CHAPTER 11

Agriculture

Field Notes Changing Greens

Figure 11.1
Presho, South Dakota. Soybeans growing in the semiarid ranchlands of western South Dakota. © Erin H. Fouberg.

Driving across the semiarid ranchlands of western South Dakota, I noticed the presence of a crop in the landscape that was recently found only in the eastern, moister region of the state: soybeans (Fig. 11.1).

I called a colleague who works in agriculture at South Dakota State University to ask, "When did the cattle ranchers of western South Dakota start growing soybeans?" He replied, "When the soy biodiesel plants started popping up in Nebraska and Kansas and when genetically modified soybeans made it possible to grow the crop here." He explained the development of Roundup Ready soybeans, a particular genetically modified soybean that can grow in more arid regions of the country.

First, you plant the soybean; then you use an airplane to spray Roundup, a common weed killer that is manufactured by the company that produces the Roundup Ready soybeans, over the field. The application of Roundup over the entire field saves a lot of time and energy for the farmers because the genetically modified soybeans are resistant to the Roundup, but the weeds are killed. Monsanto, the company that produces Roundup, has developed soybeans, corn, cotton, and other crops that are resistant to Roundup.

Counter to the genetically modified Roundup Ready crops, **organic agriculture**—the production of crops without the use of synthetic or industrially produced pesticides and fertilizers—is also on the rise in North America. In wealthier parts of the world, the demand for organic products has risen exponentially in recent years. Sales of organic food in the United States, for example, went from under $200 million in 1980 to $1.5 billion by the early 1990s to over $10 billion by 2003 and $17.8 billion in 2007. Organic foods are now about 3 percent of all food sales in the country. The growth rate is so strong that some predict organic sales will approach 10 percent of total U.S. food sales within a decade. Parts of western Europe are already approaching that figure—notably Denmark, Sweden, Finland, and parts of Germany.

Agricultural fields are devoted to organic agriculture in the core, semiperiphery, and periphery. Fields devoted to organic agriculture produce all kinds of foodstuffs, including fruits, vegetables, coffee, tea, grains, nuts, and spices. Compared to all land devoted to agriculture, the organic segment is still quite small and relatively scattered, but a farmer who can gain organic certification from a government or an internationally recognized third party has some prospect of developing a lucrative business (Fig. 11.2).

Although organic crops are grown everywhere, most organic foods are sold in the global economic core: in the United States, Canada, Japan, and Europe. The best-selling organic crops in the United States are fruits and vegetables, accounting for 42 percent of organic food sales, followed by nondairy beverages at 15 percent and dairy at 13 percent. Organic products typically cost more than conventional products in the grocery store. Nonetheless, a 2002 report issued by the United States Department of Agriculture explains that in 2000 organic foods crossed a threshold, moving out of health food stores and into supermarkets: "for the first time, more organic food was purchased in conventional supermarkets than in any other venue." Organic foods are sold in 73 percent of conventional grocery stores in the United States, with increasing demands for organic animal products such as meats and dairy.

Organic agriculture, then, has a very specific geography. It is an increasingly important part of agricultural production and consumption in wealthier countries. In the core, organic farming has helped some farmers extract themselves to a degree from the control of large, external corporate interests by tapping a niche market. The position of organic agriculture in the periphery and semiperiphery is similar to that of other major cash crops: production is almost entirely for export to the global economic core. Yet, in the periphery and semiperiphery, when organic agriculture bears a fair trade certification, more wealth can go directly to the producers (see the discussion of fair trade coffee in the last section of this chapter).

The organic movement has some clear environmental benefits, particularly in reducing levels of synthetic chemicals in soil and water. The health and taste advantages of organic produce will ensure the continued growth of the organic movement. The continually increasing demand for organic products has led the United States Department of Agriculture to certify organic products in the country, giving some standardization to claims of organic production. Yet, we are a long way from being able to grow enough crops organically to feed the mass of humanity.

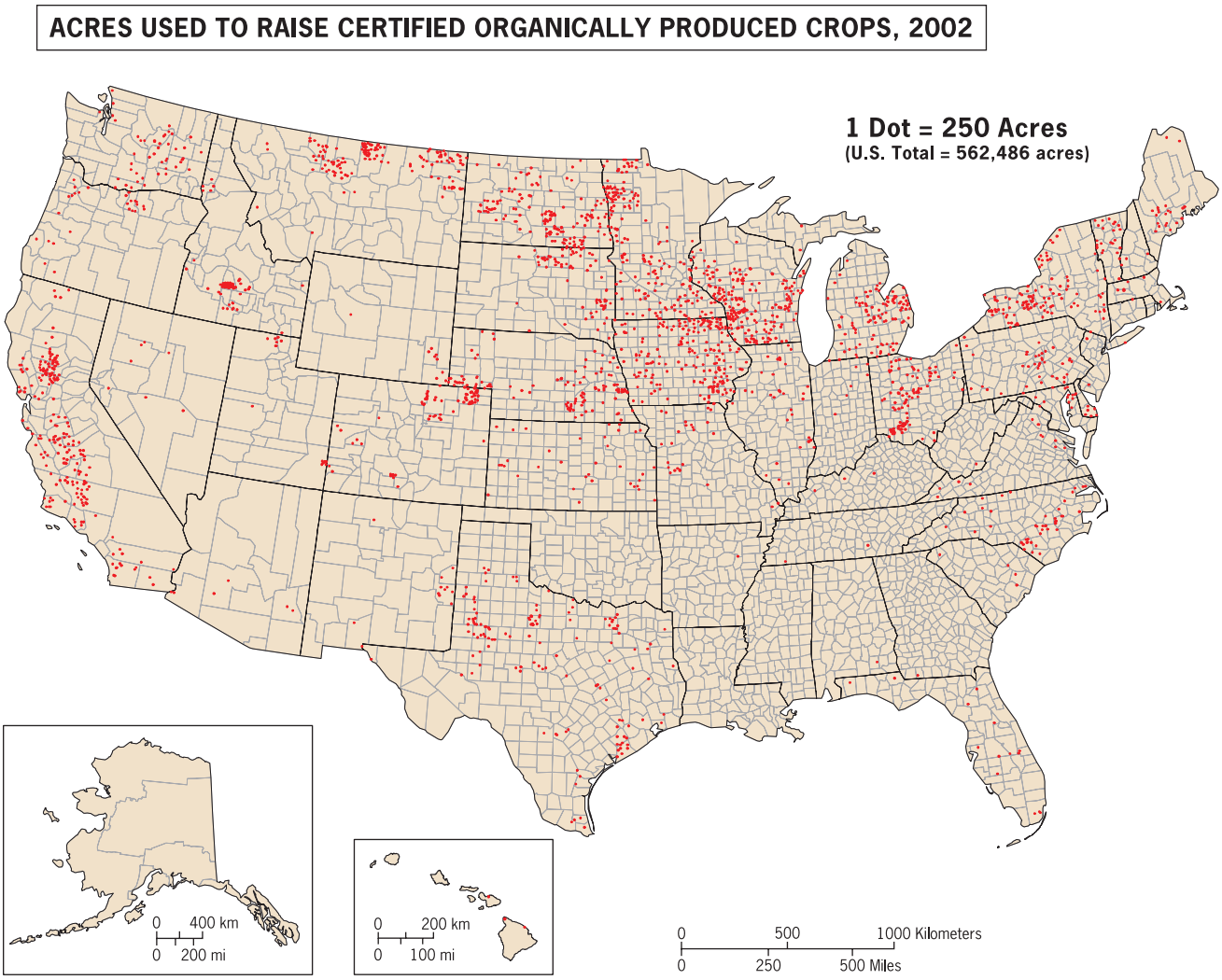


Figure 11.2
Acres of land certified for organic agricultural production in the United States, 2002.
Courtesy of: United States Census of Agriculture, 2002.

In this chapter, we examine the origins of agriculture and trace the geography of change in agriculture across time to the latest movements in agricultural production: genetic modification and organic production. In the process, we describe the early hearths of agriculture, the geography of technological changes in agriculture, the global pattern of agricultural production, and the imprint of agriculture on the cultural landscape.

Key Questions For Chapter 11

1. What is agriculture, and where did agriculture begin?
2. How did agriculture change with industrialization?
3. What imprint does agriculture make on the cultural landscape?
4. What is the global pattern of agriculture and agribusiness?

WHAT IS AGRICULTURE, AND WHERE DID AGRICULTURE BEGIN?

Agriculture is the deliberate tending of crops and livestock to produce food, feed, and fiber. When we think about agriculture, we tend to think about production of foodstuffs for humans. Only about half of all the staple grains grown in the United States are consumed directly by people; the other half are used for *feed*, grains fed directly to livestock. Raising livestock for their milk, eggs, or meat makes up a large segment of U.S. agriculture.

Whether talking about the growing of food or feed, or livestock raising, agricultural activity is classified as a primary industry. A common way of classifying economic activities is to focus on what is being produced. **Primary economic activities** involve those products closest to the ground, such as agriculture, ranching, hunting and gathering, fishing, forestry, mining, and quarrying. **Secondary economic activities** are those activities that take a primary product and manufacture it—that is, change it into something else such as toys, ships, processed foods, chemicals, and buildings. **Tertiary economic activities** are part of the service industry, connecting producers to consumers and facilitating commerce and trade. People who work as bankers, lawyers, doctors, teachers, nurses, salespeople, clerks, and secretaries are working in the tertiary sector. Some analysts separate specialized services into **quaternary** and **quinary economic activities**, dividing economic activities into those concerned with information or the exchange of money or goods (quaternary) and those tied into research or higher education (quinary). In this chapter, we use primary, secondary, and a broad classification of tertiary sectors for our analysis.

By classifying economic activities into sectors and analyzing the percentage of the population employed in each sector, we can gain insight into how goods are produced, as well as the employment structures of different societies. As we explained in our discussions of world-systems theory in Chapters 8 and 10, any product (such as wheat or rice) can be produced in core ways or in periphery ways. The generation of wealth across the globe is *better illuminated by focusing on how goods are produced (the kinds of technology, research, wages, and education that go into production), and not simply on what is produced*. Examining the proportion of people employed in a given sector in an economy gives us a basic idea of how the good is produced. For example, in Guatemala the agriculture sector accounts for 22.7 percent of the country's gross domestic product (GDP), yet 50 percent of the labor force is employed in agriculture. Contrast that with Canada, where the agriculture sector accounts for 2.3 percent of the GDP and only 3 percent of the labor force is employed in agriculture. The tertiary sector in Canada accounts for 75 percent of the labor force and over 71 percent of the GDP, and the tertiary sector in Guatemala accounts for 35 percent of the labor force and 57.9 percent of the country's GDP.

These data do not tell us exactly how goods are produced, but they are revealing. The high proportion of the labor force involved in agriculture in Guatemala (relative to the role of agriculture in the GDP) tells us that agriculture is still quite labor dependent in Guatemala, implying a lack of mechanization. In Canada, the United States, and the rest of the core, agriculture is produced with core processes on a large scale for commercial consumption. When agricultural goods are produced in core ways, the number of people involved directly with the field is quite small. In the United States, less than 2 percent of the workforce is involved in agricultural production. Thousands of others participate in supporting agricultural production by working in the tertiary sector as research scientists for universities, seed companies, or chemical (antibiotics, pesticides, and herbicides) producers; as lobbyists for industry groups such as wheat producers or cattle ranchers; as engineers who design farm implements; as the people who sell and repair the implements; and as owners and clerks at retail establishments where farmers buy other farm and nonfarm goods.

In the United States, where most agricultural products are produced with core processes, the total agricultural production is at an all-time high, but the proportion of the labor force in agriculture is at an all-time low. Mechanization and efficiencies created by new technologies have led to a significant decrease in the number of workers needed in agricultural production. In 1950, one farmer in the United States produced enough to feed 27 people; today, one farmer in the United States produces enough to feed 135 people. The mechanization of agriculture goes beyond machinery such as combines and harvesters. New technologies bring hybrid seeds and genetically engineered crops, pesticides, and herbicides, all of which are designed to increase yields. To gain economic efficiencies, the average size of farms (acres in production) in the United States is growing, regardless of the kind of agricultural good produced. The U.S. Department of Agriculture keeps data sharring the dollar value of agricultural production. The farms with the highest total production have at least $500,000 in 2002 dollars. These high-producing farms accounted for 43.9 percent of agricultural goods produced in 2002 (compared with 28.9 percent in 1989).

Agriculture in the United States has changed enormously in the last 50 years, but this is just the last episode in a human activity that has been going on for thousands of years. In the next section of the chapter, we discuss how people lived before the origins of agriculture and the circumstances that gave rise to the invention of agriculture many millennia ago.

Hunting, Gathering, and Fishing

Before agriculture, hunting, gathering, and fishing occurred anywhere in the world where people lived. What people hunted or gathered depended on the region. North America provides a good example of the diversity of regional specializations among hunter-gatherers. The oak forests of parts of North America provided an abundant harvest of nuts, sometimes enough to last more than a full year; American Indian communities living in and around these forests therefore collected and stored this food source. Other American Indians living near the Pacific Ocean became adept at salmon fishing. The bison herds of the Great Plains provided sustenance, and so bison served as a focal point for many plains cultures. In more northerly regions of North America, people followed the migrations of the caribou herds. In the north, in the coastal zone stretching from present-day Alaska to Russia, the Aleut developed specialized techniques for fishing and for sea mammal hunting.

The size of hunting and gathering clans varied according to climate and resource availability. Hunting and gathering communities in areas of abundance could support larger populations. For example, people living on the margins of forests could gather food in the forest when hunting yielded poor results and then return to hunting when the opportunities improved.

Terrain and Tools

Before developing agriculture, hunter-gatherers worked on perfecting tools, controlling fires, and adapting environments to their needs. The first tools used in hunting were simple clubs—tree limbs that were thin at one end and thick and heavy at the other. The use of bone and stone and the development of spears made hunting far more effective. The fashioning of stone into hand axes and, later, handle axes was a crucial innovation that enabled hunters to skin their prey and cut the meat; it also made it possible to cut down trees and build better shelters and tools.

The controlled use of fire was another important early achievement of human communities. The first opportunities to control fire were offered by natural conditions (lightning, spontaneous combustion of surface-heated coal). Archaeological digs of ancient settlement sites suggest that people would capture afire caused accidentally (by lightening, for instance) and would work to keep the fire burning continuously. Later, people learned that fire could be generated by rapid hand rotation of a wooden stick in a small hole surrounded by dry tinder. Fire became the focal point of settlements, and the campfire became a symbol of the community. It was a means of making foods digestible and was used to drive animals into traps or over cliffs.

In addition to hunting game on land, humans harvested shellfish, trapped fish by cutting small patches of standing water off from the open sea, and invented tools to catch fish, including harpoons for spearing large fish, hooks for catching fish, and baskets to catch fish in streams that had fish runs.

Through tools and fire, human communities altered their environments, establishing more reliable food supplies by combining hunting and fishing with some gathering and by making use of the migration cycles of fish and animal life. American Indians along the Pacific Coast and on Arctic shores, the Ainu of Japan and coastal East Asia, and communities in coastal western Europe caught salmon as they swam up rivers and negotiated rapids and falls. Archaeologists have found huge accumulations of fish bones at prehistoric sites near salmon runs.

Hunter-gatherers migrated to take advantage of cyclical movements of animals and to avoid exhausting the supply of edible plants in any one area. After the summer salmon runs, people hunted deer during the fall and again in the spring, taking advantage of seasonal movements to trap deer where they crossed rivers or in narrow valleys. During the winter, people lived off dried meat and other stored foods.

