6.2 Water Quality Programs

Several approaches for protecting water quality have been developed at the Federal and State levels. 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, policies and programs for reducing pollution from agriculture and other nonpoint sources are mostly based 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 passage of the Federal Water Pollution Control Act of 1972 (known since as the Clean Water Act). Most of the focus of clean water legislation has 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. In recent years, attention has turned to nonpoint sources, primarily runoff from agricultural operations. Federal and State programs have been implemented to address agricultural source pollution. Federal water quality programs are administered by EPA and by USDA (see box, p. 271). Some EPA and State-administered programs require mandatory actions, while USDA programs are voluntary. Even with these efforts, many water quality problems remain (see chapter 2.2, *Water Quality*, for a discussion of water quality status and trends, and pollution from agriculture).

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. Pollution from point sources is subject to both (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 that invoke State water quality standards for receiving waters. These standards consist of designated uses to be made of the streams and the criteria necessary to protect those uses. Individual discharge requirements are based on the effluent quality needed to ensure compliance with the water quality standards. Most States are using the technology-based approach but some, such as Oregon, Idaho, and North Carolina, are trying the water-quality based approach in some watersheds. The individual effluent limits are enforced through the National Pollutant Discharge Elimination System (NPDES) permits. Large confined animal operations (over 1,000 animal units) fall under the NPDES

Federal Water Quality Programs Affecting Agriculture in 1996

EPA-Administered Programs

Clean Water Act Programs:
- Clean Lakes Program (Section 314)
- Nonpoint Source Program (Section 319)
- National Estuary Program (Section 320)
- National Pollutant Discharge Elimination System (Section 402)

Coastal Nonpoint Pollution Control Programs

Regional Programs

Safe Water Drinking Act

Pesticide Programs

Comprehensive State Ground-Water Protection Program

USDA-Administered Programs

Agricultural Conservation Program (ACP):
- Water Quality Incentives Projects (WQIP)
- Integrated Crop Management (ICM) Practice

Conservation Technical Assistance (CTA) Program

Colorado River Salinity Control Program (CRSCP)

Water Quality Program (WQP):
- Research and development
- Education, technical, and financial assistance
- Data base development and evaluation

Farm Bill Programs (1985 and 1990):
- Conservation Compliance
- Conservation Reserve Program (CRP)
- Wetland Reserve Program (WRT)
- Integrated Farm Management Program
- Pesticide Record-Keeping

Great Plains Conservation Program

Small Watershed Program

Resource Conservation and Development Program

system. Over 6,000 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. The NPDES permit system is unsuited for nonpoint source pollution because discrete discharge points cannot be observed. Because of the diverse and site-specific nature of nonpoint source pollution, States are given primary responsibility. State and local governments develop nonpoint source control plans that can include regulatory measures but mostly 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 1995, EPA has provided over $274 million in grants to such projects, of which $107 million was for agriculture.

The ***Coastal Zone Management Act Reauthorization Amendments*** (CZARA) added important nonpoint source (NPS) 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 State 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." A list of economically achievable measures for controlling agricultural NPS pollution is part of each State's management plan. States can first try voluntary incentive mechanisms, but must be able to enforce management measures if voluntary approaches fail. Implementation of plans is not required until 1999. 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) 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. Currently, 43 States have an EPA-approved wellhead protection program.

The ***Comprehensive State Ground Water Protection Program (CSGWPP),*** established in 1991, coordinates all Federal, State, tribal, and local programs that address groundwater quality. States have the primary role in designing and implementing CSGWPP's in accordance with local needs and conditions. EPA has approved programs in 5 States, and plans from an additional 13 States are under review.

