Agriculture

When you buy food in the supermarket, are you reminded of a farm? Not likely. The meat is carved into pieces that no longer resemble an animal and is wrapped in paper or plastic film. Often the vegetables are canned or frozen. The milk and eggs are in cartons.

Providing food in the United States and Canada is a vast industry. Only a few people are full-time farmers, and they may be more familiar with the operation of computers and advanced machinery than the typical factory or office worker.

The mechanized, highly productive American or Canadian farm contrasts with the subsistence farm found in much of the world. The most “typical” human—if there is such a person—is an Asian farmer who grows enough food to survive, with little surplus. This sharp contrast in agricultural practices constitutes one of the most fundamental differences between the more developed and less developed countries of the world.

**KEY ISSUES**

1. Where did agriculture originate?
2. Where are agricultural regions in less developed countries?
3. Where are agricultural regions in more developed countries?
4. Why do farmers face economic difficulties?
CASE STUDY

Wheat Farmers in Kansas and Pakistan

The Iqbel family grows wheat on its 1-hectare (2.5-acre) plot of land in the Punjab province of Pakistan in a manner similar to that of their ancestors. They perform most tasks by hand or with the help of animals. To irrigate the land, for example, they lift water from a 20-meter (65-foot) well by pushing a water wheel. More prosperous farmers in Pakistan use bullocks to turn the wheel.

The farm produces about 1,500 kilograms (3,300 pounds) of wheat per year—enough to feed the Iqbel family. Some years they produce a small surplus, which they can sell. They can then use that money to buy other types of food or household items. In drought years, however, the crop yield is lower, and the Iqbel family must receive food from government and international relief organizations.

A world away, in Kansas, the McKinleys farm the prairie sod. Like the Iqbel family, they grow wheat in a climate that receives little rain. Otherwise, the two farm families lead very different lives. The McKinley family's farm is 200 times as large—200 hectares (500 acres). The McKinleys derive several hundred times more income from the sale of wheat than do the Iqbel family.

The wheat grown on the McKinleys farm is not consumed directly by them. Instead, it is sold to a processing company and ultimately turned into bread wrapped in plastic and sold in a supermarket hundreds of kilometers away. Most of the wheat from the Iqbel's farm is consumed in the village where it is grown.

More than 40 percent of the people in the world are farmers. The overwhelming majority of them are like the Iqbel family, growing enough food to feed themselves, but little more. In most African and Asian countries more than one-half of the people are farmers. In contrast, fewer than 2 percent of the people in the United States and Canada are farmers. Yet the advanced technology used by these farmers allows them to produce enough food for people in the United States and Canada at a very high standard, plus food for many people elsewhere in the world.

The previous chapter divided economic activities into primary, secondary, and tertiary sectors. This chapter is concerned with the principal form of primary-sector economic activity—agriculture. The next two chapters look at the secondary and tertiary sectors.

Geographers study where agriculture is distributed across Earth. The most important distinction is what happens to farm products. In less developed regions, the farm products are most often consumed on or near the farm where they are produced, whereas in more developed countries (MDCs) farmers sell what they produce.

Geographers observe a wide variety of agricultural practices. The reason why farming varies around the world relates to the distribution of cultural and environmental factors across space. Elements of the physical environment, such as climate, soil, and topography, set broad limits on agricultural practices, and farmers make choices to modify the environment in a variety of ways.

Farming is an economic activity that still depends very much on the local diversity of environmental and cultural conditions in each place. Despite increased knowledge of alternatives, farmers practice distinctive agriculture in different regions and, in fact, on neighboring farms. Broad climate patterns influence the crops planted in a region, and local soil conditions influence the crops planted on an individual farm.

In each society, farmers possess very specific knowledge of their environmental conditions and certain technology for modifying the landscape. Within the limits of their technology, farmers choose from a variety of agricultural practices, based on their perception of the value of each alternative. These values are partly economic and partly cultural.

How farmers deal with their physical environment varies according to dietary preferences, availability of technology, and other cultural traditions. Farmers select agricultural practices based on cultural perceptions, because a society may hold some foods in high esteem while avoiding others.

Although individual farmers may make specific decisions on a very local scale, agriculture is as caught up in the globalization of the economy as other industries. Agriculture is big business in MDCs and a major component of international trade networks in less developed countries (LDCs).

After examining the origins and diffusion of agriculture, we will consider the agricultural practices used in less developed and more developed regions. We will also examine the problems farmers face in each type of region. Although each farm has a unique set of physical conditions and choice of crops, geographers group farms into several types by their distinctive environmental and cultural characteristics.
KEY ISSUE 1
Where Did Agriculture Originate?

- Origins of agriculture
- Location of agricultural hearths
- Classifying agricultural regions

The origins of agriculture cannot be documented with certainty, because it began before recorded history. Scholars try to reconstruct a logical sequence of events based on fragments of information about ancient agricultural practices and historical environmental conditions. Improvements in cultivating plants and domesticating animals evolved over thousands of years. This section offers an explanation for the process of origin and diffusion of agriculture.

Origins of Agriculture

Determining the origin of agriculture first requires a definition of what it is—and agriculture is not easily defined. We will use this definition: agriculture is deliberate modification of Earth’s surface through cultivation of plants and rearing of animals to obtain sustenance or economic gain. Agriculture thus originated when humans domesticated plants and animals for their use. The word cultivate means “to care for,” and a crop is any plant cultivated by people.

Hunters and Gatherers

Before the invention of agriculture, all humans probably obtained the food they needed for survival through hunting for animals, fishing, or gathering plants (including berries, nuts, fruits, and roots). Hunters and gatherers lived in small groups, with usually fewer than 50 persons, because a larger number would quickly exhaust the available resources within walking distance. They survived by collecting food often, perhaps daily. The food search might take only a short time or much of the day, depending on local conditions. The men hunted game or fished, and the women collected berries, nuts, and roots. This division of labor sounds like a stereotype but is based on evidence from archaeology and anthropology.

The group traveled frequently, establishing new home bases or camps. The direction and frequency of migration depended on the movement of game and the seasonal growth of plants at various locations. We can assume that groups communicated with each other concerning hunting rights, intermarriage, and other specific subjects. For the most part, they kept the peace by steering clear of each other’s territory.

