IMPLEMENTATION OF NONPOINT SOURCE POLICIES IN SOUTHERN AGRICULTURE

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Edited by

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Sponsored by

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FOREWORD

As progress has been made in recent years in identifying and controlling point sources of water pollution in the United States, more emphasis has been placed on controlling nonpoint sources of water pollution, including agricultural sources. Section 319 of the Clean Water Act (CWA) and Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) provide federal guidance and assistance in the development and implementation of state and local nonpoint pollution control programs. Agricultural producers have concerns that requirements emanating from these programs may be prohibitively expensive and ultimately ineffective in controlling agriculture=s contribution to water pollution. Environmental interests are concerned that proposed requirements will not be sufficient to reduce pollution emissions and will lack effective enforcement provisions. Agricultural economists have the opportunity to contribute to the ensuing policy debate by providing insight as to the costs and benefits of effective implementation of alternative nonpoint pollution control strategies in agriculture.

To better understand the implementation of federal and state nonpoint source policies in southern agriculture, the Southern Regional Information Exchange Group (SRIEG-10) for Natural Resource Economics held a workshop in Atlanta, Georgia on May 21, 1998. The morning program addressed the federal perspective on policy implementation and future research needs. Presentations on the current status and future direction of nonpoint source programs under the Environmental Protection Agency (EPA), the National Oceanographic and Atmospheric Administration (NOAA), and the United States Department of Agriculture (USDA) included discussions of funding, research needs, and the role of agricultural economists. The afternoon program focused on three regional and state issues - the hypoxia problem in the Gulf of Mexico, nutrient and animal waste problems in the Neuse River of North Carolina, and development of state water quality policy in Florida. This publication is a compilation of the formal papers resulting from presentations at the workshop.

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Steven A. Henning, Editor
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AGRICULTURE AND SECTION 319 OF THE CLEAN WATER ACT

Betty Barton[1]

Background

Page one of the Clean Water Act (Section 101(A)(7) establishes national policy that, "...programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner." However, nonpoint source pollution remains a serious challenge. Because of its extensive nature, the diversity of contributing sources, and sheer number of individual contributors to the problem, there will be no easy solutions.

Water Quality Report to Congress

EPA has just released our newest Water Quality Report to Congress, required under Section 305(b) of the Clean Water Act. It is important to acknowledge that only a fraction of our waters have actually been surveyed to determine their quality. There is a need for more comprehensive water quality data, to more completely and accurately assess the condition of our waters. The following data was reported by states, based on their best available information, and is extracted from the 1996 Water Quality Report to Congress Brochure, dated May 1998.

Rivers and Streams

Only 0.7 million of the nation's 3.6 million river miles, or 19 percent, have been surveyed. Of the surveyed river miles, only 56 percent fully support their designated uses, while 36 percent are impaired and eight percent threatened. Agriculture is the most widespread source, on a national basis, of pollutants impairing surveyed rivers and streams. Twenty-five percent of surveyed river miles are impaired by agriculture. Other leading sources are municipal point sources, hydromodification, habitat modification, resource extraction, and urban runoff, each of which impairs five percent of surveyed rivers and streams. The leading pollutant or stressor of surveyed river miles is siltation, which is impacting 18 percent of surveyed river miles, followed by nutrients (14 percent), bacteria (12 percent), oxygen-depleting substances (ten percent), and pesticides (seven percent).

Lakes, Reservoirs and Ponds

Seventeen million of the nation's 42 million acres of lakes, reservoirs and ponds, or 40 percent, have been surveyed. Of the surveyed river miles, only 51 percent fully support their

[1]Funding Coordinator, EPA Region 4, Water Management Division.

designated uses, while 39 percent are impaired and ten percent threatened. Agriculture is the most widespread source of pollutants impairing surveyed lakes, reservoirs, lakes and ponds, impacting 19 percent, followed by unspecified nonpoint sources (nine percent), atmospheric deposition (eight percent), and urban runoff (eight percent).

Estuaries

Twenty-nine thousand of the nation's 40,000 square miles of estuaries, or 72 percent, have been surveyed. Of the surveyed river square miles, 58 percent fully support their designated uses, while 38 percent are impaired and four percent threatened. Industrial discharges are the most widespread source of pollutants impairing surveyed lakes, reservoirs, lakes and ponds, impacting 21 percent, followed by urban runoff/storm water sewers (18 percent), and municipal point sources (17 percent). The leading pollutants or stressors to our estuaries are nutrients, bacteria, toxic organic chemicals, and oxygen-depleting substances.

Nonpoint Source Pollution

The Clean Water Act addresses nonpoint source pollution most directly in Section 319(h), which authorizes states to receive grants to implement their state nonpoint source management programs, once certain legal requirements are met. The key legal requirements are 1) completion of a nonpoint source assessment and 2) a statewide nonpoint source management program. These requirements were largely satisfied in 1989 and 1990, and since that time, most states have received annual allocations of Section 319 funds to implement the activities in their management programs.

Each state's management program includes a description of the approach the states will use to address each category of nonpoint source pollution, such as agriculture and silviculture. Under the Clean Water Action Plan and the related Clean Water Budget Initiative, states will be given financial incentives to make significant improvements to their management programs. Most states in EPA Region 4 are either in the process of updating their nonpoint source management programs, or will be initiating updates shortly. Now that states are several years into the Section 319 program implementation, EPA is hopeful that states can significantly strengthen their programs and accelerate the pace of implementation activities.

Section 319 Grants

Section 319 funding has been well supported by the public and Congress, since the program was first funded in FY 1990. Funding has increased from $33 million in FY 1990 to $105 million nationally in FY 1998. An increase to $200 million has been proposed for FY 1999, to implement the Clean Water Action Plan. At the state level, southeastern states are receiving from $1.75 to $3.75 million for FY 1998. Of the eight states in Region 4, Florida receives the largest allocation,

$4 million for FY 1998, and South Carolina the smallest, $1.6 for FY 1998. The allocation is determined by a formula that was adopted in FY 1991. The factors that affect funding levels are: population; cropland acres; pasture and rangeland acreage; forest harvest acreage; wellhead protection areas; wetland acreage; mined acreage; and pesticide applications. More details on the factors and data sources can be found in the *Nonpoint Source Program and Grants Guidance for Fiscal Year 1997 and Future Years*, dated May 1996.

States fund many different activities with their Section 319 grants. Activities fall into two general groups. First, support of a state's base nonpoint source program. This would generally fund all or part of the state's nonpoint source program staff, some basic educational activities, and other statewide nonpoint source activities such as Adopt-A-Stream. Second, states use part of their allocation to fund geographically based projects which strive to improve water quality, either directly by installation of best management practices, or indirectly, thorough activities such as education and training.

Of the water quality threats and impairments described above, many can be associated with agricultural operations. If we narrow our focus to nonpoint sources, we see agriculture as a major concern. Most states have identified agricultural nonpoint source pollution as a leading category of nonpoint source pollution.

Each state has developed their own processes for determining how funds are distributed within the state, with wide variation among states, due to varying levels of state support available to fund key activities. EPA's role is to carry out the administrative processes necessary to award the grants to states each year, and to ensure that basic eligibility and other legal requirements are met.

Clean Water Action Plan

In his January, 1998 State of the Union Address, President Clinton acknowledged the importance of clean water, stating that, "Every child needs to grow up with water that is pure to drink, lakes that are safe for swimming, rivers that are teeming with fish.@ This was followed in February with the release of the Clean Water Action Plan, a comprehensive plan involving many federal, state and local agencies, as well as Tribes and local organizations.

The plan includes over one hundred Action Items which are aimed at addressing a wide spectrum of water quality issues, from safe drinking water and safe beaches, to wetland protection and riparian area protection. The plan in its entirety can be found at http://www.epa.gov/cleanwater. The major themes are 1) a watershed approach and 2) strengthening core clean water programs. Within this framework, many categories of actions have been identified. A major component of the plan is the strengthening of state nonpoint source programs (now referred to as polluted runoff programs).

Clean Water Budget Initiative

Associated with the Clean Water Action plan is the Clean Water Budget Initiative. This initiative, proposed by the administration, calls for significant increases in funding to implement water programs. If funded, this initiative would provide an additional $100 million in Section 3l9 funds and an additional $100 million for EQIP funding. In total, USDA would receive almost $200 million in increased funding, primarily for EQIP and activities on Federal Lands, while EPA would receive an increase of approximately $150 million. Other federal agencies, including NOAA and Army Corps of Engineers, would receive smaller increases if the initiative is fully funded.

Research Needs

What are our research needs? More and better water quality data, improvements in best management practices, more effective education and outreach programs, and information on the effectiveness of voluntary programs and financial incentives are all important research needs. Each is briefly discussed below.

Water Quality Data

We would like to have more and better information on the quality of our waters. As pointed out earlier, only a small percentage of our waters have been surveyed. This is largely a resource issue, which points out the need for more cost-effective methods for evaluating water quality. With the resources we are dedicating to water quality improvements, it is important that we have the best possible baseline data, so that we can determine which approaches are working. Related to this is the need for better techniques for identifying sources of pollution. Implementation of the Total Maximum Daily Load (TMDL) program has brought home to us the importance of being able to identify and quantify sources of impairment, so that all contributors play a proportionate role in reducing pollutant loads.

Better Best Management Practices

Air deposition, in particular, is a source we need to better understand. We need better information on sources of air deposition, as well as treatment technology. For instance, are there better alternatives for treating animal waste for large concentrated animal feeding operations?

Education and Outreach Program Effectiveness

Many states have invested significantly in outreach and education activities, such as volunteer monitoring and Adopt-A-Stream programs, in an effort to reach the next generation and

give them a stronger environmental ethic. How can we measure the effectiveness of these programs? The payoff in actual water quality improvements will be many years in the future. In the meantime, how do we determine whether these resource-intensive efforts are good investments? With the many competing demands on public funds, it is critical that we be able to demonstrate that the approaches we are using are effective.

Voluntary Approach

Many states rely heavily on the "voluntary approach" for programs such as agricultural nonpoint source pollution. The concept is that the most cost-effective method of addressing nonpoint source pollution from agriculture is to rely on landowners to voluntarily install the practices that are needed, with financial incentives. How do we know this approach is working? Is the rate of adoption of Best Management Practices (BMPs) increasing in agriculture, as public pressure increases and farmers receive more information related to water quality?

Financial Incentives

Are cost share programs, such as those used for agriculture, effective in getting the needed BMPs implemented? There has been some speculation that these programs can result in landowners delaying BMPs in hopes of eventually receiving cost share funding. What other economic incentives have been tried? Do they work?

Is it practical to have downstream users support the cost of upstream BMP implementation? For instance, Lake Lanier, the primary source of drinking water for millions of Georgians, has many nonpoint source pollution problems, and has many agricultural operations within its drainage area. Could we devise a workable system, whereby the heavily populated urban municipalities could provide financial support to those land users who install needed water quality practices?

What is the cost (to society and to landowners) when BMPs that are needed for water quality protection are not actually installed?

For More Information

Additional information and references can be accessed through EPA's home page for Water: http://www.epa.gov/owow.

AGRICULTURAL POLLUTION IN COASTAL ZONE MANAGEMENT AREAS OF THE SOUTH - IMPLEMENTATION OF SECTION 6217 OF THE COASTAL ZONE ACT REAUTHORIZATION AMENDMENTS OF 1990

Peyton Robertson[1]

Introduction

Based on available data and water quality monitoring reports, it is widely recognized that the lion's share of the Nation's remaining water quality problems are the result of "nonpoint source pollution." Nonpoint source pollution is not easily identified as a discrete discharge from a pipe or factory outfall. Instead, it results from rainwater and melting snow running over lawns, parking lots, and farm fields, through city streets and forests, picking up and carrying pollution into rivers, estuaries, and coastal waters. In coastal areas of the U.S., nonpoint source pollution is generated by several major categories of activities: agriculture (crops and livestock); forestry (timber harvesting); urban sources (cities, roads, and new home construction); marinas (boat storage and service facilities); and hydromodification (construction of dams and channelization). Pollutants from these activities include sediment (soil particles), nutrients (nitrogen and phosphorus), and chemicals and toxic pollutants (pesticides, oil, salts, and metals).

In an effort to develop a more comprehensive solution to the nonpoint source problem in coastal areas, the U.S. Congress expanded the Coastal Zone Management Act (CZMA) in 1990 to include a new section 6217 entitled "Protecting Coastal Waters." Section 6217 requires that states with approved coastal zone management programs develop Coastal Nonpoint Pollution Control Programs (coastal nonpoint programs). In keeping with the successful state-federal partnership to manage and protect coastal resources achieved by the CZMA, section 6217 envisioned that nonpoint source programs developed under section 319 of the Clean Water Act (CWA) would be combined with existing coastal management programs. By combining the water quality expertise of state 319 agencies with the land management expertise of coastal zone agencies, section 6217 was designed to more effectively manage nonpoint source pollution in coastal areas. To facilitate development of state coastal nonpoint programs and ensure coordination between states, administration of section 6217 at the federal level was assigned to the National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency (EPA).

Recognizing that a "technology-based" approach had achieved marked success in controlling point sources under the CWA, section 6217 calls for the implementation of Amanagement measures," or specified control techniques that have proven successful in controlling nonpoint source pollution. The management measures are outlined in guidance developed by EPA, in consultation with the NOAA. The guidance includes management measures for each of the major nonpoint source categories that impact coastal waters, including agriculture, forestry, urban sources, marinas, and

[1]Coastal Programs Division, NOAA Office of Ocean and Coastal Resource Management.

hydromodification. There is also a chapter in the guidance specifying management measures for protection of wetlands and riparian areas.

State Concerns with the Coastal Nonpoint Program

During the development of Coastal Nonpoint Programs, states and territories raised a number of issues and concerns regarding final program approval and implementation. In December 1994, the Coastal States Organization (CSO) articulated the primary issues confronting states and suggested several policy changes deemed necessary "...to maintain the viability and the success of the coastal nonpoint pollution control program..." The key issues raised and remedies proposed by CSO are summarized below.

