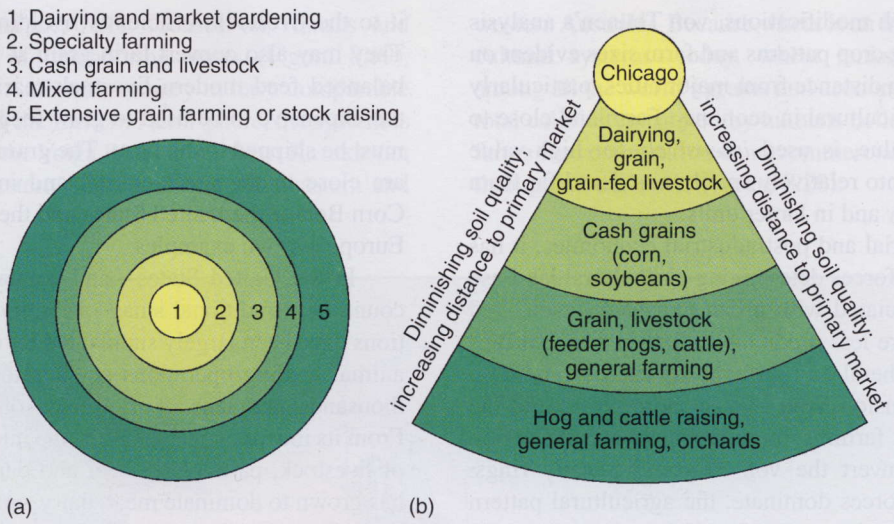

Figure 8.14 (*a*) **von Thünen's model.** Recognizing that as distance from the market increases, the value of land decreases, von Thünen developed a descriptive model of intensity of land use that holds up reasonably well in practice. The most intensively produced crops are found on land close to the market; the less intensively produced commodities are located at more distant points. The numbered zones of the diagram represent modern equivalents of the theoretical land use sequence von Thünen suggested over 175 years ago. As the metropolitan area at the center increases in size, the agricultural specialty areas are displaced outward, but the relative position of each is retained. Compare this diagram with Figure 8.18. (*b*) **A schematic view of the von Thünen zones** in the sector south of Chicago. There, farmland quality decreases southward as the boundary of recent glaciation is passed and hill lands are encountered in southern Illinois. On the margins of the city near the market, dairying competes for space with livestock feeding and suburbanization. Southward into flat, fertile central Illinois, cash grains dominate. In southern Illinois, livestock rearing and fattening, general farming, and some orchard crops are the rule.

Source: (b) Modified with permission from Bernd Andreae, Farming Development and Space: A World Agricultural Geography, *trans. Howard F. Gregor (Berlin; Hawthorne, N.Y.: Walter de Gruyter and Co., 1981).*

of distance; other items such as grain would have lower rates. Land rent for any farm commodity decreases with increasing distance from the central market, and the rate of decline is determined by the transport gradient for that commodity. Crops that have both the highest market price and the highest transport costs will be grown nearest to the market. Less perishable crops with lower production and transport costs will be grown at greater distances away (Figure 8.15). Since in this model transport costs are uniform in all directions away from the center, a concentric zonal pattern of land use called the *von Thünen rings* results.

The von Thünen model may be modified by introducing ideas of differential transport costs (Figure 8.16), variations in topography or soil fertility, or changes in commodity demand and market

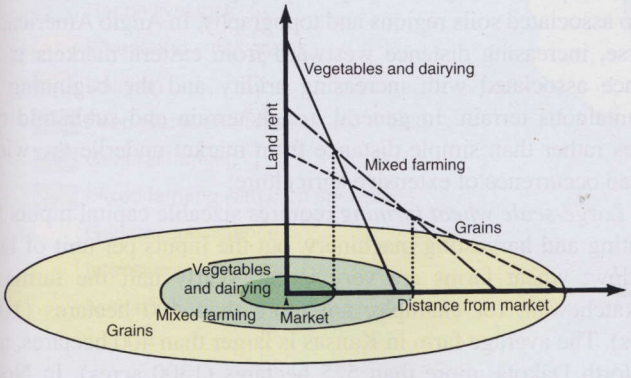

Figure 8.15 **Transport gradients and agricultural zones.**

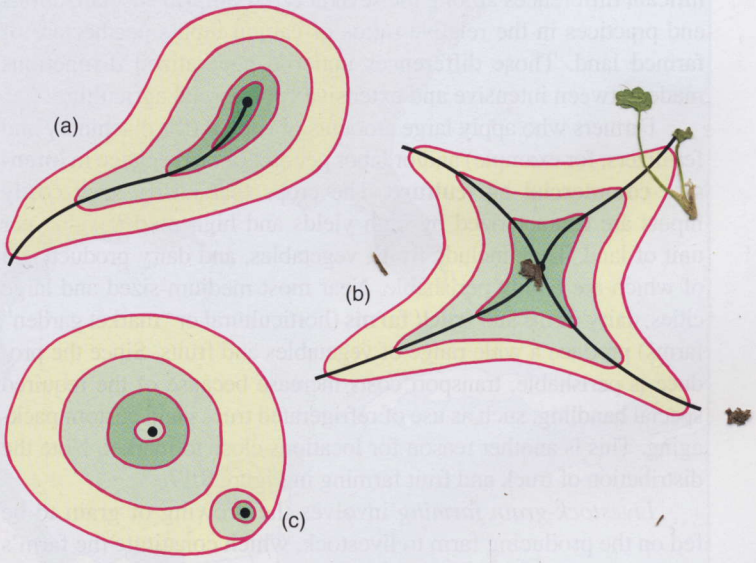

Figure 8.16 **Ring modifications.** Modifications of controlling conditions will alter the details but not change the underlying pattern of the *von Thünen rings.* For example, a growth in demand and therefore market price of a commodity would merely expand its ring of production. An increase in transport costs would contract the production area, while reductions in freight rates would extend it. (*a*) If transport costs are reduced in one direction, the circularity—but not the sequence—of the rings will be affected. (*b*) If several roads are constructed or improved, land use sequences assume a star-shaped or digitate outline. (*c*) The addition of a smaller outlying market results in the emergence of a set of von Thünen rings subordinate to it.

