

Agricultural Systems

LEARNING OBJECTIVES

1. Distinguish between subsistence and commercial systems of agriculture.
2. Identify four types of subsistence agriculture and discuss the distribution of each.
3. Provide examples of specialization in different types of commercial agriculture.
4. Summarize the von Thünen model.

One might think of agriculture as a system of food production and thus a strategy for human survival. A *system* is a set of interacting components that functions as a unit. Food-producing systems include the land, the inputs (e.g., labor, machinery, fertilizer), the outputs or commodities that are produced, the consumers, and the

various flows among the different components (e.g., migrant farm laborers to available jobs, of seeds to farmers, or of grain to food processors).

There are different ways of categorizing agricultural systems. Some experts prefer to distinguish between subsistence agriculture and commercial agriculture. Figure 11.6 describes some of the differences between these systems and maps several of the world's major agricultural systems that are discussed in greater detail in the following sections.

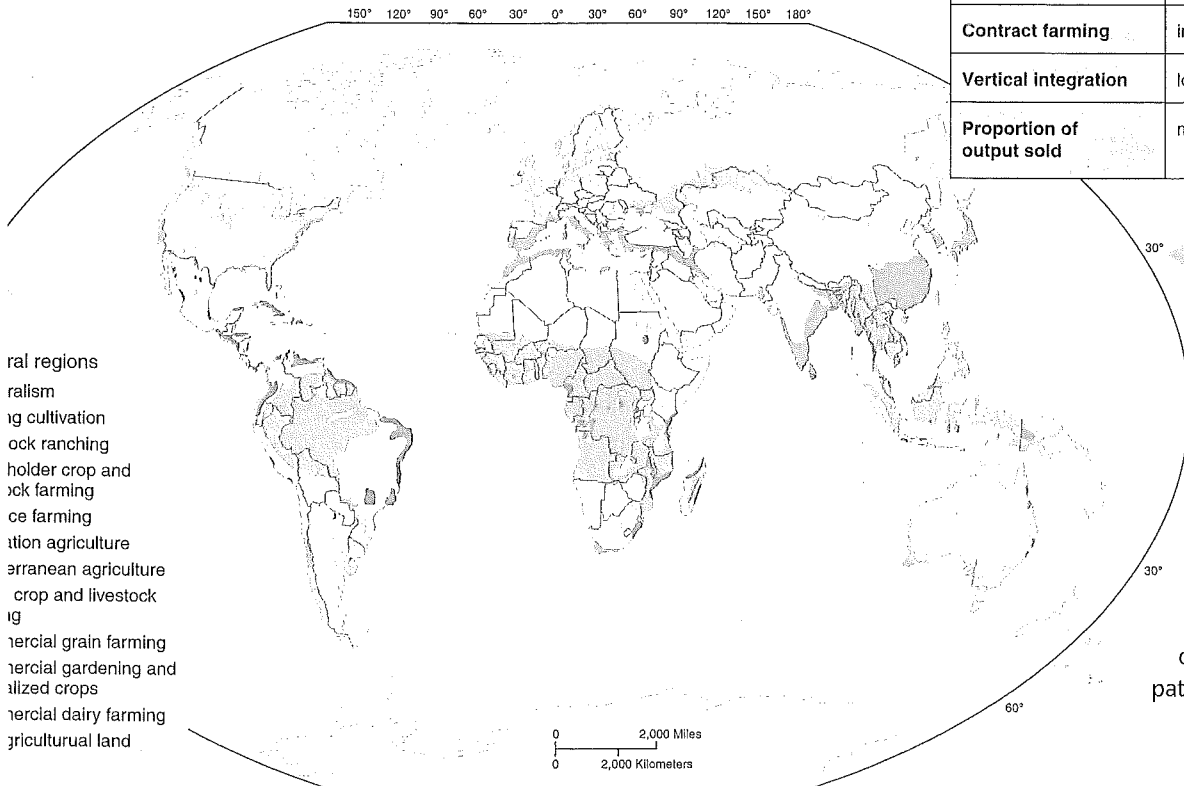
subsistence agriculture A farming system that is largely independent of purchased inputs and in which outputs are typically used or consumed by farmers and their family or extended family.

commercial agriculture A farming system that relies heavily on purchased inputs and in which products are sold for use or consumption away from the farm.

The world's major agricultural systems • Figure 11.6

a. The table distinguishes between subsistence and commercial systems of agriculture. This categorization is useful as long as we remember that the different types of agriculture form a continuum marked by a great many variations.

The continuum of agricultural systems		
	Subsistence	Commercial
Farm size	small	large
Agricultural activity	diverse	specialized
Scale of consumption	household, local	national, international
Land tenure	communal, private	private, corporate
Purchased inputs	low	high
Contract farming	infrequent	frequent
Vertical integration	low	high
Proportion of output sold	minority	majority or all



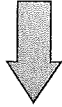
b. Hundreds of different agricultural systems exist around the world, but this map depicts just a fraction of them. For instance, urban agriculture is not included on the map. Keep in mind that even though some areas share similar agricultural systems, local agricultural practices may vary considerably because of different policies, climate patterns, or traditions.

Shifting cultivation • Figure 11.7

Shifting cultivation is associated with rainforest zones, in both lowland and upland regions of the humid tropics. The cultivated land is usually owned or controlled by local families or by an entire village. Although the total area of land controlled by a village can be sizable, individual fields are small, perhaps 5 acres (2 ha).

