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PROTECTING WATER RESOURCES FROM AGRICULTURAL POLLUTION: RESEARCH AND EDUCATION—ALTERNATIVES TO REGULATION

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Water resources include lakes, rivers and the oceans as well as underground aquifers. Contaminants may reach these waters from "point" sources such as factory waste streams or "non-point" sources such as runoff from farms and suburban lawns.

From a national perspective, the most significant water quality issue yet to be addressed is the problem of non-point pollution of groundwater. Point source pollution of surface waters was the first to be tackled by environmental legislation. Because its cause and effect are most easily observable, a solution is more easily found and enforcement more readily undertaken. In contrast, groundwater problems are hard to detect and individual sources of pollution difficult to identify. Current attention therefore is focused on attacking the thorniest of the water resource problems.

The cost to society (including future generations) of water quality degradation is not fully reflected in the price of the outputs (food, greener lawns, plutonium) whose production may result in contamination of the natural resource. Therefore, the public policy problem is to "price" the natural resource so that the marginal cost of producing the output is the same to the private producer as it is to society. Because of a lack of definition of property rights (who "owns" an underground aquifer?), public intervention may correct this private market failure.

Paying for the Protection of Groundwater

Who will bear the costs of groundwater as well as surface water pollution prevention? The design of government intervention depends on how society wants to answer this question. In a recent *Choices* article, Harold Breimyer listed four general means by which society can bring individual behavior into "an acceptable degree of social conformity." Breimyer's scheme is useful in considering options for groundwater protection. These means include cultural rules or social pressure, education, compulsion and monetary reward or penalty.

Breimyer argued that monetary reward or penalty has been the preferred choice because it is perceived as more acceptable than compulsion and more effective than social pressure or education alone. He points out that monetary incentive has been used extensively in agricultural subsidy and conservation programs in the past, but that federal budget constraints seem to preclude its application in the future.

Which of these avenues might be appropriate for addressing groundwater contamination by agricultural chemicals? As for cultural rules, the farmer has long been portrayed as a "steward" of the land, a role that implies careful and forward-looking management of resources. But does stewardship extend beyond land to the common property resource of groundwater? Farming is the last unregulated industry. Pesticide regulations apply to manufacturers, not users. On their own, farmers have faced environmental issues by getting themselves exempted from scrutiny in statutes governing agricultural chemicals.

Education about environmentally-sensitive farming practices is a time-honored method of encouraging agriculture to take care of resources. Soil Conservation Service and Extension Service demonstration programs, backed by federal and state research, are the archetypes.

In its application to preventing groundwater contamination, compulsion means legal restriction of the use of agricultural chemicals and nutrients. But, because of the lack of a direct connection between use of a substance and contamination, quantitative restrictions on the input will not suffice. Production practices must be regulated. So far, states have only begun to specify these "best management practices" and their efficacy in preventing groundwater contamination has yet to be established.

And, finally, as noted, monetary reward could be used to induce farmers to adopt more desirable practices, or, as with the Conservation Reserve Program, to obviate the problem altogether through land retirement.

Why Farmers Haven't Paid

Who bears the cost of protecting groundwater quality under each of these alternatives? Which one seems most appropriate to dealing with farm chemicals and nutrients? At the outset, it is worth noting that for most, if not all, other sectors of the economy, the question is easily settled: the polluter pays and is compelled to do so through regulation. But when it comes to agriculture this principle has not been applied. Why not? The answer has much to do with farming's grip on popular mythology. Agriculture has managed to protect its status as a sector deserving special dispensation. Farming has, by and large, enjoyed immunity from responsibilities in pollution con-

trol and worker safety (to name just two areas) that other sectors must bear. But now, with contemporary public interest in maintenance of environmental quality, can agriculture get the taxpayer to continue to foot the bill for protection from agricultural chemical contamination?

Which Alternative Should Agriculture Support?