in fall, harvested in midsummer) belt focuses on Kansas and includes adjacent sections of neighboring states (Figure 8.19). Argentina is the only South American country to have comparable large-scale wheat farming. In the Eastern Hemisphere, the system is fully developed only east of the Volga River in northern Kazakhstan and the southern part of Western Siberia, and in southeastern and western Australia. Because wheat is an important crop in many agricultural systems—today, wheat ranks first in total production among all the world's grains and accounts for more than 20% of the total calories consumed by humans collectively—large-scale wheat farms face competition from commercial and subsistence producers throughout the world (Figure 8.20).

Figure 8.17 **Generalized agricultural regions of North America.**

Sources: U.S. Bureau of Agricultural Economics; Agriculture Canada; and Secretaría de Agricultura y Recursos Hidráulicos, Mexico.

Women and the Green Revolution

Women farmers grow at least half of the world's food and up to 80% in some African countries. They are responsible for an even larger share of food consumed by their own families: 80% in sub-Saharan Africa, 65% in Asia, and 45% in Latin America and the Caribbean. Further, women comprise between one-third and one-half of all agricultural laborers in developing countries. For example, African women perform about 90% of the work of processing food crops and 80% of the work of harvesting and marketing.

Women's agricultural dominance in developing states is increasing, in fact, as male family members continue to leave for cities in search of paid urban work. In Mozambique, for example, for every 100 men working in agriculture, there are 153 women. In nearly all other sub-Saharan countries the female component runs between 120 and 150 per 100 men. The departure of men for near or distant cities means, in addition, that women must assume effective management of their families' total farm operations.

Despite their fundamental role, however, women do not share equally with men in the rewards from agriculture, nor are they always beneficiaries of presumed improvements in agricultural technologies and practices. Often, they cannot own or inherit the land on which they work, and they frequently have difficulty in obtaining improved seeds or fertilizers available to male farmers.

As a rule, women farmers work longer hours and have lower incomes than do male farmers. This is not because they are less educated or competent. Rather, it is due to restricting cultural and economic factors. First, most women farmers are involved in subsistence farming and food production for the local market, which yields little cash return. Second, they have far less access than men to credit at bank or government-subsidized rates that would make it possible for them to acquire the Green Revolution technology, such as hybrid seeds and fertilizers. Third, in some cultures women cannot own land and so are excluded from agricultural improvement programs and projects aimed at landowners. For example, many African agricultural development programs are based on the conversion of communal land, to which women have access, to private holdings, from which they are excluded. In Asia, inheritance laws favor male over female heirs, and female-inherited land is managed by husbands; in Latin America, discrimination results from the more limited status held by women under the law.

At the same time, the Green Revolution and its greater commercialization of crops has generally required an increase in labor per hectare, particularly in tasks typically reserved for women, such as weeding, harvesting, and postharvest work. If women are provided no relief from their other daily tasks, the Green Revolution for them may be more burden than blessing. But when mechanization is added to the new farming system, women tend to be losers. Frequently, such predominantly female tasks as harvesting or dehusking and polishing of grain—all traditionally done by hand—are given over to machinery, displacing rather than employing women. Even the application of chemical fertilizers (a "man's task") instead of cow dung ("women's work") has reduced the female role in agricultural development programs. The loss of those traditional female wage jobs means that already poor rural women and their families have insufficient income to improve their diets even in the light of substantial increases in food availability through Green Revolution improvements.

If women are to benefit from the Green Revolution, new cultural norms—or culturally acceptable accommodations within traditional household, gender, and customary legal relations—will be required. These must permit or recognize women's landowning and other legal rights not now clearly theirs, access to credit at favorable rates, and admission on equal footing with males to government assistance programs. Recognition of those realities fostered the Food and Agriculture Organization of the United Nations' "FAO Plan of Action for Women in Development (1996–2001)" and its "Gender and Development Plan (2002–2007)." Both aimed at stimulating and facilitating efforts to enhance the role of women as contributors and beneficiaries of economic, social, and political development. Objectives of the plan included promoting gender-based equity in access to, and control of, productive resources; enhancing women's participation in decision- and policy-making processes at all levels, local and national; and encouraging actions to reduce rural women's workload while enhancing their opportunities for paid employment and income.

UN's Food and Agriculture Organization now considers Green Revolution technologies "almost exhausted" of any further productivity gains in Asian rice cultivation. Little prime land and even less water remain to expand farming in many developing countries, and the adverse ecological and social consequences of industrial farming techniques arouse growing resistance. Nor does biotechnology—which many have hailed as a promising new Green Revolution approach—seem likely to fill the gap. Consumer resistance to the genetic modification of food crops, fear of the ecological consequences of such modification, the partial rejection of GM foods in the European Union market, and the high cost and restrictions on the new biotechnologies imposed by their corporate developers all conspire to inhibit the universal adoption of the new technologies in the developing world.

Nevertheless, the production of engineered crops is spreading rapidly. In 1996, the first year genetically modified crops were commercially available, about 1.7 million hectares (4.3 million acres) were placed in biotechnology cultivation. In 2004, a reported 81 million hectares (more than 200 million acres) were planted with GM crops, an increase of 20% over 2003. Almost one-third (30%) of the global GM crop area in that year was located in developing countries; indeed, the percentage growth of GM acreage in the developing countries—notably Argentina, Brazil, China, India, and South Africa—was twice as high as in the industrial countries in the first years of this century. Globally, the principal GM crops have been GM soybeans, GM corn (including white corn for food in South Africa), transgenic cotton, and GM canola. Herbicide resistance (Roundup Ready soybeans) and insect resistance (Bt corn and

The Economy of a Chinese Village

The village of Nanching is in subtropical southern China on the Zhu River delta near Guangzhou (Canton). Its traditional subsistence agricultural system was described by a field investigator, whose account is here condensed. The system is still followed in its essentials in other rice-oriented societies.

