CHAPTER SIXTEEN

Agriculture

The 1970 CEQ annual report included this observation about agriculture:

> *Monoculture has increased production efficiency but has reduced the plant and wildlife diversity essential to a stable ecosystem. These less complex ecosystems are highly susceptible to attack by insects and diseases which can devastate a standing crop or single species regionwide. Moreover, monoculture has forced a heavy dependence on pesticides and fertilizers.*

In the 25 years since the first edition of *Environmental Quality*, the nation has come to value "plant and wildlife diversity" as biodiversity and to adopt "stable" ecosystems as a goal of the federal government. Continued agricultural productivity goes hand-in-hand with a public awareness that the way the nation grows its food and fiber affects all aspects of the environment and impacts all types of ecosystems. In response, federal farm policy has begun to include initiatives to address public concerns for natural resources and environmental quality.

Since about 60 percent of U.S. land is in private ownership (70 percent if Alaska is excluded), according to the Department of Agriculture, agriculture's environmental agenda must target the practicing farmer and rancher. About 2 percent of the U.S. population grows much of the nation's food and fiber, with enough excess to export quantities to other countries. How agricultural land is managed has far-reaching impacts on the state of the environment, from air and water pollution to biodiversity and stable ecosystems.

Conditions and Trends

Since 1950, the total amount of land in U.S. farms—including cropland, forestland, and grazing land—has declined from 1.16 billion acres to 950 million acres in 1992 (Figure 16.1 and Part III, Table 51). Over this same period, the amount of cropland has remained fairly stable, staying within the 460-470 million-acre range (Part III, Table 49).

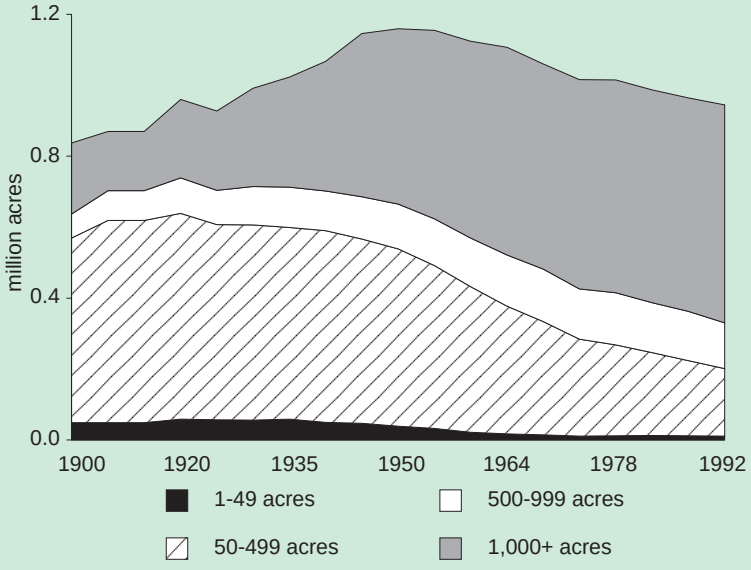
Since 1970, the trend in the United States has been toward fewer and larger farms (Figures 16.2 and 16.3) that are increasingly specialized, mechanized, labor-efficient, and capital-intensive. In the past decade, U.S. farm output per unit of input has increased by 26 percent. The factors responsible for this growth include increased use of fertilizers and pesticides, plus improvements in hybrid plant varieties and animal breeding practices.

In the 1970s, high worldwide demand for U.S. farm commodities, fueled by crop shortages abroad, encouraged a federal

farm policy that emphasized increased production. Farmers began plowing land that had not recently or ever been cropped. In addition to fewer, larger grain farms, the trend was toward more specialized livestock, dairy, and poultry operations and toward regional concentrations of livestock production.

