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Project Summary

Formulating Agricultural Nonpoint Source Policy: Analysis and Issues

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In a two-year study the social, economic, legal and institutional issues involved in the management and control of pollutants emanating from agricultural nonpoint sources were investigated. The primary focus was on nonirrigated agriculture in the Corn Belt production region. The study was performed in four parts: 1) analysis of the economic impacts of selected erosion control policies and their distribution among Corn Belt states, 2) evaluation of the equity issues involved in public policy formulation, 3) examination of the role of farmer attitudes and corresponding communication activities in the implementation of nonpoint source water pollution control programs, and 4) comparative analysis of two approaches to the agricultural nonpoint source problem — source control and instream water quality management.

This study builds on work reported in *Alternative Policies for Controlling Nonpoint Agricultural Sources of Water Pollution* (EPA-600/5-78-055), and focuses on issues raised in earlier analyses. Although the work reported here does not reflect an integrated set of analyses, the parts do, when summed, represent a unified picture that must be viewed in toto if implementable and economically efficient agricultural nonpoint source control policies are to be developed.

These analyses show that substantial reductions in erosion-related residuals can be realized at a fairly small cost to society. There may be, however, significant equity issues that should be factored into the development of control strategies. Furthermore, strategy development must include various kinds of incentives targeted toward specific factors that affect farmers' willingness to adopt and maintain best management practices. Long-term solutions will likely demand that larger problem solving frameworks (e.g., at the watershed level) be utilized if water quality management goals are to be achieved efficiently.

This Project Summary was developed by EPA's Environmental Research Laboratory, Athens, GA, to announce key findings of the research projects that are fully documented in separate reports (see Project Report ordering information at back).

Economic Impacts

Introduction

Economic Impacts of Selected Erosion Control Policies focused on two questions: (1) If states in the Corn Belt adopt varying soil loss limits as part of a nonpoint source water pollution control program, will there be adverse economic consequences? and (2) If so, what impacts would occur and would they be severe? An analysis was conducted, then, of the economic impacts on and expected changes in agriculture if various agricultural nonpoint source control strategies are implemented by different states. The focus is on soil erosion as an indirect contributor to the nonpoint source pollution problem.

Because individual states and areas within states have prepared separate water quality plans under P.L. 92-500, erosion and sedimentation controls may vary widely in the region. It is important therefore to see what spatial economic impacts may occur if different states apply different degrees of control.

The economic impact analysis looked specifically at Illinois and Wisconsin as subareas of the Corn Belt. The earlier research on which this report is based investigated a number of different agricultural management policies using a modified version of the corn-belt model. These policies included the application of per-acre soil loss restrictions: (1) only in Illinois, (2) only in Wisconsin, (3) uniformly in all areas of the Corn Belt, excluding Illinois, and (4) uniformly in the entire Corn Belt. The policies were aimed specifically at soil erosion control even though the relationships between erosion control policies and water quality have not yet been well defined.

A linear programming model of the corn-belt economy was used that accounts for production costs, soil erosion, and demand functions for corn and soybeans. As a result, prices for crops can change as production changes. The model predicts soil loss and responds to soil loss restrictions.

Conclusions

This study predicts that the application of soil loss restrictions in different states in the Corn Belt will result in relatively low costs to society. The costs will be borne by producers under some circumstances and by consumers in others. An important factor in determining who bears the costs is how crop prices and production change. Soybean prices will undoubtedly increase when soil loss restrictions are applied because it is the most erosive of the major crops grown in the Corn Belt. The distribution of crops across various soil types at the time of application of a soil loss restriction will affect changes in crop prices and the distribution of costs between producers and consumers.

In general, the impacts on the various states' shares of farm income in the Corn Belt will be relatively small. Costs to producers will not be evenly distributed within a state. Costs will be concentrated on the owners of more erodable soils. The income of owners of less erodable soils could actually increase if crop prices increase.

Soil loss will decrease in areas applying soil loss restrictions. In some cases, soil losses could increase in areas not applying soil loss restrictions because of crop shifts between states.

Finally, market incentives and educational programs may encourage farmers to adopt conservation tillage practices and reduce soil loss without government intervention. In many instances, supplementary conservation practices would be needed to reduce soil losses to SCS soil tolerance limits.

Equity Analysis

Introduction

Equity Analysis in Public Policy Formation extends and develops in considerably more detail several equity criteria developed in earlier work. A procedure for making numerical estimates of the equity impacts of various policies is presented.