In this double-crop region, rice was planted in March and August and harvested in late June or July and again in November. March to November was the major farming season. Early in March the earth was turned with an iron-tipped wooden plow pulled by a water buffalo. The very poor who could not afford a buffalo used a large iron-tipped wooden hoe for the same purpose.

The plowed soil was raked smooth, fertilizer was applied, and water was let into the field, which was then ready for the transplanting of rice seedlings. Seedlings were raised in a seedbed, a tiny patch fenced off on the side or corner of the field. Beginning from the middle of March, the transplanting of seedlings took place. The whole family was on the scene. Each took the seedlings by the bunch, ten to fifteen plants, and pushed them into the soft inundated soil. For the first thirty or forty days the emerald green crop demanded little attention except keeping the water at a proper level. But after this period came the first weeding; the second weeding followed a month later. This was done by hand, and everyone old enough for such work participated. With the second weeding went the job of adding fertilizer. The grain was now allowed to stand to "draw starch" to fill the hull of the kernels. When the kernels had "drawn enough starch," water was let out of the field, and both the soil and the stalks were allowed to dry under the hot sun.

Then came the harvest, when all the rice plants were cut off a few inches above the ground with a sickle. Threshing was done on a threshing board. Then the grain and the stalks and leaves were taken home with a carrying pole on the peasant's shoulder. The plant was used as fuel at home.

As soon as the exhausting harvest work was done, no time could be lost before starting the chores of plowing, fertilizing, pumping water into the fields, and transplanting seedlings for the second crop. The slack season of the rice crop was taken up by chores required for the vegetables which demanded continuous attention, since every peasant family devoted a part of the farm to vegetable gardening. In the hot and damp period of late spring and summer, eggplant and several varieties of squash and beans were grown. The green-leafed vegetables thrived in the cooler and drier period of fall, winter, and early spring. Leeks grew the year round.

When one crop of vegetables was harvested, the soil was turned and the clods broken up by a digging hoe and leveled with an iron rake. Fertilizer was applied, and seeds or seedlings of a new crop were planted. Hand weeding was a constant job; watering with the long-handled wooden dipper had to be done an average of three times a day, and in the very hot season when evaporation was rapid, as frequently as six times a day. The soil had to be cultivated with the hoe frequently as the heavy tropical rains packed the earth continuously. Instead of the two applications of fertilizer common with the rice crop, fertilizing was much more frequent for vegetables. Besides the heavy fertilizing of the soil at the beginning of a crop, usually with city garbage, additional fertilizer, usually diluted urine or a mixture of diluted urine and excreta, was given every ten days or so to most vegetables.

Source: Adapted from C. K. Yang, *A Chinese Village in Early Communist Transition* (Cambridge, Mass.: Massachusetts Institute of Technology, 1959).

Urban Subsistence Farming

Not all of the world's subsistence farming is based in rural areas. Urban agriculture is a rapidly growing activity, with some 800 million city farmers worldwide providing, according to United Nations figures, one-seventh of the world's total food production. Occurring in all regions of the world, developed and underdeveloped, but most prevalent in Asia, urban agricultural activities range from small garden plots, to backyard livestock breeding, to fish raised in ponds and streams. Using the garbage dumps of Jakarta, the rooftops of Mexico City, and meager dirt strips along roadways in Kolkata (Calcutta) or Kinshasa, millions of people are feeding their own families and supplying local markets with vegetables, fruit, fish, and even meat—all produced within the cities themselves and all without the expense and spoilage of storage or long-distance transportation.

In Africa where, for example, 2 of 3 Kenyan and Tanzanian urban families engage in farming, a reported 20% of urban nutritional requirement is produced in the towns and cities; in Accra, Ghana's capital, urban farming provides the city with 90% of its fresh vegetables. Early in the 21st century, city farming in Cuba produced 65% of the country's rice, 43% of its fruits and vegetables, and 12% of roots and fibers; altogether, some 165,000 urban Cubans annually produced 800,000 tons of fresh produce in 1999.

Urban agriculture occupies city land as well as city residents: in Bangkok, Thailand for example, some 60% of the metropolitan area is cultivated. A similar inclusion of adjacent rural land within urban boundaries is characteristic of China. There, based on an earlier mandate that socialist cities be self-sufficient, municipal boundaries were set to include large areas of rural land now worked intensively to supply the fruits, vegetables, fish, and the like consumed within the city proper. Chinese urban agriculture—by UN estimates providing 90% of the vegetable supply of cities—is, in reality, periurban (suburban) farming within city administrative control. Little or no backyard (or rooftop) land is available for food production within the densely developed Chinese city proper. In whatever form urban farming efforts are expressed, not all its area or yield is solely for local subsistence. An estimated 200 million global urban dwellers also produce food for sale to others.

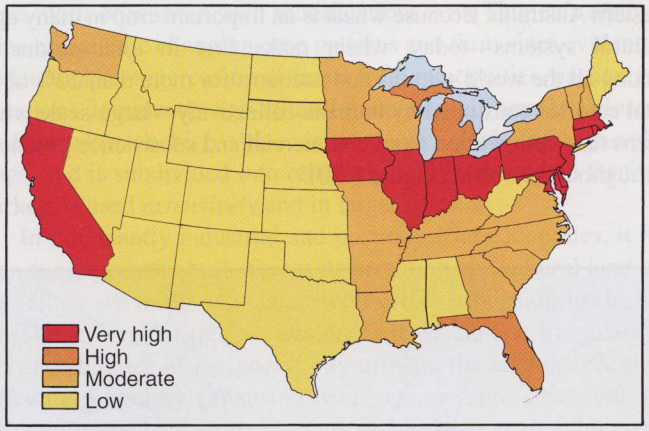

Figure 8.18 **Relative value per acre of farmland and buildings.** In a generalized way, per acre valuations support von Thünen's model. The major metropolitan markets of the Northeast, the Midwest, and California are in part reflected by high rural property valuations, and fruit and vegetable production along the Gulf Coast increases land values there. National and international markets for agricultural goods, soil productivity, climate, and terrain characteristics are also reflected in the map patterns.
Source: Statistical Abstract of the United States.