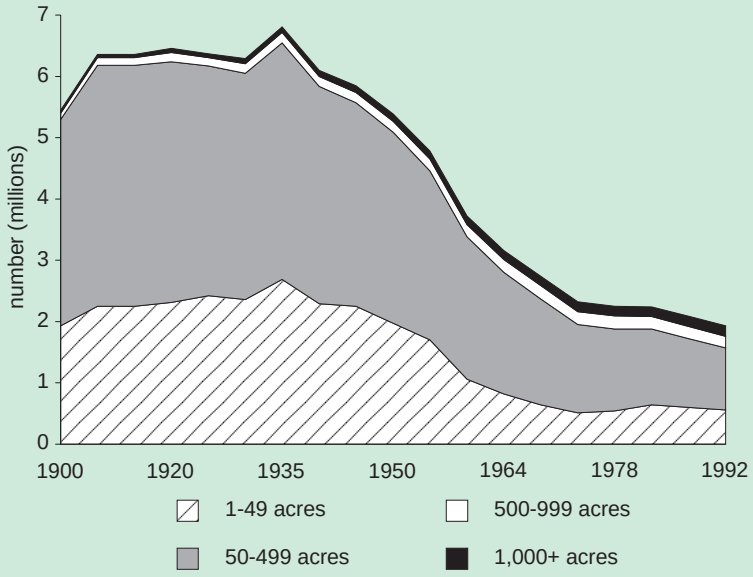
Agricultural programs and policies developed in the 1980s and 1990s have encouraged the use of more sustainable agricultural practices. Provisions of the Food Security Act of 1985 were intended to discourage land use on new-to-farm lands (Sodbuster), highly erodible lands, and wetlands (Swampbuster). The 1985 Farm Bill also established the Conservation Reserve Program (CRP), which offered farmers subsidies to temporarily retire highly erodible lands and other environmentally sensitive croplands from production and plant them to grasses or trees. By targeting highly erodible lands and wetlands, these provisions were designed to deal with commodity surpluses and resource protection. The Food, Agriculture, Conservation, and Trade Act of 1990 strengthened the links between farm production and natural resource conservation. It also introduced the Wetland Reserve Program to reduce wetlands conversions. The new provisions of the 1996 Federal Agricultural Improvement and Reform Act (otherwise known as the 1996 Farm Bill) build on the conservation gains of the past decade, improving performance and efficiency, simplifying existing programs, and creating new programs to address high priority environmental protection goals (see Recent Developments).

Figure 16.1 Land in U.S. Farms by Farm Size, 1900-1992



Source: See Part III, Table 51.

Figure 16.2 U.S. Farms by Farm Size, 1900-1992

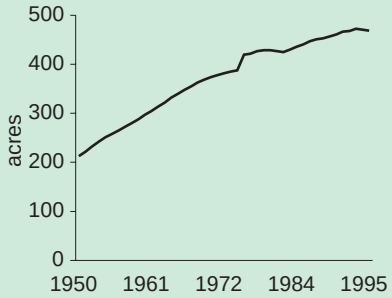


Source: See Part III, Table 51.

Cropland

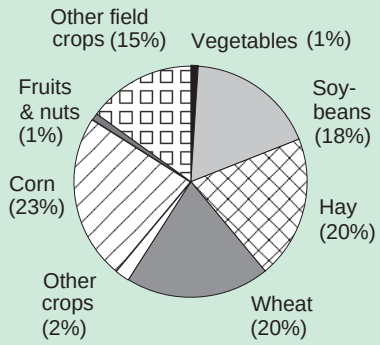
The most intensively used and most valuable agricultural land is generally that planted to crops and known as cropland. Four out of every five cropland acres produce one of four crops: corn, wheat, hay, or soybeans (Figure 16.4). Most of the corn and virtually all of the hay is fed to livestock. Corn, wheat, and soybeans also are major export commodities.

Figure 16.3 Average U.S. Farm Size, 1950-1995



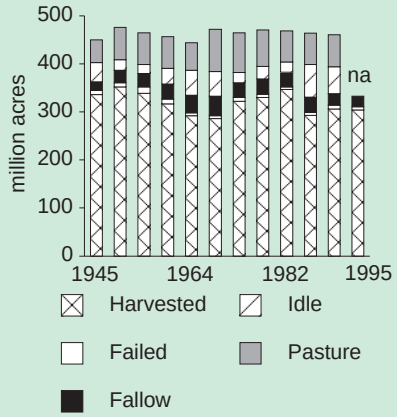
Source: USDA, National Agricultural Statistics Service.

Figure 16.4 Crops Harvested From U.S. Cropland, 1993



Source: USDA, Economic Research Service.
Note: Total cropland harvested=299 million acres.

