Current federal agricultural conservation programs offer varying potential for improving water quality

Options for agricultural nonpoint-source pollution control

By Marc O. Ribaudo

LOSS of some sediment and agricultural chemicals into the environment is an unavoidable part of agricultural production. Sediment, nutrients, and pesticides can enter surface water resources through runoff, and nutrients and pesticides can enter groundwater through leaching. These residuals often impose costs on users of water resources or adversely affect wildlife. As progress has been made in reducing pollutant loadings from point sources, the relative importance of nonpoint-source pollution, especially from agricultural activity, has become increasingly evident.

A changing program focus

With the increased concern for water quality, the U.S. Department of Agriculture (USDA) has been changing the focus of its conservation efforts. The 1985 Food Security Act contained a number of provisions for reducing the perceived harmful effects of agricultural production on the environment. The conservation compliance provision requires an approved soil conservation plan as a prerequisite for receiving USDA program payments for those producing agricultural commodities on highly erodible land. The sodbuster provision denies farm program benefits to producers who plant commodities on highly erodible grassland or forestland unless they obtain an approved conservation plan and fully apply that plan before planting a commodity. The swampbuster provision denies farm program benefits to anyone who converts wetlands to crop production.

The Conservation Reserve Program (CRP) is a long-term land retirement program designed to help farm owners and operators conserve soil and water resources. Participants agree to retire land for a period of time (generally 10 years). In return, they receive annual rental payments and up to half the cost of establishing a soil-conserving cover crop. The CRP was originally aimed at highly erodible land.

The 1990 farm bill went one step further than the 1985 farm bill. Now, USDA's goal is to improve water quality in areas where adverse impacts from agriculture have been noted or to protect threatened water bodies. Changes were made in the eligibility requirements for the CRP to emphasize water quality, although some changes in eligibility were made administratively before the Food, Agriculture, Conservation and Trade Act of 1990 became law. Eligible cropland now includes "...such lands [that] contribute to degradation of water quality or would pose an on-site or off-site environmental threat to water quality if permitted to remain in agricultural production."

The Water Quality Incentive Program (WQIP), an entirely new program, would provide financial assistance for farmers in "environmentally sensitive" areas to voluntarily adopt water-quality-enhancing best management practices (BMPs). This program is to be targeted to areas where nonpoint-source problems from agriculture are known to occur, such as those watersheds identified under Section 319 of the 1987 Water Quality Act.

Another new program is the Environmental Easement Program (EEP). Under this program, USDA can acquire permanent easements from willing owners of eligible farms to ensure the continued long-term protection of environmentally sensitive land or the reduction in the degradation of water quality. Eligible land includes land placed in the CRP that is likely to come back into production and pose a threat to the environment, riparian land, or other environmentally sensitive land.

The new Integrated Farm Management Program (IFMP) establishes a voluntary program to help producers adopt integrated, multiyear, site-specific farm management plans that promote soil conservation and water quality. Planting flexibility is promoted by allowing farmers to plant alternative crops on base acres without losing base or payment protection.

Currently, the acreage intended for the new CRP and IFMP and the financial support for the WQIP and EEP are relatively small, but these programs may play a larger role in the future. Not having to rely solely on programs aimed at soil erosion control or linked with the production of program crops is significant. The need for such a change in program design can be demonstrated by examining the water quality im-

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These include commodity programs that pay farmers on a per-bushel basis in return for "idling" a percentage of base acreage; the Conservation Reserve Program; and other conservation programs, such as Agricultural Conservation Program (ACP), Water Bank, and Emergency Conservation Program. The effectiveness of a water quality program based on compliance depends upon the attractivenes of the program benefits at stake. Farmers decide to participate in programs by comparing net returns with and without program participation. If expected government payments minus the additional costs (if any) of complying with a water quality requirement are greater than what could be made by opting not to participate in USDA programs, then the farmer should remain or enroll in the program.