Livestock ranching differs significantly from livestock-grain farming and, by its commercial orientation and distribution, from the nomadism it superficially resembles. A product of the 19th-century growth of urban markets for beef and wool in Western Europe and the northeastern United States, ranching has been

Figure 8.19 Contract harvesters follow the ripening wheat no through the plains of the United States and Canada.

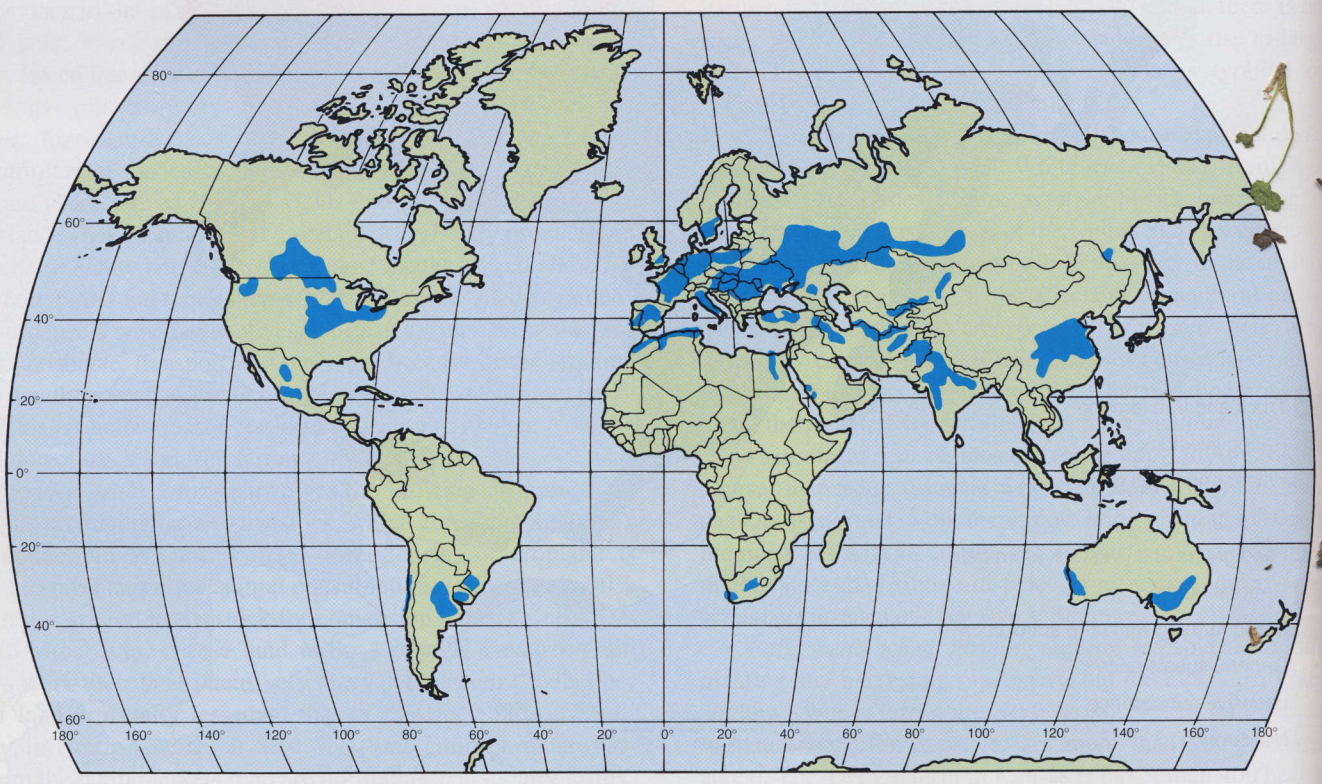

Figure 8.20 **Principal wheat-growing areas.** Only part of the world's wheat production comes from large-scale farming enterprises. In weste southern Europe, eastern and southern Asia, and North Africa, wheat growing is part of general or intensive subsistence farming. Recently, develo country successes with the Green Revolution and subsidized surpluses of the grain in Europe have altered traditional patterns of production and w trade in wheat.

