffer from malnutrition caused by inadequate intakes of micronutrients, principally iron, vitamin A, and iodine. Thus, roughly 15–20 percent of the world's population suffers from some form of malnutrition. Malnutrition does not affect all segments of the population equally. Preschool children and pregnant and nursing women are particularly vulnerable to its dangers.

Serious malnutrition in developing countries reflects primarily under-nourishment — a shortage of food — not an imbalance between calories and protein. The availability of calories per capita by country is illustrated in Figure 2-1. Many of the countries with very low per-capita calorie availability are found in sub-Saharan Africa. A close, but not perfect, correspondence exists between low calorie availability and the low-income countries identified in the previous chapter. The major nutritional problem was once believed to be the shortage of protein. Although dietary protein is important, many nutritionists now believe that when commonly consumed cereal-based diets meet energy (calorie) requirements, it is likely that most protein needs will also be satisfied, for most people older than about two years of age. Thus, for everyone except infants, the greatest concern is the total quantity of food available to eat, and this quantity can most readily be measured by total dietary energy in terms of calories per day. In settings where overall energy intake meets minimum needs, any remaining protein or micronutrient deficiencies can often be improved with rather small investments to improve the quality of the diet.

Table 2-1: Estimated Number of People Affected by Preventable Malnutrition Worldwide

| Deficiency	Morbidity due to Malnutrition	Estimated Prevalence of Morbidity	Group most affected
Protein and energy	Underweight	150,000,000	Children
Protein and energy	Stunted growth	182,000,000	Children
Iron	Anemia	2,000,000,000	Every age and sex
Vitamin A	Blindness	250,000 - 500,000	Every age and sex
Iodine	Brain damage	50,000,000	Every age and sex

Source: World Health Organization, 2003.
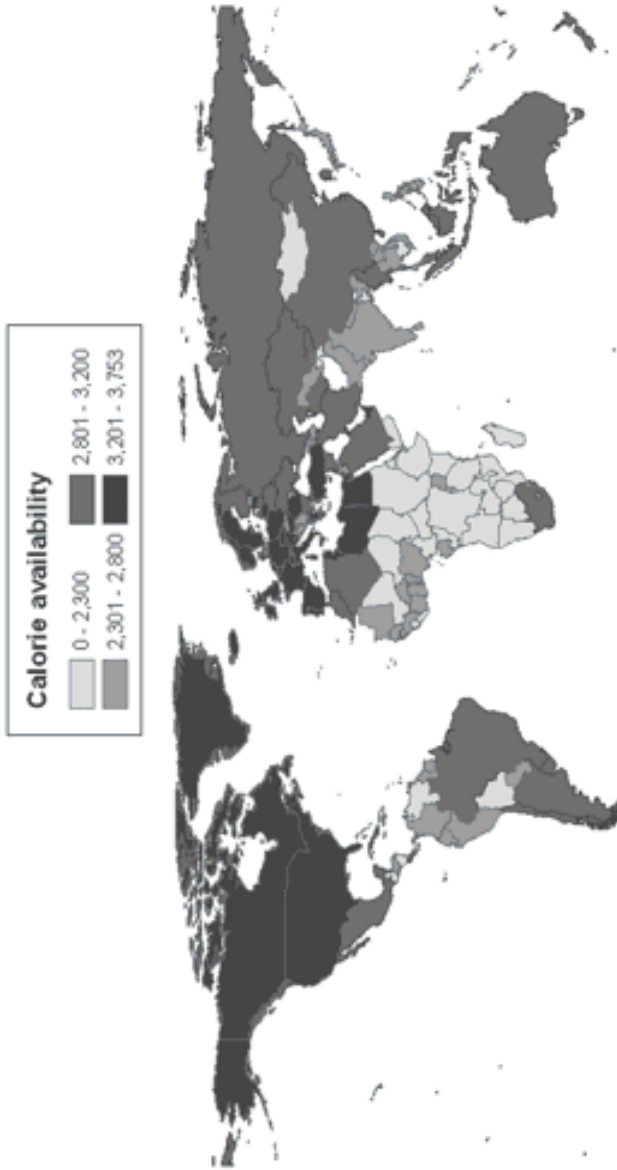
Figure 2-1. Daily calorie availability per capita, 2003. (*Source*: FAOSTAT data.)

Nevertheless, areas can be found with adequate calorie intake but deficient protein or micronutrient intake. Regions where diets are based on staples such as cassava or sugar rather than cereals are more likely to be deficient in protein even if calories are adequate. Iodine deficiency is common in regions far from the sea, for example parts of the Andes in South America. Iron deficiency is a particularly serious problem among women of childbearing age all over the world, and vitamin A deficiency is common in several countries.

Consequences of Hunger and Malnutrition

Stunted growth, reduced physical and mental activity, muscle wasting, increased vulnerability to infections and other diseases, and, in severe cases, death are the most common consequences of calorie deficiencies. Death most frequently results from dehydration caused by diarrhea, whose severity is closely linked to malnutrition. Chronic protein malnutrition results in stunted growth, skin rash, edema, and change of hair color. A diet relatively high in calories but low in protein can result in an illness known as kwashiorkor, while a diet low in both calories and protein can result in an illness known as marasmus. People can live about a month with kwashiorkor, 3 months with marasmus; 7–10 million people die each year from the two diseases.

Iron deficiency anemia affects muscle function and worker productivity. Vitamin A deficiency is a leading cause of childhood blindness and often results in death due to reduced disease resistance. Iodine deficiencies cause goiter and cretinism.

There is little doubt that hunger and malnutrition result in severe physical and mental distress even for those who survive the infections and diseases. Malnutrition can affect the ability of a person to work and earn a decent livelihood, as mental development, educational achievement, and physical productivity are reduced. People with smaller bodies because of inadequate childhood nutrition are paid less in agricultural jobs in many countries. Lower earnings perpetuate the problem across generations, leading to a vicious cycle of malnutrition and poverty.

Measuring Hunger and Malnutrition

Measuring the extent of hunger and malnutrition in the world is difficult Disagreement surrounds definitions of adequate caloric and protein requirements while data on morbidity and mortality reflect the combined effects of sickness and malnutrition.

Woman and child in Ethiopia
(photo by Mesfin Bezuneh).

Nutritional assessments are usually attempted through food balance sheets, dietary surveys, anthropometric surveys, clinical examinations, and administrative records. Food balance sheets place agricultural output, stocks, and imports on the supply side and seed for next year's crops, exports, animal feed, and wastage on the demand side. Demand is subtracted from supply to derive an estimate of the balance of food left for human consumption. That amount left can be balanced against the Food and Agricultural Organization of the United Nations' (FAO) tables of nutritional requirements to estimate the adequacy of the diet. This method provides rough estimates at best, due to difficulties in estimating agricultural production and wastage in developing countries.

Food balance sheets provide only a picture of average food availability. Malnutrition, like poverty, is better measured if the distribution of food intake or of other indicators is also taken into account. Average national food availability can be adequate, while malnutrition is common in certain areas, or among particular population groups. Even within families, some members may be malnourished while

others are not. To measure malnutrition accurately, information on households or individuals is required.

Household and individual information can be obtained from dietary or expenditure surveys and from clinical or field measurements of height, weight, body fat, and blood tests. These methods are expensive and seldom administered on a consistent and widespread basis for an entire country. They can be effective, however, in estimating malnutrition among population subgroups. Since preschool children are most vulnerable to nutritional deficiencies, random surveys to measure either their food intakes or anthropometry (body measurements) can provide a good picture of the extent of malnutrition. Another procedure for estimating the extent of malnutrition is to utilize existing data in hospital, health service, and school records. Unfortunately, these statistics can be biased because the records for rural areas are scarce, the poor are the least likely to have sought medical attention, and the quality of the information in the records is uneven. For example, many countries in Latin America record the heights, weights, and ages of first-year elementary school children. Unfortunately, many members of the poorest populations groups do not attend school. Because of these biases, estimates of malnutrition among school-aged children generally understate the true problem. One reason why malnutrition is misunderstood is that its measurement is so difficult.

CAUSES of POVERTY, HUNGER and MALNUTRITION

A variety of factors contribute to poverty, hunger and malnutrition, but inadequate income is certainly the most important underlying cause. The World Bank estimates that redistributing just 2 percent of the world's output would eliminate most poverty and malnutrition. But such redistribution would be feasible only if those who now go hungry had some way to obtain that food, or something to offer in exchange. If people, for whatever reason, produce too few goods and services, they lack income to buy food and they go hungry. Even in times of famine, decreased purchasing power rather than absolute food shortages is often the major problem, as food may be available in nearby regions. Incomes in the affected area have declined so that people cannot afford to buy food from unaffected areas.

Figure 2-2 contains a schematic diagram of the determinants of household well-being and individual nutritional status. Access to productive assets such as land, labor, natural resources, and the policy regime (prices and other factors) determine household income and well-being. Income, including the value of own production and in-kind transfers determine how much food can be purchased or consumed by
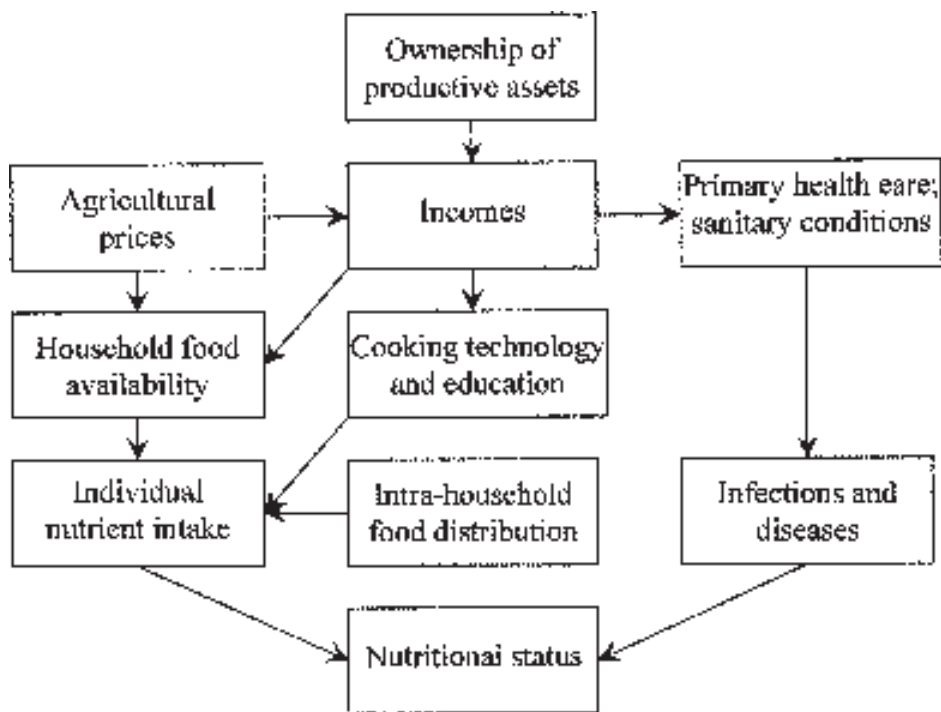
Figure 2-2. Determinants of household well-being and individual nutritional status.

the family. Total food purchases and consumption do not, however, tell the entire story. Health status and family food preparation, along with how food is distributed among members of the family, help determine how food available to a family is related to individual nutritional status.

Health and Malnutrition

Poverty's interaction with malnutrition is often compounded by infectious diseases and parasites that reduce appetites, cause malabsorption of food, or result in nutrient wastage due to fever and other metabolic processes. Health problems and malnutrition exhibit a synergistic relationship: infections and parasites lead to malnutrition while malnutrition can impair the immune system, thus increasing the risk of infection and the severity of the illness.[3] Measles, parasites, intestinal

[3] See Joanne Leslie, "Interactions of Malnutrition and Diarrhea: A Review of Research,: in J. Price Gittinger, Joanne Leslie, and Caroline Hoisington, eds., *Food Policy: Interacting Supply, Distribution, and Consumption* (Baltimore: Johns Hopkins University Press, 1987), pp. 355–70 for additional discussion.

infections, and numerous other health problems are prevalent in developing countries. Many of these health and sanitation problems lead to diarrhea, which in turn can lead to dehydration and death. Health is determined by, among other things, household sanitary conditions. These in turn are influenced by family assets and income, and by government programs. There is room for optimism related to many childhood diseases. The World Health Organization reports that, because of sustained efforts to vaccinate children, the majority of the world's children under one year old are now vaccinated against six common childhood diseases. However, the last twenty-five years have seen HIV-AIDS become an escalating problem, first in Africa and increasingly in Asia. Malaria also remains a serious problem in many countries, especially in Africa where 14 countries report over 10 percent of their populations infected.[4]

Poor Nutritional Practices

Ignorance of good nutritional practices, maldistribution of food within the family, and excessive demands on women's time can all contribute to malnutrition and perpetuate poverty. The results of studies that have examined each of these factors provide conflicting evidence as to their importance. Each factor is undoubtedly significant in some areas of the world but not in others. For example, in parts of Northern India and Bangladesh, evidence indicates that adult males receive a disproportionate share of food in the family compared to young females, but this is not universally the case.[5] Problems that appear to be related to ignorance, and are in fact discriminatory, are sometimes related to culture and often to poverty.

Some evidence shows that whether the male or female controls income within a family helps determine how food is distributed. There also is strong evidence that increased educational opportunities for women are linked to improved nutritional practices and more equitable distribution within the family.

Seasonal and Cyclical Hunger

As with poverty, many people in developing countries move in and out a state of malnutrition. There are hungry seasons, hungry years, and hungry parts of the life cycle. A given individual may or may not survive these periods and frequently experiences lasting physical, mental, and emotional impacts even if he or she does survive.

[4] UNDP, *Human Development Report 2005* (New York: Hoechstetter, 2005).
[5] See Michael Lipton, "Variable Access to Food," in Gittinger, Leslie, and Hoisington, eds., *Food Policy*, pp. 385–92.

Hungry seasons occur because of agricultural cycles. In the weeks or months preceding a harvest, food can be in short supply. This normal seasonality can be exacerbated if crops in a particular year are short or households are unable to effectively store food or income. In certain seasons of the year, particularly the rainy seasons, disease and infection are more common. Likewise, droughts, floods, and insect infestations happen in some years but not in others. Young children are vulnerable, in part due to dangers associated with diarrhea. Pregnant and lactating women experience extra nutritional demands on their bodies while the elderly suffer disproportionately as well, particularly if they lack the support of their children.

SOLUTIONS to POVERTY, HUNGER and MALNUTRITION PROBLEMS

Solutions to hunger and malnutrition problems depend on the types and causes, but alleviation of poverty is needed for a long-term solution. Famine relief strategies differ from solutions to chronic hunger and malnutrition, but even in famines, the poor are most likely to be afflicted. Unfortunately there is no magic bullet to the solution of poverty. A concerted effort across many fronts is required.

Raising Incomes

Lifting vulnerable people out of poverty is central to any long-term strategy to alleviate malnutrition in the world. For subsistence farmers, this strategy implies raising productivity, increasing access to land, or creating opportunities to migrate to off-farm employment. For the population in general, it implies a need for increased employment opportunities combined with higher productivity per person. The latter requires growth in jobs and in capital per job in the non-farm sector. Enhanced education, an investment in human capital, will also increase productivity and incomes. Equal access to jobs and expanded economic opportunities in impoverished regions can also help reduce poverty. Economic growth without increased employment for the poorest segments of the population will do little to reduce hunger. Programs to increase employment and earnings opportunities for women are particularly important, partly because these opportunities help accelerate the transition to lower birth rates (for reasons discussed in Chapter 4).

Agricultural Production

Agricultural productivity is particularly important for the incomes and nutritional status of the poor, because in most developing countries the

poorest people have no choice but to be farmers, and they feed themselves and their families using their own labor and available land. Increased productivity for those farmers not only raises their incomes and purchasing power, but can also lower the price of food for those who must buy it to feed their families, making it possible for the poor to purchase larger quantities. Hence, methods for increasing food production are a major focus of this book. Increased use of purchased inputs, improved marketing and credit institutions, improved agricultural policies, better education, effective agricultural research, and investment in infrastructure such as roads, storage, and irrigation systems are particularly important.

Safety Nets

As noted above, much poverty is transitory and caused by fluctuations in income. These fluctuations, in turn, can have dramatic impacts on nutrition, and they can lead to longer-term poverty because households often invoke harmful coping mechanisms to deal with them. Safety net programs, such as cash and in-kind transfers, public works programs, conditional cash transfers, and fee waivers for health and education, can distribute wealth to the most needy and provide insurance against risks. By protecting vulnerable farmers against the adverse consequences of risk, safety nets allow them to make better investment decisions and adopt new technologies and production practices (such as new seeds and fertilizers) that increase mean incomes. Safety nets need to be properly targeted and efficiently administered to avoid waste, but much has been learned in recent years about their design and implementation. Many countries have now successfully implemented them.[6]

Food Intervention Programs

Food price subsidies, supplementary feeding programs, and food fortification can each help reduce nutritional deficiencies. Few developing countries have come close to eliminating malnutrition without some combination of these practices. However, these programs alone cannot solve problems of chronic malnutrition.

General food price subsidies were used in Sri Lanka for several years and helped relieve malnutrition and extend life expectancy to a remarkable degree. However, food price subsidies are expensive, and

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[6] See Margaret Grosh, Carlo del Ninno, Emil Tesliuc, and Azedine Ouerghi, *For Protection and Promotion: The design and implementation of effective safety nets* (Washington, D.C.: The World Bank, 2008).

even Sri Lanka decided to cut back its general subsidy, and instead to target specific groups. A study by the International Food Policy Research Institute (IFPRI) of the Sri Lankan food stamp scheme indicated that the targeted subsidies did reduce program costs substantially, but had mixed results in reaching the poor.[7] Food price subsidy schemes sometimes lower prices, thereby reducing incentives for domestic food production.

Several countries have instituted supplementary feeding programs for vulnerable groups such as children and pregnant and nursing mothers. In some cases these programs provide food to be consumed in a specific location such as in schools or health centers, while in others food may be consumed at home. In either case, while total family food consumption rises, that of the food recipient usually grows by less than the total donation. Some food is shared with family members. The evidence on supplementary feeding programs indicates that they often are associated with measurable improvements in nutritional status, but they tend to be expensive for the benefits received. Administration of these projects can be very difficult. In some cases, these programs have been assisted with food aid from other countries as discussed below.

Another food intervention program involves fortification by adding specific nutrients during processing. The most successful example is iodine fortification of salt to prevent goiter. Vitamin A also has proven relatively inexpensive to add to foods such as tea, sugar, margarine, monosodium glutamate, and cereal products. Attempts have been made to fortify food with iron to prevent anemia, but reducing iron deficiency anemia has proven to be a complex problem. In general, the effectiveness of adding nutrients to food is reduced by the fact that the poor buy few processed foods, there is often cultural resistance to the fortified product, and the cost of fortification is prohibitive. In many cases, the "fortified" food has been shown to have no more nutrients than unfortified foods; quality control can be prohibitively expensive in developing countries. Recent success in incorporating vitamin A and iron into rice through genetic modification provides another avenue for reducing these micro-nutrient problems.

Health Improvements

Efforts to improve sanitation, reduce parasite infections, and prevent dehydration caused by diarrhea can reduce malnutrition and

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[7] Neville Edirisinghe, "The Food Stamp Scheme in Sri Lanka: Costs, Benefits, and Options for Modification," International Food Policy Research Institute, Research Report No. 58, Washington, D.C., March 1987, pp. 1–85.

mortality substantially. For example, oral rehydration therapy, involving the use of water, salt, and sugar in specified proportions to replace fluid lost during diarrhea, can significantly reduce diarrhea-related deaths. Investments in sanitation services, such as potable water and latrines, when combined with effective education programs, can improve nutritional status by reducing diarrhea. Better health services such as immunization programs can reduce the incidence and intensity of diseases that contribute to malnutrition.

Political, Social, and Educational Changes

Political stability can help alleviate both famine conditions and chronic hunger. The famine in Ethiopia in 1983 and 1984 was exacerbated by political upheaval that hampered relief efforts. The recent famine in North Korea also has political roots. Because programs to curb chronic hunger and malnutrition require long-term commitments, they are necessarily rendered less effective by political instability. Responsible political action can improve income distribution in a country, thereby reducing poverty and malnutrition.

Social, cultural, and educational factors also come into play. For example, declining rates of breastfeeding in some countries have contributed to malnutrition as substitutes can be less nutritionally complete, are often watered down, and in some cases are even unsanitary. In other cases, breastfeeding may continue too long without the addition of needed solid foods. While social and cultural factors change slowly, and economic factors influence decisions, education can help. In fact, few consumption practices are totally unaffected by education. Nutrition education programs, especially when combined with income-generating projects or efforts to increase a family's access to nutrients, such as home gardening, have been shown to lead to improved nutritional status.

International Actions

International actions can help alleviate poverty, famine, and chronic malnutrition. Because increased incomes are so important to improved nutrition, opening of markets in more developed countries, and debt relief, are actions that can help, especially in the long run. Foreign assistance can provide short-run relief and, when properly designed, facilitate long-run development.

Reduced barriers by developed countries to imports from developing countries will enable low-income nations to gain greater access to world markets. The foreign exchange earned can be used for development efforts and food imports when needed.

Rural Health Center in Colombia.

Debt relief is a dire need in many countries, particularly where past governments were not held accountable for how loans were spent, so that the funds were not invested productively. When bad debts arise, it is usually in the long-run best interests of both lender and borrower to share some of the burden of adjustment, to reduce expectation of loan repayment in line with the actual productivity of the loan. For more details on this important topic, see Chapter 19.

Foreign assistance includes food aid as well as technical and financial assistance. Gifts and loans of food at low interest rates can help solve part of the hunger problem if the food assistance is properly administered. Food aid can relive short-term famines and be used in supplementary feeding programs and in other activities, such as food for work programs, to help generate wealth in developing countries. Much more important for the long run, financial and technical assistance can help developing countries expand their capital bases and improve methods for producing food and other products, allowing them to import or develop the new technologies they need to break out of poverty.

SUMMARY

In this chapter, the types and consequences of poverty, hunger, and malnutrition were examined. We now have much better information on the distribution and extent of poverty. Even though it is difficult to measure accurately the extent of hunger and malnutrition in the world,

it is known that chronic malnutrition affects more people than do famines. Malnutrition results in reduced physical and mental activity, stunted growth, blindness, anemia, goiter, cretinism, mental anguish, and death.

The causes of hunger are many, but virtually all these causes are related to poverty. Infections, diseases and parasites, poor nutritional practices, and seasonal variability in food supplies all contribute to the severity of malnutrition. Solutions to hunger and malnutrition include raising incomes; increasing agricultural production in developing countries; food intervention programs; improving health systems; political, social, and educational changes; and a series of international activities such as food aid and other foreign assistance, debt relief, opening of foreign markets, and price stabilization.

IMPORTANT TERMS and CONCEPTS

Anthropometry	Maldistribution of food
Chronic malnutrition	Oral rehydration therapy
Debt relief	Political upheaval
Dietary surveys	Poverty
Famine	Price stabilization
Food aid	Protein and calorie deficiency
Food balance sheets	Safety nets
Food fortification	Seasonal and cyclical hunger
Food price subsidies	Supplementary feeding programs
Foreign assistance	Transitory poverty
Kwashiorkor, marasmus,	Vitamin and mineral deficiency
goiter, anemia, and cretinism	Vulnerability

Looking Ahead

Hunger and malnutrition imply a need for food but not necessarily a demand for food unless that need is backed by purchasing power. Food demand is influenced by income, prices, population, and tastes and preferences. In the next chapter, we will examine tools that can help measure or project the extent to which various demand factors affect food consumption. We will explore how demand interacts with supply to determine prices. The tools discussed are the first of a set of theories and methods presented in this book that can improve your ability to analyze and not just observe food and development problems and policies.

QUESTIONS for DISCUSSION

1 What are the causes of transitory poverty? What can be done to alleviate the problem?

2 Why is it important to have information on the depth and severity of poverty in addition to the poverty prevalence?

3 Has poverty gone down globally over time?

4 Is famine more widespread today than in the past?

5 Is protein deficiency a more severe problem in developing countries today than is calorie deficiency? Why or why not?

6 If people in the United States moved to a diet in which they consumed more grain and less meat, would there be more food for people in poor countries of the world? Why or why not?

