State Agricultural Pollution Regulation

A Quantitative Analysis

Al Rosenthal

Water pollution in the U.S. may be attributed principally to agricultural nonpoint sources (NPS). Because of the geographical variability and site-specific nature of this type of pollution, Congress has left the control over agricultural pollution in the hands of the states. Because of this, during the 1980s, many state programs were proposed and initiated.

The objectives of NPS policies are generally the same. There are several best management practices (BMPs) that reduce runoff and the concentration of nutrients, pesticides, and sediment. These practices include traditional erosion-control measures such as terraces, waterways, and conservation tillage, and other water-quality practices such as animal-waste storage and application, fertilizer management, and integrated pest management (IPM). Policies differ in the methods used to encourage implementation of these practices. Economic incentives exist, including tax benefits and direct subsidies or cost-sharing. Other command-and-control programs have emerged that prescribe farmers' activities to protect water quality.

Environmentalists increasingly call for the enactment of regulatory policies in the agricultural sector. Some argue that the "polluter pays" principle should govern agricultural activities and that voluntary programs have not proven effective; however, farmers and their representatives reject command-and-control policies as ineffective, costly, and an infringement on their property rights.

Because many state legislatures have acted on this issue, it is peculiar that the policy debate continues on such a hypothetical plane. As these pioneering programs reach maturity, an evaluation of state agricultural NPS programs can anchor policy discussions in real-world experience. Topographical, sociological, and economic differences across the U.S. may preclude generalization of a particular NPS program's experience, yet there is still a need for studies evaluating existing state interventions. Millions of tax dollars are being spent on cost-sharing programs and millions more are being spent by farmers as they attempt to meet the requirements of command-and-control water-quality programs.

The effectiveness of agricultural NPS programs in North Carolina, Florida, and Pennsylvania was assessed through a telephone survey of over 700 farmers. These state programs were selected for evaluation because they were established in the mid-1980s and each reflects a distinct policy orientation.

Levels of Intervention

- An **intervention county (IC)** is a county that, since the inception of policy intervention, has received the necessary attention and resources to achieve maximal attainment of program objectives and in which implementation, according to oversight officials, is successful.
- A **moderate intervention county (MIC)** is a county in the program where implementation does not merit distinction. While the regulatory intervention exists, resources of environmental agencies are not allocated for implementation.
- A **control county (CC)** is defined as a county in which the relevant intervention has not taken place because of selective non-participation or jurisdictional boundaries.

POLICY INTERVENTIONS EVALUATED

North Carolina is one of the many states that established a cost-sharing program that subsidizes the implementation of BMPs by farmers. The cost-sharing program may be divided into five phases: application, contracting, implementation and payment, monitoring, and enforcement. Soil Conservation Service (SCS) and Conservation District (CD) technicians, after generating interest in the program, assist farmers at each stage, particularly the installation of the practices. The program designates 75% of the average costs to be paid by the states. Once a contract is in place, the district periodically inspects sites.

District officials acknowledge that because of their wide range of activities, the spot checks have not been as frequent as they would like. Yet, compliance with contract conditions is widespread. Deficiencies are limited to

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inadequate operation and maintenance activities, and a one-growing-season grace period is granted to farmers to improve BMP performance levels. To date, in the 56 North Carolina counties participating in the program, landowners signed 7000 agreements covering almost 500,000 ac of land.

In 1984, the Florida state legislature transferred the authority to control agricultural runoff from the state's Department of Environmental Regulation (DER) to its five water-management districts. Three of these have established a stringent Management and Storage of Surface Water (MSSW) permitting program. The study focused on the South Florida Water Management District, which has the oldest and most comprehensive MSSW system. While established farming operations are exempt from the MSSW permit requirements, any increase in farming or land-use activity requires a permit. Several thousand permits have been issued to date. Applicants for Florida's MSSW permits supplement legal and institutional information with extensive technical documentation. In addition to topographic maps, locational sketches, identification of seasonal water elevations, and aerial photographs, applications include calculations showing BMP effects on drainage and runoff routing.

Although installation of the required retention and detention basins may cost over a million dollars, compliance is considered very good. Inspectors using helicopter surveillance oversee implementation with an elaborate enforcement scheme. In-house attorneys give credibility to the threat of a punitive response for noncompliance. Despite the practical difficulties, Florida maintains an enforcement position that considers water-quality factors. For example, the district takes enforcement action against a permittee only if there is the potential for adverse impacts on water resources, wetlands, or adjacent landowners. To better organize its enforcement response, the district ranks deficiency situations.