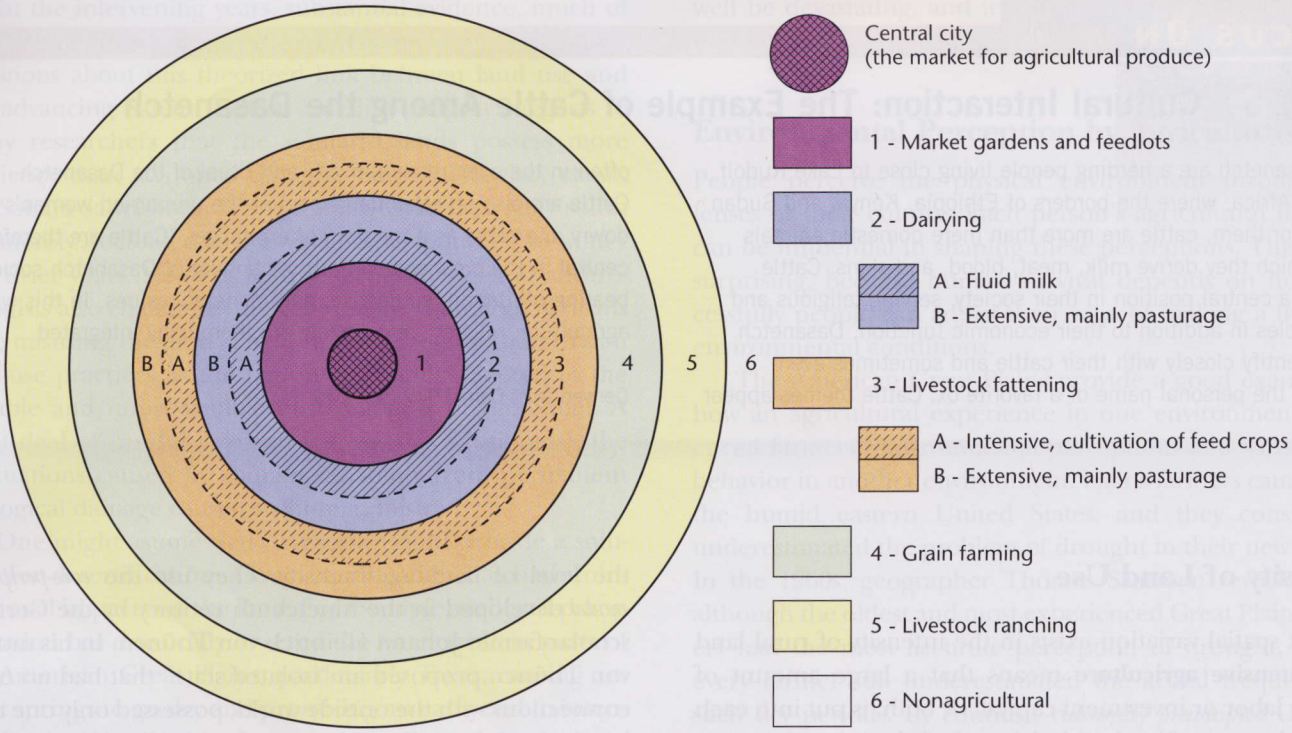

Figure 8.19 **Von Thünen's isolated-state model.** The model is modified to fit the modern world better, showing the hypothetical distribution of types of commercial agriculture. Other causal factors are held constant to illustrate the effect of transportation costs and differing distances from the market. The more intensive forms of agriculture, such as market gardening, are located nearest the market, whereas the least intensive form (livestock ranching) is most remote. Why does the model have the configuration of concentric circles? Compare this model to the real-world pattern of agricultural types in Uruguay, South America, shown in Figure 8.20.

progressively more on transporting produce to market. The effect of distance means that highly perishable products such as milk, fresh fruit, and garden vegetables need to be produced near the market, whereas peripheral farmers have to produce nonperishable products or convert perishable items into a more durable form, such as cheese or dried fruit.

The concentric-zone model describes a situation in which highly capital-intensive forms of commercial agriculture, such as market gardening and feedlots, lie nearest to market. The increasingly distant, successive concentric belts are occupied by progressively less intensive types of agriculture, represented by dairying, livestock fattening, grain farming, and ranching.

How well does this modified model describe reality? As we would expect, the real world is far more complicated. Still, on a world scale, we can see that intensive commercial types of agriculture tend to occur most commonly near the huge urban markets of northwestern Europe and the eastern United States (see Figure 8.1). An even closer match can be observed in smaller areas, such as in the South American nation of Uruguay (Figure 8.20).

The value of von Thünen's model can also be seen in the underdeveloped countries of the world. Geographer Ronald Horvath made a detailed study of the African region centering on the Ethiopian capital city of Addis Ababa. Although noting disruptions caused by ethnic and environmental differences, Horvath found "remarkable parallels between von Thünen's crop theory and the agriculture around Addis Ababa." Similarly, German geographer Ursula Ewald applied the model to the farming patterns of colonial Mexico during the period of Spanish rule, concluding that even this culturally and environmentally diverse land provided "an excellent illustration of von Thünen's principles on spatial zonation in agriculture."

Can the World Be Fed?

Are starvation and recurrent famine inevitable as the world's population grows, as Thomas Malthus predicted (see Chapter 7)? Or can our agricultural systems successfully feed more than 6 billion people?

In trying to answer these questions, we face a paradox. Today, some 850 million people are malnourished, some