7 What are the principal causes and consequences of hunger?

8 How do we measure the adequacy of food availability in a country?

9 What are some solutions to hunger and malnutrition problems?

10 How might safety net programs contribute to long-term development?

11 Why and how does political upheaval contribute to famine?

12 What are the major interactions between health and nutritional problems?

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Economics of Food Demand

Rather than a race between food and population, the food equation
should be viewed as a dynamic balance… between food supply and
demand.   — J. W. Mellor. and B. F. Johnston[1]

THIS CHAPTER

1 Discusses the concept of effective demand and the relative impor-
tance of income, population, preferences, and prices in determin-
ing the demand for food as development occurs
2 Explains the importance of income elasticities and price elasticities
of demand for projecting consumption patterns and for develop-
ment planning
3 Describes how supply interacts with demand over time to deter-
mine price levels and trends

EFFECTIVE DEMAND for FOOD

The need for food and the effective demand for food are related but
distinct concepts. Food needs correspond to the nutrient consumption
required to maintain normal physical and mental growth in children
and to sustain healthy bodies and normal levels of activity in adults.
The effective demand (often just called demand) for food is the amount
of food people are willing to buy at different prices and income levels,
given their needs and preferences.

In this chapter, we consider the means for analyzing food demand
changes resulting from income and price changes. The goal is to help
you predict the likely impacts of a change in either factor on consump-
tion. Later, we'll see how these food demand pressures interact with

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[1] John W. Mellor and Bruce F. Johnston, "The World Food Equation: Interrelations
among Development, Employment, and Food Consumption," *Journal of Economic
Literature*, vol. 22 (June 1984), p. 533.

feed and bio-fuel demand and with supply conditions to determine changes in economic well-being.

Determinants of Food Demand

The quantity demanded of food, or of any commodity, is influenced by two major factors: its price, relative to all other goods, and consumers' incomes, relative to all prices. In order to isolate each effect, economists use a thought-experiment in which we imagine a change in only one variable at a time, and trace out the resulting change in another.

When considering the effect of a change in price on quantity consumed, we expect a higher price to cause a lower quantity consumed and vice versa. This inverse relationship between price and quantity consumed is often called the *law of demand,* and is illustrated on a graph using a market *demand curve* (Fig. 3-1). The slope and location of the

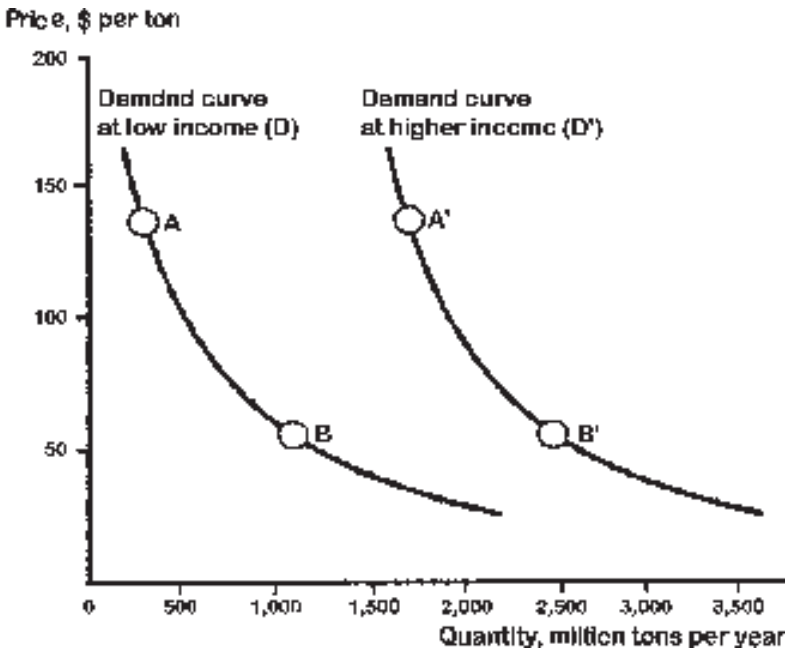Figure 3-1. Hypothetical demand curves for a commodity. A reduction in the price of the commodity, all other things being equal, will cause a movement along a demand curve, say from point A to point B, and an increase in quantity demanded. Changes in the determinants of demand — population, income, prices of other goods, and preferences — can cause a shift in demand, say from point A on demand curve D to point A' on demand curve D'.

market demand curve are determined primarily by income per person, the number of people, and the distribution of income among those people, prices of other goods, and other factors such as consumer preferences and consumption technologies. Changes in any of these factors cause the demand curve to shift, as shown by the shift from curve D to curve D′ in Figure 3-1. Such a shift might be caused by a rise in income, which increases the quantity demanded at a given price. Alternatively, the shift might be caused by population growth at a constant per-capita income. This income effect on demand varies by commodity. Because the influence of income on food demand is not constant across countries, within countries, or by commodity, it is important to have a measure of the sensitivity of demand for food and for particular goods to changes in income. The measure used is called the *income elasticity of demand*.

Income Elasticities of Demand

The *income elasticity of demand* is defined as the percentage by which the quantity demanded of a commodity will change for a one percent change in income, other things remaining constant.[2] For example, when per-capita income increases by 1 percent, if quantity demanded of a commodity increases by 0.3 percent, its income elasticity of demand is 0.3. Typically, for a very low-income country, the elasticity of demand for food as a whole is around 0.8 while for a very high-income country it is around 0.1. This difference in income elasticities means that changes to income have a much larger relative impact on food demand in low-income countries than in high-income countries.

By necessity, poor people have no choice but to spend the bulk of their income on food — at times as much as 80 percent — and when their incomes rise they spend a high proportion of that increase on more food. Eventually, however, further increases in income tend to be spent on other things. This change in the proportion of the family's budget spent on food, or *Engel's law,* says that as income increases, people spend a smaller proportion of their total income on food. This process is reflected in Fig. 3-2, which shows the percentage of total income spent on food for a number of countries with different levels of per-capita income. The distinct downward slope associated with Engel's law would be similar if the graph were constructed for individuals within

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[2] If we define n to be the income elasticity of demand for a good, Q to be the change in quantity demanded for that good, and I to be a change in income, then: $n = \dfrac{\%\Delta Q}{\%\Delta I} = \left(\dfrac{\Delta Q / Q}{\Delta I / I}\right) = \left(\dfrac{\Delta Q}{\Delta I}\right)\left(\dfrac{I}{Q}\right)$
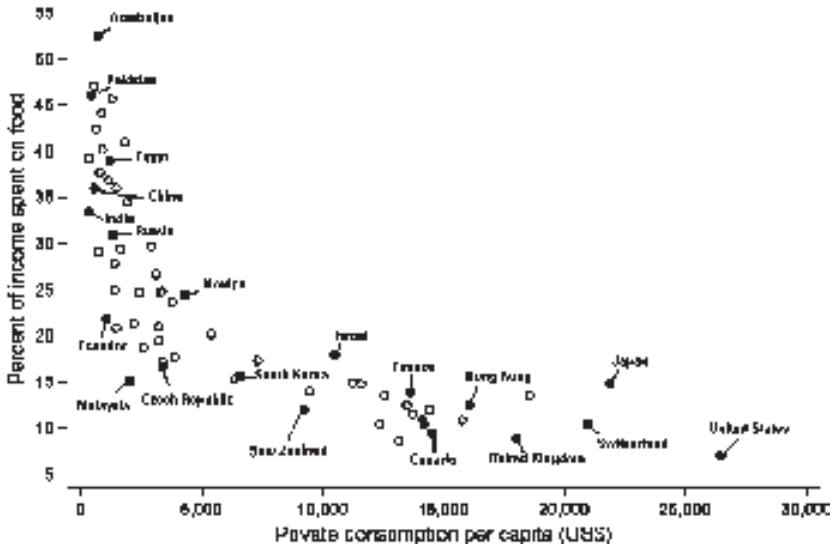
Figure 3-2. Relationship between private consumption and percentage of income spent on food, most countries. (*Source*: World Bank Indicators on-line database, 2005, and USDA/ERS, 2008.)

a country, where richer people spend a smaller fraction of their income on food.

Engel's law reflects, in part, the limited capacity of the human stomach, but note that total expenditures on food generally continue to rise with income, even as the proportion of the budget spent on food declines. Rising incomes lead people to consume more total calories, and also to consume more expensive foods. These foods are often more highly processed (for example, as people switch to bread instead of porridge) and include more animal products (meat, dairy, eggs and fish) as well as more fruits and vegetables. The transition in consumption from a few inexpensive starchy staples such as cassava, rice, or corn to this greater variety of more expensive foods is known as *Bennett's law*, named after the same M.K. Bennett mentioned in Chapter 1. But note that when consumers switch from starchy staples to animal products, demand for animal feed can rise very fast: consumers may reduce their direct consumption of cereal grains as food, while increasing their total usage of cereal grains as animal feed.

Diversification and improvement of the diet with rising incomes implies that income elasticities vary by commodity, and by income level. To show patterns of demand among some of the poorest people in the

Table 3-1. Selected Income Elasticities of Demand for Agricultural Commodities in Sub-Saharan Africa

Region	Wheat	Rice	Maize	Millet	Roots and tubers	Pulses
The Sahel	0.92	0.93	0.46	0.15	— 0.04	— 0.14
West	0.87	0.65	0.15	0.09	0.12	0.42
Central	0.55	0.93	0.66	0.28	— 0.21	0.14
Eastern	0.51	0.58	0.28	0.01	0.29	0.02
Southern	1.46	0.56	0.35	0.17	— 0.15	— 0.002

Source: Cheryl Christensen et al., *Food Problems and Prospects in Sub-Saharan Africa: The Decade of the 1980's,* U.S. Department of Agriculture, Economic Research Service, Foreign Agricultural Research Report No. 186 (Washington, D.C., August 1981).

Table 3-2. Selected Income Elasticities of Demand for Cereals and Livestock Products in Various Counties

Country	Cereals	Beef	Pork	Poultry	Cow's milk	Eggs
Brazil	0.15	0.58	0.29	0.64	0.45	0.55
Egypt	0.04	0.80	0.70	1.30	1.00	0.70
India	0.25	1.20	0.80	1.50	0.80	1.00
Indonesia	0.29	1.50	0.80	1.50	0.20	1.20
Kenya	0.35	1.00	0.70	1.20	0.59	1.30
South Korea	0.09	0.80	0.73	1.00	0.49	0.80
Malaysia	0.14	0.49	0.41	0.87	0.57	0.73
Mexico	-0.10	0.59	0.49	0.93	0.68	0.59
Nigeria	0.17	1.20	1.00	1.00	1.20	1.20
Philippines	0.22	1.20	0.93	1.00	1.50	1.00
Thailand	0.06	0.56	0.47	0.50	0.80	0.50
Turkey	-0.05	0.80	0.50	1.20	0.80	0.80

Source: J. S. Sarma, *Cereal Feed Use in the Third World: Past Trends and Protections to 2000,* International Food Policy Research Institute, Research Report No. 57 (Washington, DC., December 1986), p. 64.

world, Table 3-1 provides examples of estimated income elasticities in various regions of Sub-Saharan Africa for a range of commodities. Estimated income elasticities of demand for other countries and commodities are presented in Table 3-2. Note that income elasticities for animal products are higher than for food grains and root crops. Wheat and rice income elasticities tend to be higher than those of coarse grains, while roots and tubers have consistently small elasticities. The substantial variation in income elasticities across countries reflects differences in

income and in preferences for foods. For example, the income elasticity of demand for beef is low in Latin America compared to Africa, partly because initial levels of beef consumption are high in Latin America.

Most of the estimated income elasticities in Tables 3-1 and 3-2 range between 0 and 1. These goods are called *normal* goods. Goods with income elasticities greater than 1 are called *superior* and represent foods that can be thought of as luxuries in the diet in a particular country. If the income elasticity is less than 0, the goods are called *inferior,* because consumption of them actually declines as income increases.

The fact that income elasticities vary by commodity means that increases in income will result in an asymmetrical expansion in demand for different commodities. Demand for some commodities will expand by a greater percentage than that for others. Depending on the nature of supply, asymmetric expansion of demand can cause different pressures on commodity prices. These changes in commodity prices can influence which crops producers grow and can help determine the direction of development.

Price Elasticities of Demand

So far we've focused on per-capita income as the major determinant of food consumption per person, but quantity demanded also responds to price changes. That price response was represented by movements along the demand curve in Figure 3-1, such as movement from point A at a high price to point B with a relatively low price and a higher quantity demanded. The degree of response in demand from a change in price is measured by the (own) *price elasticity of demand,* defined as the percentage change in quantity demanded of a commodity given a one percent change in its price, other things remaining unchanged.[3] For example, an own-price elasticity of *-0.5* means that with a 1 percent change in price, the quantity demanded will change in the opposite direction by 0.5 percent. Own-price elasticities are typically negative, reflecting the negative slope of the demand curve. If the own-price elasticity of demand is greater (in absolute value) than one, the demand is said to be *elastic*. If it is equal to one, it is said to be *unit-elastic*. If it is less than

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[3] If we define E to be the price elasticity of demand for a good, "Q to be the change in quantity consumed, and "P to be the change in its price, then:

$$E = \frac{\%\Delta Q}{\%\Delta P} = \left(\frac{\Delta Q/Q}{\Delta P / P} \right) = \left(\frac{\Delta Q}{\Delta P} \right) \left(\frac{P}{Q} \right).$$

Potatoes in Ecuador.

one, it is said to be *inelastic*. In a demand curve such as shown in Figure 3-I, an elastic demand has a relatively flat slope, as small price changes lead to large quantity changes.

Price elasticities of demand are useful for projecting demand changes that might result from policies that manipulate prices or from supply shifts. *Cross-price elasticities*, which represent the percentage change in quantity consumed of one commodity for a one percent change in the price of another commodity, holding all else equal, also are important.[4] If the cross-price elasticity of demand is greater than zero, the two commodities are said to be *substitutes.* If the cross-price elasticity is zero, the commodities are unrelated, and if it is less than zero they are called *complements.*

When the price of a commodity changes, the change in relative prices causes most consumers to adjust the composition of the commodity bundle they purchase so that they buy less of the good that increased in price. This substitution is known as the *substitution effect.* Also, if the price of a commodity increases, the real purchasing power of a given amount of income is reduced, causing demand to change because of an *income effect.* In most cases, this income effect is a second

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[4] If we let E_{12} = the cross price elasticity for commodity 1 as the price of commodity 2 changes, DQ_1 = the change in the quantity demanded of commodity 1, as DP_2 = the change in price of commodity 2, then:

$$E_{12} = \frac{\%\Delta Q_1}{\%\Delta P_2} = \left(\frac{\Delta Q_1}{\Delta P_2}\right)\left(\frac{P_2}{Q_1}\right)$$

factor that reduces demand for the commodity experiencing the price increase.[5] For inferior goods, however — commodities such as potatoes and cassava — the income effect may work in the opposite direction and partially offset the reduced consumption induced by the relative price increase.

A price increase for a good will increase consumption of substitutes, and decrease consumption of complements. Part of these consumption changes are caused by changes in relative prices and part of them are due to income effects. Because the income elasticity of demand for food is large for low-income consumers and because they spend a high proportion of their income on food, low-income consumers often make larger adjustments in their commodity purchases than do high-income consumers when prices change.

Obtaining Elasticity Estimates

The effects of the changes in consumer behavior discussed above have important implications for food policies and nutrition in less-developed countries, so food-policy analysts often need updated local estimates of the sizes of the income elasticities, own-price elasticities, and cross-price elasticities of demand for various commodities. For example, if a policymaker wants to project domestic food demand and the increased production or imports needed to meet that demand, the income elasticity of demand for food is one of the pieces of information needed. If an estimate of the effect on the calorie and protein intakes of the poor resulting from a decrease in the price of rice is needed, it is important to have the own-price elasticity of demand for rice and the cross-price elasticities of demand between rice and other major foods in the country, disaggregated by income group.

How are elasticity estimates obtained? There are several approaches, and the appropriate procedure to use depends on the data available and the questions being asked. One type of estimate uses national aggregate data on consumption, production, trade, and prices. Often these data are published by international sources for several countries. If data are available on the same factors for several countries or for several regions in one country for one period of time, they are called *cross-sectional data.* If data are available for the same factors for

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[5] If the consumer is also a producer of the good, which is often the case in rural areas of developing countries, this income effect can be positive. Commodity price increases can actually raise disposable income by increasing farm profits. This profit effect can be important when examining price responses among agricultural households that both consume and produce goods.

one country for several years, they are called *time-series data.* Often we have combined cross-sectional and time-series data, that is, time-series data for the same factors for a number of countries at the aggregate level. These aggregate data are not very useful for studying short-term consumption behavior for commodities within countries because tastes and preferences vary by country. However, the data may be helpful in making long-term projections.

Sometimes, household-level, cross-sectional data are obtained by sampling many households to obtain information on income, expenditures on different commodities, prices paid, and educational levels and other demographic characteristics.[6] Occasionally the data are collected over time as well, although not often because of the cost involved. If one is interested in microeconomic issues associated with consumer behavior for different income groups, these household-level data are preferred.

Data (aggregate or household-level) are usually analyzed graphically and then in a statistical or *econometric* (statistical model which incorporates economic theory) model containing a set of demand equations.[7] These equations include variables representing the factors mentioned above. Elasticities are calculated from the estimated coefficients. These elasticities can be used for a variety of policy and planning purposes. Sometimes when data do not exist in one country or at a period in time, studies from other countries or at a different period of time are used. Elasticities from other studies may not be ideal, but they are frequently used.

Some countries have serious deficiencies in aggregate and household-level data. Often these data are unreliable or even nonexistent. Policy analysts who have little time or money to collect new data and estimate a model sometimes rely on relationships from economic theory to obtain rough approximations of missing elasticities. For example, there is a useful working assumption (called the homogeneity condition) that the sum of the own-price elasticity, the income elasticity, and the cross-price elasticities of demand for a commodity is equal to zero.[8]

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[6] Collecting household data is a difficult and costly undertaking. For an excellent overview of topics in household data collection, see Joachim von Braun and Detlev Puetz, *Data Needs for Food Policy in Developing Countries* (Washington, D.C.: International Food Policy Research Institute, 1993).

[7] See Angus Deaton, *The Analysis of Household Surveys* (Baltimore: Johns Hopkins University Press, 1997), especially Ch. 1, for an advanced treatment of types of data and their uses for policy analysis.

[8] That is, for the ith commodity out of T commodities, $E_i + \eta_i + \sum_{\substack{j=1 \\ i \neq j}}^{T} E_{ij} = 0.$

Typically, the sum of the cross-price elasticities for a commodity is greater than zero and the own-price elasticity is negative. Therefore, the absolute value of the own-price elasticity is usually larger than the income elasticity of demand. One may have an estimate of the income elasticity of demand but not the own-price elasticity. The homogeneity condition can be used to obtain a rough estimate of the size of the price elasticity of demand given that income elasticity and assumptions about cross-price elasticities. The homogeneity condition is just one example of the use of demand theory. The main points are that data availability and quality limit the potential for economic analysis, but a variety of techniques can often be exploited to interpret the available data in useful ways.

USING CONSUMPTION PARAMETERS for POLICY and PLANNING

The purpose of obtaining income and price elasticities is to assist with policy analyses and planning. A variety of questions can be answered with the help of these elasticities. For example, what will happen to the consumption of rice, wheat, sugar, or meat when income rises? What will happen to the aggregate demand for food? How will the demand change for different commodities as absolute and relative prices change? What will be the effects of price and income policies on the poor? The answers to these questions help policymakers anticipate future demand changes and production needs, and provide information for designing price and income policies (see Box 3-1).

Income-Induced Changes in the Mix of Commodities Demanded

For commodities with high income elasticities, demand can grow very rapidly when income rises. Anticipating income growth, policymakers may want to support research or use other means for encouraging increased production of those commodities. Otherwise, prices will rise or imports increase in response to demand growth.

Many highly income-elastic commodities, such as milk and vegetables, have high nutritional value. However, some goods with relatively high nutritional value have low income elasticities.[9] If a government wants to increase consumption of a good with a low income

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[9] Elasticities reflect people's preferences for different attributes of the good, including taste, convenience and nutritional value. A low value for an elasticity in not necessarily "bad"; it reflects consumer choices given income, preferences, prices, and information about the good.

BOX 3-1.

IMPACTS of RICE PRICE POLICY on the POOR in THAILAND

Angus Deaton used household-level data from Thailand to examine how policies affecting the price of rice would affect households in rural and urban areas and at different levels of income. Because rural households are both producers and consumers of rice, increased prices may or may not benefit them. They will gain as producers, but lose as consumers (all urban rice consumers will lose as a result of higher rice prices). The key to the analysis is to determine the "net benefit ratio" or the difference between the value of production and the value of consumption divided by total household expenditures. This ratio varies by total household income, and the analysis shows that middle income producers will benefit most from rice price increases. High-income rural households benefit very little from high prices (they earn their incomes outside agriculture or do not produce much rice). Very low income rural households benefit by relatively small amounts, because their marketed surplus is low. Compared to plantation-type products (such as sugar and bananas), where product price increases benefit larger-scale producers, rice price policy has its strongest impact on the middle of the income distribution in rural areas of Thailand. The study shows that the impacts of price policy depend on the commodity in question and the socioeconomic conditions of producer and consumer groups.

Source: Angus Deaton, *The Analysis of Household Surveys* (Baltimore: Johns Hopkins University Press, 1997), pp. 187–90.

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elasticity, it may have to resort to educational or subsidy programs. Educational programs help change people's perceptions about physical (nutrient) needs and the amount of these needs the food provides. These programs essentially lower the costs associated with acquiring information about nutrient needs and food nutrient content.

At the world level, differences in income elasticities by commodity imply that as per-capita income grows over time, a relative shift will occur in demand toward agricultural commodities with high income elasticities. Many of these are high protein foods such as livestock products. One can also expect the grains fed to livestock, such as corn, to increase in demand relative to food grains such as rice. These types of changes have already been occurring over the past several years.

Another impact of these patterns of income elasticities is that the average income elasticity of demand for food grains will decrease as development occurs. Small income elasticities are associated with small price elasticities of demand. With lower price elasticities, increased

Cattle in Colombia.

production of food grains would put sharp downward pressure on their prices. Lower prices should help poor consumers who continue to spend large shares of their budget on grains, but may force many of the farmers producing these grains to switch to other commodities or leave agriculture.

Changes in Aggregate Food Demand as Development Proceeds[10]

The demand for food is influenced by population, per-capita income, prices, and preferences. As development proceeds, the two primary factors shifting the demand for food outward are increases in population and in per-capita income. These two major forces are captured by the simple relation $D = p + ng$, where D = rate of growth in the demand for food, p = rate of population growth, n = income elasticity of demand for food, and g = rate of increase in per-capita income.

In the above equation, population influences food demand in two ways. First, as presented by the term p, it causes a proportional increase in demand. However, per-capita income equals total income divided by population. Therefore, the net effect of population growth will not be a proportional increase in demand, because population growth may slow the rate of per-capita income growth.

[10] Material in this section draws on John W. Mellor, *Economics of Agricultural Development* (Ithaca, N.Y.: Cornell University, 1966), pp. 73–9.

At the extreme, if income does not expand at all with increased population, the drop in per-capita income will almost completely nullify the direct effect of population growth. For example, developing countries often experience a population growth rate of 3 percent per year during the early stages of development. The income elasticity of demand for food may be as high as 0.9. If total income remains constant, then per-capita income will decline by 3 percent and the rate of growth of demand will be D = 3 + 0.9(-3) = 0.3.[11]

On the other hand, if per-capita income is growing at 3 percent per year while population is also growing at 2.5 percent (rates that are not uncommon in middle-income developing countries), even if the income elasticity of demand for food drops to 0.7, the rate of growth in demand for food would be 4.6 percent per year. Few countries have been able to maintain such a rate of growth in agricultural production over time. Thus, food imports may be needed to meet growing demands.

These examples ignore the fact that income growth in most less-developed countries is heavily dependent on agricultural output. If agricultural output fails to grow, per-capita income will grow very slowly. As development proceeds, the proportion of employment and of total national income derived from agriculture shrinks. Even so, total per-capita income still may be affected by the rate of growth of agricultural production because agriculture provides food, capital, and a market for non-agricultural products. These issues will be more fully discussed in subsequent chapters.

The determinants of food demand are interrelated; but as development proceeds, certain patterns tend to hold for some of these factors (see Table 3-3). As incomes increase, population growth rates generally increase slightly at first as death rates decline. For a number of reasons discussed in the next chapter, population growth rates eventually fall as income continues to grow. The rate of per-capita income growth is frequently highest in the middle-income countries, and the income elasticity of demand for food declines continually as income grows. The result is that the rate of growth in food demand is highest for middle-income countries. These are the countries that are most likely to need food imports. Data indicate that middle-income countries frequently exhibit the largest increase in per-capita income and food imports even though they also experience the largest increases in agricultural production.

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[11] The negative consequences of such a scenario should be obvious: total demand will increase by 0.3 percent but *per capita* demand will decline by 2.7 percent.

