## 6.4 Water Quality Programs

*Federal and State governments both have developed several approaches for protecting water quality. These approaches use a variety of incentive mechanisms for reducing pollution discharges. Pollution from factories and other point sources is controlled through regulations and penalties. In contrast, programs for reducing pollution from agriculture and other nonpoint sources rely most heavily on voluntary approaches providing education, technical, and cost-sharing assistance.*

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Water quality protection has a been a major component of U.S. environmental policy since the enactment of the Federal Water Pollution Control Act Amendments of 1972 (Clean Water Act). The focus of clean water legislation has mainly been on point sources, primarily the discharge from factories and municipal sewage treatment plants. A technology- and performance-based regulatory approach has achieved substantial reductions in point source pollution. Many water quality problems still remain, however (see chapter 2.3 for discussion of water quality status and trends and pollution from agriculture). In recent years, attention has turned to nonpoint sources, primarily runoff from agricultural operations. Federal and State programs have been implemented to address agricultural sources of pollution. Federal water quality programs are administered primarily by EPA and by USDA (see box). Some EPA and State programs require mandatory actions, while USDA programs are generally voluntary.

### USDA Conservation Programs

USDA conservation programs are multipurpose, addressing a variety of conservation and environmental goals, one of which is water quality. USDA uses six broad instruments to achieve conservation and environmental goals, including: technical assistance and education, financial assistance (cost-sharing and incentive payments), public works projects, rental and easement payments, data and research, and compliance requirements "linked" to commodity and other USDA program benefits (see Chapter 6.1). Typically one or two of these instruments are evident in the many programs and activities USDA uses to address water quality and pollution prevention. For example, the Environmental Quality Incentive Program (EQIP) provides technical assistance and cost-sharing for the adoption of conservation systems, including best management practices (BMPs). Land retirement programs such as the Conservation Reserve Program make rental payments to farmers to take land out of production and place it in conservation uses and provide technical assistance to help manage retired land. Technical assistance plays a crucial role in helping farmers to plan and to implement conservation systems. Previous experience with USDA voluntary programs has indicated that financial assistance is often critical in getting farmers to try new practices; education and technical assistance alone are not enough (Ribaudo, Horan, and Smith, 1999). Experience with USDA programs is summarized in the box "Lessons Learned from USDA Water Quality Programs".

USDA research programs complement the other five approaches. Activities include: research on new and alternative crops and agricultural technologies to reduce agriculture's harmful impacts on water resources; research that estimates the economic impacts of policies, programs, and technologies designed to improve water quality and prevent pollution; and data collection on environmental and conservation issues. USDA also administers competitive grants and coordinates conservation and water quality research conducted by State Agricultural Experiment Stations and land-grant universities.

USDA allocated $286 million in fiscal year 1999 for water quality directed and associated activities (table 6.4.1). About two-thirds went into education, technical, and financial assistance to producers to implement BMPs aimed at reducing polluted runoff. The other one-third went into research and development activities related to water quality.

***Environmental Quality Incentive Program***

The Environmental Quality Incentive Program (EQIP) was initiated in the 1996 Federal Agriculture Improvement and Reform Act (1996 Farm Act). It combines the functions of the Agricultural Conservation Program, Great Plains Conservation Program, Water Quality Incentives Program, and Colorado River Salinity defined as watersheds or other regions facing serious threats to soil, water, and related natural resources, including grazing lands, wetlands, and wildlife habitat. The goal of maximizing program cost effectiveness is a priority in funding CPA's and contracts. Contracts are for 5 to 10 years, and the annual payment limit is $10,000 per person, with a maximum of $50,000 per contract. The funding requested for 1999 by USDA was $300 million, but only $174 million was appropriated. By statute, half of the available funding for the program is targeted at practices related to livestock production. (table 6.4.2) shows the funding allocations to States for EQIP through 1998, and (table 6.4.3) shows the major practices installed with EQIP funds in 1997. In 1997, 56 percent of EQIP funds were allocated to water quality concerns, 23 percent to soil erosion, 11 percent to water quantity, and 4 percent to wildlife habitat (USDA, NRCS, 1998).

***Conservation Technical Assistance***

The Conservation Technical Assistance Program (CTA) was authorized by the Soil Conservation and Domestic Allotment Act of 1935. Conservation Technical Assistance is administered by the Natural Resources Conservation Service (NRCS; see chapter 6.1). The purpose of CTA is to assist land-users in planning and implementing conservation systems for reducing erosion, improving soil and water quality, improving and through conservation districts to land-users voluntarily applying conservation and to those who must comply with local or State laws and regulations. CTA assists agricultural producers to comply with the highly erodible land and wetland provisions of the Food Security Act of 1985, and provides technical assistance to participants in USDA cost-share and conservation assistance programs. As a component of the CTA program, NRCS and state conservation district personnel can help State and regional planning agencies with nonpoint source pollution control planning. conserving wetlands, enhancing fish and wildlife habitat, improving air quality, improving pasture and range conditions, reducing upstream flooding, and improving woodlands. Assistance is provided through conservation districts to land-users voluntarily applying conservation and to those who must comply with local or State laws and regulations. CTA assists agricultural producers to comply with the highly erodible land and wetland provisions of the Food Security Act of 1985, and provides technical assistance to participants in USDA cost-share and conservation assistance programs. As a component of the CTA programs, NRCS and state conservation district personnel can help State and regional planning agencies with nonpoint source pollution control planning.

**Table 6.4.1 - USDA spending directly related to water quality improvement, fiscal years 1996-99**

| Activity | Unit | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|
| **Educational, technical, and financial assistance activities:** | | | | | |
| Demonstration Projects-- | Mil. dol. | 5.4 | 3.7 | 1.0 | 0.3 |
| Total USDA funding[1] | Percent | 30/70/0 | 49/51/0 | 100/0/0 | 100/0/0 |
| Ratio education/technical/financial | | | | | |
| Hydrologic Unit Area projects-- | Mil. dol. | 15.4 | 10.250/ | 2.8 | 0.9 |
| Total USDA funding | Percent | 33/67/0 | 50/0 | 100/0/0 | 100/0/0 |
| Ratio education/technical/financial | | | | | |
| Water Quality Incentive ProjectsB | | | | | |
| Total USDA funding | Mil. dol. | 11.0 | 0 | 0 | 0 |
| Ratio education/technical/financial | Percent | 33/67/0 | | | |
| Environmental Quality Incentive ProgramB | | | | | |
| Total USDA funding | Mil. dol. | | 200.0 | 200.0 | 174.0 |
| Ratio education/technical/financial | Percent | 100.0 | 3/10/87 | 2/19/79 | |
| Improved program support-- | | | | | |
| CSREES | Mil. dol. | 3.3 | 2.7 | 4.5 | 7.2 |
| NRCS | Mil. dol. | 7.6 | 7.7 | 7.7 | 7.7 |
| ERS | Mil. dol. | 0.4 | 0.4 | 0.4 | 0.4 |
| Contribution to regional initiatives-- | | | | | |
| Regional projects | Mil. dol. | 15.0 | 11.0 | 6.1 | 7.0 |
| Clean Water Act/Coastal Zone Management Act | Mil. dol. | 0.3 | 0.3 | 0.3 | 0.3 |
| **Research and development activities--** | | | | | |
| Geographic Systems | Mil. dol. | 10.0 | 10.4 | 10.9 | 11.0 |
| Component research | Mil. dol. | 8.3 | 7.8 | 7.7 | 7.3 |
| Contributing research | Mil. dol. | 63.4 | 68.4 | 67.9 | 67.7 |
| **Database development and evaluation activities--** | Mil. dol. | 0.8 | 0.8 | 0.8 | 0.8 |
| ERS for agricultural chemical database | Mil. dol. | 0.3 | 0.2 | 0.2 | 0.2 |
| National Agricultural Library for information center | | | | | |
| **Total USDA funding for water quality and related** conservation activities | Mil. dol. | 241.2 | 323.5 | 309.6 | 286.4 |