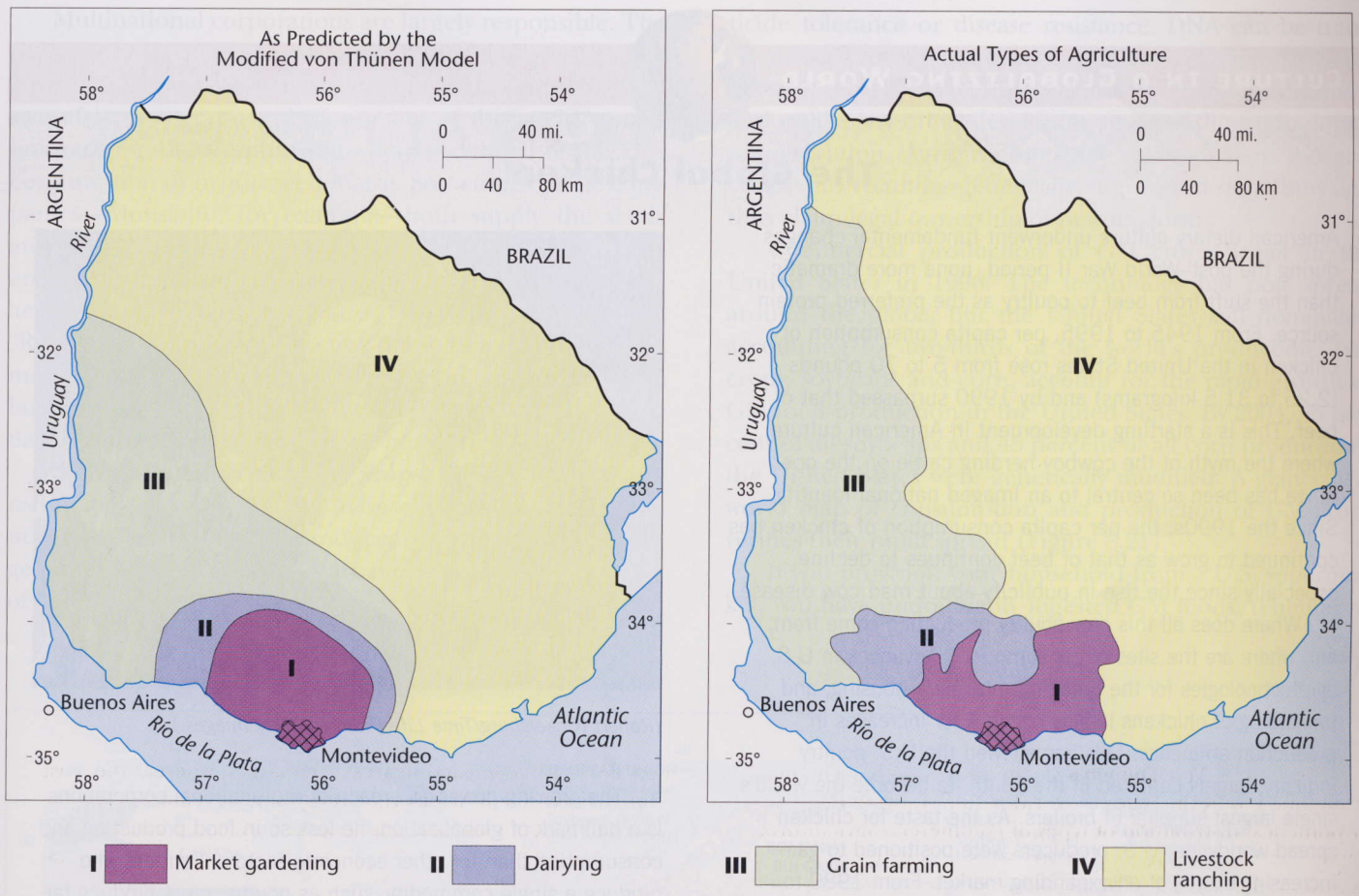

Figure 8.20 Ideal and actual distribution of types of agriculture in Uruguay. This South American country possesses some attributes of von Thünen's isolated state, in that it is largely a plains area dominated by one city. In what ways does the spatial pattern of Uruguayan agriculture conform to von Thünen's model? How is it different? What might cause the anomalies? (For the answers, see Griffin, 1973.)

to the point of starvation. Almost every year we read of famines, usually in an African country. Yet—and this would astound Malthus—food production has grown more rapidly than the world population over the past 40 or 50 years. Per capita, more food is available today than in 1950, when only about half as many people lived on Earth.

Cultural interaction helps explain these startling facts. If the world food supply is sufficient to feed everyone and yet hunger afflicts one of every six or seven persons, then some cultural or social factors must be responsible. Ultimately poverty and politics, not food shortage, cause hunger. Many Third World countries do not grow enough food to feed their populations, and they cannot afford to purchase enough imported food to make up the difference. As a result, famines can occur even when plenty of food is available. Irish starved by the millions in the 1840s while adjacent Britain possessed enough surplus food to have prevented this catastrophe. Bangladesh suffered a major famine in 1974, a year of record agricultural surpluses in the world.

Even when major efforts are made to send food from wealthy countries to famine-stricken areas, the poor transportation infrastructure of Third World countries often prevents effective distribution. Political instability can disrupt food shipments, and the donated food often falls into the hands of corrupt local officials. So while the immediate causes of famine may be environmental, the failure to relieve hunger has a political and cultural explanation.

Globalization

The process of *globalization* and its impact on agriculture has been referred to throughout this chapter. Such references have frequently been accompanied by the term *agribusiness* (see Culture in a Globalizing World). The theme of cultural interaction allows us to draw these references together.

Globalization, you will recall, involves the restructuring of the world economy by multinational corporations thriving in an era of free-trade capitalism, rapid communications,

Culture in a Globalizing World

The Global Chicken

American dietary culture underwent fundamental changes during the post–World War II period, none more dramatic than the shift from beef to poultry as the preferred protein source. From 1945 to 1995, per capita consumption of chicken in the United States rose from 5 to 70 pounds (2.25 to 31.5 kilograms) and by 1990 surpassed that of beef. This is a startling development in American culture, where the myth of the cowboy herding cattle on the open range has been so central to an imaged national identity. Since the 1990s, the per capita consumption of chicken has continued to grow as that of beef continues to decline, especially since the rise in publicity about mad cow disease

Where does all this new poultry production come from, and where are the sites of consumption? Advances in U.S. agrotechnologies for the breeding, nutrition, housing, and processing of chickens largely account for increases in production efficiency. This has allowed the U.S. poultry industry, largely centered in the South, to become the world's single largest supplier of broilers. As the taste for chicken spread worldwide, U.S. producers were positioned to gain increasing shares of an expanding market. From 1980 to 2002, world trade in broilers grew nearly 500 percent, while the U.S. share of that trade rose from 22.2 to 46.1 percent. China has been the hottest import market because rising affluence there has led to increasing per capita consumption. At the same time, China is increasing its production *and* its exports of poultry. It is likely to become a major competitor with the United States for access to other Asian markets.

The story of the global chicken gets more interesting if we look more closely at cultural food preferences. There is a peculiarity and a particularity to the culture of chicken consumption in the United States—an overwhelming preference for breast meat. This cultural predilection greatly influences what the importing countries eat, since the remainder of the chicken cannot simply be thrown away. Hence 87 percent of U.S. exports in 2000 were in the form of frozen cuts, 40 percent of which were leg quarters.

(Robert Nickelsburg/Time Life Pictures/Getty Images.)