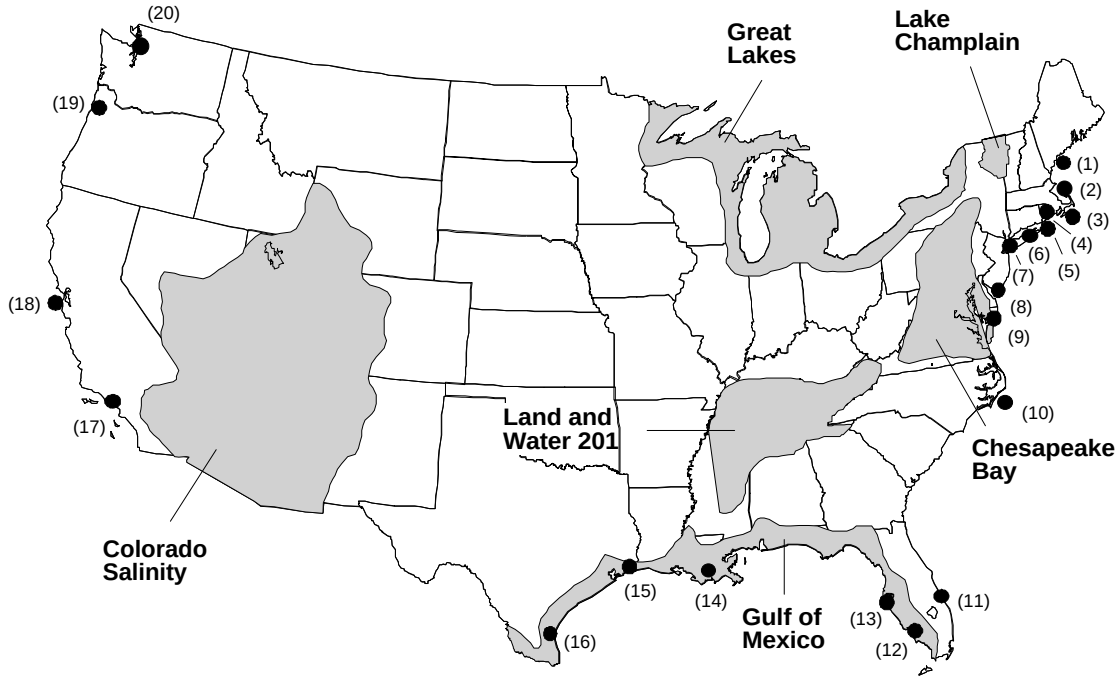
EPA also administers some multi-agency regional programs targeted at particular water bodies (fig. 6.2.1). EPA's ***National Estuary Program*** helps States to develop and carry out basin-side, comprehensive programs to conserve and manage their estuary resources (fig. 6.2.1). The ***Clean Lakes Program*** authorizes EPA grants to States for lake classification surveys, diagnostic/feasibility studies, and for projects to restore and protect lakes.

State Programs

Some 44 States have passed laws or instituted programs that either protect water quality directly, or indirectly by affecting some aspect of agricultural production that is associated with the generation of agricultural nonpoint source pollution (table 6.2.1). Some of these laws are in response to Federal laws such as the Clean Water Act. Others are in response to chronic problems such as nitrates or pesticides in ground water. States use a variety of approaches for addressing water quality problems: controls on inputs or practices, controls on land use, economic incentives, and education programs.

Input controls are primarily directed at pesticides and nutrients. Most States require certification of pesticide applicators. Some States restrict where particular chemicals can be used, usually in response to observed groundwater problems. Nutrient management plans are required in 16 States, usually in areas affected by groundwater contamination.

Figure 6.2.1--Estuary and regional programs for water quality, 1996



● Estuaries of national significance: (1) Casco Bay, (2) Massachusetts Bay, (3) Buzzards Bay, (4) Narragansett Bay, (5) Peconic Bay, (6) Long Island Sound, (7) New York-New Jersey Harbor, (8) Delaware Bay, (9) Delaware Inland Bays, (10) Albemarle-Pamlico 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).

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

Table 6.2.1—Summary of State water quality mechanisms, 1996[1]

State	Nutrient plan requirement	Restrictions on			Cost-share	Farm*A*Syst[2]
		Pesticide	Chemigation	Sediment		
Alabama					X	
Arizona	X	X			X	
Arkansas						X
California		X				
Colorado	X		X			
Connecticut	X			X	X	
Delaware				X	X	
Florida	X	X	X	X	X	X
Georgia			X		X	
Hawaii			X	X		
Idaho	X		X	X	X	
Illinois			X	X	X	X
Indiana					X	
Iowa		X	X	X	X	
Kansas			X		X	X
Kentucky	X					X
Maine				X		
Maryland	X	X		X	X	
Michigan	X			X		X
Minnesota	X		X	X	X	X
Mississippi					X	
Missouri					X	X
Montana				X	X	X
Nebraska	X		X		X	
Nevada			X			
New Hampshire			X			
New Jersey		X			X	
New Mexico						X
New York			X			
North Carolina			X		X	
North Dakota			X			X
Ohio				X	X	
Oklahoma	X			X	X	
Oregon						X
Pennsylvania	X			X	X	
Rhode Island						
South Carolina			X		X	
South Dakota			X	X	X	X
Utah					X	
Vermont	X					
Virginia	X	X			X	X
Washington			X			
Wisconsin	X	X	X	X	X	X
Wyoming	X			X		

[1] Mechanisms may apply only under certain conditions or in certain localities.[2] Farmstead Assessment System helps farmers, ranchers, and rural residents to evaluate pollution risks on their properties and to identify remedial actions.
Sources: USDA, ERS, based on Ribaudo and Woo, 1991; Gadsby, 1996; Jackson, 1996.

Chemigation is banned or tightly controlled in 19 States.

Practices for controlling soil erosion to address water quality problems are required in 18 States. In most, best management practices (BMP's) are required if a complaint is filed by a citizen or government agency. Some States require erosion control plans on cropland, but actual implementation of BMP's is contingent on the availability of cost-share funds.

As animal operations become larger, more States are looking at ways of protecting environmental quality from animal waste. Large confined animal operations can present major water quality problems at the local level. Large operations (greater than 1,000 animal units) are subject to the NPDES point-source permits of the Clean Water Act. However, these permits address only storage of manure on the site, and not disposal. Pennsylvania is the first State to pass a comprehensive nutrient management law aimed at concentrated animal operations. Animal operations with over two animal units per acre of land available for spreading must have a farmlevel nutrient management plan that demonstrates that waste is being safely collected and disposed. An animal unit is defined as 1,000 pounds of live weight.