Contemporary hunting and gathering societies are isolated groups living on the periphery of world settlement, but they provide insight into human customs that prevailed in prehistoric times, before the invention of agriculture.

Invention of Agriculture

Why did nomadic groups convert from hunting, gathering, and fishing to agriculture? In gathering wild vegetation, people inevitably cut plants and dropped berries, fruits, and seeds. These hunters probably observed that, over time, damaged or discarded food produced new plants. They may have deliberately cut plants or dropped berries on the ground to see if they would produce new plants. Subsequent generations learned to pour water over the site and to introduce manure and other soil improvements. Over thousands of years, plant cultivation apparently evolved from a combination of accident and deliberate experiment.

Prehistoric people may have originally domesticated animals for noneconomic reasons, such as for sacrifices and other religious ceremonies. Other animals probably were domesticated as household pets, surviving on the group’s food scraps.

TWO TYPES OF CULTIVATION. The earliest form of plant cultivation, according to prominent cultural geographer Carl Sauer, was vegetative planting, which is the reproduction of plants by direct cloning from existing plants, such as cutting stems and dividing roots. Plants found growing wild were deliberately divided and transplanted.

Coming later, according to Sauer, was seed agriculture, which is the reproduction of plants through annual planting of seeds that result from sexual fertilization. Seed agriculture is practiced by most farmers today.

Location of Agricultural Hearths

Agriculture probably did not originate in one location but began in multiple, independent hearths, or points of origin. From these hearths, agricultural practices diffused across Earth’s surface.

Location of First Vegetative Planting

Sauer believes that vegetative planting probably originated in Southeast Asia (Figure 10–1). The region’s diversity of climate and topography probably encouraged growth of a wide variety of plants suitable for dividing and transplanting. Also, the people obtained food primarily by fishing rather than by hunting and gathering, so they may have been more sedentary and therefore able to devote more attention to growing plants.

The first plants domesticated in Southeast Asia through vegetative planting probably included roots such as the taro and yam, and tree crops such as the banana and palm. Vegetative planting diffused from the Southeast Asian hearth northward and eastward to China and Japan, and westward through India to Southwest Asia, tropical Africa, and the Mediterranean lands. As for livestock, the dog, pig, and chicken were probably first domesticated in Southeast Asia.

Other early hearths of vegetative planting also may have emerged independently in West Africa and northwestern South
America. It may have begun with the oil-palm tree and yam in West Africa and the manioc, sweet potato, and arrowroot in South America. The practice diffused from northwestern South America to Central America and eastern portions of South America.

**Location of First Seed Agriculture**

Seed agriculture also originated in more than one hearth. Sauer identified three hearths in the Eastern Hemisphere—western India, northern China, and Ethiopia (Figure 10–2). Seed agriculture diffused quickly from western India to Southwest Asia, where important early advances were made, including the domestication of wheat and barley, two grains that became particularly important thousands of years later in European and American civilizations.

Apparently, inhabitants of Southwest Asia also were first to integrate seed agriculture with domestication of herd animals such as cattle, sheep, and goats. These animals were used to plow the land before planting seeds and, in turn, were fed part of the harvested crop. Other animal products, such as milk, meat, and skins, were first exploited at a later date, according to Sauer. This integration of plants and animals is a fundamental element of modern agriculture.

**DIFFUSION OF SEED AGRICULTURE.** Seed agriculture diffused from Southwest Asia across Europe and through North Africa. Greece, Crete, and Cyprus display the earliest evidence of seed agriculture in Europe. From these countries, agriculture may have diffused northward through the Danube River basin, eventually to the Baltic and North seas, and northward to Ukraine. Most of the plants and animals domesticated in Southwest Asia spread into Europe, although barley and cattle became more important farther north, perhaps because of cooler and moister climatic conditions.

Seed agriculture also diffused eastward from Southwest Asia to northwestern India and the Indus River plain. Again, various domesticated plants and animals were brought from Southwest Asia, although other plants, such as cotton and rice, arrived in India from different hearths.

From the northern China hearth, millet diffused to South Asia and Southeast Asia. Rice, which ultimately became the most important crop in much of Asia, has an unknown hearth, although some geographers consider Southeast Asia to be its most likely location. Sauer identified a third independent hearth in Ethiopia, where millet and sorghum were domesticated early. However, he argued that agricultural advances in Ethiopia did not diffuse widely to other locations. It is ironic that Ethiopia is an ancient hearth for seed agriculture, because rapid population growth, devastating civil wars, and adverse environmental conditions have combined to make Ethiopia the site of widespread starvation.

Two independent seed agriculture hearths originated in the Western Hemisphere—southern Mexico and northern Peru. The hearth in southern Mexico, which extended into Guatemala and Honduras, was the point of origin for squash and maize (corn). Squash, beans, and cotton may have been domesticated in northern Peru. From these two hearths, agricultural practices diffused to other parts of the Western Hemisphere, although agriculture was not widely practiced until European colonists began to arrive some 500 years ago. The only domesticated animals were the llama, alpaca, and turkey; herd animals were unknown until European explorers brought them in the sixteenth century.

That agriculture had multiple origins means that, from earliest times, people have produced food in distinctive ways in different regions. This diversity derives from a unique legacy of wild plants, climatic conditions, and cultural preferences in each region. Improved communications in recent centuries have encouraged the diffusion of some plants to varied locations around the world. Many plants and animals thrive across a wide portion of Earth's surface, not just in their place of original domestication. Only after 1500, for example, were wheat, oats, and barley introduced to the Western Hemisphere, and maize to the Eastern Hemisphere.

**Classifying Agricultural Regions**

The most fundamental differences in agricultural practices are between those in LDCs and those in MDCs. Farmers in LDCs generally practice subsistence agriculture, whereas farmers in MDCs, including the United States, Canada, Western Europe, Australia, and New Zealand, practice commercial agriculture.

