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# Agriculture and Water Quality Conflicts

Steve Crutchfield  
(202) 219-0444

**W**ater quality problems, thought to be caused in part by cropland runoff or nonpoint source pollution, affect drinking water and the Nation's lakes, streams, and estuaries. Actions taken by public officials to protect our water resources may change the diversity, quality, and quantity of farm products, production systems, and ultimately the prices consumers pay.

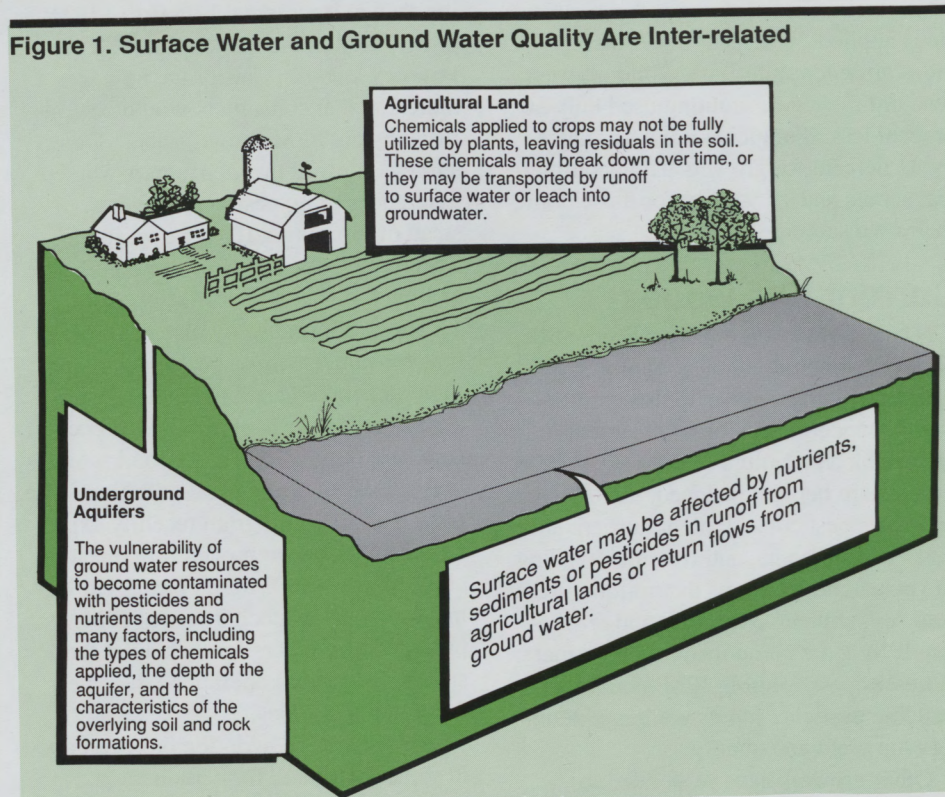
Losses from impaired water quality can cost billions of dollars, not just to agriculture but also to recreation, commercial fishing, municipal water treatment, and river navigation. Estimated annual costs to nonagricultural water uses when quality is impaired range from \$4 to \$12 billion. One-time testing of all private drinking wells vulnerable to nitrates or pesticides could cost up to \$2.2 billion.

Ground water resources are vulnerable to contamination from many directions (figure 1). When animal wastes, fertilizers, herbicides, insecticides, and fungicides are applied to cropland, some residues remain in the soil after plant uptake and may leach into subsurface waters, or the residues may move to surface water by dissolving in runoff or adsorbing to sediment. Spray drifts during application may carry pesticides to surface waters also.

Chemical or physical processes transform residues into products that may also contaminate water. For example, nitrogen fertilizer or nitrogen from animal waste may be transformed first into ammonium and then into nitrates. Nitrates can turn into nitrites and both are detrimental to human health.

Nutrients, particularly nitrogen and phosphorus from fertilizers, promote

Figure 1. Surface Water and Ground Water Quality Are Inter-related



algae growth and premature aging of lakes, streams, and estuaries (a process called eutrophication). Suspended sediment impairs aquatic life by reducing sunlight, damaging spawning grounds, and may be toxic to aquatic organisms. Pesticide residues that reach surface water systems may also affect the health and vigor of freshwater and marine organisms.

## Water Quality Concerns

Humans drinking water from contaminated wells are exposed to pesticide and fertilizer residues. A well-documented human health risk from nitrate contamination is infant methemoglobinemia, a condition where nitrates are converted into nitrites in the digestive system, im-

pairing the ability of infants' blood to carry oxygen. Nitrites are also considered carcinogenic (tumor causing) by some analysts.