Boundary - CSO raised concerns regarding how the geographic scope of the Coastal Nonpoint Program within each state would be determined and proposed that final determination of the boundaries for the program should be made by the states.

Geographic Targeting - CSO felt that NOAA and EPA had not sufficiently provided for targeting of Coastal Nonpoint Programs. CSO argued that the scope of the Coastal Nonpoint Program should be limited to coastal waters that do not meet applicable water quality standards or where it is "reasonably foreseeable" that those standards will not be met in the future due to new or expanding sources.

Enforceable policies and mechanisms - In accordance with the statute, Coastal Nonpoint Programs must include enforceable policies and mechanisms to ensure implementation of the management measures. CSO suggested that the definition of "enforceable policy" under the Coastal Zone Management Act should be interpreted broadly and proposed that where a state has enforcement authority against activities which are resulting in water quality impairments, such authority should be adequate to meet the enforceable policy requirement.

Timeframe - The statute establishes only a timeframe by which states must develop Coastal Nonpoint Programs. In program guidance for the Coastal Nonpoint Program, NOAA and EPA established a timeframe of three years for implementation of the management measures. CSO suggested that the three year timeframe was unreasonable, particularly in light of large number of sources to be addressed, and needed to be significantly increased.

Responding to State Concerns - *Flexibility for State Coastal Nonpoint Programs*

In January 1995, NOAA and EPA outlined a specific set of administrative actions to address state issues and concerns and to provide further flexibility for the Coastal Nonpoint Program. Further details of this administrative flexibility were described in a March 16, 1995 document

entitled *Flexibility for State Coastal Nonpoint Programs*. Highlights of the actions described in that document are summarized below.

Boundary - NOAA and EPA agreed to generally defer to state determinations of the boundary for Coastal Nonpoint Programs, unless there was evidence that the state's proposal excluded land or water uses reasonably expected to have significant impacts or present threats to coastal waters.

Geographic Targeting - NOAA and EPA maintained that the Coastal Nonpoint Program was already targeted to coastal waters, but provided flexibility for targeting in three ways:

1) Exclusion of categories, subcategories, and individual sources that did not present significant adverse effects to coastal waters;

2) Generally deferring to state proposals on the geographic scope of the program; and

3) Phasing of the program within an expanded timeframe.

Enforceable policies and mechanisms - NOAA and EPA expanded their view of the kinds of enforceable policies and mechanisms states could use, allowing for existing "bad actor laws," enforceable water quality standards, general environmental laws and prohibitions, and other existing authorities to serve as "back-up" authorities for voluntary programs. In these cases, NOAA and EPA agreed to conditionally approve state Coastal Nonpoint Programs for up to five years, providing the opportunity to demonstrate that less specific authorities, in combination with voluntary efforts, would be effective in ensuring program implementation.

Timeframe - NOAA and EPA substantially extended the timeframe for program implementation, providing eight years to achieve full implementation of the management measures.

NOAA and EPA Review of State Coastal Nonpoint Programs

NOAA and EPA received Coastal Nonpoint Program submittals from all 29 states and territories subject to '6217 (Texas, Ohio, and Georgia have recently joined the CZM program, but these states will have 30 months from the date of their CZM program approval date to develop a coastal nonpoint program). Program submittals were jointly reviewed by NOAA, EPA Headquarters, and EPA Regional staff. Each state program review was documented in a set of Findings that evaluates how the state Coastal Nonpoint Program addresses all of the programmatic and technical requirements of '6217. In addition, NOAA was responsible for undertaking a review of the environmental impact of state program approvals in compliance with the National Environmental Policy Act. NOAA produced a programmatic environmental impact statement for the Coastal Nonpoint Program as a whole, and drafted individual environmental assessments for each of the state coastal nonpoint programs. To date, NOAA and EPA have issued conditional

approval decisions and program Findings to 22 states and territories, with the remaining 7 nearing completion[2].

NOAA and EPA expect that all states and territories will receive conditional approval of their coastal nonpoint programs. Conditional approval was designed to provide states and territories with additional time to address areas of their programs which do not yet meet the requirements of '6217. Many states have included proposals in their program submittals which, if implemented, will meet '6217 program requirements. In these instances, the conditions in the Findings are based on the state proposals.

Further Challenges for the Coastal Nonpoint Program

Following the initial phase of program reviews, it soon became apparent to both the Federal agencies and the states that no program would be fully approvable and each would include some conditions for further development. In providing additional flexibility, NOAA and EPA viewed the results as positive, since no program was found to be "unapprovable" and therefore no states were subject to the penalty provisions of the statute. Further, the Federal agencies viewed the programs as "approved, with conditions." States, on the other hand, viewed the fact that all states would receive conditional approval as negative, since no program was found to be "fully approved" and therefore no states had successfully met all of the program requirements.

In response to remaining state concerns over the issues of enforceability, targeting, timeframe for implementation, and resources, NOAA and EPA agreed to propose a second round of administrative changes in March 1998. At the time of this writing, the availability of the proposed administrative changes has been noticed in the Federal Register and the comment period closed on May 11, 1998. Based on the comments received, NOAA and EPA will make appropriate revisions and issue final administrative changes in July. The Federal agencies will then evaluate each state's program Findings in light of the changes and make any necessary adjustments. Generally, the proposed changes will shift attention from the program approval phase to the program implementation phase, giving states more flexibility now in return for more accountability later. The implications of these changes remain to be seen, but there will clearly be challenges for both the states and NOAA and EPA not only in applying the changes, but also in ensuring the successful implementation of the Coastal Nonpoint Program.

National Progress in Addressing Coastal Nonpoint Pollution

A number of national successes were identified as part of coastal nonpoint program development:

[2]Editor=s Note. All 29 programs had received conditional approval at the time of proceedings publication.

- The Management Measures Guidance developed under '6217(g) represents a compendium of the best available approaches to control nonpoint pollution control for a broad range of sources. Such a complete national encyclopedia of nonpoint source control techniques did not previously exist. The (g) guidance has been a useful tool not only for coastal states, but also for inland states, local governments and practitioners looking for tools to solve nonpoint problems.

- Developing coastal nonpoint programs has improved coordination between state coastal management and water quality agencies. Program development has involved the full range of players who assist in making nonpoint source control programs work, including state departments of agriculture, forestry, marine resources and fisheries, and planning.

- Through program development, states conducted a complete inventory of available programs and resources to address coastal nonpoint pollution. This "self-evaluation" provided states with valuable information on strengths and weaknesses of existing efforts and, in some cases, identified unknown or underutilized tools.

- Through public participation, interagency workgroups, and special task forces, a number of audiences became more aware of nonpoint source pollution as a serious issue for coastal water quality. This expanded knowledge will engender broader public support for new efforts to control nonpoint pollution.

- States are tackling coastal nonpoint source pollution in new and creative ways. A number of coastal states are trying innovative approaches, building on existing programs and designing new efforts to ensure more widespread application of nonpoint source controls.

- Conditional approval has provided states and territories with more time to address remaining deficiencies in coastal nonpoint pollution control programs. By working with NOAA and EPA to address gaps in existing programs, the national effort to address nonpoint pollution will move forward through strengthened coastal nonpoint programs which can be used as models for non-coastal states.

Progress in the Southeast

As part of a recent workshop sponsored by NOAA and EPA for state coastal nonpoint coordinators, states responded to several questions regarding the Coastal Nonpoint Program. The following highlights are based on the responses of the Southeastern states.

The value of developing a state coastal nonpoint program:

- Coordination among governmental entities and new, updated, and revised BMP manuals, brochures, and programs.

- Identifying all of the different programs having a role in managing nonpoint pollution and documenting how well those programs (collectively) achieve, and in some cases surpass, the federal goals for managing nonpoint pollution from various source categories.

- In addition to developing a better working relationship between the coastal program and state water quality program, the overview it has provided of all the ongoing NPS-related activities in the state, as well as the program gaps it has identified.

Major state activities and accomplishments that have improved the management of coastal nonpoint pollution within the last two and one-half years:

NORTH CAROLINA

Statewide animal operation rules strengthened via passage of SB 1217 by the 1996 General Assembly. SB1217:

- Required general permits from the state water quality agency, DWQ, for all existing and new operations over thresholds, replacing a presumption that operations with certified waste management plans were "deemed permitted."

- Required dry litter poultry operations to develop waste management plans with certain specifications and have them available on-site.

- Required annual operational inspections of all operations by agriculture agency staff AND annual compliance inspections by DWQ staff.

- Established a mandatory certification process for waste system operators.

- Strengthened siting requirements for animal operation components.

SOUTH CAROLINA

A Memorandum of Understanding between DHEC and the South Carolina Forestry Commission provides the enforcement link to a strong voluntary program. The state has developed and distributed an agricultural BMP handbook entitled "Farming for Clean Water in South Carolina."

South Carolina passed the Confined Swine Feeding Operation Bill in 1996 and anticipates adoption of new regulations for agricultural animal facilities in May 1998. The state has also development of an herbicide manual by the Highway Department.

GEORGIA

Just getting started, but the erosion and sedimentation program along with new initiatives to permit and manage stormwater and the management of dredging projects between DNR's Coastal Resources Division and the Environmental Protection Division are currently on-going. There is federal and state interagency coordination with 319 and 6217.

FLORIDA

Florida has been implementing a wide variety of NPS/Watershed management programs since the late 1970s. During the past 2.5 years, no new initiatives have been undertaken except for beginning the development of biological assessment tools and metrics for use in estuarine waters.

ALABAMA

Erosion Control (development and land disturbance), On-site Sewage, Boat and Marina, Forestry, Agriculture, Urban Runoff, and other task forces and work groups have been established whose purpose is to identify the problems and develop and distribute the means to address the problem (such as BMP manuals, model programs, etc.).

The Coastal Program has embarked on a series of watershed studies to intensively evaluate the quality of the water environment in each of its watersheds draining to the Coastal Area (irrespective of legal coastal area boundary). This involves land use analysis and water, bottom sediment, and benthic invertebrate sampling under both average and high water conditions. These studies have been instrumental in identifying the problem areas, the magnitude of the problem, and the specific sources.

MISSISSIPPI

Mississippi is in the formative stages of a Comprehensive Resource Management Planning Effort covering two of the three primary watershed areas along the Mississippi Gulf Coast.

LOUISIANA

Louisiana is developing and implementing educational opportunities/programs related to the forestry industry. Watershed-based advocacy groups, such as the Lake Maurepas Society, Concerned Citizens of the Mermentau Basin, and Calcasieu LEAN, have formed. Construction of pumpouts and other sewage management facilities for recreational boating is occurring.

Remaining Issues and Common Challenges

There are a number of remaining issues and challenges facing the southeastern states in implementing their coastal nonpoint programs.

General Issues

- Of continuing concern is the ambitious scope of the coastal nonpoint program and the difficulty in documenting success.

- Many states have indicated that further improvement of efforts to deal with agricultural runoff (particularly confined animal facilities), existing urban development, and failing septic systems will demand significant infusion of dollars to install appropriate technology.

- Adoption of new regulatory programs is politically difficult in light of many regulatory reform initiatives and, in some cases, prohibitions on any new regulations.

- Though most states have improved cooperation between coastal management and water quality agencies, there remain institutional barriers to ensuring that coastal nonpoint pollution is addressed in a comprehensive fashion. There is a continuing need not only for coordination of multiple government programs, but for accountability of implementing agencies and affected interests.

Agricultural Issues

- There continues to be a perception that 6217 is a purely regulatory program that will fundamentally alter the working relationships farmers have with their traditional Federal partners (NRCS, Extension, etc.). In fact, the Coastal Nonpoint Program looks to strengthen these programs while at the same time providing the opportunity to demonstrate existing programs can be successful.

- Development of state coastal nonpoint programs identified a need for improvements in data collection and reporting. Many states found it difficult to evaluate the extent to which agricultural programs have been successful in achieving on-the-ground implementation of management measures. There are also data privacy and reporting sensitivity issues that need to be resolved.

- Most states have agricultural BMP manuals or use the NRCS Field Office Technical Guide as a technical resource for designing and implementing BMPS. However, there is limited information on the extent to which the technical standards have been implemented consistently and whether practices have been maintained over time.

- There continue to be social, political, and cultural issues associated with the adoption of BMPs. States report that farmers continue to resist changes in practices when they cannot visibly see the impacts of their farming activities. In other words, the nature of nonpoint source pollution continues to present challenges in convincing landowners of the need to modify behavior.

The Future of the Coastal Nonpoint Program

Upon completion of the program approval process, attention will turn to providing technical and other assistance to the states and territories to help them meet conditions and implement their approved programs. NOAA and EPA have committed to work with coastal states to ensure effective implementation through a variety of means, including direct technical assistance to improve land use planning and management capabilities (GIS, nonpoint pollution modeling, comprehensive planning), providing federal and state experts to assist local and state government managers in improving coastal management programs and policies for controlling polluted runoff, and targeted education programs for specific audiences.

The Administration budget for FY 1998 includes $2 million to support continued state development and implementation of the Coastal Nonpoint Program. As part of the President's Clean Water Action Plan and companion budget initiative, the budget for FY 1999 requests $12 million for the Coastal Nonpoint Program. By FY 1999, 29 CZM states will have approved Coastal Nonpoint Programs, though certain portions of these programs will need further development (to address conditions). In addition, the three states new to the Coastal Zone Management program (Texas, Georgia, and Ohio) need resources to fully develop approvable Coastal Nonpoint Programs. NOAA is requesting $6 million for Coastal Nonpoint Program grants to enable all states to fully develop Coastal Nonpoint Programs.

