Ground Water Supply and Contamination Causing Concern and New Studies

Great quantities of water flow in rivers and lakes across the North American continent. But beneath the surface lies another vast store of water, saturating the ground and filling the spaces in the rock beneath.

Along with precipitation and surface water, ground water serves as a source for wells and springs, providing farmers in many parts of the nation with the moisture they need to grow crops.

"Ground water supplies about 58 percent of U.S. irrigated acreage, and also serves as the main water source for rural domestic and livestock supplies nationwide," explain economists Noel Gollehon and Marcel Aillery of USDA's Economic Research Service. The economists point out that although the amount of ground water used for irrigation is greater in the West, ground water supplies a larger percentage of irrigation water use in the East.

In 1988, about 44 percent of the West's irrigated cropland was served exclusively by well water, about 36 percent exclusively by surface water, and about 20 percent by well surface water combined.

Ground water is usually drawn from deep aquifers that cannot be exhausted by several dry years. Nevertheless, extended periods of low precipitation or soil moisture can increase the need to pump ground water for irrigation and other purposes, raising production costs and further depleting aquifers.

According to U.S. Department of Commerce estimates, the Southern Pacific region — California — used the most ground water for irrigation in 1988, about 10 million acre-feet. (An acre-foot is about 326,000 gallons, enough to cover a l-acre field with water 1 foot deep.) The Northern Plains, Southern Mountain and Delta States pumped about 9.0, 5.2 and 4.9 million acre-feet, respectively.

In the arid West, ground water as a precentage of total irrigation water use was greatest in the Northern Plains (85 percent), followed by the Southern Plains (69 percent) and Southern Pacific (43 percent).

Of the roughly 346,000 active irrigation wells in the United States in 1988, about 263,000 — 76 percent — are located in the West. Depth to water in pumped wells averaged 84 feet in the 17 Western states, compared with an average of 42 feet in the East. However, depth to water figures vary considerably, from very shallow alluvial aquifers to deep aquifers in excess of 600 feet.

"Depth to water has a big impact on the cost of pumping water out," the economists note. "In general, the greater the depth to water, the higher the cost to pump it, and the more sensitive that cost is to fluctuating energy prices."

Power sources for pumping ground water include electricity, natural gas, liquefied petroleum gas, and other petroleum-based fuels. In the Western states, nearly 70 percent of irrigation pumps are driven by electricity, and 18 percent by natural gas. In the East, on the other hand, 46 percent of the pumps are petroleum powered, and 43 percent are electrically driven.

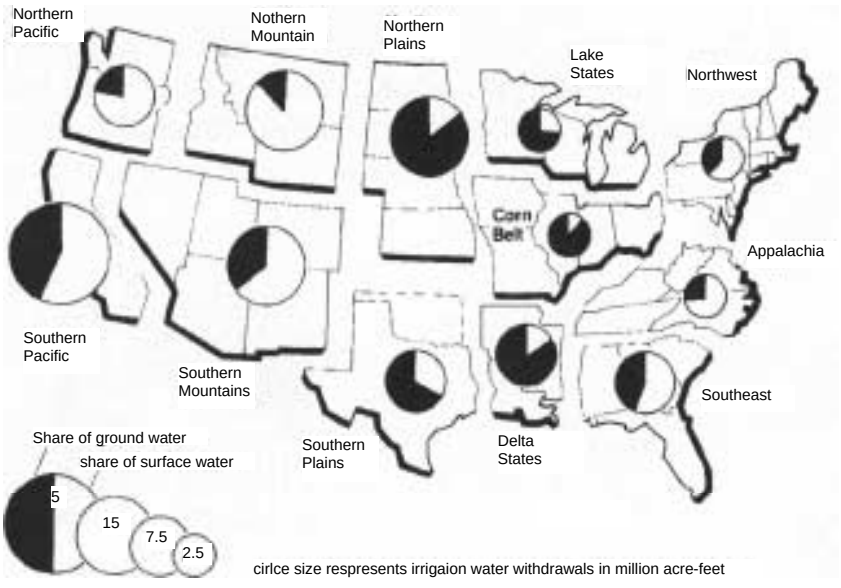
"These figures indicate that Eastern irrigators are more vulnerable to fluctuations in water costs caused by changes in the price of petroleum than their Western counterparts," Aillery and Gollehon explain. "Western irrigators, because of their reliance on electricity derived from low-cost hydroelectric and coal-fired power supplied under long-term contracts, experience less volatility in annual energy costs."

Long-run Quantity Concerns

Ground water overdraft occurs where withdrawals for irrigation and other uses exceed the rate at which the aquifer is replenished, causing a decline in the water table.

"Declining water tables translate into higher pumping costs, which are borne by farmers and other users," the economists explain. In addition, lower well yields can

The Amount of Ground Water Used for Irrigation Is Greater in the West, Although It Supplies a Bigger Share fn the East



lengthen the time needed to draw out a given quantity of water, and consequently raise labor and equipment costs.