Concentration of nitrates or pesticides in drinking water may be below levels at which acute health effects have been observed. However, continued exposure may result in chronic effects (i.e., reproductive impairments, cancer, etc.) to humans or other organisms. The degree of health risk associated with drinking water containing traces of pesticides or nitrates at, or below, levels where human health could be endangered is poorly understood.

Some pesticides are considered carcinogenic in large doses, and as a result, the U.S. Environmental Protection

The author is an agricultural economist and section leader in the Water Branch, Resources and Technology Division.

Agency (EPA) has issued health standards defining maximum allowable contamination levels for 26 pesticides.

Contaminated groundwater that resurfaces also affects nontargeted plants, birds, or aquatic organisms (some of which are endangered) in the environment.

The share of pollution from point sources, such as discharges from sewage treatment plants or industrial sources, appears to be diminishing following several years of control efforts. But nonpoint source pollution resulting from agricultural tillage, pesticide application, and urban development sites is the chief cause of surface water degradation today, according to the EPA.

Agricultural runoff is the single most extensive source of surface water pollution, accounting for 55 percent of impaired river miles and 58 percent of impaired lake acres assessed by the States in 1986 and 1987.

In a recent study by USDA's Economic Research Service (ERS), the degree to which agricultural runoff contributed to delivery of nutrients and sediments to lakes and streams was calculated. Of 99 watersheds examined, 48 had excessive levels of nutrients or sediment. The study found agriculture to be a "significant source" (defined as contributing more than 50 percent of pollutant discharge) of nitrogen in nine watersheds. Agricultural sources of sediment were significant in 34 watersheds. Thirty-one watersheds had significant agricultural discharge of phosphorus.

Another recent ERS study identified the scope and significance of agricultural contributions to coastal water pollution. For the 78 estuarine systems considered, agricultural runoff supplied an average of 24 percent of total nutrients and 40 percent of total sediment. Agriculture contributed more than 25 percent of total nutrients in 22 of the 78 estuaries. High rates of pesticide losses to surface waters were found in 21 systems. Fifteen estuarine systems showed both significant agricultural nutrients and high pesticide losses.

The extent to which the Nation's groundwater resources are affected by agricultural chemicals is less well known. Discoveries of chemical residuals in groundwater during the late 1970's and

early 1980's dispelled the commonly held view that groundwater was protected from agricultural chemicals by impervious layers of rock, soil, and clay.

Groundwater may also be contaminated by other sources, including nonagricultural use of pesticides and fertilizers, and leaking underground storage tanks. In addition, the extent to which detected pesticide residues are due to normal field applications or to improper storage, mixing, loading, or disposal near wellheads is unclear.

The EPA recently completed a survey of agricultural chemicals in drinking water wells. Conducted over a 5-year period, this survey evaluated the presence of pesticides and nitrates in both community and private drinking water wells in the United States.

The survey showed that while at least half of the Nation's drinking water wells contained detectable amounts of nitrate, only about 1.2 percent of community water systems and 2.4 percent of rural private domestic wells contained nitrates at levels higher than the EPA's recommended levels. About 10 percent of community wells and 4 percent of domestic wells surveyed contained detectable levels of one or more pesticides, but the EPA estimates that less than 1 percent of the surveyed wells contained pesticides at concentrations higher than those considered to pose an immediate risk to human health.

## **Costs of Impaired Water Quality**

The economic losses from impaired water quality can take a number of forms, including the costs of alternative sources of drinking water, increased treatment at public and private water systems, lost boating and swimming opportunities, and damages to valuable recreational and commercial fishery resources.

ERS economists have analyzed some of the costs incurred by consumers to avoid drinking water which may contain agricultural chemicals. One-time testing of all private drinking wells in areas thought to be vulnerable to nitrates or pesticides could cost between \$890 million and \$2.2 billion. Testing public wells could cost an additional \$14 million.

Estimated costs of damages caused by agricultural nonpoint source pollution of surface water range from \$4 to \$12 billion per year, with a "best guess" estimate of \$7 billion annually. These annual costs consist primarily of damages to freshwater fishing, boating, and recreation, \$1.9 billion; water storage facilities, \$1.1 billion; navigable waterways, \$680 million; commercial fishing, \$400 million; and municipal treatment plants, \$350 million.

## **Efforts To Minimize Water Quality Impairments**

In response to growing concern about agriculture's impact on water quality, several initiatives have been developed at both Federal and State levels to help farmers use chemicals wisely and to minimize any adverse environmental impact. Even though water quality problems from agricultural production have been recognized for some time, developing programs to control these types of pollution is a difficult task. Unlike water pollution from point sources (such as industrial plant discharges), it is very difficult to establish a cause-and-effect relationship between agricultural production, agricultural chemical use, and the eventual impact on water quality when the sources of pollutants are widespread and diffuse. Moreover, when water quality is affected by many different sources of pollution, it can be difficult to assess the degree to which controlling one pollutant source (such as cropland runoff) can contribute to the overall quality of a given water resource.

