How Clean is Clean?  An Agricultural Perspective

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Abstract

U.S. agriculture is moving rapidly to reduce agricultural nonpoint sources of water impairments. The national data submitted by EPA to the Congress indicate that 90 percent of the assessed surface waters meet designated uses. USDA programs to encourage and assist farmers have been appropriately aggressive in developing voluntary programs to reduce agricultural nonpoint source pollution. The entire effort is hampered by the lack of definition of acceptable and pragmatic levels of expected water quality, and by the high level of generic rhetoric about the scope and seriousness of the problem.

Introduction

We have made tremendous progress in addressing the various aspects of water pollution. As a result of the Clean Water Act, we have greatly reduced most of the significant point sources. Industrial discharges have been controlled by permits. Raw sewage discharges have been reduced by the construction of sewage treatment plants. Phosphorus discharges have been greatly reduced by technology, or through a combination of education and laws (e.g., the widespread banning of phosphorus-based detergents). This progress has resulted in the resurrection of Lake Erie (once proclaimed “dead”), the reclamation of the Cuyahoga River (which once caught fire), and the improvement of water quality in many major rivers. Water quality in the tidal Potomac, is an often cited example; as the result of the construction of the sewage treatment plants, the Potomac is now swimmable and fishable.

But we have yet to solve some very real secondary problems, such as the management and land disposal/application of sewage sludges produced by these treatment plants. Land disposal/application schemes are being approached in a typical disposal mode in most cases — without consideration of the rates of application of nitrogen contained in the sludge. At the same time agriculture is being “encouraged” to control the application of fertilizers and animal manures to reduce the environmental impacts of excess nitrogen.

Combined sewer overflows still occur in over 1000 communities, and at variable intervals discharge untreated sewage directly into our surface waters. Because of the high costs of remediation, there are no effective strategies to deal with this problem. The fiscal problems faced by all levels of government reduce the likelihood that the problem will be effectively addressed in the near future. This fiscal reality overshadows the situation, the clear identification of the problem, and its known, but expensive, solutions.

The U.S. Environmental Protection Agency (EPA) estimates that about one-third of our assessed surface waters do not meet designated uses, and that agriculture is the source of 60 percent of this impairment, largely from diffuse or nonpoint sources (NPS) (EPA, 1990). These estimates are applicable only to the assessed one-third of our surface waters. EPA is careful to point out that these data do not constitute a representative sample of the nation’s waters, but that “States are generally constrained by diminishing reources and competing needs to monitor most often on those waters with known or suspected problems.”

Restoring the chemical and biological integrity of the nation’s waters is a laudable theoretical goal. It is quite clear that the estimates of the sources and extent of the impairment have not been adequately documented, nor have achievable and realistic levels of remediation been defined. We cannot adequately or confidently define such integrity in chemical, biological or ecological terms.

The EPA (1992) conducted a national “Pesticides in Well Water” survey. The data, reliable on a national level, indicate that there is no massive national problem. On a national basis, pesticides are likely to be detected in only four percent of our water wells; the likelihood is somewhat higher in rural wells than in urban ones; and nitrate contamination is more widespread. Note that “detection” of chemicals in water does not imply anything about health effects or legal limits; detection levels are usually well below such effect levels, and the disparity among these levels is sure to increase as our detection capabilities develop.

The EPA survey also reported a number of “statistical associations” between water contaminants and human health problems, but pointed out that such associations do not establish any cause-and-effect relationships. This distinction is important, even though it is difficult to explain to non-scientists; and it is crucial in developing realistic programs and expectations.

The U.S. General Accounting Office (1990) identified the lack of monitoring data as a key barrier to state and local efforts to control nonpoint source pollution. There are few credible data on the scope and impacts of nonpoint source pollution, or on the effectiveness of potential solutions. Without such information, it may be difficult to
convince farmers or other landowners of the need to act, or to invest resources.

Agriculture

There is little doubt — even within the US Department of Agriculture (USDA) or agricultural organizations — that agriculture contributes to the degradation of water resources in some situations. It is even likely that the impacts are sometimes rather widespread. But the real extent is unknown (and perhaps unknowable). It is quite possible to make generic statements about the problem, but USDA must concern itself with practical solutions to identified site-specific problems. Farmers, ranchers and other landowners perhaps can be convinced to alleviate identified NPS problems, but neither they — nor the Nation — can afford generic approaches.