Land-use laws that affect agriculture are being used by municipalities, counties, and other local governments. Land-use controls include zoning, land acquisition, and easements targeted to areas deemed critical for protecting water resources. Zoning ordinances are used in many areas, especially around the rural-urban fringe, to ban confined animal operations.

Economic incentives for water quality primarily take the form of cost-sharing; 27 States have cost-share programs for soil conservation and other practices. Tax credits are used to a much lesser degree. (Many States have fertilizer taxes, which can be a negative incentive, but these are for revenue generation rather than environmental protection.)

State water quality laws are often driven by court decisions brought about by citizen suit. For example, in hearing a citizen suit brought against a dairy operation in New York, the Second Circuit Court of Appeals made a ruling that could expand the point-source designation of concentrated animal feeding operations to cover all associated lands used for manure disposal (Martin, 1996).

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 15. Farm*A*Syst is also being integrated into USDA and EPA water quality programs.

USDA Programs

In FY 1995, the USDA spent an estimated $3.5 billion on voluntary resource conservation and other environmental programs and activities, many of which addressed water quality (see chapter 6.1, *Conservation and Environmental Programs Overview*). USDA uses six broad approaches to achieve conservation and environmental goals, including: (1) technical assistance and education, (2) financial assistance (cost-sharing and incentive payments), (3) public works projects, (4) rental and easement programs, (5) data and research programs, and (6) compliance programs "linked" to commodity and other USDA program benefits. Typically one or two of these approaches are evident in the many programs and activities USDA has used to address water quality and pollution prevention. For example, the Agricultural Conservation Program (ACP) and the Colorado Salinity Control Program (CRSCP) provided technical assistance (by the Natural Resources Conservation Service) and cost-sharing (by the Farm Service Agency) for installation of BMP's. Rental and easement programs (primarily land retirement programs) pay 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 programs that are linked to commodity programs, such as Conservation Compliance.

USDA research programs complement the other five approaches. Activities include: (1) research on new and alternative crops and agricultural technologies to reduce agriculture's harmful impacts on water resources; (2) research that estimates the economic impacts of policies, programs, and technologies designed to improve water quality and prevent pollution; and (3) environmental and conservation data collection. USDA also administers competitive grants and coordinates conservation and water quality research conducted by State Agricultural Experiment Stations and land grant universities.

The 1996 Federal Agriculture Improvement and Reform Act (1996 Farm Act) continues the same approaches but, beginning in 1997, consolidates some

Addressing Water Quality in the 1996 Farm Act

The Federal Agriculture Improvement and Reform Act of 1996 (the 1996 Farm Act) made significant changes in how USDA provides support to landowners for adopting conservation practices. The Act combined the functions of the Agricultural Conservation Program (ACP), Great Plains Conservation Program (GPCP), Water Quality Incentives Projects, and Colorado River Salinity Control Program into a single program, the ***Environmental Quality Incentives Program (EQIP)***. EQIP is to provide financial assistance to farmers and ranchers such that environmental benefits per dollar expended are maximized. Whereas previous USDA conservation assistance was often available on a first-come, first-serve basis to farmers and ranchers, EQIP will be targeted to priority conservation areas and identified problems outside of priority areas. Assistance will be provided only to those farmers and ranchers facing the most serious threats to soil, water, and related natural resources, including grazing lands, wetlands, and wildlife habitat. Contracts will be for 5 to 10 years, giving farmers the chance to learn to use new practices successfully. Cost-sharing may pay up to 75 percent of the costs of installing approved practices. The annual payment limit is $10,000, with a maximum of $50,000 per contract. Half of the appropriated funding for the program is targeted at practices or systems relating to livestock production. However, owners of large confined livestock operations (generally over 1,000 animal units, but States may request another definition based on environmental circumstances) are not eligible for cost-share asistance for installing animal waste storage or treatment facilities.

The ***Conservation Farm Option*** of the 1996 Farm Act is a pilot program that will provide producers of wheat, feed grains, cotton, and rice who have acres enrolled in production flexibility contracts the opportunity to receive one consolidated payment for implementing a 10-year conservation plan in lieu of separate payments from CRP, WRP, and EQIP (see chapter 6.1, *Conservation and Environmental Programs Overview*).