Table 3-3. Comparison of Growth of Demand for Agricultural Goods, Hypothetical Cases

Levels of Development	Rate of population growth	Rate of per capita income growth	Income elasticity of demand	Rate of growth of demand
Very low income	2.5	0	1.0	2.5
Low income	3.0	1.0	0.9	3.9
Medium income	2.5	4.0	0.7	5.3
High income	2.0	4.0	0.5	4.0
Very high income	1.0	3.0	0.2	1.3

Adapted from John W. Mellor, *Economics of Agricultural Development* (Ithaca, N.Y.: Cornell University Press, 1966), p. 78.

DEMAND for FARM PRODUCTS for NON-FOOD or FEED USES

Many agricultural products are used not only for food and feed, but for industrial purposes such as starch, fiber, and energy. In recent years, foods crops such as maize, soybeans, and sugarcane have increasingly been diverted to production of bio-fuels such as ethanol and bio-diesel. As the demand for these energy products grows, it competes directly with the demand for food and feed, driving up the overall demand (and prices) for farm products as growth in supply has not been able to keep up with growth in overall demand, and the supply of agricultural products for food and feed is diverted to bio-fuels.

Demand for bio-fuels has grown because the demand for energy has risen due to population and income growth around the world, while energy — primarily oil and gas — supplies have not grown as rapidly, thus driving up the price of energy products. Technology to produce ethanol and biodiesel has improved over time, so that the net energy balance (energy used to produce as compared to energy obtained from a gallon of bio-fuel) has become more favorable, reducing the cost of supplying bio-fuels. Governments, led by the United States and Brazil, have also subsidized research on and production of bio-fuels.

At any given time, speculators are also in the market, driving prices up or down as they make bets on the future supply and demand situations for energy products. Due to speculation and uncertainty, prices may rise above or drop below the level that fundamental supply and demand factors would dictate they should be. However, prices

eventually adjust (and remove over-adjustment) as new information becomes available. A good example is the price patterns for maize, rice, soybeans, and other basic cereals in 2007–2008. Grain prices rose sharply in those years after being relatively constant for several years. Fundamental demand forces — such as increased population and incomes in several countries and increased demand for bio-fuels — combined with supply factors such as slow growth in productivity, higher input costs, and poor weather in major producing countries to drive up grain prices. However, prices were driven even higher than they would have been otherwise for several months due to speculation. In the section below, we examine further how demand and supply factors interact to determine price.

INTERACTIONS between DEMAND and SUPPLY

If markets operate freely with numerous buyers and sellers, supply interacts with demand to determine the quantity supplied and demanded as well as the price. Market supply is defined as the amounts of a product offered for sale in a market at each specified price during a specified period of time (see Fig. 3-3).

A given supply curve assumes that the following factors are held constant: (1) technology of production (the way the good is produced), (2) prices of inputs used in production, (3) prices of products that may be substituted in production, and (4) number of sellers in the market. Changes in these factors can cause the supply curve to shift inward or outward. For food as a whole, changes in technology are a major factor causing shifts in supply over time. A new technology that lowers the cost of production will shift the supply curve downward to the right (such as from supply curve 1 to supply curve 2 in Fig. 3-3).

Price and Policy Implications

The rate of growth or decline in agricultural prices over time depends in large part on the net effects of supply and demand shifts (see Figure 3-4). Because of outward shifts of the demand curve caused by population and income growth, it is unlikely that agricultural prices will experience major declines resulting from supply growth in a country during the early stages of development.[12] If the supply curve for food shifts out very little, population- and income-driven demand growth could

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[12] However, there may be substantial local or regional variation (see Box 3-2), and agricultural prices in a country may go up or down as well, due to changes in supply and demand in international markets.
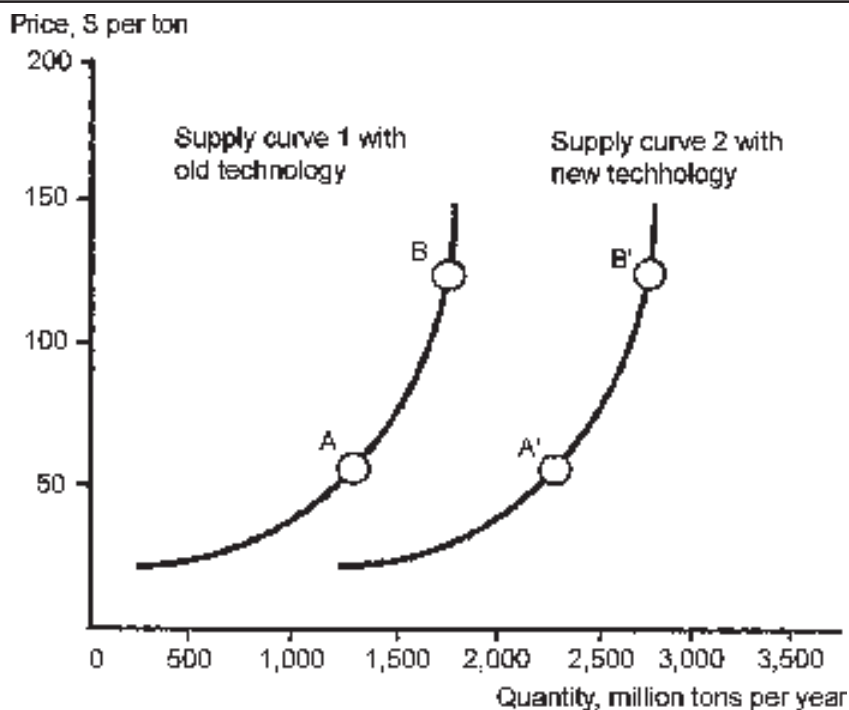
Figure 3-3. Hypothetical supply curve for a commodity. An increase in the price of the commodity, all other things being equal, will cause a movement along a supply curve, say from point A to point B, and an increase in quantity supplied. Changes in the determinants of supply — technology, input prices, other output prices, number of sellers — can cause a shift in the supply curve, say from A along supply curve I to A' along supply curve 2, or vice versa if there is a worsening of productivity.

lead to price increases, especially if a country has isolated its markets from world markets. However, these increases are likely to be small because of the close relationship between agricultural production growth and income growth during early stages of development. As noted earlier, it is difficult to get large increases in income, and therefore effective demand, without corresponding increases in agricultural production.

Other important determinants of the effect of supply and demand shifts on agricultural prices are the elasticities of supply and demand. The more elastic the supply curve (roughly the flatter it is in Figure 3-4), the less prices will change as demands grow. Open economies (those where imports and exports are common) tend to be characterized by
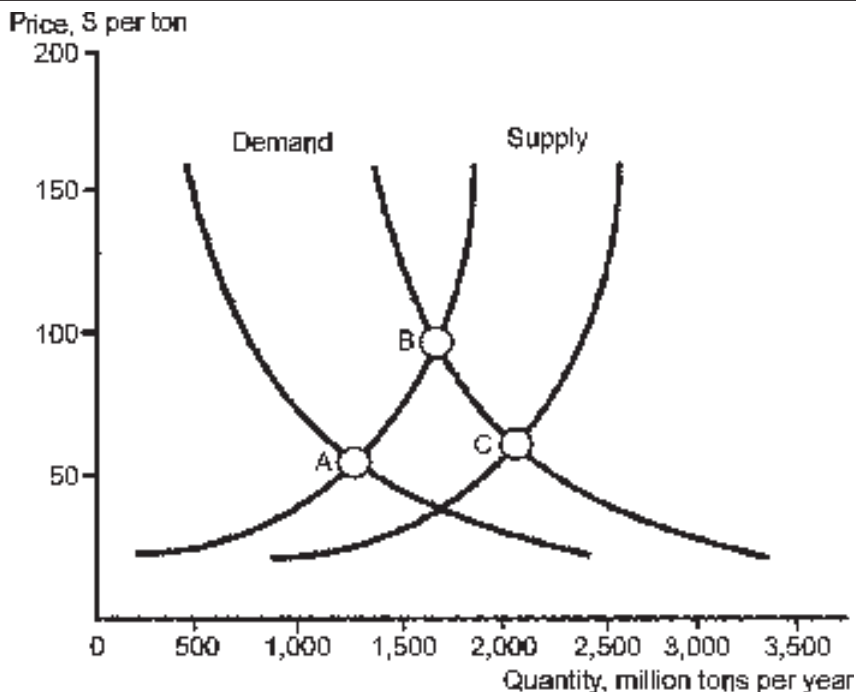
Price, S per ton

Figure 3-4. Hypothetical supply and demand curves for a commodity. Changes in determinants of demand — for example, income and population — can cause a shift in demand while changes in the determinants of supply — for example, technology — can cause a shift in supply. When both are shifting, whether the net effect is a price increase or decrease (whether A is higher or lower than C) depends on the relative size of shifts of supply and demand and the slopes of the curves.

more-elastic commodity supplies. One means of minimizing demand-induced price increases is to permit food imports. Another is to increase the responsiveness of the food production sector. However, open economies are also susceptible to sizable price swings if changes in supply and demand occur elsewhere in the world. These implications are examined in greater detail in Chapters 16 and 17.

The expected relative stability in food prices during the early stages of development (except as prices are affected by short-run phenomena such as weather or by international forces) implies a need to place emphasis on policies to shift out the agricultural supply curve and to raise incomes rather than on pricing policies. Thus, the focus of public investment needs to be where the return is highest, whether it is inside or outside agriculture. Because it is difficult to increase incomes of the

BOX 3-2.
MARKETS and REGIONAL PRICE VARIATION

Developing countries are often characterized by poor transportation systems, sparsely populated areas, or isolated pockets of high population densities and limited means of knowing what economic conditions exist in these isolated regions. Because of these factors, regional food markets tend to be isolated and independent. Prices can vary widely from region to region, with little relationship to average national prices and quantities, or to those prices prevailing in markets in large cities. In addition, local prices tend to be more variable than national prices since, with few market participants, changes in behavior by small numbers of participants can affect prices.

The consequences of these market problems can be high regional food prices and less ability to meet consumption needs for given incomes. High price variability causes uncertainty to producers and consumers of the products. These factors worsen national welfare, and can cause isolated pockets of poverty. Increases in national supply will do little to improve such situations.

Regional supply differences caused by high marketing costs due to poor transportation systems can only be lowered by improvements in infrastructure and market information. Poor information causes these differences when costs associated with gathering price and demand information impairs the effectiveness of the marketing system. Measures to enhance information flows include collection and dissemination of market-related information and telecommunications systems to transmit the information.

poor without increasing employment, the country may need to focus investments on labor-intensive commodities and industries.

As development proceeds, incomes grow, and demand shifts outward, the possibilities for rapid increases in food prices arise even in countries experiencing rapid growth in agricultural production. The reasons for this were discussed earlier and illustrated in Table 3-3. Middle-income countries experiencing rapid rates of income growth are likely to need increased agricultural imports.

Eventually, when high income levels are reached, income elasticities of demand for food and population growth rates become smaller. These small income elasticities relieve the upward pressure on food prices but create the potential for food surpluses and low farm prices. Policies at this stage tend to be concerned with easing the cost of adjusting large portions of the labor force out of agriculture, directing producers into those commodities for which the country has a relative advantage in world markets, and stabilizing domestic farm prices, which

tend to be more heavily influenced by swings in international prices now than they were in the past.

The existence of structural changes in the market for agricultural goods over time suggests a strong need to tailor development policies to each country's stage of development. It also suggests a need for each country to consider the stages of development of other countries in the world and changes in energy markets when making projections about future demands for agricultural products.

SUMMARY

The effective demand for food is determined by the physical and psychological need for food combined with the ability to pay for it. Demand is influenced by prices, population, income and preferences. The level of per-capita income is a major determinant of food demand in low-income countries. The income elasticity of demand for food varies systematically by income level, by commodity, and by places and socioeconomic groups within a country. The income elasticity of demand for food declines as development proceeds, and shifts in consumption occur away from starchy staples toward higher-protein foods. Own- and cross-price elasticities of demand are useful for projecting demand changes. Several procedures are available for obtaining income and price elasticities. Middle-income developing countries generally experience the most rapid rates of growth in demand for food. Changes in energy markets have added an additional factor to consider when projecting food price changes.

IMPORTANT TERMS and CONCEPTS

Aggregate versus household data
Bennett's law and why it holds
Bio-fuels
Contradictory role of agricultural prices
Cross-price elasticity of demand
Cross-sectional versus time-series data
Econometric model
Effective demand
Elastic versus inelastic demands
Engel's law and why it holds
Factors that shift the demand curve
Factors that shift the supply curve
Homogeneity condition and its use

Income effect
Income elasticity of demand
Law of demand
Major determinants of long-run price trends
Normal, superior, and inferior goods
One-price elasticity of demand
State of development
Substitutes of complements
Substitution effect
Supply
Use of aggregate versus house hold-level data

Looking Ahead

Rapid population growth over the past few years has dramatically increased the world's population and made the task of raising per capita income and reducing hunger in some countries more difficult. Population growth is influenced by many factors, and several policies have been tried or suggested for controlling it. In the next chapter, you will learn about population growth, including implications for food consumption and natural resource use. You will examine population projections and policies for the future.

QUESTIONS for DISCUSSION

1 As incomes increase, do people spend greater, smaller, or the same proportion of their income on food?
2 Distinguish between an income elasticity of demand and a cross-price elasticity of demand.
3 What tends to happen to the income elasticity of demand for food as the per-capita income of a nation increases? Why?
4 To estimate the effect on the calorie and protein intake of a population resulting from a decrease in the price of rice, why is it important to know something about the cross-price elasticities of demand between rice and other major foods in the country?
5 Assume the price elasticity of demand for eggs in India is –0.75. By what percentage would the price of eggs have to change to increase egg consumption by IS percent?
6 Do you expect the price of food in the world to be higher or lower 10 years from now? To answer this question, draw a graph with supply and demand curves and show how you expect the curves to change over time and why.
7 If population is growing at 2.6 percent per year, the income elasticity of demand for food is 0.6, and per-capita income is growing at 4 percent per year, what would be the growth in demand for food per year, assuming prices remain constant?
8 What tends to happen to the mix of foods consumed as per-capita income in a country increases? Why?
9 If agricultural development is successful at increasing the level of per-capita food production in several less-developed countries over the next 10 years, why might these same countries become less self-sufficient in food (have to import more food than before) during that period of time?

10 Assume you have the following cross-price elasticities for a particular country:

Commodity	Cross-price elasticity
Rice and beans	– 0.35
Rice and wheat	0.40
Rice and chicken	– 0.10
Rice and milk	– 0.05
Rice and other goods	0

a You are a planner for the country represented above and you want to raise the consumption of rice by 6 percent to improve calorie intake of the population. The income elasticity of demand for rice is 0.4. Use the information above and the homogeneity condition to determine the necessary percentage change in the price of rice.

b If rice consumption increases by 6 percent, what else besides the calories obtained from rice would you need to consider when assessing the impact on calorie consumption?

11 What distinguishes the need for food from the effective demand for food?

12 Which of the following factors shift primarily the demand curve and which factors shift primarily the supply curve: per capita income changes; new technologies; population growth; tastes and preferences; prices of inputs used in production; prices of other goods consumed; prices of substitute goods in production?

13 Why is there a close relationship between agricultural production growth and a nation's income growth during the early stages of development?

14 Even if agricultural production increases rapidly, why is it unlikely that countries in early stages of development will experience major price decreases as a result?

15 Why do middle-income countries experiencing rapid rates of growth in food production often need food imports, while very poor countries that are experiencing slower rates of food production growth do not?

RECOMMENDED READINGS

Foster, Phillips, and Howard Leathers, *The World Food Problem* (Boulder, Colo.: Lynne Rienner, 1999), Chapter 8.

Mellor, John W., *Economics of Agricultural Development* (Ithaca, N.Y.: Cornell University Press, 1966), Chapter 4.

Runge, C. Ford, C. Benjamin Senauer, Philip G. Pardey, and Mark W. Rosegrant, *Ending Hunger in Our Lifetime* (Baltimore: Johns Hopkins University Press, 2003) pp. 39–56.

von Braun, Joachim, *Rising Food Prices: What Should be Done?* IFPRI Policy Brief, April 2008. http://www.ifpri.org/pubs/bp/bp001.pdf.

Population

> When poverty is tied to rapid population growth rates (as it generally is), the risk of widespread hunger is *ever present.*
> — Runge, Senauer, Pardey, and Rosegrant[1]

THIS CHAPTER

1 Presents basic facts about the distribution of the world's population, the rate of population growth, and the consequences of rapid population growth.

2 Explains the determinants of population growth and policies that can affect that growth.

3 Examines causes and implications of migration from rural to urban areas

BASIC FACTS about POPULATION GROWTH

The human race dates back about 3 million years. During more than 99 percent of this time there was virtually zero population growth. Average life expectancy was 20 to 25 years, and world population probably never exceeded 10 million people. After agriculture replaced hunting and gathering of food, around 6,000 to 8,000 B.C., population began to grow more quickly because larger numbers of people could be supported by food production. By the year 1 A.D., there were about 300 million people and, by 1650, 500 million.

Population began to grow more rapidly during the industrial revolution in the eighteenth century and really accelerated after World War II when populations in developing countries began to grow dramatically. World population reached 1 billion around 1800,

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[1] C. Ford Runge, Benjamin Senauer, Philip G. Pardey, and Mark W. Rosegrant, *Ending Hunger in Our Lifetime: Food Security and Globalization* (Baltimore: Johns Hopkins University Press, 2003), p. 21.

2 billion in 1930, and 3 billion in 1960. It grew to 4 billion in 1975, 5 billion in 1986, 6 billion in 1999, 6.5 billion in 2006, and will exceed 7 billion around 2013 based on projected future growth rates (see Figure 4-1). The rate of population growth in the world peaked at 2.0 percent per year in 1965 and has declined since then to its current (2009) rate of about 1.2 percent. However, population itself will continue to grow for many years since the future number of parents will be much larger than the current number because of the rapid population growth in the recent past.

Distribution of the World Population

The world's population is distributed unevenly across the globe, reflecting the degree to which each location attracted migrants and was able to sustain growth in its local population over time. The earliest human ancestors lived in Sub-Saharan Africa, and migrated from there to other regions. By far the greatest accumulation of population has occurred in Asia, which holds over 60 percent of the world's population and has the highest population densities. Large populations
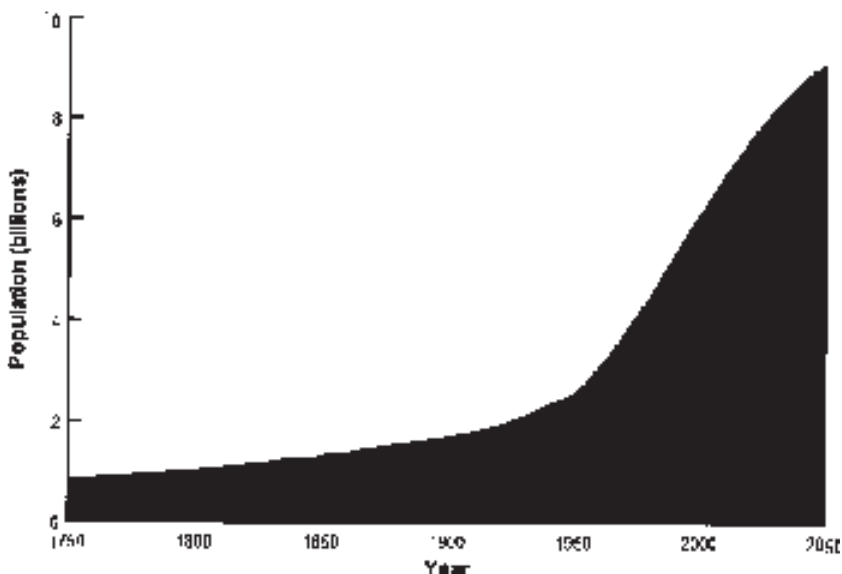

Figure 4.1. Past and projected world population, 1750 to 2150, medium estimate. (*Source*: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, *World Population Prospects: The 2004 Revision.*)

are also found across Europe, along the coasts of North and South America, and within Africa.

The current size and density of the ten most populous countries are shown in Table 4.1. The list is dominated by China and India, but several other Asian countries have large populations and also have very high density, with more than 100 people per square kilometer. These countries account for the bulk of historical population growth. Today, population growth in Asia and elsewhere has slowed, and the fastest growing countries are mainly in Sub-Saharan Africa (Table 4-2). The ten fastest growing countries are all in Africa, with annual rates of population increase at or above 3.0 percent per year. Such rapid growth is almost unprecedented in human history. It is occurring in the world's poorest places, where purchasing power per capita is below a dollar a day, and it is often occurring in places where rapid population growth is a fairly recent phenomenon. At the other end of the spectrum, the slowest-growing countries and presented in Table 4.2. Some of these countries are actually losing population. Countries that have negative population growth rates are mainly the former socialist countries of Eastern Europe, but also include some high income countries in Europe (Germany and Portugal).

Table 4-1. The World's Most Populous Nations

Nation	Mid-2008 population (millions)	Population density (people/kilometer)
China	1,325	139
India	1,149	350
United States	305	32
Indonesia	240	126
Brazil	195	23
Pakistan	173	217
Nigeria	148	64
Bangladesh	147	1,023
Russia	142	8
Japan	128	338
Total (10 nations)	3952	
Total (world)	6705	49

*Source: P*opulation Reference Bureau, Inc., 2008 World Population Data Sheet.

Table 4.2. Population Growth Rates in the World's Fastest and Slowest Growing Nations (with 7 Million or More Population)

Fastest growing nations	Annual growth rate (percentage, 2008)	Mid-2008 population (millions)
Mali	3.3	12.7
Malawi	3.2	13.6
Yemen	3.2	22.2
Niger	3.1	14.7
Uganda	3.1	29.2
Dem Rep. of the Congo	3.1	66.5
Benin	3.0	9.3
Burkina Faso	3.0	15.2
Burundi	3.0	8.9
Guinea	2.9	10.3

Slowest growing nations	Annual growth rate (percentage, 2008)	Mid-2008 population (millions)
Ukraine	− 0.6	46.2
Bulgaria	− 0.5	7.6
Hungary	− 0.4	10.0
Serbia	− 0.4	7.4
Russia	− 0.3	141.9
Belarus	− 0.3	9.7
Romania	− 0.2	21.5
Germany	− 0.2	82.2
Portugal	− 0.0	10.6
Poland	0.0	38.1

Source: Population Reference Bureau, Inc., 2008 World Population Data Sheet.