| Table 6.4.2 - EQIP fund allocations, by State, FY 97-99 | | | |
|---|---|---|---|
| | 1997 | 1998 | 1999 |
| Alabama | 4,275 | 3,200 | 3,209 |
| Alaska | 192 | 432 | 421 |
| Arizona | 2,249 | 5,069 | 6,887 |
| Arkansas | 5,739 | 6,490 | 3,680 |
| California | 5,592 | 7,558 | 8,087 |
| Colorado | 6,490 | 6,386 | 7,390 |
| Connecticut | 590 | 614 | 686 |
| Delaware | 759 | 1,113 | 852 |
| Florida | 3,692 | 4,774 | 4,689 |
| Georgia | 4,656 | 4,267 | 3,612 |
| Hawaii | 552 | 1,051 | 574 |
| Idaho | 3,435 | 4,143 | 2,810 |
| Illinois | 5,692 | 4,198 | 3,078 |
| Indiana | 2,978 | 3,180 | 2,481 |
| Iowa | 5,472 | 5,490 | 4,085 |
| Kansas | 7,400 | 5,188 | 4,294 |
| Kansas | 7,400 | 5,188 | 4,294 |
| Kentucky | 3,652 | 2,891 | 2,721 |
| Louisiana | 5,465 | 5,311 | 3,151 |
| Maine | 3,173 | 2,545 | 1,871 |
| Maryland | 1,584 | 2,249 | 1,863 |
| Massachusetts | 550 | 860 | 824 |
| Michigan | 5,105 | 4,157 | 3,866 |
| Minnesota | 6,865 | 5,569 | 5,097 |
| Mississippi | 4,849 | 5,391 | 4,343 |
| Missouri | 5,746 | 4,975 | 4,364 |
| Montana | 7,095 | 6,294 | 5,710 |
| Nebraska | 5,992 | 5,023 | 4,211 |
| Nevada | 960 | 1,507 | 1,259 |
| New Hampshire | 653 | 372 | 533 |
| New Jersey | 734 | 1,070 | 847 |
| New Mexico | 3,031 | 3,865 | 5,130 |
| New York | 4,069 | 4,560 | 3,336 |
| North Carolina | 4,879 | 5,720 | 4,377 |
| North Dakota | 4,788 | 4,479 | 3,712 |
| Ohio | 3,532 | 3,284 | 2,882 |
| Oklahoma | 4,898 | 5,391 | 4,580 |
| Oregon | 4,045 | 4,219 | 3,948 |
| Pacific Basin | 316 | 516 | 279 |
| Pennsylvania | 3,954 | 4,180 | 2,991 |
| Puerto Rico and Virgin Is. | 516 | 1,159 | 846 |
| Rhode Island | 262 | 245 | 371 |
| South Carolina | 2,955 | 2,080 | 2,000 |
| South Dakota | 4,772 | 4,348 | 4,208 |
| Tennessee | 3,156 | 3,056 | 2,673 |
| Texas | 15,733 | 16,335 | 13,336 |
| Utah | 3,693 | 3,838 | 3,133 |
| Vermont | 1,513 | 1,218 | 1,173 |
| Virginia | 3,481 | 2,631 | 2,798 |
| Washington | 4,093 | 4,999 | 3,706 |
| West Virginia | 2,014 | 1,809 | 1,584 |
| Wisconsin | 5,078 | 4,356 | 3,981 |
| Wyoming | 3,196 | 3,875 | 3,461 |
| | | | |
| Total allocated to States | 196,167 | 197,500 | 172,000 |
| Unallocated | 3,833 | 2,500 | 2,000 |
| Total funding | 200,000 | 200,000 | 174,000 |
| | | | |
| Source: USDA, Natural Resources Conservation Service | | | |

| Table 6.4.3- Major practices installed under FY 1997 EQIP contracts | |
|---|---|
| Prescribed or Improved Grazing | 2,800,000 acres |
| Pasture or Hayland Management | 400,000 acres |
| Animal Waste Management Facility | 103,000 units |
| Nutrient Management | 1,900,000 acres |
| Pest Management | 1,200,000 acres |
| Residue Management | 1,200,000 acres |
| Irrigation Water Management | 400,000 acres |
| Source: USDA, Natural Resources Conservation Service | |

***Conservation Compliance***

Conservation Compliance provisions were enacted in the Food Security Act of 1985 to reduce soil erosion. Producers who farmed highly erodible land (HEL) were required to implement a soil conservation plan, including prescribed or alternative technical practices, to remain eligible for programs such as commodity price and income upport, crop insurance (dropped in 1996), disaster relief, Conservation Reserve Program (CRP), and farm loans (see chapter 6.3 for more on compliance mechanisms). USDA provides technical assistance for planning and implementing the practices, and cost-share assistance may be available through financial assistance programs. The magnitude of erosion reductions from conservation compliance has resulted in sizable water quality benefits. Over 76 million acres of HEL cropland are subject to compliance. As of 1998, nearly all of this land was operating under approved conservation plans.

***Conservation Reserve Program***

The Conservation Reserve Program (CRP) was established in Title XII of the Food Security Act of 1985 as a voluntary long-term cropland retirement program. USDA provides CRP participants with an annual per-acre rent and half the cost of establishing a permanent land cover (usually grass or trees) in exchange for retiring highly erodible or other environmentally sensitive cropland for 10-15 years. CRP enrollment reached 36.4 million acres in 1993. At its peak in 1993, the CRP reduced soil erosion by nearly 700 million tons per year, or 19 tons per acre. This was a 22-percent reduction in U.S. cropland erosion from that occurring in 1982 (USDA, ERS, 1997). At the end of 1998, about 30 million acres were enrolled in the program. While the initial focus was to prevent soil erosion on highly erodible cropland, improving water quality has grown as an emphasis of the program. Under the 1996 Farm Act, new acreage enrolled in the CRP had to meet higher environmental and conservation criteria to be accepted, and provide significant soil erosion, water quality, or wildlife benefits.

Related to the CRP is the Conservation Reserve Enhancement Program (CREP). This is a State-Federal partnership program, for partial field retirement aimed at specific State and nationally significant water quality, soil erosion, and wildlife habitat problems related to agriculture. As of October 1999, Delaware, Illinois, Maryland, Minnesota, New York, North Carolina, Oregon, and Washington had signed CREP agreements. (For more on the CRP and CREP, see chapter 6.2.)

***Buffer Initiative***

Under the 1997 National Conservation Buffer Initiative, USDA pledged to help landowners install 2 million miles (more than 7 million acres) of conservation buffers by the year 2002. Unlike other programs designed to help reduce sources of pollution, the Buffer Initiative is aimed at pollutant interception. Agricultural producers and other landowners who install buffers can improve soil, air, and water quality; enhance wildlife habitat; restore biodiversity; and create scenic landscapes. The initiative makes use of existing programs to help accomplish its goal, such as the continuous signup provision of the Conservation Reserve Program (CRP), Environmental Quality Incentives Program (EQIP), Wildlife Habitat Incentives Program (WHIP), Wetlands Reserve Program (WRP), Stewardship Incentives Program (SIP), and the Emergency and Watershed Protection Program (EWP). To date, approximately 949,400 acres of buffers have been established under the CRP continuous sign-up. The CREP focuses on buffer practices.

***Wetlands Reserve Program***

The Wetlands Reserve Program was authorized in 1990 as part of the Food, Agriculture, Conservation and Trade Act of 1990. Administered by NRCS, the WRP provides easement payments and restoration cost-shares to landowners who permanently return prior-converted or farmed wetlands to wetland condition. Easement payments cannot exceed the fair market value of the land, less the value of permitted uses, such as hunting or fishing leases or managed timber harvest. An enrollment goal of 975,000 acres by the year 2000 was set. As of September 1999, over 785,000 acres had been enrolled (USDA, NRCS, 1999a).

The Wetlands Reserve Program provides flood damage mitigation and wildlife habitat benefits, but retiring cropland and maintaining and restoring wetlands also has major water quality benefits. Some benefits arise from reduced erosion and chemical use on former cropland, but the greatest potential benefits come from the ability of wetlands to filter sediment and agricultural chemicals from runoff and to stabilize stream banks. The value of wetlands and other riparian vegetation as water purification systems has been well documented (Cooper and others, 1987; Cooper and Gilliam, 1987). Wetlands in a demonstration project in Iowa were found to retain from 40 to 95 percent of influent nitrogen (Mitsch et al., 1998). Research in Illinois indicates that adequate flood control and water quality improvements in a watershed can be achieved with as little as 2 to 5 percent of the watershed acreage in strategically located wetlands (Stevens, 1995). (For more on the Wetlands Reserve Program, see chapter 6.5).