The monetary incentive approach can allocate the costs of pollution prevention between the taxpayer and the farmer who chooses to participate, depending on the cost share. Compulsion through regulatory fiat requires the polluter (the farmer) to pay all costs, thereby internalizing the full cost of production. Regulation also subjects the farmer to both civil and criminal penalties for violation. As such, regulation is the most effective mechanism for pollution reduction. Moral suasion could induce farmers to value water quality as the rest of society does but imposes none of the strictures that lead to the full internalization of costs. Research and education represent a compromise on the cost-share between farmers and the public, although it still leaves compliance voluntary. Given that society has insisted that groundwater be protected from contamination, which alternative should agriculture support in meeting that objective?

The farm community could hold out for cost-share programs much like those the Agricultural Conservation and Stabilization Service has administered over the past several decades. Or farmers could support wholesale land retirement in sensitive areas. In either case concerns about the federal budget constraint and equity across industries are likely to prevent the funds necessary to address the problem on a national scale from being directed to agriculture. Insistence on treatment markedly different from that of other sectors will certainly engender a backlash of "me-too-ism." Making a case for special treatment of farmers as polluters may be increasingly difficult as all segments of society are asked to shoulder part of the burden of cost for many kinds of pollution prevention and abatement. By the same token, society has essentially rejected the stewardship argument; farmers will not be left to their own devices to address water quality protection.

Education and compulsion are the two remaining viable alternatives. Their essential difference is that participation in education is still voluntary and thus legitimate questions about its effectiveness as a pollution prevention strategy can be raised. On the other hand, the nature of the regulatory task is complicated by the spatial variation in the difference between private and social costs due to the effects of different physical environments in determining whether contamination actually does occur and with what severity.

Essentially, the question concerns the worth of a regulatory program that cannot be enforced and implemented on a national basis because the problems it seeks to address are driven by local con-

cerns. Therefore, the prescribed "best management practices" must also vary with probability of harm. So, in this instance, an effective regulatory solution (one that everywhere equates marginal social and private costs) could be very expensive to implement. An ineffective regulatory solution could be wasteful in terms of inefficiency of resource use.

The Most Sensible Approach

For these reasons, the most sensible approach to preventing groundwater quality degradation for farming and society would seem to be reliance on a semi-voluntary program, based on research and education that promote benign practices with the credible threat of regulation as incentive for participation. However, the challenge to the efficacy of the voluntary approach is formidable.

Research and development must design a set of best management practices that farmers will continue to use even if commodity prices rise significantly. Recent experience with adoption (and abandonment) of conservation tillage instructs caution in this respect.

And it is difficult to be sanguine about the prospect of success today because the production technology is still fundamentally dependent on fertilizers and chemicals. In the future, ensuring against groundwater contamination will require a truly alternative agriculture. Plants that fix their own nitrogen, repel insects and outcompete weeds would obviate the need for man to help by applying nutrients and pest toxins. In this respect, advances in biotechnology will make very real contributions.

The short-term question of coping with contamination persists, however, because society will not wait for science to deliver on this promise (a prospect five, ten even twenty years in the future). Groundwater contamination is very slow to dissipate and very difficult and expensive to ameliorate once it has occurred.

The President's Water Quality Initiative

With the FY 1990 budget, President Bush endorsed a federal initiative to protect groundwater resources from contamination by fertilizers and pesticides without jeopardizing the economic vitality of U.S. agriculture. Water quality programs will be designed to accommodate both the immediate need to halt contamination and the future need to alter fundamental farming production practices. The president explicitly made the point that, ultimately, farmers must be responsible for changing production practices to avoid contaminating ground and surface waters. Federal and state resources will be available, however, to provide information and technical assistance to farmers so that environmentally-sensitive techniques can be implemented at minimum cost.

The initiative is led by the Department of Agriculture, in cooperation with the Environmental Protection Agency, the Geological Survey, and the National Oceanic and Atmospheric Administration. Base funding of a quarter of a billion dollars is proposed to be increased by about a third (\$70 million) in FY 1990. Action by the House and Senate appropriations committees, before conference, gives good reason to believe the initiative will survive intact. Full, unearmarked funding of the initiative is critical, especially in this, its first year, as the administration envisions and has planned for a five-year life.