Consequences of Rapid Population Growth

Rapid population growth is a problem for most developing countries mainly because it changes the age composition of the country, with a larger fraction of the population being children. Population growth mainly takes the form of a rising number of children and young people, which imposes a strain on the natural resource base, increases pressures for jobs, reduces food production gains per capita, contributes to pollution, and strains the capacity of schools and other social services. While it would be an over-simplification to say that population growth is the root cause of natural resource problems, unemployment, and so forth, it certainly intensifies these problems.
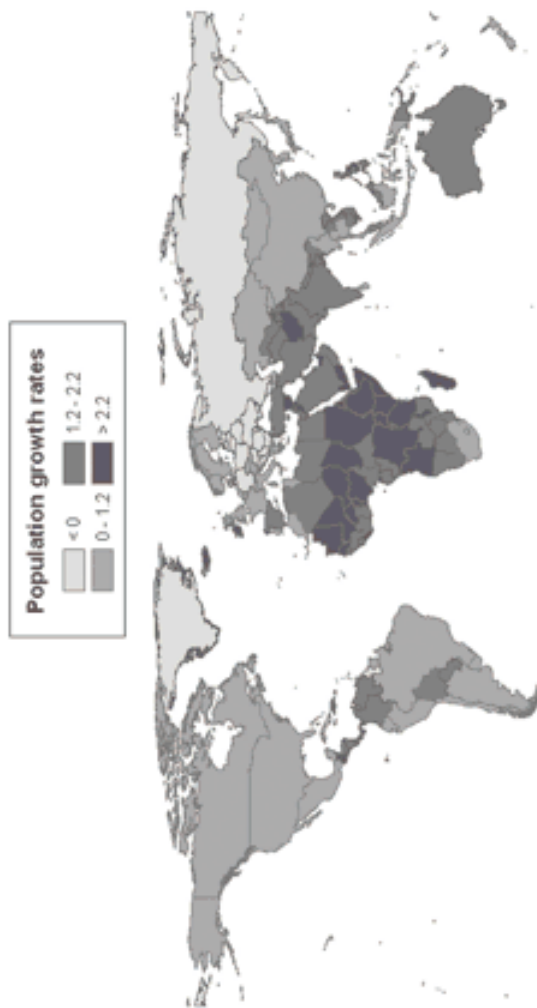
Figure 4-2: Population growth rates (percent), 2007. (*Source*: World Bank: World Development Indicators on-line database.)
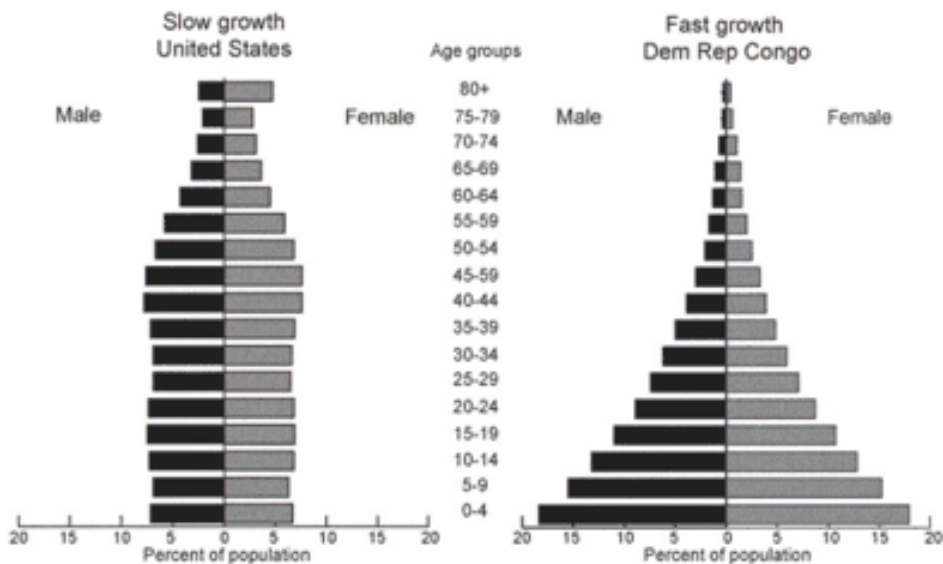
Figure 4-3. Population Profiles, Growth, and Momentum: The age distribution of the people in a country has a major impact on the future rate of growth of its population. The population pyramid is a tool that demographers use to describe this distribution. Shown above are two population pyramids, reflecting differing rates of current and future population growth. The broad base on the Congo pyramid means that there is population growth "momentum" which will cause population to grow, even if fertility, or the number of children that each family has, slows immediately to replacement levels. As the large number of people in the younger age groups in Congo reach child-bearing age, the number of births will rise dramatically, even if the number of births per couple falls. The United States has a relatively even age distribution, and is unlikely to experience a large increase in population. (*Source*: U.S. Census Bureau, 2005.)

Differences in age structure associated with different rates of population growth are illustrated in figure 4-3. Those with rapid growth have large numbers of very young children relative to working-aged people. This high dependency causes increased current consumption and reduced savings and investment. The impacts of rapid population growth on schooling can be particularly important. Since about 25 percent of the people in developing countries are of school age, compared to 15 percent in typical developed countries, equal amounts of budget outlay for education translate either to low expenditures per pupil or low enrollment rates. Inadequate investments in either physical or human capital will hurt the long-run possibilities for development.

The argument that most countries need more population to provide labor and markets is not very compelling, given the abundance of unskilled labor relative to capital in many countries and the fact that increased consumption of manufactured goods is heavily dependent on per-capita income growth.

Hunger, famine, and poverty were serious problems long before population began its rapid rise. However, the population explosion has made it difficult for some countries to invest and has magnified the lack of social justice in others.

CAUSES of FERTILITY CHANGE and POPULATION GROWTH

Population growth occurs for the world as a whole when births exceed deaths.[2] Years ago, births and deaths were both high, on the order of 40 to 50 every year per 1000 people in the population. About half of the deaths occurred before age ten, and death rates fluctuated from year to year with contagious diseases and with variations in food supplies. During this time, population fluctuated but did not grow rapidly for any sustained period of time.

Sustained population growth began in Europe and other now-industrialized regions during the eighteenth century, with a slow but steady decline in the death rate. Technological and economic progress resulted in improved nutrition and health, which reduced infant deaths and extended life expectancy well before scientists or medical doctors understood what caused disease or knew how to cure people once they fell ill. Population growth accelerated as death rates fell with no change in the birth rate for about one hundred years, until the late nineteenth century, when birth rates began to fall as women delayed marriage and had fewer children (see Figure 4-4). Birth and death rates declined in tandem until the 1950s, when death rates stabilized and the total population growth rate slowed. It took roughly 200 years for the now-industrialized countries to transition from high birth and death rates in the early eighteenth century to low birth and death rates in late twentieth century. During this period, births exceeded deaths by about 10 per 1,000 people, for a population growth rate on the order of 1 percent per year.

In contrast, today's less-developed countries experienced no significant decline in mortality until the twentieth century, when their death rates declined more rapidly than they ever had in the now-developed countries. This precipitous drop in the death rate was not due to slow

[2] Population in individual countries also depends on immigration and emigration.
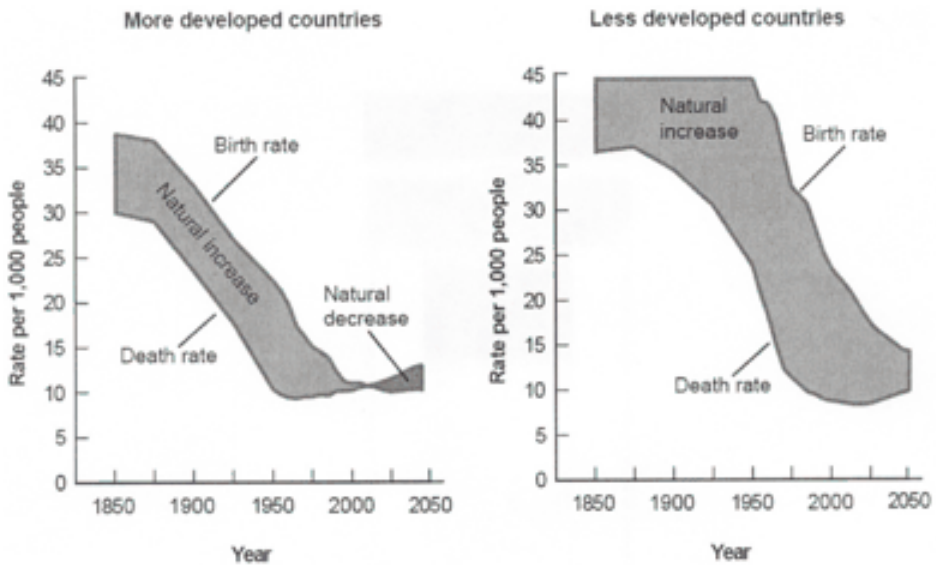
Figure 4-4. Population growth through natural increase, 1850–2050. (*Source*: World Bank, *World Development Report 1980*, New York: Oxford University Press, 1980, p.64;and UN Population Division, World Population Prospects: 2004 Revision Population Database.)

improvements in nutrition and wealth, but to the sudden introduction of technological improvements developed through scientific research. Once scientists and doctors understood the causes of disease and the principles of nutrition, especially after World War Il, countries rapidly deployed the new antibiotics, immunizations, and insecticides to control disease-bearing insects. They invested heavily in sanitation and maternal and child health programs. After the decline in death rates, it took several decades for birth rates to begin falling — but by then the gap between deaths and births was on the order of 20 per 1,000 people, or 2 percent per year, and in many countries it was over 3 percent per year.

In summary, population growth has been much faster in today's low-income countries than it ever was in today's high-income countries for one reason: the low-income countries' death rates fell faster, due to the sudden introduction of life-saving technologies. It is hard to imagine any serious observer wishing that those techniques had *not* been introduced, since they saved millions of lives and made possible much of the population we have today — but the speed of introduction made it relatively difficult for those countries to raise their per-capita incomes, until the transition to lower birth rates could be completed.

The historical *demographic transition* shown in Figure 4-4 has repeated itself in country after country. Each has a different timing and speed of transition, but all began with high birth and death rates and a relatively stable population size, then a decline in the death rate that initiates population growth. For those countries that have completed the demographic transition, a decline in the birth rate has followed, closing the gap between birth and death rates and stabilizing the population size at a new higher level.

The fact that this demographic transition has been observed in many countries in the past does not, of course, guarantee that it will be observed in the future. If population growth outstrips society's resources, death rates could rise again, and indeed in much of Africa they already have, due to the ravages of HIV/AIDS as well as continued high levels of child malnutrition and disease. To understand where and when the demographic transition can be completed without rising death rates, we need to examine the causes of fertility (birth rate) changes and consider policies that might influence those changes.

Causes of Fertility Changes

Family size is largely determined by parental motivation, and this motivation reflects rational, and in many cases, economic decisions. Tastes, religion, culture, and social norms all play a role; yet evidence suggests that differences in economic factors as well as family planning, education, and access to birth control play the major roles. Female education is particularly important in reducing family size.

People receive pleasure and emotional satisfaction from children. Thus there is a consumption benefit from having children, and in poor societies there may be little competition from other consumption goods. It costs time and money to raise children, but these costs (both out of pocket and in terms of earnings foregone while caring for children) may be relatively low, especially in rural areas.

Children are also an investment. This investment value increases the benefits associated with having children. They frequently work during childhood. In rural areas they gather firewood, collect water, work in the field, move livestock, and do other chores. In urban areas, a child's ability to contribute work to the family is more limited; however, income opportunities exist for very young children in urban areas of most less-developed countries (LDCs). An important source of urban employment of children is the "informal sector," often in petty trading and services. When older children leave home, especially if they go to the city, they may send cash back home. Children also provide

Child weeding onions in the Philippines.

security during old age. Most less-developed countries have no social security system. These benefits from additional children raise the number of desired children in less-developed countries, especially among poor families. In many countries, child mortality is high, so that extra births may be necessary to ensure that the desired number children survive. All these factors increase birth rates.

As people obtain more education and earn more money, they delay marriage and have fewer children. Parents have more options, and come to prefer keeping their children in school rather than earning income from children's work. An increase in per-capita income is inherently a rise in the value of time. A rise in the value of time, particularly if women have expanded employment opportunities outside the household, creates strong incentives to have fewer children and to invest more in the health and education of each child.

Thus, poverty and high fertility are mutually reinforcing. Social and economic factors such as income, literacy, and life expectancy account for as much as 60 percent of the variation in fertility changes among developing countries. The strength of family-planning programs also accounts for a significant share.

Birth rates do not decline immediately when incomes begin to increase. Expectations about desired family size may take years to evolve,

and in any case they will change at different rates for different social groups. Within each country, people with fewer opportunities — especially fewer opportunities for women — will often continue to have higher birth rates than other groups, further slowing the transition. And of course the speed of reduction in birth rates depends on the availability of effective family-planning techniques. To reduce fertility, households must both want to reduce their total family size, and be able to control the number and timing of births through effective contraception.

Policies That Influence Population Growth

Virtually everyone favors public and private actions to reduce death rates, but measures to reduce birth rates are more controversial. The controversy arises because some question the cost-effectiveness of family planning programs and others find efforts to control fertility in conflict with their strongly held values and beliefs. Family-planning programs in at least one country appear to have been coercive, and some argue that more people are needed to provide labor and domestic markets.

Those who call for public actions to help curb birth rates argue that public costs (schools, hospitals, pollution, etc.) associated with large families exceed social benefits. Therefore society has a right to at least inform its citizens of ways to control births. Evidence from countries that have had strong family-planning programs, such as Colombia and Indonesia, shows that these programs can be effective.[3]

China combined educational programs, social pressure, and economic incentives to reduce rates of birth. These were effective, but many people consider China's family planning program too strong; they particularly object to the use of abortion to control family size. These critics can point to less-coercive educational programs that appear to have been equally effective in Sri Lanka, in parts of India, and in other countries.

Measures to improve income growth and distribution, develop social insurance and pension programs, and expand education and employment opportunities for women are all likely to help reduce birth rates. These efforts take time, however, which is why the policy debate often centers on family planning issues. Increased populations make all these programs more expensive and difficult to implement, so that current investments in family planning will save money in the long

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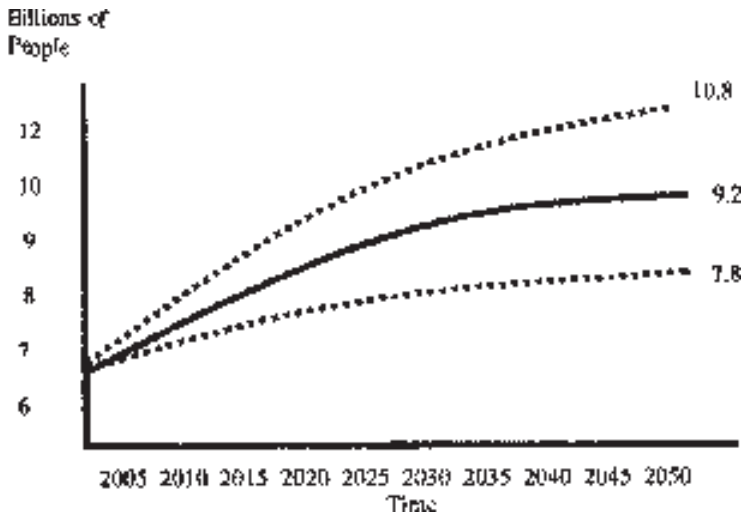[3] World Bank, *World Development Report 1984*, p. 9.

Figure 4-5. Future population projections (*Source*: United Nations, World Population Prospects, The 2006 Revision).

run. Most people in developing countries consider the fertility rates in their countries too high, and only a few consider them too low.[4]

Future Population Projections

The United Nations has projected that by the year 2050 world population will have grown to around 9 billion people.[5] Projections vary, however, from 7.8 billion to 10.8 billion, due to the uncertainty in factors affecting the projections (see Figure 4.5). Most of the growth will be concentrated in the developing countries. Future population projections are uncertain because they depend on income increases, educational improvements, family planning programs, and the future progression of the AIDS epidemic that are hard to predict. If present trends in growth rates continue, however, the middle estimate appears the most likely.

URBANIZATION

Regardless of the total increase in population, it is clear that urbanization will continue at a rapid pace and that, by the year 2050, the world will be substantially more urban. While total population in developing

[4] The Hunger Project, *Ending Hunger: An Idea Whose Time Has Come* (New York: Praeger, 1985), p. 30.
[5] United Nations, *World Population Prospects; the 2002 Revision* (New York: United Nations, 2003).

countries grew roughly 2 percent annually from 1993 to 2008, urban population grew at an annual rate of more than 3 percent. Natural population increases in urban areas account for about 60 percent of this growth rate, and another 8 to 15 percent is attributable to reclassification of rural areas to urban areas. At least 25 percent of the rapid growth in urban areas is caused by migration from rural to urban areas. Because a large proportion of the migrants are of child-bearing age, a sizable part of the "natural increase" in urban populations also can be attributed to recent migrants. The percentage of urban population growth due to migration is highest in those countries in the early stages of development.

Causes of Rural-to-Urban Migration

Rural-to-urban migration is, in a broad sense, a natural reflection of the economic transformation from agriculture to industry that economies undergo during the development process. As we discuss in Chapter 5, the process of industrialization increases the demand for labor in the manufacturing and service sectors. In the early stages of development, much of this labor must come from the rural areas.

By and large, people move to urban areas because they expect increased economic opportunities in terms of both employment earnings and access to goods or services produced by others. Landlessness and rural poverty, natural calamities, lack of educational opportunities, unequal public services provision, and other factors come into play as well. Although living costs are higher in urban areas, migrants are searching for a better level of living; they are pushed out of rural areas by poverty and desperation, and pulled to the cities by hope and opportunity.

The vast majority of people who migrate to cities perceive that the benefits of the move exceed its costs (these costs include foregone rural income and the cost of the move), or they would not make the move. Migrants tend to be young, disproportionately single, and better educated than the average of those left behind. The first two of these characteristics tend to lower the costs of the move, while the third raises the benefits. Better-educated people can expect higher returns from their education (wages) in urban areas. Most migrants to large cities in developing countries have relatives or friends already living there, a fact that tends to lower the cost of the move.

Rural-to-urban migration has been persistent despite rising unemployment rates in urban areas. The likely reasons for this persistence are that workers consider both rural-urban wage differentials and the

Many of the migrants in Dhaka Bangladesh
seek work as bicycle rickshaw drivers.

probability of obtaining a job (which is often much less than 100 percent) and still perceive that they will be made better off by moving. Many of these migrants realize it is unlikely that they will obtain a high-paying or "formal" job immediately, but they are willing to work in low-paying jobs such as selling goods on street corners, "watching over" parked cars, or doing other jobs in the "informal" sector. For some of these migrants, these high-paying jobs may come only to their children, and then only if the children receive a better education than their parents had.

The importance of educational opportunities and other public services cannot be overlooked as reasons for rural-to-urban migration. In many countries, an urban political bias has created a large disparity between the levels of services, including quality of public education, in rural and urban areas. Furthermore, and perhaps more important, the political bias extends to economic policies such as pricing policies. Food prices are often kept artificially low (through policies discussed later in this book). This policy helps urban consumers but discourages investment in food production and lowers incomes in rural areas. These distortions help explain some of the attractions of cities.

Consequences of Rural-to-Urban Migration

Urbanization per se is not a problem. There are economies of scale resulting from the concentration of suppliers and consumers for industry

BOX 4-1.
MEXICO CITY: AN EXAMPLE OF RAPID URBAN GROWTH

The situation in Mexico City, whose population more than tripled over the past 25 years, is an example of some of the strains imposed by rapid urbanization. The growth of Mexico City outstripped the growth in the availability of services. The city opened an ultramodern subway system in 1969, began large-scale construction of housing in the early 1970s, and inaugurated a deep-drainage sewer system that was hailed as an engineering marvel in 1975. Now, however, the subway and other transportation systems are hopelessly overloaded. Thirty percent of the families in the city live in single rooms, and fully 40 percent of houses lack sewerage. Congestion and air pollution are severe, water is pumped into the city from as far away as 50 miles; rainwater and sewage are pumped out. The sewer system is so overtaxed that sewers back up and overflow into the streets during downpours. The city's garbage dumps are overflowing, and thousands earn their livelihood by picking garbage at the public dump.

Rural-to-urban migration continues in spite of these problems, with about 400,000 rural Mexicans moving to Mexico City each year. The hope of a better life provides a strong pull. While roughly 23 percent of the country's population lives in the city, 40 percent of the GDP is produced there, and more than one-third of the factory and commercial jobs is located in the capital. Rural Mexico is very poor, with high rates of malnutrition, low literacy, and poor services even compared to the capital.

and public services. Innovative and knowledge-intensive industries are more likely to form and prosper in high population-density areas. The problem arises when cities become "too large, too quickly," often because rural-to-urban migration increases the urban population at a rate faster than industry, schools, sewage systems, and so forth, can expand. The result is substandard housing, poor sanitation, and lack of other services for recent migrants (see Box 4-1). While migrants have been shown to be assets to the cities, the shanty towns that surround almost all large cities in less-developed countries attest to the growing disparities that occur within cities if urbanization occurs too rapidly. Many people live in absolute squalor, often without sewage systems and sometimes in garbage dumps. The fact that people are willing to live in these areas highlights the poverty and lack of opportunity in rural areas.

Evidence suggests that farm output has not been affected greatly by the loss of migrants and their labor to urban markets. In most low-income countries, the number of farmers keeps rising despite rural-urban migration, because the total population is growing faster than cities can expand. And migrants help sustain their relatives on the farm,

when they remit money back to rural areas. However, some rural areas have suffered because the brightest and most educated workers have migrated.

Governments have employed many approaches to the task of slowing down rural-to-urban migration. Some countries are restricting migration, implementing resettlement schemes, and providing services to smaller towns and cities. It appears, however, that unless the urban bias in economic policies is removed and economic development proceeds to the point where living conditions improve in rural areas, rural-to-urban migration will continue in many countries at a very fast rate.

SUMMARY

The current world population of more than 6.7 billion is growing at an annual rate of 1.2 percent, an extremely high rate by historical standards. The developing world is experiencing a population explosion caused by rapid decline in death rates due to improved health and nutrition. While birth rates have begun to decline due to higher incomes, family planning, education, and other factors, world population is likely to continue to grow for more than a century. Effective measures to control population growth should consider the economics of fertility and how different economic and social policies affect childbearing decisions. Rural-to-urban migration is proceeding at a rapid rate in many developing countries as migrants seek to achieve higher standards of living. Rapid urbanization has caused a strain on public services, pollution, and other problems.

IMPORTANT TERMS and CONCEPTS

Birth rates and death rates	Family planning
Causes of fertility changes	Population density
Causes of rural-to-urban migration	Population distribution
Characteristics of migrants	Population growth
Consequences of rapid population growth	Rural-to-urban migration
	Urban political bias
Demographic transition	Why death rates decline

Looking Ahead

This chapter concludes our overview of several dimensions of the world food- income-population problem. Hunger and development problems are both severe and complex. We move now to a set of two chapters, which examine economic theories that have been used in attempts to identify the heart of the development process. We begin in the next

chapter with a discussion of important factors related to production growth. Subsequent chapters then incorporate these factors into development theories.

QUESTIONS for DISCUSSION

1 Has population increased at a fairly constant rate since prehistoric times?

2 What is the current world population and how fast is it growing? When will it stop growing?

3 At present growth rates, how long will it take to add 1 billion people to the world population?

4 Why is population increasing more rapidly today in LDCs than it did during early stages of development in Europe and the United States?

5 What are the major determinants of birth rates in LDCs?

6 What are the impacts of rapid population growth?

7 What policies can be used to help reduce population growth?

8 Are population growth rates more likely to increase or decrease over the next 15 years?

9 Which are the fastest and slowest growing countries in the world (in terms of population)?

10 What proportion of the world's population lives in Asia?

11 Why are we seeing rapid rural-to-urban migration in many developing countries?

12 What are the consequences of rapid rural-to-urban migration?

13 Describe the characteristics of the most common type of migrant.

14 How can high fertility be viewed as a consequence of poverty as well as a cause of it?

15 Describe the demographic transition that tends to occur as development takes place and why it occurs.

RECOMMENDED READINGS

Gelbard, Arlene, Carl Haub, and Mary M. Kent, "World Population Beyond Six Billion", *Population Bulletin*, Volume 54, No.1, Population Reference Bureau, March 1999.

Population Reference Bureau, http://www.prb.org/

Population Reference Bureau, http://www.prb.org/Publications/Datasheets/2008/2008wpds.aspx

United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2006 Revision, Highlights, Working Paper No. ESA/P/WP.202, 2007.

Development Theories and the Role of Agriculture

Rice in Peru.

Economic Transformation and Growth

> Economic growth depends ultimately on the impact of productive resources and the efficiency with which they are used.
>
> — Angus Maddison[1]

This Chapter

1 Describes the economic transformation that occurs with economic development, involving a decline in the size of agriculture relative to non-agricultural activities.

2 Introduces the concept of a production function and the law of diminishing returns.

3 Identifies potential sources of economic growth.

THE ECONOMIC TRANSFORMATION

Economic growth is almost always accompanied by an *economic transformation* from agriculture into other activities. As the economy expands, the agricultural sector grows more slowly than manufacturing and services, and agriculture accounts for a declining fraction of employment, output, and consumer expenditures. The transformation from farm to non-farm activities as incomes rise applies to regions, countries, and the world as a whole. It is among the most dependable relationships in the world economy, and has major effects on peoples' lives. This chapter explores its causes and its consequences, both within agriculture and for society as a whole.

The tendency for richer countries to derive a smaller share of their income from agriculture is shown in Figure 5-1, and their tendency to have

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[1] Angus Maddison, *Economic Progress and Policy in Developing Countries* (New York: W. W. Norton and Co., 1970), p. 34.
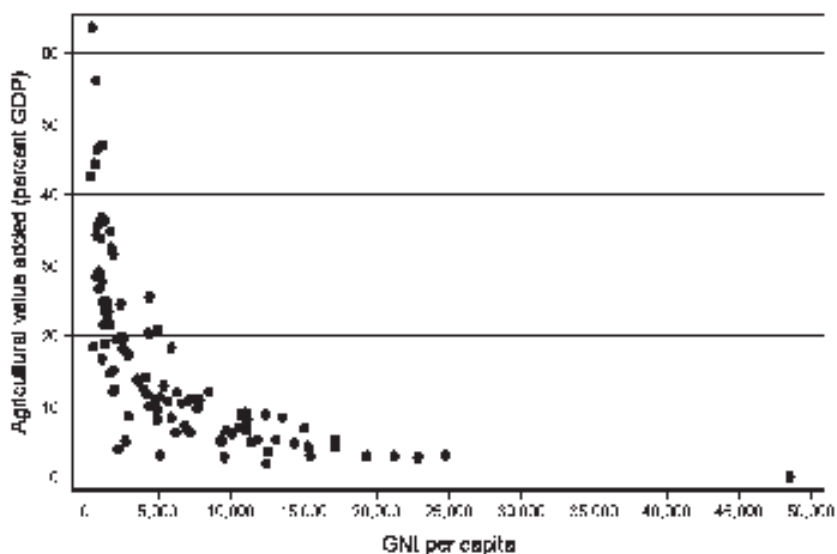
Figure 5-1. Agriculture's share of total output and Gross National Income, 2007. (*Source*: World Bank: World Development Indicators on-line database.)

a smaller share of total employment in agriculture is shown in Fig. 5-2. These two figures show remarkable similarity and an interesting difference. The similarity is the clear downward trend. All poor countries derive a significant share of their income from agriculture, while all rich countries derive only a small fraction from it. Note that agriculture never disappears entirely in the rich countries, and there is wide variation in its share among the poorest countries. A key difference between the two figures is that, in poor countries, agriculture accounts for a larger fraction of employment than of output. Roughly speaking, countries below $1,000 per year in per-capita income have 40-90 percent of the workforce engaged in agriculture, and these people earn 20–50 percent of their country's total income. In other words, within poor countries, on average each farmer earns roughly half of what non-farmers earn.