The First Agricultural Revolution

Out of areas of plenty came agriculture, the deliberate tending of crops and livestock to produce food, feed, and fiber. Geographer Carl Sauer believed the experiments necessary to establish agriculture and settle in one place would occur in lands of plenty. Only in a place of plenty could people afford to experiment with raising plants or take the time to capture animals and breed them for domestication. Sauer studied the geography of the First Agricultural Revolution, focusing on the location of the agriculture hearths and what kinds of agricultural innovations took place in those hearths.

Where did **plant domestication** begin? Sauer, who spent a lifetime studying cultural origins and diffusion, suggested that *Southeast and South Asia* may have been the scene, more than 14,000 years ago, of the first domestication of tropical plants. There, he believed, the combination of human settlements, forest margins, and fresh water streams may have given rise to the earliest planned cultivation of **root crops**—crops that are reproduced by cultivating either the roots or cuttings from the plants (such as tubers, including manioc or cassava, yams, and sweet potatoes in the tropics). A similar but later development may have taken place in northwestern South America.

The planned cultivation of **seed crops**, plants that are reproduced by cultivating seeds, is a more complex process, involving seed selection, sowing, watering, and well-timed harvesting. Again, the practice seems to have developed in more than one area and at different times. Some scholars believe that the first domestication of seed plants may have occurred in the Nile River Valley in North Africa, but the majority view is that this crucial development took place in a region of *Southwest Asia* (also called the *Fertile Crescent*), through which flow the two major rivers of present-day Iraq: the Tigris and the Euphrates (Fig. 11.3). This marked the beginning of what has been called the **First Agricultural Revolution**.

Archaeologists note that a number of changes occurred in Southwest Asia along with plant domestication. First, the plants themselves changed because people would choose seeds from the largest, heartiest plants to save for planting, yielding domesticated plants that grew *larger* over time than their counterparts in the wild. Archaeologists in Southwest Asia have found preserved seeds, which tell them what plants were being domesticated when. The grain crops wheat and barley grew well in the warming Southwest Asian climate. Soon, people found that the river-inundated plains of Mesopotamia provided alternate irrigable fields for farming. Agriculture provided a reliable food source, and grain surpluses enabled people to store grain for long-term distribution and use and to settle permanently in one place. With a reliable food source and a permanent settlement, the population of settlements began to increase.

Figure 11.3

The Fertile Crescent. The Fertile Crescent and ancient states (in different colors) of Mesopotamia and adjacent areas, and of the Nile Valley. Modern political boundaries are shown for reference. © E. H. Fouberg, A. B. Murphy, H. J. de Blij, and John Wiley & Sons, Inc.

Figure 11.4 depicts the truly global distribution of plant domestication hearths. In Southeast Asia (Region 1), taro, yams, and bananas were the leading food plants. In Southwest Asia (Region 4), plant domestication centered on wheat, barley, and other grains. In the Mesoamerican region (Region 6), the basic plants were maize (corn), squashes, and several kinds of beans.

Archaeologists continually find new sites to excavate, and as places are analyzed further, academics revise their assumptions about the timing of the hearths of agriculture. The Central China hearth (Region 7) has recently attracted greater attention because new evidence supports a much earlier development of agriculture in this region—so early, in fact, that Chinese farmers may have been among the world's first. Another agricultural source region lies in West Africa (Region 9). Archaeological research on agriculture in this area is relatively recent, and analysts are not certain whether agriculture developed independently there, but they are certain secondary domestication took place in West Africa.

Table 11.1 may be overwhelming at first glance, but it is worth careful attention. It reveals the enormous range of crops that were cultivated around the world, as well as how at various times and in different locales, particular groups of crops became the mainstays of life. Soon the knowledge needed to farm such crops diffused outward from these agricultural hearths. For example, both millet and sorghum diffused from the West African region—millet to India and sorghum to China.

In many cases, what we now think of as centers of production of particular crops are not the places where those crops were originally domesticated. The corn (maize) we associate with the American Corn Belt diffused from Central America and Southern Mexico into North America. Later, the Portuguese brought it across the Atlantic, and corn became a staple in much of Africa. The white potato we associate with Ireland and Idaho came originally from the Andean highlands but was brought to Europe in the 1600s where it became a staple from Ireland to the eastern expanses of the North European Plain. The banana we associate with Central America came from Southeast Asia, as did a variety of yams. Diffusion of crops and seeds was greatly accelerated by worldwide trade and communications networks established with mercantilism and colonialism.

Domestication of Animals

Some scholars believe that animal domestication began earlier than plant cultivation, but others argue that animal domestication began as recently as 8000 years ago—well after crop agriculture. In any case, goats, pigs, and sheep became part of a rapidly growing array of domestic animals, and in captivity they changed considerably from their wild state. As with the growing of root crops, the notion of **animal domestication** must have emerged over time, in stages.

Figure 11.4

World Areas of Agricultural Innovations. Cultural geographer Carl Sauer identified 11 areas where agricultural innovations occurred. *Adapted with permission from:* C. O. Sauer, *Agricultural Origins and Dispersals.* New York: American Geographical Society, 1952, p. 24.

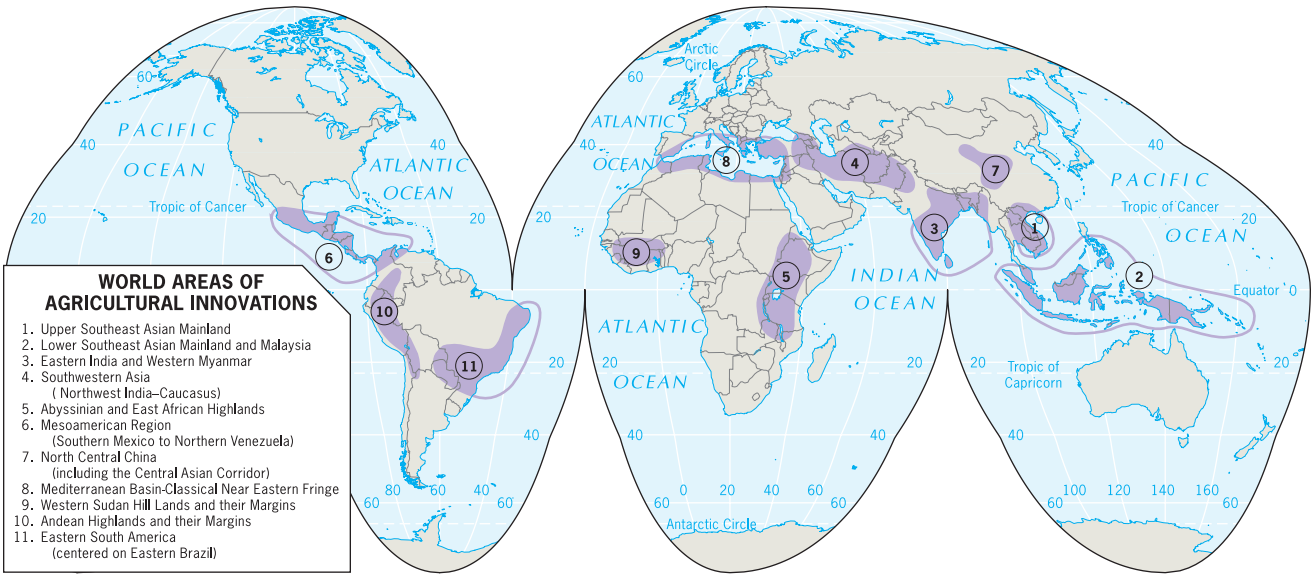


TABLE 11.1

Chief Source Regions of Important Crop Plant Domestications. ***Adapted with permission from*: J. E. Spencer and W. L. Thomas, *Introducing Cultural Geography*, 1978, John Wiley & Sons, Inc.**

A. Primary Regions of Domestications

1. The Upper Southeast Asian Mainlands

Citrus Fruits*	Bamboos*	Yams*	Rices*	Eugenias*	Lichi	Teas	Ramie
Bananas*	Taros*	Cabbages*	Beans*	Job's tears	Longan	Tung oils	Water chestnut

2. Lower Southeast Asian Mainland and Malaysia (including New Guinea)

Citrus fruits*	Taros*	Pandanuses	Breadfruits	Lanzones	Vine peppers*	Nutmeg	Areca
Bananas*	Yams*	Cucumbers*	Jackfruits	Durian	Gingers*	Clove	Abaca
Bamboos*	Almonds*	Sugarcanes	Coconuts	Rambutan	Brinjals*	Cardamom	

3. Eastern India and Western Burma

Bananas*	Beans*	Millets*	Grams	Vine peppers*	Mangoes	Safflower	Lotus
Yams*	Rices*	Sorghums*	Eggplants	Gingers*	Kapok*	Jute	Turmeric
Taros*	Amaranths*	Peas*	Brinjals*	Palms*	Indigo	Sunn	Hemp

4. Southwestern Asia (Northwest India-Caucasus)

Soft wheats*	Peas*	Rye*	Beets*	Hemp	Soft Pears*	Pomegranates	Walnuts
Barleys*	Oil seeds*	Onions	Spinach	Apples	Cherries*	Grapes*	Melons
Lentils*	Poppies	Carrots*	Sesames	Almonds*	Plums*	Jujubes*	Tamarind
Beans*	Oats*	Turnips	Flax	Peaches*	Figs	Pistachio	Alfalfa

5. Ethiopian and East African Highlands

Hard wheats*	Sorghums*	Barleys	Beans*	Oil seeds*	Melons*	Coffees	Okras
Millets*	Rices*	Peas*	Vetches	Cucumbers*	Gourds*	Castor beans	Cottons*

6. Meso-American Region (Southern Mexico to Northern Venezuela)

Maizes	Taros*	Tomatoes*	Avocados	Muskmelons	Cottons*
Amaranths*	Sweet potatoes	Chili peppers	Sapotes	Palms*	Agaves
Beans*	Squashes	Custard apples	Plums*	Manioc	Kapok

B. Secondary Regions of Domestications

7. North-Central China (including the Central Asian corridor)

Millets*	Soybeans	Naked oat*	Mulberries	Bush cherries*	Peaches*
Barleys*	Cabbages*	Mustards	Persimmons	Hard pears*	Jujubes*
Buckwheats	Radishes*	Rhubarb	Plums*	Apricots	

8. Mediterranean Basin—Classical Near Eastern Fringe

Barleys*	Lentils*	Grapes*	Dates	Parsnips	Lettuces	Carrots*	Sugar beet
Oats*	Peas*	Olives	Carobs	Asparagus	Celeries	Garlic	Leek

9. Western Sudan Hill Lands and Their Margins

Sorghums*	Rices*	Yams*	Peas*	Melons*	Oil palms	Kola nut
Millets*	Fonio	Beans*	Oil seeds*	Gourds*	Tamarind*	

10. Andean Highlands and Their Margins

White potatoes	Tomatoes*	Beans*	Quinoa	Cubio	Ulluco
Pumpkins	Strawberries	Papayas	Oca	Arrocacha	

11. Eastern South America (centered on eastern Brazil)

Taros*	Peanuts	Cashew nut	Cacao	Cottons*
Beans*	Pineapples	Brazil nut	Passion fruits	Tobaccos

Source: J. E. Spencer and W. L. Thomas, *Introducing Cultural Geography*: 1978. Reproduced by permission from John Wiley & Sons.

*The asterisk indicates domestication of related species or hybridized development of new species during domestication in some other region or regions. Some of these secondary domestications were later than in the original region, but evidence of chronologic priority seldom is clear-cut.

The plural rendering of the crop name indicates that several different varieties/species either were involved in initial domestication or followed thereafter,

The term *oil seeds* indicates several varieties or species of small-seeded crop plants grown for the production of edible oils, without further breakdown.

In regions 2 and 3 the brinjals refer to the spicy members of the eggplant group used in curries, whereas in region 3 the eggplants refer to the sweet vegetable members.

None of the regional lists attempts a complete listing of all crop plants/species domesticated within the region.

The table has been compiled from a wide variety of sources.

The process of animal domestication began when people became more sedentary. Animals were kept as pets or for other reasons, such as for ceremonial purposes. Quite possibly, animals attached themselves to human settlements as scavengers (foraging through garbage near human settlements) and even for protection against predators, thus reinforcing the idea that they might be tamed and kept. Orphaned young probably were adopted as pets; some wild animals were docile and easily penned up. Goats were domesticated in the Zagros Mountains (in the Fertile Crescent) as long as 10,000 years ago; sheep some 9500 years ago in Anatolia (Turkey); and pigs and cattle shortly thereafter. The advantages of animal domestication—their use as beasts of burden, as a source of meat, and as providers of milk—stimulated the rapid diffusion of this idea among interlinked places and gave the sedentary farmers of Southwest Asia and elsewhere a new measure of security.

Archaeological research indicates that when animals such as wild cattle are penned in a corral, they undergo physical changes over time. In a pen, animals are protected from predators, allowing the survival of animals that would have been killed in the wild. Our domestic versions of the goat, the pig, the cow, and the horse differ considerably from those first kept by our ancestors. In early animal domestication, people chose the more docile, often smaller animals to breed, in order to protect themselves from the animals. Archaeologists discern the beginnings of animal domestication in a region by inspecting the bones of excavated animals. They look for places where bones get smaller over time, as this usually indicates early domestication.

As with plant domestication, archaeologists can use the combination of bone fragments and tools to identify general areas where the domestication of particular animals occurred. In Southwest Asia and adjacent parts of Northeast Africa, people domesticated the goat, sheep, and camel. Southeast Asians domesticated several kinds of pigs, the water buffalo, chickens, and some water fowl (ducks, geese). In South Asia, people domesticated cattle, and cattle came to occupy an important place in the regional culture. In Central Asia, people domesticated the yak, horse, some species of goats, and sheep. In the Mesoamerican region (including the Andes from Peru northward and Middle America north to central Mexico), early Americans domesticated the llama and alpaca, along with a species of pig and the turkey.

Some species of animals may have been domesticated almost simultaneously in different places. The water buffalo, for example, was probably domesticated in both Southeast and South Asia during the same period. Camels may have been domesticated in Central Asia as well as in Southwest Asia. The pig was domesticated in numerous areas. Different species of cattle were domesticated in regions other than South Asia. Dogs and cats attached themselves to human settlements very early (they may have been the first animals to be domesticated) and in widely separated regions. Single, specific hearths can be pinpointed for only a few animals, including the llama and the alpaca, the yak, the turkey, and the reindeer.

Efforts to domesticate animals continue today. In Africa, people are attempting to domesticate the eland, to serve as a source of meat in a region where a stable protein source is greatly needed. Several experiment stations in the savannalands are trying to find ways to breed Africa's wildlife. They have had some success with a species of eland, but less so with various species of gazelles, and they have been unable to domesticate the buffalo (Fig. 11.5). In fact, throughout the world only about 40 species of higher animals have been domesticated—and most of these were domesticated long ago. Jared Diamond, author of *Guns, Germs, and Steel*, explains that only five domesticated mammals are important throughout the world: the cow, sheep, goat, pig, and horse. According to Diamond, if we select only the big (over 100 pounds), herbivorous, terrestrial animals, we have 148 species that meet these criteria in the "wild." Only 14 of those 148 have been domesticated successfully, and each of these 14 was domesticated at least 4500 years ago. Modern attempts at animal domestication, even those driven by knowledgeable geneticists, have failed because of problems with the breed of animal's diet, growth rate, breeding, disposition, or social structure.

Thus, the process of animal domestication, set in motion more than 8000 (and perhaps as long as 14,000) years ago, continues. The integrated use of domesticated plants and domesticated animals eased the work burden for early farmers. Animal waste fertilized crops, animals pulled plows, and crops fed animals. The first place that successfully integrated domesticated plants and animals was Southwest Asia (the Fertile Crescent).