1 Selecting a site

Farmers consider family needs, ecological conditions, past successes or failures in the area, and other factors when choosing a site.



2 Clearing a field

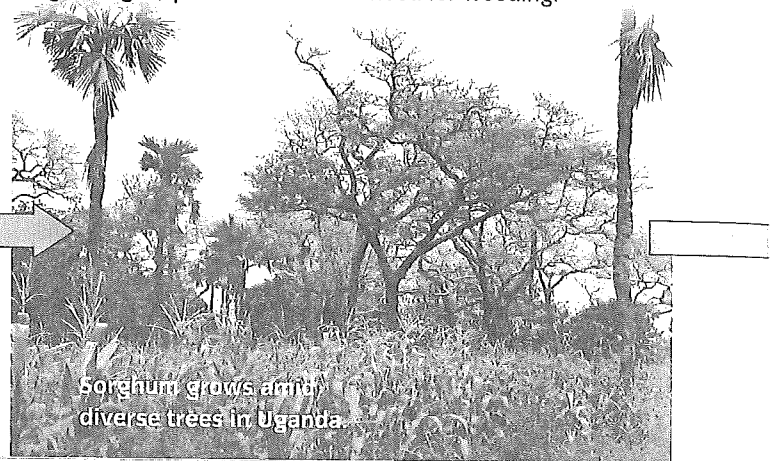
Using a “slash-and-burn” technique, farmers kill the trees by cutting into them and removing a ring of bark from each. They then burn the trees and undergrowth, sometimes selectively retaining those that provide a resource or serve an important function, such as preventing soil erosion. The residual ash adds nutrients and improves the soil.

3 Planting

Fields may include a single crop, have patches planted to different crops, or may be intercropped. If intercropped, tall, sturdy, or broadleaved crops provide support, shade, and even protection from heavy rains for lower growing crops and reduce the need for weeding.



A farmer plants cassava in a cleared field in Borneo.



Sorghum grows among diverse trees in Uganda.

Subsistence Agriculture

Worldwide, millions of people earn their living through subsistence agriculture. This system is especially prevalent in Africa, much of Asia, and parts of Central and South America. There is a stunning array of subsistence agricultural practices around the world. Here, we will consider a few of them so that you may better understand some of the constraints and opportunities that subsistence agriculturalists face. From the many different types of subsistence agriculture, we will focus on four, each of which is suited to a different climate, environment, and land type.

shifting cultivation
An agricultural system that uses fire to clear vegetation in order to create fields for crops; it is based on a cycle of land rotation that includes fallow periods.

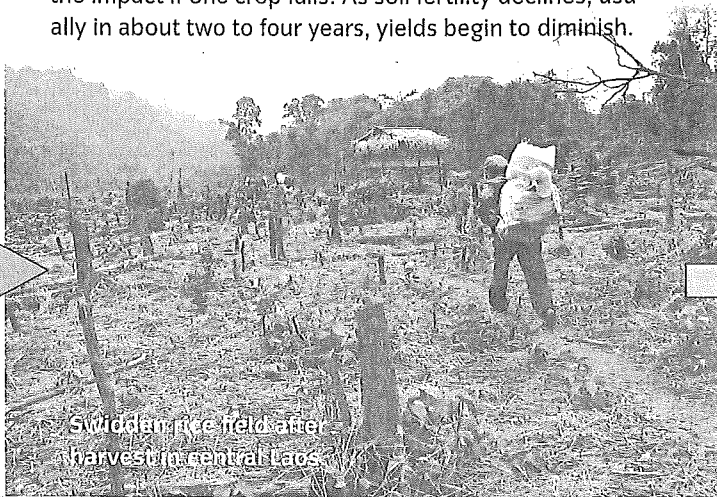
Shifting cultivation Also known as *swidden* or *slash-and-burn agriculture*, shifting cultivation has been practiced for thousands of years in the tropical and subtropical regions

of Southeast Asia, Central and South America, and Africa. Shifting cultivation has different local names: *milpa* in Central America, *ladang* in Indonesia and Malaysia, *roca* in Brazil, and *chitimene* in some African countries, including Zambia and Zimbabwe. Some shifting cultivators plant two or more crops in a field at the same time—a strategy known as **intercropping**. (Figure 11.7).

Agricultural experts are divided over the impact that shifting cultivation has on tropical deforestation, in part because they interpret deforestation in different ways. For example, deforestation is commonly understood to include both permanent and temporary forest removal; a view that magnifies the role of shifting cultivation in deforestation. In the Amazon, however, the expansion of other agricultural systems, including cattle ranches and soybean plantations, is hastening the permanent destruction of tropical rainforests on an unprecedented scale.

