Land Transformation in Agriculture
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CHAPTER 5
Agricultural Practices Leading to Land Transformation: Introduction

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The preceding chapters have dealt with the history of agriculture and the forces that influence transformation of the land in agriculture. A major series of essays follows in Chapters 5.I–5.VI. The first four of these chapters describe those factors that directly affect or transform the land itself—including irrigation, mechanization, conservation practices and wetland reclamation. Chapters 5.V and 5.VI then deal with indirect influences—fertilizers and substances used to protect plants. Both the direct and indirect influences may alter the land itself as well as the air and water environment. Each essay attempts to deal with the three media in looking at the way these major forces are transforming land, landscape and environment.

The first type of land transformation was the disturbance of natural vegetation—the clearing of land in order to get land suitable for producing food and fibres for human beings and feed for domestic animals. In the beginning only very simple hand tools consisting of pieces of rock or wood were used. These were improved when iron became available. Transforming land by hand, as was done for thousands of years, was hard and time-consuming. It became somewhat easier when draught animals and appropriate implements became available. Finally, when industry developed, all kinds of special machinery and implements became available to reclaim new land, to improve existing agricultural land and to prepare land for sowing, to do weeding and harvesting. Almost all human and animal work was replaced by mechanical work, including clearing of dense forest to get new arable land or grassland. Human and animal energy were replaced by fossil energy. In the past, much land could not be reclaimed because it was too wet or too dry or because the natural vegetation could hardly be removed. At present, such land can be brought under cultivation, provided knowledge and capital are available.

Improvement of the infrastructure—such as new canals, roads and railways—also influenced land transformation as the agricultural products could be more easily transported to markets. Construction of dams in rivers, of irrigation and drainage canals, and of farm ponds were important for irrigation. When diesel and electric pumps became available much more land, including private land, could be irrigated. In addition to improving productivity, irrigation has been accompanied in places by waterlogging and salinization. These degradative effects and techniques for their amelioration are also considered in the following chapters.

Because mismanagement of land has led to significant soil erosion in a number of areas, conservation and land management are considered as separate land-transforming processes. While the productivity of some lands has been completely lost to erosion, erosion and deposition which accompany it are complex phenomena involving both landscape and river systems. Because modern conservation efforts, like large-scale irrigation and drainage projects, involve many land owners or farmers over large areas, they are also likely to involve governments as well. Careful planning is essential and policies and strategies must be developed to guide governments in these land-transforming activities. These issues are implicit in many of the essays that follow and are emphasized particularly in connection with irrigation and conservation management.

Other examples are presented, dealing with changes in land resulting from crop pests and diseases. Phytophagous organisms have always reduced crop yields or prevented cultivation of specific crops. The value of annual food crop losses is currently estimated to be about $300 billion. Farmers have always tried to minimize such crop losses by adoption of crop rotations. Rotation, for example, is particularly important for controlling organisms such as nematodes which are often crop-specific. Yet epidemics of new diseases have developed, because they were accidentally brought into some regions or countries where they did not exist before. In 1939, following the identification of DDT as an insecticide, a wide variety of synthetic organic pesticides have become available. Insecticides, fungicides and herbicides have changed agriculture and agricultural land use during the last decades, as noted in Chapter 4. Traditional crop-rotation systems have been altered, monocropping and no-tillage practices introduced, and agricultural production increased even as the labour force was reduced. Although pesticides have many advantages, there are again shortcomings. Among them are unforeseen side-effects such as the emergence of pesticide-resistant strains of pest organisms, the disturbance of agro-ecosystems and the pollution of the environment. Use and management of pesticides and other materials, including adoption of integrated pest management systems, markedly influences land and its transformation.

Up to the Second World War, inorganic fertilizers were used in only a few

industrial countries. Since then, application has rapidly increased in developed countries and to a more limited extent in developing countries as well. While the application of nitrogen fertilizers is perhaps the single most important factor in worldwide increases in crop yield, land use itself was affected as lands with low nutrient status could be converted into productive crop land. At the same time, intensive application of fertilizers may cause nutrient inbalances in soils, soil and groundwater pollution. Mitigation or avoidance of these effects also transforms the land.

Mechanization in agriculture has contributed significantly to land transformation. As tractors replaced draught animals, much land needed to produce feed for the animals became available for food production. Machinery well-adapted to the situation on the farm reduces the time needed for many tasks, eases the work and frees time for other work. Moreover, various tasks can be carried out at the appropriate time, improving the quality of the work and increasing yields. With the gains, of course, there are losses. For example, a tractor does not produce manure, it makes noise and pollutes the atmosphere. It needs fuel and the capital investment required for mechanization is high. During the last decades more powerful and heavier tractors and machinery have been constructed, leading to increases in weight of the equipment, and in places gradually causing compaction of the soil. In some cases this has changed cropping patterns—for example, the abandonment of root crops on compact, heavy, textured soils.

The following six chapters indicate clearly the advantages and disadvantages of agricultural practices leading to land transformation. Agricultural production depends on land, labour and capital. For traditional agriculture much land and labour and only little capital is needed. In technological agriculture, where more productive crop varieties are used and where inorganic fertilizers, pesticides and mechanization are important, less labour but much capital is needed. Agricultural production must be more intensive and crop yields higher in technological agriculture because of the costs of these inputs. Analyses of historical changes, and of the way current direct and indirect agricultural practices affect the land, clearly demonstrate the dynamic character of forces leading to transformation of the land.