**Differences Between Subsistence and Commercial Agriculture**

**Subsistence agriculture,** found in LDCs, is the production of food primarily for consumption by the farmer's family. **Commercial agriculture,** found in MDCs, is the production of food
primarily for sale off the farm. Five principal features distinguish commercial agriculture from subsistence agriculture:

- Purpose of farming
- Percentage of farmers in the labor force
- Use of machinery
- Farm size
- Relationship of farming to other businesses

**PURPOSE OF FARMING.** Subsistence and commercial agriculture are undertaken for different purposes. In LDCs most people produce food for their own consumption. Some surplus may be sold to the government or to private firms, but the surplus product is not the farmer’s primary purpose and may not even exist some years because of growing conditions.

In commercial farming, farmers grow crops and raise animals primarily for sale off the farm rather than for their own consumption. Agricultural products are not sold directly to consumers but to food-processing companies. Large processors, such as General Mills and Kraft, typically sign contracts with commercial farmers to buy their grain, chickens, cattle, and other output. Farmers may have contracts to sell sugar beets to sugar refineries, potatoes to distilleries, and oranges to manufacturers of concentrated juices.

**PERCENTAGE OF FARMERS IN THE LABOR FORCE.** In MDCs less than one-tenth of the workers are engaged directly in farming, compared to more than one-half in LDCs (Figure 10–3). The percentage of farmers is even lower in the United States and Canada, at only 2 percent. Yet the small percentage of

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**FIGURE 10–3** Percent primary-sector workers, 2005. A priority for all people is to secure the food they need to survive. In less developed countries most people work in agriculture to produce the food they and their families require. In more developed countries few people are farmers, and most people buy food with money earned by working in factories or offices or by performing other services.
farmers in the United States and Canada produces enough food not only for themselves and the rest of the region but also a surplus to feed people elsewhere.

The number of farmers declined dramatically in MDCs during the twentieth century. The United States had about 6 million farms in 1940 and 4 million in 1960; the number has stabilized during the past two decades at around 2 million. Both push and pull migration factors have been responsible for the decline: people were pushed away from farms by lack of opportunity to earn a decent income, and at the same time they were pulled to higher-paying jobs in urban areas.

**USE OF MACHINERY.** A small number of farmers in more developed societies can feed many people because they rely on machinery to perform work, rather than relying on people or animals (Figure 10-4). In LDCs, farmers do much of the work with hand tools and animal power.

Traditionally, the farmer or local craftspeople made equipment from wood, but beginning in the late eighteenth century, factories produced farm machinery. The first all-iron plow was made in the 1770s and was followed in the nineteenth and twentieth centuries by inventions that made farming less dependent on human or animal power. Tractors, combines,
corn pickers, planters, and other factory-made farm machines have replaced or supplemented manual labor.

Transportation improvements also aid commercial farmers. The building of railroads in the nineteenth century, and highways and trucks in the twentieth century, have enabled farmers to transport crops and livestock farther and faster. Cattle arrive at market heavier and in better condition when transported by truck or train than when driven on hoof. Crops reach markets without spoiling.

Commercial farmers use scientific advances to increase productivity. Experiments conducted in university laboratories, industry, and research organizations generate new fertilizers, herbicides, hybrid plants, animal breeds, and farming practices, which produce higher crop yields and healthier animals. Access to other scientific information has enabled farmers to make more intelligent decisions concerning proper agricultural practices. Some farmers conduct their own on-farm research.

Electronics also aid commercial farmers. Global positioning system (GPS) units determine the precise coordinates for spreading different types and amounts of fertilizers. On large ranches, GPS is also used to monitor the location of cattle. Satellite imagery monitors crop progress. Yield monitors attached to combines determine the precise number of bushels being harvested.

**FARM SIZE.** The average farm size is relatively large in commercial agriculture, especially in the United States and Canada. U.S. farms average about 171 hectares (444 acres). Despite their size, most commercial farms in MDCs are family owned and operated—98 percent in the United States. Commercial farmers frequently expand their holdings by renting nearby fields.

Commercial agriculture is increasingly dominated by a handful of large farms. In the United States, the 29,000 largest farms average more than 1,200 hectares (3,000 acres) and sell an average of more than $3 million of agricultural products per year, or $400 per hectare ($1,000 per acre). These 29,000 farms comprise only 1.4 percent of all U.S. farms, but they account for 48 percent of all agricultural sales. At the other extreme, one-half of the 2 million U.S. farms generate less than $5,000 per year in sales, and they average a bit more than 40 hectares (100 acres) in size, so they generate sales of only around $20 per hectare ($50 per acre).

Large size is partly a consequence of mechanization. Combines, pickers, and other machinery perform most efficiently at very large scales, and their considerable expense cannot be justified on a small farm. As a result of the large size and the high level of mechanization, commercial agriculture is an expensive business. Farmers spend hundreds of thousands of dollars to buy or rent land and machinery before beginning operations. This money is frequently borrowed from a bank and repaid after the output is sold.

Although the United States currently has fewer farms and farmers than in 1900, the amount of land devoted to agriculture has increased. The United States had 60 percent fewer farms and 85 percent fewer farmers in 2000 than in 1900, but 13 percent more farmland, primarily through irrigation and reclamation.

However, the amount of U.S. farmland has declined from an all-time peak around 1960. The United States has been losing 500,000 hectares (1.2 million acres) per year of its 400 million hectares (1 billion acres) of farmland, primarily because of expansion of urban areas. A more serious problem in the United States has been the loss of 200,000 hectares (500,000 acres) of the most productive farmland, known as prime agricultural land, as urban areas sprawl into the surrounding countryside (see Contemporary Geographic Tools box).

**RELATIONSHIP OF FARMING TO OTHER BUSINESSES.**

Commercial farming is closely tied to other businesses. The system of commercial farming found in the United States and other relatively developed countries has been called agribusiness, because the family farm is not an isolated activity but is integrated into a large food-production industry. Commercial farmers make heavy use of modern communications and information technology to stay in touch and keep track of prices, yields, and expenditures.

Although farmers are less than 2 percent of the U.S. labor force, around 20 percent of U.S. labor works in food production and service related to agribusiness—food processing, packaging, storing, distributing, and retailing. Agribusiness encompasses such diverse enterprises as tractor manufacturing, fertilizer production, and seed distribution. Although most farms are owned by individual families, many other aspects of agribusiness are controlled by large corporations.