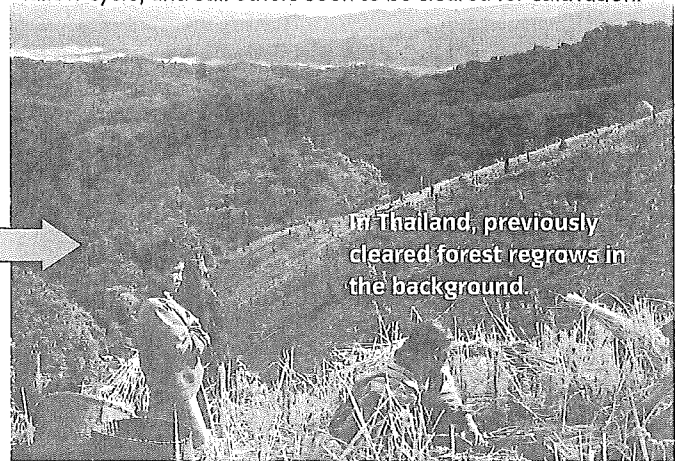
④ Harvesting

The harvest cycle depends on the crops that are planted. Intercropping may extend the harvest as different crops reach maturity at different times and may lessen the impact if one crop fails. As soil fertility declines, usually in about two to four years, yields begin to diminish.



⑤ Following the land

The field is fallowed in order to regain fertility. The length of the fallow period—5, 7, 10, or more years—depends on local conditions. A single family will have several fields in different phases: Some ready to be fallowed, others about mid-way through the fallow cycle, and still others soon to be cleared for cultivation.



Shifting cultivation can be sustainably practiced, but under certain conditions it can adversely affect the environment, or fail. Conditions that shorten the fallow period present a serious problem because they inhibit the ability of the soils to regain their fertility. An increase in the number of households engaged in shifting cultivation or loss of land to urbanization or highways can shorten the fallow period and affect the sustainability of the system.

When faced with such pressures, one strategy used by shifting cultivators to maintain adequate yields and improve the soil involves **agroforestry**, or the purposeful integration of trees with crops and/or livestock in the same field simultaneously or sequentially, one after the other. Many shifting cultivators now increasingly “manage the fallows” by planting species that help restore the soil’s fertility or provide another resource, such as a fruit crop.

Pastoralism Domesticated livestock form the centerpiece of pastoralism. Pastoralists favor reindeer in the cold lands, and camels, cattle, goats, or sheep in arid regions. Because of their importance as a resource, the livestock are rarely killed and consumed for their meat. Consequently, in varying degrees pastoralists trade with, and rely on, settled farmers for cereal crops, fruits, and vegetables. Pastoralism is well adapted to arid and semiarid regions.

pastoralism An agricultural system in which animal husbandry based on open grazing of herd animals is the sole or dominant farming activity.

Mobility is an important dimension of pastoralism, since pastures cannot support livestock herds year-round. **Transhumance**—moving herds on a seasonal basis to new pastures or water sources—is a common practice, but the nature and frequency of mobility varies among pastoralists.

Often the women and children may not move with the animals; instead, they will settle and farm small plots of land in areas where rainfall or access to water is more reliable (Figure 11.8).

Is pastoral life incompatible with modernization? Some government officials claim that the mobility of pastoralists interferes with government programs such as population censuses, the provision of schools or basic medical care, and the establishment of protected areas and reserves. Increasingly, pastoral groups are pressured to take up sedentary agriculture in permanent settlements or seek non-agricultural occupations. For example, since the breakup of the Soviet Union, land privatization in Kyrgyzstan has limited pastoralists' access to pastures.

Wet rice farming Where rice is the primary crop and staple food, wet rice farming constitutes a prime example of intensive agriculture. In the world's most densely populated regions, the amount of land owned or worked by a family may be only 3 or 4 acres (1–2 ha), sometimes even smaller. In these circumstances, wet rice farming also constitutes a form of smallholder agriculture. Farmers cultivate wet rice in coastal lowlands, deltas, and river valleys (Figure 11.9).

wet rice farming
Rice cultivation in a flooded field.

intensive agriculture An agricultural system characterized by high inputs, such as labor, capital, or equipment, per unit area of land.

smallholder agriculture A farming system characterized by small farms in which the household is the main scale of agricultural production and consumption.

In order to produce yields sufficient to provide for a family, the land must be intensively worked year-round. Following the harvest, the paddy may be prepared for planting a second time. The technique of **double cropping**—completing the cycle from planting to harvesting on the same field twice in one year—is common. Where a humid winter aids the cultivation cycle, as in southeastern China, rice is double cropped. In drier areas, farmers double crop by growing rice in the summer and wheat or barley during the winter.

Asia produces and consumes most of the rice in the world, and wet rice production benefited from the Green Revolution. Leading rice exporters include Thailand, Vietnam, India, and the United States, but rice production in the United States differs vastly from that in these other countries because it is not a smallholder system. In addition, rice production is highly mechanized in all stages in Japan, Korea, Taiwan, and the United States.

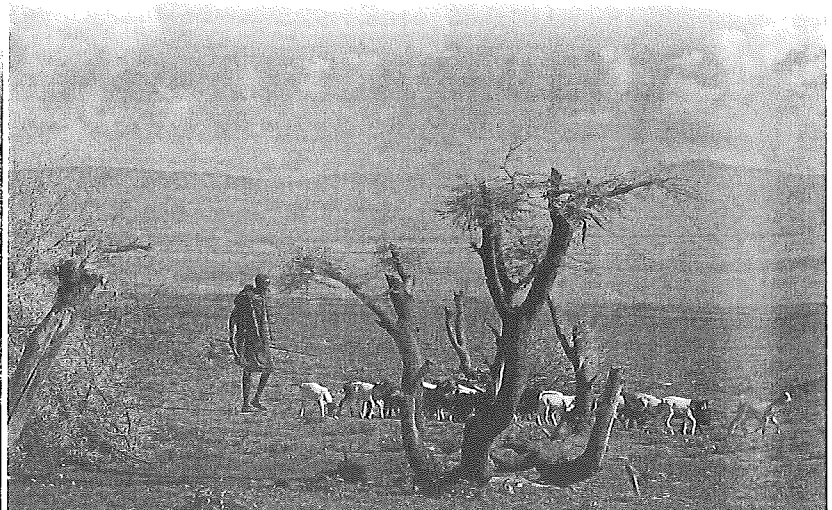
Smallholder crop and livestock farming In those places in Asia where conditions are not conducive to wet rice farming, **smallholder crop and livestock farming** prevails. This system also occurs in other parts of the developing world, but the specific combination of crop types and livestock varies significantly from one place to another because of different socioeconomic,