Causes of the Economic Transformation

In low-income countries, labor productivity is low and people, out of necessity, spend a high proportion of their income on food. Labor and small amounts of land are their primary assets, and many have no choice but to devote at least some of their labor to farming, to feed themselves and their family. Many low-income farmers are actually
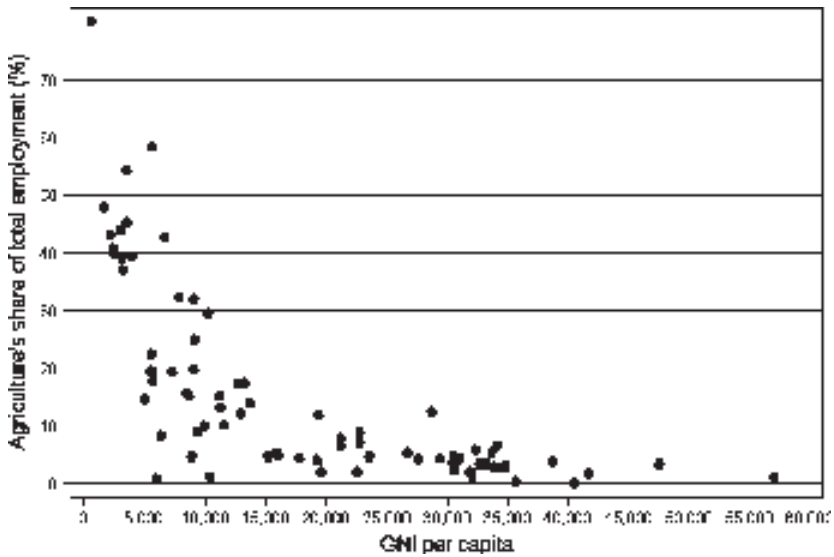
Figure 5-2. Agriculture's share of total employment and Gross National Income, 2005. (*Source*: World Bank: World Development Indicators on-line database.)

net food buyers, using small amounts of non-farm income or the sale of high-valued crops and livestock to supplement the basic foods they grow on the farm. To emerge from poverty, these semi-subsistence farmers must improve their productivity either on the farm or in non-farm activities.

As the productivity of labor and other factors increases, four major factors drive the transformation from farm to non-farm activities. The first factor is that incomes rise due to the productivity increase, causing a gradual shift in demand from food to non-food items. This consumption shift occurs primarily because the income elasticity of demand for food is less than 1.0 and tends to decline as income grows. Declining income elasticities mean that for each percentage increase in income, progressively lower proportions are spent on food (see Engel's Law in Chapter 3). These changes in demands for agricultural and non-agricultural products imply that, as development proceeds, relatively more labor inputs and other resources are devoted to non-agricultural activities.

The second factor driving the transformation is that at any given income level, the quantity of food demanded changes relatively little when its price changes. In other words the price elasticity of demand

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for food is low, less than 1.0 in absolute value, and it may be even smaller at higher levels of income. This "price-inelastic" aspect of food demand means that, if agricultural productivity grows, prices received by farmers will fall by a higher percentage than the quantity demanded rises, creating incentives to remove resources from farming and transfer them to non-farm activities.

These two "demand-side" drivers cannot explain the transition in settings where farmers are selling their produce at prices that are determined in a world market. In those cases, prices received by farmers depend little on local demand, so there must be "supply-side" explanations for the transformation as well.

A third, supply-side, factor driving transformation is specialization. Even if the mix of activities in the economy remains the same, during economic growth the availability of capital and market opportunities allows people to expand production of what they do best, and then trade with others for the products they want to consume. Thus farmers produce less of their own food, clothes, furniture, and so forth, and an increasing share of these kinds of activities is re-classified from "agriculture" to "industry."

Another supply-side factor that could drive transformation is the fact that land supply is fixed, while other forms of capital can expand. As people accumulate savings from year to year, they find fewer and fewer opportunities to add resources to their farms, and so prefer to invest their savings in non-farm enterprises. For example, the farmer who already has good buildings, fencing, livestock, and equipment will tend to invest her savings in something else, such as a retail trade or services.

Does Agriculture Actually Shrink?

The fact that having higher incomes leads to a smaller fraction of output and employment in agriculture does not mean that the absolute size of the farm sector declines. Indeed, as countries get richer, the level of farm production and consumer expenditure on farm goods usually keeps rising, and in countries with rapid farm productivity growth, output in the sector can grow as fast as non-farm output. As agricultural productivity and incomes grow, labor is gradually transferred from work on farms to work in other enterprises. Some of this work occurs in the same rural areas where the farms themselves are located — people find employment in small-scale manufacturing, in value-added processing of agricultural products, in transport and services, etc. Others, as noted in Chapter 4, migrate to cities and find work in the formal and informal sectors.

In most countries, the land area available for farm use is roughly constant over time, so any change in the number of farm workers translates directly into a change in number of acres available per worker. One might expect economic development to influence the number of people working on each farm, and it does, but in an unexpected way. Across countries and over time, the number of workers on each farm stays close to the number of workers in the family. Family farming dominates the sector, and so the number of workers per farm varies with family size, which tends to decline as the economy grows. Thus poor countries may have five to eight workers per farm while rich countries may have only one or two, but that is mainly because of the declining number of workers per family. Furthermore, at every level of income, many family members work only part-time on the farm, and hire themselves out for off-farm work. A few do hired farm work, but hired workers are less common in agriculture than in other sectors.

Family workers dominate farming for many reasons, but perhaps the primary reason is that many field operations are difficult to supervise and monitor, and are therefore done better by self-motivated workers. For example, a farm owner would have great difficulty ensuring that a hired
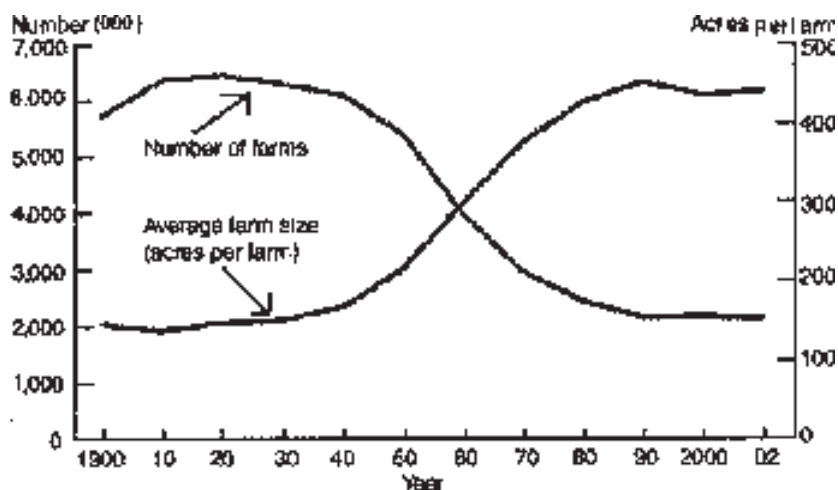

Figure 5-3. Number and average size of farms in the United States, 1900–2002. (*Source*: Carolyn Dimitri, Anne Effland, and Neilson Conklin, 2005, *The 20th Century Transformation of U.S. Agriculture and Farm Policy* [Washington, D.C.: Economic Research Service, USDA].)

worker plows, plants, or fertilizes appropriately, because these operations are dispersed across the field and many other factors intervene to determine that field's eventual yield.

Since family farming dominates the sector, any change in the number of farm families translates directly into a change in the average cropped area per farm. Figure 5-3 illustrates this process for the United States. The number of farms peaked in the 1920s, but as farm labor moved into cities, the acreage per farm increased as exiting farmers rented or sold their land to the remaining operators. Note that the decline in the number of farmers cannot go on forever. In the United States, there has been no further decline since 1990, with roughly one-third the number of farms as there were in the 1910 to 1920 period, and farm sizes roughly three times as large.

A great deal of variability in farm sizes over time exists across countries. Several middle-income countries in Asia are now in a period of rapid decline in the number of farmers, much like the United States in the 1960s. The poorest countries, however, have growing rural populations and fixed land bases. Many regions in South Asia and Africa have experienced decades of decline in the available acreage per farmer, sharply reducing their ability to feed themselves or initiate the economic transformation out of agriculture.

Implications of Changes in the Number of Farmers

The key fact about the economic transformation presented above is that, as incomes rise the share of agriculture falls, but the absolute number of farmers *rises and then falls*. The initially rising number of farmers in low-income countries translates directly into rising number of workers per acre of available land. If output per acre cannot rise at least as fast as the number of workers, output per worker must fall. This downward pressure on farmers' income accounts for much of the deterioration in social conditions that we observe in the world's poorest regions.

An essential aspect of rural population growth is that it is temporary. If economic development continues, eventually non-farm employment becomes large enough to absorb all new workers, rural population growth slows, and any growth in output per acre translates directly into growing output per worker. Many of the people moving off the farm incur significant adjustment costs during the transition.

The fact that an economic transformation occurs with development does not explain the sources of economic growth and development. Understanding those sources of growth and how they contribute to development requires knowledge of a few basic economic principles

related to production economics. In the next section we introduce a set of principles that can be used to help explain the output and economic effects of input and technology choices.

EXPLAINING PRODUCTION CHOICES

Economic growth requires transforming a country's basic production resources into products and doing so in ever more efficient ways. Economists have developed ways to characterize how that transformation occurs, utilizing the concepts of a *production function,* a *marginal product*, and *economic optimality*. These three basic production economic concepts are presented here and then used subsequently in models of economic growth and development.

Production Functions

Production requires resources or inputs such as labor, natural resources, and tools or other capital items. These inputs are often called factors of production. Production also requires that these factors be combined by a producing unit that can organize their use to obtain desired goods and services. A description of the way in which factors of production are combined to produce goods and services is commonly called a production function. A production function describes, for a given technology, the different output levels that can be obtained from various combinations of inputs or factors of production.

The relationship between the level of production that can be obtained when only one input is allowed to vary (say labor), while all other inputs are held fixed, may look something like that shown in Figure 5-4. This relationship is also referred to as an *input response curve,* or a *total product curve*. In the case of labor, when no work is done the production level is usually zero, so the input response curve starts at zero. Output may then rise at an increasing rate, showing "increasing returns" to each additional unit of input. In farming for example, the initial effort of planting is more productive if followed by additional effort spent weeding, so doubling labor time could more than double the resulting output. Eventually, however, all such opportunities will be exhausted and each additional hour of labor or unit of other input begins to offer "decreasing returns": output continues to rise, but at a decreasing rate. Finally, at very high levels of input use, all opportunities to do *anything* productive may be exhausted, and additional inputs might actually reduce output.

On the particular curve drawn in Figure 5-4, the transition from increasing to decreasing returns occurs at the input level marked K.
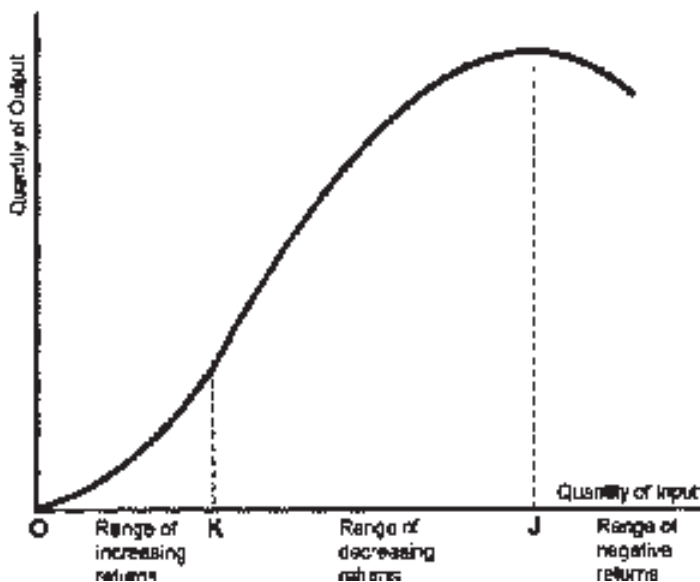
Figure 5-4. A production function with one variable input.

Beyond that point, for each additional unit of labor, the *additions* to output become smaller and smaller, until eventually, at point J, additions to output may stop entirely. Beyond that point, additional units could actually reduce output, so the curve begins to slope down.

The input-response curve in Figure 5-4 shows the productivity of one input, when all the other inputs are held constant. Changing the quantity of this one input, perhaps labor, results in a movement along the curve. If other inputs were to change, that would be shown as a shift in the curve. We will see an example of such a shift later in this chapter.

If two inputs are allowed to vary simultaneously, the resulting production function can be illustrated as in Figure 5-5, with each curve (called an *isoquant)* representing a different level of output. Curves higher and to the right represent greater output levels than curves lower and to the left. For example, point C represents a higher output level (200 units) than points A or B (100 units).

The isoquant that represents 100 units of output illustrates that the same level of output (100 in this case) can be produced with different
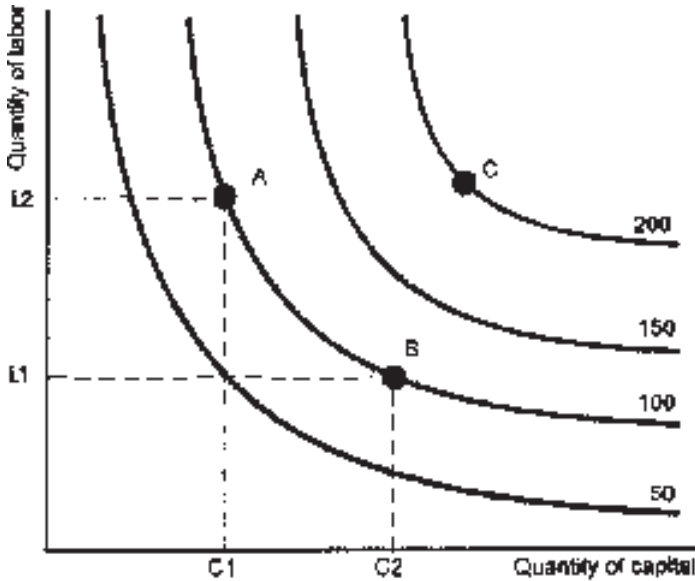
Figure 5-5. Production function with two variable inputs.

combinations of labor and capital (combination A versus combination B). Thus, if a country has abundant labor and little capital it might produce using the combination of labor and capital represented by A. If it has abundant capital and little labor, it might produce at B. The isoquant through points A and B shows all the different combinations of labor and capital that can be used to produce 100 units of output. It also tells us how easy it is to substitute labor for capital in the production of that output. When isoquants are very curved, inputs are not easily substituted for each other. Straighter isoquants imply easier substitution.

Marginal Product and the Law of Diminishing Returns

The idea illustrated in Figure 5.4 that, after some point, adding additional units of input tends to generate less and less additional output is known as the *law of diminishing returns.* Specifically the law says: 'In the production of any commodity, as we add more units of one factor of production to a fixed quantity of another factor (or factors), the additions to total output with each subsequent unit of the variable factor will eventually begin to diminish.'' What is diminishing is the *marginal*

output gain or *marginal product* of the factor (labor in Fig. 5-4).[2] As discussed below, the law of diminishing returns has important implications for countries experiencing rapid population (and labor) growth with a fixed natural resource base.

A marginal product curve can be obtained (derived) from Figure 5-4 by examining *changes* in total output for each successive unit of input. The marginal product curve corresponding to the production function in Figure 5-4 is shown in Figure 5-6. To the left of K, the slope of the production function is increasing (Fig. 5-4); thus the changes in output are growing and the marginal product curve is rising (Fig. 5-6). To the right of K, the changes are smaller and marginal product curve falls. If total output eventually ceases to grow at all as more labor is applied, the marginal product goes to zero; this is point J on the production function and on the marginal product curve. Marginal productivity is important because it helps determine payments to factors of production, such as wages paid to labor. In addition, the marginal productivity of an input, together with prices of outputs and inputs, determines the demand for the input.

Economic Optimality: What Output and Input Levels Will People Choose?

All points along a production function are equally possible to achieve. But are they equally likely to be chosen? What factors might motivate a farmer to choose one point as opposed to another? When people are asked what explains their choices, they mention a variety of factors such as input scarcity, the need for output of particular products, traditions or habits, and a desire to minimize risk. Repeated studies have found that actual choices by large numbers of people over several years are best explained by *economic optimality*. Economic optimality means that farmers are rational and choose options that will give them the highest level of well-being attainable given the prices they face, the available resources and technology, and their ability to absorb risk.

Even in very low-income settings and across cultures, farmers generally attempt to optimize. They may consider cultural and risk factors as they optimize, but economic well being plays an important role. Because farmers optimize, they will generally choose to be somewhere along the production function and not below it. For any given level of

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[2] The marginal product of an input is equal to the slope of the total product curve, or $\Delta Y / \Delta X$, where Δ represents a small change. Therefore, anything affecting this slope changes the marginal product.
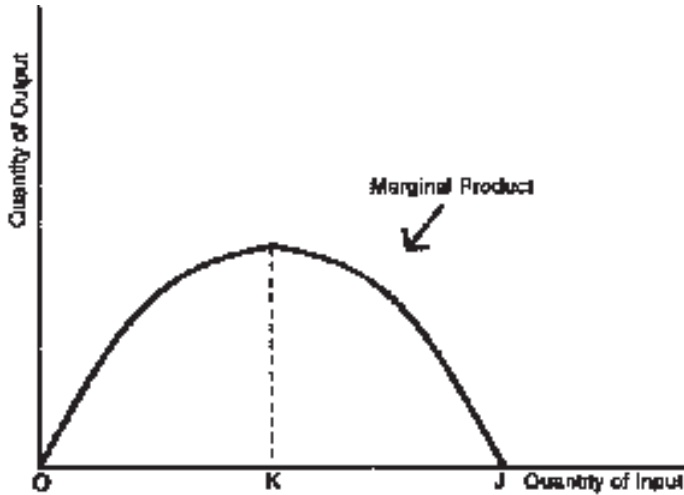
Figure 5-6: Marginal product curve derived from the total product curve in Figure 5-4.

input(s) they prefer to obtain as much output as they can attain. In other words they prefer to be on the production function and not below it. But where along the total product curve would they prefer to produce? Prices help determine the answer. Even for farmers whose production is largely for home consumption, some of their outputs and inputs are sold and purchased at prices set in markets off the farm. When markets set prices, farmers can often reach the highest-possible level of well-being by *maximizing profits,* subject to acceptable risk, and then trading those profits for goods they want to consume.

This kind of economic optimality typically leads to a single point along the production function, as illustrated in Figure 5-7. In Figure 5-7, each level of profits can be represented by a straight line, whose slope is the price of the input divided by the price of output. This ratio of market prices is the rate at which the two goods could be exchanged in the market. In the left hand panel in Figure 5-7, the highest such line, representing the highest attainable level of profits, occurs where the line touches the production function and their slopes are the same. Marginal revenue from the output equals the marginal cost of the input (MR=MC). On the right-hand panel in Figure 5-7, the profit line is the
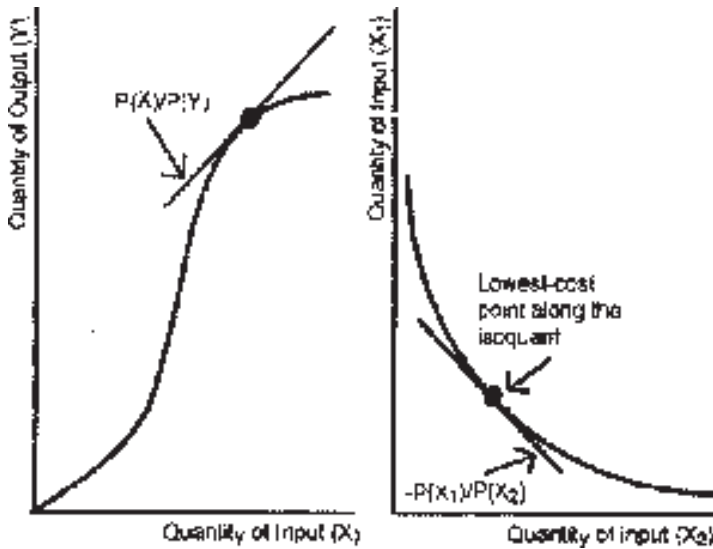
Figure 5-7. The economically optimal level of output and input choice.

ratio of the two input prices and also represents the total cost of pro-
duction. When farmers are producing on their production functions
and employing the correct amount of inputs to equate their marginal
revenue to their marginal cost of obtaining the last unit of output (the
price lines are tangent to the curves in Fig. 5-7), they are said to have
achieved *price or allocative efficiency*. This concept of efficiency can be an
important source of economic growth.

SOURCES of ECONOMIC GROWTH

We can now use the production economics concepts described above
to explore the possible sources of growth in an economy over time. One
of the major ways that economic growth can occur is through increases
in the amounts of inputs used in production. While production func-
tions usually refer to a particular type of output (say corn), one can
think of an aggregate production function relating total inputs to total
output or total national product. Additional inputs can move a country
out of its aggregate production function to higher isoquants and higher
levels of output. Therefore, (1) *population growth* (which affects labor
availability and cost), (2) *natural resource availability* (which affects the
cost of environmental factors such as land with its associated soils, water,
and forests), and (3) *capital accumulation* (which affects the availability

of man-made inputs) are three major elements in the development process. These sources of growth cause movement along a given multi-factor production function.

A second means of spurring economic growth is to change the way in which a country uses its factors of production, increasing the amount of output produced by these inputs. These output increases can result from better organization of production or from shifts in the production function. For example, a new technology can shift the total product curve upward so more output is produced per unit of inputs.

BOX 5-1.
SOURCES of GROWTH and the PRODUCTION FUNCTION

Growth in output can occur either through a change in market opportunities and relative prices, which leads farmers to add inputs using existing technologies, or because of an innovation that allows production of more output at a given level of inputs.

The left-hand panel below illustrates how profit-maximizing farmers would respond to increasing abundance and hence lower relative price of an input. For example, in poor countries when rural labor becomes more abundant over time, there is a decline in wages relative to other prices, leading farmers to apply more labor in land preparation, weeding, etc. in an effort to obtain more output.

The right-hand panel shows how those same farmers might respond to a new invention, such as better-performing seeds or veterinary medicine for their livestock. Now the farmer can obtain more output at each level of input. This particular innovation was drawn so that the new profit-maximizing level of input use happens to be exactly the same as before: thanks to the innovation, the farmer has gotten more output for no change in the input.
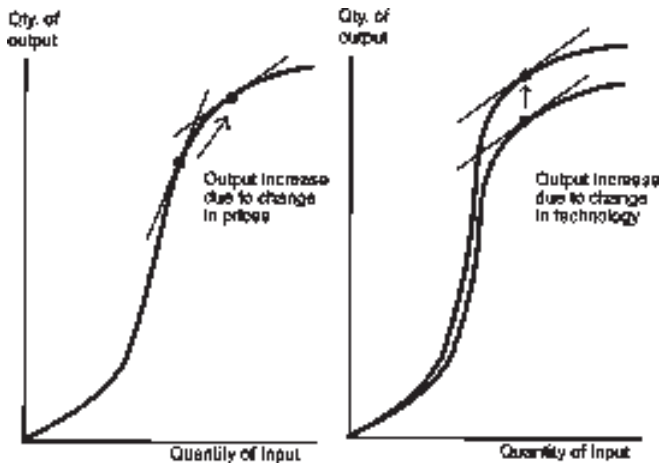
There are three ways to get increased output per unit of input: (1) increases in scale or specialization; (2) increases in efficiency; and (3) technological change. In many cases, markets can change, which in turn stimulates changes in these factors. Movements along a given production function versus shifts in the function are illustrated in Box 5-1.