Table 6.2.2—Summary of ACP expenditures and acres treated for water quality purposes, FY 1991-95

Item	1991	1992	1993	1994	1995
Expenditures, by category:			*$ million*		
Integrated crop management	0.8	1.3	1.4	1.7	1.8
Water Quality Incentive Project	NA	0.3	1.9	4.3	6.5
Animal waste structures	15.9	18.2	19.0	21.9	16.4
Other	13.8	16.9	15.7	16.4	11.9
Total	30.5	36.7	38.0	44.2	36.6
Percent of expenditures, by purpose:			*Percent of water quality expenditures*		
Sediment	15.9	16.0	14.9	13.4	13.2
Animal waste	60.4	56.0	55.1	56.3	56.4
Nutrients	15.7	15.7	15.8	18.4	17.6
Pesticides	1.9	3.1	3.0	3.9	4.9
Salinity	2.6	2.4	2.6	2.4	3.1
Other	3.5	6.8	8.6	5.6	4.7
Total	100.0	100.0	100.0	100.0	100.0
Acres treated, by major practice:			*1,000 acres treated*		
Water quality incentive practice	NA	47.6	250.9	551.7	822.1
Integrated crop management	137.7	221.0	237.1	345.7	284.7
Cropland protective cover	225.8	257.1	189.2	163.9	9.2
Grazing land protection	46.2	88.5	123.0	89.2	73.6
No-till	57.6	74.9	69.8	92.9	54.2
Permanent vegetative cover	60.3	64.2	67.7	85.1	43.8
Irrigation water conservation	66.1	76.4	59.6	105.0	44.1

NA - WQIP not in effect
Source: USDA, ERS, based on Farm Service Agency data.

programs and increases the targeting of conservation and water quality efforts to priority problem areas (see box, "Addressing Water Quality in the 1996 Farm Act" for more detail). USDA programs that addressed water quality in 1995-96 are described below.

Agricultural Conservation Program (ACP)

The ACP provided financial 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. About 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 also reimbursed the Natural Resources Conservation Service (NRCS) for technical assistance in planning and implementing technical practices.

ACP was traditionally used to address soil erosion and water conservation issues. In recent years, as concern over water quality grew, more ACP resources were devoted to water quality practices. Cost-share expenditures on practices whose primary purpose was water quality rose from $13.4 million in 1988 to $44.2 million in 1994 (table 6.2.2), or from 7.1 percent of ACP expenditures to 23.1 percent (USDA, CFSA, 1995a). By 1994, almost all of USDA's water quality cost-share funds came from ACP.

Evidence suggests that profitability is the primary factor for farmers adopting new practices (Logan, 1990; Camboni and Napier, 1994; Magleby and others, 1989). Practices most frequently cost-shared

by ACP included conservation tillage, irrigation water management, and nutrient management. All have been shown to increase net returns in many parts of the country.

Conservation Technical Assistance (CTA)

Conservation Technical Assistance provides technical assistance to farmers for soil and water conservation and water quality practices, and is administered by NRCS. CTA provides technical assistance to farmers adopting practices cost-shared under ACP, and to other producers who ask for assistance in adopting approved NRCS practices. In 1995, the CTA program spent $7.6 million on water quality-related assistance, apart from those activities directly related to the Water Quality Program (see below). This includes assistance provided to programs run by agencies other than USDA (see below).

Water Quality Incentive Projects (WQIP)

The Water Quality Incentives Projects 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 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 farms, as part of an overall water quality plan, in return for an incentive payment. The WQIP supported 39 different practices for protecting water quality (table 6.2.3). Consistent with practices funded under ACP, these were the conservation practices most likely to increase net farm returns.

Integrated Crop Management (ICM)

Integrated crop management was instituted in 1990 on a trial basis as part of the ACP. ICM promoted the efficient use of pesticides and fertilizers in an environmentally sound and economical manner. ICM provided 75-percent cost sharing, not exceeding $7 per acre for most field crops or $14 per acre for horticultural and specialty crops. Cost sharing was made available for up to 3 years for practices including pest scouting services, soil testing, or the rental of specialized machinery. In 1992, ICM was included as an eligible practice under WQIP, where it received a flat incentive payment of up to $10 per acre for field crops and $20 per acre for specialty crops. From 1990 to 1993, ICM was implemented on about 830,000 acres.

Table 6.2.3—Major practices installed under WQIP, FY 1992-95

Practice	Acres
	1,000 acres
Conservation Cropping Sequence	181.1
Conservation Tillage	140.4
Crop Residue Use	78.6
Integrated Crop Management	305.6
Irrigation Water Management	152.4
Nutrient Management	349.5
Pasture and Hayland Management	123.0
Pest Management	273.7
Waste Utilization	124.2

Note - one acre treated in two different years with the same practice is counted as two acres treated.
Source: USDA, ERS, based on FSA program data.

An analysis of the first year of ICM on four crops grown in four States indicated limited success (Osborn and others, 1994): nitrogen fertilizer reductions of 16 to 32 percent per acre on corn, wheat, and cotton were found. Use of other fertilizers (phosphorus and potassium) were largely unaffected. ICM's effect on herbicide use varied by crop. ICM resulted in a net increase in total herbicide use on corn, no significant effect on soybeans, and a decrease on wheat.

Health and environmental risks from pesticide applications were apparently reduced by ICM in some instances, while in others they were increased. An index that accounts for risks to farmworkers, consumers, and the environment from pesticide applications indicated that ICM generally reduced risks in its first year (Dicks and others, 1991). However, ICM impacts were not uniform. About 40 percent of the sampled farms demonstrated a net increase in the index or a negative environmental impact, often due to a change in the mix of chemicals used. Producers switched to chemicals that can be applied at lower rates but leach more easily or are

more toxic. Simply reducing chemical applications may not provide adequate environmental protection from pesticides. The toxicity or leaching characteristics of new chemicals must be considered, as well as changes in application strategies.