Pastoralism • Figure 11.8

NATIONAL GEOGRAPHIC

a. Yak herders in India practice vertical transhumance—moving their herds into mountain pastures in the summer and into lowland pastures in the winter. In Nigeria, the Fulani practice horizontal transhumance, moving their cattle north to avoid the brunt of the wet season. They return south in the dry season.

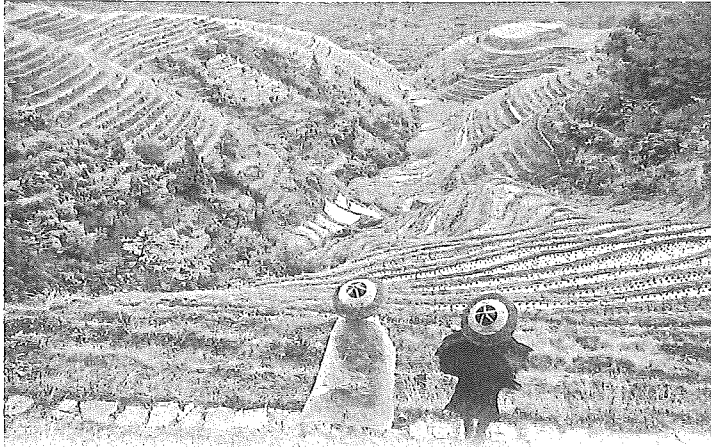
b. Governmental policies can unleash changes that cause pastoralism to break down. After the Ngorongoro Conservation Area was created in Tanzania, Maasai herders like the one shown here have had their rangelands reduced and have been banned from growing crops, even though crop cultivation improves their overall food security.



Wet rice farming • Figure 11.9

NATIONAL
GEOGRAPHIC

In smallholder wet rice systems, most rice is consumed by the members of the household but any surplus rice is sold. Households also typically keep some pigs or poultry and cultivate small plots for vegetables.



a. Population pressures and lack of flat land have led to the terracing of hillsides and mountains to cultivate rice in Longsheng, China. Wet rice cultivation begins as seeds are sown in planting beds. In one to two months the seedlings will be ready for transplanting, and the wet field where the rice seedlings will grow to maturity—the paddy—is plowed.



b. Women in Vietnam transplant rice seedlings into a field that has been flooded with water. Workers apply large amounts of fertilizer, manually weed and harvest the rice, and after harvesting, thresh it. Paddy preparation and seeding are activities usually performed by men, but women contribute half or more of the labor through their work transplanting, weeding, harvesting, and threshing.

climatic, and soil conditions. Crop cultivation generally revolves around a grain crop, a tuber or root crop, legumes, and some vegetable crops. Many households also keep different kinds of livestock but in small numbers—for example, a single cow and a few pigs or chickens.

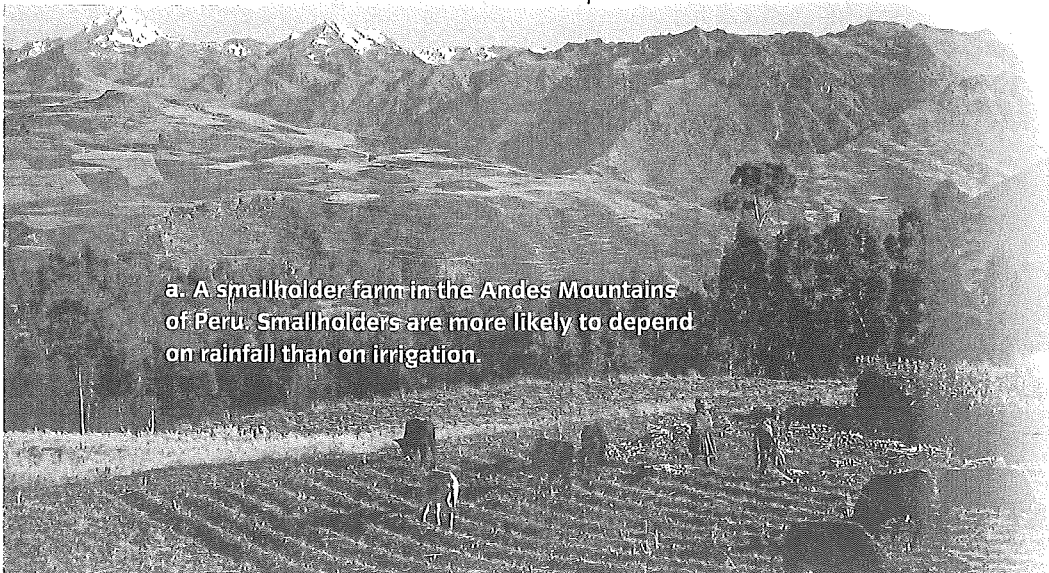
Across the drier parts of Asia corn and wheat are common grains, sweet potatoes a key root crop, and cattle and pigs the main livestock. In the Middle East and North

Africa, farmers cultivate wheat as the staple grain, barley primarily as animal feed, and legumes such as lentils and chickpeas. Sheep, goats, and cattle are important livestock. Corn, millet, and sorghum are common grains cultivated in Africa south of the Sahara. Cassava, a tuber, is also widely cultivated there. In contrast to wet rice cultivation, smallholder crop and livestock farmers apply fewer inputs of fertilizer and irrigated water, and do not double crop (Figure 11.10).

