CHAPTER 8

Food for Thought: The Globalization of Agriculture

INTRODUCTION

Unlike most of the chapters in this book, which focus on a single big idea in human geography, this chapter deals with two of them. This chapter looks at agriculture and the traditional geographic idea of how and what people farm in different places. It also looks at the contemporary idea of **globalization**—the increasing tendency for distant places and people to link together in a global market by fast, cheap transportation and communication (Figure 8.1). These old and new ideas will come together to explain how the forces of globalization are changing local agricultural systems in Latin America.

Students need to know more about agriculture for three reasons. First, much of the land surface of the planet is devoted to agriculture. Even some of earth's water bodies are being farmed. Second, although only 2 percent of Americans are farmers, half of all families in less-developed countries (LDCs) earn their living by

Figure 8.1 A Coca-Cola advertisement in Vietnam demonstrates the contemporary idea of globalization.

farming. Third, agriculture is a major contributor to environmental change in the form of pesticide and fertilizer runoff, soil erosion, freshwater depletion, damming of rivers for irrigation purposes, and deforestation (Figure 8.2).

It is important to recognize that **agriculture**, defined as intentional planting of crops and raising of domesticated animals (**livestock**), is not synonymous with food production (Figure 8.3). Some crops and livestock are raised for nonfood purposes: corn for ethanol, rubber for tires, and minks for fur coats. Likewise, many food (and nonfood) products are produced from plants and animals through methods other than agriculture. They can be artificially synthesized—as are NutraSweet® (a sweetener), Tang® (a breakfast drink), and Simplesse® (a fat-free oil)—or collected from nature via **hunting and gathering** of wild plants and animals. Hunting and gathering usually brings to mind a primitive, preagricultural society that is rapidly disappearing from the earth; but if you think about it, most fishing and forestry are in fact modern-day forms of hunting wild fish and gathering wild trees. Sometimes agriculture overlaps hunting and gathering (not shown in Figure 8.3), blurring the distinction between the two, as when people prune or weed around wild plants from which they gather food, or when people throw food scraps to attract wild animals. The true distinction between agriculture and hunting and gathering is not the technological level, but whether humans raise the plants and animals or they grow wild. Therefore, forestry and fishing, while usually a modern-day form of hunting and gathering, *can also be* forms of agriculture if the trees are planted (plantation forestry) and the fish raised in enclosures (aquaculture). Finally, Figure 8.3 also

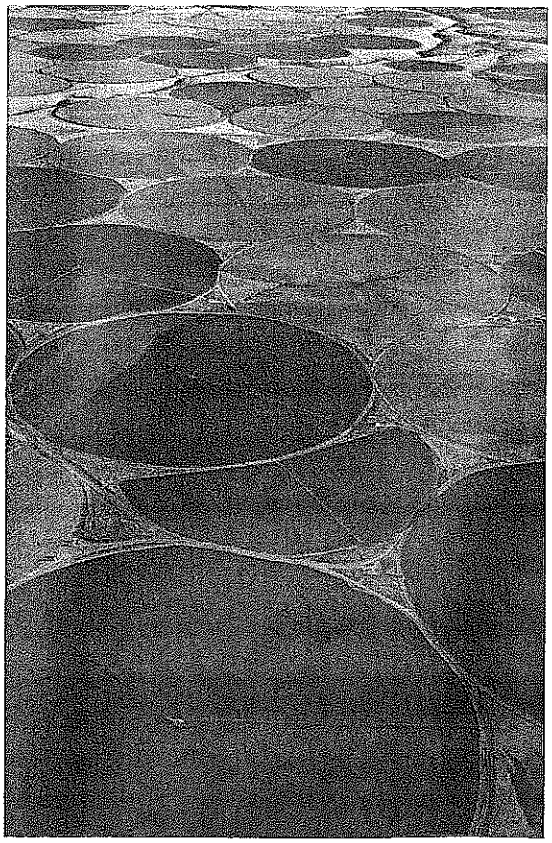

Figure 8.2 Irrigated fields in Oregon. Damming of rivers and pumping water from deep aquifers for irrigation purposes are major contributons to environmental change.