Figure 16.5 Major Uses of U.S. Cropland, 1945-1995



Source: See Part III, Table 52.
Note: na=not available until next Agricultural Census.

Variations in cropland use (Figure 16.5) have occurred largely as a result of acreage diverted from production by government programs (Figure 16.6).

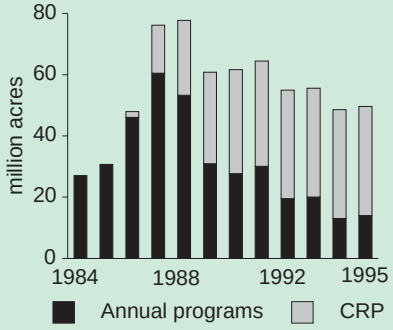
Grazing Lands

According to the Department of Agriculture, the nation has 803 million acres of grazing lands. About 55 percent of grazing lands are privately owned, with the rest on federal lands in 11 western states and Alaska (36 percent), on state and local government land (5 percent), and on land managed by the Bureau of Indian Affairs held in trust for Indian tribes and individuals (4 percent). Of the public-private total, 67 million acres are cropland used for pasture, 591 million acres are grassland pasture and range, and 145 million acres are grazed forestland. The federal agencies that assess the condition of grazing lands—Natural Resources Conservation Service (NRCS), Bureau of Land Management (BLM), Forest Service, and U.S. Environmental Protection Agency (EPA)—have used different approaches but are developing a uniform method to incorporate indicators of more than vegetative species composition.

Bureau of Land Management Rangeland. Through a Rangeland Reform '94 initiative, BLM is making rangeland management more compatible with ecosystem management. The key is restoration and improvement of the public range. Regulations issued in 1995, known as the Healthy Rangeland Initiative, require establishment of new standards of rangeland health and guidelines for grazing management.

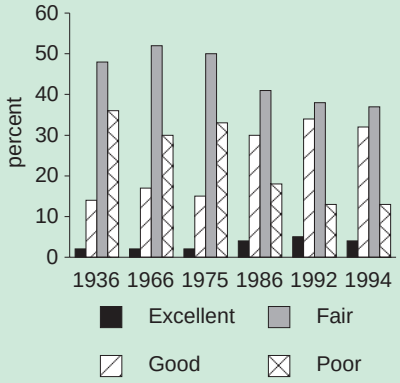
- According to BLM *Public Land Statistics*, the BLM administers 268 million acres of land, of which 164 million acres are managed for grazing under the Taylor Grazing Act, the Public Rangeland Improvement Act,

Figure 16.6 Cropland Idled by USDA Programs, 1984-1995



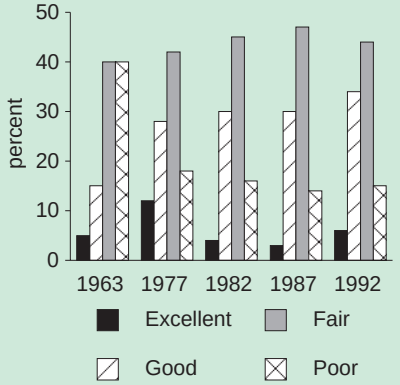
Source: See Part III, Table 52.
Note: CRP=Conservation Reserve Program.

Figure 16.7 BLM Rangeland Condition, 1936-1994



Source: See Part III, Table 60.

Figure 16.8 U.S. Nonfederal Rangeland Condition, 1963-1992



Source: See Part III, Table 60.

and the Federal Land Policy and Management Act. In 1994 the Bureau managed 22,000 grazing allotments in 16 states, collecting a grazing fee of $1.98 per animal unit month from 91,000 operators. In 1995, the number of grazing allotments and operators generally remained the same at the cost of $1.61 per animal unit month.

- The 1994 assessment, as reported in *Public Land Statistics*, reports 5 percent of BLM rangeland in excellent condition, 31 percent in good condition, and 13 percent in poor condition (Figure 16.7). Improved rangeland is attributable to a decrease in livestock numbers from excessive grazing in the past and to better livestock management resulting from cooperative efforts of BLM, livestock operators, other rangeland users, and interest groups.