Primary Objectives

The Department of Agriculture has assembled a multi-agency, multi-disciplinary plan to execute the initiative. All in the agricultural community should become familiar with the elements of the initiative and its planned implementation. The primary objectives are to determine the precise nature of the relationship between agricultural activities and groundwater quality and to develop and induce the adoption of technically and economically effective agrichemical management and agricultural production strategies to protect water quality.

The initiative will build on what is already known about groundwater quality management, while seeking to fill gaps and improve management for the future.

The building blocks of the program include:

- building nationally coordinated databases on agricultural chemical use and related farm practices;
- developing a U.S. Geographic Information System (GIS) for agriculture and water quality;
- developing improved methods for sampling, measuring and evaluating groundwater contamination problems;
- conducting fundamental research to provide new technology and knowledge for improved management of chemicals used in agriculture;
- improving agricultural chemical and production management systems;
- expanding federal and state staff capacity to deliver educational and technical assistance to producers for effective agrichemical and waste product management and environmental stewardship;
- demonstrating currently available and new technology;
- meeting water quality requirements through education and technical assistance;
- evaluating the economic, social and technological feasibility of management systems;
- disseminating findings widely to the general public.

Further elaboration on the components of the initiative will be forthcoming from the federal-state partnership in research, education, and development.

The 1990 Farm Bill

At the same time the president's water quality initiative is being implemented, the 1990 farm bill will be debated in Congress. Clearly, environmental concerns will be closer to the top of the agenda than at any time in the past. Successful implementation of the initiative would go a long way in persuading those outside the agricultural community of the efficacy of the voluntary approach. Still, other directions for groundwater policy are being contemplated, judging from current interest in extending the Conservation Reserve Program and in tying program benefits to compliance with environmental strictures.

CRP Expansion Possible

Expansion of the Conservation Reserve Program to meet groundwater quality objectives is a potential but not serious item for consideration.

At present, most of the land in the Reserve is in areas where soil erosion, not necessarily groundwater contamination, is the main environmental concern. Expansion into areas of the Midwest Corn Belt, where chemical usage is more intensive and so groundwater more of a concern, would require bidding higher-valued land out of production.

Moreover, the Reserve would be bidding against other federal subsidy programs because the right to receive those benefits is capitalized into land values.

Most importantly, federal budget constraints are prohibitive. Meeting the Reserve's target by raising enrollment in any region, let alone those with potential groundwater degradation, is problematic. Considerable federal resources have already been expended on the Reserve, nearly \$25 billion since 1985. In fact, the U.S. government spends more each year on making these land rental payments than it does building sewage treatment plants.

Tie Compliance to Benefits

Another idea with some currency is to tie compliance with environmental strictures to program benefits. This requirement is already set to begin in the early 1990s; after that, without an approved conservation compliance plan, a farmer would be ineligible for benefits of program participation.

However, the extent to which these conservation plans will also meet groundwater quality objectives has to be established. One of the presidential initiative's contributions will be the generation of information on causality that will be critical in assessing practices' effects on groundwater. Designing compliance requirements, as with writing regulations on chemical use, could be very difficult to do on a national or crop-specific scale.

When subsidy benefits are tied to environmental compliance, the costs of program participation to the farmer rise. Then, sign-up may decline if the additional expense tips the balance in favor of staying out of the program. Because program participation is voluntary, the effectiveness of the environmental strictures is greatly harmed when few farmers sign up. Simultaneously, pressure to raise subsidy benefits to compensate for the costs of compliance would logically be expected.

Environmental compliance that included groundwater concerns could be written into the farm bill; but if it were to fail, the momentum for compelling farmers through regulation to protect groundwater would be irresistible and quite justifiable. Now it is the task of the agricultural economists to determine whether the costs of compliance would outweigh the benefits of program participation.

Research and Education: Desirable and Feasible?

To both society at large and to farmers, a program of research and education aimed at groundwater quality protection would have a number of advantages over the alternatives of compulsion or outright subsidy.

For farmers, education and voluntary compliance offer at least a partial cost-share through the subsidization of the development of new farming practices and of the dissemination of information that aids in adoption. Maximum flexibility is provided to farmers when they may choose the practices that not only meet environmental objectives but also the needs of their own enterprises. And, very importantly, voluntary programs are most in the spirit of farm policy over the past fifty years.