It was assumed here that a compliance-type water quality program would make USDA program payments contingent upon taking some action to improve or protect water quality (similar to conservation compliance). Direct cash payments from USDA programs as a percentage of net income (total sales plus government payments-production expenses) were calculated for each county with data from the 1987 Census of Agriculture. These values were compared for affected and unaffected counties in each farm production region and for the nation. For the program to cause farmers in the affected counties to adopt water quality-protecting management systems, the percentage of net income from direct payments should be greater in the affected counties than in the unaffected counties. In other words, the compliance program would be naturally targeted toward problem areas.

Under the SUM>=1 definition of affected county, the Corn Belt and Delta regions have statistically greater ratios of direct payments to net income in the affected counties. The opposite relationship occurs in the Mountain and Southeast regions. Under the SUM>=5 definition, compliance would have a greater effect in affected counties in the Corn Belt, Delta, Lake States, Northeast, and Pacific regions and for the nation as a whole. The opposite relationship was apparent in the Southeast. For the SUM>=10 definition, compliance would have a greater force in the Corn Belt, Delta, Lake States, and Pacific regions. Again, the opposite relationship occurs in the Southeast. One possible explanation of the results in the Southeast is that peanuts and tobacco are supported through quotas rather than direct payments. Such support is not accounted for in the data.

Based on these results, a compliance-type program seemingly would place greater incentive for change in problem counties in the Corn Belt, Delta, Lake States, and Pacific regions. These results are consistent across the three definitions of affected county. Share of income from government payments is among the highest in the Corn Belt, Delta, and Lake States regions, indicating that compliance would have the best chance of success there. About 43 percent of all problem counties are located in these three regions under the SUM>=5 definition; 48 percent occur under the SUM>=10 definition.

Whenever program benefits are tied to performance, long-term effectiveness depends upon program attractiveness over time. Ironically, commodity programs lose their attractiveness when prices are high and the incentives to produce more intensively are greatest. It is at this time that the greatest environmental damage is likely to occur. A compliance program could counter this by requiring a long-term commitment to BMPs.

Success of a water quality compliance program also depends upon requiring management practices that farmers can afford. If the required practices are so costly that remaining in the programs is no longer a viable option, then compliance cannot work. The management practices required in a particular region should, therefore, take into account farmers' costs in terms of reduced net returns and increased risk.

Comparison of ratio of direct USDA payments to net income between affected and unaffected counties

	SUM>=1		*SUM>=5*		*SUM>=10*	
	Affected	*Unaffected*	*Affected*	*Unaffected*	*Affected*	*Unaffected*
Appalachian	.17	.14	.15	.17	.14	.17
Corn Belt	.34	.24**	.35	.29**	.34	.30**
Delta	.27	.18**	.32	.20**	.38	.22**
Lake States	.31	.25	.36	.23	.36	.27**
Mountain	.20	.31**	.23	.25	.24	.24
Northeast	.12	.10	.17	.10**	.16	.11
Northern Plains	.42	.39	.44	.40	.44	.41
Pacific	.19	.12	.22	.14**	.23	.13**
Southeast	.15	.30**	.08	.24**	.02	.22**
Southern Plains	.33	.28	.24	.29	-	.29
United States	.26	.25	.27	.24**	.25	.27

**Difference in means significant at the 5 percent level

Comparison of ratio of cropland in base to total cropland between affected and unaffected counties

	SUM>=1		*SUM>=5*		*SUM>=10*	
	Affected	*Unaffected*	*Affected*	*Unaffected*	*Affected*	*Unaffected*
Appalachian	.29	.25	.27	.29	.23	.29
Corn Belt	.51	.43**	.54	.46**	.57	.48**
Delta	.35	.27	.36	.36	.46	.35
Lake States	.41	.30**	.45	.33**	.49	.36**
Mountain	.30	.43**	.37	.34	.39	.34
Northeast	.22	.17**	.24	.19**	.23	.20
Northern Plains	.68	.66	.68	.67	.73	.67
Pacific	.27	.27	.26	.27	.26	.27
Southeast	.28	.33	.20	.34**	.13	.33**
Southern Plains	.65	.56*	.61	.58	-	.58
United States	.40	.43**	.41	.41	.40	.41

*Difference in means significant at the 10 percent level
**Difference in means significant at the 5 percent level

Program rule changes

Allowing farmers to plant alternative crops on base acreage could result in production practices that are less harmful to water quality, especially for such crops as corn and soybeans. An indication of the degree to which an increase in planting flexibility might improve water quality is the amount of program crop base relative to total cropland in each county. To participate in the deficiency payment program, a farmer must have established historical base acreage. The greater the ratio of base acreage to cropland in a county, the greater the percentage of cropland in the county that might be planted in more environmentally

provement potential of traditional USDA conservation programs.