A third means of stimulating economic growth is through increased *human capital* as embodied in people (e.g., improved education and health) and improvements in *social institutions* (the rules of the game). Human capital can make labor more productive, contributing to technological progress and increased efficiency (especially when technologies and markets are rapidly changing). Social institutions help define property rights.

Let's examine more closely each of the sources of economic growth.

The Demographic Factor: Effects of Population Growth on Agriculture and the Economy

For most of history, population growth was a major source of output growth in the world. People worked with primitive tools, and more people meant more labor and output. Crop and pasture areas expanded with the rural workforce, although output per person remained roughly the same. A greater population density also reduced the distance between people and made it easier to develop cost-effective services such as transportation, communications, schooling, and so forth. Population growth, however, is a mixed blessing because, while there are more productive hands, there are more mouths to feed. As long as farmland is plentiful, land frontiers can be pushed back and growth continues in the agricultural sector, but, in most areas of the world, the best farmland has been exhausted and rising numbers of farmers have no choice but to invest more time in each field. In this situation, diminishing returns to labor cause farm incomes to fall, unless farmers can turn to an alternative source of growth.

Population growth may also mean an increasing number of children relative to adults. If the number of consumers is growing faster than the number of producers, then the effect of population growth is also more likely to be negative. If population growth results from extending the productive life of workers, the odds of its effect being positive improve.

Ecuadoran children.

Natural Resources: Environmental Influences on the Location and Pace of Development

Natural resources — including land and its associated soil, water, forests, and minerals — have played an important role in economic development. The extension of the frontier in the United States brought more land and mineral resources into production and helped create wealth. Similar expansions have occurred in other countries. Extensive use of other types of natural resources has been important as well. For example, in the eighteenth and nineteenth centuries, one of the most important resources was coal, as countries with large and easily-accessible coal deposits, such as Britain, used coal to fuel their local industrial revolution. In the 20th century, oil became important in some countries. Will natural resources continue to be an important source of economic growth or will they be a limitation to future growth?

Some have argued that Earth is like a spaceship, that its natural resource capacity is finite. There is only so much land and, indeed, we see increasing problems with soil erosion, deforestation, and overgrazing. Increased combustion of fossil fuels releases carbon into the atmosphere and depletes a finite supply of these resources. Water resources are exploited to their fullest potential (or overexploited) in many places.

A plow and bullock can be a sizable investment in many developing countries.

While technologies change, and in essence create new resources, there is no question that land is limited and that the opening of new uninhabited fertile lands will be much less important to future economic growth in most countries than it has been historically. It is also clear that many resources, particularly forests and minerals, are being depleted in many countries and are thus becoming less available to stimulate growth than they once were. The real question for most countries may not be whether exploitation of natural resources will be a significant source of growth, but whether natural resources will act as a constraint to growth, and, what will be the cost involved in transitioning from one natural resource regime to another. This issue is discussed further in Chapter 9.

Accumulation of Physical Capital

Physical capital may be defined as a country's stock of human-made contributions to production, consisting of such items as buildings, factories, bridges, paved roads, dams, machinery, tools, equipment, and inventory of goods in stock. Physical capital, as we refer to it here, means human-made physical items and not money, stocks and bonds, etc. It refers to private physical goods but also public investments in physical infrastructure.

Capital accumulation is the process of adding to this stock of buildings, machinery, tools, bridges, etc. Another name for capital accumulation is investment. Capital investment is important because it can

increase the amount of machinery and tools per worker, thereby increasing the output or marginal product per worker. A higher marginal product per worker usually leads to a higher income per worker.

Capital accumulation is also related to the possibilities of making changes in the scale of technology of production. Furthermore, the process of capital accumulation involves a choice between consumption today and investing for future economic growth. The choices of how much to invest, and in what types of capital, have important implications for the rate and direction of economic development. As will be argued throughout this text, investment should be guided along an appropriate path by signals (prices) that reflect the true scarcity of resources.

Technological Progress

Increases in input levels (land, labor, and capital) accounted for much economic growth prior to the nineteenth century. However, evidence suggests that changes in the ways goods are produced have been the engine of modern economic growth for many if not most countries. The three sources of growth mentioned above involve increasing inputs with a given production technology. Economic growth can occur, but only through exploitation of natural resources and labor, or accumulation of costly resources through savings and investment from year to year. More important, this type of growth is subject to diminishing returns, as movements along the production function generate smaller and smaller increments of output for each additional unit of input. Sustaining economic growth over time requires the constant invention of new technologies, to shift the production function and overcome diminishing returns (see Box 5-1).

If technological progress allows the same or fewer resources to provide more output, the value of output per unit of resources rises, and this rise can lead to increases in per-capita income. Resources can also be freed up to provide new types of goods. The phenomenon of technological progress is not new and has been occurring for many years. What is new is the rapidity with which new technologies are being developed. Modern technological progress is the result of both *applied science* and *new knowledge* in the basic sciences.

Specialization

As innovation occurs and capital is accumulated, increasing opportunities arise for people to specialize and trade with each other. Such *specialization and trade* can raise productivity and attract savings and investment. Specialization is related to scale as well. As firms increase in

size, specialization is facilitated. "Division of labor" can make workers more efficient as they become proficient at just a few tasks. Adam Smith argued that this type of division of labor is at the heart of economic growth. In his famous book, *The Wealth of Nations* (1776), he noted that specialization is limited only by "the extent of the market," or the ease with which one person can trade with others, both within and across countries. As markets expand, the possibilities of mass-producing goods enable firms to gain efficiency in both production and marketing. Increased scale and specialization allow more output per unit of input and, hence, growth.

Efficiency Improvement

Another type of organizational change that can lead to economic growth is improved production efficiency. Improved efficiency means getting more for the same inputs.

Efficiency can be divided into different types. *Technical efficiency* relates to whether producers are producing on the production function as opposed to below or inside it. Using the same amount of inputs, some producers obtain higher output levels than others due to differences in management and effort. *Price or allocative efficiency*, mentioned above and illustrated in Figure 5-7, relates to the degree to which producers, operating on their production functions, employ the correct amount of inputs to equate their marginal revenue to their marginal cost of obtaining the last unit of output. By definition, producers who maximize profits are both technically and allocatively efficient.

Market efficiency is related to the type of economic system and the degree of market power within it. Improvements in resource allocation occur through market efficiency when increased competition or new technology lowers the margin between buyers and sellers. A country that has a relatively free market with many buyers and sellers, so that no producer or consumer can affect prices, has greater market efficiency than one with a few producers who are able to control prices. The availability of good information affects the degree of market efficiency, and improved information flows can help create growth due to more efficient allocation of productive resources.

Human Capital

So far in this chapter we have explained economic growth without assuming any change in the people themselves. Much of economic growth is driven by changes in people's capabilities or their *human capital* as affected particularly by their education and health. The nature of these

capabilities is easily misunderstood. Even the most illiterate, impoverished person is often intelligent and skilled, but educated healthy people can more easily contribute to the generation of new technologies and more readily utilize those technologies. Education is therefore an important source of economic growth, inextricably linked with technological progress and, of course, with the productivity of labor. Part of the economic benefits of education is derived from improved productivity of workers, part from improved quality of management, and part from education's contribution to producing new or improved technologies.[3] The term human capital is used in referring to education because education is an investment, in many ways similar to physical capital in requiring an investment of resources that pays off over a long period of time and eventually depreciates.

Education is important, but in the lowest-income countries an equally important form of human capital is a person's health. Undernutrition and preventable diseases remain the world's biggest killers, and they sharply reduce the productivity of those who survive. Improvements in nutrition and disease control raise output directly, and also make it easier and more worthwhile to keep children in school, leading to more education as well. Human capital improvements due to investments in health have also been called improvements in physiological capital.[4]

Education and health are forms of human capital that are embodied in particular individuals. If you were to trade places with a lower-income person, the odds are you would be more educated and healthier, and that might influence what you could do. But if others in your society were *also* healthier and better educated, that would allow you to develop different expectations about their behavior as well. You could rely more on other people, using your mutual education to develop and communicate new ideas about how to work together.

Institutional Change

Historical patterns of economic growth exhibit remarkable differences across countries and over time. Levels and rates of growth differ significantly even among neighboring countries. Many of these differences are not solely attributable to sources mentioned above, but to institutions as well. Institutions include government policies, legal structures,

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[3] Education can, of course, have other benefits associated with the capacity to develop new institutions and with many non-economic factors.

[4] Robert Fogel, National Bureau of Economic Research, Working Paper 9771, June 2003.

BOX 5-2.
NEW TECHNOLOGIES, INPUT USE and the DEMAND for INNOVATION

Technological innovations can have different impacts on a farmer's input use and output levels, and changes in resource availability can lead to different kinds of innovation. The diagrams below illustrate how farmers' profit maximization affects their response to new technologies, and affects the kinds of new techniques that are most needed in various countries.

The left-hand panel shows an innovation that, with no change in relative prices, would lead a farmer to increase input use. The most important examples of such technologies are "green revolution" crop varieties, whose growth habits and stress tolerance make it worthwhile for farmers to apply more labor, fertilizer, and water to the plant.

The right-hand panel shows another kind of innovation that, with no change in relative prices, would lead a farmer to cut back on input use. Most such input-saving innovations are mechanical devices such as bigger, faster implements, which take less capital and labor to do a given task.

"Input-using" innovations involve the discovery of new techniques *to the right* of existing input levels, whereas "input saving" innovation involves discovery of new techniques to the left of them. Price changes, by leading farmers to look for new techniques in one direction or the other, help influence which kind of innovation is more likely to be discovered and adopted. Most notably, in poor countries where the farm labor force is rising, labor-using innovations are demanded. In contrast, once the farm labor force starts falling in richer countries, labor-saving mechanization is farmers' priority.
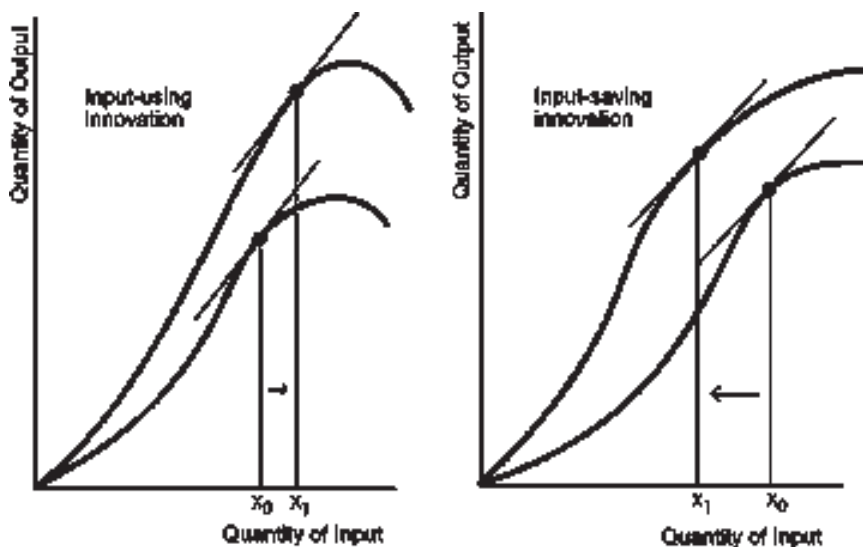
and market structures. If markets exhibit distortions, efficient price signals will not be received by producers; if financial markets are incomplete or characterized by excessive risks, savings and capital accumulation will be constrained. If people are unsure about their ability to recover investments, due to political instability or ill-defined property rights, they will not undertake investments. The ability of institutions to adapt to new needs and demands can itself be a source of economic growth.

During economic growth there is often explosive growth in many kinds of social institutions. This new *social capital* may displace previous institutions, such as family or village networks, which might have been helpful but are not as well-adapted to the new circumstances. Some of these institutional changes are a result of economic growth, but in some they may play a causal role in economic development, so that a transfer of institutions could accelerate growth. For example, many countries benefit from the introduction of quality certification systems to enforce grades and standards, uniform procedures for contract enforcement and commercial law, and well-adapted property rights of various sorts.

SUMMARY

Economic growth involves a transition from low-income agricultural societies to higher-income non-farm employment. The process is driven by capital accumulation, technological innovation, and specialization in either sector. An economic transformation occurs for several reasons. First, demand for food is relatively fixed. It is "income-inelastic", so when incomes grow, demand for other things grows faster. Second, productivity increases in agriculture free up resources for nonagricultural production. Third, as people specialize and trade with each other, many tasks that were previously done on the farm are now classified as nonagricultural.

Although agriculture declines as a share of the economy, the sector does not shrink. Typically, total farm output continues to rise during economic growth. Furthermore, when the total population is growing, the number of farmers tends to rise for many years, until the absolute size of the non-farm sector is large enough to absorb all those entering the workforce each year. The resulting change in land area per farmer will often place downward pressure on rural living standards during the early stages of economic development, even as the rest of the economy grows.

To explain the causes and consequences of economic growth, we use production functions that describe, for a given technology, the different amounts of product that can be obtained from different levels and combinations of inputs. An isoquant shows different combinations of two inputs that can be used to produce the same level of output, given a particular technology. The law of diminishing returns has important implications as population or capital increases against a fixed land base. To overcome diminishing returns and sustain growth over time, people need technological change, increased specialization and trade, and improvements in efficiency that may be related to improvements in human capital and institutions.

IMPORTANT TERMS and CONCEPTS

Capital accumulation	Law of diminishing returns
Economic efficiency	Marginal product
Economic transformation	Natural resources
Education	Non-farm job opportunities
Human capital	Population growth
Input demands	Production function
Input response curve	Scale and specialization
Institutional change	Sources of economic growth
Isoquant	Technological progress

Looking Ahead

The sources of growth discussed above relate to whole economies, to sectors within economies, and to individual firms (including farms). Various theories have been proposed to explain how the sources of growth have been, or could be, combined to transform economies from low to higher standards of living. We examine these theories in the next chapter. In subsequent chapters we consider how these growth factors can affect firms within the agricultural sector.

QUESTIONS for DISCUSSION

1 What is meant by the term 'factors of production'?
2 What are the three major factors of production and how do they relate to the major sources of economic growth?
3 What is the law of diminishing returns and what might be its significance in relation to population growth?
4 Will natural resource limitations be a serious restriction to future economic growth or growth in food production?
5 What is capital accumulation and why is it important to development?

6 Why are specialization, efficiency, and technological progress important to agricultural and economic development?

7 Why is an economic transformation inevitably associated with economic development?

8 What factors determine the rate at which an economy becomes transformed from an agricultural to a mixed economy with significant nonagricultural as well as agricultural activities?

9 If the total labor force were growing 2 percent per year and 50 percent of the labor force were in agriculture, how fast would nonagricultural employment need to expand in order to hold the number of people employed in agriculture constant? Why is this important?

10 What are the implications of the economic transformation for the agricultural sector?

11 What is meant by the terms "human capital" and "institutional change"?

RECOMMENDED READINGS

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Ruttan, V., "Productivity Growth in World Agriculture: Sources and Constraints," *Journal of Economic Perspectives*, vol. 16 (Fall 2002), pp. 161–84.

Thirlwall, A.P., *Growth and Development* (New York: Palgrave Macmillan, 2006), Chapters 4–6.

Development Theory and Growth Strategies

We can realistically envision a world without extreme poverty by the year 2025, because technological progress enables us to meet basic human needs on a global scale. — Jeffrey Sachs[1]

People respond to incentives; all the rest is commentary.
— Steven Landsburg[2]

THIS CHAPTER

1 Reviews how economic development and growth theories have evolved over time, including the role of institutions

2 Considers the interaction of technology and institutions

3 Considers the distinctive characteristics of agriculture as opposed to other sectors as the economy develops

The HISTORICAL EVOLUTION of DEVELOPMENT THEORY

In the previous chapter, we identified potential sources of economic growth and the inevitable structural transformation that accompanies economic development. We turn now to ideas and theories that attempt to explain how these sources of growth can be integrated into transformation processes that produce higher living standards. The search for appropriate theories of economic development has received economists' attention for two centuries. Different theories have led to different implications for what governments, private firms, or individuals might do to achieve their goals. One especially important contrast concerns

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[1] Jeffrey Sachs, *The End of Poverty: Economic Possibilities for Our Time* (New York: Penguin, 2005), p. 347.

[2] Steven Lansburg, *The Armchair Economist: Economics and Everyday Life* (New York: Free Press, 1995).

the relative roles attributed to technology and productivity (reflected in the quotation above from Jeffrey Sachs), as opposed to institutions and incentives (reflected in the quotation above from Steven Landsburg). Emphasis has shifted over time, partly because of changes in constraints that limit economic growth, partly because of changing technological possibilities, and partly because of experiences with what has or has not worked. We consider in this chapter the historical progression of thinking among economists. Over time, a synthesis of ideas has emerged, with increased focus on the interaction between technology and institutions.

The Classical Period

The late eighteenth century is known as the *classical* period in economic thought, and the books written then remain widely debated today. One of the most enduring debates concerns the role of international trade. At the time, conventional wisdom held that a country's wealth, like the wealth of an individual, could be measured by the amount of its gold and other monetary assets. Exports were believed to be better than imports, and this *mercantilist view* provided an important argument for trade restrictions in Britain and elsewhere. **Adam Smith** challenged the mercantilist idea, arguing that freer trade in both directions would produce higher standards of living, especially if combined with a more competitive, equal-opportunity environment at home. Adam Smith's arguments were extended by **John Stuart Mill** and **David Ricardo,** and their ideas about the division of labor and specialization, comparative advantage, and trade remain key concepts in modern economics. Their theories about the value of freer trade were not easily accepted at the time, however, and many mercantilist ideas remain widespread today.

The eighteenth century was a period of both economic expansion and population growth. Many political leaders argued that having more people would help make each country richer. In the early nineteenth century this idea was challenged by **Thomas Malthus**, who argued that population was limited mainly by the food supply, and by a fixed supply of high-quality land. Ricardo agreed with Malthus and was pessimistic that growth could be sustained in the long run in a country because of the implications of population growth, given the law of diminishing returns. Their classical theory in its simplest form proceeds as follows. (1) There are two broad types of people: workers, whose only asset is their labor, and capitalists, who own land and capital. With a certain amount of labor, just enough wages are paid to cover workers' subsistence. (2) If a new invention or some other favorable event creates an increase in production, a surplus above that necessary to pay

the subsistence wage is generated, which is accumulated by capitalists. (3) Such accumulation increases the demand for labor, and, with a given population, in the short run wages tend to rise. (4) As wages exceed the level of subsistence, population grows, generating an increased demand for food. (5) But, if high quality land is essentially fixed, the rise in food demand is met by bringing lower-quality land into production. The price of food rises to cover the higher cost of production on lower-quality land. (6) The effects of increased population (supply of labor) and higher-priced food drive the real wage, or the wage paid divided by food prices, back to the subsistence level, and the rate of population growth declines.

Thus, in the classical model, diminishing returns to increments of labor applied to a relatively fixed supply of high-quality land, and higher costs of production on lower-quality land, represent constraints to growth, so that living standards remain at subsistence levels. If technological progress occurs, the situation may change temporarily but not permanently. Ricardo's policy prescription was for Great Britain to remove its corn laws, which would free up trade, and allow food imports to keep the price of food from rising and choking off industrial growth.

History has shown that the classical model underestimates the role of technological progress. It also fails to consider factors that tend to lower birth rates as economic growth occurs. It oversimplifies the forces influencing wages and the complexity of the sharing or distribution objective found in many societies. Nevertheless, as we will see below, certain aspects of the classical model had a significant influence on subsequent theories of economic development, especially its emphasis on diminishing returns and its implications for trade.

Growth Stages: From Marx to Rostow

By the late nineteenth century, there had been enough economic development in Europe and North America for observers to notice a clear shift in the mix of activities. Many economists focused on patterns of such change, arguing that economies moved through sequential *growth stages*. While the suggested sets of stages were based on different principles, most growth stage theories attempted to emphasize that economic development involves a structural (economic and/or social) transformation of a country.

In the late nineteenth century, **Frederick List**, a German economic historian, developed a set of stages based on shifts in occupational distribution. His five stages were savage, pastoralism, agriculture,

agriculture-manufacturing, and agriculture-manufacturing-commerce. Concurrently, another German, **Karl Marx**, visualized five stages of development based on changes in technology, property rights, and ideology. His steps were primitive communism, ancient slavery, medieval feudalism, industrial capitalism, socialism, and communism. He felt that class struggles drive countries through these stages. One class possesses the land, capital, and authority over labor while the other possesses only labor. Class struggles occur because economic institutions allow the exploitation of labor. Prior to reaching the final stage, labor is never paid its full value. For example, if wages rise in the fourth stage (industrial capitalism), labor is replaced by machines, thereby creating a "reserve army of the unemployed" that brings wages back down. Because capitalists derive their profits from labor, more machines and fewer laborers mean lower profit rates. The pressure of lower profits leads to more exploitation, more unemployment, mass misery, and eventually revolution. Labor then gains control over all means of production under communism.

A different kind of thinking about growth stages emerged in the early twentieth century, when **Alan Fisher** and later **Colin Clark** developed a theory in which the transition from agriculture to manufacturing and services occurs not because of government intervention, but because of increases in output per worker, and advances in science and technology. Another growth stage theorist, **Walt W. Rostow**, argued in the 1950s that these changes were closely related to the rate of growth in per-capita incomes, which would experience a "take off" into sustained growth once enough capital had been accumulated. Rostow believed, however, that an eventual slowdown in the rate of growth would be the normal path for any sub-sector in an economy, due to declining price and income elasticities of demand for the goods produced by a sector. In this view, the secret to growth is to find and support emerging or "leading sectors".

Thinking of the economy in terms of distinct sectors has some advantages, but the idea of distinct growth stages fell out of favor in the 1950s. Countries experienced a wide variety of growth paths during the 1950s and 1960s, and some experienced sharp reversals of fortune. Most economists no longer thought of economic growth as a predetermined sequence of stages, which had relatively little prescriptive power, but instead focused on the gradual accumulation of productive resources, particularly capital.

Capital Accumulation: From the "Financing Gap" to Technology-Driven Growth

The first widely-used theory of growth based on capital accumulation was developed by **Roy Harrod** and **Evsey Domar**. They used mathematical formulas to show how the rate of output growth would be limited by the level of investment and hence the national savings rate, multiplied by the productivity of those investments. The Harrod-Domar model was simple and elegant, and yet could still be fitted to real data using the observed capital/output ratio of the economy to project the productivity of additional investment.

In the 1960s, when the Harrod-Domar approach was applied to low-income countries, it was recognized that national savings was not the only possible source of capital. Borrowing from abroad could add to national savings, permitting an even faster growth of the capital stock. Such "two-gap" models, popularized by **Hollis Chenery** and others, implied that foreign aid to fill a "financing gap" could accelerate growth significantly, as each dollar of aid would have the same productivity as a dollar of savings.

The Harrod-Domar-Chenery approach focused primarily on the rate of national savings or borrowing from abroad, with less attention to the efficiency with which additional funds were spent. In the mid-1950s, **Robert Solow** worked out the mathematics of a model in which additional capital earns diminishing returns. In that case, the long-run rate of growth of per-capita income is driven by the rate of technological progress, not savings as such. Solow did not explain how technological progress is generated: he treated new technology (and hence the growth rate of the economy) as exogenous to (outside of) his model. Much later, a new generation of economists would make growth models in which people choose how much to invest in new technologies, so that technical change and hence the growth rate is endogenous, explained by property rights and government policies. Those models are described in the final section of this chapter.

Dual-Economy Models: "Surplus Labor" and Unemployment

The first mathematical models of growth used a single sector to describe the whole economy, and focused on capital accumulation. Soon thereafter, economists produced models with two sectors, in which growth and poverty alleviation depend crucially on the allocation of labor. The most influential *dual-economy* (or two-sector) model was developed by **W. Arthur Lewis.** His model was subsequently modified by **John Fei** and **Gustav Ranis, Dale Jorgenson,** and others.

A simplified version of the dual-economy model can be illustrated using the total and marginal product curves shown in Figure 6-1. This version of the model is designed to relate most closely to the situation in large labor-surplus but relatively natural-resource-poor countries in which domestic (as opposed to international) characteristics of the economy dominate. The model could potentially represent (albeit roughly) the situation in a country such as India or China.