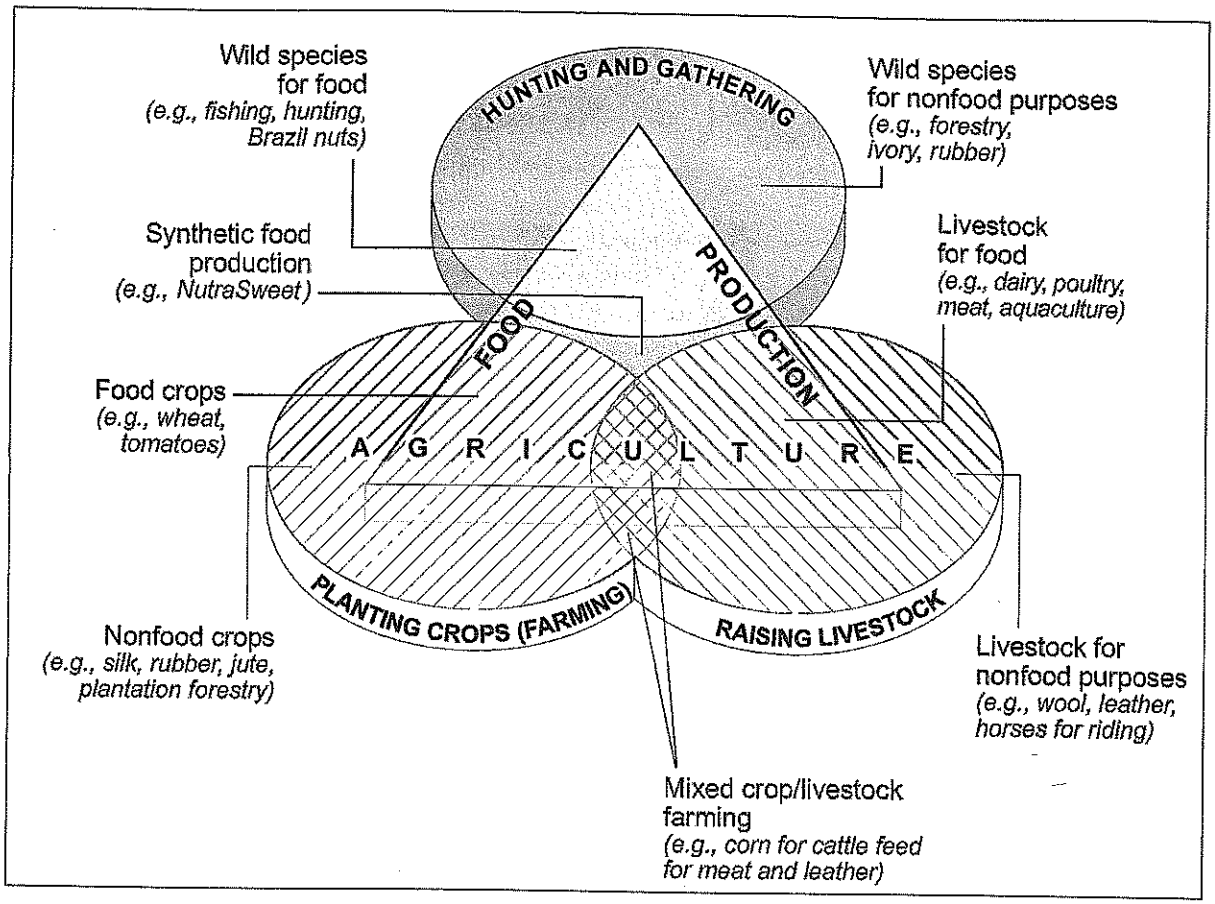

Figure 8.3 The relationship between agriculture and food production.

makes it clear that growing crops and raising livestock can overlap in **mixed farming** systems that grow crops for the purpose of feeding livestock.

Over the course of human history, three periods of technological change have led to the agricultural system we see today. In the **first agricultural revolution** during the Neolithic era some 8 to 14 thousand years ago, humans first planted and harvested edible plants and domesticated wild animals. The Fertile Crescent (see Chapter 2) was one important area of agricultural origins, but archaeological evidence points also to other and perhaps earlier source regions in China, Southeast Asia, the Indus Valley (present-day Pakistan), the Ethiopian highlands, West Africa, the Andes Mountains of South America, and Mexico/Central America (Figure 8.4). From these source regions, agriculture diffused (see Chapter 3) to other peoples around the world.

Numerous innovations have been made over the millennia to the basic idea of burying a seed in the ground and harvesting the results. Traditional innovations that we now take for granted include irrigation to deliver water to fields, plowing to loosen and turn the soil, fencing to keep animals out of fields, building terraces to provide level fields on hillsides, fertilizing with plant and animal waste, and weeding. Also important were various cultural and political practices, such as land tenure (private in some regions, communal in others), and division of labor (between humans and animals, men and women, adults and children, and among different occupations).

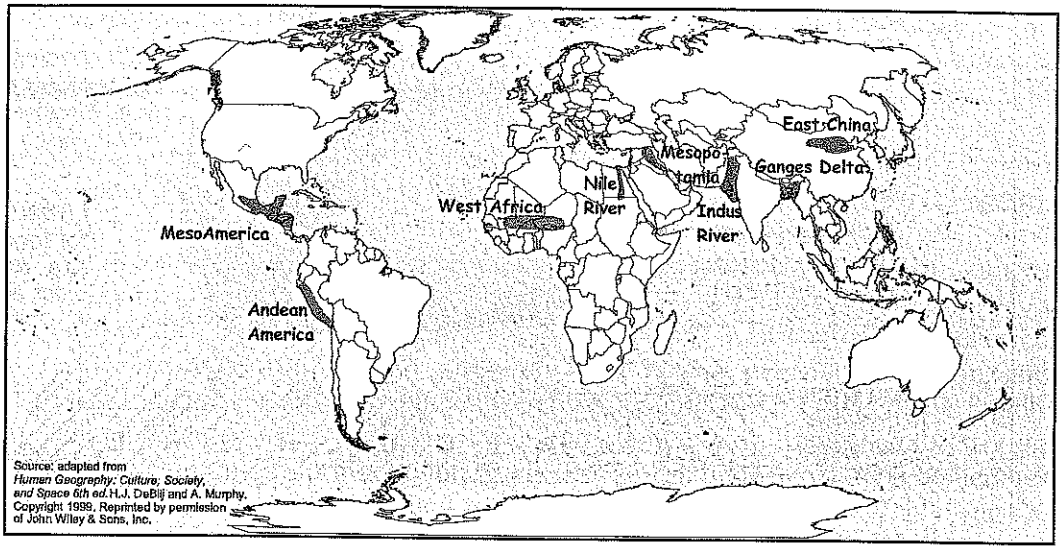

Figure 8.4 Probable culture hearths and origins of agriculture.

A **second agricultural revolution** began in western Europe in the 1600s. The second phase of agrotechnological change, which intensified agriculture in the sense of promoting higher yields per acre and per farmer, helped feed the growing urban populations in European cities. The second revolution actually began before the invention of machines with ideas such as crop rotation for sustaining soil fertility, increased use of fertilizers, and improved collars for draft animals to pull heavier plows. Then, in the nineteenth and early twentieth centuries, the Industrial Revolution introduced tractors for plowing soil, reapers for cutting crops, threshers for separating grain from stalks, and motors for pumping water to do the work of people and animals, not to mention better transport, storage, and barbed wire fencing. Industrially produced chemicals for fertilizers, herbicides (weed killers), and pesticides (insect killers) were also introduced in the twentieth century.

A dramatic **third agricultural revolution** began in the 1960s and continues to this day. The **Green Revolution**, as it is now known, introduced and diffused hybrid strains of staple grains by cross-pollinating different native strains of grain. These hybrids, known by names such as miracle rice and miracle wheat, mature in a shorter time period than conventional seeds, which means that farmers can grow an extra crop each year. Hybrid crops also respond better to chemical fertilizers and produce more grains per plant in closer proximity to other plants. Yields in both more-developed countries (MDCs) and LDCs increased by 50 to 100 percent in the space of a few years, which allowed global food production to keep pace with the exponential growth of population in the twentieth century. Unfortunately, the benefits of the Green Revolution have not spread to farmers everywhere; poor farmers lack the savings to invest in seeds, fertilizers, and pesticides. Critics also decry the Green Revolution's reliance on artificial fertilizers made from fossil fuels, the less flavorful grains, and the focus on corn, wheat, and rice, none of which are important crops in Africa.