Given this situation, some important questions are as yet unanswered:

♦ What are the agriculture-associated water quality problems?
♦ How do we separate agricultural NPS pollution from geologic sources?
♦ Which are the most important agricultural NPS water quality problems?
♦ How should we address them in a realistic manner?

We have one of the world’s best, most aggressive, most progressive water pollution control programs; it is not unreasonable to ask ourselves what more we want, how much more we can afford, and how it should be spent. We have made significant progress; the remaining problems are the tough (i.e., expensive) ones.

A pragmatic approach must recognize both that there are problems, and that they are being addressed. Many States are conducting successful interagency programs to address agricultural NPS pollution. More always could be done, given the necessary resources and policy direction. The difficulty lies in the reality that resources are in short supply and that, nationally, it is not at all clear that more mandates are either necessary or desirable. There is an adage of some repute among pragmatists that exhorts “If it ain’t broke, don’t fix it.”

At the national level, however, the first prerequisite of funding or increased funding is to convince the Congress that some horrendous problem — at or very near crisis proportions — is a major concern to Congressional constituencies, and therefore cannot be left unfunded. In this crisis-response scenario, there must first be a crisis. From the agricultural perspective, there is no factual crisis concerning agricultural NPS pollution, and there are no credible data to support the notion of a national crisis.

Dimensions of the problem

To keep the dimensions of the agricultural nonpoint source (NPS) situation in perspective, it is important to remember that not all NPS contaminants in our waters originate from agriculture.

♦ When de Soto encountered the Mississippi River, it was in flood and was probably carrying both sediment and plant nutrients.
♦ The Missouri River was called the “Big Muddy” when early pioneers began their trek to the Great Plains. It was then described as “too thick to drink, and too thin to plow.”
♦ Bayley (1970) pointed out that when millions of buffalo roamed the lands, pioneers crossing the Kansas area had difficulty in finding a single drop of water that was not yellow and putrid — polluted from the wallowings and excretions of buffalo.

It is not clear that, in their native state, some of our surface waters would have met the designated uses that have been generically assigned to them by some less-than-rigorous processes.

The estimates of impaired waters, upon which national policies are based, are suspect. The states are required to submit regular reports to EPA on the status of their waters. Like all mandated reports, these pose some problems, by implication, such as:

♦ If there is no problem, why does your agency (and perhaps, your job) exist?
♦ If you haven’t much of a problem, why should EPA provide funds for your programs?
♦ If you make significant progress, could you work yourself out of a job?

One logical response is to make conservative (i.e., high) estimates of the extent of the problem -the waters that do not meet designated uses; and to couple these with a continuing tightening of standards (which eventually must approach "pure and unaffordable.")

The state agencies also are constrained by the financial strictures common to all levels of government. Comprehensive guidance from the EPA for the content of regular water quality reports aspires to improve the quality of the reports; there is no doubt that the state agencies respond earnestly; but the resources to adequately document
the specific problems have long been — and are likely to remain — lacking. This reality legitimizes the issues of the rigor of these reports, their component analyses, their credibility as bases for policies, or for federal or state expenditures, and their usefulness for remedial programs.

The USDA does not routinely collect data to assess water quality conditions; this is a role assumed by the U.S. Environmental Protection Agency, the U.S. Geological Survey, some other federal agencies, and many state agencies. The USDA uses information from such assessments, and from its own and cooperative research programs to develop program priorities, to shape program thrusts, and to devise appropriate "Best Management Practices" (BMPs), which farmers and rural residents can use to address water quality problems where they occur, and to prevent pollution in predictable situations.

There also are understandable differences in federal agency philosophies, that are exemplified by the glass-half-full situation. Is it half-full, or half-empty? How do you interpret the data? A national extrapolation of data from the state-submitted EPA reports, would put agricultural source impairment at less than 10 percent of the nation's (total) stream miles. On a national basis, one must ask whether this constitutes a problem requiring more Federal regulation; especially given the programs and progress being made in agriculture to reduce NPS contamination.