The President's Water Quality Initiative is a multi-agency program to assess water quality problems and to develop means to prevent or reduce the contamination of the Nation's surface and groundwater resources. The USDA and other Federal agencies will provide farmers, ranchers, and foresters with additional knowledge and technical means to respond independently and voluntarily in addressing on-farm environmental concerns and related State water quality requirements.

A principal emphasis of the Initiative is groundwater protection, particularly protection from agricultural chemicals.

Since water quality problems related to the use of agricultural chemicals tend to be localized, policies and programs stress the importance of joint, cooperative efforts across Federal, State, and local governments. There is Federal funding for several departments, including USDA, to support these efforts.

Principal activities under the Initiative include: 1) research on the impact of agricultural chemicals on water quality, and development of new farming techniques to reduce these adverse impacts; 2) education, technical assistance, and cost-sharing to promote the voluntary adoption by farmers of production systems that protect water quality; and 3) data collection efforts to improve information on agricultural chemical use.

The recently passed 1990 Farm Act also contains a number of provisions pertaining to water quality. The Conservation Title of the Act broadens the existing Conservation Reserve Program (CRP) to include cropland that adversely affects water quality. An Agricultural Water Quality Protection Program authorizes payments of up to \$3,500 per person per year and cost-share assistance of up to \$1,500 to farmers who enroll land near wellheads, or where agricultural production poses a threat to ground water or surface water supplies. An Integrated Farm Management Program will permit farmers planting conserving crops to maintain farm program payments and crop base.

The EPA continues to take a major role in the research, data collection, and development of plans to control nonpoint sources of water pollution. EPA-administered programs are currently underway to address water quality problems related to agriculture, both at a national level and from a regional approach. These activities are mandated or authorized under several Federal statutes, including the Clean Water Act of 1987, the Federal Insecticide, Fungicide, and Rodenticide Act, and the Safe Drinking Water Act.

Most States have laws and regulations regarding agricultural chemical use, but only about one-third have developed preventive or remedial programs for ground water quality. The EPA has given the States primary responsibility for ground-water protection and requires the development of State ground water strategies.



Federal, State, and local officials are working on ways to protect the Nation's water resources.

Some examples of State water quality programs include Iowa's Groundwater Protection Fund and Groundwater Protection Strategy (supported in part by a tax on nitrogen fertilizer), Massachusetts' wellhead protection program that established land use controls and restricted pesticide use in critical recharge areas around wells, Wisconsin's Risk Assessment Program (based on numerical groundwater standards), and Minnesota's agricultural chemicals fee system that creates a fund for monitoring research into the effects of chemicals on ground water.

States have also become more active in regulating agricultural chemical use. California's Proposition 65 imposes penalties for discharging carcinogenic chemicals or reproductive toxins into water supplies. Iowa recently restricted the use of atrazine. Permitted application rates were reduced from 4 pounds per acre to 3 pounds per acre in normal use, and to 1.5 pounds per acre where atrazine has been detected in groundwater. No use is permitted within 50 feet of a sinkhole, well, lake, or other water surfaces.

## Costs of Protecting Water Quality

Public policies to protect water quality have economic effects on agriculture. To comply with various State, Federal, and local laws, farmers may be faced with restrictions and possibly higher production costs. They may be required to implement management practices to reduce soil erosion and nutrient runoff, restrict or limit the use of leachable pesticides, or pay higher taxes on certain fertilizers and pesticides.

Any of these actions could affect farm

operations. Fertilizer and chemical use may be reduced as farmers modify cropping practices and substitute less polluting inputs. Structures may be built to reduce runoff and prevent pollutants from entering surface or ground water. Tillage practices may change as more farmers adopt reduced or no-till methods. Crop rotations may also change as farmers are encouraged to include meadow or pasture, or less erosive crops in their rotations.

These responses by farmers to water quality programs could affect the economic performance of the farm sector. Yields in major crops could decrease if fertilizer use is reduced or widely used pesticides are banned without an equally effective substitute. Weed control may be achieved by additional cultivation but only at the expense of higher labor, machinery, and fuel costs. Increased farm costs may, in turn, be passed on to distributors, processors, and consumers as higher food prices.

The degree to which water quality programs will affect total farm sector income will depend on several factors. If steps taken to protect water quality are only in environmentally sensitive watersheds, and if the crops affected are already in surplus, the decreased income would be confined to those local areas directly affected by efforts to protect water quality.

On the other hand, if environmental policy is nationwide, such as a total ban on a widely used pesticide, the effect on the farm sector will be more widespread. (For some cost estimates of eliminating selected pesticides see "Pesticides: How Safe and How Much?" elsewhere in this issue.) ■