Agricultural policy mechanisms

In principal, USDA water quality initiatives attempt to influence farmer behavior through three approaches. One is to make program benefits contingent upon taking certain steps to protect the environment (compliance approach). Conservation compliance, sodbuster, and swampbuster fall into this category. These programs only affect USDA program participants.

A second approach USDA could take to influence farmer behavior is to alter the current operation of price or income support programs. A recent U.S. General Accounting Office report cites USDA programs as a prime barrier to addressing nopoint-source pollution control (*5*). Many benefits associated with program participation are linked to the production of specific crops. Crop-specific policies can lead to cropping practices that result in more erosion or are chemical-intensive, thus leading to larger risks of water quality impairment (*1*). For example, base requirements of commodity programs may discourage crop rotations that could reduce erosion or chemical use. Changing program rules to introduce greater planting flexibility for farmers may result in reduced erosion and chemical use. Planting flexibility would allow farmers to plant alternative crops on a portion of their base acreage without losing program benefits. If the alternative crops result in less erosion or require less intensive use of chemicals than the program crops they replace, then water resources would benefit.

A third approach to influencing farmer behavior is through education, technical assistance, and financial incentives. The Soil Conservation Service, Extension Service, and Agricultural Stabilization and Conservation Service have a number of programs for providing technical assistance and cost-sharing to any farmer who wishes voluntarily to adopt conservation BMPs. The emphasis in the past has been on soil erosion control, but new practices that focus on water quality could be encouraged. Practices that protect water quality include buffer strips, integrated pest management, soil nutrient testing, manure management, and conservation tillage. These programs are not tied to commodity programs and could provide greater flexibility in addressing water quality problems.

Evaluation method

The potential effectiveness of agricultural programs for improving water quality was examined by conducting a statistical comparison of various physical and program characteristics of counties affected or not affected by nonpoint-source pollution. Counties were compared for each farm production region (Figure 1) and for the United States as a whole.

Data from the Environmental Protection Agency (EPA) were used to characterize each county in terms of the surface water pollution from agricultural sources. One of EPA's duties under the 1987 amendments to the Clean Water Act is to make periodic assessments of states' progress toward achieving water quality goals (Section 305b reports). Assessments reported in the most recent 305b reports, plus the state assessments made to meet the requirements of Section 319 of the Clean Water Act, indicate that sediment, pesticides, or nutrients originating on cropland adversely affect or threaten at least one EPA water segment (lake or river segment identified in the EPA Reach Indexing System) in 60 percent of the counties in the coterminous United States (1,870 of 3,109). A water segment is considered to be adversely affected if the state-determined designated use was not being met. Some examples of designated use are warmwater or coldwater fishery, domestic water supply, agriculture, irrigation, industrial, primary contact recreation, noncontact recreation, navigation, and high quality/nondegradation. Each state established designated use and determines extent of impairment. Assessments are, therefore, subjective.

Twenty-six percent of all counties reported at least five water segments affected or threatened by agricultural residuals, and 12 percent reported at least 10 affected water segments. Presumably, as the number of water segment impairments in a county increases, the more extensive the agricultural nonpoint-source problem. The EPA data do not permit a calculation of the percentage of surface water impaired, nor do they allow one to assess adequately the intensity of the impairment as measured by pollutant loadings or ambient water quality.

All farm production regions had water segments identified as affected by agricultural pollution. Counties with at least one water segment affected contain large shares of major crops, including 77 percent of corn acreage, 76 percent of soybean acreage, 77 percent of oat acreage, and 72 percent of barley acreage (based on the 1987 Census of Agriculture). Counties with at least five affected segments contain 40 percent of corn acreage, 43 percent of soybean acreage, and 37 percent of barley acreage.