Hunter-Gatherers in the Modern World

In the modern world, hunter-gatherers live in the context of a globalized economy and experience pressures to change their livelihoods. In many cases, the state places pressures on hunter-gatherers to settle in one place and farm. Cyclical migration by hunter-gatherers does not mesh well with bounded, territorial states. Some nongovernmental organizations encourage settlement by digging wells or building medical buildings, permanent houses, or schools for hunter-gatherers. Even hunter-gatherers who continue to use their knowledge of seeds, roots, fruits, berries, insects, and animals to gather and trap the goods they need for survival do so in the context of the world-economy. The San of Southern Africa, the Aboriginals of Australia, the indigenous peoples of Brazil, and several other groups in the Americas, Africa, and Asia have been

Field Note

"Attempts to tame wildlife started in ancient times, and still continue. At Hunter's Lodge on the Nairobi-Mombasa road, we met an agricultural officer who reported that an animal domestication experiment station was located not far into the bush, about 10 miles south. On his invitation, we spent the next day observing this work. In some herds, domestic animals (goats) were combined with wild gazelles, all penned together in a large enclosure. This was not working well; all day the gazelles seek to escape. By comparison, these eland were docile, manageable, and in good health. Importantly, they also were reproducing in captivity. Here, our host describes the program."

Figure 11.5
Nairobi, Kenya. © H. J. de Blij.

studied, mapped, recorded, photographed, donated to, defended, and in many cases exploited.

Subsistence Agriculture in the Modern World

Hundreds of millions of farmers are involved in **subsistence agriculture**, growing only enough food to survive. The term *subsistence* can be used in the strictest sense of the word—that is, to refer to farmers who grow food only to sustain themselves and their families, and find building materials and firewood in the natural environment, and who do not enter into the cash economy at all. This definition fits farmers in remote areas of South and Middle America, Africa, and South and Southeast Asia (Fig. 11.6). Yet many farm families living at the subsistence level sometimes sell a small quantity of produce (perhaps to pay taxes). They are not subsistence farmers in the strict sense, but the term *subsistence* is surely applicable to societies where farmers with small plots sometimes sell a few pounds of grain on the market but where poverty, indebtedness, and tenancy are ways of life. For the indigenous peoples in the Amazon Basin, the sedentary farmers of Africa's savanna areas, villagers in much of India, and peasants in Indonesia, subsistence is not only a way of life but a state of mind. Experience has taught farmers and their families that subsistence farming is often precarious and that times of comparative plenty will be followed by times of scarcity.

Subsistence farmers often hold land in common; surpluses are shared by all the members of the community; accumulation of personal wealth is restricted; and

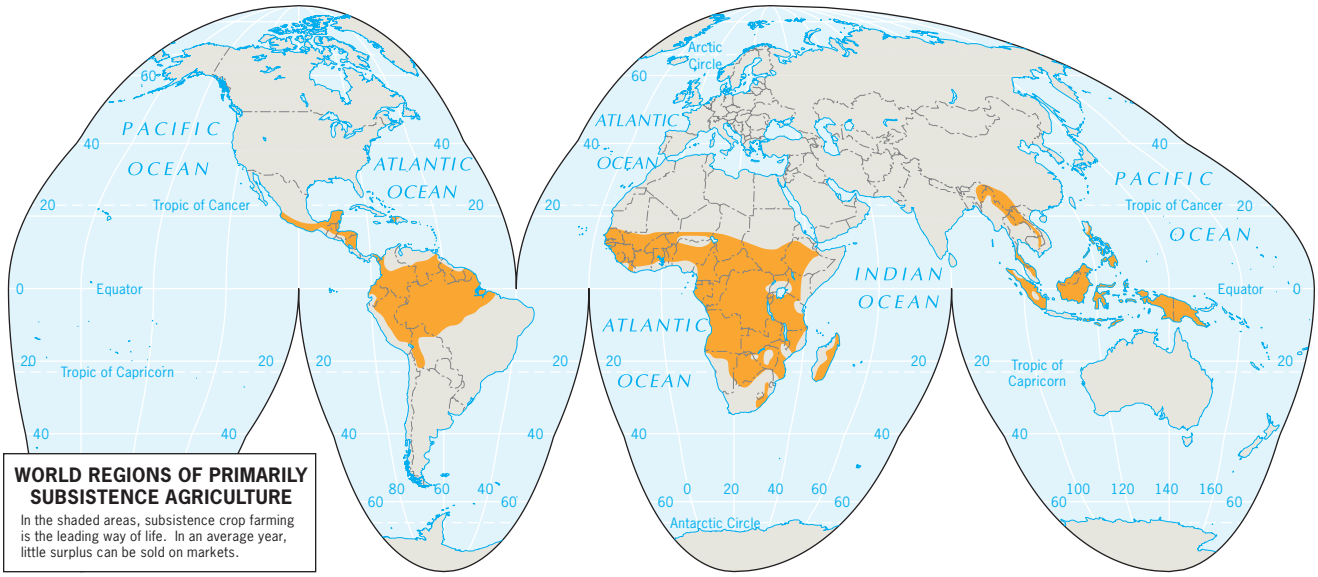


Figure 11.6

World Regions of Primarily Subsistence Agriculture. Definitions of subsistence farming vary. On this map, India and China are not shaded because farmers sell some produce at markets; in Equatorial Africa and South America, subsistence farming allows little excess, and thus little produce is sold at markets. © E. H. Fouberg, A. B. Murphy, H. J. de Blij, and John Wiley & Sons, Inc.

individual advancement at the cost of the group as a whole is limited. As A. H. Bunting wrote in *Change in Agriculture* (1970):

> *To allocate the land or manage the seasonal migrations, and to survive through hardship and calamity these societies have to be cohesive, communal and relatively little differentiated socially and economically: the chiefs, elders or elected headmen may be little richer than their fellows—to many of whom they are in addition linked by ties of relationship within the extended family. Mutual dependence, imposed by the environment and the state of the agricultural art, is maintained and reinforced by genetic relationships. The community is enclosed socially and may even tend to be isolated culturally. Landlords and feudal rulers are unknown; the cultivators are poor but free.*

Although much has changed for subsistence farmers since Bunting wrote these words in 1970, a strong sense of community remains important to the social fabric of the people.

Some subsistence farmers are sedentary, living in one place throughout the year, but many others move from place to place in search of better land. The latter engage in a form of agriculture known as **shifting cultivation**. This agriculture is found primarily in tropical and subtropical zones, where traditional farmers had to abandon plots of land after the soil became infertile. Once stripped of their natural vegetative cover and deprived of the constant input of nutrients from decaying vegetative matter on the forest floor, soils in these regions can quickly lose their nutrients as rain water leaches out organic matter. Faced with these circumstances, farmers move to another parcel of land, clear the vegetation, turn the soil, and try again. This practice of shifting cultivation, like hunting and gathering, still goes on today.

In tropical areas, a plot of cleared soil will carry a good crop at least once and perhaps two or three times. After that, the land is best left alone to regenerate its natural vegetative cover and replenish the soil with nutrients lost during cultivation. Several years later, the plot may yield a good harvest once again.

Today, shifting cultivation is a way of life for many more people than hunting and gathering. Between 150 million and 200 million people still sustain themselves through shifting cultivation in Africa, Middle America, tropical South America, and parts of Southeast Asia. The system of cultivation has changed little over thousands of years.

With shifting cultivation, people usually live in a central village surrounded by parcels of land that are worked successively. The farmers first clear vegetation from a parcel of land. Next they plant crops that are native to the region: tubers in the humid, warm tropical areas, grains in the more humid subtropics, and vegetables and fruits in cooler zones. When the village grows too large and the distance to usable land becomes too great, part of the village's population may establish a new settlement some distance away. Population densities in areas of shifting agriculture cannot be very high; therefore, shifting

cultivation continues only in areas where population densities are low.

One specific kind of shifting cultivation is **slash-and-burn agriculture** (also called milpa agriculture and patch agriculture), reflecting the central role of the controlled use of fire in places where this technique is used. Trees are cut down and all existing vegetation is burned off. In slash-and-burn, farmers use tools (machetes and knives) to slash down trees and tall vegetation, and then burn the vegetation on the ground. A layer of ash from the fire settles on the ground and contributes to the soil's fertility.

Used to seeing enormous fields of grain farmed by gigantic machines, we may look at shifting cultivation as wasteful and disorganized. Regions with shifting cultivation do not have neat rows of plants, carefully turned soil, or precisely laid-out fields. Nonetheless, shifting cultivation conserves both forest and soil; its harvests are substantial given the environmental limitations; and it requires better organization than one might assume. It also requires substantially less energy than more modern techniques of farming. Shifting cultivation and specifically slash-and-burn agriculture have been a sustained method of farming for thousands of years. Shifting cultivation gave ancient farmers opportunities to experiment with various plants, to learn the effects of weeding and crop care, to cope with environmental vagaries, and to discern the decreased fertility of soil after sustained farming.

Marginalization of Subsistence Farming

During colonialism (1500 to 1950), European powers sought to "modernize" the economies of the colonies by ending subsistence and integrating farmers into colonial systems of production and exchange. Sometimes their methods were harsh: by demanding that farmers pay some taxes, they forced subsistence farmers to begin selling some of their produce to raise the necessary cash. They also compelled many subsistence farmers to devote some land to a cash crop such as cotton, thus bringing them into the commercial economy. The colonial powers encouraged commercial farming by conducting soil surveys, building irrigation systems, and establishing lending agencies that provided loans to farmers. In addition, the colonial powers sought to make profits, yet it was difficult to squeeze very much from subsistence-farming areas. Forced cropping schemes were designed to solve this problem. If farmers in a subsistence area cultivated a certain acreage of, say, corn, they were required to grow a specified acreage of a cash crop, such as cotton, as well. Whether this crop would be grown on old land that was formerly used for grain or on newly cleared land was the farmers' decision. If no new lands were available, the farmers would have to give up food crops for the compulsory cash crops. In many areas, severe famines resulted and local economies were disrupted.

Many scholars have considered the question of how "to tempt [subsistence farmers] into wanting cash by the availability of suitable consumer goods," as A. N. Duckham and G. B. Masefield wrote in *Farming Systems of the World* in 1970. In the interests of "progress" and "modernization," subsistence farmers have been pushed away from their traditional modes of livelihood. Yet many aspects of subsistence farming may be worth preserving.

Subsistence land use is giving way to more intensive farming and cash cropping—even to mechanized farming in which equipment does much of the actual work. In the process, societies from South America to Southeast Asia are being profoundly affected. Land that was once held communally is being parceled out to individuals for cash cropping. The system that ensured an equitable distribution of resources is breaking down. And the distribution of wealth has become stratified, with poor people at the bottom and rich landowners at the top.

Settling down in one place, a rising population, and the switch to agriculture are interrelated occurrences in human history. Hypothesize which of these three happened first, second, and third and explain why.

HOW DID AGRICULTURE CHANGE WITH INDUSTRIALIZATION?

For the Industrial Revolution (see Chapter 12) to take root, a **Second Agricultural Revolution** had to take place—one that would move agriculture beyond subsistence to generate the kinds of surpluses needed to feed thousands of people working in factories instead of in agricultural fields. Like the Industrial Revolution, the Second Agricultural Revolution was composed of a series of innovations, improvements, and techniques, in this case, in Great Britain, the Netherlands, Denmark, and other neighboring countries.

By the seventeenth and eighteenth centuries, European farming underwent significant changes. New crops came into Europe from trade with the Americas, including corn and potatoes. Many of the new crops were well suited for the climate and soils of western Europe, bringing new lands (previously defined as marginal) into cultivation. The governments of Europe played a role in spurring on the Second Agricultural Revolution by passing laws such as Great Britain's Enclosure Act, which encouraged consolidation of fields into large, single-owner holdings. Farmers increased the size of their farms, pieced

together more contiguous parcels of land, fenced in their land, and instituted field rotation. Methods of soil preparation, fertilization, crop care, and harvesting improved.

New technologies improved production as well. The seed drill enabled farmers to avoid wasting seeds and to plant in rows, making it simpler to distinguish weeds from crops. Advances in breeding livestock enabled farmers to develop new breeds that were either strong milk producers or good for beef. By the 1830s, farmers were using new fertilizers on crops and feeding artificial feeds to livestock. Increased agricultural output made it possible to feed much larger urban populations, enabling the growth of a secondary (industrial) economy.

Innovations in machinery that occurred with the Industrial Revolution in the late 1800s and early 1900s helped sustain the Second Agricultural Revolution. The railroad helped move agriculture into new regions, such as the United States' Great Plains. Geographer John Hudson traced the major role railroads and agriculture played in changing the landscape of that region from open prairie to individual farmsteads. The railroad companies advertised in Europe to attract immigrants to the Great Plains region, and the railroads took the new migrants to their new towns, where they would transform lands from prairie grass to agricultural fields.

Later, the internal combustible engine made possible the invention of tractors, combines, and a multitude of large farm equipment. New banking and lending practices helped farmers afford the new equipment.

Understanding the Spatial Layout of Agriculture

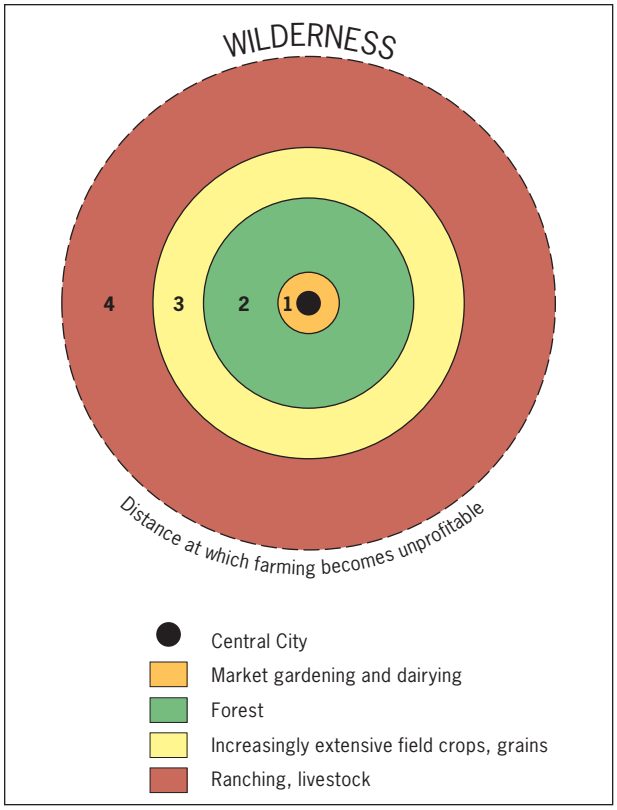
When commercial agriculture is geared to producing food for people who live in a nearby town or city, a clear geography based on perishability of products and cost of transportation emerges. In the 1800s, Johann Heinrich von Thünen (1783–1850) experienced the Second Agricultural Revolution firsthand: he farmed an estate not far from the town of Rostock, in northeast Germany. Studying the spatial patterns of farming around towns such as Rostock, von Thünen noted that one commodity or crop gave way to another in succession, as one moved away from Rostock. He also noted that this process occurred without any visible change in soil, climate, or terrain. When he mapped this pattern, he found that each town or market center was surrounded by a set of more-or-less concentric rings within which particular commodities or crops dominated.

Nearest the town, farmers produced commodities that were perishable and commanded high prices, such as dairy products and strawberries. In this zone, von Thünen believed agriculture would be produced with a high level of intensity, and much effort would go into production in part because of the value of the land closer to the city. In von Thünen's time, the town was still surrounded by a belt of forest that provided wood for fuel and building; but immediately beyond the forest the ring-like pattern of agriculture continued. In the next ring the crops were less perishable and bulkier, including wheat and other grains. Still farther out, livestock raising began to replace field crops.