The growing power and reach of multinational corporations is a hallmark of globalization, no less so in food production and consumption than for other economic sectors. Farmers who produce a single commodity, such as poultry, must produce far more than the local market can consume in order to be profitable. Thus, they must sell in national and global markets, access to which requires a dependence on multinational agribusinesses. So pervasive is the reach of agribusiness that many poultry farmers no longer own the chickens they produce; multinational corporations do. Farmers contract with multinationals to receive chicks, feed, transport, and other inputs. When the chickens mature, they are trucked to the contracting corporation's processing plant, where they are weighed and the cost of inputs deducted from the farmers' shares. The farmers take their earnings to pay the mortgages on their lands and buildings, and the chickens are processed for the global food system.

From Boyd and Watts, 1997; Norberg-Hodge, Merrifield, and Gorelick, 2002; U.S. Department of Agriculture.

improved transport, and computer-based information systems. When applied to agriculture, the globalization process tends to produce *agribusiness*—the totally commercial, large-scale, mechanized, chemical-dependent, hybrid-using, genetically engineered, and **monocultural** (raising a single specialty crop on vast tracts) modern farming system. The green revolution is part of agricultural globalization, as are countless "rural development" projects in Third World countries, usually funded by the World Bank or the International Monetary Fund. These projects typically displace *peasant* farmers to make way for agribusinesses. The family-run farm is one victim of agricultural globalization.

Multinational corporations are largely responsible. The five biggest hybrid vegetable seed suppliers control 75 percent of the global market, and the ten largest agrochemical manufacturers command 85 percent of the world supply. Four corporations supply more than two-thirds of the U.S. consumption of hybrid seed maize. Sometimes single companies—Monsanto, for example—both supply the seeds and manufacture the pesticides. What's more, the genetic engineering of seed is also often done in-house. This arrangement allows Monsanto to genetically engineer "Roundup Ready" seed varieties. Roundup is an herbicide manufactured by Monsanto, and their Roundup Ready gene builds in greater tolerance to higher doses. The seeds essentially became vehicles to sell more herbicide.

Genetically modified (GM) crops, the products of biotechnology, are seen by many as another aspect of globalization. Genetic engineering produces new organisms through gene splicing. Pieces of DNA are recombined with the DNA of other organisms to produce new properties, such as pesticide tolerance or disease resistance. DNA can be transferred not only between species but also between plants and animals, which makes this technology truly revolutionary and unlike any other developments since the beginning of domestication. Agribusinesses are able to patent the processes and resulting genetically engineered organisms and thus claim legal ownership of new life-forms.

Commercial production of GM crops began in the United States in 1996. The technology has now spread around the globe, but the United States still dominates, accounting for two-thirds of the world's production. Two crops, soybeans and corn, account for the rapid growth of GM food production in the United States. By 2004, 85 percent of all soybeans and 45 percent of all corn produced in the United States were genetically modified. A glance at a world map of consumption and production of GM crops verifies their rapid spread (Figure 8.21).

If you provision your household from a U.S. supermarket, you have undoubtedly ingested GM foods. Whether or