***Small Watershed Program***

The Small Watershed Program was authorized in 1954 (PL 83-566). Through this program, NRCS provides technical and financial assistance to States, local units of government, tribes, and other sponsoring organizations to voluntarily plan and install watershed-based projects on private lands. The purposes of watershed projects include watershed protection, flood prevention, water quality, soil erosion, water supply, irrigation water management, sedimentation control, fish and wildlife habitat enhancement, and wetland restoration. As of March 1999, over 1,600 projects were in operation (USDA, NRCS, 1999b).

***Wildlife Habitat Incentives Program***

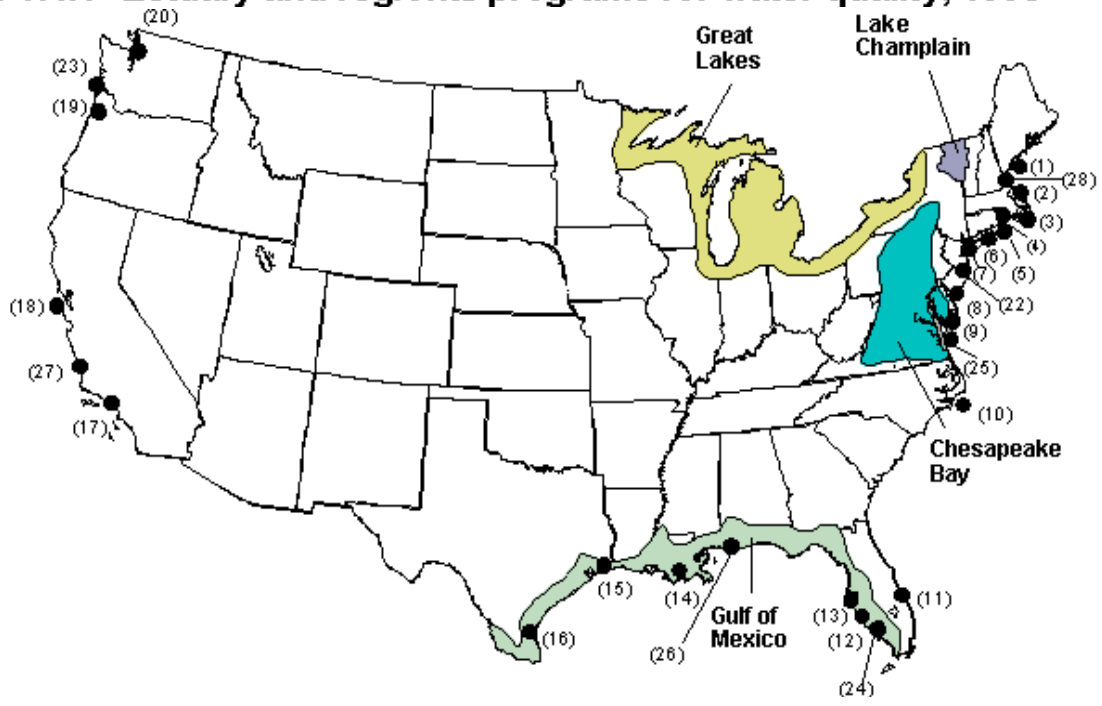
The Wildlife Habitat Incentives Program was created by the 1996 Farm Act to provide cost-sharing assistance to landowners for developing habitat for upland wildlife, wetland wildlife, threatened and endangered species, fish, and other types of wildlife. The 1996 Act authorized a total of $50 million from CRP funds to conduct the program for FY 1996-2002, which have all been obligated (see chapters 3.3 and 6.1).

The primary goal of the program is to enhance habitat for wildlife. Water quality improvement objectives are secondary, but converting cropland to wildlife habitat can help improve water quality through reduced chemical use and soil erosion and reduced runoff from fields. Some of the types of wildlife habitat eligible for protection that have clear water quality benefits include wetlands, riparian corridors, and fish habitat.

***USDA Support of Non-USDA Programs***

USDA supports several water quality projects sponsored under non-USDA programs. USDA provides accelerated technical and financial assistance to farmers in the upland areas of the 21 EPA National Estuary Program projects through CTA and EQIP. USDA provides the same support to several multi-agency regional programs to manage and protect water resources. These include the Chesapeake Bay Program, Great Lakes National Program, Gulf of Mexico Program, and the Lake Champlain Program (see following section on EPA programs for details). USDA support for the Estuary Program and regional programs totaled $6.1 million in 1998 (fig. 6.4.1).

**Figure 6.4.1–Estuary and regional programs for water quality, 1998**




Estuaries of nation significance: (1) Casco Bay, (2) Massachusetts Bay, (3) Buzzards Bay, (6) Long Island Sound, (7) New Your-New Jersey Harbor, (8) Delaware Bay, (9) Delaware Inland Bays, (10) Albermarle-Pamilico Sound, (11) Indian River Lagoon, (12) Sarasota Bay, (13) Tampa Bay, (14) Barrataria-Terrebonne Estuary, (15) Galveston Bay, (16) Corpus Christi Bay, (17) Santa Monica bay, (18) San Francisco Bay, (19) Tillamook Bay, (20) Puget Sound, (21) San Juan Bay (Puerto Rico, not pictured), (22) Barnegat Bay, (23) Columbia River Estrary, (24) Charlotte Harbor, (25) Maryland Coastal Bays, (26) Mobile Bay, (27) Morro Bay, (28) New Hampshire Estuaries.

Technical assistance provided by the Natural Resources Conservation Service.
Source: USDA, ERS, based on Natural Resources Conservation Service information.

USDA is assisting EPA's Clean Lakes Program by targeting some of the Small Watershed Program flood-control projects to Clean Lakes Program projects. USDA is also providing program support in many of EPA's Section 319 nonpoint-source watershed projects. Technical assistance from NRCS for Section 319 projects totaled $300,000 in 1998.

**EPA Programs Affecting Agriculture**

While Federal water quality laws tend to focus on point sources, they do not ignore nonpoint sources. The primary Federal law, the Clean Water Act (CWA), addresses both point and nonpoint source pollution. Point sources are controlled through enforceable mechanisms. Pollution from point sources is subject to (1) technology-based controls, which consist of uniform, EPA-established standards of treatment that apply to certain industries and municipal sewage treatment facilities, and (2) water quality-based controls where technology-based controls are not adequate to meet State water quality standards. These standards consist of designated uses to be made of the streams and the criteria necessary to protect those uses, and an anti-degradation clause. Individual discharge requirements are based on the effluent quality needed to ensure compliance with the water quality standards. Most States are using an approach based on requiring the best available technology to reduce water pollution, but Oregon, Idaho, and North Carolina are using an approach based on water quality performance in some watersheds. Effluent limits are enforced through the National Pollutant Discharge Elimination System (NPDES) permits. Confined animal feeding operations larger than 1,000 animal units, and animal feeding operations with 300 - 1000 animal units that meet certain discharge definitions, are considered point sources and fall under the NPDES system. Currently, over 6,000 animal feeding operations are large enough to require an NPDES permit. However, enforcement has been a problem, and many facilities lack permits (Westenbarger and Letson, 1995).

Section 319 of the CWA calls for controls on nonpoint sources of pollution, including agriculture, but does not provide direct authorities to regulate these sources. NPDES permits are unsuited for nonpoint sources because discrete discharge points cannot be observed. Because of the diverse and site-specific nature of nonpoint source pollution, States are given primary responsibility for developing nonpoint source management programs. State and local governments develop nonpoint source control plans that can include regulatory measures but usually emphasize voluntary actions. The **Nonpoint Source Program**, established by Section 319, authorizes grants to States for developing and promoting nonpoint source management plans. States have established a number of watershed projects under this program that involve many local, State, and Federal stakeholders. EPA's role is to provide program guidance, technical support, and limited funding. Through 1998, EPA had provided over $537 million in grants to such projects, of which $191 million was for agriculture (personal communication with Stuart Tuller, EPA, February 1999).

Under the CWA, EPA also administers some regional programs targeted at particular water bodies. EPA's **National Estuary Program** (NEP, Section 320), helps States to develop and carry out basin-wide, comprehensive programs to conserve and manage their estuary resources (U.S. EPA, 1998a). Most of the NEP projects deal with urban pollutants such as sewage, toxic chemicals, and heavy metals, but some, such as Delaware Inland Bays, address pollution from agricultural sources. EPA provides grants and technical assistance to State and local governments to develop and to implement NEP comprehensive conservation and management plans. The **Clean Lakes Program** (Section 314) authorizes EPA grants to States for lake classification surveys, diagnostic/feasibility studies, and for projects to restore and protect publicly owned lakes. The Clean Lakes

Program regulations (40 CFR 35 Subpart H), promulgated in 1980, redirected program activities to diagnose the current condition of individual lakes and their watersheds, determine the extent and sources of pollution, develop feasible lake restoration and protection plans, and implement the plans. The program funded a total of about $145 million in grants between 1976 and 1995 (U.S. EPA, 1998b). There have been no appropriations for the program since 1995. Instead, EPA has encouraged States to use Section 319 funds for such activities.