Defining a county as "affected" simply on the basis of number of impaired water segments is rather arbitrary without any additional information. Three criteria were used, therefore, in categorizing a county: one or more impairments (SUM > =1), five or more impairments (SUM > =5), 10 or more impairments (SUM > =10). This sensitivity analysis should reveal the most robust relationships and also what might be the best definition of an affected county. It should be noted that under the SUM > =10 definition there were no affected counties in the Southern Plains.

A statistical t-test was used to compare the mean values of the program variables for the counties defined as "affected" and "unaffected" by agricultural pollution. It was hypothesized that if agricultural programs are to reduce significantly the adverse water quality impacts from agricultural production, then they must influence farming practices in those areas identified as having a nonpoint-source problem.

Compliance programs

USDA administers a variety of programs that make direct cash payments to farmers.

Percentage of U.S. cropland in affected counties

Crop	SUM > =1	SUM > =5	SUM > =10
	%		
Corn	77.0	40.4	20.2
Sorghum	40.0	16.4	6.7
Wheat	72.4	27.7	12.8
Barley	72.4	36.8	19.8
Oats	77.2	35.2	15.0
Rice	41.4	6.7	1.3
Cotton	29.1	12.5	5.9
Tobacco	88.2	43.2	9.5
Peanuts	36.3	11.0	0.9
Soybeans	76.4	42.8	21.5
Alfalfa	74.1	34.1	17.1
Other	61.5	24.8	10.1
Total	68.4	33.3	16.0

modities in Eastern Europe and the Third World, could greatly reduce the attractiveness of programs and, thereby, the incentives for compliance.

The best opportunity for USDA to address farm-related water quality issues is to develop programs specifically aimed at water quality. Recent history indicates that USDA is moving in this direction. Close cooperation between USDA, EPA, and states would present the best opportunity for addressing agricultural nonpoint-source pollution without having to turn to more restrictive controls.

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Water Quality 2000 issues interim report, "Challenges for the Future"

Water Quality 2000—a consortium of more than 80 public, private, and nonprofit organizations—began a four-phase effort in 1988 to develop and implement an integrated national policy for water quality. This report completes Phase II: identifying problems. Phase III will focus on solutions, and Phase IV will begin the implementation process.

Based on the reports of 10 workgroups, Water Quality 2000 has concluded that today's water quality problems stem from a variety of human activities and that current policies and programs are not sufficient to deal with them. While significant progress has been made to improve the nation's waters, the interim goal of "fishable and swimmable" waters has not been met in many areas.

The condition of the nation's waters

Neither the quality of the nation's waters nor the health of ecosystems is measured regularly. Current ambient monitoring of the chemistry and biology of waters and aquatic resources is far too limited to be of use in assessing the performance of water programs. Moreover, data on the release of contaminants to surface and groundwaters are incomplete, covering only a fraction of all waters and, typically, a small number of pollutants. The lack of such fundamental measures of progress toward cleaner water leads to conflicting reports on the condition of water quality and aquatic ecosystems.

While contamination of surface waters from toxic chemicals is thought to be more localized than from other sources, such as siltation, nutrients, or organic matter, local impacts on public health and aquatic life can be severe where toxics have accumulated or continue to be discharged. The nation has not fully measured the prevalence of toxics, fully studied routes of exposure, or sufficiently understood levels of concern.

Comprehensive data on groundwater quality are not collected routinely. Working from anecdotal reports and one-time surveys, however, it is probably reasonable to conclude that the shallowest aquifers are at greatest risk of contamination from human activities, especially those aquifers where the overlying soil is thin and permeable. Contamination of shallow aquifers results from agricultural sources such as pesticides, animal wastes, and other agricultural sources or nitrates from fertilizers, and from industrial or other sources such as synthetic organic chemicals, leaky underground storage tanks, and spills. As yet, most deeper aquifers are believed to be relatively free from contamination.

Wetlands are not only important breeding and nursery grounds for aquatic life but also have an important function in improving water quality, recharging groundwater, flood control, recreation, fish and wildlife habitat, shoreline protection, and water storage. These resources are being rapidly destroyed by a variety of human activities.