Von Thünen used these observations to build a model of the spatial distribution of agricultural activities. As with all models, he had to make certain assumptions. For example, he assumed that the terrain was flat, that soils and other environmental conditions were the same everywhere, and that there were no barriers to transportation to market. Under such circumstances, he reasoned, transport costs would govern the use of land. He reasoned that the greater the distance to market, the higher the transport costs that had to be added to the cost of producing a crop or commodity. At a given distance to market, then, it would become unprofitable to produce high-cost, perishable commodities—and market gardens would give way to field crops such as grains and potatoes. Still farther away, livestock raising would replace field agriculture.

The **Von Thünen model** (including the ring of forest) is often described as the first effort to analyze the spatial character of economic activity (Fig. 11.7). The

Figure 11.7
Von Thünen's Model. © H. J. de Blij, P. O. Muller, and John Wiley & Sons, Inc.



Thünian patterns discerned in many parts of the world are not solely the result of the forces modeled by von Thünen. Differences in climate type and soil quality weigh heavily on the kinds of goods produced in a place. If you drive east out of Denver, heading for Nebraska, you cannot miss a certain concentric zonation that puts dairying and market gardening nearest the city, cash grains such as corn (plus soybeans) in the next "ring," more extensive grain farming and livestock raising beyond, and cattle ranching in the outermost zone.

Geographer Lee Liu studied the spatial pattern of agricultural production in one province of China, giving careful consideration to the intensity of the production methods and the amount of land degradation. Liu found that the farmers living in a village would farm lands close to the village and lands far away from the village with high levels of intensity. However, the methods used varied spatially, resulting in land improvements close to the village and land degradation farther from the village. In lands close to the village, farmers improved lands through "decades of intensive care," in particular putting organic material onto the fields, which made the grasslands close to the village "fertile and productive." In lands more remote from the village, farmers tended to use more "chemical fertilizer, pesticides, and herbicides" and fewer conservation tactics, resulting in land degradation, whereby "the originally fertile remote land became degraded." Liu argued that this pattern in modern China occurs in large part because the farmers live in the village, not in the remote fields, and therefore put most of their time and energy into the fields closest to them.

Even when agricultural production does not conform to the concentric rings of von Thünen's model, his underlying concern with the interplay of land use and transportation costs is frequently still determinative. The fresh flowers grown in the Caribbean for sale in New York City could be viewed as the application of the von Thünen model on a larger scale, for it is less expensive to grow flowers in the Caribbean and ship them to New York City than it is to grow them in other locations.

The Third Agricultural Revolution

The **Third Agricultural Revolution**, also called the **Green Revolution**, dates as far back as the 1930s, when agricultural scientists in the American Midwest began experimenting with technologically manipulated seed varieties to increase crop yields. In the 1940s, American philanthropists funded research on maize (corn) production in Mexico, trying to find a hybrid seed that would grow better. They did, and by 1960 Mexico was no longer importing corn because production within the country was high enough to meet demand. In the 1960s, the focal point of the Green Revolution shifted to India, when scientists at a research institution in the Philippines crossed a dwarf Chinese variety of rice with an Indonesian variety and produced IR8. This new rice plant had a number of desirable properties: it developed a bigger head of grain, and it had a stronger stem that did not collapse under the added weight of the bigger head. IR8 produced much better yields than either of its parents, but the researchers were not satisfied. In 1982 they produced IR36, bred from 13 parents to achieve genetic resistance against 15 pests and a growing cycle of 110 days under warm conditions, thus making possible three crops per year in some places. By 1992, IR36 was the most widely grown crop on Earth, and in September 1994, scientists developed a strain of rice that was even more productive than IR36. In addition to improving the production of rice, the Green Revolution brought new high-yield varieties of wheat and corn from the United States to other parts of the world, particularly South and Southeast Asia.

Coming at a time of growing concern about global hunger, the successes of the Green Revolution were truly extraordinary. Today, most famines result from political instability rather than failure in production. India became self-sufficient in grain production by the 1980s, and Asia saw a two-thirds increase in rice production between 1970 and 1995. These drastic increases in production stemmed not only from new seed varieties but also from the use of fertilizers, pesticides, irrigation in some places, and significant capital improvements.

The geographical impact of the Green Revolution is highly variable, however. Its traditional focus on rice, wheat, and corn means that it has had only limited impact throughout much of Africa, where agriculture is based on different crops and where lower soil fertility makes agriculture less attractive to foreign investment. Researchers at the International Rice Research Institute, for example, are working to breed a genetically modified "super rice" that will not have to be transplanted as seedlings but can be seeded directly in the paddy soil. It may yield nearly twice as much rice per acre than the average for strains in current use. The charting of the genome of rice (the 12 chromosomes that carry all of the plant's characteristics) is under way, so it may also be possible to transform rice genetically so that it will continuously acquire more desirable properties. Not only could yields improve; so could resistance to diseases and pests.

Increasingly, researchers are turning their attention to new agricultural products, and this could expand the geographical impact of the Green Revolution. Research has already led to methods for producing high-yield cassava and sorghum—both of which are grown in Africa. And beyond Africa, research on fattening livestock faster and improving the appearance of fruits is having an impact in North and South America.

The promise of increasing food production in a world in which almost a billion people are malnourished

has led many people to support genetically engineered foods. However, many other people question whether gene manipulation could create health risks and produce environmental hazards. Environmentalists have speculated about the impacts of pollen dispersal from genetically modified plants and the potential for disease-resistant plants to spur the evolution of super-pests. Vocal opponent of the Green Revolution in India, Vandana Shiva, argues that

> *[t]he Green Revolution has been a failure. It has led to reduced genetic diversity, increased vulnerability to pests, soil erosion, water shortages, reduced soil fertility, micronutrient deficiencies, soil contamination, reduced availability of nutritious food crops for the local population, the displacement of vast numbers of small farmers from their land, rural impoverishment and increased tensions and conflicts. The beneficiaries have been the agrochemical industry, large petrochemical companies, manufacturers of agricultural machinery, dam builders and large landowners.*

One difficulty of assessing the situation at present is that developments are occurring so fast that it is not easy to keep up with them.

The Green Revolution today has a large number of detractors concerned that the higher inputs of chemical fertilizers and pesticides can lead to reduced organic matter in the soil and to groundwater pollution. Moreover, many small-scale farmers lack the resources to acquire genetically enhanced seeds and the necessary fertilizers and pesticides. In most of the world that is affected by the Green Revolution, farmers produce on very small acreages. A 2005 report in *Scientific American* explains that in these cases, the Green Revolution has done little to alleviate poverty: "The supply-driven strategies of the Green Revolution, however, may not help subsistence farmers, who must play to their strengths to compete in the global marketplace. The average size of a family farm is less than four acres in India, 1.8 acres in Bangladesh and about half an acre in China." Smaller farmers are in a poor competitive position, and some are being driven off their lands. In addition, the need for capital from the West to implement Green Revolution technologies has led to a shift away from production for local consumers toward export agriculture. In the process, local places become subject to the vicissitudes of the global economy, where a downward fluctuation in the price of a given crop can create enormous problems for places dependent on the sale of that crop.

New Genetically Modified Foods

An entire field of biotechnology has sprung up in conjunction with the Third Agricultural Revolution, and the development of genetically engineered crops (GE) or **genetically modified organisms (GMOs)** is its principal orientation. Since the origin of agriculture, people have experimented with hybrid crops and cross-breeding of animals. Today, according to the Grocery Manufacturers of America, genetically modified organisms are found in 75 percent of all processed foods in the United States. The United States leads the world in production of genetically engineered crops, with 38 percent of all acres in corn and 80 percent of all acres in soybeans in the United States sown with genetically engineered seeds.

Some regions have embraced genetically engineered crops, and others have banned them. Many of the poorer countries of the world do not have access to the necessary capital and technology. Moreover, ideological resistance to genetically engineered foods is strong in some places—particularly in western Europe. Agricultural officials in most west European countries have declared genetically modified foods to be safe, but in many places, the public has a strong reaction against them based on combined concerns about health and taste. Such concerns have spread to less affluent parts of the world as well. In many poorer regions, seeds are a cultural commodity, reflecting agricultural lessons learned over generations. In these regions, many resist the invasion of foreign, genetically engineered crops.

Regional and Local Change

Recent shifts from subsistence agriculture to commercial agriculture have had dramatic impacts on rural life. Land-use patterns, land ownership arrangements, and agricultural labor conditions have all changed as rural residents cope with shifting economic, political, and environmental conditions. In Latin America, dramatic increases in the production of export crops (or *cash crops* such as fruits and coffee) have occurred at the expense of crop production for local consumption. In the process, subsistence farming has been pushed to ever more marginal lands. In Asia, where the Green Revolution has had the greatest impact, the production of cereal crops (grains such as rice and wheat) has increased for both foreign and domestic markets. Agricultural production in this region remains relatively small in scale and quite dependent on manual labor. In Subsaharan Africa, total commercialized agriculture has increased, but overall agricultural exports have decreased. As in Asia, farm units in Subsaharan Africa have remained relatively small and dependent on intensified manual labor.

What this regional-scale analysis does not tell us is how these changes have affected local rural communities. These changes can be environmental, economic, and social. A recent study in the small country of Gambia (West Africa) by Judith Carney has shown how changing agricultural practices have altered not only the rural

Guest Field Note

Gambia

I am interested in women and rural development in Subsaharan Africa. In 1983, I went to Gambia to study an irrigated rice project that was being implemented to improve the availability of rice, the dietary staple. What grabbed my attention? The donors' assurance that the project would benefit women, the country's traditional rice growers. Imagine my surprise a few months after project implementation when I encountered hundreds of angry women refusing to work because they received nothing for their labor from the first harvest.

In registering women's traditional rice plots as "family" land, project officials effectively sabotaged the equity objectives of the donors. Control now was concentrated under male heads of household who reaped the income produced by female labor. Contemporary economic strategies for Africa depend increasingly upon labor intensification. But whose labor? Human geography provides a way of seeing the significance of gender in the power relations that mediate culture, environment, and economic development.

Figure 11.8
Gambia.

Credit: Judith Carney, University of California, Los Angeles

environment and economy, but also relations between men and women (Fig. 11.8). Over the last 30 years, international developmental assistance of Gambia has led to ambitious projects designed to convert wetlands to irrigated agricultural lands, making possible production of rice year-round. By the late 1980s, virtually all of the country's suitable wetlands had been converted to year-round rice production. This transformation created tensions within rural households by converting lands women traditionally used for family subsistence into commercialized farming plots. In addition, when rice production was turned into a year-round occupation, women found themselves with less time for other activities crucial for household maintenance.

This situation underscores the fact that in Africa, as in much of the rest of the less industrialized world, agricultural work is overwhelmingly carried out by women. In Subsaharan Africa over 85 percent of all women in the labor force work in agriculture, while in China the number is close to 75 percent and in India 70 percent. A geographical perspective that is sensitive to scale helps to shed light on how changes in agricultural practices throughout the world not only alter rural landscapes but also affect family and community relationships.

thinking geographically

Genetically engineered crops are yielding some ethical problems. In the semi-periphery and periphery, farmers typically keep seeds from crops so that they can plant the seeds the next year. Companies that produce genetically engineered seeds do not approve of this process; generally, they want farmers to purchase new seeds each year. Using the concepts of scale and jumping scale, determine the ethical questions in this debate.

WHAT IMPRINT DOES AGRICULTURE MAKE ON THE CULTURAL LANDSCAPE?

Flying from the West Coast of the United States to the East Coast, if you have a window seat, you will see the major imprint agriculture makes on the American cultural landscape. The green circles standing out in arid regions of the country are places where center-pivot irrigation

systems circle around a pivot, providing irrigation to a circle of crops. The checkerboard pattern on the landscape reflects the pattern of land ownership in much of the country.

The pattern of land ownership seen in the landscape reflects the cadastral system—the method of land survey through which land ownership and property lines are defined. Cadastral systems were adopted in places where settlement could be regulated by law, and land surveys were crucial to their implementation. The prevailing survey system throughout much of the United States, the one that appears as checkerboards across agricultural fields, is the **rectangular survey system**. The U.S. government adopted the rectangular survey system after the American Revolution as part of a cadastral system known as the **township-and-range system**. Designed to facilitate the movement of non-Indians evenly across farmlands of the United States interior, the system imposed a rigid gridlike pattern on the land (Fig. 11.9). The basic unit was the 1 square mile *section*—and land was bought and sold in whole, half, or quarter sections. The section's lines were drawn without reference to the terrain, and they thus imposed a remarkable uniformity across the land. Under the Homestead Act, a homesteader received one section of land (160 acres) after living on the land for five years and making improvements to it. The pattern of farms on the landscape in the interior of the United States reflects the township-and-range system, with farms spaced by sections, half sections, or quarter sections.

The imprint of the rectangular survey system is evident in Canada as well, where the government adopted a similar cadastral system as it sought to allocate land in the Prairie Provinces. In portions of the United States and Canada different cadastral patterns predominate, however (Fig. 11.10). These patterns reflect particular notions of how land should be divided and used. Among the most significant are the **metes and bounds survey** approach adopted along the eastern seaboard, in which natural features were used to demarcate irregular parcels of land. One of the most distinct regional approaches to land division can be found in the Canadian Maritimes and in parts of Quebec, Louisiana, and Texas where a **long-lot survey system** was implemented. This system divided land into narrow parcels stretching back from rivers, roads, or canals. It reflects a particular approach to surveying that was common in French America.

In addition to the influence of the cadastral system of the landscape, a society's norms for property ownership are reflected in the landscape. Property ownership is symbolized by landscapes where parcels of land are divided into neat, clearly demarcated segments. The size and order of those parcels are heavily influenced by rules about property inheritance. In systems where one child inherits all of the land—such as the Germanic system of **primogeniture** in which all land passes to the eldest son—parcels tend to be larger and farmers work a single plot of land. This is the norm in Northern Europe and in the principal areas of Northern European colonization—the Americas, South Africa, Australia, and New Zealand.

In areas where land is divided among heirs, however, considerable fragmentation can occur over time. The latter is the norm throughout much of Asia, Africa, and Southern Europe and most of the allotted Indian reservations in the United States, meaning that farmers living in villages tend a variety of scattered small plots of land. In some places, land reform initiatives have consolidated landholdings to some degree, but fragmentation is still common in many parts of the world.

Figure 11.9
Garden City, Iowa. The township-and-range system has left its imprint on the landscape of Garden City, Iowa, where the grid pattern of 6 mile by 6 mile townships and the sections of 1 square mile each are marked by property lines and roads. © Craig Aurne/Corbis Images.