In 1972, Pennsylvania promulgated regulations requiring control plans for all earth-disturbance activities to minimize accelerated erosion and prevent sediment pollution. While these plans technically are not permits, the failure to implement them has triggered criminal prosecution. The state system relies heavily on the existing infrastructure of county CDs for implementation of its program. The most recent amendments to the law in 1985 encourage local involvement in authorizing the DER to delegate program responsibilities to county CDs. Delegation is made at three levels of participation and the districts have the option of selecting the level at which they would like to participate.

Level 1 requires a district to conduct educational and informational functions and to review and process applications for earth-disturbance permits. Level 2, in addition to requiring level 1 specifications, requires districts to resolve complaints by initiating first-step enforcement actions. Level 3, in addition to requiring both level 1 and level 2 specifications, authorizes the district to complete enforcement actions that are otherwise handled by DER staff for level 1 and 2 districts. These include investigation of complaints, monitoring of permits, and imposition of substantial administrative penalties on noncomplying landowners and farmers. The state commits itself to supporting the district, financially and technically. Engineers and legal counsel provide training and engineering expertise for CDs. At present there are five level-1 CDs, 56 level-2 CDs, and five level-3 CDs.

While enforcement actions such as letter agreements, consent orders, and criminal actions increase each year, both state and local enforcement efforts are primarily directed at urban NPS violators rather than agricultural ones. During the 1980s, the enforcement activities in the level-3 CDs exceeded those initiated by the DER in the amount of fines issued and the number of actions taken. For example, in 1987, the state levied $19,500 in fines, while Bucks County alone generated over $107,000. This was caused by a shortage of enforcement personnel at the state level. Enforcement is not a direct source of revenue for CDs because the fines are directed to the state's Clean Water Fund.

Reasons for Using BMP Implementation as an Outcome Variable

- Historic data on water quality needed for pre- and post-intervention comparisons are not uniformly available in each state.
- Even if adequate records did exist, it would be difficult to identify a single parameter to use as an outcome variable.
- The range of local conditions makes meaningful comparisons difficult.
- The multitude of contributing discharges to a surface NPS-pollution problem precludes isolation of specific changes in water quality caused by a single county's reductions.
- It may take many years before a successful intervention is reflected in decreased pollutant concentrations in lakes.
- The effect of BMP implementation on runoff is fairly well characterized in agricultural engineering literature.

QUASI-EXPERIMENTAL APPROACH

Unlike many states such as Wisconsin and Minnesota, whose agricultural NPS programs combine various policy alternatives, North Carolina, Florida, and Pennsylvania have a single NPS policy that allows an evaluation to focus on a particular strategy. Further, within each state, a range of implementation levels exists. Assessing a given policy's effectiveness is possible by contrasting counties that have different levels of intervention. The study, therefore, is best classified as having a nonequivalent, untreated-control-groups design with pretest measures at more than one interval.

State and local environmental authorities placed counties in each of the three states into one of three groups: intervention (treatment), moderate intervention (partial treatment), and non-intervention (controls). Intervention counties (ICs) are singled out to demonstrate the potential for intervention effectiveness. Moderate intervention counties (MICs) indicate more typical effectiveness. Non-intervention counties, or control counties (CCs), reflect behavior in the absence of intervention (see Box). For example, North Carolina's CC, Randolph County, does not participate in the cost-share program, while Florida's CC, De Soto County, lies outside the South Florida Water Management District. The division of counties in Pennsylvania followed the three levels of delegation of regulatory authority. Hence, there is the minimal level of local involvement in the NPS program in a CC.

Two ICs were randomly selected and contrasted with a comparable CC and MIC. Just as the approach and structure of the three state programs are different, the functional distinctions between the three treatment groups vary for each state. Nevertheless, the three levels of intervention within each state share a common conceptual basis and counties treated at these three levels of intervention may be contrasted over time, both before and after the policy's inception.