NOAA is requesting $6 million for CZM Act Section 309 Enhancement grants to enable states to implement their Coastal Nonpoint Programs. Funds would be used to improve management of lands within coastal watersheds, including activities such as pesticide and nutrient management, correcting failing or poorly designed septic systems, and improving stormwater management. Funds would accelerate the implementation of on-the-ground management measures and leverage other state and local resources working to control the flow of polluted runoff into coastal waters.

USDA PROGRAMS TARGETING NONPOINT SOURCE POLLUTION FROM AGRICULTURAL SOURCES

Marc O. Ribaudo[1]

Introduction

USDA has a long history of providing incentives for conservation practices. For most of that history, the emphasis was on soil and water conservation. Programs such as the Agriculture Conservation Program (ACP) and the Great Plains Conservation Program (GPCP) provided farmers with financial assistance for implementing conserving management practices. In addition, farmers could receive technical assistance and education from USDA to help them apply alternative practices. In recent years water quality has become an important goal in USDA programs. In this paper I will discuss the current status of USDA programs that address water quality issues, including program activity in the SRIEG-10 states. I will first present some background how these programs evolved, and then I look towards the future in terms of future policy directions and needs for research.

Programs Before 1996

After passage of Clean Water Act in 1972, water quality became an issue of increasing importance to USDA conservation programs (USDA, 1981). One of the first programs for targeting water quality in geographic areas was the Model Implementation Program (MIP) of 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 targeted to watersheds believed to be impaired by agricultural pollution. 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, which are summarized later in the paper (National Water Quality Evaluation Project, 1983).

The Rural Clean Water Program (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 in some projects 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. In some other projects, water quality improvements were not observed. Economic benefits from actual or expected water quality

[1]Agricultural Economist, Water Quality Project Leader, Economic Research Service.

improvements were estimated to exceed costs in about half the projects studied (Magleby, Piper, and Young, 1989). These results highlighted the difficulties in identifying projects where agriculture is the primary source of water quality impairment, and in getting farmers to adopt alternative management practices.

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 WQP strove 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 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, makes this program unique to USDA. Originally intended as five year program, USDA funding for limited program activities is projected beyond 1999 (USDA, ERS, 1994).

By 1996, USDA's Water Quality Program had extended assistance to farmers and landowners in over 400 selected project areas in all States but Nevada (table 1). Four different types of projects were implemented. Sixteen Demonstration Projects (DP) used education and technical assistance to demonstrate the effectiveness of, and to promote the use of, selected practices for reducing nonpoint source pollution. These projects were located in areas where agricultural pollution was believed to be affecting water quality, and were implemented jointly by the Natural Resources Conservation Service (NRCS) and the Cooperative State Research, Education and Extension Service (CSREES). Elements of the demonstrated production systems included nutrient management, alternative cropping systems, integrated pest management (IPM), alternative pest control strategies, appropriate chemical application and disposal techniques, and integration of weather data into farm decisions. Originally intended as five year projects, 15 of the Demonstration Projects have been extended for three more years.

Hydrologic Unit Area (HUA) projects, 74 in number, were located in watersheds identified by States as having significant nonpoint source water quality problems. HUAs are generally much smaller in size than Demonstration Projects. With financial assistance from the Farm Services Agency (FSA) through the Agricultural Conservation Program (ACP)[2], education from CSREES, and technical assistance from NRCS, local landowners apply alternative management practices and structural practices to meet State water quality goals without undue economic hardship. HUAs were originally planned as five year projects. However, 63 of the HUAs have been extended for an additional three years.

[2]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 exceptions, ACP funds were not targeted to specific geographic areas. Instead, assistance was available upon request.

Table 1. USDA Water Quality Program Projects, 1990 - 1996.

SRIEG-10 States	Program			
	Hydrologic Unit Area (HUA)	Water Quality Special Projects (WQSP)	Demonstration Projects (DP)	Water Quality Incentive Projects (WQIP)
Alabama	2	2		8
Arkansas	2	3	1	9
Florida	3		1	3
Georgia	1	4	1	9
Kentucky	1	3		6
Louisiana	1	3		2
Michigan	2	5	1	10
Mississippi	1	2		2
North Carolina	1	1	1	2
South Carolina	2	5		5
Tennessee	2	3		2
Texas	3		1	1
Virginia	1	2		4
SRIEG-10 Total	22	33	6	63
U.S. Total	74	110	16	242

Water Quality Special Projects (WQSP), 110 in number, extended cost-share assistance to farmers and ranchers for installing practices that reduce the runoff of agricultural pollutants in small watersheds that states identified as having agricultural nonpoint source problems. Water Quality Special Projects were initiated by FSA and funded through ACP. WQSPs were annual projects, although landowners and FSA could enter into multi-year agreements. No new projects were funded after 1992, with resources being shifted to the Water Quality Incentive Projects.

Water Quality Incentive Projects (WQIP), 242 in number, provided financial assistance for adopting alternative management systems. Projects were targeted to small watersheds of generally less than 100,000 acres. Incentive payments were for management practices such as IPM, not for structural practices, and were funded through ACP. The emphasis on non-structural practices distinguished this program from HUAs and WQSPs. Agreements with landowners were generally for three years. WQIP was not part of the original plan for the Water Quality Program, but initiated in the 1990 Farm Bill. Because of its focus on water quality, this program was Aadopted@ into the Water Quality Program, under the management of FSA. WQIP projects offered much less education and technical assistance than HUA projects. WQIP was folded into the Environmental Quality Incentive Program by the 1996 Federal Agriculture Improvement and Reform Act.

While an impressive amount of resources has been directed into WQP projects (over $500 million through 1995), little evidence has yet emerged that water quality has been improved (USDA, ERS, 1997). A lack of adequate monitoring is one reason. More time may be needed to detect changes, due to physical/biological lags between changes in practices and improvements in water quality. There are also indications that the projects may have been less than fully successful in getting farmers to adopt those practices that are believed to be most effective in improving water quality. A study of producer adoption of improved farming practices in USDA Water Quality Program Demonstration Projects could find little difference in increases in awareness, familiarity, and adoption of alternative management practices between control sites and the Demonstration Projects (Nowak, O=Keefe, Bennett, Anderson, and Trumbo, 1997). This study used survey data to compare adoption rates of similar management practices in the Demonstration Project areas and in control areas. Analysis of the data found that in only two cases was there a significantly greater management practice adoption rate in the Demonstration Project over 1992-1994 than in the comparison sites. It is possible that information spillover from the Demonstration Projects influenced the control sites, but it is just as possible that farmers are generally looking for more efficient management practices that cut costs and increase net returns, and that education alone was inadequate for accelerating the adoption process.

Evidence suggests that the subsidy rates for many of the practices supported by the WQIP were inadequate for encouraging adoption of practices less damaging to water quality. A study by the Sustainable Agriculture Coalition found that WQIP incentive payments were too low to interest producers in some parts of the country to implement management practices that were identified as necessary for meeting individual project goals (Higgins). Extra paperwork associated with the program further reduced the incentive to adopt a practice.

Cooper and Keim (1996) found that WQIP incentive payments may have been insufficient for adopting and maintaining practices beyond three years. For the practices split fertilizer applications, integrated pest management, legume crediting, manure crediting, and soil moisture testing, adoption rates of 12 to 20 percent could be achieved for a $0 payment, suggesting that some producers may be willing to adopt certain practices without incentive payment because of the profitability of the practice. At the WQIP offer rate of about $10 per acre, the adoption rate would not increase beyond 30 percent. They found that achieving a fifty percent adoption for any of the

practices would require a substantial increase in the incentive payment (up to $60 per acre for some practices).

Cooper and Keim=s results are supported by the findings of a survey conducted in the Cornbelt (Kraft, Lant, and Gillman, 1996). A survey of farmer attitudes toward the WQIP found that only 17.5 percent indicated they would be interested in enrolling, and an additional 27.8 percent stated they might be interested. The average per acre incentive payment requested by those expressing at least some interest in the program was almost $76 per acre, much greater than maximum current level of $25 per acre. Only 18.8 percent were willing to accept a per acre incentive payment of $25 per acre or less.

For a given (limited) financial incentive, practices that enhance net returns will have a higher probability of being adopted than practices that are not profitable or if the benefits of adoption accrue largely off-farm. Therefore, traditional cost-share programs may be less effective in promoting water quality practices with off-farm environmental benefits. In addition, the ability of USDA subsidies to achieve a specific water quality goal depends on program managers= skill in identifying the Acorrect@ practices to support, rather than on farmers= own skills.

Lessons Learned from USDA Water Quality Programs

Experience with earlier conservation programs that were targeted to particular water quality problems, including the Model Implementation Program, Rural Clean Water Program, and USDA Water Quality Program, has brought to light a number of program characteristics that enhance the chances that the ultimate goal of environmental quality protection will be met (Ribaudo, 1998).

These are:

- Target programs to watersheds or other regions where agriculture is the primary source of environmental impairment.
- Include local stakeholders in project planning and implementation.
- Allow an adequate time frame for overcoming constraints to adoption and the lags between on-field changes and off-site effects.
- Identify and promote those alternative management practices that improve environmental quality and increase net returns.
- Support local research on the environmental and economic performance of recommended practices.

- Educate farmers on local environmental problems and the impacts their operations have on those problems.

- Make available the full range of education, technical, and financial assistance throughout the life of the project.

- Offer flexible financial assistance for practice adoption that is sufficient to result in desired changes.
- Include adequate resources for project evaluation, including surveys, and monitoring of water quality, crop yields, and economic returns.

- Take advantage of local or state regulations to design projects and incentive packages that help farmers meet state goals.

Current USDA Programs

The Federal Agriculture Improvement and Reform Act of 1996 (FAIR) made significant changes in how USDA provides support to landowners for adopting conservation practices. The primary program for delivering education, technical, and financial assistance to farmers is the Environmental Quality Incentive Program (EQIP). It combines the functions of the Agricultural Conservation Program, Great Plains Conservation Program, Water Quality Incentives Program, and Colorado River Salinity Control Program. EQIP provides technical, educational, and financial assistance to farmers and ranchers for adopting structural, vegetative, and management practices that protect or enhance environmental quality.

Whereas the majority of USDA assistance under the previous programs was available on a first-come, first-serve basis to most farmers and ranchers, EQIP is primarily targeted to conservation priority areas (CPA), which can be defined as watersheds or other regions facing serious threats to soil, water, and related natural resources, including grazing lands, wetlands, and wildlife habitat. CPAs and contracts are prioritized so that cost-effectiveness of program resources are maximized. Contracts are for five to ten years, and the annual payment limit is $10,000 per person, with a maximum of $50,000 per contract. The program is currently funded at $200 million per year. By statute, half of the available funding for the program is to be targeted at practices relating to livestock production. Table 2 shows the status of EQIP through 1997.

Based on the lessons learned from previous programs, EQIP is an improvement over past programs. How has EQIP incorporated these lessons?

Target programs to regions or watersheds where agriculture is the primary source of environmental degradation. Targeting program resources to areas believed to be suffering environmental impairments due to agriculture is one of the most important ways of enhancing program cost-effectiveness. Cost-effectiveness is one of the objectives of EQIP, and targeting is an

important component of the program. Program delivery is to be targeted primarily to Apriority areas.@ A priority area is a watershed, a subwatershed, an area, or a region that can be geographically or physically described and has a natural resource or environmental concern.

Local work groups put together project proposals that go to the State Conservationist and then to national NRCS headquarters. To enhance cost-effectiveness of program funds, recommended projects are ranked at both the State and National levels to select those with the greatest expected environmental benefit per dollar expended. Characteristics considered in ranking project proposals include conditions of natural resources, seriousness of those conditions, expected improvements to resources from project activities, societal benefits, likely producer participation, and availability of local resources.

Table 2. Status of the Environmental Quality Incentive Program (EQIP), Through 1997.

SRIEG-10 States	Signed Contracts	Contract Acres	Priority Areas
Alabama	741	50,586	19
Arkansas	998	128,541	18
Florida	672	75,915	9
Georgia	699	49,974	19
Kentucky	680	51,538	12
Louisiana	2,125	163,163	8
Michigan	270	67,294	11
Mississippi	693	83,164	7
North Carolina	815	27,985	10
South Carolina	507	38,532	10
Tennessee	550	34,074	6
Texas	1,990	1,232,681	12
Virginia	386	30,624	4
SRIEG-10 Total	11,126	2,034,071	145
U.S. Total	24,339	8,723,730	476

Besides ranking projects, priority is assigned to producer contract applications within projects in order to maximize environmental benefits per dollar expended. For each potential

contract, an environmental index is calculated by assigning points that relate to improvement of natural resource concerns, reduction of the agricultural causes of the concerns, protection of the environment, or enhancement of the environment. Which characteristics are used in the index and their weights depend on problems being addressed by the project. An offer index is then calculated for each contract by dividing the estimated program payment cost of practices by the environmental index. This is similar to how CRP contracts are evaluated using the Environmental Benefits Index (see the section on the CRP). But contract selection under EQIP is done at the priority-area level, whereas CRP contract selection is done at the National level.

Include local stakeholders in project planning and implementation. Involving local stakeholders early in project planning and implementation minimizes future conflicts, and may attract additional resources. EQIP, as all recent USDA programs, involves local stakeholders in most aspects of project development and implementation. Specific roles have been identified for State technical committees and local work groups. Local work group members include an NRCS designated conservationist, conservation district board(s) or equivalent, county FSA committee(s), FSA county executive director, conservation district manager, cooperative extension, state and local government representatives, and tribes. Advice and input may be sought from agricultural producers and agribusinesses, cooperative extension=s advisory board and IPM implementation team, organizations with conservation expertise, and other interested persons and stakeholders. The local work groups assesses natural resource conditions and needs, identify program priorities and resources available, develop proposals for priority areas, and makes program policy recommendations to the State Technical Committee. Future plans call for EQIP to be fully implemented at the State level with project proposals, rankings, and selections made using locally determined criteria and weights (R. Molleur, personal communication).