The **Coastal Zone Management Act Reauthorization Amendments** (CZARA) of 1990 added important nonpoint source water pollution requirements to the Coastal Zone Management Act. This is the first federally mandated program requiring specific measures to deal with agricultural nonpoint sources. CZARA requires that each of the 29 States and territories with an approved coastal zone management program submit to EPA and to the National Oceanic and Atmospheric Administration a program to "implement management measures for nonpoint source pollution to restore and protect coastal waters" (U.S. EPA, 1996). A list of economically achievable measures for controlling agricultural NPS pollution is part of each State's management plan. States can initially utilize voluntary incentive mechanisms such as education, technical assistance, and financial assistance, but must be able to enforce management measures if voluntary approaches fail. Implementation of plans is not required to begin until 2004. In general, annual costs of CZARA management measures are estimated to be less than $5,000 per farm for most farm sizes. Exceptions are grazing management measures for larger farms in the West, and manure management measures on larger dairy farms (Heimlich and Barnard, 1995).

The **Safe Drinking Water Act** (SDWA) of 1974 requires the EPA to set standards for drinking-water quality and requirements for water treatment by public water systems. The SDWA authorized the **Wellhead Protection Program** in 1986 to protect supplies of ground water used as public drinking water from contamination by chemicals and other hazards, including pesticides, nutrients, and other agricultural chemicals. The program is based on the concept that land-use controls and other preventive measures can protect ground water. As of December 1998, 45 States have EPA-approved wellhead protection programs. The 1996 amendments to the SDWA have potential, though indirect, implications for agricultural producers (Smith and Ribaudo, 1998). For example, under the amendments, EPA is required to establish a list of contaminants for consideration in future regulation. The Drinking Water Contaminant Candidate List, released in March 1998, lists chemicals by priority for (a) regulatory determination, (b) research, and (c) monitoring. Several agricultural chemicals, including metolachlor, metribuzin, and the triazines, are among those to be considered for potential regulatory action. EPA will select five contaminants from the "regulatory determination priorities" list and determine, by August of 2001, whether to regulate them for the purpose of protecting drinking water supplies.

Also under the 1996 amendments to the SDWA, water suppliers are required to inform their customers about the levels of certain contaminants and associated EPA standards, and the likely sources of the contaminants, among other items. If the supplier lacks specific information on the likely sources, set language must be used for the contaminants, such as "runoff from herbicide used on row crops" (e.g., for atrazine). The first reports were provided between April and October 1999. "The information contained in the consumer confidence reports can raise consumer's awareness of where their water comes from,…and educate them about the importance of preventative measures, such as source water protection..." (P. 44512, Federal Register, August 19.

1998). Increased consumer awareness concerning water supplies could lead to public pressure on farmers to reduce pesticide use (Smith and Ribaudo, 1998).

The **Comprehensive State Ground Water Protection Program (CSGWPP),** established in 1991, coordinates all Federal, State, tribal, and local programs that address ground water quality. States have the primary role in designing and implementing CSGWPP's in accordance with local needs and conditions. EPA has approved programs in nine States (Alabama, Connecticut, Georgia, Illinois, Massachusetts, Nevada, Oklahoma, Vermont, and Wisconsin) (U.S. EPA, 1998).

EPA is the lead Federal agency for several regional water quality programs. The **Great Lakes Program** was established in 1978 for restoring and protecting the water quality of the Great Lakes. Habitat alteration and pollution had greatly diminished the quality of the Great Lakes. Some of the problems being addressed are fish and wildlife contaminated by toxic chemicals, contaminated bottom sediments, nutrient enrichment, and diminished wetlands. Partners include EPA, the eight Great Lakes States, Department of Agriculture, Army Corps of Engineers, Fish and Wildlife Service, and local advisory groups. USDA has assisted the program by targeting assistance to farmers through past and present programs such as ACP, WQIP, and EQIP. Progress has been made in reducing phosphorus loads to the lakes from both agriculture and industry (U.S. EPA, 1994).

The **Chesapeake Bay Program** is a partnership of State and other regional bodies that has been directing the restoration of the Chesapeake Bay since 1983. Program partners include Maryland, Pennsylvania, Virginia, the District of Columbia, the Chesapeake Bay Commission, EPA, and participating advisory groups. Nutrient enrichment is one of the causes of the Bay's degradation, and reducing nutrient loads from agriculture, industry, and municipalities has been a major goal of the program. All participating States have initiated nutrient reduction programs. The program has succeeded in reducing nitrogen runoff from agriculture and other sources into Bay tributaries (U.S. EPA, 1999).

The **Gulf of Mexico Program** was established in 1988 to halt the decline in Gulf resources. The program is a network of partners with interests in Gulf resources, including EPA, Florida, Alabama, Mississippi, Louisiana, Texas, and business, environmental, and citizen interest groups. The program leverages EPA funds to attract matching funds for research, demonstration projects, restoration activities, and public information activities. A major issue of concern is nutrient enrichment, exemplified by the hypoxic zone in the Gulf (see chapter 2.3). Agriculture has been identified as a major source of nutrient loads to the Gulf, and efforts to protect Gulf resources by reducing nutrient flows will have to address agricultural activities (Gulf of Mexico Program, 1999).

The **Lake Champlain Basin Program** (LCBP) was established by the Lake Champlain Special Designation Act (1990). The act's goal is to create a comprehensive pollution prevention, control, and restoration plan for protecting the future of the Lake Champlain Basin. The LCBP is administered jointly by EPA, Vermont, New York, and the New England Interstate Water Pollution Control Commission. Cooperating agencies include the USDA, U.S. Fish and Wildlife Service, U.S. Geological Survey, NOAA, National Park Service, and local advisory groups. USDA assists the program by targeting assistance to farmers through programs such as EQIP

(Lake Champlain Basin Program, 1999).

**State Programs**

Much of the legislative activity for addressing agricultural water quality issues is taking place at the State level. All States provide education or financial assistance for implementing best management practices. Thirty-one States have taken the additional step of passing laws or instituting programs that use enforceable mechanisms to protect water quality from pollution from agricultural sources (table 6.4.4).

Some of these laws are in response to Federal laws such as the Clean Water Act or Coastal Zone Management Act. Others are in response to chronic problems such as nitrates or pesticides in ground water, and go beyond the requirements outlined in Federal laws. For example, Maryland passed a nutrient management law in 1998, largely in response to the outbreak of the microorganism *pfiesteria piscicida* in the lower Eastern Shore of the Chesapeake Bay. The most common mechanisms employed by State water quality programs are technology standards (Ribaudo and Caswell, 1999). These generally call for farmers to implement a unique conservation plan that contains recommended best management practices. States apply this approach either uniformly across the State (non-targeted), or just to specific geographic areas (targeted). Non-targeted technology standards require farmers to adopt a conservation plan containing management practices generally believed to represent "good stewardship". Few States have developed a list of approved BMPs (Kentucky has a list of 58 practices, for example), while others are less specific as to what a plan should contain. Enforcement is generally through citizen complaint. If a suitable plan had been adopted and is in force, the producer is not subject to fines or penalties if a citizen files a complaint for damages, and may receive State assistance to alter the plan to address the specific complaint.

In some States, technology standards are targeted to specific geographic areas, defined by a water quality problem (Ribaudo and Caswell, 1999). Monitoring figures heavily in defining the area and determining the level of action required. In many cases, the law is directed at a particular problem, such as pesticides in groundwater.