Table 1—Post-Intervention Increase in BMP Implementation: Florida

	Percent			
	Hendry (IC)	Collier (IC)	Glades (MIC)	DeSoto (CC)
Ditching and diking	15.3	14.1	2.4	22.1
Retention basins	28.9	35.0	7.1	18.6
Cover crops	13.6	16.3	0.0	9.3
Fertilizer management	20.3	18.6	7.0	7.0
IPM	21.9	28.0	2.4	10.3
Grass swales	20.4	16.3	2.3	13.1
Land retirement	17.0	11.7	7.1	3.7

Study design. The inputs of a program are the prescriptions, appropriations, and activities taken to initiate a given policy intervention. The process stage corresponds to the implementation phase and the manner that the policy is applied to reality. Output represents the actual alteration in behavior in the targeted population caused by the intervention. The final outcome of the policy should be the aggregate change caused by the modification of behavior expressed as output. Changing the outcome constitutes the policy objective of the intervention.

There are two outcome variables that a NPS-program evaluation may use. NPS policies aim to increase implementation of BMPs to improve water quality in targeted receiving waters. In the present context, implementation of BMPs corresponds to the output, and water-quality improvement or preservation constitutes the outcome of a policy intervention. Although water quality constitutes a bottom line for environmental policy makers, in this study the focus is on BMP implementation (see Box).

Pilot studies suggested that it was more informative to assign respondents to one of three groups based on BMP-implementation level rather than use a dichotomous scheme. While respondents were assigned to a group according to specific decision rules, a description of the three categories is instructive. The first and easiest group to identify includes farmers who are not installing BMPs at all ("no BMPs"). The second group includes farmers who install some BMPs, but do not have a comprehensive system that eliminates discharges on all lands or meets the criteria of a water-quality or SCS program ("some BMPs"). The third group includes farmers who implement a complete BMP system that effectively reduces discharges on all lands to the satisfaction of local officials ("full BMPs").

Respondents provided a chronological description of BMP use that interviewers translated into a matrix depicting annual implementation for each practice beginning in 1970. On the basis of several factors such as percentage of cultivated land with practices, propriety of practices, animal-waste retention and application, and approval of SCS, individual BMPs were aggregated and farmers were assigned to one of the three groups.

Follow-up visits to randomly selected farms confirmed the validity of the trichotomous ranking system. Yet, as anticipated, site-specific factors led to inappropriate assignment. For example, inadequate maintenance or poor installation of BMPs among "full BMPs" rendered many systems ineffective. In other cases, a farm from the "some BMPs" installed relatively few practices that proved to be highly effective. Nevertheless, these flaws do not detract from the merits of the system as a means of identifying change in farmer activity. Trichotomous ranking captures increases in intensity and diversity of BMPs following program interventions. The rules are designed to enable researchers to record changes in BMP implementation following the intervention and to make inferences about the ability of NPS programs to change farmer behavior.

METHODOLOGY

The telephone survey of over 700 farmers was designed on the basis of several interviews and in consultation with the U.S. Department of Agriculture's (USDA) National Agricultural Statistical Service (NASS) using its standard questionnaire. The questionnaires for each state were slightly different, contained about 40 questions, and could be answered during a 15-minute telephone call. Supervision was ongoing, with intermittent checks of interview quality. The length of interviews fluctuated widely. Interviews were considered complete if the farmers provided enough information about their BMP implementation to assign them a pre- and post-intervention BMP level.

Response rate and quality control. As expected from previous surveys involving rural populations, the response rate was quite high. There are a number of ways to compute a response rate for the present study. A county-by-county breakdown of the outcomes of telephone calls showed that 43% of the 1438 individuals contacted by interviewers neither farmed nor leased land to a tenant farmer. Only 108 of the remaining eligible individuals refused to speak to interviewers or ended the interview before completion. In this best-case scenario, the response rate was 86%. As it was not always possible to determine whether a respondent was involved in an agricultural operation before a refusal, this percentage may be slightly higher. A worst-case response rate would include as eligible any individual that interviewers attempted to contact who did not exclude himself as a non-agricultural landowner. Under these assumptions, the response rate would be 53%.