Allow adequate time frame for overcoming constraints to adoption and the lags between on-field changes and off-site effects. The ten year contracts available under EQIP are an improvement over previous programs, where one to three year contracts were the norm. Voluntary adoption and continued use of alternative practices takes time. The adoption process, from first learning about a practice through implementation, can take years. Farmers must be convinced that there is a problem to be addressed, learn about alternative management practices, adopt the practices, and successfully implement them. Successful completion of a project is enhanced when adequate assistance resources are made available for an extended period of time.

Support local research on the environmental and economic performance of alternative practices. Farmers tend to be skeptical of practices with Anational@ standards when there is no local history of use. Alternative practices new to a project area need to be locally field tested so that farmers can see the environmental and economic benefits first-hand. The Environmental Quality Incentives Program Manual states that practices be science based and sufficiently field tested (NRCS, 1996). Practices eligible for funding must also be approved for a priority area in consultation with the local work group. It is unlikely that such a group would approve of practices that have not been locally tried or tested .

Make available the full range of education, technical, and financial assistance throughout the project life. The EQIP program calls for education, technical, and financial assistance to be provided to producers in project areas, enhancing the probability of long-term success. There are a number of constraints to farmers adopting alternative management practices. Not all can be addressed by a single type of assistance. Education can inform producers about innovative practices, reduce the cost of obtaining information about practices, and clarify what may be inconsistent and conflicting information about a new practice. Technical assistance reduces the private cost of obtaining information about a particular practice on a particular farm, helps provide managerial skill that may be lacking, and enables the producer to handle increasingly complex practices. Financial assistance helps overcome a short planning horizon, allows the farmer to accept greater risk over the short run (during the learning phase), and provides an incentive to try something that may be seen as non-traditional.

EQIP is limited in the amount of funds that can be used for education and technical assistance. For 1997, OMB set a maximum of up to ten percent of the available funds to technical assistance (John Stierna, personal communication). The educational assistance needs are to be determined at the state and local level. State conservationists will enter into cooperative agreements with Extension, conservation districts, and other education providers. It cannot be said at this time whether the resources set aside for education activities will be adequate. Lack of adequate personnel and funding could decrease the effectiveness of financial assistance, and decrease project and program cost-effectiveness.

Offer flexible financial assistance for practice adoption that is sufficient to result in desired changes. Flexible financial assistance, in terms of incentive levels and practices eligible for assistance, enhances the likelihood that adequate incentives to farmers to try alternative practices will be provided. Financial and resource conditions vary between projects and between producers within projects. Project cost-effectiveness is enhanced when financial assistance is based on the amount necessary for a particular farmer to implement a particular practice, while accounting for expected benefits. The EQIP program uses two different payment approaches. Structural practices are supported with a 75 percent cost-share (except for manure handling facilities for confined livestock operations over 1,000 animal units, which are not eligible by law). Management practices are supported by a per acre incentive payment. The level of the payment is to be sufficient enough to encourage adoption, even if actual adoption costs are exceeded. EQIP allows incentive payment levels to be set at the local or State level, allowing customization for local conditions. EQIP also allows projects to support experimental practices at their discretion, avoiding the long National Office approval process. These rules enhance the likelihood of project success. While it is difficult to make a general statement, the payment caps of $10,000 per year and $50,000 per contract should not be a major constraint for management practices. They may be binding for structural practices for large animal operations.

Include adequate resources for project evaluation, including water quality monitoring, yield, and economic returns. The success of a project can only be determined if an adequate baseline is established, and changes in environmental quality monitored throughout the project=s life.

Environmental monitoring is the most scientifically accurate means for evaluating a project=s success, but it is also the most expensive. In addition, an effective mechanism for tracking changes in land management in the project area provides valuable data to project managers on project progress. Such information enables interim assessments of whether project milestones are being achieved, and where additional resources or adjustments in rules might be needed. EQIP calls for annual evaluations at the farm, project, state, and national levels. Benchmarks are to be established, environmental indicators identified, and a means for measuring environmental changes developed at the farm and project level. These data, if properly collected, should enable an assessment of project success.

Conservation Reserve Program

The Conservation Reserve Program (CRP) encourages farmers to retire highly erodible cropland in return for annual rental payments and a one-time conservation practices cost share payment. The CRP is not a new program, being part of the 1985 Food Security Act. Its staying power has much to do with the perceived environmental benefits of retiring marginal cropland from production, and the ability to address multiple environmental goals. Water quality benefits from reduced sedimentation were estimated to be $3.5 to $4 billion over CRP contract life (Ribaudo, 1989).

During first nine sign-ups, the CRP had multiple objectives: to decrease water and wind erosion; to protect the land=s long-term capacity to produce food and fiber; to decrease sedimentation in streams and along roads; to improve water quality; to create better habitat for fish and wildlife through improved food and cover; to curb production of surplus commodities; and to provide income support to farmers. The primary purpose, though, was to reduce erosion. Because erosion control was the primary concern, in the early sign-up periods the criterion for the acceptance of a bid was based on whether the land was highly erodible (Berg, 1994). Nearly 34 million acres of cropland were enrolled in the CRP during the first nine signups, much of this enrollment occurring west of the Mississippi River (table 3).

Revisions in the CRP enrollment criteria and procedure followed passage of the 1990 FACT Act. Their purpose was to minimize rental rate distortions and to maximize potential environmental benefits per dollar spent (CAST, 1995). To accomplish this, USDA developed a new bid process using an environmental benefit index (EBI) to select acres that would fulfill this objective. The use of the new bidding process started with the 10th signup in 1991.

The EBI was used as a targeting mechanism to obtain higher benefit-cost ratios than previous bid selection strategies (Diebel, Janssen, and Smith). The EBI was comprised of seven criteria: surface water quality improvement; ground water quality improvement; soil productivity preservation; assistance to farmers affected by conservation compliance; tree planting; Hydrologic Unit Area enrollment; and established conservation priority-area enrollment. Four of these relate to water quality, resulting in a shift in CRP away from arid areas prone to wind erosion to more

humid regions where water erosion, and sediment problems, are of concern. About 2.5 million acres were enrolled under the revised bidding process. Table 3 shows how the EBI affected enrollment in the SRIEG-10 states.

The EBI had several weaknesses (Osborn). It failed to directly recognize wildlife benefits, which was emerging as one of the major benefits of the program. It was also criticized by producers and local agencies administering the program for being a Ablack box@ that made a priori identification of favorable bids difficult (Diebel, Jansen, and Smith). A new set of national ranking factors was used beginning with the 13th signup. The factors include: wildlife benefits; water quality benefits; erodibility index; new tree plantings; and cost. Weights were assigned to each factor and made known to producers and local agencies, making it easier for a producer to identify those land use or environmental enhancements that would improve the likelihood of contract acceptance. Air quality and conservation priority areas were added as components of the EBI starting with the 15th signup.

One way USDA is encouraging farmers to place CRP acreage into particularly environmentally friendly practices is through continuous signups. Starting in September 1996, farmers could offer land into the program at any time, if it was to be placed into Ahigh priority@ conservation practices. Included among these high-priority practices are riparian buffers, filter

Table 3. Conservation Reserve Program (CRP) Enrollment, Before and After Introduction of the Environmental Benefits Index (EBI).

SRIEG-10 States	Before EBI		After EBI	
	Enrollment Acreage FY86-90	Percent of Total Enrollment FY86-90	Enrollment Acreage FY91-93	Percent of Total Enrollment FY91-93
Alabama	519,529	1.5	53,661	2.1
Arkansas	225,354	0.7	34,652	1.4
Florida	123,013	0.4	11,847	0.5
Georgia	663,156	2.0	43,302	1.7
Kentucky	416,799	1.2	34,158	1.4
Louisiana	132,908	0.4	13,664	0.5
Michigan	193,305	0.6	136,548	5.5
Mississippi	726,898	2.1	114,928	4.6
North Carolina	137,039	0.4	13,967	0.6
South Carolina	265,513	0.8	12,557	0.5
Tennessee	429,352	1.3	46,272	1.9
Texas	3,921,377	11.6	229,107	9.2
Virginia	73,938	0.2	5,618	0.2
SRIEG-10 Total	7,828,181	23.1	750,281	30
U.S. Total	33,921,899		2,500,834	

strips, and grass waterways. Offers are automatically accepted, provided the acreage and producer meet certain eligibility requirements and the CRP rental payment cap is acceptable to the producer. An additional financial incentive above the soil rental rate is offered for buffers, filter strips, and grass waterways to encourage enrollment.

USDA Buffer Initiative

In 1997 NRCS launched the USDA Buffer Initiative. The goal is to establish two million miles of buffers along streams, lakes, and rivers by the year 2002. Buffers are promoted through existing USDA programs, including EQIP and the CRP. Buffers can be enrolled under the continuous sign-up provision of the CRP.

Conservation Reserve Enhancement Program

The Conservation Reserve Enhancement Program (CREP) builds upon CRP in several important ways. First, it is designed to address specific state and local concerns through a state-federal partnership. Proposals are developed by governors in consultation with local citizens, including farmers and ranchers. Second, CREP is targeted to specific geographic areas of state and national significance. Third, the program=s flexibility permits the design of conservation strategies to address specific issues and concerns. The program typically uses financial incentives and in some cases expanded land eligibility on top of the CRP rental rate to encourage farmers and ranchers to enroll in the CRP in contracts of ten to 15 years= duration to remove lands from agricultural production. USDA anticipates that much of the land in the CREP will go into stream buffers (USDA, FSA, 1998). Currently, three CREP programs have been approved: Maryland (Chesapeake Bay); Minnesota (Minnesota River); and Illinois (Illinois River). CREP proposals are currently being developed with New York to protect drinking water quality for New York City, and with Oregon and Washington for protecting dwindling salmon stocks.

In CREP, a state and USDA work together to link resources and share costs to meet conservation and environmental objectives. Using Maryland as an example, USDA and Maryland contributed a total of about $200 million for ten to 15 year contracts, cost-share assistance, and technical assistance to encourage landowners to devote environmentally sensitive cropland or marginal pasture land adjacent to streams, rivers, or other water bodies to long-term resource conserving vegetative covers.

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. Current enrollment is 315,175 acres, with a goal of 975,000 acres by the year 2000 (table 4).

Table 4. Status of the Wetlands Reserve Program (WRP), Through 1997.

SRIEG-10 States	Contracts	Acres

Alabama	6	919
Arkansas	103	28,883
Florida	0	0
Georgia	4	2,005
Kentucky	9	1,420
Louisiana	187	61,912
Michigan	34	1,995
Mississippi	130	57,872
North Carolina	54	10,725
South Carolina	18	2,333
Tennessee	24	5,746
Texas	13	9,021
Virginia	16	623
SRIEG-10 Total	598	183,454
U.S. Total	1,769	315,175

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 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 two to five percent of the watershed acreage in strategically located wetlands (Stevens, 1995).

Wildlife Habitat Incentives Program

The Wildlife Habitat Incentives Program (WHIP) was created by the 1996 FAIR 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.

With the assistance of NRCS, participating landowners will develop plans that include schedules for installing wildlife habitat development practices and requirements for maintaining the habitat for the life of the agreement. Each state identifies the types of wildlife habitat, or wildlife species, that are eligible for WHIP funds. Agreements are for a minimum of ten years from the date the practices are established. Cost-share payments may be used to establish practices needed to meet the objectives of the program, and replace practices that fail for reasons beyond the landowner=s control. Generally, the total cost-share amount cannot exceed $10,000 per agreement. The NRCS State Conservationist has the authority to exceed this limit on a case-by-case basis. Table 5 summarizes WHIP priorities for the SRIEG-10 states.

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

Future

USDA will have an important role in future water quality protection efforts at both the state and federal levels. The recent Administration=s Clean Water Action Plan states that important water quality problems remain in this country, and that polluted runoff is a major source of those problems (see Barton=s paper in this proceedings). Agriculture has been identified as the major source of water quality impairment to rivers, streams, and lakes (EPA, 1998). To address these remaining water quality problems, the Clean Water Action Plan lays out a course of action that will place a greater emphasis on landowners adopting alternative management practices for reducing polluted runoff, particularly nutrient-enriched runoff.

USDA programs will have an important role in meeting the water quality objectives outlined in the Plan. EQIP is recognized as an important tool for providing farmers and ranchers the means for better managing fertilizer and animal waste. The Plan calls for an additional $100 million for EQIP for FY 1999. The CREP has also emerged as an important tool for retiring cropland in watersheds facing particularly critical water quality problems as noted in the Clean Water Action Plan.

A concern facing USDA is what happens to overall conservation efforts with the potential phase-out of commodity flexibility program payments after 2002. These programs provide the bulk of incentives behind the conservation compliance and swampbuster provisions of the 1985 Food

Security Act. Conservation compliance provisions were enacted for the purpose of reducing soil erosion. Producers who farmed highly erodible land (HEL) are required to implement a soil conservation plan in order to preserve eligibility for farm program payments. Programs requiring conservation compliance include price support, loan rate, crop insurance, disaster relief, CRP, and FmHA loan programs. While not intended to be a pollution prevention program, reducing soil erosion has water quality implications. Swampbuster provided that farmers receiving program benefits would lose those benefits if they drained a wetland. Protecting wetlands is also beneficial for water quality. If commodity program contributions to net farm income are greatly reduced, the incentive to adopt conservation practices on HEL or to preserve a wetland are greatly diminished. USDA may have to devote EQIP and other program resources to protecting what had already been protected at little cost to the Federal Government.

Research along several avenues can help the performance of USDA water quality projects. One area is project targeting. Past USDA water quality projects have not always been located in watersheds where implementing alternative management practices improve water quality (Ribaudo, 1998). Other sources of pollution or the physical nature of the watershed prevented water quality from improving. Research on how to better identify watersheds where agriculture is the major source of pollutants, and where alternative management practices can be effective, will enhance program cost-effectiveness.

