Agriculture

Thursday, January 09, 2014
11:57 AM

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 initially 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 helped create the conditions necessary for 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. 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. In 1831, Cyrus McCormick, a farmer in Lexington, Virginia, perfected his father's design for a mechanical reaper (Fig. 11.6). At the time, farmers were limited in their production not by what they could sow (plant), but what they could reap (harvest) because harvesting required much more time and labor than planting. Harvesting involved laborers cutting grain with a scythe followed by more laborers who bundled the grain into bales. McCormick's mechanical reaper, which was pulled by horses, both cut and bundled grain. His invention diffused quickly during the 1840s purportedly increasing yields of individual farmers by at least ten times. McCormick's company eventually became International Harvester and now Case IH, one of the largest agriculture implement companies in the world today.

Figure 11.6 **Midwest, United States.**

Pioneers in 1870 used the mechanical reaper designed by Cyrus McCormick to cut and bundle grain on the prairie. Pulled by horses, the mechanical reaper sped up harvesting and diffused around the world.

Advances in breeding livestock enabled farmers to develop new breeds that were either strong milk producers or good for beef. The most common breeds of dairy cattle found in North America today trace their lineage back to the Second Agricultural Revolution in Europe. In the 1700s and 1800s, European farmers bred dairy cattle to adapt to different climates and topography. For example, the black and white Holstein dairy cow came from the Netherlands and is well suited to graze on grass and produce high quantities of milk. Scottish farmers bred the red and white Ayrshire breed of dairy cattle to produce milk well suited for butter and cheese and to forage for food in rough, rocky topography.

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 geographichal pattern of land use based on the “perishability” of products and cost of transportation often 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 as one moved away from the town, one commodity or crop gave way to another. 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, 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 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 around settlements (Fig. 11.7). 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.

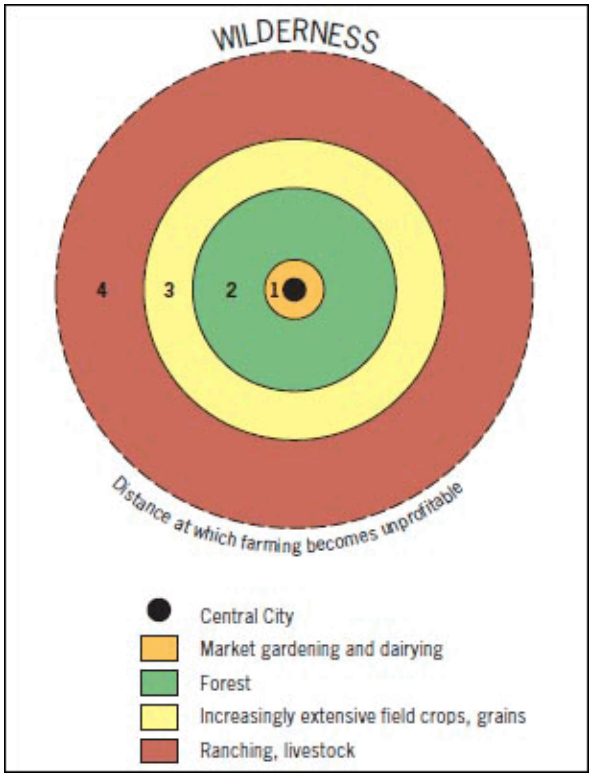

Figure 11.7 **Von Thünen's Model.**

The **Von Thünen model** (including the ring of forest) is often described as the first effort to analyze the spatial character of economic activity. The 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. Yet 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 as well as 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 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 frequently still explains agricultural patterns. 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 increased yields of the Green Revolution were truly extraordinary. In subsequent decades, most famines resulted from political instability rather than failure in production. India became self-sufficient in grain production by the 1980s, and Asia as a whole 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. But innovations are continually being developed. 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) may make it 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. 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. Others, however, 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. Moreover, the large-scale monocropping that is often part of Green Revolution agriculture can make farms vulnerable to changes in climate or the infestation of particular pests. One 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.

It is no easy matter to weigh the enormous increases in food production that have occurred in places that have adopted Green Revolution approaches against the types of social and environmental issues highlighted by Shiva.

There is growing concern that higher inputs of chemical fertilizers, herbicides, and pesticides associated with Green Revolution agriculture can lead to reduced organic matter in the soil and to groundwater pollution. Moreover, the Green Revolution has worked against the interest of many small-scale farmers who lack the resources to acquire genetically enhanced seeds and the necessary chemical inputs to grow them.