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**Mapping Agricultural Regions**

Several attempts have been made to outline the major types of subsistence and commercial agriculture currently practiced in the world, but few of these classifications include maps that show regional distributions. The most widely used map of world agricultural regions was prepared by geographer Derwent Whittlesey in 1936.

Whittlesey identified 11 main agricultural regions, plus an area where agriculture was nonexistent. Whittlesey's 11 regions are divided between five that are important in LDCs and six that are important in MDCs (Figure 10-5, bottom).
CONTEMPORARY GEOGRAPHIC TOOLS

Protecting Farmland

Loss of farmland to urban growth is especially severe at the edge of the string of large metropolitan areas along the East Coast of the United States. Some of the most threatened agricultural land lies in Maryland, a small state where two major cities—Washington and Baltimore—have coalesced into a continuous built-up area (see Chapter 13). A geographic information system (GIS) was used to identify which farms should be preserved.

Farmland preservation efforts traditionally identify “prime” agricultural areas on the basis of only one factor—soil quality. “Prime” farmland is typically flat and well drained, qualities that also attract developers of new housing projects. Through GIS, the distribution of Maryland’s most productive soils could be compared to the distribution of other factors.

Maps generated through GIS were essential in identifying agricultural land to protect, because the most appropriate farms to preserve were not necessarily those with the highest-quality soil. Why should the state and nonprofit organizations spend scarce funds to preserve “prime” farmland that is nowhere near the path of urban sprawl? Conversely, why purchase an expensive, isolated farm already totally surrounded by residential developments, when the same amount of money could buy several large contiguous farms that effectively blocked urban sprawl elsewhere?

To identify the “best” lands according to several economic and environmental factors, not just soil quality, GIS consultants produced a series of maps at the state and county levels. Environmental maps identified farmland in need of preservation because of water quality, flood control, species habitats, historic sites, or especially attractive scenery. Economic maps included the market value of the products grown or raised on the land and areas projected to have relatively high population growth if not curtailed. The GIS maps showed that 63 percent of Maryland’s farmland contained prime soils, 32 percent important environmental features, and 23 percent high population growth pressures.

The various soil quality, environmental, and economic maps were combined through the GIS to produce a single composite map of all three sets of important factors (Figure 10–1.1). The map shows that 4 percent of the state’s farmland had prime soils, significant environmental features, and high projected population growth, and 25 percent had two of the three factors (such as prime soils and significant environmental features but not high population growth).

GIS cannot rank the relative importance of the various physical, environmental, and economic factors. Land with one important physical, environmental, or economic feature may be as important to preserve as land with three features. Still, Maryland officials are making use of the results of the GIS as part of an overall strategy to minimize sprawl and keep new developments as tightly packed around existing urban areas as possible. For example, state highway money is allocated to improving roads in existing built-up areas rather than extend new roads through rural areas.

![Figure 10-1.1 Maryland soil quality, environmental conditions, and population growth.](image)

Within more developed and less developed regions, Whittlesey sorted out agricultural practices primarily by climate. Climate influences the crop that is grown, or whether animals are raised instead of growing any crop (Figure 10–5, top). Similarities between the two maps are striking. For example, pastoral nomadism is the predominant type of agriculture in the Middle East, which has a dry climate, whereas shifting cultivation is the predominant type of agriculture in central Africa, which has a tropical climate.

Note the division between southeastern China (warm midlatitude climate, intensive subsistence agriculture with wet rice domnant) and northeastern China (cold midlatitude climate, intensive subsistence agriculture with wet rice not dominant). In the United States much of the West is distinguished from the rest of the country according to climate (dry) and agriculture (livestock ranching). Thus, agriculture varies between the drylands and the tropics within LDCs—as well as between the drylands of less developed and more developed countries.

The correlation between agriculture and climate is by no means perfect, but clearly some relationship exists between climate and agriculture. Because of the problems with environmental determinism discussed in Chapter 1, geographers are wary of placing too much emphasis on the role of climate.

Cultural preferences, discussed in Chapter 4, explain some agricultural differences in areas of similar climate. Hog production is virtually nonexistent in predominantly Muslim regions, because of that religion’s taboo against consuming pork products (refer to Figure 4–6). Wine production is relatively low in Africa and Asia, even where climate is favorable for growing grapes, because of alcohol avoidance in predominantly non-Christian countries (refer to Figure 4–13).
KEY ISSUE 2

Where Are Agricultural Regions in Less Developed Countries?

- Shifting cultivation
- Pastoral nomadism
- Intensive subsistence agriculture
- Plantation farming

This section considers four agricultural types characteristic of LDCs—shifting cultivation, pastoral nomadism, intensive subsistence, and plantation. Intensive subsistence agriculture is divided into two regions, depending on the choice of crop.

Shifting Cultivation

Shifting cultivation is practiced in much of the world’s Humid Low-Latitude, or A, climate regions, which have relatively high temperatures and abundant rainfall. It predominates in the Amazon area of South America, Central and West Africa, and Southeast Asia, including Indochina, Indonesia, and New Guinea. It is estimated to be practiced by roughly 250 million people across 36 million square kilometers (14 million square miles).

Why is it called shifting cultivation rather than shifting agriculture? It is essentially a matter of scale. We use the term cultivation (as in “cultivate a garden”) because agriculture implies greater use of tools and animals and more sophisticated modification of the landscape. Shifting cultivation bears little relation to the agriculture practiced in the more developed regions of Western Europe and North America, or even in other LDCs such as China.

Characteristics of Shifting Cultivation

Shifting cultivation has two distinguishing hallmarks:

- Farmers clear land for planting by slashing vegetation and burning the debris (slash-and-burn agriculture).
- Farmers grow crops on a cleared field for only a few years until soil nutrients are depleted and then leave it fallow (nothing planted) for many years so the soil can recover.

People who practice shifting cultivation generally live in small villages and grow food on the surrounding land, which the village controls. Well-recognized boundaries usually separate neighboring villages.