Another area for research is project assessment. EQIP requires that program dollars be spent to maximize program benefits (Federal Register). A means for estimating what those project benefits are is greatly needed. Estimating dollar benefits for many of the environmental impacts is difficult, expensive, and often subject to debate or controversy. Research on how to use benefit-transfer techniques, or on the use of environmental indicators for documenting improvements in water quality, air quality, wildlife habitat, and other environmental benefits would greatly aid program administrators.

Another research area is on farmer adoption of alternative management practices. While some research has been conducted on constraints to adoption, more needs to be known about the role of stewardship in management decisions, and how farmers account for risk. Stewardship is often assumed, but evidence suggests that profits are the primary motivation for adopting alternative management practices. Research on the role of stewardship in management decisions could lead to more effective education programs.

Risk is another factor that plays a role in farmer decision making. Farmers may be reluctant to try alternative management practices, even those that should increase net returns, because of a perception of increased risk. Research on the role risk plays in farmer decision making could lead to new incentive tools for reducing that risk.

Table 5. State Priorities, Wildlife Habitat Incentives Program (WHIP).

SRIEG-10 States	State Priorities
Alabama	Restoring wintering waterfowl habitat; Landowners implementing practices that provide long term benefit for wildlife, provide water quality benefits, and provide educational measures; Restoring habitat for bobwhite quail and associated wildlife habitat
Arkansas	Riparian corridors; Wetlands-bottomland hardwoods; Tall grass prairies; Early successional plant communities; Native grass communities; Cave ecosystems
Florida	Improvement of wildlife habitat within Strategic Habitat Conservation areas; Improving neotropical migrant bird habitat; Improving grassland habitat for declining wildlife species such as bobwhite
Georgia	Longleaf pine ecosystems; Early successional plant habitats; Other habitats of special concern (to protect endangered and threatened species)
Kentucky	Successional habitat; Wetland habitat; Wildlife buffers
Louisiana	Upland habitat; Prairie habitat; Alluvial habitat; Marsh habitat
Michigan	Wildlife corridors; Grassland; Riparian corridors; Threatened and endangered species habitat
Mississippi	Grass and shrub habitat; Nesting habitat and resting areas; Successional hardwoods; Woody and grass habitat; Threatened and endangered species habitat
North Carolina	Early successional habitat; Native warm season grasses; Aquatic habitat; Native pine ecosystems
South Carolina	Early successional habitat; Riparian areas; Rice fields and marshland habitat; Longleaf pine savannas and Carolina Bays
Tennessee	Wetland/stream habitat; Grassland/shrub habitat
Texas	Upland prairies and savannah; Riparian zones and woody corridors; Wetlands; Specific threatened and endangered species (5 mammals, 12 birds, 2 amphibians, 2 fish)
Virginia	Early successional/grassland wildlife; Riparian habitat/associate aquatic wildlife; Migration corridors; Decreasing habitat

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THE DOWNSTREAM IMPLICATIONS OF NUTRIENT OVERLOAD: THE HYPOXIA PROBLEM IN THE NORTHERN GULF OF MEXICO

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Introduction

The industrial, urban, and agricultural activities of humans often result in the nutrient loading of river ecosystems. A direct result of this nutrient loading is the nutrient enrichment of marine catchment basins (MCB), a phenomenon that has been observed in the marine environments bordering every inhabited continent (Caddy 1998; Justic 1998). This nutrification, and the accompanying change in critical nitrogen:phosphorus:silica ratios, has been implicated in the various biological resource problems that occur when water oxygen concentrations fall to low levels. These low levels of oxygen are termed hypoxia (<2mg/l oxygen concentration) and anoxia (near 0mg/l oxygen concentration).

While limited hypoxic and anoxic environments occur naturally in some marine ecosystems (including the Black Sea, Baltic Sea, Chesapeake Bay, and the New York Bight), their occurrence in shallow coastal and estuarine systems has increased over the last four decades. The suspect cause of this increase in hypoxia is the increased human manipulation of land-based ecosystems (Diaz and Rosenberg 1995; Ortner and Dagg 1995). Anthropogenic sources of nutrient enrichment in marine systems appear to have altered the organization and energy flow within the effected ecological communities. The fear, to some extent realized in many MCB around the world, is that continued nutrification and the accompanying hypoxia/anoxia conditions will inevitably lead to marine ecosystem collapse and its negative consequences, including the loss of commercial and recreational fisheries, reduced ecological biodiversity, and increases in health-endangering toxic algal blooms.

Hypoxia in the Gulf of Mexico

Although hypoxic marine environments are frequently associated with relatively enclosed, limited circulation systems such as inland seas and sheltered bays, the phenomenon has also been measured in the relatively open system of the Northern Gulf of Mexico. Seasonally severe hypoxia on the continental shelf off the coast of Louisiana and Texas has been observed since the mid-1980s, primarily in the areas influenced by freshwater discharges from the Mississippi and the Atchafalaya Rivers. The Gulf of Mexico hypoxia varies in both extent and persistence each year, fluctuating with the stochastic occurrence of storm activity from the Atlantic ocean. In general, the hypoxia zone can begin to form as early as late February and persist until early October, although its location, severity, and homogeneity are only inferred from transect sampling that has been limited geographically and

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temporally. From the data that does exist, hypoxia in the Northern Gulf of Mexico appears most widespread, persistent, and severe during the summer months of June through August (Rabalais et al. 1996). Mid-summer field mappings of hypoxia have identified zones averaging 8,000-9,000 km^2 during the period 1985-1992, and zones averaging 16,000-18,000 km^2 beginning with the 1993 Mississippi River flood (Rabalais et al. 1998) (figure 1). Hypoxia on the upper Texas coast is usually an extension of the larger hypoxic zone off of Louisiana, although isolated hypoxic areas with no apparent connection to the larger hypoxic zone do exist, particularly in the Galveston Bay area. Hypoxia has also been measured off the Mississippi Sound and Mobile Bay, particularly in flood years when hypoxia in general appears to increase across the Northern Gulf of Mexico (Rabalais 1992). Overall, estimating the true extent and severity of hypoxia in the Gulf is hampered by incomplete sampling coverage and consistency, which in turn is a result of financial resource constraints.

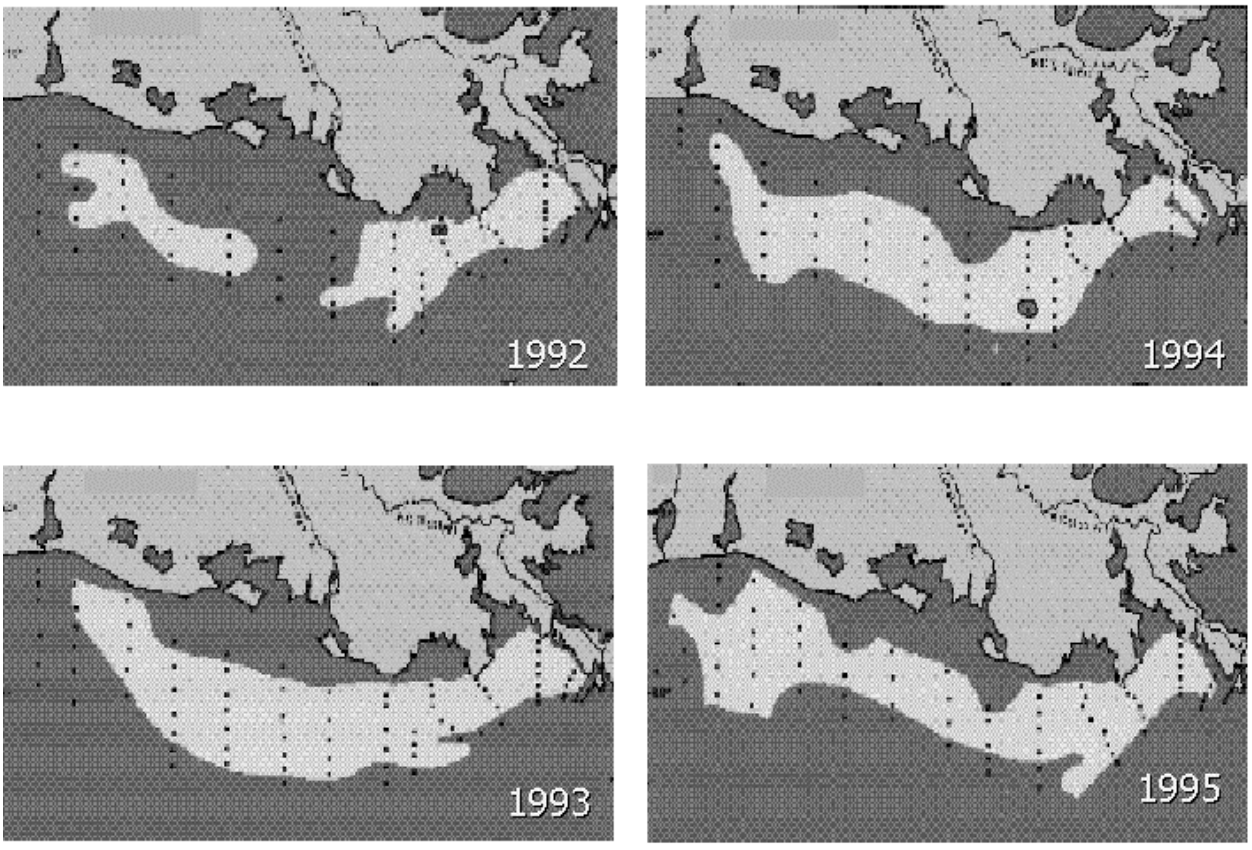


Figure 1. Estimated Occurrence of Hypoxia in the Northern Gulf of Mexico in the Years Around the 1993 Mississippi Flood (adapted from Rabalais, et al., 1998).

Linking Nutrients to Gulf Hypoxia

The spatial and temporal variability of hypoxia in the Northern Gulf of Mexico has been linked to the magnitude and timing of Mississippi and Atchafalaya River discharges, and the subsequent net primary productivity in surface waters that occurs as freshwater inflows bring nutrients to the marine ecosystem (Atwood et al. 1994; Justic et al. 1993; Rabalais et al. 1996) (figure 2). The Mississippi and Atchafalaya Rivers are the primary land-based sources of freshwater and nutrients discharged to the Gulf of Mexico, together accounting for 21,800 m^3/sec or nearly 80 percent of all freshwater inflows (Dunn 1996). Given the magnitude of the freshwater contribution, it is not surprising that these two rivers also account for an estimated 90 percent of the total nitrogen load and 87 percent of the total phosphorus load entering the Gulf annually (Dunn 1996). The average transport since 1980 of nitrogen from the Mississippi River Basin to the Gulf of Mexico has been approximately 1.5 million metric tons per year, primarily in the form of nitrate-N, dissolved organic, and particulate nitrogen (Battaglin et al. 1997). This transport typically peaks in the spring and early summer months when transport rates can be as high as 5,000 metric tons per day.

Estimating the Economic Impacts of Gulf Hypoxia

Although challenging, an economic assessment of the ramification of hypoxia is part of the Committee on Environment and Natural Resources (CENR) Hypoxia Work Group=s tasks. Efficiency conditions directly address the need to recognize economic tradeoffs involving farm profitability and water quality. The conditions imply that farmers must sacrifice some profits to improve water quality if they are currently operating at maximum efficiency and only considering their private costs, *ceteris paribus*. The challenge is to define an analytical framework that can be used to guide the choice of a policy alternative that will achieve the socially optimal tradeoff.

Alternative Frameworks for the Analysis

Benefit-Cost Analysis (BCA) is an analytical approach that, in principle, eliminates individual and group biases associated with decision making by heuristics, intuition, or consensus. Given an objective of maximum net economic value or economic efficiency, BCA provides a set of definitions and procedures for measuring benefits and costs and determining optimal policy (Freeman 1994). In doing so, BCA has the potential to rationalize policy making and assure that the outcomes of policy decisions are optimal (Fisher et al. 1986). Promoted as the empirical technique of choice for determining many policy decisions (e.g., U.S. Executive Order (E.O.) 12291, 12866), BCA has a firm foundation in microeconomic theory and management accounting practice, particularly when assessing the net value of a policy or project when the underlying objective is economic efficiency (Dasgupta and Pearce 1972, Mishan 1977, Sassone and Schaffer 1978, Thompson l980, Gramlich l981, Sugden and Williams l985).

Of course, resource and environmental policy is not based primarily on economic efficiency criteria, either because decision makers have additional objectives (e.g., equity considerations, intergenerational effects, social risk aversion) or because the information base required to define all the benefits and costs cannot be obtained. Thus, BCA might be best thought of as a set of procedures to help organize the available information, rather than a straightforward set of decision rules (Freeman 1994). While this perspective on BCA does not attempt to define the ultimately rational policy choice, it is capable of meeting the basic requirements of E.O. 12866 -- analyses that are economically sound, based on appropriate data and methods, correctly interpreted, identifying all affected parties, and estimating, where possible, all relevant costs and benefits (Schaub 1997). The level of sophistication and method in BCA can range from simple comparisons of directly and readily measurable financial factors to multifaceted techniques that incorporate tangible and intangible factors (Clarke and Stevens 1997). In general, all BCAs attempt to identify the benefits and costs attributable to a policy, measure the benefits and costs, and compute a policy's net value (Office of Management and Budget (OMB) 1996).

Although pure Pareto efficiency and decision making based on benefit-cost analysis is the conceptually ideal approach for addressing pollution problems, efficiency is not generally attainable in practice if the damage and/or pollution transport functions are unknown or poorly understood, as is generally the case with nonpoint source pollution. While these problems do not prevent the design of economically sound pollution control policies, they do require that policies be based on alternative objectives. Baumol and Oates (1988) suggested designing pollution control policy to meet an emissions or ambient pollution target when damages are unknown. For example, without information on damages, the regulatory agency's goal when designing policy would be to attain a mean ambient water quality goal at least cost. Alternatively, without information on pollution transport to water resources, the regulatory agency's goal when designing policy would be to attain specific mean runoff goals at least cost.