National Forest System Grazing Lands. According to the USDA Forest Service, half of the 191 million acres in the National Forest System are available for grazing by livestock. Rangeland management on the national forests and grasslands emphasizes restoration and long-term health of rangeland ecosystems. In 1994, the Forest Service administered 9,413 grazing allotments in 32 states and collected $11.1 million in grazing fees. The agency has set management objectives for 75 million acres of its rangeland and in 1994 met or moved toward them on 50 million acres, up 4 million acres from the previous year.

Nonfederal Rangeland. The 1992 National Resources Inventory found an increase of nonfederal rangeland in excellent and good condition (Figure 16.8). As its condition improves, rangeland becomes more resistant to change from natural forces (drought, fire, and flood), but—as with federal rangeland—

more than half of nonfederal rangeland remains in the fair and poor categories.

Conservation Compliance

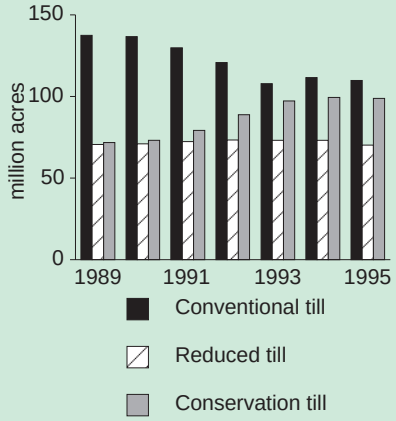
The conservation compliance provision of the 1985 Farm Bill stipulated that farmers with highly erodible lands (HEL) who did not implement approved conservation plans by 1995 would lose eligibility for USDA farm program benefits. Approved conservation plans specify the use of conservation management systems, such as conservation (crop-residue) tillage, on 75 percent of HEL planted to crops. Other conservation practices include contour plowing and stripcropping, vegetative buffer strips, windrows, vegetative covers, and crop rotations.

Conservation tillage systems leave a protective cover of residue on the field from the previous crop, which serves not only as a primary defense against sediment loss, water runoff, and chemical leaching, but also improves soil structure, organic content, and moisture retention. Conservation tillage allows chemicals to break down into harmless components through the action of microorganisms in the organic matter of the residue or in the top layer of soil in the presence of air and sunlight. Used on less than 5 percent of planted acreage prior to 1970, crop residue tillage exceeded 35 percent in 1994 (Figure 16.9) on HEL and on other cropland devoted to corn, cotton, soybeans, and wheat. A greater share of highly erodible cropland (43 percent) was planted with conservation tillage compared to other cropland (33 percent). Use of conservation tillage and crop-residue management is increasing along with related improvements in soil quality.

For corn and soybeans, use of conservation tillage systems, especially no-till or ridge till, has increased much faster than for wheat on highly erodible cropland. Conversely, conservation tillage has not been widely used on cotton acreage.

Many farmers are adopting conservation tillage and other crop-residue management systems for cost savings as well as soil conservation. They cite fuel and labor savings, lower machinery investments, and long-term benefits to soil quality as advantages over conventional tillage systems.

Figure 16.9 U.S. Cropland Tillage Practices, 1989-1995

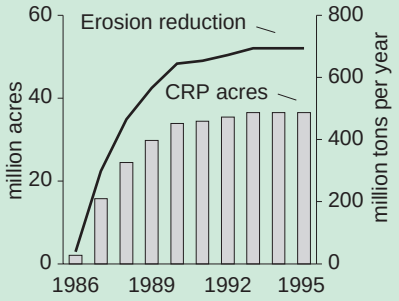


Source: See Part III, Table 53.

Conservation Reserve Program

CRP is a voluntary program under which farmers temporarily convert highly erodible and other environmentally sensitive cropland to soil-conserving uses,

Figure 16.10 CRP Acres and Erosion Reduction, 1986-1995



Source: USDA, Economic Research Service.
Note: Erosion reduction refers to amount of soil prevented from eroding by CRP. Data are cumulative.

such as grass or trees. Since the first CRP signup in 1986, farmers have enrolled more than 36 million acres in the program.

Farmers with land that qualified for CRP bid their land into the program by offering it at an annual per-acre rental rate for 10-15 years. Of the 13 CRP signups to date, the first 5 focused on highly erodible cropland. In 1988, the program expanded to include vegetative filter strips along water bodies to trap sediment, nutrients, and pesticides; and, beginning in 1989, CRP temporarily accepted restoration of previously cropped wetlands.