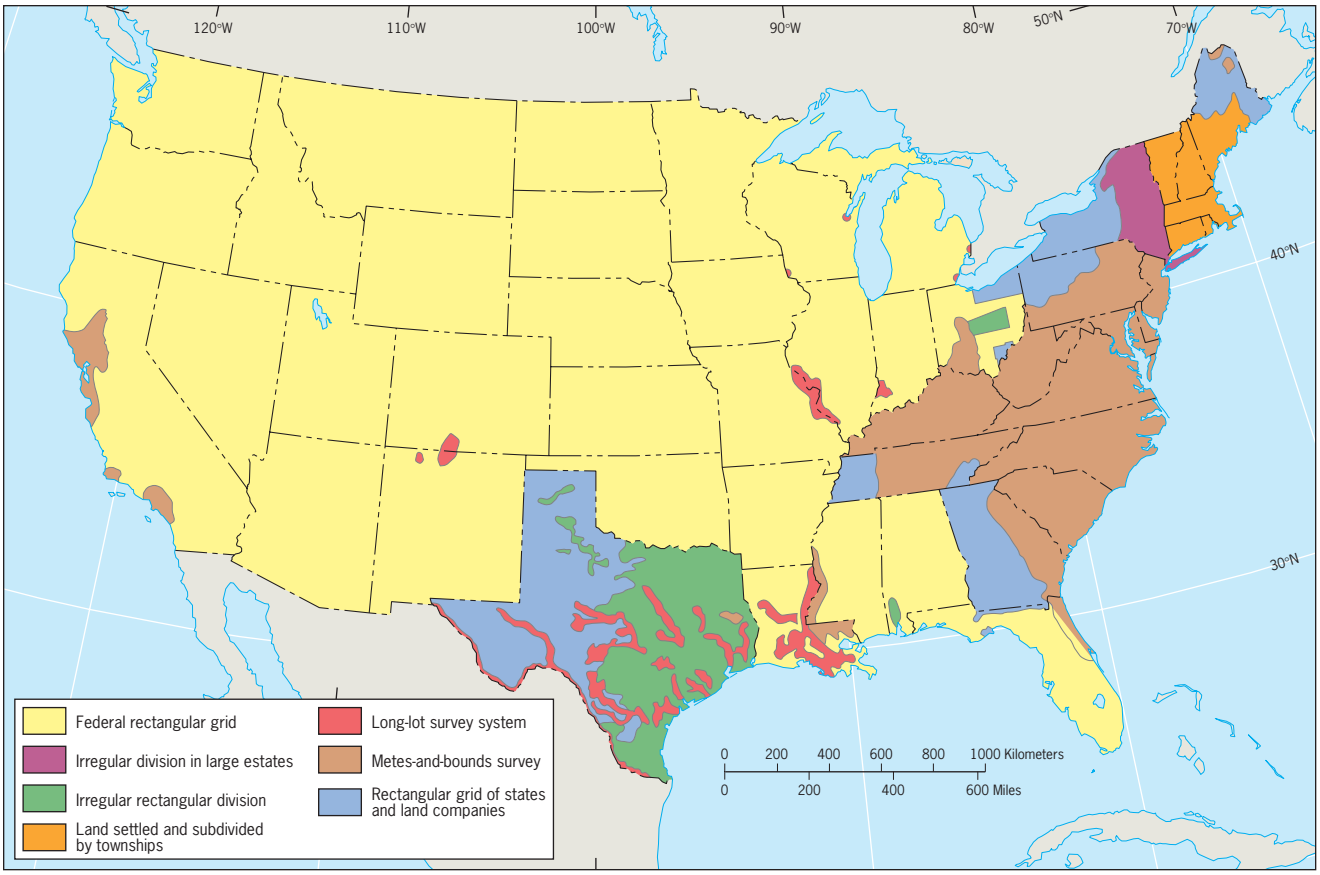


Figure 11.10

Dominant Land Survey Patterns in the United States. *Data from: Dividing the Land: Early American Beginnings of Our Private Property Mosaic.* Chicago: University of Chicago Press, 1995, p. 8 and several other sources.

Villages

Throughout this book we take note of various core-periphery contrasts our world presents. Such contrasts are prominent in rural as well as urban areas. Traditional farm-village life is still common in India, Subsaharan Africa, China, and Southeast Asia. In India, farming, much of it subsistence farming, still occupies nearly 70 percent of the population. In the world's core areas, however, agriculture has taken on a very different form, and true farm villages, in which farming or providing services for farmers are the dominant activities, are disappearing. In the United States, where farming once was the leading economic activity, only some 2 percent of the labor force remains engaged in agriculture.

Traditionally, the people who lived in villages either farmed the surrounding land or provided services to those who do the farming. Thus, they were closely connected to the land, and most of their livelihoods depended, directly or indirectly, on the cultivation of nearby farmland. As such, they tended to reflect historical and environmental conditions. Houses in Japanese farming villages, for example, are so tightly packed together that only the narrowest passageways remain between them. This reflects the need to allocate every possible square foot of land to farming; villages must not use land where crops could grow.

Unlike Japan, in the United States Midwest, individual farmhouses lie quite far apart in what we call a *dispersed settlement* pattern: the land is intensively cultivated but by machine rather than by hand. In the populous Indonesian island of Java, villages are located every half-mile or so along a rural road, and settlement there is defined as nucleated. Land use is just as intense, but the work is done by people and animals. Hence, when we consider the density of human settlement as it relates to the intensity of land use, we should keep in mind the way the land is cultivated. *Nucleated settlement* is by far the most prevalent rural residential pattern in agricultural areas (Fig. 11.11). When houses are grouped together in tiny clusters or hamlets, or in slightly larger clusters we call villages, their spatial arrangement also has significance.

In the hilly regions of Europe, villages frequently are clustered on hillslopes, leaving the level land for farming. Often an old castle sits atop the hill, so in earlier times the site offered protection as well as land conservation.

Figure 11.11
Burgundy, France. The agricultural landscape of Burgundy demonstrates three features of rural France: people living in nucleated villages, a highly fragmented land ownership pattern, and land divided according to the French long-lot system. © Barbara A. Weightman.

In many low-lying areas of western Europe, villages are located on dikes and levees, so that they often take on linear characteristics (Fig. 11.12 A). Where there is space, a house and outbuildings may be surrounded by a small garden; the farms and pasturelands lie just beyond. In other cases, a village may take on the characteristics of a cluster (Fig. 11.12 B). It may have begun as a small hamlet at the intersection of two roads and then developed by accretion. The European version of the East African circular village, with its central cattle corral, is the round village or *rundling* (Fig. 11.12 C). This layout was first used by Slavic farmer-herdsmen in eastern Europe and was later modified by Germanic settlers.

In many parts of the world, farm villages were fortified to protect their inhabitants against marauders. Ten thousand years ago, the first farmers in the Fertile Crescent faced attacks from the horsemen of Asia's steppes and clustered together to ward off this danger. In Nigeria's Yorubaland, the farmers would go out into the surrounding fields by day but retreat to the protection of walled villages at night. Villages, as well as larger towns and cities in Europe, were frequently walled and surrounded by moats. When the population became so large that people had to build houses outside the original wall, a new wall would be built to protect them as well. *Walled villages* (Fig. 11.12 D) still exist in rural areas of many countries, reminders of a turbulent past.

More modern villages, notably planned rural settlements, may be arranged on a grid pattern (Fig. 11.12 E). This is not, however, a twentieth-century novelty. Centuries ago the Spanish invaders of Middle America laid out *grid villages* and towns, as did other colonial powers elsewhere in the world. In urban Africa, such imprints of colonization are pervasive.

Although the twentieth century has witnessed unprecedented urban growth throughout the world, half of the world's people still reside in villages and rural areas. As total world population increases, total population in rural areas is increasing in many parts of the world (even though the proportion of the total population in rural areas may be stagnant or declining). In China alone, some 60 percent of the more than 1.3 billion people inhabit villages and hamlets. In India, with a population over 1 billion, about 70 percent of the people live in places the government defines as nonurban. Small rural settlements are home to most of the inhabitants of Indonesia, Bangladesh, Pakistan, and other countries of the periphery, including those in Africa. The agrarian village remains one of the most common forms of settlement on Earth.

In some places, rural villages have changed as the global economy has changed. For example, Mexico has experienced rapid economic change since passage of the North American Free Trade Act (NAFTA) in 1992. Along with major changes in industrial production (see Chapter 12), major changes in agricultural production have occurred in Mexico. Daniel Klooster studied changes in Mexican agriculture and found that since NAFTA, U.S. exports of maize (corn) to Mexico have tripled and "now supply a third of Mexican domestic demand." Agricultural production in Mexico has decreased since NAFTA, but

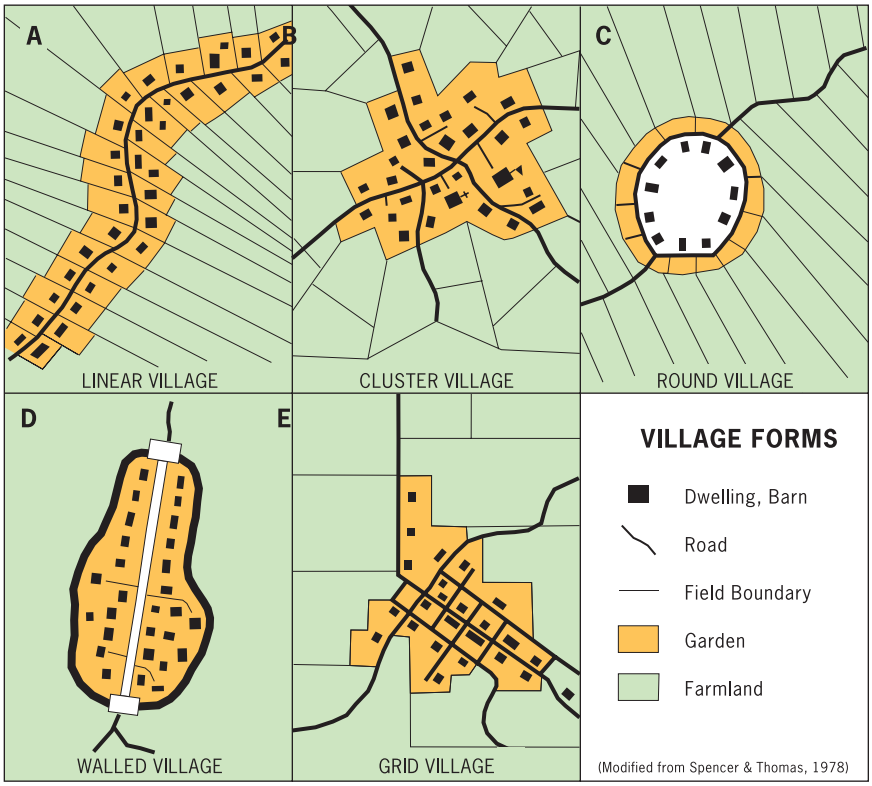


Figure 11.12
Village Forms. Five different representative village layouts are shown here. *Adapted with permission from:* J. E. Spencer and W. H. Thomas, *Introducing Cultural Geography*. New York: John Wiley & Sons, Inc., 1978, p. 154.

the total rural population in Mexico is growing (along with the total population of the country). How, then, are people in rural areas making a living? Klooster found that "as agriculture declined, off-farm income from activities such as construction work, petty commerce and craft production increased" and that for rural families in Mexico (as in much of the rural United States), off-farm income accounts for "more than half of family income." Decreasing agricultural production has increased the rate of migration of Mexicans to the United States, with many people from rural areas without jobs coming to the United States for work and sending remittances home.

Functional Differentiation Within Villages

Villages everywhere display certain common qualities, including evidence of social stratification and differentiation of buildings. The range in size and quality of houses, representing their owners' wealth and standing in the community, reflects social stratification. Material well-being is the chief determinant of stratification in Western commercial agricultural regions, where it translates into more elaborate homes. In Africa, a higher social position in the community is associated with a more impressive house. The house of the chief or headman may not only be more elaborate than others but may also be in a more prominent location. In India, caste still strongly influences daily life, including village housing; the manors of landlords, often comprising large walled compounds, stand in striking contrast to the modest houses of domestic servants, farm workers, carpenters, and craftspeople. The poorest people of the lowest castes live in small one-room, wattle-and-thatch dwellings. In Cambodia, the buildings in the stilt villages built throughout the Mekong Basin look similar (Fig. 11.13). The building along the pond in the left foreground of Figure 11.13 has a different function—it is an outhouse. Its location on the pond accounts for a major part of the pollution problem in this village: waste from the outhouses drains directly into the pond, which has become mosquito-infested and severely polluted.

The functional differentiation (like the functional zonation of cities whereby different areas of the village play different roles and function differently) of buildings within farm villages is more elaborate in some societies than in others. Protection of livestock and storage of harvested crops are primary functions of farm villages, and in many villages where subsistence farming is the prevailing way of life, the storage place for grains and other food is constructed with as much care as the best-built house. Moisture and vermin must be kept away from stored food; containers of grain often stand on stilts under a carefully thatched roof or behind walls made of carefully maintained sun-dried mud. In India's villages, the paddy-bin made of mud (in which rice is stored) often stands inside the house. Similarly, livestock pens are often attached to houses, or, as in Africa, dwellings are built in a circle surrounding the corral.

Figure 11.13
Siem Reap, Cambodia. A stilt village in the Mekong Basin of Cambodia. © Barbara A. Weightman.

The functional differentiation of buildings is greatest in Western cultures, where a single farmstead may contain as many buildings as an entire hamlet elsewhere in the world. A prosperous North American farm is likely to include a two-story farmhouse, a stable, a barn, and various outbuildings, including a garage for motorized equipment, a workshop, a shed for tools, and a silo for grain storage (Fig. 11.14). The space these structures occupy often exceeds that used by entire villages in Japan, China, and other agrarian regions where space must be conserved.

Figure 11.14
Winthrop, Minnesota. The modern American farm typically has a two-story farm house surrounded by several outbuildings. © Erin H. Fouberg.

thinking geographically

Think of an agricultural region you have either visited or seen from an airplane. Describe the imprint of agriculture on the landscape and consider what the cultural landscape tells you about how agriculture is produced in this region and how production has changed over time.

WHAT IS THE GLOBAL PATTERN OF AGRICULTURE AND AGRIBUSINESS?

When looking at patterns of agriculture at the global scale, it is important to recognize that von Thünen's concerns with the interplay of market location, land use, and transportation costs can reveal only one part of the picture. We must also consider the effects of different climate and soil conditions, variations in farming methods and technology, involvement by governments, and the lasting impacts of history. Decisions made by colonial powers in Europe led to the establishment of plantations from Middle America to Malaysia. The plantations grew crops not for local markets but for consumers in Europe; similarly, U.S. companies founded huge plantations in the Americas. Over the past few centuries, the impact of this plantation system transformed the map of world agriculture. The end of colonial rule did not merely signal the end of the agricultural practices and systems that had been imposed on the former colonial areas. Even food-poor countries must continue to grow commercial crops for export on some of their best soils where their own food should be harvested. Long-entrenched agricultural systems and patterns are not quickly or easily transformed.

Commercial farming has come to dominate in the world's economic core, as well as some of the places in the semiperiphery and periphery. Commercial farming is the agriculture of large-scale grain producers and cattle ranches, mechanized equipment and factory-type labor forces, plantations and profit. As we will see, it is a world apart from the traditional farms of Asia and Africa.

The roots of modern **commercial agriculture** can be traced to the vast colonial empires established by European powers in the eighteenth and nineteenth centuries. Europe became a market for agricultural products from around the world but with an added dimension: European countries manufactured and sold in their colonies the finished products made from imported raw materials. Thus, cotton grown in Egypt, Sudan, India, and other countries colonized by Europe was bought cheaply, imported to European factories, and made into clothes—many of which were then exported and sold, often in the very colonies where the cotton had been grown in the first place.

Major changes in transportation and food storage, especially refrigeration, have further intertwined agricultural production and food processing regions around the world (Fig. 11.15). The beef industry of Argentina, for example, secured a world market when the invention of

Field Note

"The technology of refrigeration has kept pace with the containerization of seaborne freight traffic. When we sailed into the port of Dunedin, New Zealand, I was unsure of just what those red boxes were. Closer inspection revealed that they are refrigeration units, to which incoming containers are attached. Meats and other perishables can thus be kept frozen until they are transferred to a refrigerator ship."