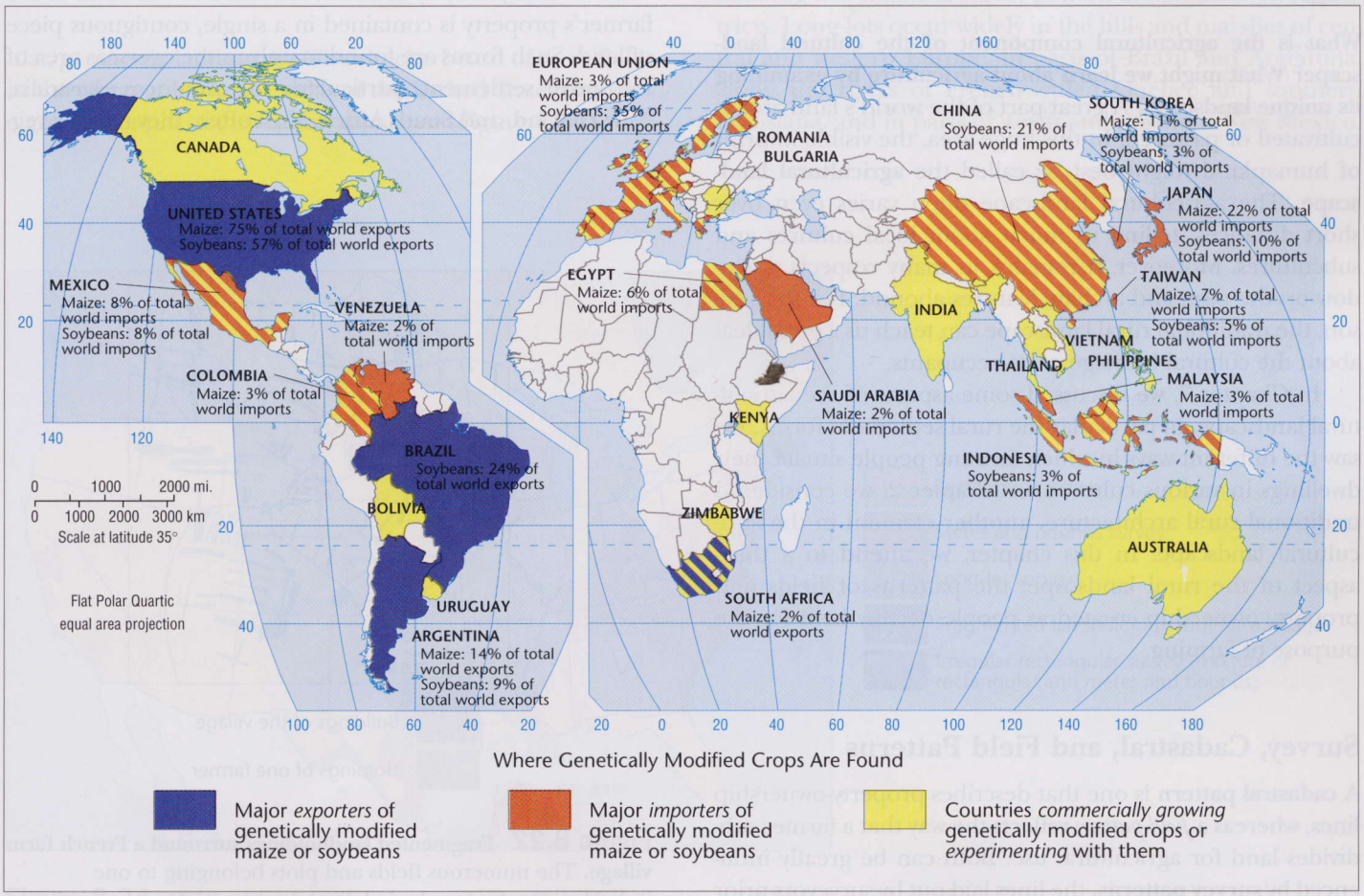

Figure 8.21 **Worldwide use of genetically altered crop plants, especially maize and soybeans.** This diffusion has occurred despite warnings from many ecologists and geneticists.

What problems might arise? *(Sources: National Corn Growers Association; U.S. Department of Agriculture.)*

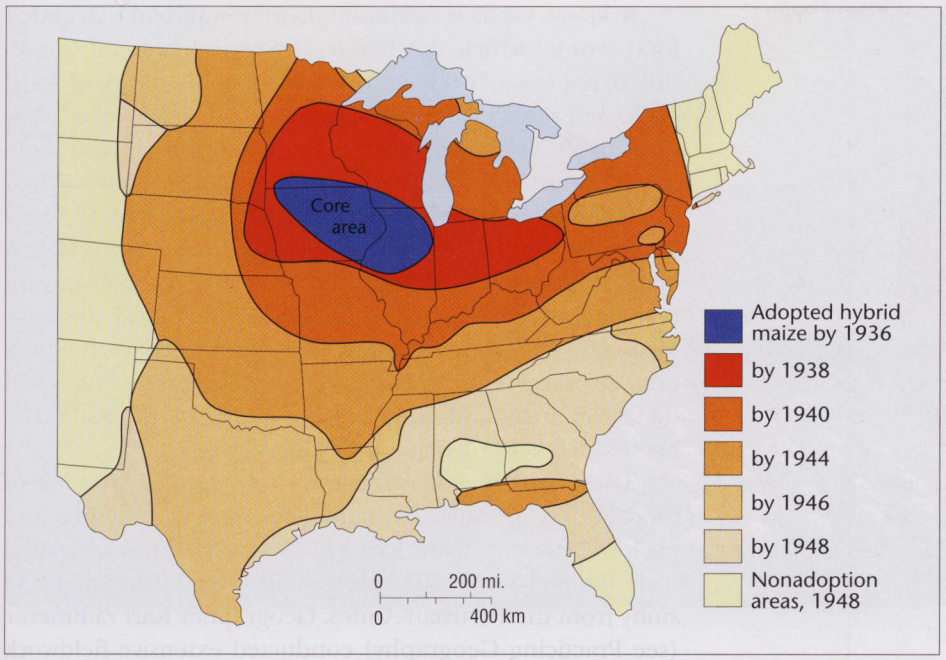

Figure 8.14 The diffusion of hybrid maize in the United States. Hybrid maize spread from a core area of initial acceptance in Iowa and Illinois through expansion diffusion, reaching most of the eastern United States in little over a decade. What type of diffusion does the pattern suggest? *(After Griliches, 1960: 277.)*

aggravating urban problems. To make matters worse, the use of chemicals and poisons on the land heightened environmental damage.

The widespread adoption of hybrid seeds has created another problem: the loss of plant diversity, or genetic variety. Before hybrid seeds diffused around the world, each farm developed its own distinctive seed types through the annual harvest-time practice of saving seeds from the better plants for the next season's sowing. Enormous *genetic diversity* vanished almost instantly when farmers began purchasing hybrids rather than saving seed from the last harvest. "Gene banks" have belatedly been set up to preserve what remains of domesticated plant variety, not just in the areas affected by the green revolution but also in the American Corn Belt and many other agricultural regions where hybrids are now dominant. In sum, the green revolution proved at best to be a mixed blessing.

Agro-Ecology

How are agriculture and ecology interrelated? How does the theme of cultural ecology help us understand types of agriculture? Agriculture is related to the physical environment at the most basic level, for farming involves direct use of the land and is directly influenced by the local climate. Because farmers and herders work and live on the land, a very close relationship exists between agriculture and the physical environment. In many ways, the map of agricultural regions reflects adaptation to environmental influences. At the same time, thousands of years of agricultural use of the land have led to massive alterations in our natural environment.

Markets and Cultural Ecological Change

Historically, climate and the physical environment have exerted perhaps the greatest influence on the different forms of agriculture. People had to adjust their subsistence strategies and techniques to prevailing regional climate conditions. In addition, soils play an influential role in both agricultural practices and food provisioning. Swidden cultivation, in part, reflects an adaptation to poor tropical soils, which rapidly lose their fertility when farmed. Peasant agriculture, by contrast, often owes its high productivity to the fertility of local volcanic soils, which are not so quickly exhausted. Terrain is also an influence, with farmers tending to cultivate relatively level areas (Figure 8.15). In sum, the constraints of climate, soil, and terrain historically limited the types of crops and cultivation practices possible.

For most of human history, people obtained their provisions locally and had locally distinct dietary cultures. The development of global markets over the past 500 years has shifted cultural food preferences and altered the ecology of vast areas of the planet. A multitude of crops have diffused around the globe, creating new regional cuisines (imagine Italian cuisine without tomatoes!) while at the same time simplifying the global diet to a disproportionate reliance on only three grains: wheat, rice, and maize. The expansion of European empires in the seventeenth and eighteenth