A 2005 report in *Scientific American* explains that the Green Revolution has done little to alleviate poverty in areas where most farmers still work small plots of land: "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 their position is further undermined by the fact that a few large corporations with the seed patents for genetically modified grains and a virtual monopoly of the needed chemical inputs can have tremendous power over the agricultural production process. 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 target. 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 the production of genetically engineered crops, with 88 percent of all acres in corn (up from 25 percent in 2000) and 94 percent of all acres in soybeans (up from 54 percent in 2000) 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.

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

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 environment and economy, but also relations between men and women (Fig. 11.8). Over the last 30 years, international developmental assistance to 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 and South Asia, 60 percent of all employed females work in the agriculture sector. A geographical perspective 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.

The Impacts of Agricultural Modernization on Earlier Practices

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.

Unlike hunting and gathering, subsistence farming continues to be a relatively common practice in Africa, Middle America, tropical South America, and parts of Southeast Asia (Fig. 11.9). The system of cultivation has changed little over thousands of years. 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. 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 periodically sell a few pounds of grain on the market but where poverty, indebtedness, and tenancy are ways of life. For the indigenous peoples of 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.

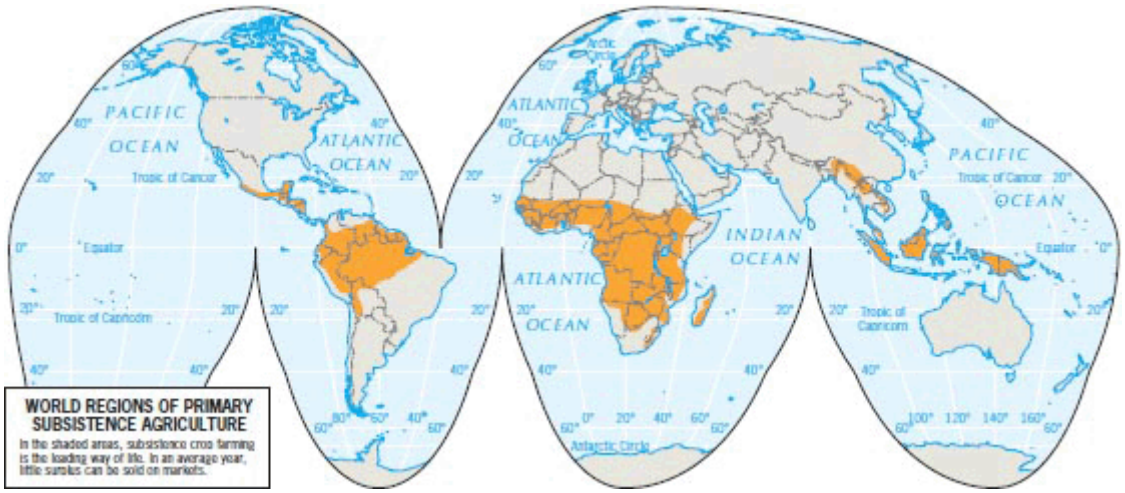

Figure 11.9

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.

Subsistence farming has been in retreat for centuries. From 1500 to 1950, European powers sought to "modernize" the economies of their colonies by ending subsistence farming 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 crop to be sold on the world market 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. 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 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.

Subsistence land use continues to give 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. In the process, small landowners are often squeezed out, leaving the land in the hands of wealthier farmers and the owners of commercialized farming operations.

For too long, the question has been 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 were pushed away from their traditional modes of livelihood even though many aspects of subsistence farming may be worth preserving. Regions with shifting cultivation do not have neat rows of plants, carefully turned soil, or precisely laid-out fields. Yet shifting cultivation conserves both forest and soil; its harvests are often substantial given environmental limitations; and it requires better organization than one might assume. It also requires substantially less energy than more modern techniques of farming. It is no surprise, then, that shifting cultivation and specifically slash-and-burn agriculture have been a sustained method of farming for thousands of years.

thinking geographically

Many arguments have been raised about the impacts of the Green Revolution, both pro and con. How might the scale at which the Green Revolution is examined affect the arguments that are made about it? What types of factors are likely to be considered if the question is, "has the Green Revolution been good for Asia" as opposed to "has the Green Revolution been good for a village or a particular agricultural community in India?"

Inserted from
<http://edugen.wileyplus.com/edugen/courses/crs6655/fouberg9781118018699/c11/fouberg9781118018699c11_3_0.xform?course=crs6655&id=ref&mode=preview>