The science of genetic engineering has breathed new life into the Green Revolution. Instead of crossing two varieties of plant or animal and hoping that a desirable combination of characteristics will emerge in some individuals of the next generation, genetic engineers leave little to chance. They identify the particular

genes on the DNA molecules that produce the desirable characteristic and splice the gene directly into the chromosomes of the other plant or animal. Genetically engineered products are already on the market, mainly corn and soybeans that perform very well with particular weed-killing herbicides. The "Holy Grail" of bioengineering is to identify the gene that allows legume crops to take nitrogen out of the air instead of through their roots and splice it into crops such as rice and wheat; these new plant varieties will eliminate the major need for chemical fertilizers. As is often the case, however, technological change carries risks, and some environmentalists and consumers are concerned about the effect of these "unnatural" crops on human health and on other species, such as monarch butterflies that pollinate corn. European consumers in particular have rejected genetically engineered crops, forcing U.S. farmers to carefully separate genetically engineered from traditional crops. Concerns also focus on the potential threat to natural species from aggressive bioengineered crops. Such was the outcry when genetically modified corn was discovered in Oaxaca, Mexico, the culture hearth of domesticated corn and home to dozens of diverse corn plants.

Geographers look at the spatial variation in *what* crops or livestock are produced and *how* they are produced. The natural environment plays an important role in determining what can be grown where (see the agricultural regions map layer in Activity 1). Rice needs more water than corn and wheat do. Wine-quality grapes need cool, wet winters and hot, dry summers. Citrus crops can be ruined by a winter freeze, whereas dairy cattle can thrive in cold and hilly areas. Tea and cacao (cocoa) are tropical crops, and, as we all know, Folgers® coffee is "mountain grown®." The physical environment alone does not, however, determine what is grown. If bananas, a plant native to the tropics, can be grown in Iceland in geothermally heated greenhouses (they can and they are!), then surely we must realize that climate is only one factor that determines where crops are grown. In fact, much of the farmland in the world is suitable for a variety of crops, and new varieties of grapes and rice are proving successful outside their traditional climate zones.

Culture is a second factor determining what is grown where. No meal is complete without rice in East and South Asia or corn tortillas in Mexico, whereas in Europe, the United States, and Canada, restaurants automatically serve bread made of wheat with every meal. Although it is true that traditional diets evolved based on available local ingredients, migration of cultural groups spread certain crops and livestock to other regions. Islamic and Jewish rules against eating pork, for instance, are not due to any difficulty of raising pigs in arid regions.

A third factor is economic. Rational farmers produce the crop that makes the greatest profit in any particular location. A German landowner, Johann Heinrich von Thünen, wrote a still classic work of economic geography in 1826 detailing how agriculture was organized into a series of concentric rings around each town. In von Thünen's model, climate and soils are assumed not to vary among sites. Location relative to the market determines what crops are grown. The farther a farm is from the market, the more transportation costs eat into the farmer's profits. Therefore, the agricultural land closest to the market will be the most valuable, all else being equal, and distant land will be least valuable. Different crops will be grown at different distances from the major metropolitan markets depending on factors such as **yield** (tons per acre per year), market price, production cost, and unit transport cost per ton. Generally speaking, crops with the highest annual transportation costs for an acre's worth of annual production, such as vegetables, eggs, and milk, tend to be produced in the ring immediately surrounding the market. Crops with low annual

transportation costs, such as forestry (one crop every 20 to 50 years) or wheat (only the actual grains, not the stalks, are transported), can afford to be located far from markets. Other crops fall somewhere between. Thus, crops are not necessarily grown in their ideal bioclimate. Although wheat is better suited to the Ohio River valley, it is mainly grown in the Great Plains because other crops can make a greater profit in the Ohio Valley and few crops besides wheat can make a profit in the Plains.

The focus in Activity 1 is on *how* crops are grown in different parts of the world. As you will see, the same crop can be grown in remarkably different ways. The first distinction in agricultural methods is between labor-intensive and capital-intensive agriculture. **Capital** refers to goods that are used in the production of other goods, such as machinery, tools, facilities, vehicles, and transport networks. **Labor-intensive agriculture** employs large numbers of people and relatively little capital to produce a given amount of output. Some capital, such as hoes and plows and baskets and wells, is employed but not much, and most work is done by hand. **Capital-intensive agriculture** allows a single farmer to produce as much as 100 labor-intensive farmers can by substituting capital for labor (Figure 8.5). By using tractors for plowing, seed drills for planting, airplanes for spreading fertilizers, "combines" for reaping (cutting the plants) and threshing (separating the grains from the stalks), silos for storage, and railroads for transport, nearly every step of the agricultural process can be automated. Whether a region uses capital-intensive or labor-intensive methods depends largely on the price of capital and labor. As countries develop (see Chapter 7), wages increase, people have fewer children, people save more money, and bank loans become easier to obtain. As a result, labor becomes more scarce and capital more abundant. Farmers gradually automate their production process and become more capital intensive.