A standard test of whether any public policy is desirable from an economic perspective is to determine whether it is efficient and equitable. A policy that makes some individuals better off and none worse off is classified as efficient. In general, those policies for which the sum of the benefits is greater than the sum of the costs are also considered efficient. Obviously, any policy that makes all individuals worse off is inefficient, and, in general, any policy for which the sum of the costs is greater than the sum of the benefits is also classified as inefficient. Techniques that measure the efficiency of public policy changes, such as cost-benefit analyses, have been used for a number of years and are the subject of continuing reappraisal.

The goal here is to suggest an approach that can be used in analyzing the equity implications of alternative public policies being considered as a means of accomplishing objectives other than equity. The analysis begins with a brief discussion of the foundations of the concept of equity and concludes that a single measure, such as the distribution of income, is not adequate for the type of analysis suggested here. Rather, it is suggested that several equity criteria need to be considered by a policy analyst who is seriously attempting to reflect the beliefs of society.

The report then details the selection of an equity measurement statistic. While recognizing that no statistic can be completely acceptable, one believed to be workable is selected and procedures are developed for implementing each suggested criterion. Some observations are then made on how these statistics could be developed especially in the analysis of a soil erosion-water quality management policy.

Conclusion

The analysis implies that income and impacts on income are important to attempts to specify equity criteria. Thus, occupation will also be an important characteristic. Policy makers may also need to consider groups of individuals in categories such as consumers, workers, recreationists, the elderly, renters, homeowners, and students when they analyze policy alternatives that would affect these groups.

Several criteria of fairness or equity, each implicitly specifying a general set of significant characteristics for judging equity, are possible. The four equity criteria suggested here are believed to have broad popular appeal although they may not be appealing when pressed to their extremes. Public policies should at least have favorable equity impacts to the extent "possible." Stated briefly, the criteria are:

1. *Equality* — The benefits of society should be shared equally by all.
2. *Shared Consequences* — The benefits or costs of public policies should be shared equally by all.
3. *Earned Rewards* — Individuals should pay for benefits received and be compensated for costs incurred.
4. *Intertemporal Fairness* — Long-term risks associated with public policies should be minimized.

It appears that broadening the concept of equity to include several criteria reflecting values held by individuals in society will allow a policy analyst and a decision maker to more accurately assess the impacts of a policy under analysis and to thereby assess the acceptance of that policy by individual citizens. By understanding a more complete range of the equity impacts of the several policy alternatives, the decision maker can more accurately select the policies believed to be in the public interest.

The report suggests an approach that shows some promise for quantifying the several equity criteria discussed, although it is presumed that it is impossible to develop a measurement technique for the intertemporal criterion. The primary value of the development of such measurement techniques is that the equity implication can be placed on a more nearly equal footing with the efficiency implications of alternative policy choices. Doing so should facilitate the policy makers' subjective analysis of the alternatives and, as such, should make the economists' input to the decision process more valuable. The authors do not expect and would argue against an attempt to establish firm decision rules based on such numerical estimates. Remaining for future work is the application of this procedure to a real problem.

Attitudes, Acceptability and Implementation

Introduction

Recognizing Farmers' Attitudes and Implementing Nonpoint Source Control Policies examines the role of farmer attitudes and corresponding communication activities in the implementation of nonpoint source water pollution control programs. Introducing remedial policies into agriculture has proved to be quite complex. Because farmers are the principal decision makers regarding on-the-farm activities, the success of most programs, whether voluntary or mandatory, depends upon their participation. It is argued that voluntary participation is preferable because it maintains a farmer's control over his affairs, allows for local decisions, and encourages adaptations to local conditions. Much of the technology introduced voluntarily to farmers in the past has helped them to increase their productivity. Pollution-control policies whose purpose is to improve public welfare, however, may require activities not profitable to the farmer.

Policies that are based on mandatory participation can involve significant interference with farm operations. The gravity of the NPS problem and/or the necessity to bring critical acreage in an area under a pollution control program, however, may lead policy makers to decide that mandatory participation is called for. The drawbacks of mandatory programs, however, are well known. They tend to be accompanied by cumbersome administrative machinery that may be both costly and annoying to those affected by the regulations. Also, poor communications and misunderstandings between the regulatory agency and those regulated are a familiar part of most scenarios. Mandatory regulations are usually created by a central authority, frequently causing inequities and inefficiencies. Agriculture may be particularly vulnerable to such inequities because its needs are more sensitive to local conditions than almost any other sphere in which activity is regulated.

Farmers place a high value on exercising their autonomy in farm decision making and on unrestricted property rights. Farmers have, however, accepted regulatory activity interfering with their decision-making autonomy in such areas as grading standards for farm products, milk-marketing orders, and many public health regulations. While they have not necessarily cherished these regulations, there is little evidence that noncompliance has been widespread once the regulations have been introduced, probably because the farmers were persuaded that the regulations were justified. Their attitude toward the regulations, then, was important in securing their cooperation.