Table 6.4.4 - Mechanisms used in State water quality programs, 1998-1999

| State | Fertilizer restrictions | Pesticide restrictions | Sediment restrictions | Nutrient management plans for animal waste disposal | Comprehensive | Farm*A*Syst |
|---|---|---|---|---|---|---|
| Alabama | | | | | | X |
| Alaska | | | | | | |
| Arkansas | | | | | X | X |
| California | | X | | X | | X |
| Colorado | | X | | | X | X |
| Connecticut | | | | X | | X |
| Delaware | | | | | | X |
| Florida | X | | | | X | X |
| Georgia | | | | | | X |
| Hawaii | | | | | | X |
| Idaho | | | | | | X |
| Illinois | | | | | X | X |
| Indiana | | | | | | X |
| Iowa | X | X | | X | | X |
| Kansas | | | X | | X | X |
| Kentucky | | | | X | X | X |
| Louisiana | | | | | | X |
| Maine | | | | X | X | X |
| Maryland | X | | X | X | X | |
| Massachusetts | | | | | | X |
| Michigan | | | | | | X |
| Minnesota | | | | X | | X |
| Mississippi | | | | X | | |
| Missouri | | | | | X | X |
| Montana | | X | X | | X | X |
| Nebraska | X | | X | X | | X |
| Nevada | | | | | | X |
| New Hampshire | | | | | | X |
| New Jersey | | | | | | X |
| New Mexico | | | | | | X |
| New York | | | | | | X |
| North Carolina | | | | | X | X |
| North Dakota | | | | | | X |
| Ohio | | | X | X | | X |
| Oklahoma | | | | X | | X |
| Oregon | | | | | X | X X |
| Pennsylvania | | | X | X | | X |
| Rhode Island | | | | | | |
| South Carolina | | | | | X | X |
| South Dakota | | | | | X | X |
| Tennessee | | | | X | | X |
| Texan | | | | | | X |
| Utah | | | | | | X |
| Vermont | | | | | X | X X |
| Virginia | | | | | X | X X |
| Washington | | | | X | X | X |
| West Virginia | | | | X | | |
| Wisconsin | X | X | | X | X | X |
| Wyoming | | | | X | | X |

1Mechanisms may apply only under certain conditions or in certain localities. A state may have more than

2Comprehensive laws focus on meeting a water quality goal, regardless of the pollutant.

Sources: USDA, ERS, based on ELI, 1998; NRDC,1998; Animal Confinement Policy National Task Force, 1998; Farm*A*Syst, 1999.

Producers in the designated areas generally have to adopt specific BMP's and enforcement is through inspection, with targeted technology standards. By focusing on specific problems in specific areas, better information on what constitutes acceptable management practices can be reasonably, developed.

Only Florida is using a performance standard to address an agricultural pollution problem (Ribaudo and Caswell, 1999). Performance standards require that a particular level of environmental quality be achieved, without specifying management practices. Emission-based performance standards are not generally suitable extensive use of drainage structures allows systematic sampling to identify individual sources of pollution. The Works of the District Rule placed a maximum allowable phosphorus runoff standard on dairies in the area south of Lake Okeechobee to reduce the flow of phosphorus into the Everglades. Enforcement is through inspection. Dairies are allowed to use any method to reduce phosphorus runoff to reach the standard.

Performance taxes are also being applied to the Everglades in south Florida. The Everglades Forever Act calls for a uniform, per-acre tax on all cropland in the Everglades Agricultural Area. The tax starts at $24.89 per acre per year and will increase every 4 years to a maximum of $35.00 per acre unless basin-wide phosphorus levels are reduced at least 25 percent (State of Florida). The tax creates the incentive to adopt BMPs, and also for producers to apply pressure on recalcitrant neighbors. The number of producers is not so large that free-riding should be much of a problem.

Trading is a market mechanism for efficiently allocating pollution reductions among different pollution sources with different marginal costs of control. Trading between point and agricultural nonpoint sources is possible when both sources contribute significant amounts of the target pollutant in a basin and the amounts are known, and when the costs of reducing loadings from nonpoint sources at the margin are less than the costs of reducing point sources. Uncertainty in the performance of agricultural BMPs can be accounted for with a trading ratio that specifies the units of nonpoint source reduction that can replace a single unit of point source reduction. By allowing point sources to meet discharge goals by purchasing reductions from nonpoint sources, pollution control is achieved at lower cost.

Point-nonpoint trading requires a large commitment by a State, in terms of administration costs and basic data acquisition. North Carolina has adopted a basin-oriented water quality protection strategy that includes trading. The State has identified several basins as Nutrient Sensitive Waters where a total maximum daily discharge load of nutrients from all sources is set. The Tar-Pamlico Basin is one of these. Annual reductions in nitrogen discharge allowances were established for a group of wastewater treatment plants in the basin in order to meet a basin-wide discharge goal. The treatment plants can receive credit for nitrogen loading reductions by paying $56 per kilogram of desired reduction into an Agricultural Cost Share Fund that supports best management practices for farmers in the basin (U.S. EPA, 1996). If a discharger exceeds its allowance, it must pay into this fund. In comparison, the dischargers estimated that treatment plant upgrades would have provided nitrogen reductions at a cost of between $250 and $500 per kilogram (U.S. EPA, 1996). To date, there have been no point/nonpoint trades. (For additional examples of how states are addressing agricultural pollution, see the box "Examples of State Water Quality Programs for Reducing Agricultural Pollution").

Most of the State laws have been aimed at animal waste (table 6.4.1). Nutrients from livestock manure are an increasing concern across the Nation, given the trend towards larger, more specialized beef, swine, and poultry operations. Approximately 450,000 operations nationwide confine or concentrate animals (EPA and USDA, 1998). Currently, over 6,000 are large enough to be defined under the Clean Water Act as Concentrated Animal Feeding Operations, or CAFO's. Such operations handle large amounts of animal waste. There are two sources of water quality problems from CAFO's. First, they require large and sophisticated manure handling and storage systems, which have occasionally failed, with serious local consequences. Since 1990, over a dozen States have reported failures in animal waste storage lagoons that resulted in serious pollution problems (NRDC, 1998) Second, CAFO's tend to lack sufficient cropland on which manure can be spread without exceeding plant nutrient needs (Letson and Gollehon, 1996). Excess application of waste (providing more nutrients than plants need) can lead to nonpoint pollution problems. There are many instances over the past several years where animal waste storage lagoons have broken or leaked, or where excess applications to the land have adversely affected water quality (NRDC, 1998).

The CAFO's are point sources under the Clean Water Act. The Clean Water Act requires that CAFO's obtain an NPDES permit in order to discharge, The standard permit states that all runoff from the site-resulting from a storm of less intensity than the 25-year/24-hourstorn be collected and stored. However, the traditional permit does not cover application of waste on cropland or other land. So, when storage lagoons are pumped out, the material can be spread on fields at rates far beyond plant needs, resulting in the potential for a nonpoint problem (see chapter 2.3 on Water Quality Impacts of Agriculture).

A number of States have passed laws that address the problem of what happens to animal waste once it leaves the CAFO. An increasingly common approach is to require a nutrient management plan for the application of the waste. The plan can be made one of the requirements of the NPDES permit, or it can be required through a separate law. In some cases, the State requires a nutrient management plan even if the manure is sold or given to another landowner. Currently, 29 States require some form of nutrient management plan for at least some classes of animal operations.

Land application of animal waste in Illinois, for example, is allowed subject to regulations established by the Livestock Management Facilities Act, which became effective in 1996 (Il. Admin. Code Title 35, Section 505). Under the regulations, livestock management facilities with 1,000 animal units or more must prepare and maintain a nutrient management plan. Operations with 7,000 or more animal units must submit their plans to the Department of Environmental Protection for approval. The plan must demonstrate that the maximum nitrogen application rate to obtain optimum crop yields is not exceeded. Required in the plan is information on where the waste will be applied, how it will be applied, application rates, nitrogen carryover from previous crops, and cropping and yield histories of the fields receiving waste. Enforcement is through citizen complaint or inspection.

A national voluntary program that originated from local needs is Farm*A*Syst, developed in Wisconsin by State Extension staff, with support from USDA and EPA, to protect farm water supplies. Farm*A*Syst helps farmers, ranchers, and rural residents identify and reduce agricultural and household sources of pollution. Using assessment worksheets, farmers and other rural landowners evaluate structures and management practices for

their pollution risks. Once aware of potential problems, landowners can take appropriate action. All 50 States have expressed some interest in the program, and it is being implemented in 47 States Farm*A*Syst is also being integrated into USDA and EPA water quality programs.