Other potential effects of overdraft include land subsidence, saltwater intrusion, lower surface water flows in interconnected ground and surface water systems, and early exhaustion of common-property ground water reserves that can be tapped economically. (Common-property reserves are those that are not owned by anyone but may be used by everyone.)

"Overdraft generally occurs where a large area of irrigated acreage depends heavily on ground water, as in the Southern Plains, Mountain and Southern Pacific regions," Aillery and Gollehon observe. Ground water use is regulated by state laws and local district provisions, although the degree of effective control varies considerably across states.

They point out that many states have instituted ground water management programs to curb declines through technical assistance for improved water management, incentives to adopt water conserving technologies and, in some cases, limits on the spacing of wells and water withdrawals,

While the federal government exercises considerable influence on surface water management in the West, it has a relatively limited role in ground water supply management.

More Competition, Management

Although droughts have only limited effects on most Western ground water reserves, Gollehon and Aillery say, extended drought conditions do contribute to accelerated rates of overdraft.

"Low precipitation can reduce the rate of natural recharge in relatively shallow, unconfined aquifers," they explain. "At the same time, pumping rates are often increased to meet greater water demands and to compensate for reduced surface water supplies." It is estimated that overdraft in the San Joaquin Valley basins reached 11 million acre-feet.

This growing competition — combined with limited opportunities for future construction of large dams and reservoirs to collect and store surface water — is putting further pressure on Western water supplies. Consequently, satisfying the region's rising water demands will depend on the continued use of ground water as well as reallocation of existing surface water supplies.

"Farmers do not necessarily retain rights to water savings," the economists say, "so there has been little financial incentive to conserve water for other purposes, such as maintaining aquifers for future use."

Iowa Case Study:

Farm Profits Need Not Suffer to Improve Water Quality

An 18-month joint project between researchers at the University of Iowa and Iowa State University has examined the effects on farm profitability of various policy options designed to improve water quality. The study concludes the state has policy options that could increase farm profitability while improving the quality of Iowa's ground and surface water.

"Over the years, there have been several policies and programs implemented by the state in response to water quality concerns," says Cheryl Contant, associate professor in the University of Iowa's graduate program in urban and regional planning, and one of the study's authors. "Many of these programs will be phased out or downsized in June. We wanted to examine which direction the state should go with new programs because we are faced with a vast array of competing options."

"Controlling agricultural nonpoint sources of pollution requires poticies that manage the use of the land," the report notes. "Such policies attempt to control agricultural sources of water pollution by encouraging or enforcing the adoption of environmentally-centered farming practices."

Iowas State University economist Michael Duffy, another of the reports authors, said the research revealed some "win-win" outcomes.

"It seems that many times, when you consider an environmental question as it relates to agricultural practices it is immediatety cast in terms of conflicting objectives or tradeoffs. Our research indicates it doesn't have to be that way. You can have cleaner water and higher farm profits."

In the study, the researchers considered four types of policies that might be implemented to control ground and surface water contamination. regulation by mandated nutrient and pesticide management plans, taxation of farm chemicals, a combination of intensive technical assistance and cost-sharing called integrated crop management, and research and education.

Each of the four options was modeled to determine its impact on the quality of ground and surface water resources, its impact on the profitability of the farms, and an estimate of the costs of implementation.

Among the conclusions regarding the four options studied.

A policy of research and education seems to produce the best results, offering consistently better water quality and higher profits with a relatively low cost of implementation. The marginal drawback of this option is that it might contribute to somewhat higher soil erosion because of its reliance on cultivation rather than chemicals.

The taxation policy would produce the greatest water quality improvements, but at the highest cost to farm profitability. The high level of the tax would make it very likely to face stiff opposition from farmers, agricultural business interests and farm organizations. It was assumed the tax would be collected by those who sell the chemicals, therefore, the cost of implementation to Iowa taxpayers would be quite tow.

The regulation policy would produce overall improvements in water quality and would result in slightly higher farm profits, One drawback of this option is that some tradeoffs would have to be made between cleaner surface water and cleaner ground water, because of the nature of the pesticides currently available. Some pesticides are highly soluble and can leach into ground water, while others are less soluble and are carried away during runoff into surface water.

In addition, the costs of implementing this policy statewide would likely be prohibitively high. A slightly modified version of this option might make sense in some areas of the state.

The integrated crop management policy would produce positive results but would not be as high as for other options. Such a policy would have positive effects, particularly on water quality and the profitability of mixed cash grain with livestock operations. The study suggests that integrated crop management might be used to supplement other policies in those parts of the state with these types of operations.

Finally, the study urges continued research into the relationship between improving water quality and farm profits in the state. Included in this research should be an attempt to determine if there are any prudent combinations of policies that might provide better outcomes in a particular area than a single statewide policy. Such combinations of policies might be tailored to specific geographical areas of the state and the types of agricultural practices used in those areas.

Editor's note: *Reprinted from USDA Farmline magazine.*