THE PROCESS OF SHIFTING CULTIVATION. Each year villagers designate for planting an area surrounding the settlement. Before planting, they must remove the dense vegetation that typically covers tropical land. Using axes, they cut most of the trees, sparing only those that are economically useful. An efficient strategy they employ is to cut selected large trees, which bring down smaller trees that may have been weakened by notching.

The undergrowth is cleared away with a machete or other long knife. On a windless day the debris is burned under carefully controlled conditions. The rains wash the fresh ashes into the soil, providing needed nutrients. The cleared area is known by a variety of names in different regions, including swidden, ladang, milpa, brana, and kaingin.

Before planting, fields are prepared by hand, perhaps with the help of a simple implement such as a hoe; plows and animals are rarely used. The only fertilizer generally available is potash (potassium) from burning the debris when the site is cleared. Little weeding is done the first year that a cleared patch of land is farmed; weeds may be cleared with a hoe in subsequent years.

The cleared land can support crops only briefly, usually 3 years or less. In many regions the most productive harvest comes in the second year after burning. Thereafter, soil nutrients are rapidly depleted and the land becomes too infertile to nourish crops. Rapid weed growth also contributes to the abandonment of a swidden after a few years.

When the swidden is no longer fertile, villagers identify a new site and begin clearing it. They leave the old site uncropped for many years, allowing it to become overrun again by natural vegetation. The field is not actually abandoned; the villagers will return to the site someday, perhaps as few as 6 years or as many as 20 years later, to begin the process of clearing the land again. In the meantime, they may still care for fruit-bearing trees on the site.

If a cleared area outside a village is too small to provide food for the population, then some of the people may establish a new village and practice shifting cultivation there. Some farmers may move temporarily to another settlement if the field they are clearing that year is distant.
FIGURE 10-5 (top) Simplified climate regions. Figure 2-2 shows more detail. Compare the board distribution of the major climate regions with the distinctive types of agriculture in more developed and less developed countries. (bottom) Agricultural regions. The major agricultural practices of the world can be divided into subsistence and commercial regions.

**Subsistence** regions include the following:
- *Shifting cultivation*—primarily the tropical regions of South America, Africa, and Southeast Asia
- *Pastoral nomadism*—primarily the drylands of North Africa and Asia
- *Intensive subsistence, wet rice dominant*—primarily the large population concentrations of East and South Asia
- *Intensive subsistence, crop other than rice dominant*—primarily the large population concentrations of East and South Asia where growing rice is difficult

**Commercial** regions include the following:
- *Mixed crop and livestock*—primarily U.S. Midwest and central Europe
- *Dairying*—primarily near population clusters in northeastern United States, southeastern Canada, and northwestern Europe
- *Grain*—primarily north-central United States and Eastern Europe
- *Ranching*—primarily the drylands of western United States, southeastern South America, Central Asia, southern Africa, and Australia
- *Mediterranean*—primarily lands surrounding the Mediterranean Sea, western United States, and Chile
- *Commercial gardening*—primarily southeastern United States and southeastern Australia
- *Plantation*—primarily the tropical and subtropical regions of Latin America, Africa, and Asia
CROPS OF SHIFTING CULTIVATION. The precise crops grown by each village vary by local custom and taste. The predominant crops include upland rice in Southeast Asia, maize (corn) and manioc (cassava) in South America, and millet and sorghum in Africa. Yams, sugarcane, plantain, and vegetables are also grown in some regions. These crops may have begun in one region of shifting cultivation but then diffused to other areas in recent years.

The Kayapo people of Brazil's Amazon tropical rainforest do not arrange crops in the rectangular fields and rows that are familiar to us. They plant in concentric rings. At first they plant sweet potatoes and yams in the inner area. In successive rings go corn and rice, manioc, and more yams. The outermost ring contains papaya, banana, pineapple, mango, cotton, and beans. Plants that require more nutrients are located in the outer ring. It is here that the leafy crowns of cut trees fall when the field is cleared, and their rotting releases more nutrients into the soil. In subsequent years the inner area of potatoes and yams expands to replace corn and rice.

Most families grow only for their own needs, so one swidden may contain a large variety of intermingled crops, which are harvested individually at the best time. In shifting cultivation a "farm field" appears much more chaotic than do fields in MDCs, where a single crop such as corn or wheat may grow over an extensive area. In some cases, families may specialize in a few crops and trade with villagers who have a surplus of others.

OWNERSHIP AND USE OF LAND IN SHIFTING CULTIVATION. Traditionally, land is owned by the village as a whole rather than separately by each resident. The chief or ruling council allocates a patch of land to each family and allows it to retain the output. Individuals may also have the right to own or protect specific trees surrounding the village. Private individuals now own the land in some communities, especially in Latin America.

Shifting cultivation occupies approximately one-fourth of the world's land area, a higher percentage than any other type of agriculture. However, less than 5 percent of the world's people
engage in shifting cultivation. The gap between the percentage of people and land area is not surprising, because the practice of moving from one field to another every couple of years requires more land per person than do other types of agriculture.

**Future of Shifting Cultivation**

Land devoted to shifting cultivation is declining in the tropics at the rate of about 75,000 square kilometers (30,000 square miles), or 0.2 percent per year, according to the United Nations. The amount of Earth's surface allocated to tropical rain forests has already been reduced to less than half of its original area.

Shifting cultivation is being replaced by logging, cattle ranching, and cultivation of cash crops. Selling timber to builders or raising beef cattle for fast-food restaurants is a more effective development strategy than maintaining shifting cultivation. Until recent years the World Bank supported deforestation with loans to finance development schemes that required clearing forests. LDCs also see shifting cultivation as an inefficient way to grow food in a hungry world. Indeed, compared to other forms of agriculture, shifting cultivation can support only a small population in an area without causing environmental damage.

To its critics, shifting cultivation is at best a preliminary step in economic development. Pioneers use shifting cultivation to clear forests in the tropics and to open land for development where permanent agriculture never existed. People unable to find agricultural land elsewhere can migrate to the tropical forests and initially practice shifting cultivation. Critics say it then should be replaced by more sophisticated agricultural techniques that yield more per land area.