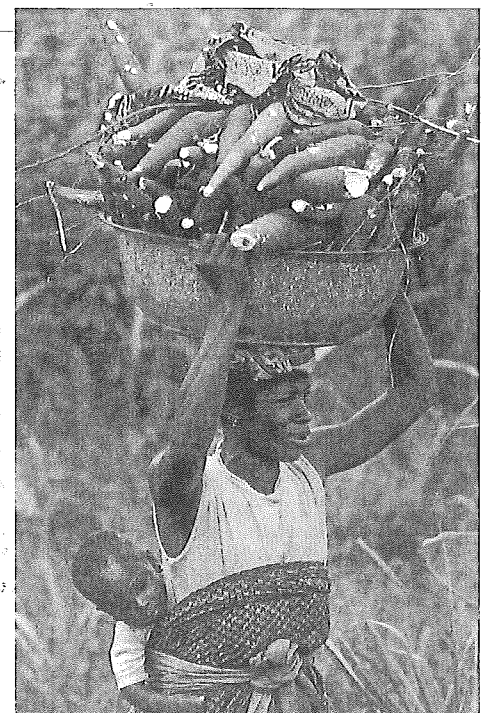
Smallholder crop and livestock farming • Figure 11.10

NATIONAL
GEOGRAPHIC

b. A Nigerian woman carries her baby and cassava home from the field. The root crop is a staple starch across Sub-Saharan Africa.



a. A smallholder farm in the Andes Mountains of Peru. Smallholders are more likely to depend on rainfall than on irrigation.



Commercial Agriculture

Commercial farmers and their families are not the primary users or consumers of the agricultural goods they produce. Rather, they sell their farm products to food-processing companies. Commercial agriculture is one part of the large industry of food production often referred to as agribusiness.

agribusiness

The interconnected industry of food production involving farmers, processors, distributors, and retailers.

One of the hallmarks of agribusiness is *vertical integration*—when a company controls two or more stages in the production or distribution of a commodity directly or through contractual arrangements (see Chapter 10).

A number of food processors, such as Tyson, Kraft, and Kellogg's, have become household names. These companies consider commercial farmers to be their suppliers and negotiate contracts with them in order to secure the beef, poultry, wheat, corn, or other products they need for processing into the packaged meats, soups, cereals, and other items for consumers. In commercial agriculture, food-processing companies serve as an intermediary between producers and consumers.

As you read about some of the different types of commercial agriculture in this section, think about the impact

they have had on landscape change, how they have altered social relations, and to what extent conventional ideas about the importance of physical proximity to market matter today.

Plantation agriculture

Plantations have long been associated with the production of high-value **cash crops**, such as coffee, tea, palm oil, and sugar, that are sold on the international market. As we discussed in Chapter 10, many developing countries have become highly dependent on the export of staple commodities, including cash crops, because they contribute significantly to the national economy. Cotton, for example, ranks as the most valuable fiber crop. Plantations are not the sole source of the world's so-called plantation crops, however. Smallholder farmers also cultivate a number of these crops, including cacao, coffee, and coconuts among others (Figure 11.11).

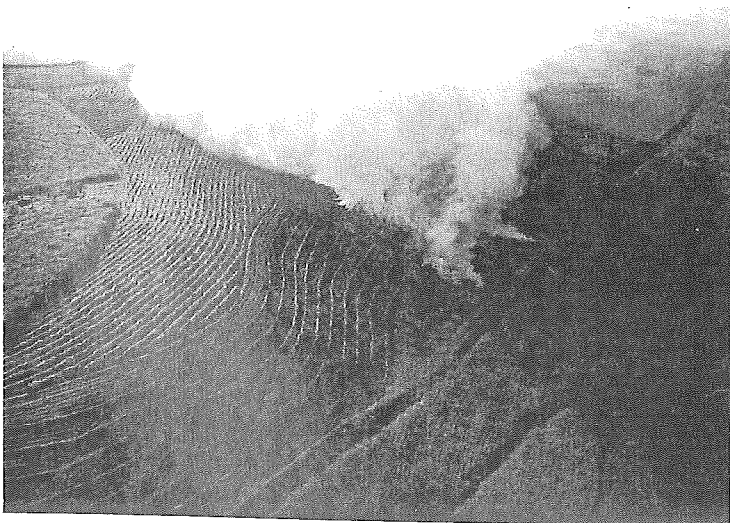
plantation A large estate in tropical or subtropical areas that specializes in the production of a cash crop.