Table 2—Post-Intervention Increase in BMP Implementation: North Carolina

	Percent			
	Guilford (IC)	Chatham (IC)	Alamance (MIC)	Randolph (CC)
Terraces	8.3	0.0	2.8	1.5
Contour plowing	1.7	0.0	2.8	1.5
Vegetative strips	5.6	2.5	12.8	2.9
Conservation tillage	5.0	35.0	14.3	5.8
Cover crops	10.0	0.0	7.1	3.9
No tillage	5.0	0.0	5.7	4.3
Fertilizer management	6.6	0.5	7.1	0.0
IPM	7.2	0.0	4.2	0.0
Retention basins	3.3	0.0	1.4	0.0
Grass waterways	16.0	10.0	17.1	10.0
Animal-waste management	3.3	5.0	1.4	1.4
Land retirement	3.3	7.5	4.3	7.1

The validity of the information was assessed during visits to 60 randomly selected farms in all 12 counties. This follow-up revealed discrepancies between BMPs reported and those actually in place in five farms. In all cases, respondents claimed the existence of BMPs that had been discontinued. Explanations for these inconsistencies by respondents involved misunderstanding or inaccurate perceptions. Either respondents had installed a given practice and continued to think of it as operating, or they did not understand that they were to convey the change in practices to interviewers. While these discrepancies do not invalidate the survey data, they are the largest single source of error. The fact that 8% of follow-up visits revealed inconsistencies in the reporting of BMP implementation constitutes an important caveat in interpretation of results. Opinions offered during the survey, however, do not seem to have changed among these individuals.

PROGRAM EFFECTIVENESS

The statistical analysis proceeds in two stages. The first tests whether there are changes in farming practices associated with the interventions. Because there are many forces at work that shape agricultural behavior, the second stage isolates the policy intervention's impact on BMP implementation. In so doing, the significance of other relevant factors is considered.

BMP trends. The single, common trend in the data for each state is the uni-directional nature of BMP implementation. No respondent reported a reduced level of BMPs or abandoned management practices unless the practices became obviated by a change of crop or replaced by an alternative practice. Not only did respondents' chronological descriptions of BMP implementation bear this out, but later in the survey they were specifically asked if they had discontinued any practices and why. Many farmers discontinued BMPs altogether when they converted cropland into permanent pasture, but this constitutes a net improvement in their runoff control.

Tables 1 through 3 provide "raw data" for the states, describing the percent change in use of specific BMPs. Certain statewide trends should be mentioned before contrasting counties. In North Carolina and Pennsylvania, the use of terracing increased marginally, while there was marked growth in practices such as conservation tillage and grass waterways. The effect of Florida's MSSW programs is shown by the increase in retention and detention basin installation. These capital-intensive practices are the systems of choice within MSSW permits, and their prevalence among respondents in ICs has increased over 100% since 1985.

In Florida, the increase in BMP use was greater among IC respondents than the other two types of counties. The exception to this was "ditching and diking." Because this practice is designed for flood control and not water quality, most farmers installed ditches as a matter of course. Practices whose central purpose is water-quality management, such as IPM, retention basins, and swales, increased twice as fast in the ICs as in the MIC and CC. Background rates of BMP implementation were similar between Florida's ICs and the CC, although this was not the case with the MIC.

Neither North Carolina nor Pennsylvania had such striking contrasts between intervention levels. In North Carolina, the most surprising aspect of the data was the relatively large growth in BMP implementation in Alamance County, an MIC, relative to Chatham County, a CC. Except for the increased use of conservation tillage by two-fold in Chatham in the past 5 years, relatively few respondents indicated changes in farm practices. Alamance and Guilford showed moderate increases in the use of each practice, while in Randolph County, the only practice that became more popular was grass waterways. In retrospect, state officials think that the MIC classification may have been faulty. Pre-1985 background levels are similar between counties. Hence, results suggest that there were meaningful increases in BMP implementation among respondents in two of the three counties that began the cost-share program in 1985.

With the exception of conservation tillage and no till, increases in BMP implementation were larger in Pennsylvania's ICs than its MICs and CC. Grass waterways and contour plowing in the ICs showed moderate growth. Discrepancies in pre-1985 background implementation levels are varied, suggesting that no county began the program with greater use of BMPs. The overall picture of individual practices suggests that there has not been substantial change in any of the counties since 1985. The relative growth of BMP implementation in ICs should be viewed within this limiting context.

STATISTICAL ANALYSIS

Chi-square tests and a variety of logistic-regression analyses suggest that Florida's NPS intervention has succeeded in changing farmer behavior with respect to BMP implementation. While some statistical measures suggest that the other two states' programs may be associated with an increase in certain farm practices, they do not seem to be the cause of statistically significant change. At the very least, all quantitative analyses suggest that Florida's program has had a far greater impact than programs in Pennsylvania and North Carolina.