Figure 11.15
Dunedin, New Zealand. © H. J. de Blij.

refrigerated ships made it possible to transport a highly perishable commodity over long distances. European colonial powers required farmers in their colonies to cultivate specific crops. One major impact of colonial agriculture was the establishment of **monoculture** (dependence on a single agricultural commodity), throughout much of the colonial world. Colonies became known for certain crops, and colonizers came to rely on those crops. Ghanaians still raise cacao; Moçambiquans still grow cotton; and Sri Lankans still produce tea. The production of cash crops by poorer countries today is often perpetuated by loan and aid requirements from lending countries, the World Trade Organization, the International Monetary Fund, and the World Bank (see Chapter 10).

The World Map of Climates

Before we can study the distribution of agriculture in the world today, we need to examine Figure 11.16, the distribution of climate zones in the world today. All of the elements of weather, absorption of the sun's energy, rotation of the Earth, circulation of the oceans, movement of weather systems, and the jet stream produce a pattern of climates represented in the map. We owe this remarkable map to Wladimir Köppen (1846–1940), who devised a scheme called the **Köppen climate classification system** for classifying the world's climates on the basis of temperature and precipitation.

Köppen's map provides one means of understanding the distribution of **climatic regions** (areas with similar climatic characteristics) across the planet. The legend looks complicated, but it really is not; here is one of those maps worth spending some time on. For present purposes, it is enough to get a sense of the distribution of the major types of climate. The letter categories in the legend give a clear indication of the conditions they represent.

The (A) climates are hot or very warm and generally humid. The "no dry season" (Af) regions are *equatorial rainforest* regions. The "short dry season" (Am) climate is known as the *monsoon climate*. And if you can envisage an African savanna, you know what the (Aw, *savanna*) designation means.

Once you realize that the yellow and light brown colors on the map represent dry climates (BW, *desert* and BS, *steppe*), it becomes clear how much of the world has limited water availability. Nonetheless, some very large population clusters have developed in these water-deficient regions, especially at lower (and warmer) latitudes. The world faces a long-term water crisis, and the Köppen map helps show why.

The (C) climates also have familiar names. The (Cf) climate, represented by dark green, prevails over the southeastern United States. If you know the local climate in Atlanta or Nashville or Jacksonville, you understand why this climate is often called "humid temperate." It is moist, and it does not get as cold as it does in Canada or as warm (continuously, anyway) as in the Amazon Basin. If you have experienced this kind of climate, the map gives you a good idea of what it's like in much of eastern China, southeastern Australia, and a large part of southeastern South America.

The "dry summer" (C) climates are known as *Mediterranean* climates (the small s in Cs means that summers are dry). This mild climate occurs not only around the Mediterranean Sea, and thus in the famous wine countries of France, Italy, and Spain, but also in California, Chile, South Africa's Cape, and southern parts of Australia. So you know what kind of climate to expect in Rome, San Francisco, Santiago, Cape Town, and Adelaide.

Farther toward the poles, the planet gets rather cold. Note that the (D) climates dominate in the United States' upper Midwest and Canada, but it gets even colder in Siberia. The "milder" (Da) climates (here the key is the small a, which denotes a warm summer) are found only in limited parts of Eurasia. Winters are very cold in all the (D) climates and downright frigid (and long) in the (Dfb) and (Dfc) regions. The latter merge into the *polar* climates, where tundra and ice prevail.

The World Map of Agriculture

When comparing the world map of agriculture (Fig. 11.17) with the distribution of climate types across the world (Fig. 11.16), we can see the correlation between climate and agriculture. Drier lands rely on livestock ranching, where moister climates are marked with grain production. In this section of the chapter, we examine climatic patterns and other influences on the distribution of agriculture.

Cash Crops and Plantation Agriculture

Nonsubsistence farming in many poorer countries is a leftover from colonial times. Colonial powers implemented agriculture systems to benefit their needs, a practice that has tended to lock poorer countries into production of one or two "cash" crops. Cash farming continues to provide badly needed money, even if the conditions of sale to the urban-industrial world are unfavorable. In the Caribbean region, for example, whole national economies depend on sugar exports (sugar having been introduced by the European colonists in the 1600s). These island countries wish to sell the sugar at the highest possible price, but they are not in a position to dictate prices. Sugar is produced by many countries in various parts of the world, as well as by farmers in the core (Fig. 11.17). Governments in the core place quotas on imports of agricultural products and subsidize domestic production of the same commodities.

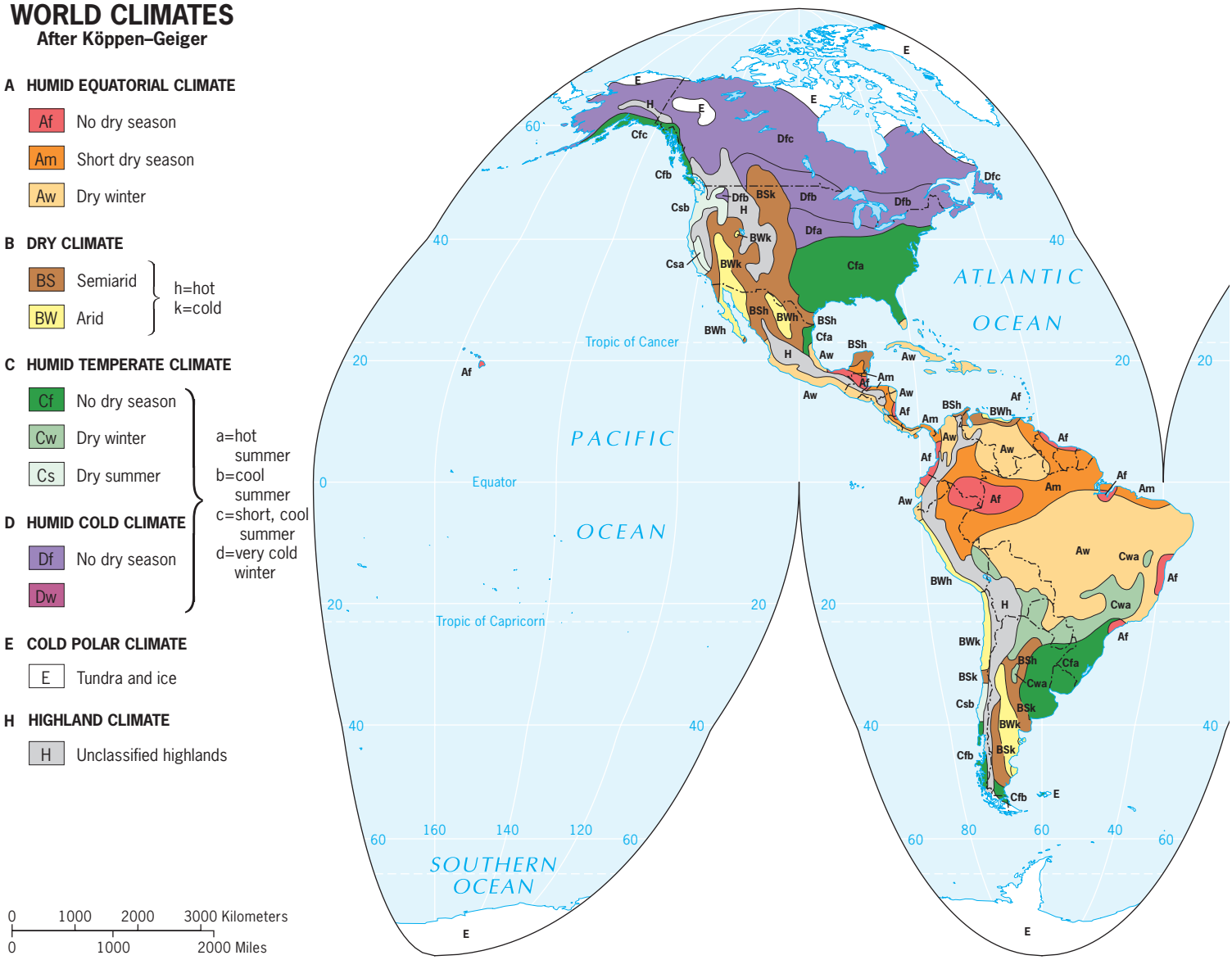
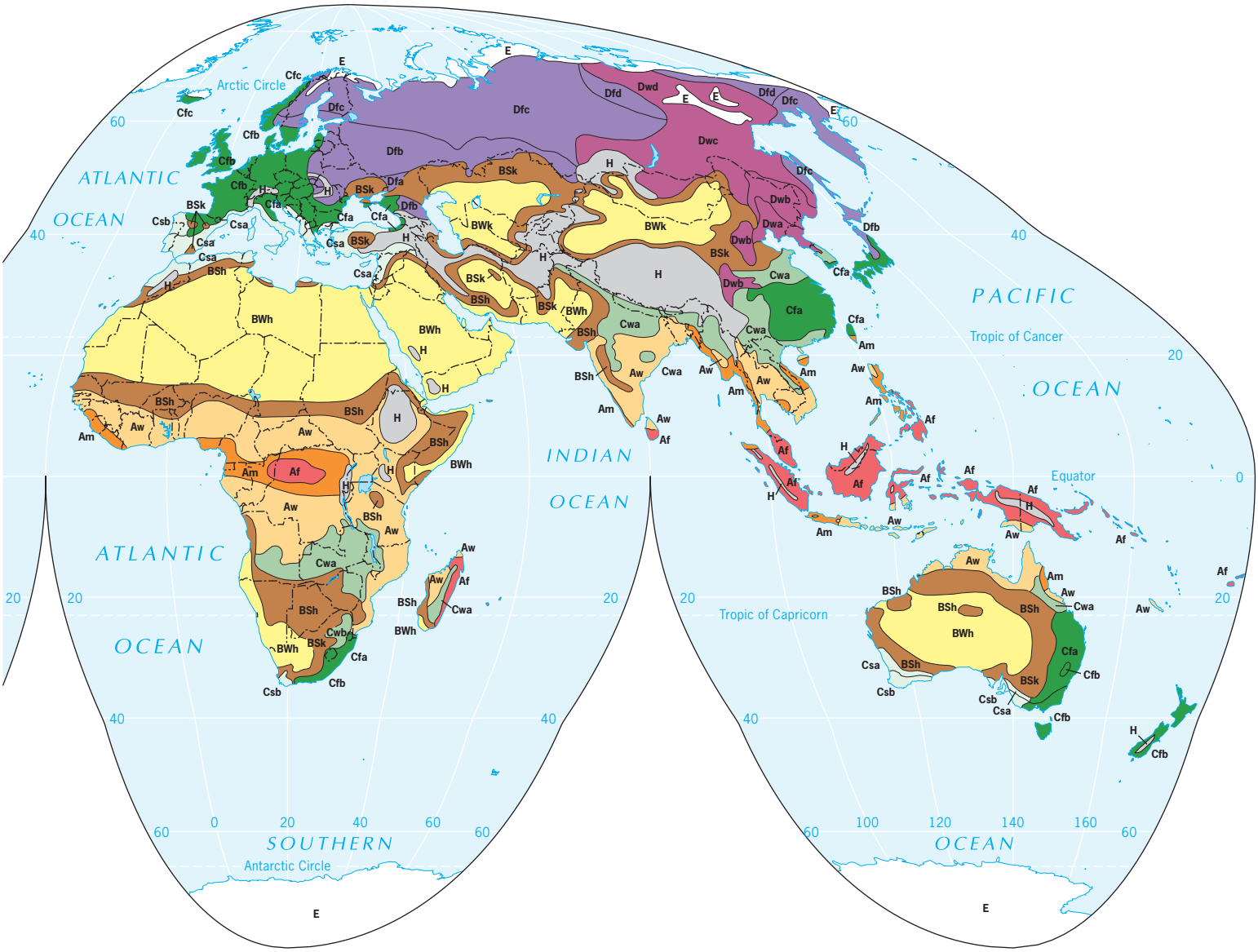


Figure 11.16
World Climates. The Köppen map of world climates, as modified by R. Geiger. These are macroclimatic regions; microclimates are set within these but cannot be shown at this scale.

Occasionally, producing countries consider forming a cartel in order to present a united front to the importing countries and to gain a better price, as oil-producing states did during the 1970s. Such collective action is difficult, as the wealthy importing countries can buy products from countries that are not members of the cartel. Also, the withholding of produce by exporting countries may stimulate domestic production among importers. For example, although cane sugar accounts for more than 70 percent of the commercial world sugar crop each year, farmers in the United States, Europe, and Russia produce sugar from sugar beets. In Europe and Russia, these beets already yield 25 percent of the annual world sugar harvest. Collective action by countries producing sugarcane could easily cause that percentage to increase.

When cash crops are grown on large estates, we use the term **plantation agriculture** to describe the production system. Plantations are colonial legacies that persist in poorer, primarily tropical, countries along with subsistence farming. Figure 11.17 shows that plantation agriculture (7 in the legend) continues in Middle and South America, Africa, and South Asia. Laid out to produce bananas, sugar, coffee, and cocoa in Middle and South America, rubber, cocoa, and tea in West and East Africa, tea in South Asia, and rubber in Southeast Asia, these plantations have outlasted the period of decolonization and



continue to provide specialized crops to wealthier markets. Many of the most productive plantations are owned by European or American individuals or corporations.

Multinational corporations have tenaciously protected their economic interests in plantations. In the 1940s and 1950s, the Guatemalan government began an agrarian reform program. In part, the plan entailed renting unused land from foreign corporations to landless citizens at a low appraised value. The United Fruit Company, an American firm with extensive holdings in the country, was greatly concerned by this turn of events. The company had close ties to powerful individuals in the American government, including Secretary of State John Foster Dulles, CIA director Allen Dulles (the two were brothers), and Assistant Secretary of State for Inter-American Affairs John Moors Cabot. In 1954, the United States supported the overthrow of the government of Guatemala because of stated concerns about the spread of communism. This ended all land reform initiatives, however, leading many commentators to question the degree to which the United Fruit Company was behind the coup. Indeed, with the exception of President Dwight Eisenhower, every individual involved in the decision to help topple Guatemala's government had ties to the company. This example illustrates the inextricable links between economics and political motivations—and it raises questions about the degree to which multinational corporations based in wealthy