Colorado River Salinity Control Program (CRSCP)

The Colorado River Salinity Control Program was started in 1984 to identify salt source areas in the Basin; assist landowners and operators in installing practices to reduce salinity in the Colorado River; carry out research, education, and demonstration activities; and monitor and evaluate the activities being performed. The Colorado River is the primary source of water for over 18 million people in Arizona, California, Colorado, Nevada, New Mexico, Utah, Wyoming, and Mexico. Water is used for irrigated agriculture, generating hydroelectric power, and municipal and industrial purposes. 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.

The improved irrigation systems were designed to increase irrigation efficiency and to reduce the movement of salt into the ground water. Efforts included installing more efficient sprinklers, installing pipe, and lining delivery canals. Landowners who wish to participate, once their application was approved, submitted to a contract of 3 to 10 years. Besides agreeing to build and install the salinity control project, the landowner agreed to operate and maintain the project for as long as 25 years. The cost-shares mitigated the upfront costs of more efficient systems, which might otherwise have discouraged landowners.

Through 1994, 150,000 acres had been treated, out of 360,000 acres originally identified as needing treatment (U.S. GAO, 1995b). The program has conserved about 300,000 acre-feet of water (USDA, CFSA, 1995b). Salt loadings are down 191,223 tons per year (U.S. GAO, 1995b), 38 percent of the total reduction believed possible. The cost-effectiveness of the project ranges from $38 to $70 per ton of salt removed (U.S. GAO, 1995). Salt levels at the three monitoring stations have remained below the limits instituted under the Clean Water Act, thus satisfying the program's goal.

USDA's Water Quality Program

In 1990, USDA made a commitment to protect the Nation's waters from contamination by agricultural chemicals and waste products by establishing the Water Quality Program (WQP). The WQP was in response to a Presidential initiative in the 1990 budget for enhancing water quality. The initiative integrates 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 in 1996 was in its seventh year, with annual expenditures ranging from $83 to $116 million (table 6.2.4).

The WQP strives to (1) determine the precise nature of the relationship between agricultural activities and water quality; and (2) develop, and induce the adoption of, technically and economically effective agrichemical management and agricultural production strategies that protect surface- and groundwater quality (USDA, 1993). The WQP contains 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, makes this program unique to USDA. Originally intended as 5-year program, USDA funding for limited program activities is projected beyond 1999 (USDA, ERS, 1994).

WQP research has improved our understanding of the relationship between water quality and production practices in the Midwest. In particular, the Management System Evaluation Area (MSEA) efforts have resulted in a number of improvements in nitrogen management, herbicide management, crop management, and irrigation water management. The MSEA findings are improving USDA's ability to provide farmers with information on practices that are sound economically, agronomically, and environmentally.

The Hydrologic Unit Area (HUA) and Demonstration Projects (DP), which target education, technical, and financial assistance in areas with known agricultural pollution problems, have shown progress in:

- *Nitrogen management*. Through 1993, nitrogen management practices (including cover and green manure crops) have been implemented on 1 million acres, about 46 percent of the 5-year goal for the 90

Table 6.2.4—Status of Water Quality Program (WQP) and associated activities, FY 1991-95

Activity	Unit	1991	1992	1993	1994	1995
Educational, technical, and financial assistance activities:						
Demonstration Projects:						
Number of active projects	Number	16	16	16	16	15
Demonstration farms	Number	135	135	NA	NA	NA
Total USDA funding[1]	Mil. dol.	8.5	8.5	7.7	5.8	5.7
Ratio education/technical/financial	Percent	25/54/21	25/54/21	29/60/11	36/64/0	37/63/0
Hydrologic Unit Area projects:						
Number of active projects	Number	74	74	74	74	68
Total USDA funding	Mil. dol.	31.5	28.1	17.3	15.0	14.7
Ratio education/technical/financial	Percent	12/50/38	14/43/43	20/60/11	27/73/0	28/72/0
Water Quality Special Projects:						
Number of annual projects	Number	35	35	2	0	0
Total USDA funding	Mil. dol.	9.1	9.1	1.1	0	0
Ratio education/technical/financial	Percent	0/5/95	0/5/95	0/5/95	NA	NA
Water Quality Incentive Projects:						
Number of projects started	Number	0	0[2]	106	71	65
Project acres	Mil. acre	0	0[2]	4.8	3.8	8.4
Total USDA funding	Mil. dol.	0	6.8	15.0	15.0	15.0
Regional activities:						
Regional continuing projects	Number	5	5	6	6	6
Estuaries of National Significance	Number	17	21	21	21	21
Total USDA funding	Mil. dol.	22.7	23.1	22.1	25.2	15.1
Ratio education/technical/financial	Percent	0/61/39	0/58/42	0/63/37	0/67/33	0/96/4
Improved program support:						
CSREES	Mil. dol.	3.9	5.0	5.0	4.6	4.6
NRCS	Mil. dol.	7.5	7.6	7.6	8.1	7.9
ERS	Mil. dol.	0.5	0.5	0.5	0.4	0.4
Research and development activities:						
Management System Evaluation Areas	Number	5	5	5	5	6
ARS expenditures	Mil. dol.	12.9	15.3	15.3	15.3	15.3
CSREES research grants	Mil. dol.	9.0	9.0	9.0	4.2	2.8
ERS collaboration	Mil. dol.	0.5	0.5	0.5	0.4	0.4
Database development and evaluation activities:						
ERS for agricultural chemical database	Mil. dol.	1.9	1.9	2.3	1.0	1.0
CSREES for chemical database support	Mil. dol.	0.3	0.3	0.3	0.4	0.4
National Agricultural Library for information center	Mil. dol.	0.3	0.3	0.3	0.3	0.3
Total USDA funding for WQP and associated activities	Mil. dol.	108.6	116.0	104.0	95.7	83.6