Cost-effective solutions are not Pareto efficient because water quality damages, and thus the benefits from reducing pollution, are not a consideration (since they are unknown) (Shortle 1987, 1990). As a result, the traditional BCA is truncated in the sense that benefits of proposed policy actions may not be measurable given available information. In these cases, a cost-effectiveness analysis (CEA) is designed to provide information about the economic tradeoffs associated with different types of management strategies. CEA is considered appropriate whenever it is impractical or impossible to consider the monetary value of the benefits provided by alternative policies (OMB Circular A-94). Under a CEA, a policy can be considered cost effective if, on the basis of life cycle costs analysis of competing alternatives, it is determined to have the lowest costs for a given amount of benefit, however benefit is defined.

The potential complexity of efficient or cost-effective nonpoint source pollution policies can make the administration and implementation of those policies difficult and costly. At a minimum, the regulatory agency would need perfect information about the production and runoff functions for each site. Some optimal policies are site-specific and require the regulatory agency to perfectly monitor technology and input usage on each site, including those inputs that are not sold in the market. The costs associated with obtaining the necessary information for determining and applying site-specific policies and monitoring input usage and technology choices can be substantial. These costs are relevant and should not be ignored when a potential policy is designed or analyzed. Under these conditions, the costs of obtaining an efficient or cost-effective outcome should be weighed against the decreased benefits that might result from taking a more uniform, but informationally less-intensive, approach to policy design. Policies that are specifically designed to reduce information and administrative costs at the expense of efficiency or cost-effectiveness are referred to as second-best policies.[2] Most, if not all, nonpoint source pollution policies can be considered second-best polices.

Scope and Outline of the Economic Analysis

Under E.O. 12866, agencies determine whether a potential rule or regulatory action is "significant" and therefore subject to the requirements of the E.O., which include the drafting an Economic Analysis (EA) and review by OMB. While the Gulf of Mexico Hypoxia Assessment is not itself a rule making or regulatory activity, analysis of the economic impacts of hypoxia and potential actions that might be taken to mitigate hypoxia in the Gulf of Mexico would almost certainly involve some form of federal intervention. Federal intervention could take many forms, and would likely interact with current state and federal ambient water quality criteria and designated uses for inland surface waters, enclosed bays and estuaries. Thus, the EA of hypoxia in the Gulf of Mexico was designed to be relatively broad in scope, seeking to identify major benefits and costs that could be identified using available information and numerical models.

Given the scope of this assessment, the EA requires assumptions about the source of benefits and costs associated with hypoxia and hypoxia mitigation, as well as how mitigation activities might be implemented. The assumptions used in this economic analysis were based on standard practice within the economics profession, information provided by other groups participating in the hypoxia assessment, and past experience with mitigation activities associated with large watersheds. To account for some of the uncertainty in these assumptions, a range of scenarios were estimated and may be used to bracket the likely effects of hypoxia and hypoxia mitigation activities. In addition, attempts were made to qualitatively identify potential benefits and costs that could not be estimated due to a lack of information or relevant research. These latter benefits and costs may be useful in directing future research associated with hypoxia.

[2] Efficient policies are first-best. Cost-effective policies are also technically second-best because they are not efficient. For simplicity and consistency, we make a distinction between cost-effective and alternative second-best policies.

An immediate difficulty with conducting an EA of Gulf of Mexico Hypoxia concerns the lack of measurable benefits (and thus the benefits side of a BCA calculation) that might accrue from reduced hypoxia. A preliminary examination of the historical time-series and geographical data to discern the effects of hypoxia on the Gulf of Mexico ecosystem and the fishing industry over the last 30 years has been completed. This assessment suggested that, given the available data, there was no effect in the shrimp, snapper, or menhaden fisheries data that could be attributed with high confidence to hypoxia. In addition, the failure to identify hypoxic effects in the fisheries data was consistent with the results of broader ecological studies being conducted as part of the CENR study.

It is worth emphasizing that failure to identify hypoxic effects in the commercial fisheries data does not mean that they do not exist. But, if hypoxic effects do exist, their magnitude must be small in relation to other sources of variability in the data. Another constraining factor was that the data needed to identify indirect and nonmarket effects of hypoxia, such as its impact on tourism and recreation, was not readily available for the Gulf. In addition, the inability to identify hypoxic effects in the historical data does not imply that larger effects would not occur should hypoxia continue or expand in the Gulf of Mexico. In fact, experience in other geographic areas indicates that effects of hypoxia become progressively larger as the frequency and extent of hypoxic events expands (Caddy 1998).

Nonetheless, given the lack of measurable economic benefits from reduced hypoxia, the EA was restricted to a cost-effectiveness analysis that sought to identify least-cost policies for attaining a representative reduction in nonpoint nitrogen runoff to the Gulf of Mexico. The fixed target level of nitrogen loss reduction, 20 percent, was suggested by other groups within the CENR study as a reasonable level that could be attained given current technology and that would have the potential to decrease the incidence of hypoxia in the Gulf.

Each specific policy simulation to be conducted as part of the EA has a specific set of assumptions, but there are some important general assumptions that will be used throughout the analysis:

1) The analysis will assume continuation of the current 'reformed' agricultural policy, where producers are free to make choices about the crops they grow and where acres are not taken out of production just to regulate supply.

2) The analytical model upon which the policy simulations are based will assume profit maximizing behavior by the producers. This assumption also implicitly, if not explicitly, conditions the analysis of the simulation results and judgements concerning producer or individual firm reactions to policy options.

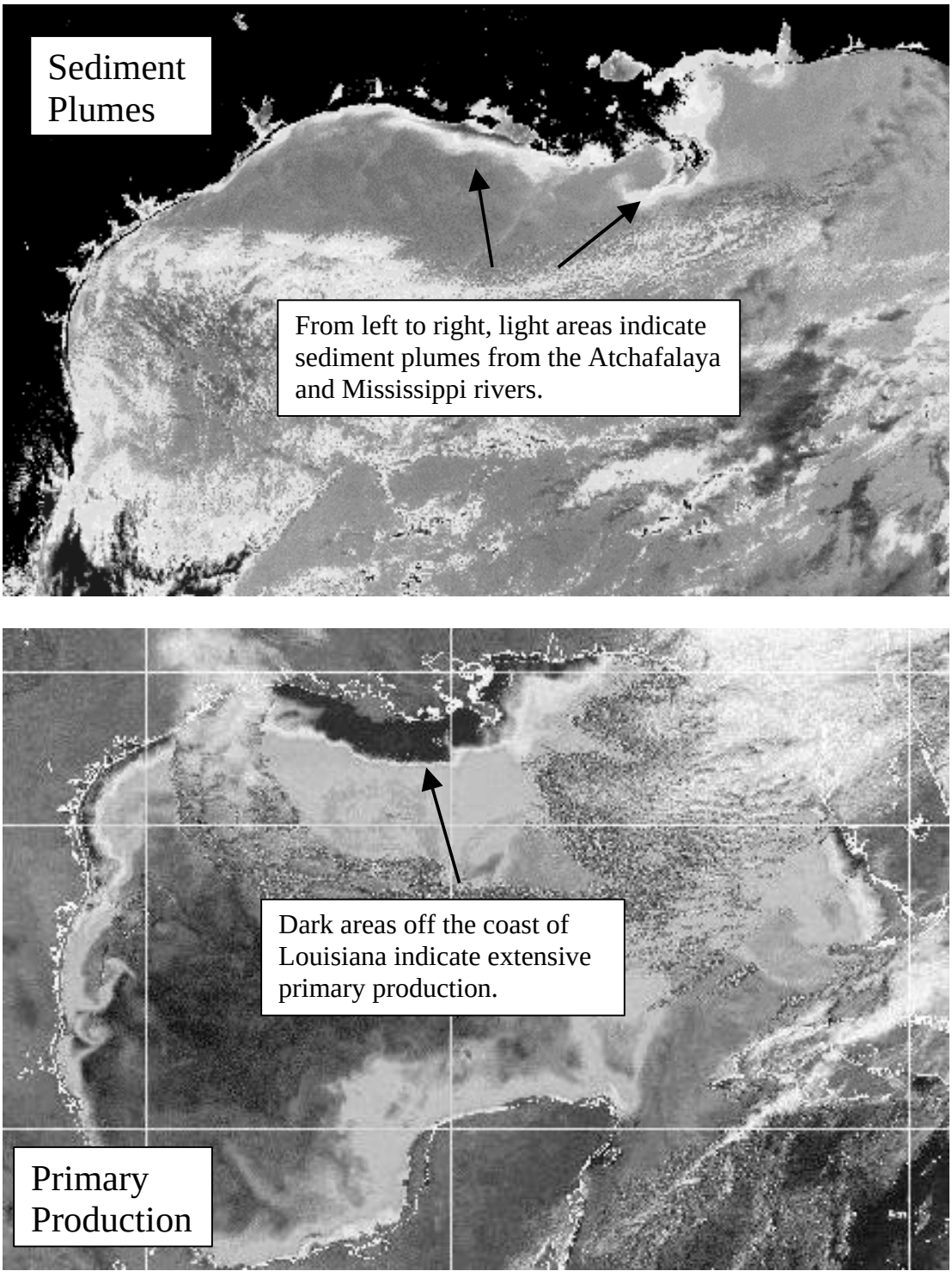


Figure 2. Example of Sediment Plumes and Primary Productivity Off the Mouths of the Mississippi and Atchafalaya Rivers in the Northern Gulf of Mexico (NOAA Satellites, early summer).

3) A stable hydrology in the Mississippi River Basin will be assumed, where the river would continue to be a critically important transportation corridor. Activities of dredging and lock and dam maintenance were expected to continue, constraining (to some extent) the potential policy options that could be examined.

4) There are important time frame assumptions. From nonpoint sources such as soils under fertilization, there can be substantial time lags before actions like reductions in nitrogen fertilization are reflected in reduced nitrogen loss from the soil. This is a critically important and also an uncertain factor when assessing the efficacy of a practice or activity to reduce nitrogen losses to the river system. It will be recognized in the analysis that changing policy or placing new activities or practices in operation takes time. For both of these, the time lag is likely to be measured in years rather than months.

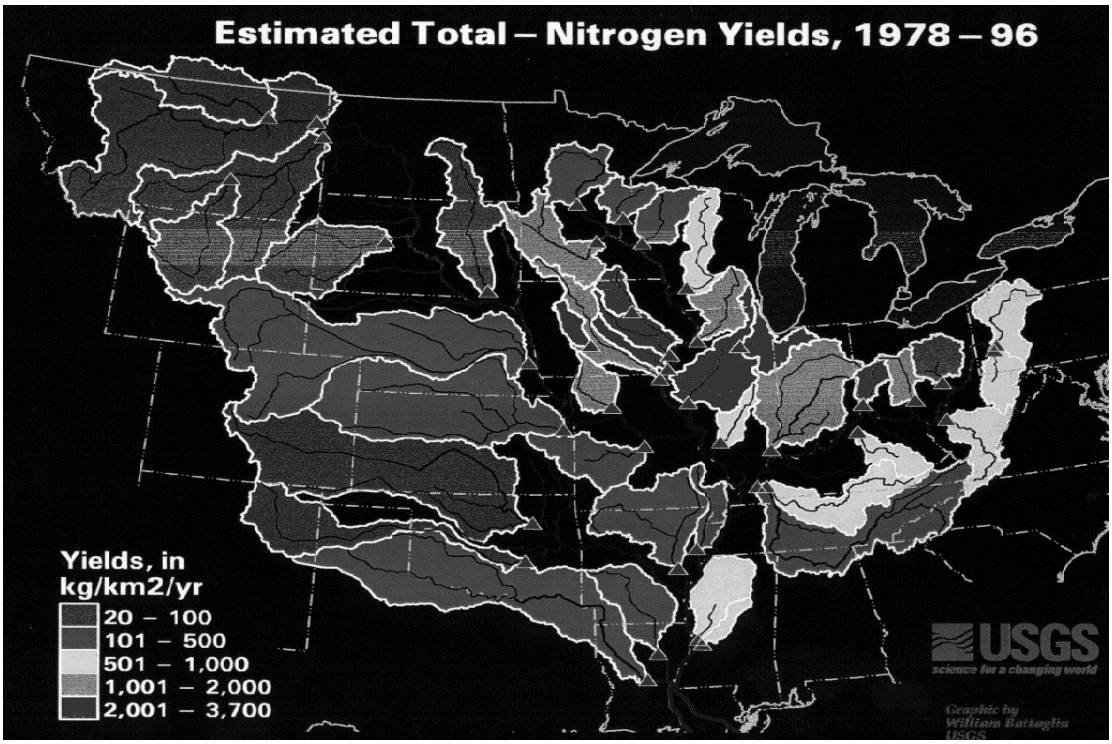
Given that the CENR hypoxia project is designed to be an *assessment* of current knowledge and potential policy alternatives, defining the links between human activities and nutrient loadings depends on existing studies and models. The United States Geological Service (USGS) has been collecting nutrient input and transport data for the Mississippi watershed for nearly 20 years, both for the overall watershed and for sub-watersheds. Currently published data suggest that there are a number of sub-watersheds in the mid and upper Mississippi drainage that contribute a large percentage of the nutrient load to the river system (figure 3). Using this data as a guide, a cost efficiency study can focus on the cropping systems and nutrient management strategies that exist in problem regions. Scaling the results to the aggregate will then pose an interesting challenge. The ultimate objective is to provide a matrix of tradeoffs of load reduction and aggregate cost that allow decision makers and the public to assess such tradeoffs in an informed way.