But defenders of shifting cultivation consider it the most environmentally sound approach for the tropics. Practices used in other forms of agriculture, such as using fertilizers and pesticides and permanently clearing fields, may damage the soil, cause severe erosion, and upset balanced ecosystems.

Large-scale destruction of the rain forests also may contribute to global warming. When large numbers of trees are cut, their burning and decay release large volumes of carbon dioxide. This gas can build up in the atmosphere, acting like the window glass in a greenhouse to trap solar energy in the atmosphere, resulting in the "greenhouse effect," discussed in Chapter 14.

Elimination of shifting cultivation could also upset the traditional local diversity of cultures in the tropics. The activities of shifting cultivation are intertwined with other social, religious, political, and various folk customs. A drastic change in the agricultural economy could disrupt other activities of daily life.

As the importance of tropical rain forests to the global environment has become recognized, LDCs have been pressured to restrict further destruction of them. In one innovative strategy, Bolivia agreed to set aside 1.5 million hectares (3.7 million acres) in a forest reserve in exchange for cancellation of $650,000,000 of its debt to developed countries. Meanwhile, in Brazil's Amazon rain forest, deforestation has increased from 2.7 million hectares (7 million acres) per year during the 1990s to 3.1 million hectares (8 million acres) since 2000.

**Pastoral Nomadism**

**Pastoral nomadism** is a form of subsistence agriculture based on the herding of domesticated animals. The word *pastoral* refers to sheep herding. It is adapted to dry climates, where planting crops is impossible. Pastoral nomads live primarily in the large belt of arid and semiarid land that includes North Africa, the Middle East, and parts of Central Asia. The Bedouins of Saudi Arabia and North Africa and the Masai of East Africa are examples of nomadic groups. Only about 15 million people are pastoral nomads, but they sparsely occupy about 20 percent of Earth's land area.

**Characteristics of Pastoral Nomadism**

In contrast to other subsistence farmers, pastoral nomads depend primarily on animals rather than crops for survival. The animals provide milk, and their skins and hair are used for clothing and tents. Like other subsistence farmers, though,
pastoral nomads consume mostly grain rather than meat. Their animals are usually not slaughtered, although dead ones may be consumed. To nomads, the size of their herd is both an important measure of power and prestige and their main security during adverse environmental conditions.

Some pastoral nomads obtain grain from sedentary subsistence farmers in exchange for animal products. More often, part of a nomadic group—perhaps the women and children—may plant crops at a fixed location while the rest of the group wanders with the herd. Nomads might hire workers to practice sedentary agriculture in return for grain and protection. Other nomads might sow grain in recently flooded areas and return later in the year to harvest the crop. Yet another strategy is to remain in one place and cultivate the land when rainfall is abundant; then, during periods that are too dry to grow crops, the group can increase the size of the herd and migrate in search of food and water.

**CHOICE OF ANIMALS.** Nomads select the type and number of animals for the herd according to local cultural and physical characteristics. The choice depends on the relative prestige of animals and the ability of species to adapt to a particular climate and vegetation. The camel is most frequently desired in North Africa and the Middle East, followed by sheep and goats. In Central Asia the horse is particularly important. The camel is well suited to arid climates because it can go long periods without water, carry heavy baggage, and move rapidly. However, the camel is particularly bothered by flies and sleeping sickness and has a relatively long gestation period—12 months from conception to birth. Goats need more water than do camels but are tough and agile and can survive on virtually any vegetation, no matter how poor. Sheep are relatively slow moving and are more affected by climatic changes. They require more water and are more selective as to which plants they will eat. The minimum number of animals necessary to support each family adequately varies according to the particular group and animal. The typical nomadic family needs 25 to 60 goats or sheep or 10 to 25 camels.

**MOVEMENTS OF PASTORAL NOMADS.** Pastoral nomads do not wander randomly across the landscape but have a strong sense of territoriality. Every group controls a piece of territory and will invade another group’s territory only in an emergency or if war is declared. The goal of each group is to control a territory large enough to contain the forage and water needed for survival. The actual amount of land a group controls depends on its wealth and power.

The precise migration patterns evolve from intimate knowledge of the area’s physical and cultural characteristics. Groups frequently divide into herding units of five or six families and choose routes based on the most likely water sources during the various seasons of the year. The selection of routes varies in unusually wet or dry years and is influenced by the condition of their animals and the area’s political stability.

Some pastoral nomads practice transhumance, which is seasonal migration of livestock between mountains and lowland pasture areas. Pasture is grass or other plants grown for feeding grazing animals, as well as land used for grazing. Sheep or other animals may pasture in alpine meadows in the summer and be herded back down into valleys for winter pasture.

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**The Future of Pastoral Nomadism**

Agricultural experts once regarded pastoral nomadism as a stage in the evolution of agriculture—between the hunters and gatherers who migrated across Earth’s surface in search of food, and sedentary farmers who cultivate grain in one place. Because they had domesticated animals but not plants, pastoral nomads were considered more advanced than hunters and gatherers but less advanced than settled farmers.

Pastoral nomadism is now generally recognized as an offshoot of sedentary agriculture, not as a primitive precursor of it. It is simply a practical way of surviving on land that receives too little rain for cultivation of crops. The domestication of animals—the basis for pastoral nomadism—probably was achieved originally by sedentary farmers, not by nomadic hunters. Pastoral nomads therefore had to be familiar with sedentary farming, and in many cases they practiced it.

Today pastoral nomadism is a declining form of agriculture, partly a victim of modern technology. Before recent transportation and communications inventions, pastoral nomads played an important role as carriers of goods and information across the sparsely inhabited drylands. Nomads used to be the most powerful inhabitants of the drylands, but now, with modern weapons, national governments can control the nomadic population more effectively.

Government efforts to resettle nomads have been particularly vigorous in China, Kazakhstan, and several Middle Eastern countries, including Egypt, Israel, Saudi Arabia, and Syria. Nomads are reluctant to cooperate, so these countries have experienced difficulty in trying to force settlement in collectives and cooperatives. Governments force groups to give up pastoral nomadism because they want the land for other uses. Land that can be irrigated is converted from nomadic to sedentary agriculture. In some instances the mining and petroleum industries now operate in drylands formerly occupied by pastoral nomads.