Programs

The USDA has developed and implemented a number of programs to address matters of agricultural contamination from both point and non-point sources. In the 1970's, considerable research emphasis was placed on the point-source aspects of the treatment and handling of animal wastes, and the influence of agriculture on water contamination (Willrich and Hines, 1967; Cornell, 1970; Porter, 1975; American Society of Agronomy, 1977; Loehr, 1977). This resulted in many new handling and treatment processes.

Formal programs to address NPS remediation began with the joint USDA-EPA Model Implementation Program, initiated in 1977. This program funded NPS projects in seven states to demonstrate interagency cooperation, accelerated farmer adoption of BMPs, and the effects of those BMPs on water quality. Interagency cooperation was achieved, and the farmer-adoption of BMPs was significantly accelerated over the life of the projects; water quality impacts were, and are, the most difficult to document.

One of those projects, on the east branch of the Delaware River (N.Y.), was designed to reduce phosphorus inputs to a water supply impoundment, by promoting the adoption of BMP's. The federal, state, and local agencies worked diligently, and farmers adopted such BMP's as fencing cattle out of tributary streams, and reducing barnyard runoff to the impoundment tributaries. Over the three-year project life, BMP's were adopted by a significant number of farmers in the project area. The effect on the quality of impounded water was minimal, however, because the chief source of phosphorus — located several miles upstream of the project area — was the spray disposal field for the liquid wastes from a cheese manufacturing operation. That source has since been treated; but the incident emphasizes the difficulty in documenting the effects of agricultural NPS remediation; and it is not an exceptional circumstance.

In the early 1980's, the USDA's experimental Rural Clean Water Program (RCWP) established projects in 21 states, with funding of $70 million for the 10-year life of the program. Significant adoption of BMPs occurred in all of the areas; some were reflected in improved water quality. Meek et al. (1992) provided a description of the RCWP and the individual projects, which were selected in conjunction with officials at the state level. These projects were successful in stimulating the farmer-adoption of specified BMP's and in demonstrating the effectiveness of deliberate programs to stimulate such adoption.

But the adoption of even the most pragmatic BMPs is not always reflected in short-term changes in water quality. For example, Clausen et al. (1992) reviewed the impacts of 10 years of monitoring and extensive BMP adoption covering 74 percent of the critical acres in the watershed of St. Albans Bay (Lake Champlain, VT) and found no significant reduction in nutrient levels in either tributary streams or in the bay. Their model shows that reducing nutrient exports may take many years, depending on the amount of input reduction, and on initial field concentrations.

In the late 1980's, there was a considerable degree of concern in Congress about the contamination of groundwater by agricultural chemicals and the need for efforts to enhance or protect the nation's groundwater resources from such contamination. A "Presidential Initiative on Water Quality," announced in February 1989, identified the following guiding principles:

- The protection of the Nation's groundwater resources from contamination by fertilizer and pesticides without jeopardizing the economic viability of U.S. agriculture;
- The immediate need to halt contamination and the future need to alter farm production practices;
- The ultimate responsibility of farmers to change production practices to avoid contaminating ground and surface waters.

The leadership responsibility was assigned to the
USDA, with additional roles to the U.S. Geological Survey, the U.S. Environmental Protection Agency, and the National Oceanic and Atmospheric Administration. The challenge, as interpreted by the USDA, was to conduct biological, physical and chemical research, to address the management of chemicals for crop production and to develop and demonstrate alternative cropping systems, to educate and assist farmers in making appropriate changes in production practices, and to monitor implementation of improved management practices and systems.

The program was launched in Fiscal Year 1990 (FY90). Since then, the USDA has received an earmarked appropriation increase of some $80 million per year to carry out this program. These resources, along with redirected resources from participating USDA agencies, have funded the following efforts:

- Management Systems Evaluation Area (MSEA) projects in five Midwestern states, representing the Corn Belt, designed to evaluate current production systems, to develop new ones, and to transfer the information to farmers;
- Sixteen (16) Demonstration projects, to accelerate the transfer of research results to farmer adoption;
- Seventy-four (74) Hydrologic Unit Area projects, to accelerate the application of BMP’s in identified critical hydrologic units;
- Seventy-one (71) Water Quality Special projects, designed to accelerate adoption of improved management practices, especially through cost-share programs;
- Fifty-nine (59) in-house research projects to assist the MSEA efforts, and to increase understanding of the movement and fate of agricultural chemicals in the environment;
- Ninety (90) cooperative research projects, in which University researchers are investigating various aspects of agricultural chemical management, movement and fate.