Of course, estimating the economic costs of technology and management changes assumes that some changes have been mandated, and there are numerous ways in which individuals can be persuaded into changing their behavior. From an agricultural/environmental policy perspective, one approach to encouraging reduced nutrient use (and thus, presumably, reduced loadings in the river system) would be to institute a tax on the nutrient source. At the other extreme would be a command-and-control regulatory approach to reduced loadings. Between these two options lie a myriad of possible policy options that combined incentives and coercion to attain reduction in nutrient use or, at the very least, nutrient losses from the land to the river systems. Exploration of these possibilities and their potential economic impacts will utilize established agricultural policy simulation models such as the USDA Economic Research Service=s USMP model.

Summary

The success of the economic assessment in the CENR Hypoxia project depends, in part, on the objectives of the analysis. Given the apparent gaps in the scientific understanding of the linkages between ephemeral hypoxia and economic activity that depends on an intact marine resource, the assessment is not likely to yield concrete estimates of the costs of hypoxia or, alternately, the

potential benefits of reducing the incidence of hypoxia in the Gulf of Mexico. Even a cost effectiveness study can be problematic, as varying efficacy of nutrient reduction strategies (across cropping regions and time) may blur the cost differences between different technology and management control packages. In all cases, direct and indirect costs will be associated with any policy action, even if the decision is to take no action. For direct costs, increased restrictions on agricultural activities in the Mississippi basin may result in newly created environmental costs as activities move to other regions.



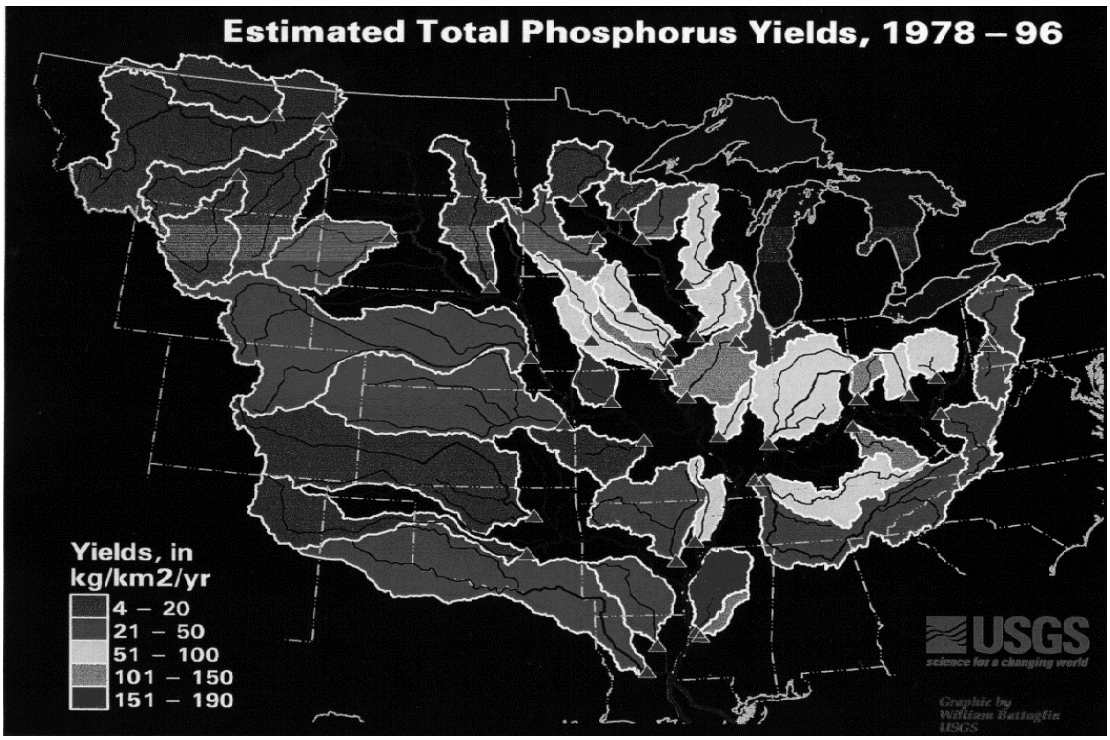


Figure 3. Measured Sub-Watershed Sources of Nitrogen and Phosphorus Loadings in the Mississippi River Watershed.

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WORKING TOWARD SOLUTIONS IN THE NEUSE RIVER BASIN

Greg Jennings[1]

Introduction

The Neuse River Basin is the third largest basin in North Carolina and one of three major river basins located entirely within the state. The Neuse River flows approximately 200 miles from its headwaters near Raleigh in the Piedmont through the Coastal Plain and into the Pamlico Sound near New Bern.

The river basin was classified by the state as nutrient sensitive waters (NSW) in 1988. In 1993, the North Carolina Division of Water Quality (NCDWQ) published the Neuse River Basinwide Water Quality Management Plan, the first of seventeen water quality management plans for the state's major river basins. The report identified pollution from nonpoint sources (NPS) as the major source of water quality degradation in the Neuse River Basin, with agriculture, urban development, and construction activities the leading sources of pollutants.

During the summer of 1995, several major fish kills and algae blooms occurred in the lower part of the Neuse River, leading to public outcries for regulations to improve water quality. Over the next three years, the NCDWQ worked with stakeholders to develop a set of regulations to reduce nutrient pollution from agriculture, urban stormwater, wastewater treatment plants, and other sources with a goal of reducing annual nitrogen loading to the river by 30 percent over five years. After extensive public debate and revision, the regulations went into effect in August 1998. Following are the major components of the regulations.

Existing Riparian Buffers. Fifty feet of existing riparian vegetation (30 feet forest, 20 feet grass or harvested trees) must be protected. New buffers are not required. This part of the revised rules was adopted as a temporary rule by the EMC in 1997 to prevent destruction of existing buffers during the review period.

Wastewater Discharges. Dischargers can work as a group to meet the 30 percent reduction goal. Existing dischargers below Falls Lake must meet an annual mass total nitrogen load based on 3.5 mg/L concentration times their 1995 permitted flow.

Urban Stormwater. Ten cities and five counties (Cary, Durham, Garner, Goldsboro, Havelock, Kinston, New Bern, Raleigh, Smithfield, Wilson, Durham Co., Johnston Co., Orange Co., Wake Co., and Wayne Co.) must develop stormwater management plans to address nutrients. New development must maintain nitrogen loading at 70 percent or less of 1995 loading (performance

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standard = 3.6 lbs/ac/yr). Local governments have two years to establish stormwater management programs.

Agriculture. Farmers have the option of signing up to participate in county nitrogen reduction plans or implementing individual Best Management Practices (BMPs). A Basin Oversight Committee and Local Advisory Committees were appointed to develop individualized local plans to meet assigned reduction goals.

Nutrient Management Training. Nutrient applicators are required to obtain a certificate verifying completion of training in nutrient management within five years:

- Farmers who fertilize 50 acres of cropland.
- Managers who fertilize 50 acres of golf courses or other turfgrass.
- Commercial applicators who fertilize 50 acres of lawns/gardens.

The certificate would be given by either the Cooperative Extension Service or the Division of Water Quality. Persons who do not receive a certificate must develop an approved nutrient management plan.

Neuse River Education Team

The North Carolina Cooperative Extension Service (NCCES) initiated a comprehensive education program in support of the state's basinwide management plan in 1996. With its strong track record of implementing research and extension educational programs focusing on nonpoint source pollution, the Cooperative Extension Service is well positioned to educational leadership in the Neuse River Basin.

A team of 11 Extension faculty was formed to address all aspects of environmental education. Six members of the team are located at North Carolina State University (NCSU), with the remaining five located throughout the river basin and serving as Area Environmental Extension Agents.

The primary responsibilities of the Area Environmental Extension Agents include: facilitating communication between local stakeholders and agencies; assisting county extension faculty organizing programs and activities related to reducing NPS pollution; identifying existing efforts in NPS reduction; assisting in identification of problem areas for additional NPS reduction strategies; and providing leadership for focused watershed projects in their areas. The NCSU-based faculty provide specialized technical support for county-based programs.

Below are listed the Neuse River Education Team members and their technical expertise:

- Mitch Woodward - Area Specialized Agent and Team Coordinator - Wake County: Water Quality, Crop Nutrient Management.
- David Hardy - Area Specialized Agent - Craven, Jones, Carteret, and Pamlico Counties: Crop Nutrient Management.
- Mike Regans - Area Specialized Agent - Greene, Pitt, Lenoir, and Wayne Counties: Animal Waste Management.
- Bill Lord - Area Specialized Agent - Franklin, Johnston, Wilson, and Nash Counties: Horticulture, Forestry.
- Craven Hudson - Area Specialized Agent - Person, Durham, Orange, and Granville Counties. On-site Wastewater, Forestry.
- Steve Hodges - Extension Soil Science Specialist, NCSU: Crop Nutrient Management.
- Deanna Osmond - Extension Soil Science Specialist, NCSU: Crop Nutrient Management.
- Greg Jennings - Extension Water Quality Specialist, NCSU: Watershed Management.
- Leon Danielson - Extension Economics Specialist, NCSU: Public Issues Education.
- Bill Hunt - Extension Water Quality Specialist, NCSU: Urban Stormwater Management.
- Andy Fisher - Extension Communications Specialist, NCSU: Media Relations, Publications.

For More Information

The team has been successful at increasing public awareness of environmental issues and initiating many local projects to solve water quality problems. A complete list of activities and accomplishments is available at http://ces.soil.ncsu.edu/net/.

FLORIDA=S WATER: SUPPLY, USE, AND PUBLIC POLICY

Roy R. Carriker[1]

Florida=s Water Resource

Florida receives an average of 55 inches of rainfall a year. This compares to an average of 30 inches for the nation as a whole, and only nine inches per year in Nevada, the driest state. Total annual rainfall for Florida typically varies (sometimes greatly) from one part of the state to another, from one season of the year to another, and from one year to the next. Such rainfall variations have direct impacts upon surface water and groundwater supplies. Lack of rainfall for a few weeks causes depletion of moisture in Florida=s predominately sandy soils, along with reduction of streamflow and groundwater recharge.

There are significant differences in runoff and evapotranspiration between north Florida and south Florida. Evaporation from water bodies ranges from about 46 inches in the northern counties to about 54 inches in the southern portion of the state. Conversely, measured runoff averages only 0 to 10 inches per year in much of extreme south Florida, but ranges from 20 to 40 inches per year in parts of the northwest Apanhandle.@ Differences in rainfall, topography, soil permeability, air temperature, humidity, wind speed, and vegetative ground cover account for the differences in runoff and evapotranspiration.

Of Florida=s five largest rivers, four are in the drainage basins of northern Florida, with headwaters in Alabama or Georgia. The fifth largest, the St. Johns, flows northward from Indian River County, flowing into the Atlantic Ocean near Jacksonville. Southern Florida is dominated by the Kissimmee-Okeechobee-Everglades basin which extends from near Orlando to the southern tip of the peninsula. Many streams in south Florida have been altered by an extensive system of canals and levees that provide flood control, drainage, and water supply for agriculture near Lake Okeechobee and for cities on the lower east coast. Some portions of the original Everglades have been used as shallow water conservation areas during the past three decades. The remaining Everglades at the southern tip of the peninsula comprise the Everglades National Park, which receives water from this managed system.

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The principal source of groundwater for most of Florida is the Floridan Aquifer. It is the source of municipal water supply for such cities as Tallahassee, Jacksonville, Gainesville, Orlando, Daytona Beach, Tampa, and St. Petersburg. It also yields water to thousands of domestic, industrial, and irrigation wells. The thick layers of porous limestone comprising the Floridan Aquifer underlie all of the state, but in the southern portion of the state, the water it contains is too highly mineralized for domestic, industrial or agriculture use. Water in the Floridan Aquifer is replenished by rainfall in central and northern Florida where the aquifer emerges at the surface, is covered by permeable materials, or where the confining material is breached by sinkholes. In some areas the aquifer is confined beneath impermeable layers with sufficient artesian pressure to produce free-flowing wells. Capping, plugging, and controlling abandoned free-flowing wells in these areas has become an important water management function.

The unconfined, surfacial Biscayne Aquifer underlies an area of about 3,000 square miles in Dade, Broward, and Palm Beach Counties. Water in the Biscayne Aquifer is derived mainly from local rainfall and, during dry periods, from canals ultimately linked to Lake Okeechobee. The Biscayne Aquifer is a major source of water supply for the lower east coast cities and for some agricultural users.

A non-artesian, sand-and-gravel aquifer is the major source of groundwater in the extreme western part of north Florida. Water in this aquifer is derived chiefly from local rainfall and furnishes most of the groundwater supplies used in Escambia and Santa Rosa Counties, and part of Okaloosa County.

Shallow aquifers are present over much of the state, but in most areas these are not major sources of groundwater.

Water Use in Florida

Whether water is scarce or abundant depends not only upon available supplies, but also upon patterns of water use and demand. The United States Geological Survey (USGS) has developed estimates of water withdrawals and water use by several water-use categories over the years. These estimates provide a perspective on patterns of water use by sector and over time.

In examining water use statistics, it is important to distinguish between water Awithdrawal@ and Aconsumptive use@ of water. Water consumed is that which is withdrawn from a freshwater source and is not returned to the same source or another useable source, thus being unavailable for re-use except by way of the hydrologic cycle. For water management purposes, consumptive use may be considered all of the water withdrawn from an important, allocated source, even though a portion may be returned to another useable body of water.

According to estimates compiled by the USGS, withdrawals of freshwater for all uses averaged 7.5 billion gallons per day in 1990, which is almost a 100 percent increase in the rate of

withdrawals estimated for 1960, a 31 percent increase over the 1970 rate, and a 2.7 percent increase over the 1980 rate. The use of water treated through desalination to meet drinking water standards increased from 17 million gallons per day in 1985 to 48 million gallons per day in 1990. Dependence on groundwater as the principal source of freshwater has continued to increase. In 1950, 21 percent of freshwater withdrawals were from groundwater. By 1990, 62 percent were from groundwater. Nearly 10.0 million people in Florida served by public supply and all residents that use self-supplied domestic systems (1.71 million) depended on groundwater for their drinking water needs in 1990. Surface water withdrawals actually decreased by one percent between 1970 and 1990.