The report begins with a discussion of attitudes — how they are formulated and changed and how they influence behavior. The process of communication is then examined as it influences an individual's behavior by modifying what that person knows or feels. It is apparent that the proper use of communication and educational programs will be crucial to the successful implementation of NPS pollution control programs. Methods of achieving better implementation, such as the development of better communication, incentive programs, and citizen participation are then examined.

Conclusions

A program of NPS pollution abatement will have to operate under certain restrictions. In the near future it does not seem likely that a widespread centrally organized program of mandatory participation will be initiated. At the same time, complete reliance on voluntary programs will probably not get the job done; all indications from previous research are that certain farmers will not participate in voluntary programs and that many farmers, including those more economically innovative, will not participate in programs that will be costly to them. Although incentive programs induce farmers to participate, such programs will need to be restructured if they are to meet the needs of a NPS pollution control program. The following program steps should strengthen a NPS pollution-control program in agriculture.

(1) A strong educational program providing technical information as well as stressing the conservation and environmental values involved should create an awareness of and receptivity to the need for NPS pollution control. A strong educational campaign will be necessary for any type of implementation program and may, of course, on its own merits increase participation in NPS pollution control.

(2) While general standards and norms may be set at the state or federal level, local units such as Soil and Water Conservation Districts will be charged with local implementation and will thus make decisions on priorities and resource allocations. In the future, because local governing agencies may have to allocate resources according to the greatest need or impact, the local citizens they select for decision-making groups will have to be representative of the persons affected by the decision making, rather than just those who express an interest in program participation.

In addition, local decision makers will need to have the technical information necessary to make priority and resource-distribution decisions, and technical agencies will need to have the authority and capability to provide this information. This practice would also be a departure from the past, when information was typically provided on the basis of individual farmer interest.

(3) Incentives should be structured in such a way that the money spent would yield results. We know little about those levels at which farmers will respond well to specific incentives, but it is clear that the cost of providing financial incentives to individual farmers will be substantial. State and federal governments, however, already have a large number of specialized financial transactions with farmers. Policies that would make the reception of other government benefits contingent upon participation in NPS pollution-control programs would increase the magnitude of the incentives systems without requiring large new outlays of money. Some of these steps have, of course, already been taken at the federal

level, but further integration of NPS pollution control programs into agricultural policy would be helpful.

(4) Local implementation groups should be given definite and realistic targets on what is to be accomplished by what date. Although local implementation authority appears to be the most efficient and equitable, clearly defined objectives would do more than just provide benchmarks against which progress can be measured. If they acquire the proper authority, local decision-making units will be in a better position to introduce mandatory participation by pointing to outside requirements. In addition, the optimal time for mandatory participation will frequently be when, through educational and incentive programs, local support has been obtained. Local support, however, will be gained at different times in various localities.

Water Quality Management

Introduction

Toward Instream Water Quality Management compares two approaches to the agricultural nonpoint source pollution control problem: source control and instream water quality management (ISWQM). This report views controlling sediment as a water quality problem. It is recognized, however, that there are other nonpoint pollutants such as pesticides and fertilizers. Much of the discussion in this report applies to nonsediment pollutants.

Source control is a strategy of controlling pollution loadings by using standards such as soil loss limits or best management practices (BMPs) without relating them directly to water quality goals. ISWQM is a strategy of determining water-quality goals by examining pollution effects and other considerations and developing a resource management plan for achieving those goals. ISWQM relates land management more closely to water quality goals. Source control focuses on a more manageable piece of the overall problem because the techniques to be used are relatively well understood and the institutional framework is in place to implement such an approach. Nevertheless, while the impacts of such a program on water quality may be significant and positive, the precise impacts are not well known, and the most effective source controls to improve water quality may be hard to specify. ISWQM, on the other hand, would capture a larger subset of problems, so the analytical problem would become much more difficult. The report discusses the strengths and weaknesses of each approach and suggests some intermediate alternatives that could be explored.

Institutionally, ISWQM requires a close integration of nonpoint source pollution control with the management of water uses and formulation of water quality goals. A land management plan defining BMPs or effluent standards would be related to water quality goals for a stream and could be changed if the water quality goals are not met. Under source control, the land management plan is typically applied without analysis of the impacts on changes in water quality in a particular stream. The ISWQM planning process requires an institutional structure such that agencies defining water uses and managing water resources, agencies defining water-quality goals and standards, and agencies developing land-management plans must work together to relate land management to desired water quality. Under source controls, agencies planning land management could work independently of agencies defining water uses and managing waterways.