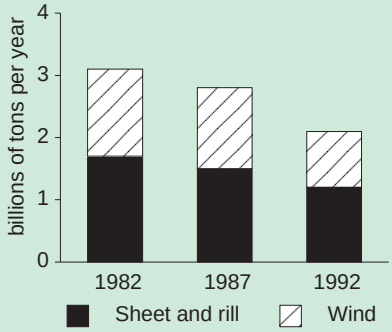
Although farmers and ranchers have planted most CRP acres to grass, 2 million acres are in trees, and another 2 million acres represent special wildlife practices. Nearly half a million acres are restored wetlands, and 8,900 miles of CRP filter strips protect waterways.

Erosion reduction credited to CRP may be as high as 700 million tons annually or 19 tons per acre per year (Figure 16.10). CRP also provides benefits in terms of wildlife habitat and populations, water quality, and restored wetlands and forestlands. The program has reduced federal outlays for farm deficiency payments, strengthened farm income, and helped balance supply and demand for agricultural commodities.

Wetlands Conservation

Wetlands losses attributed to agricultural practices are showing a downward trend. In 1994, NRCS, EPA, the U.S. Fish and Wildlife Service, and the U.S. Army Corps of Engineers signed a memorandum of agreement for delineating wetlands under Section 404 of the Clean Water Act and the wetlands conservation provision of the Food Security Act. Land users will now be able to rely on wetlands determinations made on agricultural land by one agency for all federal programs.

Figure 16.11 U.S. Cropland Erosion by Type, 1982-1992



Source: See Part III, Table 54.

Box 16.1
Natural Resources Conservation Service: Reading the Land

In 1994, Congress renamed the Soil Conservation Service—born in the Dust Bowl days of the 1930s—as the Natural Resources Conservation Service (NRCS) to recognize agriculture's environmental importance. The NRCS provides a variety of services, including:

National Resources Inventory

NRCS constantly "reads the land" to maintain a National Resources Inventory (NRI) and to produce a 5-year report card on trends in soil erosion by water and wind, wetland losses, prime farmland acreage, irrigation, and conservation treatments. Data and analytic software for the most recent NRI (1992) are available to the public on CD-ROM.

The agency links digitized soil surveys with resource data from other agencies in geographic information system (GIS) technology. By layering information from various data sources, GIS shows how pieces of the environment interact and helps landowners, resource managers, and policymakers visualize effects of land-use options.

National Conservation Partnership

NRCS has formed a National Conservation Partnership of federal, state, and nonprofit agricultural groups. Members pledge to provide leadership for "a productive nation in harmony with a quality environment." The partners are NRCS, the National Association of Conservation Districts (NACD), representing 3,000 local conservation districts that promote voluntary conservation practices by farmers and ranchers, and the National Association of State Conservation Agencies (NASCA), a coalition of state conservation agencies that funds conservation districts and programs for sediment control and soil erosion prevention. Partnership efforts include the following:

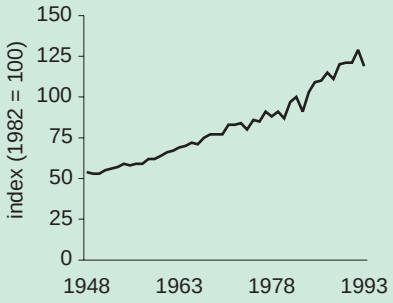
- In Santa Cruz, California, the Partnership developed stabilization practices and revegetation techniques to prevent erosion, landslides, spread of wildfire, and poor water quality.
- The Partnership also developed a community plan for Holly Grove, Arkansas, to help that community deal with creek flooding.

In Louisiana, which has 40 percent of remaining U.S. coastal wetlands and 80 percent of coastal wetlands losses, NRCS is helping landowners with a watershed management approach to conserve wetlands while meeting landowner objectives for fisheries, wildlife habitat, wildlife management, and grazing. An NRCS plant materials center in Louisiana conducts studies on wetlands plant species to use in wetlands restoration (see also Chapter 15, "Wetlands").

Soil Erosion

In the past decade, the USDA has administered conservation programs responsible for saving a billion tons of soil—a remarkable soil conservation success story. Soil erosion is a universal problem. In the East, Southeast, Midwest,

Figure 16.12 U.S. Agricultural Productivity, 1948-1993



Source: See Part III, Table 55.