Some nomads are encouraged to try sedentary agriculture or to work for mining or petroleum companies. Others are still allowed to move about, but only within ranches of fixed boundaries. In the future, pastoral nomadism will be increasingly confined to areas that cannot be irrigated or that lack valuable raw materials.

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**Intensive Subsistence Agriculture**

Shifting cultivation and pastoral nomadism are forms of subsistence agriculture found in regions of low density. But three-fourths of the world’s people live in LDCs, and another form of subsistence agriculture is needed to feed most of them—**intensive subsistence agriculture**. The term intensive implies that farmers must work more intensively to subsist on a parcel of land.

In densely populated East, South, and Southeast Asia, most farmers practice intensive subsistence agriculture. The typical farm in Asia’s intensive subsistence agriculture regions is much smaller than elsewhere in the world. Many Asian farmers own several fragmented plots, frequently a result of dividing individual holdings among several children over several centuries.

Because the agricultural density—the ratio of farmers to arable land—is so high in parts of East and South Asia, families must produce enough food for their survival from a very small
area of land. They do this through careful agricultural practices, refined over thousands of years in response to local environmental and cultural patterns. Most of the work is done by hand or with animals rather than with machines, in part due to abundant labor, but largely from lack of funds to buy equipment.

To maximize food production, intensive subsistence farmers waste virtually no land. Corners of fields and irregularly shaped pieces of land are planted rather than left idle. Paths and roads are kept as narrow as possible to minimize the loss of arable land. Livestock are rarely permitted to graze on land that could be used to plant crops, and little grain is grown to feed the animals.

Intensive Subsistence with Wet Rice Dominant

The intensive agriculture region of Asia can be divided between areas where wet rice dominates and areas where it does not (refer to Figure 10-5). The term wet rice refers to the practice of planting rice on dry land in a nursery and then moving the seedlings to a flooded field to promote growth. Wet rice occupies a relatively small percentage of Asia's agricultural land but is the region's most important source of food. Intensive wet-rice farming is the dominant type of agriculture in Southeast China, East India, and much of Southeast Asia (Figure 10-6).

Successful production of large yields of rice is an elaborate process that is time consuming and done mostly by hand. The consumers of the rice also perform the work, and all family members, including children, contribute to the effort.

Growing rice involves several steps. First, a farmer prepares the field for planting, using a plow drawn by water buffalo or oxen. The use of a plow and animal power is one characteristic that distinguishes subsistence agriculture from shifting cultivation.

The plowed land is then flooded with water. The water is collected from rainfall, river overflow, or irrigation. Too much or too little can damage the crop—a particular problem for farmers in South Asia who depend on monsoon rains, which do not always arrive at the same time each summer. Before planting, dikes and canals are repaired to ensure the right quantity of water in the field. The flooded field is called a sawah in the Austronesian language widely spoken in Indonesia, including Java. Europeans and North Americans frequently, but incorrectly, call it a paddy, the Malay word for wet rice.

The customary way to plant rice is to grow seedlings on dry land in a nursery and then transplant the seedlings into the flooded field. Typically, one-tenth of a sawah is devoted to the cultivation of seedlings. After about a month they are transferred to the rest of the field. Rice plants grow submerged in water for approximately

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**FIGURE 10-6** Rice production, 2005. Rice is the most important crop in the large population concentrations of East, South, and Southeast Asia. Asian farmers grow more than 90 percent of the world's rice, and two countries—China and India—account for more than half of world production. Growing rice is a labor-intensive operation, done mostly by hand.
Rice is harvested by hand in the large population concentrations of Asia, including this field in Indonesia.

three-fourths of the growing period. Another method of planting rice is to broadcast dry seeds by scattering them through the field, a method used to some extent in South Asia.

Rice plants are harvested by hand, usually with knives. To separate the husks, known as chaff, from the seeds, the heads are threshed by beating them on the ground or treading on them barefoot. The threshed rice is placed in a tray, and the lighter chaff is winnowed—that is, allowed to be blown away by the wind. If the rice is to be consumed directly by the farmer, the hull, or outer covering, is removed by mortar and pestle. Rice that is sold commercially is frequently whitened and polished, a process that removes some nutrients but leaves rice more pleasing in appearance and taste to many consumers.

Wet rice is most easily grown on flat land, because the plants are submerged in water much of the time. Thus most wet-rice cultivation takes place in river valleys and deltas. But the pressure of population growth in parts of East Asia has forced expansion of areas under rice cultivation. One method of developing additional land suitable for growing rice is to terrace the hillsides of river valleys.

Land is used even more intensively in parts of Asia by obtaining two harvests per year from one field, a process known as double cropping. Double cropping is common in places that have warm winters, such as South China and Taiwan, but is relatively rare in India, where most areas have dry winters. Normally, double cropping involves alternating between wet rice, grown in the summer when precipitation is higher, and wheat, barley, or another dry crop, grown in the drier winter season. Crops other than rice may be grown in the wet-rice region in the summer on nonirrigated land.

Intensive Subsistence with Wet Rice Not Dominant

Climate prevents farmers from growing wet rice in portions of Asia, especially where summer precipitation levels are too low and winters are too harsh (refer to Figure 10–5). Agriculture in much of interior India and northeast China is devoted to crops other than wet rice.

Aside from what is grown, this region shares most of the characteristics of intensive subsistence agriculture with the wet-rice region. Land is used intensively and worked primarily by human power with the assistance of some hand implements and animals. Wheat is the most important crop, followed by barley. Various other grains and legumes are grown for household consumption, including millet, oats, corn, kaoliang, sorghum, and soybeans. Also grown are some crops sold for cash, such as cotton, flax, hemp, and tobacco.

In milder parts of the region where wet rice does not dominate, more than one harvest can be obtained some years through skilled use of crop rotation, which is the practice of rotating use of different fields from crop to crop each year to avoid exhausting the soil. In colder climates, wheat or another crop is planted in the spring and harvested in the fall, but no crops can be sown through the winter.