The second distinction, between intensive and extensive agriculture, refers to the intensity of land use. **Intensive agriculture** yields a large amount of output

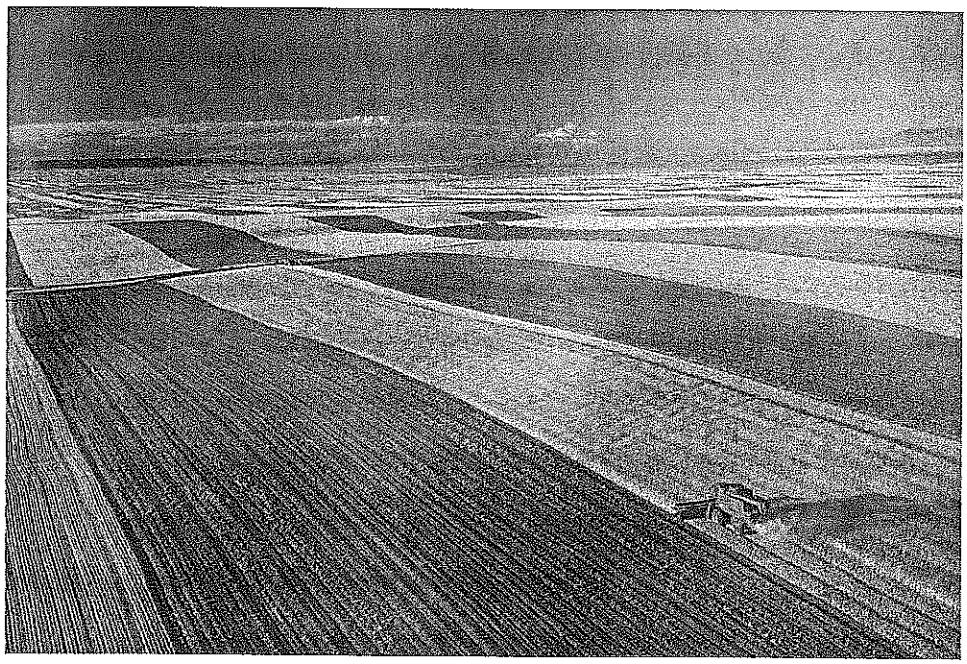

Figure 8.5 The immense scale of capital-intensive agriculture is captured in this image from Montana. One combine can harvest many square miles of wheat, a feat that would have required hundreds of field workers prior to mechanization.

per acre through concentrated application of labor and/or capital, usually to small land holdings. In contrast, **extensive agriculture** yields a much smaller output per acre as farmers or ranchers spread their labor and capital over large areas of land. Intensity of land use depends on several factors, including the price of land (higher price, more intensive use) and the population density (more people per square mile, more intensive use). The intensive-extensive spectrum is largely independent of the capital-intensive–labor-intensive spectrum. Thus, intensive land use can be capital intensive as in greenhouses and hydroponics or labor intensive as in rice paddies with hundreds of workers per acre. Similarly, extensive land use can be capital intensive for a U.S. wheat farmer with a 500-acre farm and gigantic farm equipment or labor intensive for a nomadic goat herder ranging over many square miles.

A third distinction is between commercial and subsistence agriculture; and it, like the others, involves shades of gray. In pure **subsistence agriculture**, farmers and ranchers produce animals or crops to feed their families. Families and villages are nearly self-sufficient and do not depend on trade with other regions. In pure **commercial agriculture**, farmers and ranchers sell all of their output for money and buy their families' food at stores. Most subsistence farmers today sell some of their excess output on the market and link to other regions for specialized products. Similarly, many commercial farmers consume small amounts of output themselves. Generally speaking, regions shift from subsistence to commercial agriculture as a result of increasing wealth, trade, and specialization within the entire economy (i.e., as a result of development; see Chapter 7). However, political factors also play a role. Colonialism forced local people to convert from subsistence farming to commercial farming in order to pay colonial taxes in cash. Similarly, Chinese communism forced farmers into self-sufficient village communes in the 1950s to 1970s until a new regime let farmers sell their output for a profit in the 1980s. Today nearly pure subsistence farming is practiced only in some parts of Latin America, Africa, and Southeast Asia. However, farmers in nearly all LDCs subsist at least partly on their own production.

A fourth distinction is between sedentary and nomadic forms of agriculture. **Sedentary** refers to farmers and ranchers who live and work in a single location, whereas *nomadic* refers to production that shifts from place to place. **Nomadism** is usually associated with livestock herders who move from place to place in search of fresh pasture. As noted in Chapter 2 (the Middle East), nomadism is not random wandering but a systematic movement pattern among proven locations. Nomadic herding can be horizontal, from one water source to another, or vertical, from lowlands in the winter to highlands in the summer (also known as *transhumance*). In tropical rain forests, a nomadic form of farming known as **shifting cultivation** has also evolved. Farmers work the land for several years before moving on to another area. This form of farming is also known as slash-and-burn because the farmers cut the undergrowth and smaller trees and burn them. The burning clears the field of debris, and the resulting ash provides a short-term source of fertilizer to the relatively infertile rain-forest soils. Shifting cultivation can be a sustainable form of agriculture but only if the farmers stay for only a few years, do not return for several decades, and leave enough large trees standing to keep the torrential rains from eroding the soil. Thus nomadism is an adaption to life in difficult environments where sedentary agriculture would quickly exhaust water and soil resources.

A fifth broad categorization of agricultural systems is between irrigated and non-irrigated lands. **Irrigation** simply refers to artificial watering of farmland; it has many forms, including wells, tunnels, diversion channels, spraying, drip systems,

and dams of all sizes. Irrigation is necessary in arid lands and areas with uncertain or seasonal precipitation.

Beyond these five universal dimensions, many other forms of agriculture relate to land ownership. Within commercial forms of agriculture, many organizational types exist: family farms, tenant farmers, sharecroppers, plantations, state-owned farms, garden plots, and agribusiness. Family farms are the traditional North American farm. In many parts of the world, however, most farmers rent their land and struggle to produce enough to pay the rent and still have enough to feed themselves and set some aside for next season's seed. A variation on tenant farming is *sharecropping*, by which farmers pay rent in the form of a percentage of the crop, which allows the farmers to share the risk with landowners. Located in LDCs, **plantations** are mainly historical leftovers from colonialism. They produce tropical crops such as bananas, cotton, rubber, coffee, cocoa, and peanuts by labor-intensive methods for export to MDCs. Individuals or corporations from MDCs still own many plantations, but local landowners or even local governments have taken over some plantations and continue to exploit local labor.

Socialist countries have experimented with many forms of farming on state-owned land. Workers can be collectivized into cooperatives or communes, rent from the state, be employed on state-run farms, or some other variation. In some such countries, workers are given small garden plots for their own use, which they farm very intensively. Yields from these backyard, quasi-private plots, which are also found in Latin America, can be several times higher than those achieved on the state farms because the worker gets to keep the proceeds. *Land reform* is a general term encompassing policies designed to give more of the population access to land that they can manage and steward themselves.