Northwest, and other humid regions of the United States, sheet-and-rill erosion occurs as water removes soil in thin layers (sheets) and tiny channels (rills). In many parts of the Great Plains and West, wind erosion is the more serious problem. The average annual rate of sheet-and-rill erosion on cropland was 3.1 tons per acre in 1992, down 25 percent in a decade (Figure 16.11). Cropland wind erosion also declined from 3.3 to 2.5 tons per acre, due in large part to the HEL provisions. Preliminary results of a 1995 erosion study suggest a continuation of this downward trend, but 135 million acres continue to erode at rates above T (the soil-loss tolerance rate, at which erosion does not reduce the long-term productivity of soil). NRCS provides a variety of programs to promote soil conservation (Box 16.1).

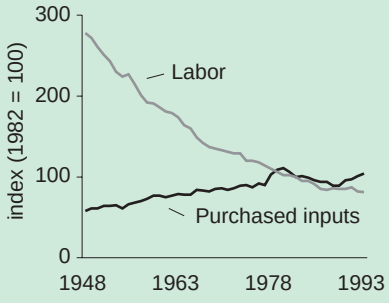
Agricultural Productivity

Productivity—the difference in rates of growth in output and aggregate input—of U.S. agriculture has increased each year since World War II (Figure 16.12). Excluding 1993 when extensive flooding in the upper Mississippi and lower Missouri River basins severely curtailed output, the average annual rate of increase is 1.84 percent. Stable aggregate inputs disguise shifts in intermediate (purchased) inputs that have increased 1.3 percent per year (Figure 16.13). Underlying this increase are energy inputs that increased 1 percent per year and chemicals that increased at 2.5 percent annually, while labor input decreased 2.75 percent per year.

Fertilizer Use

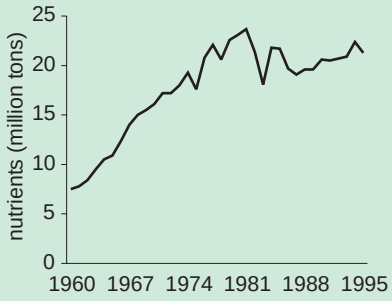
When rain or irrigation water flushes fertilizers past the reach of crop roots, it means not only a waste of expensive inputs but a threat to the environment. Agricultural runoff, rich in nitrogen and phosphorus, can pollute surface waters and groundwater. For this reason, nutrient management practices that help adjust fertilizer applications to crop

Figure 16.13 U.S. Agricultural Inputs, 1948-1993



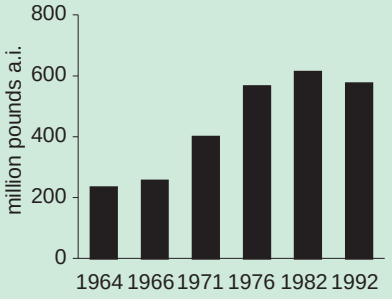
Source: See Part III, Table 55.
Note: Purchased inputs=energy, chemicals, feed, etc.

Figure 16.14 U.S. Commercial Fertilizer Use, 1960-1995



Source: See Part III, Table 57.

Figure 16.15 U.S. Farm Pesticide Use, 1964-1992



Source: USDA, Economic Research Service.
Note: a.i.=active ingredients.

needs and reduce losses to the environment are seeing increased use.

The total amount of nitrogen, phosphate, and potash used for all purposes (farms, lawns, golf courses, home gardens, and other nonfarm lands) tripled in the United States between the 1960s and 1980s, peaking at 23.7 million tons in 1981 (Part III, Table 57). The total volume used in 1995 was 21.3 million tons, in step with total crop acreage declines (Figure 16.14). Nitrogen use also has tripled and equaled 11.7 million tons or 55 percent of all commercial fertilizers used in 1995. In contrast, phosphate's share declined to 21 percent, and potash now exceeds phosphate at 24 percent. According to Department of Agriculture estimates, agriculture accounts for greater than 80 percent of total U.S. fertilizer use.

Pesticide Use

Farmers began widespread use of pesticides—herbicides, insecticides, fungicides, and others—in the late 1950s, and today agriculture accounts for about three fourths of all pesticide use in the United States, according to EPA. The industrial, commercial, and government sector uses 18 percent, with the remainder used by the home and garden sector.