While the analyses consider whether NPS interventions in Pennsylvania, North Carolina, and Florida affect BMP implementation, they do not consider why. Other insights from the survey are used to offer alternative explanations for the results of the statistical analysis.

Self-ascribed motives. The questionnaire attempted to identify the motives of farm operators who installed BMPs. Farmers who implemented BMPs were read a list of reasons for BMP implementation and asked to give those that matched their personal motivations (Figure 1). While soil preservation ranked highest in each of North Carolina and Pennsylvania's

Table 3—Post-Intervention Increase in BMP Implementation: Pennsylvania

	Percent			
	Bucks (IC)	Northampton (IC)	Lebanon (MIC)	Berks (CC)
Terracing	4.0	2.0	2.5	1.3
Contour plowing	3.8	16.0	1.3	2.5
Vegetative strips	4.9	9.8	2.5	8.7
Conservation tillage	3.9	4.9	8.7	6.2
Cover crops	2.0	0.0	7.4	3.8
No tilling	3.9	7.8	9.8	7.5
Fertilizer management	5.8	4.0	3.8	12.3
IPM	3.5	4.9	7.5	3.8
Retention basins	5.9	3.9	6.2	0.0
Grass waterways	12.0	12.7	7.5	6.3
Animal-waste management	5.9	3.9	6.2	6.3
Land retirement	2.0	1.9	3.7	0.0

counties, in the non-erosive flat lands of Florida it seemed to be a secondary consideration. Similarly, long-term economic benefits were the second most common motivation ascribed.

Water quality ranked relatively low in most Pennsylvania and North Carolina counties as a reason for implementation. Lebanon, Pa., whose western half has been the target of some promotion by EPA's Chesapeake Bay Program because of its proximity to the Susquehanna River, proved an exception. In contrast, in Florida, water quality proved to be a major factor in farmer behavior. Indeed, in Hendry County, more farmers identified it as a reason for their BMP decisions than any other factor.

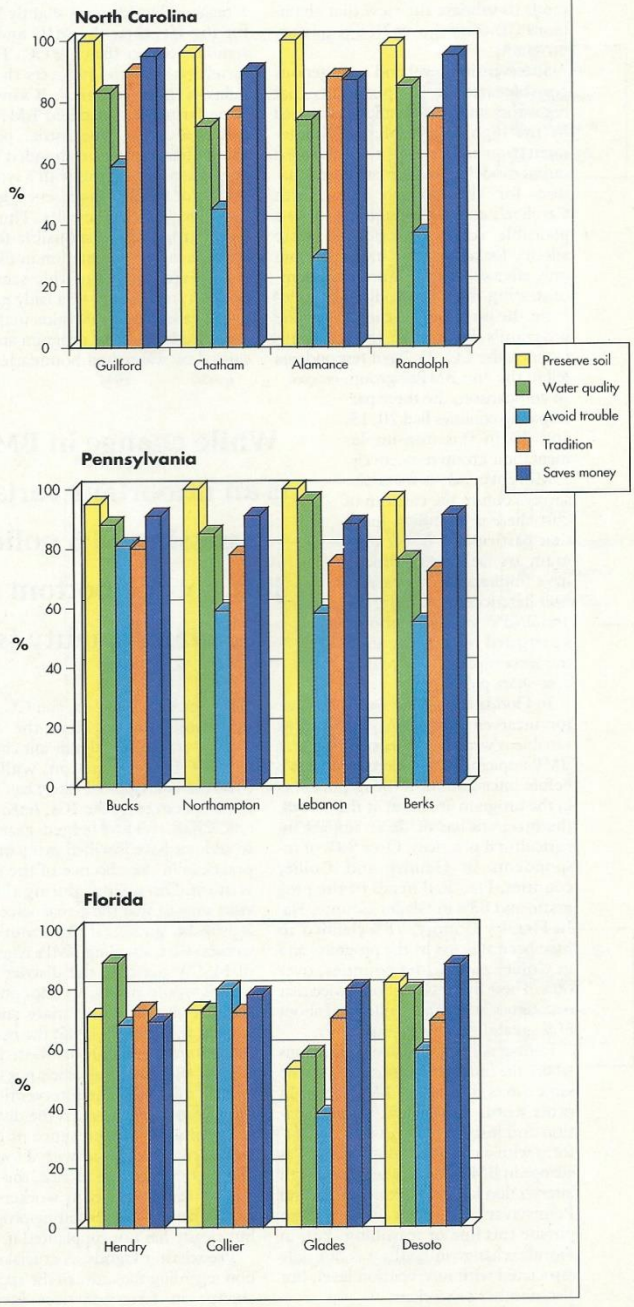
Avoiding trouble with the government was the least important reason given by farmers in Pennsylvania and North Carolina. A manifestation of the South Florida Water Management District's regulatory presence is seen in the Collier County responses, where it was the most prevalent motivator for BMP implementation.