Finally, **agribusiness**, an industrialized, corporate form of agriculture, is organized into integrated networks of agricultural inputs and outputs beginning with seed, fertilizer, and pesticide production all the way through to processing and distributing food consumables. A small number of large corporations rather than a large number of independent farmers control agribusiness.

Similar to multinational industrial companies, telecommunications companies, and financial institutions, agribusinesses are increasingly extending their sources, sales, and power over a global network. The globalization of agriculture brings benefits to consumers in the MDCs of North America, Europe, Japan, and Australia (see Activity 2), but it also creates many negative local effects in peripheral LDCs (Activity 3) and often environmental and health concerns in the MDCs themselves. As the chief beneficiaries of globalized agriculture, we should be aware of these effects.

DEFINITIONS OF KEY TERMS

Agribusiness An industrialized, corporate form of agriculture organized into integrated networks of agricultural inputs and outputs controlled by a small number of large corporations.

Agriculture The intentional cultivation of crops and raising of livestock.

Capital Goods such as equipment and buildings used to produce other goods.

Capital-Intensive Agriculture Agriculture in which a large amount of capital is applied per unit of output.

Commercial Agriculture Agriculture primarily for the purpose of selling the products for money.

Comparative Advantage When one region is relatively more efficient at producing a particular product compared with other regions.

Extensive Agriculture Large-area farms or ranches with low inputs of labor per acre and low output per acre.

First Agricultural Revolution The original invention of farming and domestication of livestock 8,000–14,000 years ago and the subsequent dispersal of these methods from the source regions.

Free Trade Imports and exports between countries that are unrestricted by tariffs, quotas, or excessive approvals and paperwork.

Friction of Distance A measure of how much distance discourages movement between places, based on the time, energy, or dollar cost that must be expended.

Globalization The increasing economic, cultural, demographic, political, and environmental interdependence of different places around the world.

Global-Local Continuum The interaction between global processes and local lifestyles. This continuum is a two-way process in which the local and the global shape each other.

Green Revolution The application of biological science to the development of better strains of plants and animals for increasing agricultural yields (the **Third Agricultural Revolution**).

Hunting and Gathering The collecting of roots, seeds, fruit, and fiber from wild plants and the hunting and fishing of wild animals.

Intensive Agriculture Small-area farms and ranches with high inputs of labor per acre and high output per acre.

Irrigation Artificial watering of farmland.

Labor-Intensive Agriculture Agriculture in which a large amount of human work is applied per unit of output.

Land Cover The general class of material or vegetation that dominates the surface of the land in a particular area.

Land Use The general class of activity for which land is used by humans in a particular area.

Livestock Domesticated animals such as cows, sheep, and poultry that are raised and managed to produce meat, milk, eggs, wool, leather, etc.

Mixed Farming An integrated agricultural system in which crops are grown and fed to livestock.

Monoculture Agriculture that uses a large area of land for production of a single crop year after year.

Nomadism Migratory movement of herders and their animals according to the availability of grazing land.

Plantation A large estate that produces a single cash crop. Mainly found now in the tropics.

Remote Sensing The use of satellite images of the earth's surface.

Second Agricultural Revolution A period of technological change from the 1600s to mid-1900s that started in western Europe, beginning with pre-industrial improvements such as crop rotation and better horse collars, and concluding with industrial innovations to replace human labor with machines and to supplement natural fertilizers and pesticides with chemical ones.

Sedentary Agriculture Agriculture that takes place in the immediate surroundings of a permanent settlement.

Shifting Cultivation A farming method in tropical areas in which wild vegetation is cleared and burned before crops are planted. When the soil fertility is diminished, farmers abandon the land to restore itself naturally, and they move to new areas where they repeat the process. Also known as *slash-and-burn agriculture*.

Subsistence Agriculture Self-sufficient agriculture, usually small scale and low tech, primarily for direct consumption by the local population.

Third Agricultural Revolution See **Green Revolution**.

Time-Space Convergence The rate at which the time separating two places decreases because of improvements in transportation or communication technology.

Yield Output per unit land per unit time (e.g., tons per acre per year).

FURTHER READINGS

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CASE STUDY

FOOD FOR THOUGHT

GOAL

To understand how and why agricultural practices and agricultural landscapes vary around the world, to investigate where your food comes from, and to use remote sensing to evaluate land use and land cover change in Latin American agriculture.

LEARNING OUTCOMES

After completing the chapter, you will be able to:

- Differentiate among agricultural landscapes.
- Understand how and why the same crops and livestock are produced in different ways in different regions of the world.
- Collect primary data in your local supermarket.
- Describe global food chains.
- Recognize different land uses in satellite images.
- Use remote sensing to study land use change.

SPECIAL MATERIALS NEEDED

- Computer with high-speed Internet access and a recent release of a Web browser. If using the Student Companion Site with the printed book, click on *Tech Support* for system requirements and technical support. (If using the e-book in WileyPlus, click on *Help* for details about the system requirements.)

BACKGROUND

We now live in a global economy. Rapid transport and instantaneous communications technologies shrink space and stretch time, something geographers call **time-space convergence**. The **friction of distance** (i.e., the time, cost, or effort of movement) is continually being reduced, bringing distant places closer together. **Globalization** is a popular term used to describe the economic integration of different countries and regions around the world. The goods we use, including the food we eat, are now produced all around the globe. Globalization has affected local landscapes and economies even in what were previously very isolated places. This is perhaps most true for agriculture because so much of the world's land area is used for crops and livestock.

Globalization affects different people and places in various ways. In North America, the benefits have been great for some industries and farmers; they now export to larger markets around the world. Consumers benefit from the import of foods from all over the world. Imports produced more cheaply elsewhere (including food), however, have put many people in agriculture or related industries out of business. Globalization leads to a more unequal distribution of wealth and land. The number of small farmers in North America has declined for decades as more efficient **agribusinesses** underprice them and take advantage of the larger markets that globalization brings. Globalization of agriculture leads to a growing monopolization of the world food production in the hands of a few multinational corporations. In 1996, the world's 10 largest agrochemical corporations captured 82 percent of global sales of fertilizers and pesticides, and the 10 largest seed corporations sold 40 percent of the seeds. Globalization also diffuses new agricultural innovations rapidly around the world.