The Portuguese established the first plantations in Africa in the 15th century. These plantations used slave labor to produce sugarcane. Relying on unskilled or semiskilled labor to plant, harvest, and process the

Plantation agriculture • Figure 11.11

a. A sugar plantation near Durban, South Africa

Historically, plantations were established near the coast or serviced by rail lines in order to facilitate the export of plantation commodities. It is presently more cost-effective to burn the vegetation that remains once the sugarcane is harvested, though such burning is contested by environmentalists.



b. Modest housing for tea plantation workers in Malaysia

Work conditions at plantations are demanding, sometimes dangerous, and the pay is low. Why are the houses virtually identical?



farm commodities remains a defining feature of plantation agriculture today. Indeed, the plantation system perpetuates a **dual society** consisting of two distinct social classes—the upper-class plantation managers and the lower-class laborers.

In addition, the plantations are frequently owned by multinational corporations, a number of which are headquartered in Europe or North America. One example is the fruit company Dole. It is headquartered in California, operates plantations in the Philippines and Costa Rica, owns and runs a cannery in Thailand, and has cold-storage facilities in Chile. These pockets of commercial agriculture in developing countries also foster a **dual economy**, with large-scale, export-oriented agriculture operating alongside smallholder agriculture.

Commercial gardening, specialized crops, and Mediterranean agriculture

Geographically, commercial gardening zones developed just beyond the built-up areas of towns and cities and supplied urban residents with fresh produce. Historically, farmers located near the markets to minimize the problem of spoilage,

commercial gardening The intensive production of nontropical fruits, vegetables, and flowers for sale off the farm.

and local products were destined for local consumption. However, well-developed transportation networks and long-distance trucking industries mean that fresh produce can now be shipped from farm to market over hundreds of miles in a matter of hours.

Since World War II, a form of commercial gardening known as **truck farming** has emerged in the United States. Important crops produced on truck farms include tomatoes, lettuce, melons, broccoli, onions, and strawberries. Most of these farms are large, specialize in the production of one commodity, are distant from the markets they serve, and rely on migrant farm laborers during the harvest season. Although product shipment involves large-capacity trucks, this is not the source of the term *truck farming*. Rather, one of the meanings of the word *truck* is “vegetables grown for market.” Truck farming is heavily concentrated in the southeastern United States, but numerous other zones of specialized crop production exist, including parts of Maine and Idaho where potatoes are produced, and the Caucasus (located between Europe and Asia)



Mediterranean agriculture • Figure 11.12

Sheep graze in between the grape vines, an illustration of one facet of the integration of livestock and vine crops in Portugal. The sheep keep the vineyard weeded, provide manure, and can be trained to avoid eating the grape vines.

where such crops as cabbage, onions, and eggplant are farmed.

The lands surrounding the Mediterranean Sea constitute the hearth of **Mediterranean agriculture**. In its traditional form, Mediterranean agriculture was a kind of agroforestry centered on the integrated cultivation of livestock, a grain crop, and a tree or vine crop. Olives, grapes, and citrus fruits are strongly associated with regions of Mediterranean agriculture, but, as with commercial gardening, Mediterranean agriculture has been affected by specialization. This is especially the case in the Central Valley of California and in the region surrounding Valparaiso, Chile, which increasingly focus on the production of specialized crops. Around the Mediterranean Sea, wheat remains a principal grain crop, and some farms still manage livestock; however, tree and vine crops, especially olives and grapes, provide the most valuable commodities (Figure 11.12). Seasonal demand for work on these farms in Europe draws many farm laborers from Romania, Bulgaria, and Albania as well as North Africa. Migrant labor has long been crucial to agricultural harvesting in the Central Valley of California as well.

Commercial dairy farming Commercial dairy farming is an intensive and heavily mechanized form of agriculture. Fresh milk production relies on automatic milking machines, vacuum systems, and pipelines to move the milk into refrigerated storage tanks before it is transferred to tank trucks for shipment to milk-processing plants. In spite of the mechanization, dairy farming requires constant vigilance. The cows need to be milked twice a day and have their nutrition closely monitored, or they will not produce the desired quality or volume of milk.

The geography of fluid milk production has evolved in connection with the rise of cities. Because milk is perishable, it initially had to be consumed on the farm or made into another, less perishable dairy product such as cheese. Dairy farming areas on the outskirts of cities that supply fluid milk constitute the *milkshed*. Improvements in transportation and refrigeration now enable dairy farms producing milk to locate farther from cities, expanding the milkshed. California has been the largest fluid milk-producing state in the United States since the early 1990s, a development closely associated with the emergence of *dry-lot dairies* that facilitate high-volume production (Figure 11.13).

Mixed crop and livestock farming As historically practiced, **mixed crop and livestock farming** was an integrated system that involved

commercial dairy farming The management of cattle for producing and marketing milk, butter, cheese, or other milk by-products.