Causes of water quality problems

The fundamental causes of water quality problems lie in seemingly unrelated aspects of life: the way we farm, produce, consume, transport people and goods, and plan for the future. Many aspects of modern life and past practices put pressure on water quality. Until recently, these activities proceeded with little recognition of the degradation they caused in surface waters, groundwater, or aquatic habitats. Even today, when we are beginning to recognize some of the basic conflicts between human activities and environmental quality, few contemporary solutions address the basic economic and social forces at the root of water problems. Governmental water quality programs and policies are part of the problem to the degree that they do not fully address these societal causes of impairment. Whether or not Water Quality 2000's goal for the nation can be achieved will be determined, in large part, by whether we can reshape these societal functions in ways that are compatible with protecting and enhancing water quality and aquatic ecosystems

Sources of impairment

Degradation of water resources results from direct human activity, such as municipal or industrial discharges of wastewaters, and from indirect actions, such as land alteration for farming, forestry, mining, transportation, or development. Overall, the following sources (listed alphabetically) contribute significantly to impairment in many locations and ecosystems: agriculture, community wastewater, deposition of atmospheric contaminants, industry, land alteration, stocking and harvest of aquatic species, transportation, urban runoff, and water projects.

Impediments to solutions

Societal factors in conflict with a healthy environment produce serious, long-term impediments to improved water quality. In the near term, however, opportunities exist to address impediments posed by current water policies and programs. The workgroup reports consistently raised the following types of impediments:

Narrowly focused water policies impede the holistic solutions that address watershed-based planning, cross-media effects, the connection between water quantity and water quality, incentives for pollution prevention, and management for environmental results.

Conflicts among water quality institutions impede collaborative solutions in which all levels of government, the private sector, and individuals participate according to their strengths and limitations.

Legislative and regulatory overlaps, conflicts, and gaps sometimes create inefficient or ineffective solutions to water problems or may result in the underprotection of water quality or water-based natural resources.

Inadequate funding and ineffective economic incentives for clean water programs and construction, operation, and maintenance of facilities impede progress toward national goals and are out of touch with general public opinion and actual need.

Lack of attention to the need for trained people has created a serious gap between a limited supply of professionals and a growing demand for their skills.

Current research and development programs fail to meet the challenge presented by the complexity of today's water quality problems and the need to improve our basic scientific understanding of ecosystems.

Inadequate communication has resulted in citizens who are largely unaware of the linkages between daily life and water resources, what they can do to improve the quality of water and aquatic habitat, or why they should participate in the first place.

This is an abbreviated version of the Executive Summary of "Challenges for the Future." The full report is available from Water Quality 2000, 601 Wythe Street, Alexandria, Virginia 22314.

benign rotations and, hence, improve water quality.

The base acreage for each crop in each county was obtained from the 1987 Census of Agriculture. Under the SUM > =1 definition of affected county, the analysis indicated that the percentage of cropland in base was statistically greater in affected counties in the Corn Belt, Lake States, Northeast, and Southern Plains regions. The opposite relationship existed for the Mountain region and for the U.S. as a whole. For the SUM > =5 definition, planting flexibility might have the greatest effect in the Corn Belt, Lake States, and Northeast regions. The opposite could be said for the Southeast. For the SUM > =10 definition, planting flexibility might have the greatest potential in the Corn Belt and Lake States regions. Percentage of cropland in base was again greater in unaffected counties in the Southeast.

The results are consistent across the three definitions of affected county. Planting flexibility appears to have the greatest potential for addressing water quality problems in the Corn Belt and Lake States regions. In the Southeast, planting flexibility appears to offer little opportunity for improving water quality because the low percentage of cropland in base implies farmers are not tied to program rules. In other words, they already have the flexibility option.

Presumably, planting flexibility will result in rotations that are not as harmful to the environment. This is not necessarily true, however. Given the option of planting flexibility, farmers may not exercise it because of economic conditions. Also, the alternatives may be just as damaging to the environment unless there are specific rules concerning acceptable rotations.