The Farm Bill's impact. Claims of the state program's effectiveness are challenged by the 1985 Food Security Act's initiatives and cross-compliance provisions. This reauthorization of the Farm Bill linked installation of conservation practices on highly erosive lands with receipt of USDA benefits. Change in BMP implementation, therefore, may have been caused by this national intervention, rather than the state's initiative.

Respondents indicated whether they were familiar with these programs and whether they were affected by them. These programs ostensibly did not affect Florida because it lies on non-erosive lands and does not produce crops that receive federal subsidies. In contrast, not only did the tremendous familiarity with the MSSW program serve as an implicit indication of the program's impact, but a high percentage of respondents acknowledged its effect on their practices.

The Farm Bill undoubtedly is responsible for much of the change in North Carolina and Pennsylvania farmers' practices. A larger number of North Carolina farmers had heard of the Sodbuster and Conservation Compliance programs than of the state's cost-share program. In Guilford County, N.C., these programs seemed to have had as great an impact as the state's cost-share program. In Pennsylvania, only Berks County, the CC that elected to forgo local enforcement, claimed to be affected by USDA programs at a level comparable to the state's Clean Streams Law's erosion and

Figure 1—Personal Motives Behind BMP Implementation



sedimentation provisions. A higher percentage of farmers were affected by the state program in ICs that were delegated full, local enforcement. This tends to validate the view that champions CD control over NPS regulatory programs.

Intervention level and endogenous considerations. The possibility that regulatory intervention might be caused by the high degree of BMP implementation rather than the proposed causal model is an alternative explanation for the results. For North Carolina's cost-share program, this is a plausible scenario. Counties were selected for participation in the program only after submitting a proposal demonstrating the CD's ability to implement the program. At the time of the program's inception, in Randolph County, the CC, 35.7% of respondents fell in the "no BMPs" group. In comparison, the three participating counties had 20, 15, and 8% in this non-implementation group respectively.

Moreover, data from the survey confirm the criticism of cost-share programs arguing that participants in the program are farms that already have implemented conservation practices. Ironically, the "no BMPs" group that should be targeted by the program is the least represented among cost-share participants.

In Florida and Pennsylvania, the case for intervention as an endogenous variable is weaker. Pre-existing levels of BMP implementation were comparable before intervention. If the respondents in the program are taken at their word, the program has made an impact on agricultural practices. Over 90% of respondents in Hendry and Collier counties, Fla., had heard of the program, and 83% in Glades County, Fla. In Hendry County, 78% claimed to have been affected by the program, and in Collier and Glades counties, over 60%. These figures are about twice that of counties in North Carolina and about 50% greater than in Pennsylvania.

Endogeneity also refers to situations where the intervention is caused by the same forces that induce BMP usage. In other words, both BMP implementation and intervention level are symptoms with a common cause. Insofar as change in BMPs was not associated with intervention level in North Carolina and Pennsylvania, there is little need to pursue this line of reasoning. Yet, in Florida, change in BMPs was not only associated with intervention level, but also number of workers.

Accordingly, one could argue that large farms with many workers were the cause of the intervention levels and the change in practices. Mean and median acreage in Florida were slightly higher for the ICs than the MIC and substantially higher than the CC. This alternative scenario suggests that the influx of citrus to Florida's ICs involved large farms that installed BMPs as a matter of course. The district, perhaps for political reasons, responded to the presence of large farms with a symbolic display of regulatory presence, issuing numerous MSSW permits. Thus, the large farms were responsible for the increase in implementation in Florida.