[1] Excludes funds to ERS, which are included under improved program support.
[2] Funds distributed to 49 existing HUA's.
NA = Not available.
Source: USDA, ERS, based on Office of Budget and Program Analysis data.

DP and HUA projects (USDA, NRCS, 1995). Annual nitrogen reductions averaged almost 42 pounds per acre on land receiving treatments.

- *Phosphorus management*. Phosphorus management practices, including those for managing field applications of animal waste, had been implemented on about 850,000 acres by 1993, which is nearly 100 percent of the 5-year goal (USDA, NRCS, 1995). Annual phosphorus reductions averaged about 40 pounds per acre. Predominant phosphorus management practices include nutrient management, use of cover and green manure crops, and conservation tillage.

- *Pesticide management*. Through 1993, 501,000 acres had been treated with pesticide management practices (USDA, NRCS, 1995), nearly 43 percent of the 5-year goal of the 90 projects. Practices include scouting, improved application/timing, mechanical control of pests, use of host crops and predators for pest control, and crop rotations. Pesticide reductions averaged nearly 0.6 pound per acre active ingredient (AI) in 1993. The significance of the chemical reductions in many projects is limited by inadequate knowledge of pre-project application rates (USDA, SCS, 1993).

- *Erosion and sediment control*. Erosion and sediment control practices have been installed on over 1 million acres (USDA, NRCS, 1995). Over 50 different conservation practices are being used to abate erosion and sediment delivery in the project areas, some of which are innovative and not included in the SCS technical manual. Practices include rotations, crop residue use, conservation tillage, cover and green manure crops, and pasture and hayland planting.

- *Water management*. In 1993, the HUA's and DP's implemented irrigation water management practices on 119,000 acres, reducing average annual application of irrigation water by 11 inches per acre (USDA, NRCS, 1995). Irrigation application efficiency on treated fields increased by 18 percent.

The practices successfully promoted are those known to increase net returns, consistent with ACP and WQIP. Targeted financial assistance ended as of 1993. An assessment of HUA's found that acreage goals for a number of practices have not yet been achieved (USDA, NRCS, 1996). 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 (Magleby and others, 1989).

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 price support, loan rate, crop insurance, disaster relief, CRP, and FmHA loans (see chapter 6.4, *Conservation Compliance*). NRCS provides technical assistance for planning and implementing the practices, and some-cost share assistance may be available through ACP or other programs. The magnitude of erosion reductions will result in sizable water quality benefits. ERS has estimated that the average annual water quality benefits from Conservation Compliance are about $13.80 per acre (USDA, ERS, 1994). Conservation compliance results in a large social dividend, primarily due to offsite benefits. An evaluation using 1994 data on HEL fields indicates that the national benefit/cost ratio for Compliance is greater than 2, based on reported changes in tillage practices and expected changes in water quality. In other words, the monetary benefits associated with water quality, air quality, and productivity outweigh the costs to government and producers (USDA, ERS, 1994).

Conservation Reserve Program

The Conservation Reserve Program 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, 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 (USDA, ERS, 1994). (For more on the CRP, see chapter 6.3).

Erosion from cropland has been estimated to cause between $2 and $8 billion in damages each year (Ribaudo, 1989; Clark, Haverkamp, and Chapman, 1985). These damages include reduced recreation opportunities, increased water treatment costs, sedimentation of reservoirs, increased dredging of navigation channels, and silting up of drainage and irrigation channels. The erosion reductions estimated

for the 36.4 million acres enrolled in the CRP are estimated to generate about $437 million annually in benefits to water users. These estimates do not include the water quality benefits from reduced use of nutrients and pesticides on the land removed from production.

As a general approach for improving water quality, retiring cropland can be very expensive. Even though the water quality benefits are "guaranteed" as long as the land is retired, land retirement probably cannot be economically justified on the basis of water quality benefits alone. However, there are areas where the benefits of retiring cropland outweigh the costs. These could include riparian areas, wellhead recharge areas, and drainage areas around particularly valuable reservoirs.

Wetland Reserve Program

The Wetland 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.