Pesticides promote reliable harvests, quality crops, and stable farm income. Many pesticides have adverse environmental and health impacts, but most environmentally damaging pesticides have been or are being taken off the market, and farmers have refined pesticide management to reduce farm worker exposure and environmental damage (Box 16.2).

After peaking in 1980, pesticide use declined through 1993 (Figure 16.15). Preliminary EPA figures suggest that the total volume of active ingredients may have rebounded in 1994 and 1995.

Corn, with the largest acreage of all U.S. crops, also exceeds other commodities in pesticide use. In 1995, corn accounted for 35 percent of major crop acres and 47 percent of all pesticide use (including 63 percent of all herbicide use and 35 percent of all insecticide use).

Box 16.2
Integrated Pest Management

Integrated Pest Management (IPM), which coordinates natural pest controls with pesticide use, gained attention in the 1970s as a strategy for responding to the adverse environmental effects of DDT and other insecticides. IPM techniques include prevention, monitoring, mechanical trapping devices, natural predators, biological pesticides, and, if appropriate, chemical pesticides.

Biological pesticides, which target specific pests, are considered to pose little or no risk to human beings, other species, or the environment. They include insect growth regulators, which halt or interfere with the development of an insect before it matures; pheromones, which disrupt normal mating behavior by stimulating breeding pests and luring them into traps; and microbial pesticides, which infect specific pests.

IPM Studies

Government and university studies that track IPM have found greater use of biocontrol techniques in fruit, vegetable, and cotton production, where insects are the major pest problem, than in corn, soybeans, and wheat, where weeds are the major pest. Insecticide use on 11 major agricultural crops declined by more than half between 1971 and 1990 (measured by pounds of active ingredients). In contrast, herbicide use on the same crops almost doubled before peaking in the early 1980s and leveling off by 1990.

IPM surveys made in the 1990s found that although monitoring and thresholds for insect pests were common in fruit, vegetable, and cotton production, only crop rotation and a few other nonchemical control techniques were widely used, except in certified organic production systems. Half of the fruit and nut acreage and three-fourths of the vegetable acres in surveyed states were scouted for insects; and economic thresholds were used to make pesticide treatment decisions on scouted acres. On fruit and nut acreage, producers used the following IPM techniques in varying amounts: traps to lure harmful insects, beneficial insects, resistant varieties, and pheromones. Vegetable crop producers used purchased beneficial insects, pheromones, and adjusted planting dates. Surveyors found such techniques in common use on certified organic vegetable acreage.

IPM techniques used for corn included scouting and thresholds for insect pests, banded applications of herbicides, and a shift to post-emergence herbicides. Only 10 percent of corn and soybean growers alternated herbicides to slow development of resistance. Producers who practiced banding reduced herbicide use significantly. Half of the corn and soybeans were grown in rotation with each other, while monoculture was practiced on two-thirds of cotton acreage. Farmers rotating corn with other crops used insecticides less frequently than did those planting corn two years in succession (11 percent versus 46 percent).

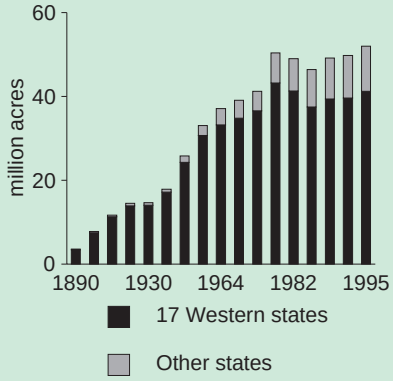
Pesticide Environmental Stewardship Program

This effort by EPA, USDA, and the U.S. Food and Drug Administration to reduce pesticide use and risk in agricultural and other settings relies on public/private partnerships. When the agencies announced PESP partnerships in 1994, more than 20 private organizations signed on as charter members to help attain the following goals:

- To develop use/risk reduction strategies including reliance on biological pesticides and other controls thought to be safer than traditional chemical methods.
- By 2000, to have 75 percent of U.S. agricultural acreage in integrated pest management programs.

More than 50 major groups are now either PESP partners or supporters. Partners are groups that use pesticides or represent pesticide users and agree to adopt strategies to reduce the use and risk of pesticides; and supporters are groups, such as food processors, that do not use pesticides but do influence pest management practices and agree to promote environmental stewardship programs.