For society, the cost share aspect of education provides at least some relief to taxpayers, whereas complete subsidy would not.

In terms of best resource use, allowing farmers maximum flexibility also promotes efficiency because the site-specific nature of the groundwater contamination problem also dictates a site-specific solution. U.S. farmers could face significant disadvantages in world markets if costs of environmental compliance are higher than other countries. While environmental quality is a societal goal, it must be balanced against the need for competitiveness in world-class export sectors such as agriculture.

Will Education Work?

The apparent mutual advantages of the voluntary education approach notwithstanding, the real question is, will it work? Will it actually prevent groundwater contamination? And, will it work fast enough? A recent tour of a groundwater project in Iowa prompts these ruminations on the feasibility of the voluntary solution.

The Big Spring Basin of northeast Iowa has been a laboratory for federal and state agencies studying the fate and transport of agricultural chemicals and nutrients. The basin is characterized by Karst topography and is drained by a single underground aquifer, whose boundaries are well-identified. Within the area, farming is diversified by crop and with livestock. What can be learned here that is useful from a national perspective?

A Look at the Barriers

Looking at the Big Spring Basin leads one to ask whether quantities and use of agricultural chemicals can be adjusted sufficiently to meet water quality objectives. Beyond the not inconsiderable problems related to sensitivity to commodity prices and the constraints of the fundamental technology, what barriers might there be?

First, the question of diversification away from chemical-intensive crops, at least to allow for rotations, is critical. While diversification in cropping patterns was feasible in this area of northeastern Iowa, it is not clear how practicable it would be in, say, central Illinois, should that be a groundwater-sensitive area. The forces that drove farming toward specialization need to be better understood and recognized in designing new multi-output systems.

Another barrier to groundwater quality protection may, ironically enough, be soil conservation. As was learned with conservation tillage, it can be that inhibiting runoff of chemicals and nutrients leads to their percolation through the soil and perhaps into groundwater. What if higher T values are the price of less groundwater contamination? Just try suggesting that to the Soil Conservation Service! However, man thought up T values and it seems safe to presume he can change them, with sufficient prodding.

But the more fundamental issue here is the recognition and acknowledgement that, no matter what, agriculture disturbs the natural environment. The real issue is how much disturbance society will accept; not whether it will accept any at all.

Concluding Observations

The president's water quality initiative puts its eggs in the education basket. But it is a choice that can be revoked, and, quite frankly, pressure is increasing to do just that.

Threat of Regulation Real

The threat of regulation of farming practices is very real and must be given credence by the agricultural community. Special status for farmers as polluters will likely not be granted by society.

Consequently, as the initiative moves forward, the agricultural research and education community needs to be vigilant about monitoring progress and learning new lessons. The agricultural community as a whole should insist to the Congress that the president's initiative be funded as requested. The Office of Management and Budget cannot be as credible. Farming's support would signal the commitment necessary (although not sufficient) to forestall regulatory action.

Success Depends on Efficient Delivery

The success of the strategy has to be considered from a national perspective. An evaluation at that level presents a challenge to agricultural scientists who are most comfortable with parameters set to be narrowly site-specific. Projects such as the Big Spring Basin, while invaluable as laboratories, cannot be thought of as amenable to application everywhere. Society does not have the resources to devote on the same per acre or per cubic foot basis as the intensive program in northeastern Iowa. That is, there must also be concern about efficiency in the federal delivery of research and development to the farm sector.

Rethinking Biases

The agricultural community also probably needs to rethink its biases about its responsibilities to the environment and the rest of society. A widely-shared perspective outside farming is that society has spent lavishly, if justifiably, on agriculture over the past eight years, a time during which other seemingly worthy government projects languished. To continue to press claims on the treasury, beyond those already legitimized by past history, might be to invite a backlash whose results would help neither farming nor society.

The bottom line is that farmers need to understand that there will indeed be a cost to pollution abatement and that it may well be their responsibility to accept those costs in moving quickly to meet society's objectives for protection of environmental quality.

REFERENCES

- Breimyer, Harold F. "How Budget Tightness Will Affect a New Farm Bill." *Choices*, Third Quarter 1989, pp. 26-27.