Many of these efforts are being conducted with active collaboration with the U.S. Geological Survey, the U.S. Environmental Protection Agency, state water quality agencies, and units of state and county government. Protocols have been established to involve a wide array of local, state, and federal inputs to the selection of such projects, and to assure that they reflect state and local priorities for enhancing or protecting water quality. Specific information is available from USDA (1993).

Progress

These cooperative projects are now operational and are producing significant results. Through FY91, they resulted in the adoption of water quality practices by 10,000 producers on 552,000 acres of farmland; and reduced applications of nitrogen by 2.7 million pounds, phosphorus by 1.7 million pounds; and pesticide applications by 239,000 pounds. In addition, over 9,000 people received water quality training in FY90, including more than 4,000 people from non-USDA agencies. These projects have since gathered momentum, and the accomplishment numbers are expected to increase substantially.

The USDA and its state cooperators are achieving results; but there is not yet any realistic water quality standard against which these results can be evaluated. The situation is still that suggested by Stewart et al. (1975); most USDA program results must be reported in terms of "surrogate parameters," rather than terms of water quality improvements. The USDA sees its role as one of encouraging and assisting farmers to adopt management practices and systems that should enhance or protect water quality. Since the connections between NPS pollution and the quality of the receiving waters remain diffuse, the impacts of agricultural programs can be reasonably documented by recording the extent of farmer adoption of such practices.

The USDA’s Water Quality Program has responded to the results of EPA’s National Pesticide Survey, which indicated some potential problems of nitrate in groundwater. In 1992, USDA allocated some $700,000 for research on analyses for and management of nitrogen from soils, manures, and fertilizers. We have also encouraged our state staffs and counterparts to address the complex, field-and-crop-specific management practices for nitrogen management.

Magoffin’s (1991) “Pre-Sidedress Nitrogen Test (PSNT)” for rapid, on-site assessments of the status of plant nitrogen in corn, and its use by farmers from Vermont to Iowa, is reducing the application of excess nitrogen fertilizers in corn production. While the procedure is being used on only a small proportion of the total corn acreage, and while PSNT is not universally applicable to corn growing areas, it is an indicator of the kinds of technology that will likely reduce total use of nitrogen fertilizers in US agriculture by an estimated 20% in the next decade, and greatly reduce nitrogen loadings to water resources.

The USDA (1990) has developed a position paper on nitrate fertilizers and a status report on the extent of the nitrate contamination of groundwater. These have been widely distributed, to help agency personnel and farmers to understand that there are identified areas where nitrate contamination of water is a problem. (And conversely, to help policy makers to understand that it is not an ubiquitous
While American agriculture is addressing the matter of excess nitrogen fertilizer use and subsequent loadings to water resources, it must be recognized that much of the farmer adoption is in reactions to the economic benefits of careful management of nitrogen fertilizers, rather than to allegations/suspicions of adverse impacts on human health. While even a single fatality from methemoglobinemia is tragic, one documented occurrence in the last two decades would be considered an acceptable risk by most standards.

The USDA also has conducted a separate “Conservation Reserve Program,” (CRP) which has retired some 35 million acres of highly erodible lands from crop production. Grasses have been planted on 28 million of these acres, trees on 2 million acres, and the remaining 5 million acres have been converted to windbreaks, filter strips, wildlife and wetland areas. Ivavri (1992) projected that these conversions will reduce sediment loadings to surface waters by 210 million tons per year; phosphorus loadings by 66 percent, and nitrogen loadings by 75 percent. Ribaudo (1989) estimated that the CRP might generate $3.5 billion to $4 billion in water quality benefits.

Other USDA (1992) programs are aimed at reducing the use of agricultural chemicals, and the loadings of such chemicals to the environment. USDA’s program to eradicate the boll weevil, for example, has essentially eliminated the pest from Virginia (1983), North Carolina (1988) and South Carolina (1992). The discontinuance boll weevil insecticides in cotton fields greatly reduces the likelihood of their appearance in the environment. Programs to foster the use of integrated pest management, integrated crop management, and sustainable agriculture also contribute to reducing the environmental loadings of agricultural chemicals.