There is also an intermediate approach between source control and ISWQM. An initial source control plan might be developed that simply applies technical standards. The performance of the plan is reassessed in light of water quality goals and changed where performance is inadequate. This approach will be considered to be an ISWQM approach because land management plans and water quality goals are being integrated in the planning process and a feedback mechanism exists to assess performance and change the plan.

The information base needed and the state of the art of NPS modeling and economic evaluation methodologies is evaluated in light of both control approaches.

Conclusions

The source control approach to water quality management is currently feasible, an example being the soil conservation program. Economic and physical models are readily available for use under this approach. Institutions to implement such an approach on agricultural lands already exist. Some changes in existing institutions, specifically Soil and Water Conservation Districts, would likely be desirable: (1) A role in planning land management should be provided for people living outside of the boundarie of an SWCD who have an interest in the impact of the management of land within the SWCD on water quality, (2) Nonlandowners should be allowed to vote in elections concerning land-use regulations, and (3) Urban residents should be brought into the planning process. These changes in institutions, however, could require changes in state soil and conservation laws, a process that could be time-consuming and could encounter political resistance.

ISWQM encounters more problems than source control because the information and planning costs and technical problems of implementation and political resistance to implementation would be greater. It would not, however, be impossible to implement ISWQM.

Institutional changes are needed for ISWQM in addition to those outlined for source control. A closer integration of land management and water use and water quality goals is needed for ISWQM than for source control. Agencies managing waterways, defining water uses, defining water quality goals, and developing land management plans need to work more closely together in the ISWQM planning process than under source control.

The creation of nonlocal coordinating agencies, such as 208 planning agencies, would provide the changes needed in institutions and the planning process for ISWQM. These agencies will require some legal powers to coordinate the activities of SWCDs. There would probably be political resistance to giving a coordinating agency a role in local decision-making. Another problem would be the cost of funding the coordination agency. The implementation of ISWQM would thus be more difficult than source control because of these institutional problems.

There are a number of technical difficulties for developing land and water resource plans under ISWQM. Lists of water quality criteria have already been developed and could be used to define water quality goals for uses. The lists are incomplete, however. Criteria have not been developed for sediment and many other pollutants. Some criteria refer only to general uses when specific breakdowns might be desirable. Research to estimate values for these criteria would be time-consuming and expensive. Waiting for more complete lists of water-quality criteria to be developed would preclud implementation of ISWQM in the foreseeable future.

There are no particular problems for the implementation of ISWQM in the area of land management modeling. Land management models have been developed that could be applied to a ISWQM study, but more realistic models would be desirable. There is also a need to develop a better understanding of the impacts of agricultural land management on noncrop production values.

Modeling the land management/water quality relationships is the biggest technical problem in applying the ISWQM. A number of planning models of physical processes are available. All of the physical process models have strengths and weaknesses. The more sophisticated models require an iterative procedure to develop land management plans when they are linked to a land management model.

These significant technical problems for the application of ISWQM are the important areas for further research. More work needs to be directed toward studying: the impacts of resource management on natural processes affecting water quality, the development of models of these processes, the impact of stream processes on water quality in small and large watersheds, the water quality needs for various uses to aid in defining water quality goals, and the benefits and damages of water quality changes.

In summary, ISWQM is a feasible approach to agricultural nonpoint source pollution control. ISWQM will be more expensive and difficult to apply than source control. ISWQM can, however, define goals and problems more accurately and plan resource management to control problems more efficiently than source control. If ISWQM is to be applied, the greater analytical and administrative expense and difficulty of applying ISWQM as compared to source control will have to be justified by the more efficient allocation of resources to alleviate water quality problems than would occur under source control. Because of relatively high expense and difficulties of application, however, a sophisticated ISWQM approach of developing a land management plan to meet a precisely defined set of water quality goals seems most appropriate for waterways with complex management problems or critical values to protect. Other waterways could be managed with a simple ISWQM approach of defining priorities for pollutants and critical source areas or with a source control approach. In some cases, a source control approach might solve water quality problems.

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T. E. Waddell is the EPA Project Officer (see below).

This Project Summary covers four reports, entitled:

"Toward Instream Water Quality Management," (Order No. PB 83-110 957; Cost: $10.00, subject to change)

"Recognizing Farmers' Attitudes and Implementing Nonpoint Source Pollution Control Policies," (Order No. PB 83-111 013; Cost: $8.50, subject to change)

"Equity Analysis in Public Policy Formation," (Order No. PB 83-111 047; Cost: $8.50, subject to change)

"Economic Impacts of Selected Erosion Control Policies: Distribution Among Corn Belt States," (Order No. PB 83-112 797; Cost: $8.50, subject to change)

The above reports will be available only from:

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