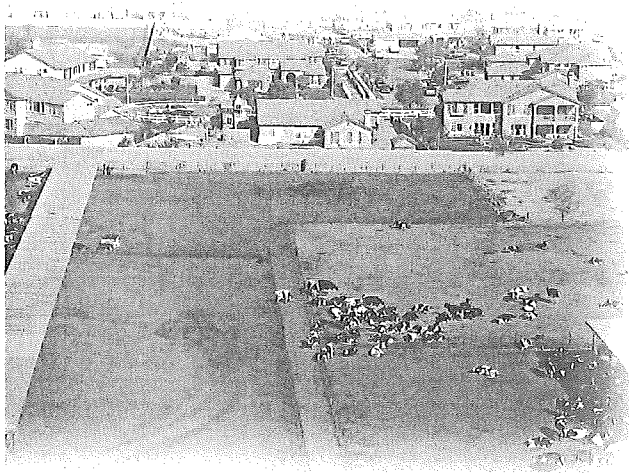
raising crops to feed livestock. The animal products were then sold off the farm, generating most of the farm's revenue. This type of farming once defined an extensive part of Europe, stretching from France across central Europe and into Russia, where corn, barley, and oats were grown as feed crops for beef cattle and hogs. Across the Corn Belt of the United States (from central Ohio to eastern Nebraska), corn and soybeans were raised to feed cattle and hogs.

Agricultural specialization continues to transform these practices, however. In Europe, some regions once associated with mixed crop and livestock farming in countries including Germany, France, and Poland now concentrate on producing high-value oilseed crops such as canola. Specialization in the Corn Belt has involved two main trends. One trend emphasizes cash-grain farming of corn and soybeans in rotation, with corn planted one year and soybeans the next year. There are different ways to define *cash-grain farms* (also called commercial grain

farms) but the distinction is usually based on revenue, with grains sales accounting for 50% or more of farm products sold. The second trend involves specialized hog production on *factory farms*, also known as concentrated animal feeding operations (CAFOs). Feedlots have become emblematic of factory farms. The dry-lot dairies mentioned in the previous section are a type of feedlot developed for dairy cattle. Figure 11.14 illustrates some of the changes affecting the Corn Belt.

factory farm A farm that houses huge quantities of livestock or poultry in buildings, dry-lot dairies, or feedlots.

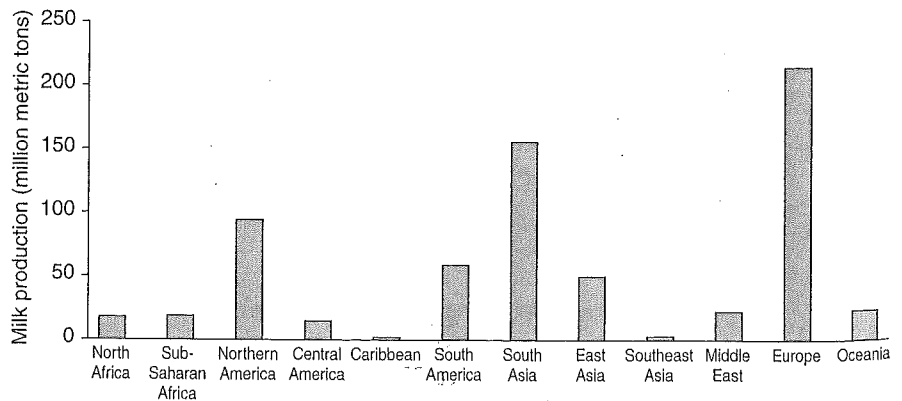
feedlot Confined space used for the controlled feeding of animals.



b. Regionally, the three main centers of milk production are in Europe, South Asia, and Northern America. More than half of the milk produced in South Asia comes from water buffalo. (Source: Data from FAOSTAT, 2010.)

Dairy farming and milk production • Figure 11.13

a. A California dry-lot dairy, like this one, contains no pasture and holds some 600 dairy cows on open lots, often with sun shades. In contrast, dairy farms in the Upper Midwest typically maintain about 70 pasture-fed dairy cows. Globally, dry-lot dairying is the exception rather than the rule.



Commercial grain farming and livestock ranching The staple item of most people's diets is the grain of a cereal grass. Common grains include wheat, rice, corn, barley, oats, millet, and sorghum. These grains not only feed people and animals, they frequently have industrial uses as well.

commercial grain farming
Agriculture involving the large-scale, highly mechanized cultivation of grain.

Commercial grain farming is closely associated with temperate grassland environments. Monoculture prevails, with farms covering large areas of flat to gently rolling land that is planted to a single crop.

Some of these farms can top 2,000 acres (800 ha). This type of large-scale grain farming has been made possible because of mechanization. Indeed, commercial grain farming remains heavily dependent on fossil fuels used in the production of fertilizers and in the gas consumed in working the fields.

Lands that are unsuitable for more valuable agricultural uses—for example, in arid and semiarid regions—tend to be used for livestock ranching. Ranchers have fixed places of residence and graze their livestock on the open range or on fenced land. The rangelands used cover sizable areas. Historically, these regions have been distant from the centers of demand—the cities and towns. Getting the animals to slaughterhouses required that they be herded long distances overland to railroads. Both commercial grain

livestock ranching
A form of agriculture devoted to raising large numbers of cattle or sheep for sale to meat processors.

farming and livestock ranching are considered examples of extensive agriculture (Figure 11.15).

extensive agriculture
An agricultural system characterized by low inputs of labor, capital, or equipment per unit area of land.

Spatial Variations in Agriculture

Thus far we have examined the practice and distribution of different types of agriculture, but land use decisions are another aspect of the geography of agriculture that interest many scholars. More specifically, is it possible to predict what crops will be grown or how land on a commercial farm will be used if we know where the farm is located in relation to the market?