Figure 16.16 Irrigated U.S. Farmland, 1890-1995



Source: See Part III, Table 59.

Irrigation

Farmland irrigation, which today is practiced in all 50 states, developed in three waves (Figure 16.16). The initial wave, a western phenomenon that lasted into World War I, was characterized by private or local district development of surface water sources relying primarily on gravity to convey water to nearby farms and distribute it over fields.

World War II triggered a second wave of development, also in the West, that used efficient, high capacity pumps and electric power. A third wave of development followed the export-led agriculture boom of the 1970s and built on new deep-well pumping technology, center-pivot sprinklers, and other labor-saving technologies. All regions participated in this last growth phase.

In 1890, when questions relating to irrigation were first included in the Census of Agriculture, the nation already had 3.6 million acres under irrigation, with a million irrigated acres in California. In 1995, the Department of Agriculture estimates that some 52 million acres of irrigated land produced 40 percent of total crop value—on only 15 percent of total harvested cropland. Economic value and total production output from irrigated lands continues to increase, even as irrigated cropland has begun to decrease.

RECENT DEVELOPMENTS

The 1996 Farm Bill

In 1996, Congress completed action on a new farm bill—the Federal Agriculture Improvement and Reform Act of 1996—that was designed to, among other things, further integrate environmental values into U.S. agricultural policy.

President Clinton signed the 1996 Farm Bill on April 4, 1996 (PL 104-127). Briefly, the new law includes the following conservation provisions :

- A major change in federal farm policy that would almost completely eliminate production-based payments. Farmers would receive income-support payments for 7 years as long as they comply with existing conservation plans for the farm, wetland provisions, and planting flexibility provisions, as well as to keep the land in agricultural uses.
- Extension of the Wetlands Reserve Program and Conservation Reserve Program through 2002. Landowners would have more options for protecting wetlands and highly erodible lands. In the WRP, landowners would be able to choose either permanent or

30-year easements or restoration cost-share agreements.

- Modification of swampbuster and wetlands provisions to provide farmers with more flexibility to meet wetlands conservation compliance requirements. Changes would expand areas where mitigation could be used, allowing mitigation by restoration, enhancement, or creation, and changing the abandonment clause.

- Changes in conservation compliance, directing USDA employees who provide on-site technical assistance to notify landowners of potential compliance problems. Landowners would be allowed time for corrective action and, in cases of economic hardship, would be eligible for relief.

- A new Environmental Quality Incentives Program would consolidate conservation programs, focusing assistance on locally identified conservation priority areas or areas where agricultural improvements would help meet water quality goals or other natural resource concerns, such as wildlife and wetlands. The program would provide technical assistance, costsharing, or incentive payments for conservation practices. Half of the funds would be targeted to conservation on livestock operations.

- A new farmland protection program that would help farmers preserve their land in agriculture. A federal program would assist states, tribes, and local governments with existing farmland protection programs and the purchase of conservation easements.

- A new Wildlife Habitat Incentives Program would help landowners improve wildlife habitat on private lands.

- A flood risk reduction program that would allow farmers to contract for a lump-sum payment of remaining income support on lands with high flood potential, if they forego some USDA benefits. The program would create incentives to switch to less vulnerable cropping practices such as pasture or to move farming operations entirely from frequently flooded land.

- An emergency watershed protection program that would allow purchase by the federal government of floodplain easements.

- A conservation of private grazing land initiative that would offer landowners technical, educational, and related assistance on private grazing lands.

- Membership in State Technical Committees, groups which provide guidance on technical standards for conservation programs, would be broadened to include agricultural producers and others knowledgeable about conservation.

- A new conservation farm option would be created for producers of wheat, feed grains, upland cotton, and rice who are eligible for Agriculture Market Transition Contracts. Under a pilot program, landowners would be able to consolidate their payments from the Conservation Reserve Program, Wetlands Reserve Program, and proposed environmental quality

incentive program into one annual payment. Participants would enter into a multi-year contract and agree to adopt a conservation farm plan.

- Expansion of the definition of agricultural land to include not only cropland and pastureland but also rangeland, native pastureland, other land used to support livestock production, and tree farms.

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