The USDA is continuing to address the matters of pesticide nutrient and contamination of the nation’s water resources (CAST, 1992). But the USDA, and the scientific, academic and policy communities, must address these matters with some sense of reality — to be sure that we are reacting to real (rather than perceived) problems, and that we are addressing problems to which agriculture contributes, for which there are practical solutions, and that will result in enhancing or protecting water quality in some demonstrable ways.

The role of the USDA is to represent the interests of U.S. Agriculture, of its productivity, and of its $18 billion annual positive balance in international trade, and to provide leadership for some balance between efficient agricultural production and the legitimate demands for enhancing and protecting environmental quality. The agricultural community is moving toward an environmental ethic, as CAST (1992) points out: “The time is right for everyone to work toward a new agricultural ethic that places equal emphasis on production and environmental protection;” but “Environmentalists need to recognize that there are limits on the speed and degree to which agricultural programs can be altered to serve environmental goals.”

Agriculture neither has nor expects license to pollute our water resources. By the same token, it should not be saddled with requirements to comply with unrealistic or undefined environmental objectives or regulations. The USDA has developed, and continues to implement programs that encourage farmers to voluntarily adopt realistic, environment-compatible practices. American agriculture is making progress in changing both attitudes and production practices.

There is little doubt — even in the USDA — that some operators are unaware of, or do not adequately consider, their impacts on the environment. American farmers are becoming more environmentally sensitive; and are adopting improved management practices, as they become convinced of the desirability to do so, whether the incentive is a reduction of input costs, or compliance with environmental ethics or regulations. But they can hardly be faulted for a limited response to generic allegations and unsupportable estimates of the problems. When (or where) a cause-and-effect relationship between agricultural operations and adverse impacts on water quality can be presented, operators usually can be convinced to make significant changes in their practices. If such changes are not forthcoming, state or local regulations often soon follow. But the crucial element is a convincing connection between agricultural practices and water quality. In the case of agricultural NPS contamination, such convincing connections are — by definition — hard to establish.

At the extreme, abandoned farm lands may result in reduced loadings of agricultural nonpoint source pollutants to our nation’s waters. Horton (Horton & Eichbaum) points out that their likely replacements — housing developments, shopping malls, roads and parking lots — may not enhance environmental quality; and they do not necessarily reflect an improved quality of life for those who are “paying the bill”. The costs of gains in environmental quality must be realistically measured in human and social costs, as well as financial ones.

There is a good deal of discussion about “pollution prevention,” and we all agree that it should be prevented. There are two difficulties associated with prevention: one is that we have no definite end points against which to gauge progress; the other is that it is impossible to prove that one prevented that which never happened. The latter is especially critical in times of tight budgets.

The setting of environmental priorities, in some holistic framework, is too important to be left solely to selfinterested bureaucrats, whether agricultural or environmen-
tal. The challenge to all of us (setting aside immediate self-interest) is to become part of such a holistic assessment, and to assist in setting realistic goals and priorities for water quality.

It is our collective responsibility, as citizens, scientists, academics, and bureaucrats to assist ourselves ("...a government of the people," etc.) in setting realistic expectations for environmental programs. We must remember that there are no "no-cost solutions"; that the nation's financial resources are limited; that someone must always pay the bill; that NPS pollution is diffuse and hard to identify as to source; and that site-specific solutions cannot be applied to generic problems.

Summary

♦ We have made tremendous progress in enhancing our water quality.

♦ The USDA continues to conduct programs to reduce agricultural NPS pollution.

♦ There is no doubt that more can and should be done.

♦ We are now on the relatively flat part of the "unit pollutant reduction curve;" additional increments of water quality will be increasingly difficult and expensive to attain.

♦ There are serious questions about the water quality data base, especially as the basis for federal legislation and regulations.

♦ Documentation of the effects of agricultural NPS control programs cannot be better than the documentation of the cause-and-effect relationships.

♦ Preventive programs are difficult to establish, maintain, and justify - the public conceptually supports more preventive maintenance than it is willing to financially support.

♦ Legislation or regulations to address allegations, inaccurate perceptions, or non-documented problems are likely to be expensive and ineffective.

♦ The challenge, for all of us, is to develop reasonable goals, priorities and strategies to achieve realistic levels of water quality.

References


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