Globalization thrives under **free trade**. Markets must be accessible to the supplier that can produce the best product for the lowest price. Absent restrictive trade barriers, regions around the world now produce those products in which they have a **comparative advantage**, and trade with other regions for what they need. Comparative advantage depends on the relative efficiency with which a region can produce a product compared with other products and other regions. Comparative advantage can lead to beneficial trade even when one region can produce all products for a lower cost. Why trade for something that could be produced more cheaply at home? Well, think about a lawyer who also happens to be a very fast typist and a sparkling receptionist. It still makes financial sense for the lawyer to hire someone to type documents and answer the phones, which would allow the lawyer to spend more time billing clients at a lawyer's high hourly rate. Likewise, regions can afford a higher standard of living by specializing in products in which they have a comparative advantage and using the profits to import other products.

One of the most daring experiments in free trade has been the North American Free Trade Agreement (NAFTA), which is the gradual removal of trade and investment restrictions among Canada, the United States, and Mexico. Between its inception in January 1994 and 2007, trade among the NAFTA countries more than tripled, from $297 billion to $930 billion. The three countries don't just trade with each other—they make things together, moving parts and assemblies up and down supply chains, back and forth across borders, until the final products are ready for market in any of the countries. The relationship—or better yet, partnership—between the United States and Canada is especially strong and generates millions of jobs in each country. Canada is the leading export market for 36 of the 50 U.S. states, and the United States exports more to Canada than to the 27 countries of the European Community combined. Mexico was the second largest trading partner of the United States until passed by China in 2005, but on a per capita basis, the United States exports about 25 times more to each Mexican citizen than to each person in China.

Although much of the growth has occurred in industry, NAFTA also has greatly affected agriculture. Mexico holds a comparative advantage in many agricultural products, such as tomatoes and vegetables, and has greatly increased the export of these crops to the United States (Figure 8.6). Traditional peasant lifestyles based on the production of maize (corn), beans, squash, and other staple crops for the local market and subsistence are becoming less common (Figure 8.7). Now many agricultural regions in Mexico produce goods for corporations that export crops to the United States, Canada, and Europe.

▶ CASE STUDY (continued)

Farms and entire regions that traditionally produced a mixture of crops are increasingly changing to **monoculture**—production of one crop year after year—with factories located nearby to process and package the product for export. Monoculture increases a region's vulnerability to the vicissitudes of bad weather, pests, and global price swings.

Planting a variety of crops is actually a type of community insurance against unforeseen disasters. In Central America, entire regions that relied predominantly on banana plantations as their economic base were devastated when fungi wiped out the entire banana crop. Monoculture creates a heavier reliance on pesticides as the biodiversity of the natural predators of the pests disappears. Furthermore, in traditional Mexican agriculture, intermixed planting of maize, beans, and squash also provided environmental benefits. Beans helped refertilize the soil with nitrogen, maize provided physical support for smaller vines, and squash planted between the rows as groundcover reduced soil erosion and evaporation.

Figure 8.6 U.S. Customs agent on the border of Nogales, Sonora, Mexico.

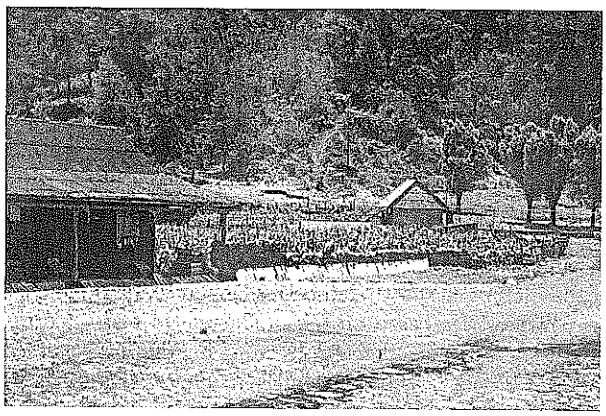

Figure 8.7 A traditional Mexican peasant house and small field of maize.

From a strictly economic perspective, the phasing out of peasant near-subsistence economies based on maize production in Mexico makes perfect sense. Traditional lifestyles were inefficient and labor intensive compared with monoculture. Mexico could never compete against the highly mechanized corn production in the United States, but Mexico's changing agricultural economy has had negative cultural and societal impacts on some people and regions. Maize production takes on religious significance to many Native Americans in Mexico. For them to change their lifestyles and take industrial jobs challenges their fundamental identities. Just as important, Mexico's pre-NAFTA land tenure system was communal in peasant villages called *ejidos*. In the mid-twentieth century, the Mexican government rewarded peasants in ejidos with land distribution and subsidized prices in return for votes. It also fostered allegiance with strong messages of nationalism. To implement NAFTA, Mexico had to amend its constitution to allow private sale of farmland on ejidos and stop many subsidies for peasant agriculture. These changes, plus the new emphasis on multinational corporations running the agricultural economy (which was previously seen as a threat to Mexican nationalism; see Chapter 7 on theories of development), have caused great upheaval and debate in rural Mexico. One expression of concern with globalization was the Zapatista uprising by indigenous people in southern Mexico that began on the very day NAFTA went into effect in 1994. To Native Americans in the state of Chiapas, globalization threatens lifestyles and strengthens a political system that does not represent their interests.

Elsewhere in Latin America, local economies and landscapes also are changing in response to globalization. One land use change is the conversion of forest to cattle production to satisfy the growing demand for beef in the more-developed world. In the Amazon Basin, much of the tropical rain forest cut down each year is eventually converted into ranches (Figure 8.8). Often the rain forest is first opened for oil and mineral exploration. Settlers fleeing poverty and crowding in urban areas soon follow using newly constructed roads for access to previously undeveloped areas (Figure 8.9). Homesteaders clear-cut the rain forest in hopes of establishing farms, most of which are productive only for a few years. Later, however, the land is abandoned because of encroaching weeds and depleted nutrients in soils not suitable for sedentary agriculture. Eventually, deforested areas are converted to ranching using grasses that thrive in tropical ecosystems, and the agricultural frontier moves on to repeat the process.