The model includes several sources of growth discussed in Chapter 5, and illustrates the potential for using "surplus" labor and technological progress in agriculture to achieve economic growth. It assumes the existence of a large population in the traditional agricultural sector, for which the marginal product of labor is below the wage rate, which is determined by society's rules about sharing output. There is disguised unemployment in the sense that if the people who appear to be working are removed, production will not drop or will drop very little. In other words, labor is applied in the agricultural sector up to the point where it is redundant in the upper left-hand graph in Figure 6-1; or to the right of N3 or N2 in the lower left-hand graph.
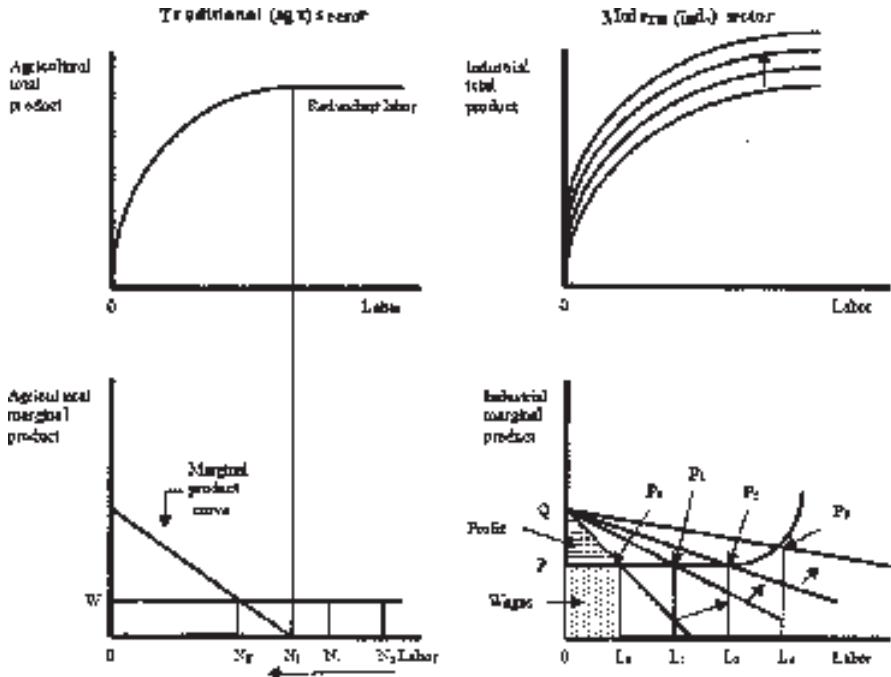

Figure 6-1. Graphical representation of labor-surplus dual-economy model.

The wage rate in agriculture (W) is assumed to initially approximate the average productivity of labor in that sector (and eventually be determined in an inter-sector labor market). Land is fixed. Wages in the modern industrial sector are assumed to be higher than in the agricultural sector in order to attract labor from the agricultural sector. Firms in the modern sector hire labor up to the point at which the marginal product of labor equals the wage rate. Initially this is the point Po in the lower right-hand graph of Figure 6-1. Labor in industry is hired up to Lo at the wage P.

In a "labor surplus" economy, the development process can be driven by transfer of labor from agriculture to the industrial sector, where it creates a profit that can be used for further economic growth. In the lower right-hand graph in Figure 6-1, total wages initially paid to labor in the industrial sector equal the area PPoLoO while profits equal the triangular area QP0P. This profit, or part of it, is reinvested in capital items such as equipment, machinery, and buildings — items that make labor more productive. This greater productivity shifts the total product of labor in industry upward (see the upper right-hand graph of Figure 6-1) and the corresponding marginal product of labor (demand for labor) out to the right (see the lower right-hand graph of Figure 6-1). This demand for labor is met by drawing more labor out of agriculture.

In the model, a shift of labor from agriculture to industry continues to drive economic growth as long as the marginal cost of labor remains constant (represented by the horizontal line between Po and P2 in the lower right-hand graph in Fig. 6-1). Once the supply of "surplus" labor from the traditional farm sector has been absorbed, the marginal cost of labor supplied to the modern sector turns upward (as it does to the right of L2), the growth in demand for labor by industry slows, because fewer profits are available for reinvestment.

Why might the wage rate in industry increase and the demand for labor stop shifting out? First, surplus labor in agriculture might be used up so industry would have to offer higher wages to compete with agriculture for labor. Second, food production will start to decline if fewer than N2 workers are employed in the agricultural sector. If population is increasing and incomes in the industrial sector are rising, then the demand for food will rise. Unless an increase in agricultural production occurs, agricultural prices eventually rise relative to industrial prices. This rise, in turn, raises the wage at which employers are able to obtain workers from agriculture for industry. The major implication is that economic growth becomes constrained unless there is technological improvement in both sectors.

The labor-surplus dual-economy model is a highly simplified view of the situation in countries with underemployed people. It has several limitations. First, evidence indicates that few if any situations exist where the marginal product of labor in agriculture is close to zero. Few countries have excess labor in agriculture. However, Jorgenson and others have pointed out that the presence of an active labor market in which the two sectors compete for labor can generate the same implication of the need for technological improvement in both sectors. Second, the model ignores the possibility of international trade, although it could be added without much difficulty. Third, and more important, the model fails to recognize the cost of resources used in conducting research and educating farmers to produce more and facilitate adoption of new technologies. The issue of how to endogenize (build in the process for self generating) the development of new technologies in a model of economic development was not addressed. Despite these limitations, it is a useful means of thinking about linkages between multiple economic sectors in a developing-country context.

Dependency Theory and Trade Protectionism

In the 1950s and 1960s, a number of theorists saw international trade and investment as a cause rather than a remedy for poverty in low-income regions, arguing that trade made the poor increasingly dependent and weak. **Immanuel Wallerstein**, for example, popularized the idea that prosperity of the "center" was linked to the impoverishment of the "periphery". *Dependency theory* encompassed a range of arguments, generally leading to the conclusion that the governments of low-income countries should protect their local economies from foreign trade and investment, pursuing self-sufficiency as a form of political and economic independence.

A few dependency theorists, notably **Andre Gunder Frank,** adopted a *Marxist* perspective, arguing that the income of wealthy countries was derived from the output of poor countries. In this view, wealthy countries use military and political power to limit poor countries' options, and thereby extract income that would otherwise belong to the poor. Some expropriation of this type clearly has occurred, in the colonial period and through other kinds of intervention, but most economic historians believe the output of poor countries can explain only a very small fraction of the wealth we see in industrialized countries.

A more widely-accepted set of ideas come from *structuralists* such as **Raul Prebish** and **Hans Singer,** who argued that market forces limit the degree to which poor countries can develop through trade with richer countries. In this view, the terms of trade (the ratio of prices of

exports to prices of imports) tend to turn against developing countries over time, because they produce mainly primary products (agricultural and mineral) for which prices decline over time relative to the manufactured products they import. This deterioration in the *terms of trade* is believed to be generated by (1) low price and income elasticities of demand for primary products compared to manufactured products, (2) slow productivity growth in primary product production, and (3) monopolistic elements in the production of products imported by developing countries while primary products are produced competitively. To the extent that demand for poor countries' exports is price- and income-inelastic, then output expansion in the poor countries or in the world as a whole does indeed worsen poor countries' terms of trade, although again this influence can explain only a fraction of the income gap between rich and poor countries.

The trade restrictions favored by dependency theorists could also be justified by much older arguments in favor of government intervention to protect domestic markets from foreign competitors, notably the idea that *infant industries* can get started only if they are temporarily protected from foreign competition, and the idea that a *big push* to expand many industries simultaneously could help countries take advantage of synergies between them. During the 1970s and 1980s, however, it became increasingly clear that industrialization aimed at replacing imports for the domestic market could generate only a temporary burst of economic growth. Export-oriented industrialization proved to be more successful.

Contemporary Growth Theory: Technological Innovation and Public Institutions

By the mid-1980s, enough statistics on national income across countries were available for researchers to test the basic predictions of the standard growth model, posited thirty years earlier by **Robert Solow**. Results were surprising, and sparked a burst of academic research on economic growth and poverty reduction that continues today.

The Solow model predicted that poor countries would eventually catch up to rich ones, because of diminishing returns to capital. Statistical tests showed that this type of "convergence" did indeed occur, but only among sub-groups of countries. The highest-income group of countries continued to grow with no sign of diminishing returns, while some poorer countries grew even faster to catch up, and other poor countries just stayed poor.

Economic theorists attempted to explain these results. **Robert Lucas**, **Paul Romer**, and others showed how rich countries' growth could

be explained by a flow of new technologies, which help overcome diminishing returns. Their models hinge on the idea that new knowledge is a public good: once discovered, it can be used repeatedly in new technologies without being used up, and so technological innovations can accumulate without limit. But not all countries are able to generate or use these innovations.

What determines whether a country develops and applies appropriate new techniques? Knowledge itself is a public good, whose development and dissemination depends on public education and government-funded research. Individuals and private firms will never have enough incentive to invest as much in these resources as they are worth to society as a whole. But knowledge is economically valuable only when embodied in goods and services that meet consumer needs. Successful countries promote both public knowledge and also private enterprise, encouraging new enterprises with new technologies.

A key question is the degree to which innovators should be given monopoly rights over the sale of new products, through patents and other forms of intellectual property rights. Government-enforced protection from imitators is a double-edged sword: it makes each invention more profitable than it otherwise would be, but it does so by restricting its use! The patent policies that are most economically successful limit the scope and duration of protection, to be just enough to reward past innovators, while encouraging others to make use of the innovation. The British and U.S. patent systems were early pioneers in this regard, offering protection only to a specific product (to allow the entry of other, somewhat similar products), and limiting the time period of protection (to hasten the entry of other firms), while allowing competitors to challenge others' patents in a free and fair judicial system.

The interplay among technology, natural resources, human capital, and institutions remains an active area of research today. It is clear that other sources of growth are only effective if they operate in an institutional environment conducive to growth. The importance of the rule of law, enforceable property rights and contracts, absence of serious government distortions to markets, and relatively low levels of corruption are all important to economic development. The high costs of transacting also seem to prevent many countries from realizing improved levels of living. Improved information flows may help reduce the cost of transacting and make it more difficult for inefficient institutional and political structures to survive. We return to this issue of how to reduce transactions costs in Chapter 11.

FROM THEORY to ALTERNATIVE STRATEGIES

The concept of a *development strategy* implies a long-term road map that encompasses a series of fundamental decisions with respect to sector emphasis (agriculture versus industry), factor use (capital-led versus employment-led growth), international market orientation (inward versus outward), concern for growth versus distribution, and the roles of the private versus the public sector. Many of these decisions present conflicting choices that countries must make when designing their development strategies. The appropriate path for a particular country depends on its starting characteristics and global economic conditions.

Industry versus Agriculture

The question of whether to channel public and private investments into the agricultural or industrial sectors has been asked by policymakers for many decades. In most countries, agriculture is initially the dominant sector containing most of society's resources, but it contains the poorest and least politically influential people and so is often relatively neglected by government. Investments in agriculture are slowed by this weak political base, but other factors inhibit such investments. Impacts of agricultural productivity growth can be difficult to observe. As seen in Chapter 5, an increase in farm output generally leads to an increase in *other* activity, as farmers invest their resources in non-farm enterprises, and a lower cost of food helps non-farmers buy more of other things. So agriculture appears to be a slow-growth sector, even as it drives the expansion of other sectors. Politicians generally want to please urban constituents and often adopt policies to lower food prices. Lower food prices, in turn, reduce the profitability of investments in agriculture. There is usually much stronger political pressure for urban investments, and for policies that produce immediate, highly visible results.

The degree to which governments support agriculture as opposed to industry also depends on world market conditions: in the late 1960s and early 1970s, the threat of food scarcity associated with Asian population growth led many countries to invest heavily in irrigation and crop breeding to raise agricultural productivity, especially within Asia. During the 1980s and 1990s, the payoff from those investments produced a relative abundance of food on world markets, which reduced demand for further investment, even in regions such as Africa where food was increasingly scarce. During the current decade, agricultural markets have tightened again, due in part to those lower investments in agriculture in the 1980s and 1990s, and in part due to growth in use

of agricultural products for bio-fuels. The resulting higher prices for food once again appear to be stimulating some public investments in agriculture. In addition, private companies and private foundations such as the Gates Foundation have responded with increased investments in agriculture.

Inward- versus Outward-Led Growth

A persistent debate in the development literature has centered on the merits of an inward (import-substitution, self-sufficiency)–oriented strategy versus an outward (international trade, export promotion)–oriented strategy. Some observers have argued that developing countries are hurt by trade because they produce mainly primary products for which prices decline over time relative to the manufactured products they import. In addition, the colonial heritage in several developing countries included the export of certain primary products to developed countries with the profits going to foreign companies or to small groups of elites in the developing countries. Proponents of an inward strategy have also argued that countries following an inward-oriented path suffer less from debt crises and protectionist policies in the developed countries.

The impact of inward-directed strategies depends largely on the policies used to implement the strategy. Policies such as overvalued exchange rates, import restrictions, and explicit export taxes, which discourage exports and stimulate substitution of domestically produced goods for imports, have generally been shown to be counterproductive. They lead to distortions in resource prices, create monopoly profits, high government budget deficits and, usually, inflationary pressures. Policies supporting production of foods for internal consumption via research, infrastructure, and other public investments can be called inward-oriented, yet are not associated with some of the distortions caused by measures typically used to promote import-substitution.

Proponents of outward strategies argue that by removing the bias against exports, countries can achieve significant economic benefits from specialization and comparative advantage, from the import of products manufactured by highly capital-intensive industries abroad, and from the stimulus to employment provided by reduced pressures to concentrate capital in a limited number of capital-intensive industries. Economies of scale can be achieved due to enlargement of the effective market size. Some countries that have been successful at promoting export-led growth have, in fact, also relied on government interventions in exporting industries.

Many developing countries have a comparative advantage in exporting
sugar, but face protectionist sugar policies in developed countries.

Theoretical arguments support either position. However, over the past 30 years, empirical evidence is weighted in favor of an outward-looking strategy that biases the economy neither for nor against exports. Evidence shows that policies often used to create an inward-looking strategy can lead to inefficiency. The economic efficiencies sacrificed in attempts to insulate a country from world market forces can be significant. Open markets expose a country to the effects of protectionist policies and interest rate fluctuations abroad. However they also offer insurance against risks originating at home.

Outward-looking strategies will be most successful if international markets are truly competitive and if access to markets is unrestricted. International trade agreements, covered later in this book, have moved the world markets toward more transparency and fewer trade restrictions. Many restrictions, however, still exist.

Growth versus Equity

The persistence of abject poverty even in countries experiencing rapid rates of economic growth has spurred a debate over the appropriate focus of development efforts. Most of us accept the goal of lifting as many people as possible out of extreme poverty, but there are many competing ideas on how to do it. Essentially three general approaches have been suggested, sometimes in combination. The first is to make direct transfer payments (money, goods, services) from the more well-to-do to the poor. The second is for the country to concentrate entirely

on growth as a goal, no matter who receives the income, in the expectation that part of the benefits will trickle down to the poor. A third approach is to direct specific efforts toward raising the productivity of the poorest segments of society during the growth process.

Direct transfer payments are difficult for developing countries to afford unless obtained as grants from international sources. The most important role of direct transfers can occur (1) during short-run weather-induced famines, unusually high food price spikes, or other emergency situations and (2) among the perpetually disadvantaged elderly, orphaned, and handicapped.

The majority of the poor in most developing countries, however, are the unemployed and underemployed rural landless. Even unskilled urban workers are usually better off than the rural landless. The landless live close to the margin and may fall below it during bad crop years. Therefore the important question is whether the benefits of growth will trickle down to the poor or whether development efforts must be directed at the poor.

During rapid growth, some benefits are captured by the poor. However, the income distribution often will worsen (become more unequal) during initial stages of growth unless specific efforts are directed toward incorporating the poor into productive activities. The poor can be bypassed by growth-oriented investments especially when possession of assets, particularly land and education, is skewed. Countries that begin with a more equal distribution of assets tend to experience growth with equity more than others. Growth can actually stagnate under conditions of extremely inequitable asset distribution. Growth itself can be affected by the wider spread of assets, institutional changes, and employment-creating activities.

The mere widening of the income distribution as development occurs is not as much a concern as what happens to income *levels* of the poor. Neither the level nor the distribution of income will be improved for the poor in most countries unless they have improved access to assets such as land and education which can make their primary asset, labor, more productive during the growth process. Development strategies that increase employment opportunities and promote the supply of wage goods (mainly food) will have the best chances for reducing poverty under virtually all circumstances.

Private versus Public

The appropriate mix of public and private activity varies by country, and by sector. Some services are almost always best funded through the public sector, such as an independent judicial system and roads.

These are *public goods,* whose provision is limited by *free rider* problems: people can benefit without paying, so government intervention is needed to force everyone to pay a share of their costs. Other activities can be funded voluntarily through private activity, but must be regulated by the public sector or they will be provided inefficiently.

Activities that are typically regulated by government, if not provided directly in the public sector, include *natural monopolies* such as water supplies, or services with *positive externalities* such as sanitation and health. Too little of these services would be provided by private firms if they were not regulated in some way by government. On the other hand, unregulated firms would provide too many goods that generate *negative externalities* such as pollution.

The outcome of interactions between the public and private sectors is often determined not by who does what, but by the degree of transparency and accountability in what they do. Private firms that can be held accountable to their investors and customers tend to work efficiently, as do public institutions that are accountable to voters and taxpayers. Either kind of institution can become corrupt and inefficient, in the absence of appropriate checks and balances, within and between each sector.

A useful way to explain the degree of accountability in the economy, over both public and private institutions, is through the relative size of *transaction costs* in the market or political system. Lower transaction costs typically make either system more accountable to a larger number of people. Easier transactions between customers and suppliers make the market more efficient, and easier transactions between citizens and their government usually make the public sector more efficient.

A range of institutional arrangements can keep transactions costs low and sustain checks and balances over time. Private markets must be regulated by public institutions, and the public sector must be kept accountable to the private individuals. Otherwise, even if new technologies are available, growth can be hindered by an inefficient or inequitable institutional structure.

Many examples of insufficient institutional structures exist in the world. In developing countries, these inefficient or insufficient institutions constrain economic growth continually and contribute to short-term economic crises. In developed countries they also can cause periodic problems, such as the recent financial crisis that was facilitated by lax financial regulations with limited oversight. Achieving the appropriate balance of institutional efficiency and accountability is difficult but critical for economic development.

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SUMMARY

The classical model of economic growth stressed the importance of diminishing returns to labor as a constraint to growth, and the mid-twentieth-century Solow model stressed diminishing returns to capital. Contemporary experience, however, shows how countries with institutions that reward innovation can sustain rapid economic growth far beyond these constraints.

Growth-stage theories attempted to categorize the growth process into successive stages through which countries must pass as they develop. Dual-economy models focused on movement of labor out of agriculture and how the agricultural transformation can be smoothed by balanced growth in both sectors. Dependency theorists argued that developing countries became increasingly exploited as they become more integrated into world markets, and so should withdraw into self-sufficiency. Each of these classes of theories provides some insights into the development process, but does not provide a comprehensive theory of growth and development.

Contemporary development strategies recognize the role of agriculture as an engine of economic growth. Agricultural growth frees up labor and other resources that can be used in other sectors. It helps alleviate poverty by improving food availability and stimulating broad-based employment growth. Most economists agree that international trade should be kept relatively open, and that governments should provide public goods, promote innovation, regulate monopolies, and make markets more efficient. The exact development strategy for each country depends on its resource mix, stage of development, and institutional structure. New institutional arrangements will have to be designed in many countries to enhance information flows and lower transactions costs, to make markets more efficient and promote accountability in the public and private sectors.

IMPORTANT TERMS and CONCEPTS

Accountability	lmport substitution
Capital-led growth	Income distribution
Center and periphery	Institutional arrangements
Classical model	Integrated rural development
Comparative advantage	Labor-surplus dual-economy
Dependency theory	Open versus closed economy
Employment-led growth	Public good
Export-led growth	Stage of development
Growth stage theory	Terms of trade
Growth versus equity	Transactions costs
Harrod-Domar model	

Looking Ahead

In this chapter, the roles of agriculture in economic development were mentioned along with the need for countries to have development strategies. In much of the rest of the book we will be examining how to develop the agricultural sector itself. Before we do that, however, it is important to discuss the nature of existing agricultural systems in developing countries. In the next chapter, we discuss the characteristics of traditional agriculture and agricultural systems.

QUESTIONS for DISCUSSION

1 What is the major factor that is hypothesized to constrain economic growth in the classical model?
2 What are the major features of the labor-surplus dual-economy model and what are its primary weaknesses?
3 Why might the wage rate eventually increase in the industrial sector in the labor-surplus dual-economy model?
4 What implications does technological change in the agricultural sector have in the labor-surplus dual-economy model?
5 What is the distinguishing feature of dependency theories? What are the policy implications of dependency theories?
6 Why is agricultural development important in most developing countries?
7 What is employment-led growth and why is employment important to development?
8 What are the arguments for and against inward- versus outward-oriented development strategies?
9 What are the three general approaches that have been suggested for alleviating abject poverty?
10 Why might both the private and public sectors have important roles to play in development?

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Agricultural Systems and Resource Use

Traditional farm in Nepal.

Agriculture
in Traditional Societies

> In low-income countries, peasant agriculture tends to be character-
> ized by low levels of utilization of certain resources, low levels of pro-
> ductivity, and relatively high levels of efficiency in combining resources
> and enterprises. — John W. Mellor[1]

This Chapter
1 Describes the common characteristics of traditional agriculture
2 Discusses how traditional farms make decisions about their
   livelihoods
3 Discusses implications of characteristics of traditional farming
   systems for agricultural development

CHARACTERISTICS of TRADITIONAL AGRICULTURE
The world food-hunger-poverty problem is serious, and solutions de-
pend in part on agricultural development. Before considering how to
foster development, one needs knowledge of the nature of agriculture
in developing countries. Without this knowledge, it is difficult to un-
derstand the steps needed to stimulate agricultural development and
how these changes will affect the people involved. In this chapter, we
examine several general characteristics of traditional agriculture. Then
in Chapter 8 we compare specific types of agricultural systems in vari-
ous stages of development.[2]

   The term *traditional agriculture* conveys part of its own meaning.
The word "traditional" means "to do things the way they have usually

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[1] John W. Mellor, *Economics of Agricultural Development* (Ithaca, N.Y.: Cornell Univer-
   sity Press, 1966), p. 134.
[2] Agricultural systems include production practices, or *how* things are produced, as
   well as the types of enterprises, or *what* things are produced.

been done." Because natural resources, culture, history, and other factors vary from place to place, the way things have usually been done also differs greatly from one location to another. And, because conditions change, no type of farming system, no matter how traditional, is ever completely stable. In fact, one of the major challenges to agricultural development is to stimulate improvements in production practices and introduce higher value products to raise incomes over time. To do so, we need to understand the common characteristics found in traditional agriculture.

Livelihoods and the Intermixing of Farm and Family Decisions

Traditional agriculture takes several forms, but small farms predominate in most developing countries. Farm families have access to many types of assets including human labor, land, physical capital such as equipment, financial capital, natural assets, and social and political assets. Farmers make decisions about how to use their assets in production, labor supply, consumption, and other activities, and these decisions reflect their "livelihood strategies". Production and consumption decisions are generally intermixed on traditional farms. For example, in remote areas in Bolivia, farmers produce a number of potato varieties, some for sale. However, some varieties are needed for families and guests during festivals; these varieties are often not available in local markets. The cultural requirement that such varieties should be available at these times affects household planting decisions. The importance of the family and the close relationship between production and consumption decisions occur because much of the labor, management, and capital come from the same household. A sizable proportion of the production is consumed on the farm or at least in the community where it is produced. Success in the farm enterprise may enhance nutritional status, which can in turn lead to higher productivity.

Labor and Land Use

Traditional farms generally are very small, usually only 1 to 3 hectares (about 2.5 to 7.5 acres). Labor applied per hectare planted, however, tends to be high. In many areas, land is a limiting factor and is becoming more limiting over time as populations continue to grow. Labor is often underemployed at certain times of the year, while capital assets are fully exploited. Much sharing of work and income occurs on traditional farms so there is little open unemployment during slack times. This sharing means that the individual's wage may be determined by the average rather than the marginal productivity of labor, as mentioned

BOX 7-1.
KEFA VILLAGE in EASTERN ZAMBIA

The anthropologist Else Skjonsberg visited Kefa Village first in 1977 and several times since. Her book *Change in an African Village: Kefa Speaks* portrays a traditional agricultural system in Eastern Africa. Villagers in Kefa depend on land, which is controlled and allocated by the local chief. Some inherit cultivation rights from their parents, others request unused land from the chief, and others borrow land from relatives and neighbors. When land shortages arise, groups of villagers break away and search other areas for unused lands.