One of the people who initiated the study of this question was Johann Heinrich von Thünen (1783–1850), a farmer, scholar, and estate owner who lived in northern Germany. Over years of traveling from his property to towns in the region, he observed that agricultural practices and crops changed as he got farther away from the marketplace. He used these observations to devise a model, the **von Thünen model**, to account for spatial variations in commercial agriculture.

To simplify the complexity of real-world conditions, von Thünen assumed that the quality of the land is the same everywhere. Following the economic principle that land-use decisions are profit-maximizing decisions, he reasoned that transportation costs determine how farmers can make the most profitable use of their land (Figure 11.16).

Extensive agriculture • Figure 11.15

a. Wheat being harvested in Saskatchewan, Canada

In the Southern Plains wheat is harvested in early summer. In the Northern Plains wheat is harvested at the end of the summer. Crews of laborers and “custom cutters” with combines move across the wheat belt to take advantage of these seasonal differences.



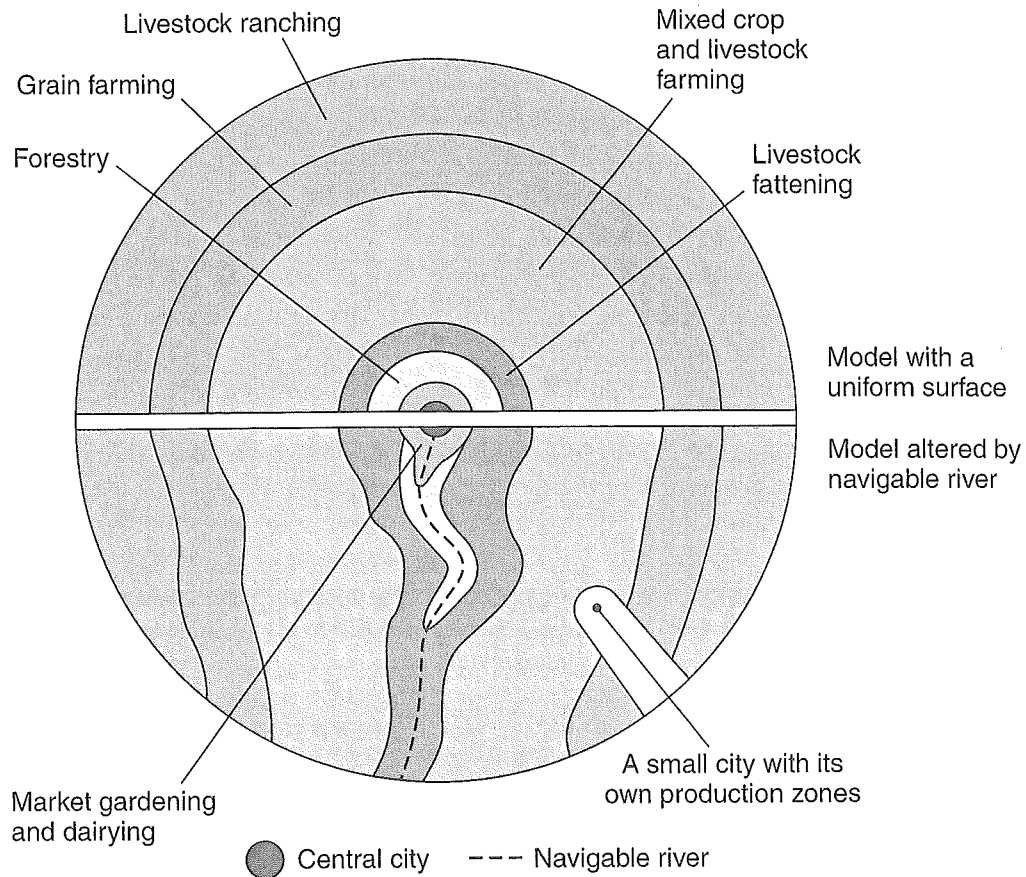
b. Sheep grazing in Wanaka, New Zealand

In New Zealand, more than 40% of the farmland in the country is devoted to sheep raising, and the country remains the world's leading exporter of mutton.



The von Thünen model • Figure 11.16

Farmers located near the market or city have low transportation costs and can afford to engage in more intensive agriculture than farmers farther away, creating rings of agricultural land use. The forestry ring provides one exception to this pattern. Timber, still needed for fuel and building in von Thünen's time, is a less intensive, low-value good that would not be profitable if transported long distances. What accounts for our ability to profitably transport timber over longer distances today? What does the diagram suggest about how terrain might influence land use? (Source: Adapted from Chisholm, 1968.)



Although von Thünen's model may seem oversimplified, its principles still have relevance and help us explore such questions as what economic forces make it possible for cut flowers from Colombia to be shipped to Miami and sold in other U.S. cities, and how does globalization affect the geography of intensive agriculture? Taking a different approach, Arild Angelsen, a scientist with the Center for International Forestry Research, has used von Thünen's model to examine the relationship between profitable land use and tropical deforestation. Angelsen shows that land used for agriculture—for example, beef cattle production—generates more profit than land that is forested. Thus, economic considerations can drive tropical deforestation and influence decisions about land use.

CONCEPT CHECK

STOP

1. What is meant by the continuum of agricultural systems?
2. How is mobility a factor in shifting cultivation and nomadic pastoralism, and why are these systems of production changing?
3. Where have plantations tended to locate and why?
4. How does von Thünen's model account for spatial variations in intensive and extensive agriculture?