Comparison of ratio of CRP-eligible cropland (HEL) to total cropland between affected and unaffected counties

	SUM> =1		*SUM> =5*		*SUM> =10*	
	Affected	*Unaffected*	*Affected*	*Unaffected*	*Affected*	*Unaffected*
Appalachian	.24	.20	.27	.22**	.28	.23
Corn Belt	.24	.27	.25	.25	.22	.25
Delta	.27	.17**	.32	.19**	.32	.21
Lake States	.14	.05**	.12	.14	.12	.14
Mountain	.22	.35**	.19	.30**	.20	.27
Northeast	.20	.18	.20	.19	.16	.20
Northern Plains	.20	.25**	.20	.22	.15	.22
Pacific	.11	.09	.13	.09	.13	.10
Southeast	.16	.23	.13	.20**	.06	.22**
Southern Plains	.17	.29**	.12	.27	-	.20
United States	.21	.24**	.21	.22*	.18	.22**

*Difference in means significant at the 10 percent level
**Difference in means significant at the 5 percent level

Financial incentives

Programs that reduce the costs of adopting conservation practices are an important part of USDA's conservation efforts. Control of soil erosion has been the primary objective of USDA efforts for more than 50 years. When USDA first began addressing water quality, the implicit assumption was that soil erosion and water quality are closely linked. Hence, the view that the CRP program, as originally implemented, could also be treated as a water quality program. In fact, many states mentioned the CRP in their Section 319 management plans as an avenue for addressing agricultural-related water quality problems, and EPA was encouraging this use of CRP even before changes in enrollment criteria were made.

The question of whether soil erosion control for water quality improvement is, in general, a good idea can be examined by comparing crop acreage eligible for the CRP under the highly erodible criteria for affected and unaffected counties. If a large percentage of the crop acreage in problem counties is eligible for the CRP, then an incentive program for erosion control could be used to address agricultural nonpoint-source pollution problems.

A region-by-region comparison of affected and unaffected counties indicated that an erosion-control-based program is not a particularly good mechanism for addressing water quality problems. The percentage of eligible cropland is significantly greater in affected counties in the Delta and Lake States for the SUM > =1 definition. However, the percentage of eligible cropland is significantly greater in unaffected counties in the Mountain, Northern Plains, and Southern Plains regions and for the United States as a whole. Under the SUM > =5 definition, such a program would be more targeted toward problem areas in the Appalachian and Delta regions. The opposite relationship exists for the Mountain and Southeast regions and for the United States as a whole. No regions had a significantly greater percentage of cropland in affected counties eligible under the SUM > =10 definition. The Southeast had a significantly greater percentage of cropland eligible in the unaffected counties, as did the United States as a whole.

These results are generally consistent across the three definitions of affected county. An erosion-control-based program would appear to address current water quality problems effectively only in the Delta region. The primary reason is that the original CRP eligibility criteria were based largely on both wind and water erosion. Thus, the correlation between eligibility based on erosion and the potential contribution to water quality problems would be expected to be poor, especially in drier regions, such as the Southern Plains and Mountain regions. The correlation also was poor in most regions where water erosion predominates.

Recent changes in CRP criteria permit enrollment of land that is not highly erodible if that land can act as a vegetative filter strip. This improves the CRP's ability to address surface water quality problems. But land retirement is generally an expensive option for improving water quality.

In conclusion

USDA's ability to address water quality problems depends upon the approach taken. Programs linked to program crops or to reducing soil erosion appear to offer the least potential in terms of widespread mitigation of water quality problems. A compliance program that links a variety of direct USDA program payments to adoption of water quality improvement practices appears to present an opportunity for influencing production in problem areas within most farm production regions. The level of incentive in some of these areas, however, may still not be sufficient to entice a change in behavior. For example, direct payments as a percentage of net income are significantly greater in affected counties than in unaffected counties in the Northeast. Direct payments in the affected counties, however, account for about 17 percent of net income, less than the national average. This incentive may not be sufficient to keep farmers in the programs if they must adopt water quality BMPs. In addition, the future attractiveness of government programs is uncertain. Budgetary concerns may result in a reduction of program benefits. That, coupled with increased demand for U.S. farm com-