**Documentation of Water Quality Impacts**

Federal and State water quality programs directed at nonpoint sources proceed on the premise that reductions in pollutant loadings to water systems will result in improved water quality in those systems. Some documentation and anecdotal evidence supports this premise (see box "Water Quality Impacts of Projects" and chapter 2.3 Water Quality Impacts of Agriculture). In general, however, water quality improvements attributable to past and present programs have been difficult to document. Water quality improvements from reductions in the generation of nonpoint source pollutants often take years to occur because of the store of pollutants already in the water and soil, and are hard to detect because of other factors such as weather variations and changes in crops grown. Also, the monitoring of water quality and of factors affecting it is expensive and few projects have (or allocate) the resources to conduct the type and duration of monitoring activities necessary to document resultant water quality improvements.

**The Administration's Clean Water Action Plan**

Although the CWA has resulted in a great number of successes, many water quality problems remain - especially those related to nonpoint sources (EPA and USDA, 1998). Instead of waiting for the next reauthorization of the CWA (which has been delayed for 6 years), the White House ordered EPA and USDA to jointly develop a Clean Water Action Plan (CWAP) with assistance from other Federal agencies. The CWAP was released in February 1998. It is an ambitious proposal that lays out a fundamental shift in water quality policy to emphasize control of nonpoint sources of pollution, especially sources of polluted runoff, using existing laws and authorities for more complete water quality protection.

Many of the 111 action items outlined in the CWAP are directed towards polluted runoff, or nonpoint source pollution. Polluted runoff (especially nitrogen and phosphorous pollution) is an important source of remaining problems, with agriculture as the largest single contributor (see chapter 2.3 Water Quality Impacts of Agriculture). Since agricultural operations are major sources of polluted runoff, programs developed to carry out CWAP initiatives will likely place greater pressure on farmers in impaired watersheds to address runoff problems. Whether the programs will use voluntary approaches similar to current programs or new, innovative approaches has yet to be determined.

One of the earliest actions completed was the development of a strategy for addressing the water quality and public health impacts associated with animal feeding operations. USDA and EPA released the Unified National Strategy for Animal Feeding Operations on March 9, 1999. The major goal for the strategy is that all animal feeding operations develop and implement technically sound, economically feasible, and site-specific Comprehensive Nutrient Management Plans (CNMP's) that address how animal waste is managed both on the site and when applied to land. The contents of the CNMP's and the mechanisms for getting producers to develop and implement these plans will be addressed in guidance and rules to be developed by EPA and USDA.

EPA will also revise the permitting rules for confined animal feeding operations to clarify which operations will be required to obtain a National Pollutant Discharge Elimination System permit.

The CWAP acknowledges USDA's experience in working with farmers on a watershed basis. Specifically, USDA will have a role in helping States develop watershed protection goals and water quality protection strategies, along with EPA. In addition, USDA will be a major source of education, technical assistance, and financial assistance to landowners developing comprehensive management plans to protect water quality. Current USDA programs such as the Environmental Quality Incentive Program, Conservation Reserve Program, Wetland Reserve Program, and Wildlife Habitat Incentive Program can all provide incentives to farmers for addressing water quality concerns. The CWAP proposes increased funding for USDA to support water quality efforts.

*Author: Marc Ribaudo. (202) 694-5488 (mribaudo@ers.ag.gov) Contributors: Dwight Gadsby, Richard Horan, and Mark Smith.*

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**Federal Water Quality and Conservation Programs Affecting Agriculture**

| *EPA-Administered Programs* | *USDA-Administered Programs* |
|---|---|
| Clean Water Act Programs:<br>Clean Lakes Program (Section 314)<br>Nonpoint Source Program (Section 319)<br>National Estuary Program (Section 320)<br>National Pollutant Discharge Elimination System (Section 402)<br><br>Coastal Nonpoint Pollution Control Programs<br><br>Regional Programs<br>Chesapeake Bay Program<br>Gulf of Mexico Program<br>Great Lakes Program<br>Lake Champlain Program<br><br>Safe Drinking Water Act<br>Wellhead Protection Program<br><br>Comprehensive State Ground-Water Protection Program | Environmental Quality Incentive Program (EQIP)<br><br>Conservation Technical Assistance (CTA) Program<br><br>Conservation Compliance<br><br>Conservation Reserve Program (CRP)<br><br>Conservation Reserve Enhancement Program (CREP)<br><br>Wetlands Reserve Program (WRP)<br><br>Wildlife Habitat Incentives Program (WHIP) |

**Comprehensive Nonpoint Source Program - Kentucky**

In 1994 Kentucky passed the Kentucky Agriculture Water Quality Act (SB 241; codified in Ky. Rev. Stat. 224.71). The Act's main goal is to protect surface and groundwater resources from agricultural pollution, including sediment and agricultural chemicals. One of the few comprehensive water quality protection laws in the Nation, the Act requires that all land users with 10 or more acres develop and implement a water quality plan based upon guidance from the Statewide Water Quality Plan, which lists 58 approved best management practices. A farmer will select applicable best-management practices to be included in his plan. Education, technical assistance, and financial assistance (conditional on availability of funds) will be available for the development and implementation of the plans. Landowners will have five years to implement their plans after they have been approved.

In cases of unique, local water quality problems where agriculture has been identified through monitoring as a major contributor, the law provides for creation of water priority protection regions. A regional water quality plan would be developed for the priority region. Modifications to individual plans may be required to meet a protection region's water quality goals. Technical and financial assistance will be made available to assist landowners in modifying their plans. Land users must comply with the regional water quality plan to receive assistance.

If a watershed is still impaired after 5 years, all operations will be checked for approved best management practices. Farmers not using the necessary practices will be given another opportunity to adopt them. Assistance will be again provided to make the necessary changes. However, failure to take protective measures may result in a "bad actor" label, making the landowner subject to enforcement action, including fines of not more than $1,000 (Ky. Rev. Stat. 224.71-130 (2)). continued…

**Groundwater Protection from Pesticides- California**

Pesticides in groundwater are a major concern in California. Intensive production of fruits, vegetables, and other crops requires the application of a wide variety of pesticides. California is using the Pesticide Contamination Prevention Act (Division 7, Chapter 2, Article 15, FAC) to protect groundwater from pesticide pollution. The State has created a groundwater protection list of pesticides subject to regulation. Inclusion on the list is determined by the physical characteristics of the chemical. The law requires the State to set numeric values for six chemical characteristics that define the chemical-s ability to leach into groundwater. During the registration process the manufacturer must submit information on these characteristics. If the value for one of the characteristics exceeds the prescribed numeric value, the chemical is placed on the groundwater protection list.

Pesticides on the list are regularly monitored in the environment. If the pesticide or any of its potentially toxic degradation products are found in groundwater, found 8 feet below the surface, found below the root zone or found below the zone of microbial activity, the pesticide is subject to restrictions in use or to cancellation. If the State determines that legal use of the chemical does not threaten to pollute groundwater anywhere in the State where it may be used, then use can continue without change. If the State determines that current legal use poses a threat, limited use is allowed, if there is a high probability that groundwater contamination will not occur with the limited use. The limitations can include the establishment of pesticide management zones, where use of the chemical is restricted. If the State determines that the chemical will contaminate ground water, even with limited use, then the chemical can be banned. However, if the State determines that cancellation or modified use will cause a severe economic hardship to agriculture, and no substitute products or practices can be effectively used, then use can continue subject to meeting water quality standards that are believed to represent acceptable risks. If continued use is allowed under the above restrictions, and groundwater contamination is found after 2 years, the chemical will be canceled if it is carcinogenic, mutagenic, teratogenic, or neurogenic.

California-s law is designed to minimize statewide economic hardships. However, farmers within pesticide management zones may face increased production costs and/or greater risk of pest losses, placing them at a competitive disadvantage to neighboring producers. Also, important chemicals can be banned if they continue to be found after 2 years and they pose health risks to humans.

Seven herbicides were detected in California groundwater in 1997: atrazine, bromacil, diuron, hexozinone, norflurazon, prometron, and simazine (Calif. EPA, 1997). Ninety-two pesticide management zones have been established in 10 counties to protect groundwater from these pesticides. Growers operating within these zones are denied access to the banned pesticides through the registration process. The State has also developed a geographic information system that enables the permit issuer to determine whether a grower-s field is within a pesticide management zone.

**Protection of Surface Water from Phosphorus - Florida**

Florida is home to the Everglades, a vast wetland containing a multitude of unique wildlife species. These wetlands have been degraded over time by man-s activities, including drainage, development, and agriculture. A strategy has been developed for reducing phosphorus loadings to the Everglades. Phosphorus loadings to the Everglades ecosystem upset the nutrient balance and promote the growth of undesirable plant species. Much of the phosphorus is coming from the agricultural areas north of the Everglades.