About 60 percent of the total groundwater withdrawn in Florida in 1990 was obtained from the Floridan Aquifer system. Polk, Orange, Hillsborough, and Duval Counties were the largest users of water from the Floridan Aquifer in 1990. About 18 percent of the state=s groundwater withdrawals were obtained from the Biscayne Aquifer. Dade and Broward Counties withdrew all of their groundwater from the Biscayne Aquifer, and Palm Beach County withdrew some water from this aquifer.

Since 1950, all categories of freshwater withdrawals in Florida have increased. Between 1970 and 1990, however, freshwater withdrawals for public-supply, self-supplied domestic use, and agricultural irrigation have increased and withdrawals for self-supplied commercial-industrial use and thermoelectric power generation have decreased.

Agriculture was the largest use of freshwater in Florida in 1990 (followed by public supply, self-supplied commercial-industrial, domestic, and thermoelectric power generation). Withdrawals of freshwater for agricultural uses constituted 50 percent of total water withdrawals for the state in 1990. Agricultural water withdrawals totaled 3,805 million gallons per day of groundwater and 47 percent was surface water. In addition, 170 million gallons per day of reclaimed wastewater was used for irrigation purposes. Estimated consumptive water use in agricultural irrigation was 2,561 million gallons per day, or 67 percent of water withdrawn for agricultural use. The Floridan Aquifer system supplied 1,249 million gallons per day (62 percent) of the groundwater withdrawn for agricultural irrigation in 1990. Surface water canals, mostly from Lake Okeechobee, supplied large amounts of water for agricultural use in South Florida. Withdrawals for agricultural irrigation in 1990 varied seasonally and were lowest in December and highest in May. The seasonal fluctuations were attributed by the Geological Survey to intense crop production and the dry conditions during the early spring. More than 32 percent of the water used for irrigation was withdrawn during the months of March, April, and May and less that 20 percent was withdrawn during the months of October, November, and December. Irrigation of citrus crops accounted for the largest amount of water withdrawn (33 percent), followed by sugarcane (22 percent), sod (five percent), and turf grass [golf courses] (five percent).

A total of 2.15 million acres were irrigated in Florida in 1990. Palm Beach, Hendry, Dade, Polk, and Brevard Counties each had more than 100,000 acres irrigated in 1990. Irrigated acreage increased in the state between 1980 and 1990, despite a reduction in citrus acreage.

Water withdrawn for public supply in Florida totaled 1,925 million gallons per day in 1990. Groundwater was the source of more than 88 percent of the water withdrawn for public supply, serving about 10.0 million people. The Floridan Aquifer system supplied about 852 million gallons per day (50 percent) of the water withdrawn for public supply. The Biscayne Aquifer delivered another 573 million gallons per day. Public supply withdrawals were lowest in January and highest in May during 1990. Water withdrawals for public supply in Florida have increased rapidly, from 170 million gallons per day in 1950 to 1,925 in 1990. The population served by public supply systems increased from 5.42 million in 1970 to 11.23 million in 1990. In 1990, 87 percent of the population was served by public supply systems. Self-supplied commercial use includes water withdrawn at government and military facilities, schools, prisons, hospitals, recreational facilities, and nonmanufacturing establishments. Self-supplied industrial use includes water withdrawn at mining, processing, and manufacturing facilities. In 1990, there were 174 self-supplied commercial users inventoried and 278 self-supplied industrial users inventoried. Total water withdrawn by self-supplied commercial-industrial systems was 826 million gallons per day, of which 93 percent was freshwater. Withdrawals by industrial facilities accounted for 92 percent of the freshwater withdrawals, and commercial facilities accounted for the remaining eight percent. The largest single use of freshwater within the self-supplied category in 1990 was for mining, with total withdrawals of 315 million gallon per day, followed by the pulp and paper industry, with withdrawals of 189 million gallons per day. Mining tends to be concentrated in the central part of the state, while pulp and paper operations are located in the forested areas of northern and western Florida. Freshwater withdrawn for self-supplied commercial-industrial used in Florida has decreased between 1970 and 1990 (partly due to water conservation practices), but has not changed much since 1980. However, deliveries to commercial and industrial users from public supply systems increased nearly 300 million gallons per day during this period.

Total water withdrawals for the 52 self-supplied thermoelectric powerplants in Florida amounted to 11,042 million gallons per day, but only about seven percent of that amount (732 million gallons per day) was freshwater. Of the total freshwater withdrawn, 97 percent (709 million gallons per day) was surface water. Almost all of the water used for thermoelectric power generation in 1990 was for cooling purposes. Much of the water used was for once-through cooling, although some systems recirculated water several times before it was returned to its surface source. Because most of the water used for cooling is returned to its source, actual consumptive use of water for thermoelectric power generation is quite low.

Self-supplied domestic water use is water provided by individual domestic wells or by small utility companies. In 1990, an estimated 1.71 million people in Florida used self-supplied water systems and withdrew about 199 million gallons per day, almost entirely of groundwater.

Public Policy and Water In Florida

Water Allocation Policy

The early history of water policy in Florida dealt mostly with drainage and flood control, especially in central and southern Florida. Special acts of the legislature created special drainage districts which, in more recent years, provide water storage and conservation as well as drainage and flood control. The United States Army Corps of Engineers, with federal government funding, built the Central and Southern Florida Flood Control project between 1949 and 1965.

Otherwise, Florida=s water law was based in common law, which, through case law and long established practices, provided a basis for water use rights. When the state=s population began to grow rapidly in the 1950s, policymakers and water managers began to argue for a more effective institutional basis for water management. The Florida Water Resources Act of 1972 (Chapter 373 Florida Statutes) established a form of administrative water law that brought all waters of the state under regulatory control. Five water management districts were formed, encompassing the entire state. Each district covers one or more important water basins. The five districts are: the South Florida Water Management District; the Southwest Florida Water Management District; the St. John=s Water management District; the Suwannee River Water Management District; and the Northwest Florida Water Management District. Each district is controlled by a governing board of nine members who reside within the district. They are appointed by the governor and confirmed by the Florida Senate to serve four-year terms.

The districts are required to implement regulatory programs for well construction, consumptive water use, and for alterations to the hydrologic regime (management and storage of surface water). In addition to permitting authority, the districts have broad powers with respect to maintaining, regulating, altering, or constructing waterways and appurtenant facilities. An important source of funding for the districts is the ad valorem tax. A constitutional amendment, passed by statewide referendum in 1976, granted ad valorem taxing power to the water management districts.

Statewide authority for water resource management was vested in the Department of Environmental Regulation [which has since merged with the Department of Natural Resources by an act of the 1993 Florida legislature to become the Department of Environmental Protection (DEP)]. The state agency was directed to develop, with the five water management districts, a State Water Use Plan and to delegate water management authority to the districts Ato the greatest extent practicable.@ Legislative intent was to provide for continuity of water management policy, statewide, with regional implementation taking into account the variability of water resources over the state.

Water Quality Policy

The Air and Water Pollution Control Act as amended (Chapter 403 Florida Statutes), along with several other pieces of legislation, provides the statutory basis for regulation of most aspects of water quality in Florida. It provides the DEP with broad powers and duties to accomplish the statutory goal of protecting and improving water quality throughout the state. These include the

power to classify surface and groundwater bodies according to their most beneficial uses, establish ambient water quality criteria within each classification for various parameters of water quality, develop standards of quality for wastewater discharges, implement a permit system for the Aoperation, construction, or expansion of any installation that may be a source of...water pollution,@ and require posting bond to operate such installations.

The Environmental Regulation Commission (ERC), established by the Florida Environmental Reorganization Act of 1975, is empowered to act as an adjudicatory body for final actions taken by the DEP and is the exclusive standard-setting authority of the Department.

Other State Programs

Other programs have been created by state legislation which are motivated, at least in part, by water quality protection or restoration goals:

- The Florida Safe Drinking Water Act of 1977 provided for the adoption and enforcement of state primary and secondary drinking water regulations and standards.

- The Water Quality Assurance Act of 1983 was divided into twelve separate parts, each of which addressed a distinct groundwater or hazardous waste problem. It addressed the need to compile data relating to water resources, prevent contamination of potable water supplies, plug abandoned artesian wells, control siting of septic tanks, clean up existing contamination sites, prevent pollution from leaking underground fuel storage tanks, and require that all hazardous wastes be properly treated, stored, or disposed of.

- The State Underground Petroleum Environmental Response Act of 1986 further addressed the need to prevent pollution from leaking underground storage tanks and to fund the cleanup of existing pollution sites.

- The Warren S. Henderson Wetlands Protection Act of 1984 augmented the role of the Department of Environmental Regulation (now the DEP) in the regulation of upland wetlands and assigned responsibility for regulation of agricultural impacts on wetlands to the state=s five water management districts.

- The Surface Water Improvement and Management Act of 1987 (SWIM) promised state funding to water management districts for remedial measures to restore water quality in surface waterbodies that had been contaminated in the past.

- The Marjory Stoneman Douglas Everglades Protection Act of 1991 was a combination of provisions for taxes, land acquisition, and regulation designed to resolve a complex and

controversial lawsuit concerning water quality impacts of irrigation drainage on the Everglades marsh ecosystem in south Florida.

- The Florida Cooperative Extension Service and the University of Florida=s Institute of Food and Agricultural Sciences conduct research, education, and demonstration projects specifically directed at minimizing water quality impacts of agricultural operations, and these projects often involve cooperation with the DEP, water management districts, or with the Soil Conservation Service of the U.S. Department of Agriculture.

- Both DEP and the USDA have provided for cost-share assistance and technical assistance to farmers to help reduce both point source and nonpoint source pollution from agriculture operations, especially from dairies.

- The Department of Agriculture and Consumer Services administers a pesticide review and registration program to assure that pesticides labeled for use in Florida have been tested under Florida conditions and will not pose an unreasonable threat to water quality.

Conceptually, state policymakers have a menu of policy tools with which to implement water quality goals. In generic terms, these tools include regulations, taxes and monetary incentives, acquisition, and research and education, not to mention recourse to the common law approach to dispute settlement through litigation. In the main, Florida=s approach to water pollution control is built on a framework of comprehensive regulation. Much of Florida=s regulatory approach tracks with federal environmental regulatory programs administered through the states by the Environmental Protection Agency. Florida has also made significant use of public acquisition and management of land for water management purposes. Research, education, and technical assistance have been used in supplemental ways, often incidental to regulatory approaches. Taxes and other monetary incentives, as a mechanism to influence behavior, have not been widely used.

Water Issues

Several broad issues exist against this backdrop of information about Florida=s water resources. These may be grouped into allocation issues, quality issues, and institutional issues.

Allocation Issues

The Southwest Florida Water Management District has designated a multi-county area south of Tampa as a Water Use Caution Area. District hydrologists have become convinced that withdrawals from the aquifer in that area have exceeded recharge for many years with the result that the salt water interface from the Gulf of Mexico has moved upward and inland, threatening long-term availability of freshwater from the aquifer. To address the problem, the District has imposed

a moratorium on new consumptive use permits in the area, and is considering non-renewal of expiring permits in the future. Much of agriculture in the area depends on groundwater for irrigation.

In the South Florida Water Management District a major allocation issue revolves around concerns that remaining portions of the original Everglades marsh ecosystem are declining because of long-term alteration of the hydro period in the region as a result of flood control works built by the Corps of Engineers and managed by the District. Conservationists argue that restoration of the ecosystem will require redesign of the flood control system and cessation of agricultural production in what is now know as the Everglades Agricultural Area. These arguments are controversial because the stakes are high for all parties to the dispute.

Interjurisdictional transfers of water from one county to another or from one water management district to another are the subject of dispute in some parts of the state. Because population demographics shape patterns of water use, and since populations centers tend to be located where water resources are least abundant, the fear or the reality of water transfers from sparsely populated areas to heavily populated areas are likely to continue into the future.

Water Quality Issues

In the South Florida Water Management District, the effects of nutrients in drainage water from the Everglades Agricultural Area on the remaining Everglades marsh ecosystem has been the focus of a major lawsuit and of much political controversy. The dispute has pitted conservationists against agriculturalists in the area.

Issues concerning the siting of new dairies in north central Florida is an out-growth of quality problems from dairies north of Lake Okeechobee. Some citizen groups have opposed the siting of new dairies in Levy and Gilcrest Counties because of concerns over impacts on water quality in the area.

Groundwater quality problems persist in the kharst region in Jackson County, and have been an issue in the fern production region of Volusia County. The DEP is investigating the possibility of nitrate contamination of groundwater in the ridge citrus production area.

Saltwater intrusion is a part of the water allocation issue in the Southwest District=s Water Use Caution Area. It is a constant water management concern in many parts of Florida because of the state=s situation as a peninsula between large bodies of salt water.

Institution Issues

Much is made in some circles about the fact that Florida=s water management districts have ad valorem taxing authority, but the district boards are not elected. This gives rise to the argument

that the districts are engaging in Ataxation without representation.@ Some argue that the boards should be elected. Others argue that their taxing authority should be revoked. Others argue that the existing system is appropriate.

Regulation in general frequently draws charges of unconstitutional Ataking@ of private property without compensation as property owners find that their opportunities to profit from land ownership are sometimes seriously constrained by environmental regulations. The property rights issues and the issues of Aregulatory takings@ will likely be aired in the future.

As population pressures continue to grow, there is concern that Florida=s case-by-case regulatory approach to consumptive use regulation is grossly inefficient in terms of bureaucratic process and in terms of water allocation decision-making. Some argue that market-like processes for allocating and re-allocating available water supplies may need to be implemented in order to assure orderly water management decision-making in the future.

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