The Wetland Reserve Program is primarily a habitat protection program, but retiring cropland and converting back to wetlands also has water quality benefits. Some benefits arise from reduced chemical use on former cropland, but the greatest potential benefits come from the ability of the wetland 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). Artificial wetlands are currently used to treat runoff from animal facilities.

The degree to which created wetlands will improve water quality has not been estimated. One study put the water quality benefits of converting cropland to streamside vegetative buffers at about $95 per acre (Ogg and others, 1989). Creation of a wetland as opposed to a filter strip would likely generate greater water quality benefits.

The Wetland Reserve Program is not targeted on a watershed basis. Water quality benefits would be enhanced by targeting enrollment to watersheds in greatest need of protection from agricultural runoff. 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).

USDA Support of Non-USDA Programs

USDA is supporting several water quality projects sponsored under non-USDA programs (see fig. 6.2.1). USDA provides accelerated technical and financial assistance to farmers in the upland areas of the 21 National Estuary Program projects through CTA and ACP. 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***, ***Lake Champlain Program***, *and* ***Land and Water 201 Program***. USDA support for the Estuary Program and regional programs totaled $15.1 million in 1995.

USDA is assisting EPA's Clean Lakes Program by targeting some of the Small Watershed Program flood control and land treatment projects to Clean Lakes Program projects. USDA is providing program support in many of EPA's Section 319 watershed projects. Some of the HUA and WQIP projects have been targeted to watersheds identified under Section 319. Technical assistance from NRCS for Section 319 projects totaled $300,000 in 1995.

Successful Water Quality Projects

Besides the programs currently being administered, USDA has gained experience from previous efforts targeting agricultural nonpoint source reductions (see box, "Past USDA Water Quality Efforts"). Improvements in water quality from nonpoint source pollution reductions often take years to detect because of the store of pollutants already in the water resources, pollutants already in the soil profile, and other factors such as weather variations and changes in crops grown. While improvements to water quality from most current USDA programs are not yet apparent, the sizable reductions in pollutants entering water resources because of these programs suggest that water quality improvements will follow.

Several completed watershed projects have documented improvements in water quality from activities undertaken in the watershed. Animal waste management 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

Past USDA Water Quality Targeted Efforts

Model Implementation Program (MIP) 1978-82. The Model Implementation Program 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. RCWP 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. Water Quality Special Projects extended cost-share assistance to farmers and ranchers for installing approved water quality practices in small watersheds with identified agricultural nonpoint-source problems. Funding was through ACP. Limited technical assistance was available from the Soil Conservation Service. WQSP's were annual projects, although landowners could enter into multiyear agreements. No new projects were funded after 1992.

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). 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.

Lessons Learned From Water Quality Programs

Experience with past and present water quality programs suggests several recommendations for the success of voluntary water quality programs:

- ***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***. A survey of producers in some Water Quality Program projects indicated that farmers believe they have a responsibility to protect water quality if they are

causing a problem (Nowak and O'Keefe, 1995). The lack of such a belief has been attributed to slow progress in the Darby Creek HUA project in Ohio (Camboni and Napier, 1994). On the other hand, the immediate threat to West Lake Reservoir in Iowa apparently spurred quick action by the farm community (U.S. EPA, 1994).

One of the roles of education is to increase problem awareness. Educating producers about the potential impacts of poor water quality on personal health, the health of neighbors, and the health of the environment may speed up the adoption process. Farm*A*Syst has been successful in getting farmers to reduce risks to water supplies by raising their awareness of activities around the farm that pose risks to them and their families. Assessments of the program in Arkansas, Minnesota, and Wisconsin found that those who participated in the risk-assessment activities were more likely to implement groundwater protection practices (Jackson, Knox, and Nevers, 1995).

- ***Voluntary programs are likely to be successful when the alternative practices recommended generate higher returns.*** The long-term success of voluntary programs depends on farmers continuing to use new practices after assistance ends. Continued use is more likely if practices are profitable. The practices being adopted under ACP and the Water Quality Program are those known to increase net returns, namely conservation tillage, nutrient management, and irrigation water management. Some practices being promoted in the Water Quality Program Demonstration Projects (Rockwell and others, 1991) were not adopted by farmers because they were not profitable. Research can help identify those practices that protect water quality and are also profitable.

- ***Cost-effectiveness is enhanced when program activities are targeted to watersheds—and to critical areas within watersheds—where agriculture is the primary source of a water quality impairment.*** Watersheds with identifiable problems may differ greatly in the water quality improvement that can be achieved and in the economic and social benefits and costs of that achievement. The success of some RCWP projects was limited because agriculture turned out not to be the primary source of water quality impairment (Magleby and others, 1989). In addition, identifying critical areas for priority treatment within watersheds, as well as the set of management practices that are best suited for addressing the particular problem, increases the cost-effectiveness of assistance.