Animal waste from dairy operations around Lake Okeechobee has been identified as a major source of phosphorus loadings. A series of three regulatory policies was applied to the Lake Okeechobee basin to reduce these loadings (Schmitz, Boggess, and Tefertiller). The Dairy Rule technology standard required the collection, storage, and treatment of wastewater from dairy operations (Fla. Admin. Code 62-670.500). As an alternative to complying with the Dairy Rule, operators could choose to enroll in the dairy buyout program, under which operators were offered a one-time payment for moving their operations out of the basin and accepting an easement on the land. The third policy, known as the Works of the District Rule, imposed a maximum allowable phosphorus concentration in runoff performance standards for dairies (Fla. Admin. Code 62-670.500). Such an approach is possible because the extensive system of drainage ditches enables the monitoring of phosphorus discharges from individual sources.

The imposition of regulations resulted in direct cost, opportunity cost of the operator-s time, waiting cost, and regulatory uncertainty cost (Schmitz, Boggess, and Tefertiller). Implementation of the three regulatory programs was estimated to have cost $41.4 million. About half of that cost was incurred by the dairy industry, the rest by the government. The dairy buyout program reduced the region-s cow herd by 14,000 animals. For the dairies that remained in operation, the Dairy Rule and the Works of the District Rule increased average costs of production by $1.15 per hundredweight. Annualized investment costs of compliance were estimated at $0.97 per cwt. Annual operation and maintenance costs were estimated to range between $0.14 and $0.20 per cwt. The targeting of the regulations to a particular geographic area shifted milk production to other regions of the State.

A basin-wide incentive program for the Everglades was authorized in the 1994 Everglades Forever Act to reduce phosphorus loadings from cropland, primarily vegetables and sugar cane (F.S. 373.4592). The law mandates a 25-percent reduction in phosphorus loads discharging from the Everglades Agricultural Area between Lake Okeechobee and Everglades National Park. The Act required farmers to prepare plans and to install BMPs by the beginning of 1995. BMP-s include soil testing, applying fertilizer directly to crop roots, providing for longer drainage retention, sediment controls, and innovative crop location. Associated with the Act is the Agricultural Privilege Tax. This tax is aimed at increasing the discharge reductions beyond 25 percent. A tax, starting at $24.89 per acre, was put on all crop acres in the EAA. The tax will increase every 4 years to a maximum of $35.00 per acre from 2006 through 2014, unless farmers in the EAA exceed an overall 25-percent basin-wide phosphorus reduction goal. Revenue from the tax is earmarked for the construction of Stormwater Treatment Areas, essentially wetlands constructed to remove phosphorus before it reaches Everglades National Park.

**Past USDA Efforts Targeting Water Quality**

***Model Implementation Program (MIP, 1978-82)*** was an experimental program designed to demonstrate and study a concerted attempt by USDA and EPA to address agricultural nonpoint source water quality problems by using existing program authorities. The MIP consisted of seven projects. USDA offered education, technical, and financial assistance to help farmers adopt best management practices. The project resulted in a number of recommendations for improving future agricultural water quality programs (National Water Quality Evaluation Project, 1983).

***Rural Clean Water Program (RCWP, 1980-86)*** was initiated in 1980 as an experimental effort to address agricultural nonpoint source pollution in watersheds across the country. Twenty-one projects were funded, representing a wide range of pollution problems and impaired water uses. Farmer participants received technical and financial assistance to implement best management practices to reduce polluted runoff or infiltration. Monitoring and evaluation were conducted to document water quality improvement and economic benefits and costs. Funding for practices ended in 1986, but monitoring continued until 1995. Results of the program were mixed. Some projects documented water quality improvements. Economic benefits from actual or expected water quality improvements were estimated to exceed costs in about half the projects studied (Magleby and others, 1989).

***Water Quality Special Projects (WQSP, 1991-92)*** extended cost-share and technical assistance to farmers and ranchers for installing approved water quality practices in small watersheds with identified agricultural nonpoint-source problems. Funding was through ACP. WQSP's were annual projects, although landowners could enter into multiyear agreements. No new projects were funded after 1992.

***Agricultural Conservation Program (ACP, 1933-96)*** provided financial and technical assistance to agricultural producers to help solve a wide range of agricultural conservation and environmental problems, including water quality. Program activities included prevention of soil loss, water conservation, improvement of water quality, conservation of forest and wildlife resources, and pollution abatement. With several important exceptions, ACP funds were not targeted to specific geographic areas. In 1995 over 100 technical practices were eligible for ACP cost-share funds. Up to 75 percent of the total cost of implementing the practice could be payed by ACP, with a maximum of $3,500 per recipient per year. ACP was replaced by the Environmental Quality Incentive Program (EQIP) in 1996.

***Water Quality Incentives Program (WQIP, 1990-1996)*** was created by the 1990 Food, Agriculture, Conservation and Trade Act and was administered as an ACP practice. The goal of WQIP was to reduce agricultural pollutants through sound farm management practices that restore or enhance the quality of water resources compromised by agricultural nonpoint source pollution. Areas eligible for WQIP included watersheds identified by States as being impaired by nonpoint source pollution under Section 319 of the Clean Water Act, areas identified by state agencies for environmental protection and so designated by the governor, and areas where sinkholes conveyed runoff directly into ground water. A total of 242 projects were started during FY 1993-95. Eligible producers entered into 3- to 5-year agreements with USDA to implement approved management practices on their farm, as part of an overall water quality plan, in return for an incentive payment. The WQIP supported 39 different practices for protecting water quality. WQIP was replaced by the Environmental Quality Incentive Program (EQIP) in 1996. continued...

**Past USDA Efforts Targeting Water Quality (continued)**

***Colorado River Salinity Control Program (CRSCP, 1984-96)*** was started in 1984 to identify salt source areas in the Colorado River Basin, to assist landowners and operators in installing practices to reduce salinity in the Colorado River, to carry out research, education, and demonstration activities, and to monitor and evaluate the activities being performed. CRSCP was jointly administered by USDA and the U.S. Department of the Interior. The Bureau of Reclamation constructed salinity control structures for water distribution systems, and USDA provided technical and financial assistance to help irrigators implement improved irrigation systems. Efforts to improve irrigation efficiency and reduce the movement of salt to water resources included installing more efficient sprinklers, installing pipe, and lining delivery canals. Landowners participating in the program agreed to a contract of 3 to 10 years, and agreed to operate and maintain the project for as long as 25 years. The cost-shares mitigate the up-front costs of more efficient systems, which might otherwise discourage landowner participation. CRSCP was replaced by the Environmental Quality Incentive Program (EQIP) in 1996.

***Water Quality Program (WQP, 1990-1996)*** was started in response to a Presidential initiative in the 1990 budget for enhancing water quality. The initiative integrated the combined expertise of four Federal departments (USDA, EPA, Interior, and Commerce) to promote the use of environmentally and economically sound farm production practices, and to develop improved chemical and biological pest controls. The WQP strove to (1) determine the precise nature of the relationships between agricultural activities and water quality, and (2) develop and induce the adoption of technically and economically effective agri-chemical management and agricultural production strategies that protect surface- and groundwater quality (USDA, 1993). The WQP contained three major components: (1) research and development; (2) education, technical, and financial assistance; and (3) database development and evaluation. The scale of the program, and the integration of research and database development with the traditional education, technical, and financial assistance projects, made this program unique to USDA. Research was focused mainly in eight Management System Evaluation Area projects. Education, technical, and financial assistance was provided in 90 projects (74 Hydrologic Unit Area projects and 16 Demonstration Projects) targeted to areas with known water quality problems from agriculture.

***Great Plains Conservation Program (GPCP, 1956-96)*** was authorized in 1956 to provide long-term technical and financial assistance to farmers and ranchers in designated wind erosion counties. It was administered by NRCS. Assistance was provided through contracts with individuals based on plans to mitigate climatic hazards. The objectives of the program were later expanded to include enhancement of fish, wildlife, and recreation resources and to control agricultural pollution. Conservation practices were chosen from a national list by State and county GPCP committees. The cost-share rate was set locally and varied according to the urgency of the need for the practice in the area. Producers contracted to install conservation practices for 3 to 10 years, with NRCS paying 50-80 percent of the costs. GPCP was replaced by the EQIP in 1996.

**Lessons Learned from USDA Water Quality Programs**

Experience with programs such as the Model Implementation Program, Rural Clean Waters Program, and the Water Quality Program suggest some important factors that can enhance the performance of USDA efforts to protect water quality.