Since the Communist Revolution in 1949, private individuals have owned little agricultural land in China. Instead, the Communist government organized agricultural producer communes, which typically consisted of several villages of several hundred people. By combining several small fields into a single large unit, the government hoped to promote agricultural efficiency, because scarce equipment and animals could be shared, and larger improvement projects, such as flood control, water storage, and terracing, could be completed. In reality productivity did not increase as much as the government had expected, because people worked less efficiently for the commune than when working for themselves.

China has dismantled the agricultural communes. The communes still hold legal title to agricultural land, but villagers sign contracts entitling them to farm portions of the land as private individuals. Chinese farmers may sell to others the right to use the land and to pass on the right to their children. Reorganization has been difficult because irrigation systems, equipment, and other infrastructure were developed to serve large communal farms rather than small individually managed ones, which cannot afford to operate and maintain the machinery. But production has increased greatly.

Plantation Farming

The plantation is a form of commercial agriculture found in the tropics and subtropics, especially in Latin America, Africa, and Asia. Although generally situated in LDCs, plantations are often owned or operated by Europeans or North Americans and grow crops for sale primarily in MDCs.

A plantation is a large farm that specializes in one or two crops. Among the most important crops grown on plantations are cotton, sugarcane, coffee, rubber, and tobacco. Also produced in large quantities are cocoa, jute, bananas, tea, coconuts, and palm oil. Latin American plantations are more likely to grow coffee, sugarcane, and bananas, whereas Asian plantations may provide rubber and palm oil.

Because plantations are usually situated in sparsely settled locations, they must import workers and provide them with food, housing, and social services. Plantation managers try to spread the work as evenly as possible throughout the year to make full use of the large labor force. Where the climate permits, more than one crop is planted and harvested during the year. Rubber-tree plantations try to spread the task of tapping the trees throughout the year.
Crops such as tobacco, cotton, and sugarcane, which can be planted only once a year, are less likely to be grown on large plantations today than in the past. Crops are normally processed at the plantation before shipping, because processed goods are less bulky and are therefore cheaper to ship long distances to the North American and European markets.

Until the Civil War, plantations were important in the U.S. South, where the principal crop was cotton, followed by tobacco and sugarcane. Demand for cotton increased dramatically after the establishment of textile factories in England at the start of the Industrial Revolution in the late eighteenth century. Cotton production was stimulated by the improvement of the cotton gin by Eli Whitney in 1793 and the development of new varieties of cotton that were harder and easier to pick. Slaves brought from Africa performed most of the labor until the abolition of slavery and the defeat of the South in the Civil War. Thereafter, plantations declined in the United States; they were subdivided and either sold to individual farmers or worked by tenant farmers.

**KEY ISSUE 3**

Where Are Agricultural Regions in More Developed Countries?

- Mixed crop and livestock farming
- Dairy farming
- Grain farming
- Livestock ranching
- Mediterranean agriculture
- Commercial gardening and fruit farming
- Importance of access to markets

Commercial agriculture in MDCs can be divided into six main types—mixed crops and livestock, dairying, grain farming, livestock ranching, Mediterranean agriculture, and gardening and fruit culture. Each type is predominant in distinctive regions within MDCs, depending largely on climate.

**Mixed Crop and Livestock Farming**

Mixed crop and livestock farming is the most common form of commercial agriculture in the United States west of the Appalachians and east of 98° west longitude and in much of Europe from France to Russia (refer to Figure 10–5).

**Characteristics of Mixed Crop and Livestock Farming**

The most distinctive characteristic of mixed crop and livestock farming is its integration of crops and livestock. Most of the crops are fed to animals rather than consumed directly by humans. In turn, the livestock supply manure to improve soil fertility to grow more crops. A typical mixed commercial farm devotes nearly all land area to growing crops but derives more than three-fourths of its income from the sale of animal products, such as beef, milk, and eggs. In the United States pigs are often bred directly on the farms, whereas cattle may be brought in to be fattened on corn.

Mixed crop and livestock farming permits farmers to distribute the workload more evenly through the year. Fields require less attention in the winter than in the spring, when crops are planted, and in the fall, when they are harvested. Livestock, on the other hand, require year-long attention. A mix of crops and livestock also reduces seasonal variations in income; most income from crops comes during the harvest season, but livestock products can be sold throughout the year.

**CROP ROTATION SYSTEMS.** Mixed crop and livestock farming typically involves crop rotation. The farm is divided into a number of fields, and each field is planted on a planned cycle, often of several years. The crop planted changes from one year to the next, typically going through a cycle of two or more crops and a year of fallow before the cycle is repeated. Crop rotation helps maintain the fertility of a field, because various crops deplete the soil of certain nutrients but restore others.

Crop rotation contrasts with shifting cultivation, in which nutrients depleted from a field are restored only by leaving the field fallow (uncropped) for many years. In any given year, crops cannot be planted in most of an area's fields, so overall production in shifting cultivation is much lower than in mixed commercial farming.

A two-field crop-rotation system was developed in Northern Europe as early as the fifth century. A *cereal grain*, such as oats, wheat, rye, or barley, was planted in Field A one year, while Field B was left fallow. The following year Field B was planted but A left fallow, and so forth. Beginning in the eighth century, a three-field system was introduced. The first field was planted with a winter cereal, the second with a spring cereal, and the third was left fallow. As a result, each field yielded four harvests every 6 years, compared to three every 6 years under the two-field system.

A four-field system was used in Northwest Europe by the eighteenth century. The first year, the farmer could plant a root crop (such as turnips) in Field A, a cereal in Field B, a "rest" crop (such as clover, which helps restore the field) in Field C, and a cereal in Field D. The second year, the farmer might select a cereal for Field A, a rest crop for Field B, a cereal for Field C, and a root for Field D. The rotation would continue for two more years before the cycle would start again. Each field thus passed through a cycle of four crops—root, cereal, rest crop, and another cereal.

Cereals such as wheat and barley were sold for flour and beer production, and straw (the stalks remaining after the heads of wheat are threshed) was retained for animal bedding. Root crops such as turnips were fed to the animals during the winter. Clover and other "rest" crops were used for cattle grazing and restoration of nitrogen to the soil.

**Choice of Crops**

In the United States, mixed crop and livestock farmers select corn most frequently because of higher yields per area than other crops. Some of the corn is consumed by people either