We have stressed the way globally driven free trade influences local landscapes, but the **global-local continuum** is not a one-way street. Local people, places, and regions have the power now to affect the global economy. Once-local innovations such as livestock feedlots and organic farming are spreading globally, as are once-local pests and crop diseases. The discovery of mad cow disease and the outbreak of hoof-and-mouth disease in Britain sent shock waves through the global beef distribution system, and a flood or labor strike in the Andes can drive up coffee prices in Toronto. The global-local continuum also refers to the fact that actions by millions of

▶ CASE STUDY (continued)

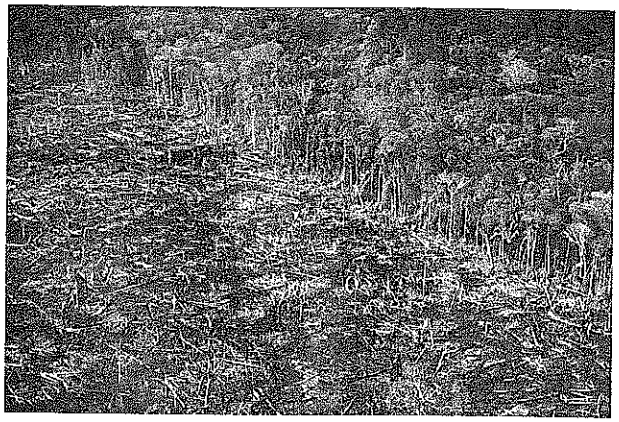

Figure 8.8 Homesteaders clear the forest in the Amazon Basin for farming and ranching.

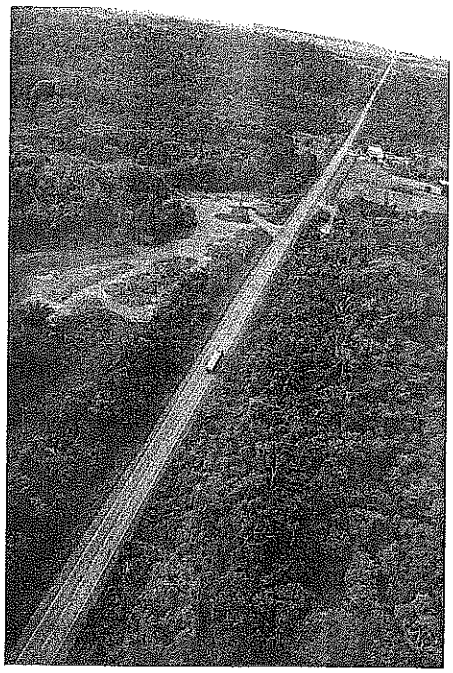

Figure 8.9 Roads for mineral extraction open the rain forest to migrants.

small producers can add up to produce significant global change, as in the piecemeal destruction of the Amazon rain forest. Also, each local place adapts differently to the forces of globalization. Some local farmers lose their land to agribusinesses, but others band together to form cooperatives and find new markets for their specialty products over the Internet.

You can see from the discussion in this chapter that globalization has caused profound changes throughout the world with many winners but also many losers. Among those who benefit from the global agricultural system are consumers who now have access to increased supplies of inexpensive products throughout all seasons and from around the world, large multinational corporations that control trade networks and key inputs (such as seeds and chemical fertilizers), and technologically advanced producers that can exploit economies of scale to serve the global market. However, proponents of globalization have recently met challenges to unfettered and ever-expanding agribusiness from a variety of fronts. One main force of opposition came from the LDCs when they stopped the expansion of agricultural trade accords at a series of meetings from 2003 to 2007. In what are referred to as the Doha trade negotiations, LDCs objected to what they see as unfair practices by the United States and the European Union. In spite of the push by the powerful world leaders for open markets to sell agricultural commodities, both the United States and the European Union continue to subsidize their own agricultural industries. For instance, the 2008 Farm Bill passed in the United States cost U.S. taxpayers $307 billion, much of it for subsidies to agribusiness. About 75 percent of the subsidies are for a few commodities (mostly wheat, corn, and oilseeds) that are sold in the global market. The effect is that agricultural products from the United States are cheaper in the LDCs than locally produced goods, and products grown in the LDCs cannot compete on the global market. This puts farmers in the developing world out of business and enriches large corporate agricultural entities in the United States and Europe. These hardships are particularly difficult for developing countries where agriculture typically accounts for a much higher share of economic output, exports, and employment than in developed countries. The agricultural sector is critical to many developing countries' overall economic growth. Brazil, India, and other developing countries are now demanding that, in exchange for removing trade barriers and agricultural subsidies in their own countries, the United States and the European Union must do the same.

A second source of resistance to the increasing globalization of agriculture comes from people concerned about environmental and community health. Their arguments are many: that the system of global production and trade is based on cheap oil for the transportation of products around the world and for the production of petrochemical fertilizers and is therefore unsustainable; that the environmental effects of fertilizers, pesticides, and herbicides are severely damaging our ecosystems; that the mass production of animals in corporate feedlots and factory farms is unethical and inhumane; that emphasis on monoculture and mass processing endangers food security by facilitating disease vectors and contamination of the food supply; that the current system produces inexpensive but highly processed products that are low in nutritional content and contribute to obesity, diabetes, and other diseases; and that the corporatization of agriculture puts small family farmers out of business and therefore weakens local cultures and local economies. Health and environmental activists in the United States are enraged that federal subsidies in the Farm Bill promote the production of the raw ingredients for food sweeteners, junk food, and livestock feed, using a system reliant on petrochemical inputs. Nearly 70 percent of farm subsidies

▶ CASE STUDY (continued)

go to the top 10 percent of the country's biggest growers while small farmers growing fruits and vegetables serving local communities receive nothing (and are actually put at an economic disadvantage). In response, a series of movements has grown rapidly in recent years promoting local agriculture and local food traditions, organic farming, urban and community gardens, and grass-fed/free-range livestock ranching. Outlets for these alternative production methods include farmers' markets (Figure 8.10), various forms of direct marketing such as community-supported agriculture (where consumers invest in farm shares and receive a weekly delivery), and restaurants with chefs who prefer local, fresh produce. Whether these social movements will affect the powerful global agribusiness system is uncertain, but alternatives to the global production model increasingly are available and much in demand.