- ***Flexible cost-share programs for practice adoption are more efficient than those with fixed rates and limited lists of supported practices.*** Improvements in current cost-share programs can be made by increasing the maximum amount of incentive payment and quickly approving the financial support of innovative practices. A study by the Sustainable Agriculture Coalition found that per-acre incentive payments for WQIP were not enough to interest some producers to implement management changes identified as necessary for meeting individual project goals (Higgins, 1995). The study concluded that the payments for the following practices were too low in some regions: Waste Management System, Conservation Cover, Conservation Tillage, Critical Area Planting, Filter Strip, Pasture and Hayland Management, Pasture and Hayland Planting, Planned Grazing System, Stripcropping, Nutrient Management, Pest Management, and Record Keeping (Higgins, 1995).

  These conclusions are supported by ERS research findings. Feather and Cooper (1995) found that incentive payments were insufficient for adopting and maintaining some practices beyond 3 years. A survey of farmers in four regions was used to estimate farmers' willingness to adopt conservation tillage, split fertilizer applications, integrated pest management, legume crediting, manure crediting, and soil moisture testing given different incentive payment levels. The results indicated that 8 to 73 percent of the producers were willing to adopt certain practices without incentive payments because of the profitability of the practice (depending on the practices), provided that they are given sufficient information on the practice. Practices such as nutrient management, rotations, and conservation tillage have been shown to increase net returns in many areas, and these practices were the most popular in the WQIP. However, the study also found that at program payment levels, only conservation tillage and split applications were attractive to at least 50 percent of producers. Fifty-percent adoption for the other practices would require a substantial increase in the WQIP incentive payment, unless farmer concern over the impacts of farming operations on water quality can be increased through education.

  Lack of financial assistance may have slowed practice adoption in some Demonstration Projects. In the Wisconsin Demonstration Project, cost-share funds were available for less than half the farmers

wanting to adopt ICM (Finlayson and Erb, 1995). In addition, a lack of flexibility may be hindering the promotion and adoption of innovative practices. For example, the length of time required for an innovative practice with no national standards to be approved for financial assistance could have slowed project implementation (Rockwell and others, 1991).

- ***Local research on the economic and physical performance of recommended practices can improve practice adoption***. Farmers are skeptical of practices with "national" standards when there is no local history of use to readily observe. Project managers in eight USDA Demonstration Projects evaluated by the University of Wisconsin indicated the lack of data to support claims that certain BMP's are effective and economically advantageous (Rockwell and others, 1991). A number of projects diverted considerable resources to applied research to investigate the economic, environmental, and agronomic features of promoted practices (Nowak and O'Keefe, 1995). A research component to watershed projects for testing alternative management practices would accelerate the adoption process.

- ***Interaction with non-USDA agencies, organizations, and local businesses within a watershed is important***. Local districts such as soil and water conservation districts, drainage districts, irrigation districts, and natural resource districts may be operating in project areas. Local business and environmental groups may have some interest in water quality issues. Involving these stakeholders early in project planning would minimize future conflicts, and may bring in additional resources. Seeking and obtaining local cooperation has been identified as a strength of USDA Water Quality Program projects (Rockwell and others, 1991; Nowak and O'Keefe, 1995).

- ***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***. Standardized reporting mechanisms that include economic information and water quality monitoring data provide the information necessary to understand both producer behavior and the efficacy of new practices. Lack of water quality monitoring in USDA Water Quality Program and Water Quality Incentive Projects has been cited as a reason why the ultimate impacts on water quality of many watershed projects may never be known (USDA, NRCS, 1996). Likewise, the lack of data on the economic impacts of the practices adopted with incentives provided by USDA limits the degree to which the effectiveness of implementation strategies can be evaluated.

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Recent ERS Reports Related to Water Quality Programs

The Conservation Reserve Program: Enrollment Statistics for Signup Periods 1-12 and Fiscal Years 1986-93, SB-925, November 1995 (C. Tim Osborn, Felix Llacuna, Michael Linsenbigler). The U.S. Department of Agriculture accepted about 33.9 million acres of cropland into the CRP during 1986-89. An additional 2.5 million acres were enrolled in 1991 and 1992 under significantly revised program rules.

Soil Erosion and Conservation in the Unites States: An Overview, AIB-718, Oct. 1995 (Richard Magleby, Carmen Sandretto, William Crosswhite, C. Tim Osborn). Soil erosion in 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.

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.

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.

A Preliminary Assessment of the Integrated Crop Management Practices, ERS Staff Report AGES-9402, Feb. 1994 (C. Tim Osborn, D. Hellerstein, C. Matthew Rendelman, Marc Ribaudo, and Russ Keim). Analysis of the first year of ICM, based on a sample of four crops grown in four States, indicates limited success. The primary effect of ICM appears to have been reduced nitrogen fertilizer use.

Water Quality Benefits from the Conservation Reserve Program, AER-606, Feb. 1989 (Marc Ribaudo). The Conservation Reserve Program is estimated to generate between $3.5 and $4 billion in water quality benefits if it achieves its original enrollment goal of 40-45 million acres. Potential benefits include lower water treatment costs, lower sediment removal costs, less flood damage, less damage to equipment that uses water, and increased recreational fishing.

(Contact to obtain reports: Marc Ribaudo, (202) 501-8387 [mribaudo@econ.ag.gov])

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