Voluntary programs are likely to be most successful in areas where farmers recognize that agriculture contributes to severe local pollution problems such as groundwater impairment.

Voluntary programs are likely to be successful when recommended practices generate higher returns.

Cost-effectiveness is enhanced when program activities are targeted to watersheds where agriculture is the primary source of water quality impairment.

Flexible cost-share programs to encourage producers to adopt certain management practices are more efficient than those with fixed rates and limited lists of supported practices.

Local research on the economic and physical performance of recommended practices can improve adoption rates of those practices.

Interaction with non-USDA agencies, organizations, and local businesses within a watershed is important.

More attention to and resources for water quality monitoring and project evaluation could help determine the cost effectiveness of alternative practices and assist in the development of targeting strategies for program improvement.

Source: Ribaudo, 1998.

**Water Quality Impacts of Projects**

Several completed watershed projects have documented improvements in water quality from activities undertaken in the watershed. Animal waste management, which reduced phosphorus and fecal coliform from animal waste by substantial amounts, greatly improved water quality in Rural Clean Water Program (RCWP) projects in **Snake Creek, Utah**, and the **Tillamook Bay, Oregon** (U.S. EPA, 1990). Implementation of BMP's reduced phosphorus and fecal coliform from animal waste by substantial amounts. Keeping animals out of streams in the **Taylor Creek-Nubbin Slough Basin, Florida** RCWP project cut phosphorus concentrations in some Lake Okeechobee tributaries by 50 percent. Irrigation water management and other BMP's in the **Rock Creek, Idaho** RCWP project reduced suspended sediment concentrations in the watershed. These projects were able to document water quality improvements only after many years of implementation activity and extensive monitoring.

In the **Ketch Brook Watershed Section 319 project in Connecticut**, agricultural and other BMP's reduced sediment in roadside ditches and a wetland (U.S. EPA 1994). The **Nolichucky River Watershed in Tennessee** had a significant pollution problem from animal wastes. One year after animal waste BMP's were installed on the majority of animal operations as part of a Section 319 project, statistically significant improvements in benthic habitat in two subwatersheds were observed (U.S. EPA, 1994). **Battle Branch Watershed in Oklahoma**, a Section 319 project, suffered elevated nutrient loadings from poultry and dairy operations. Structural and nonstructural BMP's for managing nutrients reduced nitrate levels during runoff as much as 72 percent, and total phosphorus levels as much as 35 percent (U.S. EPA, 1994).

**West Lake Reservoir, a Section 319 project in Iowa,** was being hurt by sediment and atrazine. Half the watershed for the reservoir was in corn-soybean rotation. Sediment was rapidly reducing reservoir capacity, damaging filtration systems, and increasing operation and maintenance costs. Atrazine levels were above the maximum contaminant levels specified under the Safe Drinking Water Act. As part of the project, no-till and ICM were promoted to producers in the watershed. Atrazine use in the watershed was cut in half and there were significant reductions in soil erosion (U.S. EPA, 1994). As a result of these reductions, atrazine concentrations in the reservoir have dropped below the maximum contaminant level. The concentrations of another pesticide, cyanazine, have also decreased.

**Moore's Creek and Beatty Branch** in Arkansas suffered from nutrient enrichment problems resulting from confined animal feeding operations and pasture management (U.S. EPA, 1997). Nitrogen and phosphorus management practices were implemented through a USDA Hydrologic Unit Area project, and water quality monitoring conducted through Section 319 project. Monitoring during and after BMP implementation showed decreasing levels of total Kjeldahl nitrogen, chemical oxygen demand, and nitrate.

**Lake Shaokatan in Minnesota** was severely degraded by phosphorus from feedlots and tile drainage (U.S. EPA, 1997). To counteract these problems, a watershed restoration project was initiated using Section 319 funds. A combination of activities, including diverting a stream away from a swine operation, rehabilitating a feedlot-impacted wetland, upgrading a dairy feedlot operation, and buying out a swine operation resulted in significant reductions in phosphorus and sediment loading rates. As a result, water quality in the lake improved.

**Recent Reports on ERS Research Related to Water Quality Programs**

***Economics of Water Quality Protection from Nonpoint Sources: Theory and Practice,*** AER-728, November 1999 (Marc Ribaudo, Richard Horan, and Mark Smith). A number of different policy instruments can be used to address pollution problems. These include economic incentives, standards, education, liability, and research and development. Each has its strengths and weaknesses when applied to agricultural nonpoint source pollution.

***Economic Valuation of Environmental Benefits and the Targeting of Conservation Programs: The Case of the CRP***, AER 778, April 1999 (Peter Feather, Daniel Hellerstein, and LeRoy Hansen). The effect of environmental targeting of the CRP on the magnitude and type of environmental benefits is assessed using nonmarket valuation techniques.

***U.S. Environmental Regulation in Agriculture and Adoption of Environmental Technologies,*** (Marc Ribaudo and Margriet Caswell) in *Flexible Incentives for the Adoption of Environmental Technologies in Agriculture* Frank Casey, Scott Swinton, Andrew Schmitz, and David Zilberman (editors), 1999. A number of incentives have been applied to agriculture through environmental policies to reduce nonpoint source pollution.

***Wetlands and Agriculture: Private Interests and Public Benefits,*** AER-765, September 1998 (Ralph heimlich, Keith Wiebe, Roger Claassen, Dwight Gadsby, and Robert House). Society places value on the services that wetlands provide, including water quality improvements. There are differences between public and private incentives for preserving wetlands. Federal policy has shifted in recent years to provide incentives to private landowners for preserving wetlands.

***Lessons learned about the performance of USDA agricultural nonpoint source pollution programs***, ***Journal of Soil and Water Conservation***, January-February 1998, pages 4-10 (Marc Ribaudo). Experience with the Water Quality Program and with the tools it used to get farmers to adopt best management practices provides some lessons about which types of assistance are effective, and some effective ways of providing that assistance.

***The New Safe Drinking Water Act: Implications for Agriculture***, *Choices*, Third Quarter 1998, pages 26-30 (Mark Smith and Marc Ribaudo). Amendments to the Safe Drinking Water Act require that water utilities provide their customers information on chemicals in their drinking water. Information on pesticides in drinking water could induce increased public pressure on agriculture to reduce pesticide use.

***The Clean Water Action Plan: Implications for Agriculture***, *Agricultural Outlook* AGO-255, October 1998, pages 26-30. (Marc Ribaudo and Richard Horan). The Clean Water Action Plan was started in 1998. Its goals portend greater effort to reduce agricultural nonpoint source pollution, particularly pollution from animal operations and nutrient runoff. continued...

**Recent Reports on ERS Research Related to Water Quality Programs (continued)**

***Soil Erosion and Conservation in the United States: An Overview***, AIB-718, Oct. 1995 (Richard Magleby, Carmen Sandretto, William Crosswhite, and C. Tim Osborn). Soil erosion in Soil Erosion and Conservation in the United States: An Overview, AIB-718, Oct. 1995 (Richard Magleby, Carmen Sandretto, William Crosswhite, and C. Tim Osborn ). the United States does not pose an immediate threat to the Nation's ability to produce food and fiber, but it does reduce the productivity of some soils, and it also causes water quality damage. USDA has initiated a number of programs for promoting soil conservation measures to farmers.'

***Voluntary Incentives for Reducing Agricultural Nonpoint Source Water Pollution***, AIB-716, May 1995 (Peter Feather and Joe Cooper). Data from the Area Studies are used to evaluate the success of existing incentive programs to control agricultural nonpoint source pollution. Because profitability drives production decisions, these programs tend to be most successful when they promote inexpensive changes in existing practices.

***USDA's Water Quality Program Enters its 6th Year***, AREI Update, 1995 No. 11 (Marc Ribaudo). Sixty-five water quality projects were started in 1995, and 6 projects were completed at the end of 1994. Over 400 water quality projects have been started since 1990.

***Point-Nonpoint Source Trading for Managing Agricultural Pollutant Loadings***, AER-674, September 1993. (David Letson, Stephen Crutchfield, and Arun Malik). "Trading" pollution control efforts between pollution sources is one approach for reducing the overall pollution control costs for achieving a water quality goal. Water quality legislation such as the Clean Water Act and the Coastal Zone Management Act can provide the impetus for local trading programs where point sources can meet part of their obligations by purchasing reductions from nonpoint sources, such as agriculture.