Geographers analyze **land use** and **land cover** change with **remote sensing**, a process by which we acquire images of Earth from orbiting satellites. With the 1972 launch of the first Landsat satellite by the United States, images from space have been used to measure land cover change, monitor environmental health, explore for geologic resources, make maps, and predict crop production.

Satellite remote-sensing images are not photographs (although photos are taken from manned spacecraft such as the space shuttle). If a satellite took a photo, how would we get the film back to Earth to develop it, and how would we "reload" the satellite with more film? Satellites instead look at one small part of Earth and record a brightness value, which usually is just reflected sunlight (although some sensors actually emit a radar-like beam or signal that is recorded when it bounces back). This value can range from a low number (zero) if that part of Earth is very dark and no reflected light is recorded, to a high number if that area is very bright and much light is reflected. After the satellite sensor records its brightness value, it moves on to the next small part of the earth and repeats the process. This all happens incredibly fast because the satellite is whizzing by overhead at a very fast speed. Each brightness value is called a *pixel*, which represents an average reflectance value for all features in that area of Earth. The size of the pixel varies by satellite. Some are as detailed as 1 square meter. Others, like weather satellites, use pixel resolutions of 5 kilometers.

Rather than record a brightness value for *all* reflected light, however, most sensors break the light (which is really just energy) into different colors with a prism. They can then record a brightness value for blue light, green light, red light, and many other parts of the electromagnetic spectrum such as infrared or ultraviolet that our eyes (which are also "remote sensors") cannot see. We call each of these "colors" a *band* because the spectral bandwidth refers to the energy wavelength that defines each color.

Satellite images are digital images, nothing more than a bunch of numbers in a matrix. The photos that we produce from these images are like paint-by-number images. Which spectral bands are painted with which colors determines how the image appears. If we use a band that corresponds to blue light and color it blue and do the same for green and red, we will produce an image that appears in "natural" color as it would look from the satellite through a telescope. More frequently, satellites use bands that gather brightness values in the infrared part of the

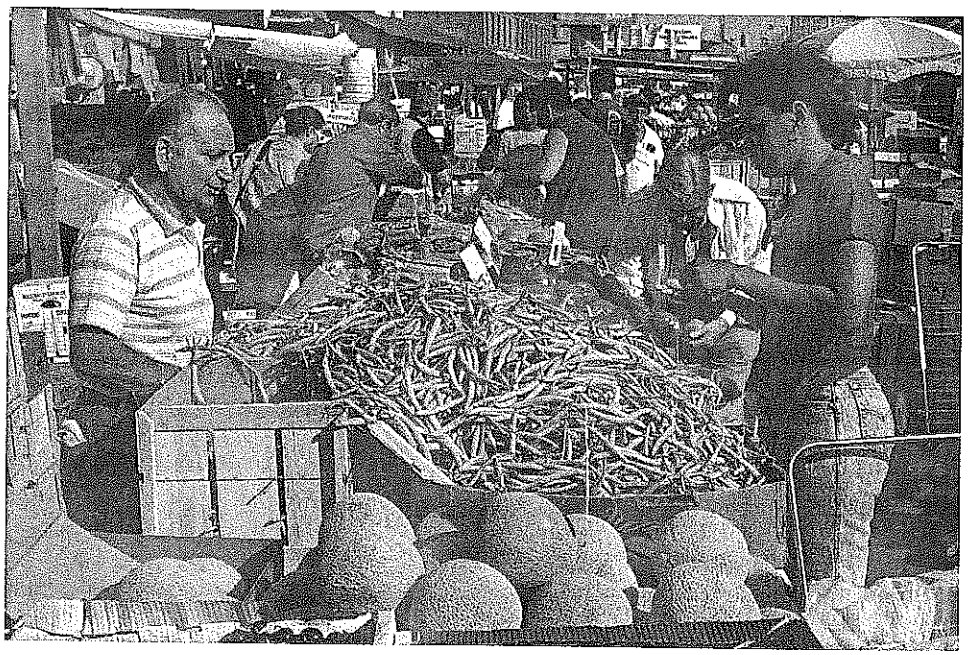

Figure 8.10 Farmer's markets are an increasingly attractive alternative for urban dwellers to purchase fresh produce, connect with the people who grow their food, support a local agricultural economy, and reduce the environmental impact of the food they eat.

▶ CASE STUDY (continued)

electromagnetic spectrum because they tend to cut through atmospheric haze much better and produce clearer images. For the same reason, early satellites' sensors excluded blue light because it scatters easily and adds haze. The near-infrared bands are also better at monitoring the health of vegetation, which reflects infrared light very brightly. The drawback with the infrared band is that it must be "painted" on the image with a color humans can see when in fact it is invisible to us, with the net result that the image won't look "natural." The most widely used band/color combination is called a "false-color infrared" in which the blue on an image is actually green light, the green is actually red light, and the red is actually near-infrared light. The result is an image in which healthy vegetation is bright red, bare fields range from white or gray to a bluish green, and urban areas look white or cyan (greenish blue).

Because all features have a unique reflectance pattern across the electromagnetic spectrum (called their *spectral signature*), we can classify the numbers that make up a digital image to find out where different features are located. Forests have a different spectral signature than grasses, and both are different from roads, water, and rooftops. The smaller the pixel size and the more spectral bands used, the more accurate classifications can be. We can also easily detect changes from images acquired at one date to those at a later date.

In Activity 1, you will focus on seven agricultural products to look at the various ways the same product can be produced around the world. This will enable you to understand how landscapes are modified in different places by agricultural activities. You will then link these to a map of the world to see *where* these different modes of production occur.

In Activity 2, you will go to a local grocery store and gather evidence of the global agricultural economy by finding products produced outside the United States and Canada. This will reinforce your understanding that time-space convergence has brought faraway places to your door.

Finally, in Activity 3 you will look at an early satellite image (from the 1970s or 1980s) and a later satellite image (from the late 1990s or 2000) for three areas in Latin America. By overlaying these images, you can highlight all pixels that have changed. You will be able to calculate the area of change between these scenes using geographic information systems (GIS) operations and see how globalization of agriculture has affected these remote Latin American locations.