Households cultivate 1-4 hectares, with maize, groundnuts, sweet potatoes, and pumpkins produced for own consumption, and tobacco and cotton produced for sale. Fortunate farmers have access to wetland dambos, where they grow vegetables year-round. The agricultural year starts before the first rains in October, when the ground is broken by hand hoes. Maize, the most important food crop, is planted first, weeded first, and harvested first. Most villagers plant open-pollinated maize varieties, which have been used for generations. Maize is stored in granaries, and in years of abundance it is used to brew beer or sell. Groundnuts are rotated with maize to maintain soil fertility and provide dietary protein. Hybrid maize varieties, with higher yields and shorter growing seasons, have been introduced, but most Kefa villagers are suspicious of their quality and only produce them for sale. Hybrids require purchased fertilizer, and in dryland farming, exposure to risk invites trouble. Many believe use of fertilizers will breed dependency and bring ruin to adventurous farmers.

Family members share work responsibilities. Women prepare meals, carry them to the fields, hand-cultivate all day, then return home with pots and pans, loads of firewood and water. During December and January, the women take responsibility for weeding. It takes as long as three weeks to weed a hectare of maize, so family time is fully occupied. On rainy days, men make repairs around their huts, while women manage household affairs. When labor is scarce, some mobilize workers by throwing home-brewed beer parties; others trade labor and work together. During April through June, labor is in short supply and entire villages participate in harvests. Women are chiefly responsible for harvest, but men and older children assist. Women headload food crops in 50 kilogram bags from the fields to storage bins. In rare cases where oxen or motorized transport is used, men take responsibility for the task.

Although agriculture is the main source of well being in Kefa, all households are engaged in non-agricultural activities. Some brew and sell beer, others practice crafts such as weaving or woodworking, many engage in petty trading, and others are healers, scribes, or have specialized skills. Cattle raising and off-farm incomes supplement farm incomes and help families buy farm and household equipment, clothes, and blankets and

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BOX 7-1, continued

pay for services such as school fees. Off-farm activities are divided by gender: women brew and sell beer, trade and weave, while men more often have specialized skills, work with wood, or do repairs. Incomes earned in these activities are held separately by men and women, and women are eager to engage in such activities because the money they earn provides them a degree of autonomy in decision making.

Families in Kefa are structured in different ways. Only about half of the households are nuclear in the sense of two parents and children. About a third of households are headed by women, some divorced or widowed, some whose husband is absent. Children participate actively in household economic life; by age 5 most contribute to household tasks and, past 8 years, farmwork increases. Boys are responsible for tending cattle, while girls assist their mothers in the house and care for younger siblings. Most children attend schools, but are excused during periods of peak agricultural labor. The elderly live with their families or are cared for by family members. The poorest of the poor have few relatives and depend on handouts from other villagers.

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in Chapter 6. As a part of a diversified livelihood strategies, family members often work off the farm part time, sometimes on neighboring farms, sometimes in other areas as they seasonally migrate, and sometimes outside agriculture. Petty trading, often carried out by women, is a common off-farm livelihood strategy in many countries.

Although family labor is important, traditional farms may hire some labor, at least during the busy times of the year. Low wages caused by high underemployment in peasant agriculture create incentives to hire laborers. That is, traditional farmers can hire labor or buy a small amount of leisure and enhance their social status at relatively low cost. The people with the lowest economic and social status are usually not the owners of small traditional farms, but landless workers hired by those farmers.

Seasonality

Labor use in traditional agriculture varies seasonally along with agricultural cycles. During slack seasons, those immediately following planting or preceding harvest, labor may be abundant. However, during peak seasons, especially during weeding and harvest, labor can be in short supply. Wages often exhibit similar seasonal fluctuations. The seasonal nature of agricultural production causes variations in consumption and

nutritional status, particularly in African settings. Because storage facilities may be lacking and mechanisms for saving and borrowing incomplete, consumption patterns can follow agricultural cycles. It is common to find ''lean seasons,'' when consumption is low and short-run malnutrition high, especially immediately prior to harvest (see Box 7-2).

BOX 7-2.
SEASONAL MIGRATION: A RATIONAL RESPONSE

Seasonal weather patterns cause traditional farmers to adopt production and consumption patterns to help smooth variations. Seasonality also induces migration as people search for employment opportunities and food. Other seasonal causes of migration are trade and marketing, cultivation of secondary landholding, and pasturing cattle. Seasonal migration is a worldwide phenomenon. In some rain-fed areas of Africa, 30 to 40 percent of the economically active population migrates, while in rural Nepal as much as 30 percent of the households have at least one member who migrates.

Why does seasonal migration occur? During the lean season, labor demands on the farm are low, incomes are stretched, and food can be in short supply. Other rural regions may have crop conditions (due to environmental factors, technologies, or irrigation) that alter the agricultural calendar and create counter-cyclical demands for workers. Large plantations commonly producing many export crops also demand labor on a seasonal basis. Seasonal rural-to-urban migration involves workers migrating to towns, cities, and mines in search of work. These reasons combine to push migrants out of regions where their labor is temporarily in surplus and pull them into areas with high demands for labor.

Seasonal migration is not inefficient nor is it caused by factors such as imperfect labor markets. It is a natural adaptation to highly seasonal agricultural cycles and can smooth family incomes and consumption. Seasonal migration also provides insurance; in the event of a crop failure family income can be maintained in the short-run by migration.

Seasonal labor flows have benefited countries by minimizing labor shortages in harvest times. Exports of cocoa and coffee from forest regions of Western Africa are largely made possible by seasonal migrants who provide labor during harvest. Other regions of the world have seen their total production possibilities shift outward as labor moves to fill seasonal gaps.

Source: Material was drawn from David E. Sahn, ed., *Causes and Implications of Seasonal Variability in Household Food Security* (Baltimore: Johns Hopkins University Press, 1987).

Productivity and Efficiency

Traditional farms are characterized by low use of purchased inputs other than labor. Yield per hectare, production per person, and other measures of productivity tend to be low. These factors do not mean, however, that traditional farms are inefficient. As T. W. Schultz points out, traditional farms tend to be *poor but efficient.*[3] Why?

The crop varieties, power sources, methods for altering soil fertility, and certain other factors available to traditional farms constrain productivity growth, and hence reduce returns to labor and traditional types of capital. Efficiency, as measured by equating marginal returns to resources in alternative uses, is often high. In other words, given the technologies available to traditional farmers, they tend to do a good job of allocating labor, land, and other resources. The implication is that just reallocating the resources they currently have will not have a major impact on output.

It makes sense that with static levels of technology, physical conditions, and factor costs, farmers would gradually become very efficient at what they do. When conditions change rapidly, many of the mistakes in resource allocation occur. Also, one must be careful not to equate limited education (another common characteristic in traditional agriculture) with lack of intelligence.

A situation with low use of certain inputs, low productivity, but high economic efficiency under static conditions has important implications if productivity is to be increased. First, new technologies can help to change the production possibilities available to farmers. Second, investments to improve the quantity and quality of productive assets such as land can stimulate income growth. Third, education may be needed to help farmers learn to adjust resource use to changing conditions so as to maintain their high levels of efficiency. However, under the static conditions of traditional agriculture, education will do little to improve productivity, since peasant producers are already relatively efficient.

Rationality and Risk

Traditional farmers are economically rational. They are motivated to raise their standard of living while, of necessity, they are cautious. Traditional farmers are not adverse to change, but proposed changes must fit into their farming systems without altering too abruptly the methods they have developed over time to reduce risk and spread out labor

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

use. Traditional farmers face many risks, including weather-related uncertainty, agricultural pests and diseases, price and market-related risks, and human health risks. Decisions often reflect attempts to manage this risk. Because formal risk management mechanisms such as insurance are often not available, traditional households turn to informal mechanisms in response to a risky environment.[4]

One mechanism by which traditional farmers spread risk is by exchanging labor and other resources through joint and extended families. By joint and extended families, we mean relatives (and sometimes friends) beyond parents and their children. In many countries, a substantial degree of sharing labor and goods occurs among friends and neighbors, which not only adds to social status but spreads risk. Reciprocal agreements to assist others in times of need can spread risk across space, through agreements with people facing other agro-ecological conditions or in different regions, across economic sectors, through migration and work choice, and across time, through inter-generational sharing. Some of these informal arrangements may deteriorate as development proceeds, creating a need for new institutional arrangements to manage risk.

Another risk-spreading mechanism is reliance on diversified livelihood strategies. Traditional farmers frequently plant multiple crops on a single plot of land in a single season. For example, maize and beans are planted together throughout Latin America; in Africa, maize is intercropped with sweet potatoes, groundnuts, and other foods, depending on the location. Intercropping reduces reliance on success in a single crop and helps manage risk. Off-farm employment further diversifies income sources.

Off-farm Employment

Because agriculture is so visible in developing countries, it is easy to assume that rural dwellers are only farmers. In reality, in most countries, off-farm income is an important source of earnings, especially for the rural poor. Many landless and near-landless families provide labor to other farmers; these agricultural labor markets are described in more detail in Chapter 13. Others work in non-agricultural enterprises; some are self-employed, producing goods and services for sale. Non-farm employment involves small-scale rural manufacturing, transport, services, and petty trading. Income from these enterprises helps offset

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[4] See Paul B. Siegel and Jeffrey Alwang, *An Asset Based Approach to Social Risk Management*. SP Discussion Series 9926, Human Development Network, Social Protection Unit, the World Bank, Washington, October 1999.

fluctuations in earnings from agriculture, representing a risk-management strategy. It can smooth intra-year variations in on-farm labor demands. Rural non-farm employment accounts for about 35–30 percent of income across the developing world.[5] Non-farm income is particularly important for women who can combine their household obligations, including child care, with work. The percentage of rural workers in the non-farm sectors varies from country to country, but generally is in the range of 20–50 percent.[6] Between 1960 and 1990 in Asia, the proportion ranged from 67 percent in Taiwan to 20 percent in China. Off-farm employment is a higher proportion of total employment in Asia and Latin America than in Africa, but even in Africa, it exceeds 60 percent in countries such as Botswana and Swaziland.

THE ROLES of LIVESTOCK

Livestock play many vitally important roles in traditional farming systems, roles that are sometimes misunderstood by outsiders. Since about 60 percent of the poor in sub-Saharan Africa and Asia are dependent on livestock for some part of their livelihoods,[7] there is need to improve animal productivity in developing countries. Livestock systems can place pressure on the environment, while environmental stress and change has important implications for small-scale producers. There is little doubt that when crops and livestock directly compete for the same resources, it is usually more efficient for humans to consume grain than it is to feed the grain to livestock and consume meat. However, in most traditional farming systems, livestock consume little grain. Let's consider several roles of livestock and some of the factors leading to change in livestock production systems.

Buffers and Extenders of the Food Supply

Farm animals provide a special protection to farm families, acting as a buffer between the family and a precarious food supply. Animals are

[5] See Steven Haggblade, Peter Hazell, and Thomas Reardon, Strategies for Stimulating Poverty-Alleviating Growth in the Rural Nonfarm Economy in Developing Countries, *EPTD Discussion Paper No. 93*, International Food Policy Research Institute, 2002.

[6] See Nurul Islam, "The Nonfarm Sector and Rural Development: Review of Issues and Evidence," *2020 Discussion Paper Number 22*, International Food Policy Research Institute, 1997.

[7] D. Thomas and D. Rangnekar, "Responding to the increasing global demand for animal products: implications for the livelihoods of livestock producers in developing countries," in *Responding to the Livestock Revolution: The Role of Globalisation and Implications for Poverty Alleviation*, ed. E. Owen, T. Smith, M. A. Steele, S. Anderson, A. J. Duncan, M. Herrero, J. D. Leaver, C. K. Reynolds, I. Richards, J. C. Ku-Vera, British Society of Animal Science Publication 33, Nottingham University Press, 2004.

A cow is a type of savings bank in Kenya.

like a savings bank and an insurance plan. Farmers can invest in them, they grow, and they can be consumed or sold during crop failures. In most traditional agriculture, livestock do not directly compete with crops because they eat crop residues, feed off steep slopes and poor soils, and consume materials, which "extend" the food supply. Many are ruminants (e.g., cattle, goats, sheep, and buffalo) eating grass and other forages that humans cannot and converting them to products for human consumption. Livestock also make important contributions to the quality of the diet by providing meat, milk, and eggs. Small amounts of these high-protein, nutrient-rich foods can have a significant impact on human health.

Sources of Fertilizer, Fuel, Hides, and Hair

Animal manure is vitally important as a source of fertilizer and fuel in many countries. For example, in the remote hills of Nepal, it is difficult to obtain chemical fertilizer. Animal manure increases soil fertility and adds organic matter. In countries where wood is scarce, animal dung is dried and burned for fuel. Often, these two uses of animal manure compete. Dung that is burned cannot be used to increase soil fertility. In India and other countries, methane digesters have been developed, and the gas produced is used for cooking, and the residual nitrogen applied to crops.

Few livestock products are wasted in traditional society. Clothing and blankets are made from animal hides and hair of not only cattle and sheep, but buffalo, goats, and other livestock.

Providers of Power and Transport

In many countries, livestock are the principal source of power. They plow the fields, transport products to market, and are used in processing tasks like grinding sugarcane. Tractors are still relatively rare in many developing countries. The large investments needed to purchase tractors make them prohibitively expensive for traditional farmers. And, on the steep slopes and rough terrain in parts of some developing countries, it will be many years, if ever, before mechanical power replaces animal power.

Social and Cultural Symbols

Livestock, particularly cattle and goats, are highly valued in some societies for social and cultural reasons. A family's social status may be measured by the number of animals it owns.[8] Cattle are given as gifts during ceremonial occasions. While livestock serve major economic functions, they serve these other social and cultural functions as well.

Changes in Livestock Systems

Rapid urbanization and growing incomes in many developing countries have been associated with increased demands for animal proteins as a food source, a phenomenon that has been named the livestock revolution.[9] Growing demand has raised meat prices and put pressure on global livestock systems.[10] While much of this demand will be met by industrial producers, traditional farmers can play a role. This role is probably strongest in the dairy sector as cheese can be produced on a small scale. Traditional farmers, particularly those with access to grazing land, can also benefit from increased prices of cattle and other ruminants.

An additional strain on livestock systems comes from climate change, which is discussed in more detail in Chapter 9. Although impacts of climate change will vary by location, it is likely that substantial

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[8] In nomadic societies where no individual family owns the land, animal ownership is almost the only criterion available for measuring social status.

[9] C. Delgado, M. Rosegrant, H. Steinfeld, S. Ehui, and C. Courbois, "Livestock to 2020: the next food revolution," Food, Agriculture and the Environment Discussion Paper 28, IFPRI/FAO/ILRI, Washington, D.C., USA, 1999.

[10] Scientists at the International Livestock Research Institute (ILRI) have identified three main livestock systems: agro-pastoral and pastoral systems where natural resources are constrained and people adopt strategies to meet these constraints, smallholder crop-livestock systems where natural resources may be managed to improve productivity, and highly intensive industrial livestock systems.

Farmer plowing with bullock in Thailand.

temperature increases will occur in many areas, with especially harsh consequences on tropical drylands, where livestock grazing predominates. Feed resources in these areas will decline along with water availability, while increased temperatures will increase livestock consumption of already scarce water.

A final challenge to livestock systems is related to their adverse impacts on the environment. As noted, livestock often feed on steeply sloped and low-productivity lands. As a result, they contribute to loss of soil cover, soil erosion, and nutrient-laden run-off that pollutes surface water. For example, in many areas of Central America water quality issues are tied to livestock grazing on fragile lands; ground cover is being lost and erosion leads to siltation and bacterial pollution in rivers. It is critically important that all these challenges to traditional livestock producers be met through research and policy changes that increase productivity and reduce the pressure on fragile environments.

IMPLICATION of TRADITIONAL FARMS for AGRICULTURAL DEVELOPMENT

Despite the common features described above, one of the striking characteristics of farms in developing countries is their diversity. How land is organized and controlled within farms, gender roles, ties to formal markets, use of mechanical or animal traction, institutional relation-

ships with respect to water rights and access to irrigation, and many other factors differ markedly across regions and sometimes within countries. Farms in much of Sub-Saharan Africa are still quite traditional, whereas farms in many parts of Asia and the Pacific have begun to intensify and modernize. In the next chapter, we discuss factors that cause livelihood strategies and farming systems to change over time.

Traditional farms are efficient but poor. As population grows and less land is available per farmer, poverty increases unless agriculture changes; as noted in Chapter 5, unless agricultural productivity growth outstrips population growth, rural poverty will increase over time. But change brings additional risks and the danger of increasing income disparities. The distribution of income generated through new plant varieties or power tillers can be affected by asset distribution patterns and institutions that govern the rules of behavior in society. Risks must be managed, and institutions that substitute for the historical sharing arrangements must be created. Improved transportation systems are needed to improve information flows and build market linkages.

Several Asian countries face a need to alter their farming systems and to diversify out of rice. While rice will remain the dominant agricultural commodity, vegetable and livestock production become increasingly attractive because of changing consumer demands as incomes grow. Additional education and non-farm employment opportunities become important elements in an overall development strategy. Otherwise the law of diminishing returns will doom traditional farmers to poverty for the foreseeable future. African farmers face problems of low soil fertility, lack of access to markets, and low opportunity costs of time.

As incomes grow in many developing regions, consumer demands change and the global economy will respond to these changes in demand. Growth in meat and milk demand will put pressure on traditional livestock grazing systems, and policies may be needed to smooth the transition to more commercially oriented confinement and open-access grazing systems. Without such policies, market-based pressures may lead to social dislocation and environmental degradation in livestock-producing areas.

SUMMARY

Traditional agriculture is diverse, but traditional farms have some common characteristics. Traditional agriculture is generally characterized by small farms, with intertwined farm and family decisions. Traditional farm families consume, sell, or trade most of their products locally. Their labor use and land area per farm are small, but labor input per hectare

Traditional farmers in Bangladesh.

is high. Hired labor is often important. These product and labor sales and purchases mean that farmers are, in general, closely linked to the local economy and respond to market signals. Productivity and use of purchased inputs are low but efficiency is relatively high. Traditional farmers are rational but risk averse. They often live in extended or joint families. Livestock play many roles, including extending the food supply; providing a buffer against poor harvests; improving the quality of the diet; generating fertilizer, fuel, hides, and hair. They also provide power and transport and meet social and cultural needs. Traditional farms differ by region, and as farms change some people, particularly the landless, may be left behind unless new technologies are accompanied by improved institutions and education.

IMPORTANT TERMS and CONCEPTS

Asset distribution pattern	Mixed cropping
Biological technologies	Off-farm employment
Buffers and extenders	Poor but efficient
Diversification	Rational but cautious
Intermixing of farm and family decisions	Role of livestock
Joint and extended families	Seasonality
Landless labor	Semi-subsistence farms
Livelihoods	Traditional agriculture

Looking Ahead

A wide variety of agricultural systems are found in the world. These systems evolve over time. In the next chapter we examine the factors that influence the type of farming systems found in a particular country at a point in time. The importance of technical, human, institutional, and political factors is discussed. Several common types of agricultural systems are described, and the significant roles of women and children are highlighted.

QUESTIONS for DISCUSSION

1 Why might traditional farms be fairly conservative or slow to change from current practices?
2 Are traditional farms subsistence farms? What is meant by "subsistence?"
3 Why are livestock important in many traditional farming systems?
4 Distinguish between productivity and efficiency. Why do traditional farms tend to have high levels of efficiency? Why do they tend to have low or high levels of productivity?
5 What factors influence resource allocation on traditional farms? If a farmer fails to adopt a new, apparently more profitable, farming practice, is he or she irrational?
6 If traditional farmers use resources efficiently, why should we be concerned with raising productivity by increasing the use of new technologies?
7 Are the farmers who own 1 to 3 hectares the poorest people in rural communities in developing countries?
8 Why are joint and extended families still important in many developing countries?
9 Why are farm and household decisions often inseparably linked in developing countries?
10 Why are institutional changes often as important as technological changes for agricultural development?
11 Why do farmers practice mixed cropping? Are agricultural diversification and mixed cropping synonymous?
12 Why is hired labor often important in traditional or semi-subsistence agriculture?
13 Why are new biological technologies often more important than new mechanical technologies for fostering agricultural development?
14 Why is agricultural diversification becoming increasingly important in many Asian countries?

RECOMMENDED READINGS

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Agricultural Systems and Their Determinants

> The agricultural pattern that has emerged in each area is in part the result of ecological factors—a particular combination of climate and soil—and in part the result of economic and cultural factors in the society that grows the crops. — Robert S. Loomis[1]

This Chapter

1 Identifies factors that influence the agricultural systems found in a particular country at a point in time

2 Explores the differences in farming systems found in various parts of the world

3 Presents economic concepts that help explain input and output choices in farming systems

MAJOR DETERMINANTS of FARMING SYSTEMS

Farming systems in each region of the world show considerable variety, and are differentiated by how production is organized, by the nature of technologies employed, and by the types of crops and livestock produced. Each system consists of a small number of dominant crops (or livestock) and numerous minor crops (or livestock). We must understand agricultural systems if we are to improve them; therefore let's examine the primary determinants of the prevailing systems before classifying and describing them.

Technical, institutional, and human factors affect the type of agricultural system that predominates in a region. These factors interact at each location and point in time to provide a unique environment for agricultural production (see Figure 8-1). When these factors remain constant for several years, the farming system that evolves represents a long-term adaptation to that environment. Different farming systems

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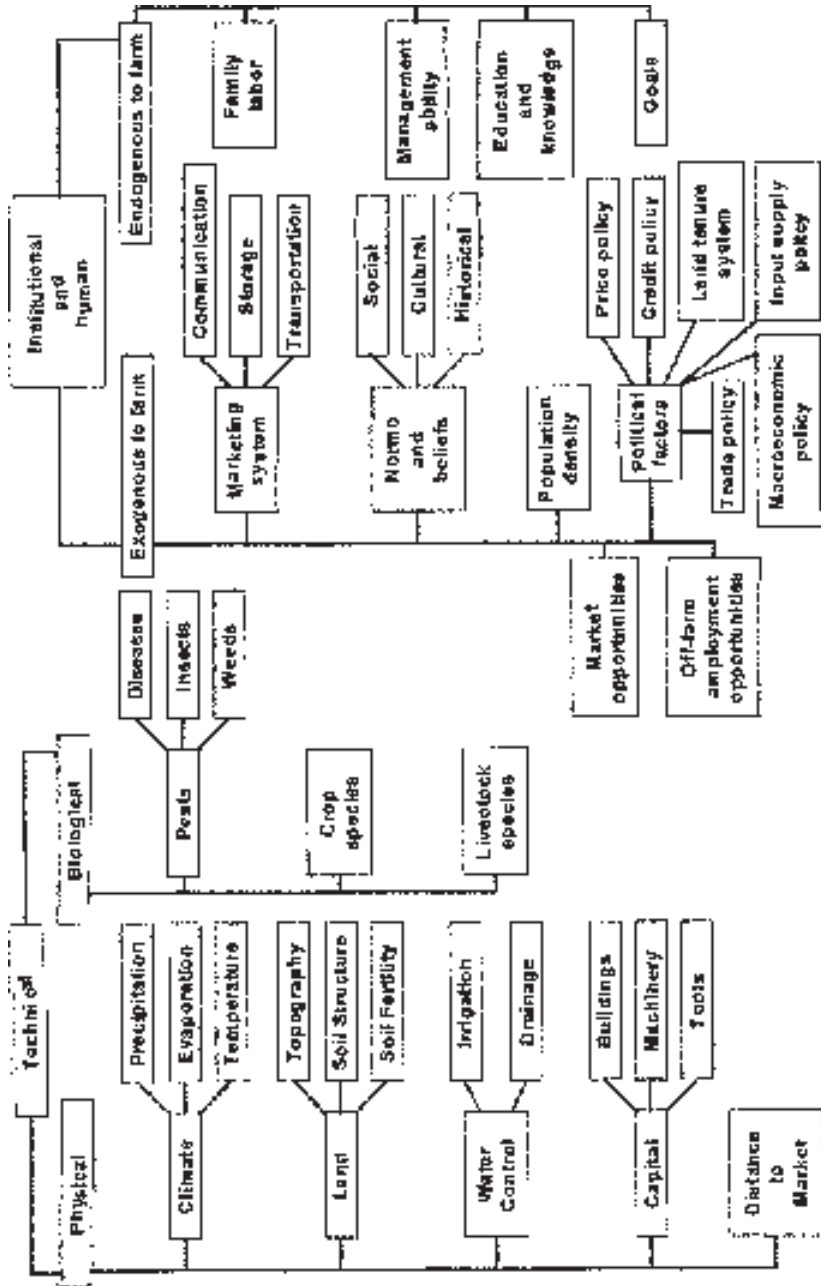[1] Robert S. Loomis, "Agricultural Systems," *Scientific American*, September 1976, p. 69.

Figure 8-1. Major determinants of the farming system at a point in time.

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