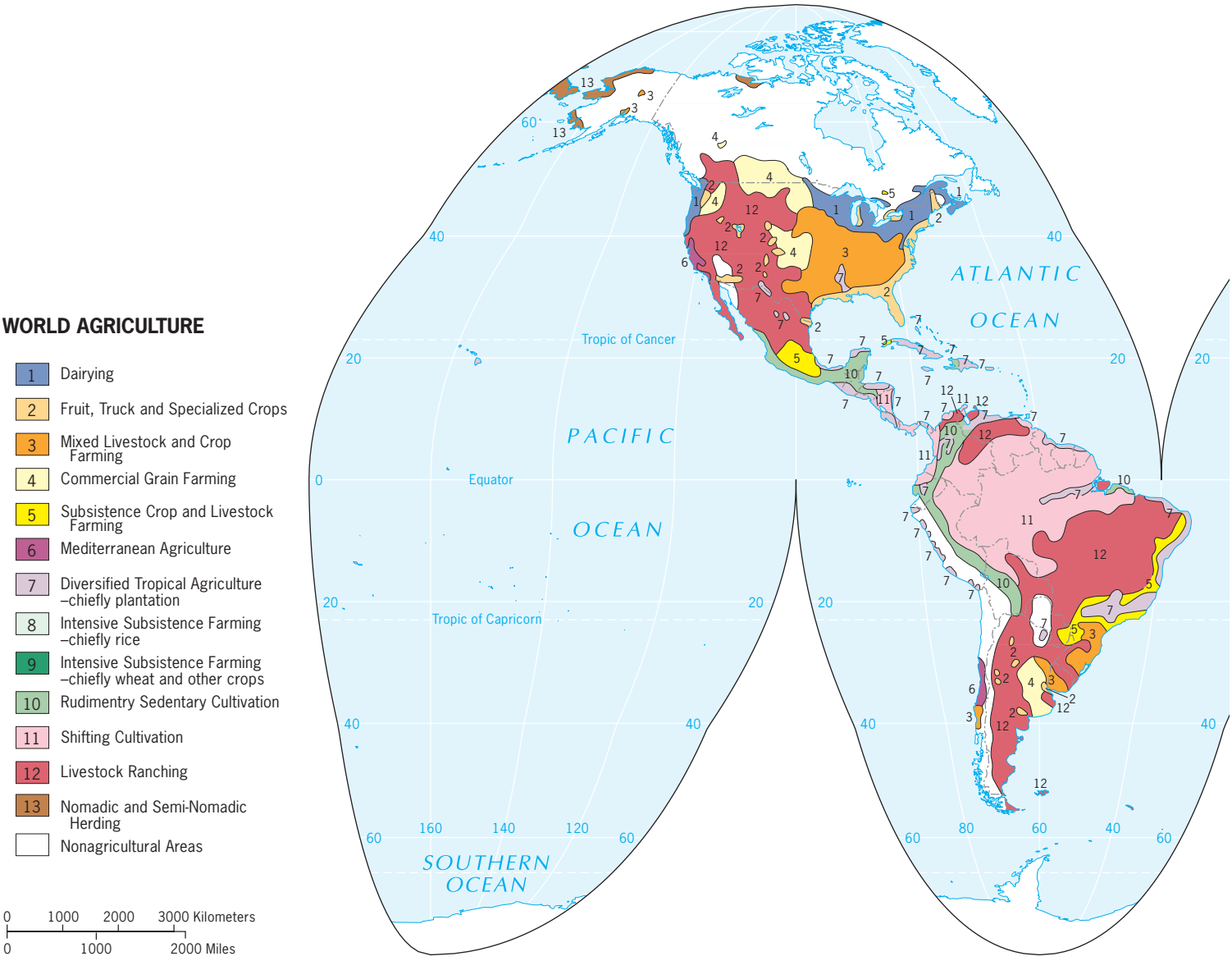


Figure 11.17

World Agriculture. Different kinds of agricultural areas are shown throughout the world. *Adapted with permission from*: Hammond, Inc., 1977.

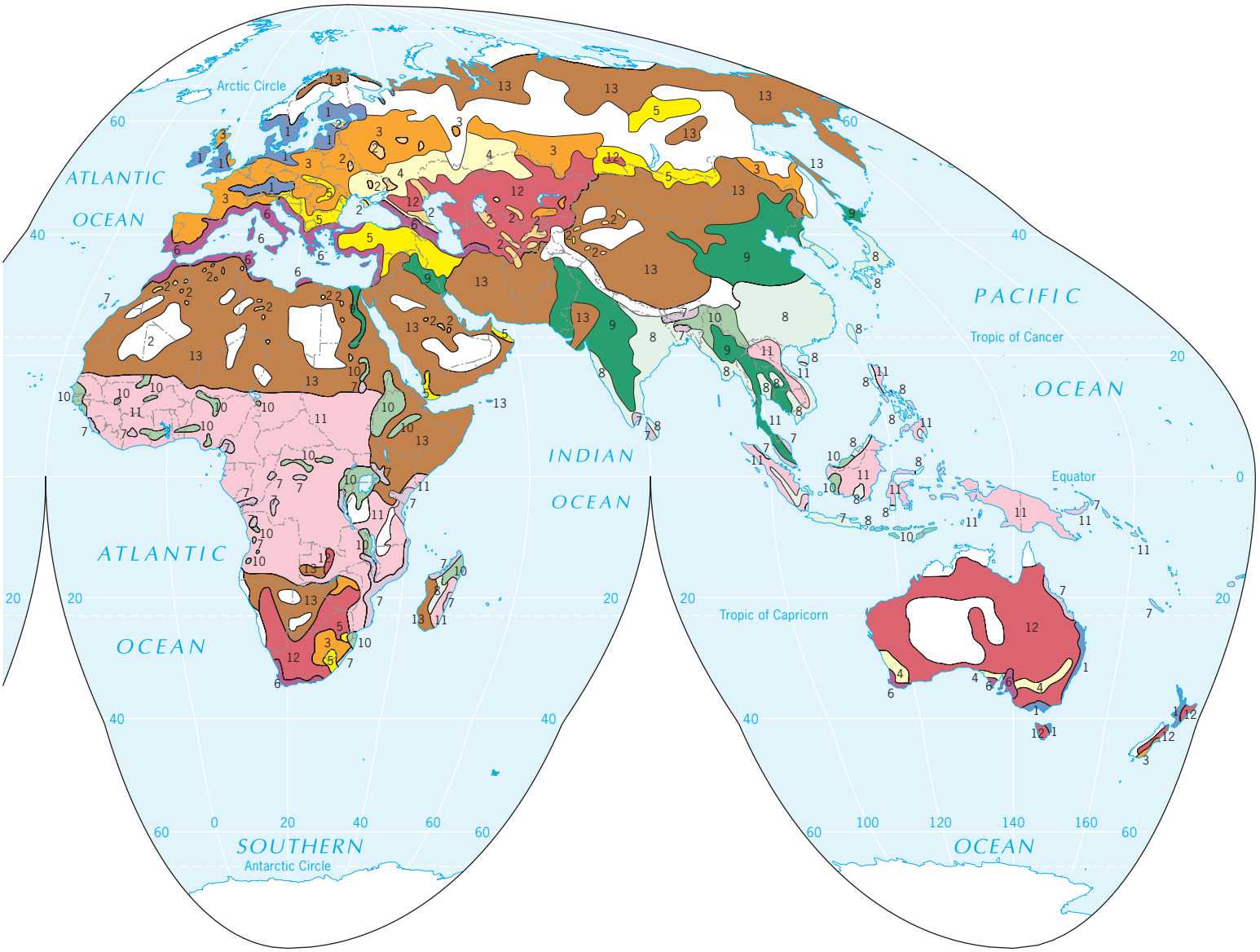
countries influence decisions about politics, agriculture, and land reform in the semiperiphery and periphery.

Cotton and Rubber

Two of the most significant contemporary cash crops are cotton and rubber. Colonialism encouraged the production of plantation-scale cotton in many regions of the world. India, for example, began producing cotton on a large scale under British colonialism.

Cotton cultivation expanded greatly during the nineteenth century, when the Industrial Revolution produced machines for cotton ginning, spinning, and weaving that increased productive capacity, brought prices down, and put cotton goods within the reach of mass markets. As with sugar, the colonial powers laid out large-scale cotton plantations, sometimes under irrigation. Cotton cultivation was also promoted on a smaller scale in numerous other countries: in Egypt's Nile Delta, in the Punjab region shared by Pakistan and India, and in Sudan, Uganda, Mexico, and Brazil. The colonial producers received low prices for their cotton, and the European industries prospered as cheap raw materials were converted into large quantities of items for sale at home and abroad.

Wealthier countries continue to buy cotton, and cotton sales remain important for some former colo-



nies. But they compete with cotton being grown in the United States, Northeast China, and Central Asia. Much of the cotton purchased by Japan, the United Kingdom, and western Europe, for example, comes from the United States. Cotton is also a major product in northeastern China and in several Central Asian Republics.

Cotton is in competition today with synthetic fibers such as nylon and rayon, and rubber is in competition with synthetic rubber. Before synthetic rubber was developed, rubber was collected from rubber-producing trees in equatorial rainforests, mainly in the Amazon Basin in northern South America. Around 1900, the town of Manaus on the Amazon River experienced a rubber boom. Rubber companies in the Congo Basin in Africa experienced a similar period of prosperity. The boom in wild rubber was short-lived, however. Rubber-tree plantations were created to make rubber collection easier and more efficient. Seedlings of Brazilian rubber trees were planted elsewhere, and they did especially well in Southeast Asia. Within two decades nearly 90 percent of the world's rubber came from new plantations in colonial territories in Malaysia, the Netherlands East Indies (now Indonesia), and neighboring colonies.

As time went on, more and more uses for rubber were found, and consumer demand grew continuously. The advent of the automobile was an enormous boost for

the industry, and most of the rubber now produced is used to manufacture vehicle tires. World War II created a need for alternative sources of rubber, since Japan had occupied much of Southeast Asia. This stimulated the production of synthetic rubber. In 2007, world rubber production totaled approximately 23.4 million tons, more than 13.5 million of it synthetic; of the remainder, natural rubber, almost 70 percent was produced on the plantations of Southeast Asia.

The development of rubber plantations in Southeast Asia, rather than in sections of the Amazon Basin or the Congo Basin, is due less to environmental factors than to the availability of labor. The colonial powers were aware that Southeast Asia combined conditions of tropical environment and labor availability that neither Amazon South America nor Equatorial Africa could match. Eventually, a large-scale rubber industry developed in Liberia (West Africa), but in the 1990s it was destroyed during the country's disastrous civil war. Lately, efforts have been made to introduce the plantation system along the Amazon River in the heart of northern Brazil.

Luxury Crops

Similar conditions—a combination of suitable environment and available labor—led the European colonial powers to establish huge plantations for the cultivation of **luxury crops** such as tea, cacao, coffee, and tobacco. Coffee was first domesticated in the region of present-day Ethiopia, but today it thrives in Middle and South America, where approximately 70 percent of the world's annual production is harvested. The United States buys more than half of all the coffee sold on world markets annually, and western Europe imports most of the rest.

Coffee is one of the best examples of the colonial legacy's impact on present-day agricultural practices. In the early eighteenth century, coffee was virtually unknown in most of the world. After petroleum, coffee is now the second most valuable traded commodity in the world. The best-known image of coffee production in North America is probably that of Juan Valdez, who is portrayed as a simple yet proud Colombian peasant who handpicks beans by day and enjoys a cup of his own coffee by night. This image is quite contrary to the reality of much coffee production in Latin America. In most cases coffee is produced on enormous, foreign-owned plantations, where it is picked by local laborers who are hired at very low wage rates. Most coffee is sent abroad; and if the coffee pickers drink coffee, it is probably of the imported and instant variety.

Coffee production is undergoing changes as more consumers demand fair trade coffee and more coffee producers seek fair trade certification. CNN reports that "Retailers who are certified Fair Traders return up to 40 percent of the retail price of an item to the producer." Once a producer meets the requirements of organic coffee production and a few other criteria, that producer can be registered on the International Fair Trade Coffee Register. Coffee importers then purchase the fair trade coffee directly from the registered producers. Being registered guarantees coffee producers a "fair trade price" of $1.26 per pound of coffee (plus bonuses of $0.20 per pound for organic). Over 500,000 farmers in 20 countries in the periphery and semi-periphery are on the fair trade register (Fig. 11.18). The fair trade campaign pressured Starbucks into selling fair trade coffee, and Starbucks now purchases more than 10 percent of the global production of fair trade coffee. Other retailers have followed suit; for example, all espresso sold at Dunkin' Donuts in North America and Europe is fair trade certified. Fair trade coffee is available at large retail outlets and under corporate brands at Target, Wal-Mart, and Sam's Club.

Figure 11.18

Las Colinas Cooperative, Department of Ahuachapan, El Salvador. This fair trade coffee farmer in El Salvador grows his coffee beans in the shade, under the canopy of the rainforest. His coffee is fair trade certified, allowing him to get a much better price for his beans in exchange for producing shade-grown, organic coffee beans. © Equal Exchange.

Fair trade production goes beyond coffee today. Dozens of commodities and products from tea, bananas, fresh cut flowers, and chocolate to soccer balls can be certified fair trade. According to Fair Trade Labeling Organizations International, consumers spent more than $2.2 billion on fair trade certified products in 2006, representing an increase by 42 percent over 2005 consumption levels.

Tea production, both the fair trade and the traditionally traded varieties, is on the rise globally to meet the increasing consumption of the luxury crop. Compared to coffee, tea is consumed in greater quantities in areas where it is grown: India, China, Sri Lanka, and Japan. Whereas coffee is cultivated and consumed mainly in the Americas, tea is the dominant beverage in significant parts of Eurasia. It goes from the Asian-producing areas to the United Kingdom and the rest of Europe and North America. Tea is a rather recent addition to the Western diet. It was grown in China perhaps 2000 years ago, but it became popular in Europe only during the nineteenth century. The colonial powers (mainly the British) established enormous tea plantations in Asia and thus began the full-scale flow of tea into European markets.

Commercial Livestock, Fruit, and Grain Agriculture

By far the largest areas of commercial agriculture (1 through 4 in the legend) lie outside the tropics. Dairying (1) is widespread at the northern margins of the midlatitudes—particularly in the northeastern United States and in northwestern Europe. Fruit, truck, and specialized crops (2), including the market gardens von Thünen observed around Rostock, are found in the eastern and southeastern United States and in widely dispersed small areas where environments are favorable. (Major oases can be seen in the Sahara and in Central Asia.)

Mixed livestock and crop farming (3) is widespread in the more humid parts of the midlatitudes, including much of the eastern United States, western Europe, and western Russia, but it is also found in smaller areas in Uruguay, Brazil, and South Africa. Commercial grain farming (4) prevails in the drier parts of the midlatitudes, including the southern Prairie Provinces of Canada, in the Dakotas and Montana in the United States, as well as in Nebraska, Kansas, and adjacent areas. Spring wheat (planted in the spring and harvested in the summer) grows in the northern zone, and winter wheat (planted in the autumn and harvested in the spring of the following year) is used in the southern area. An even larger belt of wheat farming extends from Ukraine through Russia into Kazakhstan. The Argentinean and Australian wheat zones are smaller in area, but their exports are an important component of world trade.

Even a cursory glance at Figure 11.17 reveals the wide distribution of **livestock ranching** (12), the raising of domesticated animals for the production of meat and by-products, such as leather and wool. In addition to the large cattle-ranching areas in the United States, Canada, and Mexico, much of eastern Brazil and Argentina are devoted to ranching, along with large tracts of Australia and New Zealand, as well as South Africa. You may see a Thünian pattern here: livestock ranching on the periphery and consumers in the cities. Refrigeration has overcome the problem of perishability, and high volume has lowered the unit cost of transporting beef, lamb, and other animal products.

Subsistence Agriculture

The map of world agriculture labels three types of subsistence agriculture: subsistence crop and livestock farming; intensively subsistence farming (chiefly rice); and intensively subsistence farming (chiefly wheat and other crops). In some regions that are labeled as subsistence, that label does not tell the whole story. For example. in Southeast Asia, rice is grown on small plots and is labor-intensive, so that subsistence and export production occur side by side. Despite the region's significant rice exports, most Southeast Asian farmers are subsistence farmers. Thus, Southeast Asia appears on the map as primarily a subsistence grain-growing area.

Mediterranean Agriculture

Only one form of agriculture mentioned in the legend of Figure 11.17 refers to a particular climatic zone: **Mediterranean agriculture** (6). As the map shows, this kind of specialized farming occurs only in areas where the dry summer Mediterranean climate prevails (Fig. 11.16): along the shores of the Mediterranean Sea, in parts of California and Oregon, in central Chile, at South Africa's Cape, and in parts of southwestern and southern Australia. Farmers here grow a special combination of crops: grapes, olives, citrus fruits, figs, certain vegetables, dates, and others. From these areas come many wines; these and other commodities are exported to distant markets because Mediterranean products tend to be popular and command high prices.