An examination of this scenario, however, reveals it to be a fairly garbled one. The level of intervention in the CC preceded the MSSW program and was caused by watershed boundaries, not the farm size. Even so, the CC, with operations smaller than the MIC, showed statistically significant changes in BMP implementation, while the MIC did not. Approximately half of the farm operators in the ICs, both large and small, acknowledged that they would not have installed many of their practices in the absence of the intervention. Discussions during the site visits suggest that the actual percentage is probably greater. If farms with many workers were installing BMPs regardless of MSSW permits, the district's demands would not be so unpopular in ICs. Results of a univariate analysis suggest that, before 1985, the number of workers was highly associated with BMP implementation, albeit not to the degree following the intervention. A more plausible scenario is the district's responding to the presence of large, new, citrus operations with a tougher enforcement policy. Hence, the presence of farms with many workers may have enhanced the permitting program, but clearly has not supplanted it.

Preexisting trends. A crucial question regarding the cause of the apparent change in farm practices involves preexisting trends in BMP implementation. The trends are representative of the other counties in the state. Because these model counties drive any argument advocating a given program's potential, they should be the first examined. As mentioned, these observations are not independent and assume continuous use of practices.

In Bucks County, Pa., before the 1985 intervention delegating enforcement authority to counties, there was already substantial growth in the use of most practices. This may have been caused by the Clean Streams Act that was enacted at the beginning of the 1970s. Nevertheless, it is clear that a preexisting trend may have been the source of the moderate changes detected in Pennsylvania.

The same is true in North Carolina. A growing number of farmers in Alamance County began using grass waterways, filter strips, and conservation tillage during the late 1970s and early 1980s. While use of these practices grew during the following 5 years, in many cases the growth rate decreased.

In Florida, the growth in BMP implementation followed a different pattern. Although a general upward trend existed before the mid-1980s, after 1984, when water-management districts were given authority to regulate agriculture, the trend increased dramatically. This was particularly true for key environmental practices such as retention basins, fertilizer management, and IPM. Hence, even without a formal, time-series analysis, the existence of a jump in the outcome variable at the time of interruption by the Florida program suggests that the intervention played a key role in the increased BMP implementation.

It is difficult to draw hard and fast conclusions from this information, particularly given the imperfect nature of the data. Upward trends in BMP use before intervention in every state, however, are undeniable. One may argue that without the cost-share program in North Carolina and county enforcement in Pennsylvania, BMP implementation would have leveled off, or not improved as much as it did. Yet, preexisting trends pose a credible alternative explanation to the post-1985 changes in farmers' practices. On the other hand, this same assessment tends to support conclusions about the powerful effect of regulation in Florida.

While change in BMP use is an important variable in assessing NPS policies, it is not the bottom line—water quality is.

The effect of intervention on policy views. The NPS programs also seem to have influenced the attitudes of respondents towards NPS policy options. Figure 2 presents the degree of support in the different counties for four separate policy options. One may argue that among a large percentage of the agricultural community, regulation has softened the general antagonism toward command-and-control programs. While permitting was the least popular option among Florida farmers, there was considerably greater support for such a policy there (17 to 20%) than in North Carolina and Pennsylvania.

Respondents in two of the three Florida counties supported some mandatory requirements for BMP implementation as an equally appropriate solution for a NPS pollution problem as cost sharing. Pennsylvania, also a regulatory state, showed similar results. In North Carolina, cost sharing was clearly a more popular option. These differences may of course be purely a function of cultural differences among the farmers in these different regions.

The study confirms the ability of a permitting system to change the practices of a farming population dramatically. This by no means implies that NPS regulation is a panacea. Contrary to initial predictions, Pennsylvania's regulatory program seems to have had less of an impact on farm practices than North Carolina's voluntary program has had since 1985. The gap in BMP implementation between Florida and North Carolina may be attributed to their different policy strategies. On the other hand, because both programs are regulatory, requiring landowners to install controls, the major differences between Florida and Pennsylvania seem to involve implementation.

While change in BMP use is an important variable in assessing NPS policies, it is not the bottom line—water quality is. Moreover, there are other important considerations in program evaluation such as fairness, costs, and popularity. Yet, the successful inducement of BMP implementation by Florida challenges the conventional wisdom that agricultural pollution cannot be reduced through a traditional command-and-control response. As agriculture is increasingly identified as the major source of water pollution in the U.S., regulation should increasingly be considered by policymakers as a formidable option. ■

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Figure 2—Agricultural Policies Supported to Abate Pollution