Illegal Drugs

Important cash crops that cannot be easily mapped and do not appear in Figure 11.17 are those that are turned into illegal drugs. Because of the high demand for drugs—particularly in the core—farmers in the periphery often find it more profitable to cultivate poppy, coca, or marijuana plants than to grow standard food crops. Cultivation of these plants increased steadily through the 1980s and 1990s, and they now constitute an important source of revenue for parts of the global economic periphery. Coca,

the source plant of cocaine, is grown widely in Colombia, Peru, and Bolivia. Over half of the world's cultivation of coca occurs in Colombia alone.

Heroin and opium are derived from opium poppy plants, grown predominantly in Southeast and Southwest Asia, especially in Afghanistan and Myanmar. In the 2008 World Drug Report, the United Nations reported that 92 percent of the world's opium production took place in Afghanistan. The United States-led overthrow of the Taliban in Afghanistan in 2001 created a power vacuum in the country and an opportunity for illegal drug production to quickly rebound (the austere Taliban government had virtually eradicated opium production in Afghanistan by 2001). Most opium production in Afghanistan today occurs in the five unstable southern provinces. The World Drug Report also reports an overall decline in illegal drug use in the United States in the last five years.

United States government policies have also affected production of illegal drugs in Latin America. During the 1980s and 1990s, the United States government cracked down on coca production in Colombia. With this crackdown, much of the drug production and trafficking moved north to northern Mexico. In June 2005, the *Economist* quoted one American official as reporting that "Mexican criminal gangs 'exert more influence over drug trafficking in the U.S. than any other group.' Mexicans now control 11 of the 13 largest drug markets in the United States." In 2003, Mexico's marijuana production rose 70 percent and in recent years, Mexico's methamphetamine production rose 74 percent. The United States government estimates that in 2004, 92 percent of the cocaine entering the country came through Mexico.

Environmental Impacts of Commercial Agriculture

Commercial agriculture creates significant environmental change. The growing demand for protein-rich foods and more efficient technologies are leading to overfishing in many regions of the world. Fish stocks are declining rapidly. From mid-century to the late 1980s, the fish harvest from oceans and seas increased fivefold, and there seemed to be no limit to it. Countries quarreled over fishing rights, poorer countries leased fishing grounds to richer ones, and fleets of trawlers plied the oceans. International attempts to regulate fishing industries failed. Then in the 1970s and 1980s, overfishing began destroying fish stocks. The cod fisheries on Canada's Grand Banks off Newfoundland collapsed. In 1975 biologists estimated the Atlantic bluefin tuna population at 250,000; today the western stock is listed as critically endangered, and the stock in the Mediterranean is listed as endangered. From ocean perch and king crabs off Alaska to rock lobsters and roughies off New Zealand, fish and shellfish populations are depleted. The total annual catch is also declining and may already be beyond the point of recovery. Much of the damage has been done, and fishing industries in many parts of the world report dwindling harvests and missing species.

Travel to Mediterranean Europe today and you will see a landscape that reflects the clearing of forests in ancient times to facilitate agriculture and trade. Look carefully at many hillslopes and you will see evidence of terraces cut into the hills many centuries ago. The industrialization and commercialization of agriculture has accelerated the pace and extent of agriculture's impact on the environment. More land has been cleared, and the land that is under cultivation is ever more intensively used.

Significant changes in environment go far beyond the simple clearing of land. They range from soil erosion to changes in the organic content of soils to the presence of chemicals (herbicides, pesticides, even antibiotics and growth hormones from livestock feces) in soils and groundwater. In places where large commercial crop farms dominate, the greatest concerns often center around the introduction of chemical fertilizers and pesticides into the environment—as well as soil erosion. And, as we have seen, the movement toward genetically modified crops carries with it another set of environmental concerns.

The environmental impacts can be particularly severe when commercial agriculture expands into marginal environments. This has happened, for example, with the expansion of livestock herding into arid or semiarid areas (see the map of world climate, Fig. 11.16). The natural vegetation in these areas cannot always sustain the herds, especially during prolonged droughts. This can lead to ecological damage and, in some areas, to desertification (see Chapter 10).

In recent years, the popularity of fast-food chains that serve hamburgers has led to the deforestation of wooded areas in order to open up additional pastures for beef cattle, notably in Central and South America. Livestock ranching is an extremely land-, water-, and energy-intensive process. Significant land must be turned over to the cultivation of cattle feed, and the animals themselves need extensive grazing areas. By stripping away vegetation, the animals can promote the erosion of river banks, with implications for everything from water quality to wildlife habitat.

Agribusiness and the Changing Geography of Agriculture

The commercialization of crop production and the associated development of new agricultural technologies have changed how agricultural goods are grown and have sparked the rapid growth of agribusiness. **Agribusiness** is an encompassing term for the businesses that provide a vast array of goods and services to support the agricultural industry. Agribusiness serves to connect local farms to a spatially extensive web of production and exchange. At

the same time, it fosters the spatial concentration of agricultural activities. Both of these trends are revealed in the development of the poultry industry in the United States.

Early in the twentieth century, poultry production in the United States was highly disaggregated, with many farmers raising a few chickens as part of a multifaceted farming operation. Over the past 50 years, however, poultry production has fundamentally changed. In an article on modern agriculture, David Lanegran summarized the impact of this transformation as follows:

> *Today, chickens are produced by large agribusiness companies operating hatcheries, feed mills, and processing plants. They supply chicks and feed to the farmers. The farmers are responsible for building a house and maintaining proper temperature and water supply. Once a week the companies fill the feed bins for the farmers, and guarantee them a price for the birds. The companies even collect market-ready birds and take them away for processing and marketing. Most of the nation's poultry supply is handled by a half dozen very large corporations that control the process from chicks to chicken pieces in stores.*

Lanegran goes on to show how selective breeding has produced faster growing, bigger chickens, which are housed in enormous broiler houses that are largely mechanized. These are concentrated in northwestern Arkansas, northern Georgia, the Delmarva Peninsula (Delaware, Maryland, and Virginia) east of Washington, D.C., the Piedmont areas of North Carolina, and the Shenandoah Valley of Virginia. He shows that in many respects the "farmers" who manage these operations are involved in manufacturing as much or more than farming. They are as likely to spend their time talking to bank officers, overseeing the repair of equipment, and negotiating with vendors as they are tending their animals. As such, they symbolize the breakdown between the rural and the urban in some parts of the world—as well as the interconnections between rural places and distant markets.

Not only poultry is produced in an industrial fashion. During the 1990s, hog production on the Oklahoma and Texas panhandles increased rapidly with the arrival of corporate hog farms. John Fraser Hart and Chris Mayda described the quick change with statistics. In 1992, the U.S. Census of Agriculture counted just over 31,000 hogs marketed in Texas County, Oklahoma, and just four years later "the panhandle was plastered with proliferating pork places, and Texas County alone produced 2 million hogs. It was the epicenter of an area that produced 4 million hogs, 4 percent of the national total and one-seventh as many finished hogs as the entire state of Iowa." The availability of both inexpensive water and natural gas on the Oklahoma panhandle was enticing for corporate hog farms, which require both. Hart and Mayda explain that the "reasonable" price of land and the accessibility to "growing metropolitan markets of the South and the West" also made the region attractive for hog production. Similar to poultry production, a corporation built a processing plant, and production (both by farms owned by the corporation and those owned privately) increased to meet the demand.

Agribusiness is shaping the world distribution of commercial agricultural systems and their relationship to subsistence agriculture. Through time, many factors have affected that relationship. History and tradition have played important roles, as have environment and technology. At times governments have encouraged their citizens to limit family size in an attempt to lift the population above the subsistence level. Some governments have sought to maintain the privileges of large landowners, whereas others have initiated bold land reform programs. Communist governments, notably those of the former Soviet Union and Maoist China, have tried to control agricultural output by creating collective farms and agricultural communes—a giant experiment that resulted in significant displacement of rural peoples and mixed results in terms of output. (Today farming reprivatization is under way in both Russia and China.)

Most of all, the map of global agricultural regions reveals the capacity of markets to influence the activities of farmers. The range and variety of products on the shelves of urban supermarkets in the United States is a world away from the constant quest for sufficient, nutritionally balanced food that exists in some places. A global network of farm production is oriented to the one-fifth of the world's population that is highly urbanized, wealthy, and powerful. Few farmers in distant lands have real control over land-use decisions, for the better off people in the global economic core continue to decide what will be bought at what price. The colonial era may have come to an end, but, as the map of agricultural regions reminds us, its imprint remains strong.

Loss of Productive Farmland

As cities expand outward, converting agricultural land into suburbs, some of the most fertile, productive farmlands are lost to housing and retail developments (Fig. 11.19). Many cities were established amid productive farmlands that could supply the needs of their inhabitants. Now the cities are absorbing the productive farmlands as they expand. The American Farmland Trust, for example, reported in the 1990s that 12 U.S. areas are severely affected, including California's Central Valley, South Florida, California's coastal zone, North Carolina's Piedmont, and the Chicago–Milwaukee–Madison triangle in Illinois–Wisconsin. These 12 areas represent only 5 percent of U.S. farmland, but they produce 17 percent of total agricultural sales, 67 percent of all fruit, 55 percent of all vegetables, and one-quarter of all dairy products. Figures for other countries in the richer

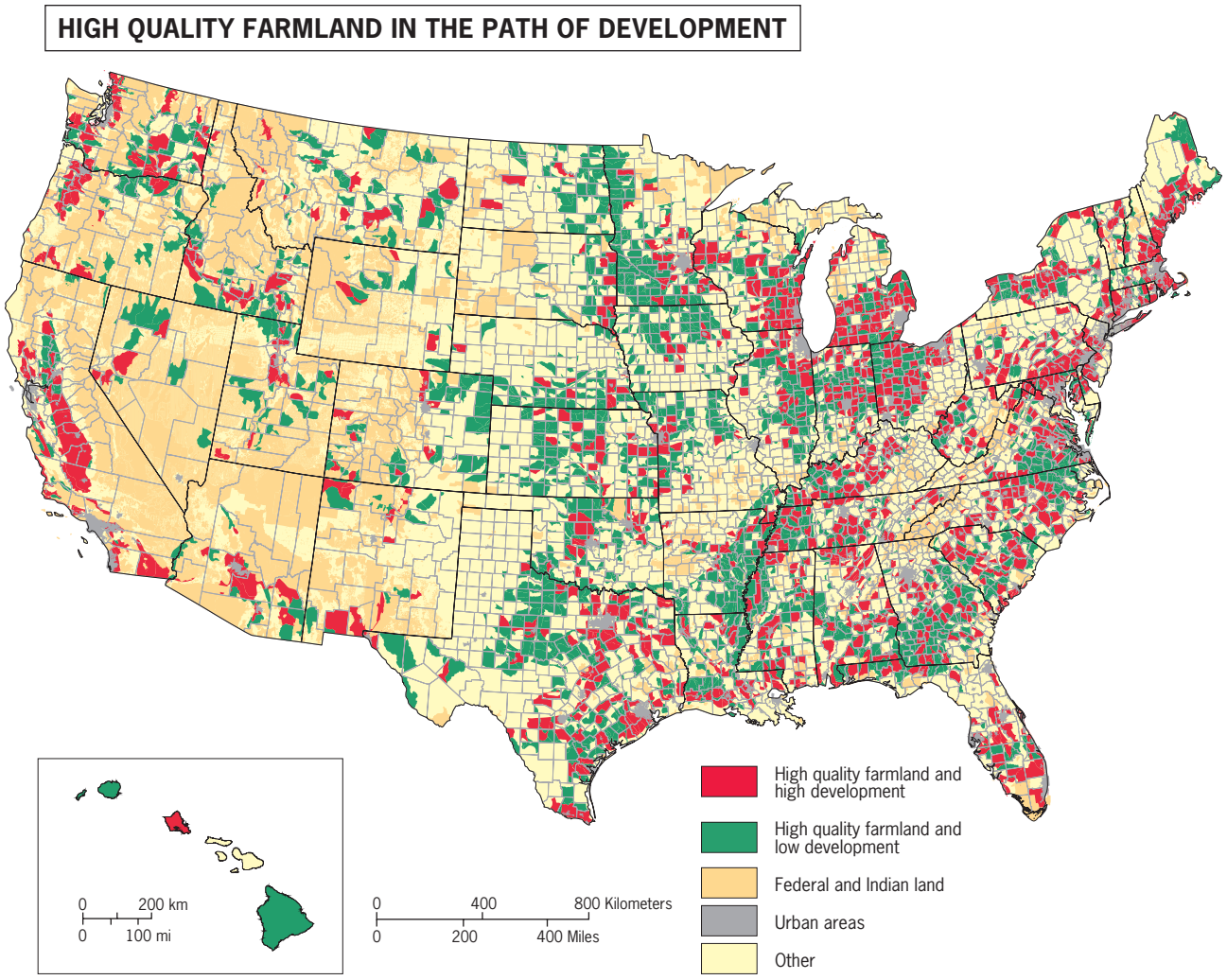


Figure 11.19

Farming on the Edge: High-Quality Farmland in the Path of Development, 2002. This map from American Farmland Trust, whose charge is to preserve farmland, highlights farmland that is endangered of being suburbanized as cities expand into neighboring farmlands. *Courtesy of:* American Farm Trust, http://www.farmland.org/farmingontheedge/maps.htm, last accessed November 2005.

parts of the world (such as Japan) as well as for poorer countries (such as Egypt) prove that this is a global problem with serious implications for the future.

The conversion of farmlands into housing developments is not confined to areas close to major cities that could become suburbs. Expendable wealth and the desire to have a place to "get away from it all" have led highly productive commercial agricultural areas to be converted into regions for second homes. One of the most intensive commercial agricultural areas in the United States is the Delmarva Peninsula, where the broiler chicken industry began in the 1920s. Four major poultry companies provide chickens to local farmers who produce 8 percent of the poultry produced in the United States, using the industrialized poultry production methods described above. The price of land is rising on the peninsula, as urbanites from Pennsylvania, Maryland, and New York buy land on the eastern shore to build second homes. Many of the new residents on the peninsula are demanding higher environmental standards, and in turn are placing a squeeze in costs on chicken production. Tyson Foods closed its production facility in spring 2004, and the *Washington Times* reported 650 lost jobs. As urban population continues to grow and expendable wealth increases for the wealthiest of the population, more agricultural lands will be converted to housing developments, especially lands in beautiful areas with recreational amenities, like the eastern shore of Maryland and its Chesapeake Bay. The Maryland State government and other State governments are balancing preservation of agricultural lands and open spaces with demand for housing and retail developments.

Summary

Agricultural production has changed drastically since the First Agricultural Revolution. Today, agricultural products, even perishable ones, are shipped around the world, and agriculture has industrialized and spurred the growth of agribusiness. A major commonality between ancient agriculture and modern agriculture remains: the need to change. Trial and error were the norms of early plant and animal domestication. And today, trial and error are still the norm, as agriculture in the globalized economy is complicated by new technologies, genetically engineered crops, cultural change, government involvement, and the lasting impacts of history.

Geographic Concepts

organic agriculture
agriculture
primary economic activity
secondary economic activity
tertiary economic activity
quaternary economic activity
quinary economic activity
plant domestication
root crops
seed crops
First Agricultural Revolution
animal domestication
subsistence agriculture
shifting cultivation
slash-and-burn agriculture
Second Agricultural Revolution
von Thünen model
Third Agricultural Revolution
Green Revolution
genetically modified organisms (GMOs)
rectangular survey system
township- and range-system
metes and bounds system
long-lot survey system
primogeniture
commercial agriculture
monoculture
Köppen climatic classification system
climatic regions
plantation agriculture
luxury crops
livestock ranching
Mediterranean agriculture
agribusiness

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