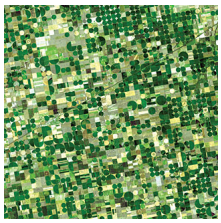
The Ogallala Aquifer: Saving a Vital U.S. Water Source

The massive underground water source feeds the middle third of the country but is disappearing fast. Can it be conserved?

By Jane Braxton Little

On America's high plains, crops in early summer stretch to the horizon: field after verdant field of corn, sorghum, soybeans, wheat and cotton. Framed by immense skies now blue, now scarlet-streaked, this 800-mile expanse of agriculture looks like it could go on forever.

It can't.



The Ogallala Aquifer, the vast underground reservoir that gives life to these fields, is disappearing. In some places, the groundwater is already gone. This is the breadbasket of America—the region that supplies at least one fifth of the total annual U.S. agricultural harvest. If the aquifer goes dry, more than $20 billion worth of food and fiber will vanish from the world's markets. And scientists say it will take natural processes 6,000 years to refill the reservoir.

The challenge of the Ogallala is how to manage human demands on the layer of water that sprawls underneath parts of eight states from South Dakota to Texas. As landowners strive to conserve what's left, they face a tug-of-war between economic growth and declining natural resources. What is happening here—the problems and solutions—is a bellwether for the rest of the planet.

High Plains farmers were blissfully unaware a generation ago that a dilemma was already unfolding. In the early 1950s, when Rodger Funk started farming near Garden City, Kan., everyone believed the water was inexhaustible. "People were drilling wells," he says. "You could pump all the water you wanted to pump."

And they did. What changed everything for Funk, now age 81, was a public meeting in the late 1960s at Garden City Community College. State and federal geologists, who had been studying where all that water was coming from, announced grim findings. “They said it’s geologic water. When it’s gone, it’s gone,” Funk says. “I remember coming home and feeling so depressed.”

Today his community in southern Kansas, 180 miles west of Wichita, is one of the High Plains areas hardest hit by the aquifer’s decline. Groundwater level has dropped 150 feet or more, forcing many farmers to abandon their wells. The cause is obvious, says Mark Rude, executive director of the Southwest Kansas Groundwater Management District: overuse.

With a liquid treasure below their feet and a global market eager for their products, farmers here and across the region have made a Faustian bargain—giving up long-term conservation for short-term gain. To capitalize on economic opportunities, landowners are knowingly “mining” a finite resource.

Choosing to use water from one of the world’s largest aquifers rather than leaving it in the ground is not irrespon-sible, says Andrew Stone, executive di-rector of the American Groundwater Trust in Concord, N.H. Like coal or natural gas, groundwater is a valuable resource. “There is no benefit to mankind to keeping it unused in cold storage,” Stone says. The challenge is to stretch the life of the aquifer to benefit future generations of farmers and those who depend on their products.

In Garden City, however, the severity of their circumstances is already forcing farmers to take action. They are grappling with how to maintain successful agricultural operations while relying on less and less water, an issue that water users throughout the region, and the world, must eventually face, Rude says. “The community of water users needs to figure this out,” he adds. “We’ll get to sustainability one way or another, but it may be sustaining an economy without the Ogallala Aquifer.”

Tapping the Aquifer

On a hydrographic map, the Ogallala is a Rorschach inkblot that some describe as the shape of a mushroom, others the South American continent. Millions of years ago, when the southern Rocky Mountains were still spewing lava, rivers and streams cut channels that carried stony pieces of the mountains eastward. Sediment eventually covered the area and filled in the

ancient channels, creating vast plains. The water that permeates the buried gravel is mostly from the vanished rivers. It has been down there for at least three million years, percolating slowly in a saturated gravel bed that varies from more than 1,000 feet thick in the North to a few feet in the Southwest.

Until recently, most of the region had no permanent settlements. Native American tribes who used the open plains for seasonal hunting retreated to river valleys to pitch their tents. When Spanish conquistador Francisco Vazquez de Coronado came through in 1541 looking for the gold cities of Cibola, he marched his iron-clad men to the brink of exhaustion, never knowing that water to quench their near-maddening thirst lay mere yards beneath their boots. Similarly, cattle drives in the 1860s and 1870s collapsed in a perfect storm of drought, overgrazing and falling meat prices. And early attempts at farming were plagued by soil erosion and cycles of drought that culminated in the 1930s Dust Bowl.

Industrial-scale extraction of the aquifer did not begin until after World War II. Diesel-powered pumps replaced windmills, increasing output from a few gallons a minute to hundreds. Over the next 20 years the High Plains turned from brown to green. The number of irrigation wells in West Texas alone exploded from 1,166 in 1937 to more than 66,000 in 1971. By 1977 one of the poorest farming regions in the country had been transformed into one of the wealthiest, raising much of the nation’s agricultural exports and fattening 40 percent of its grain-fed beef.

But the miracle of new pumping technology was taking its toll below the prairie. By 1980 water levels had dropped by an average of nearly 10 feet throughout the region. In the central and southern parts of the High Plains some declines exceeded 100 feet. Concerned public officials turned to the U.S. Geological Survey, which has studied the aquifer since the early 1900s. With their state and local counterparts, USGS officials began monitoring more than 7,000 wells to assess the annual water--level changes.

What they found was alarming: yearly groundwater withdrawals quintupled between 1949 and 1974. In some places farmers were withdrawing four to six feet a year, while nature was putting back half an inch. In 1975 the overdraft equaled the flow of the Colorado River. Today the Ogallala Aquifer is being depleted at an annual volume equivalent to 18 Colorado Rivers. Although precipitation and river systems are recharging a few parts of the northern aquifer, in most places nature cannot keep up with human demands. “We have optimistic locations. Other places we can see the end,” says David Pope, who administered groundwater regulations in Kansas from 1983 to 2007 as the state’s chief engineer.

Sustainable Solutions

For Funk, the depressing data he took home from that Garden City meeting was transforming. Whereas other farmers responded to declining water levels by adding wells, Funk eliminated them: “We decided to go dryland.” Today he pumps almost no water on his 6,000 acres, which are planted largely in wheat and grain sorghum. These crops are typically not as lucrative as corn, but they are sustaining Funk’s family. To farm without groundwater, Funk has changed some of his methods. Instead of plowing his fields after harvest, he leaves the stubble in the ground and plants a new crop in the residue. This technique not only reduces soil erosion but also decreases evaporation and catches more blowing snow than bare ground. Leaving crop residue in the field can reduce moisture loss by the equivalent of an inch or more of rainfall annually, scientists say. Funk aims to capture every bit of the 18 inches of precipitation that fall on southwestern Kansas. “Got to,” he says. “It’s all we’ve got around here.”

Funk is part of a small but steady movement away from groundwater dependence. The scientific certainty of Ogallala’s decline has spurred an interest in conservation throughout the region. Researchers are developing less thirsty crops, including drought-tolerant corn. Their goal is to reduce the amount of water corn crops require by at least 10 percent, says Wenwei Xu, a research scientist at Texas A&M. The Ogallala Initiative, a U.S. Department of Agriculture project, funds studies designed to make the agricultural industry—and the rural communities that depend on it—more sustainable. An annual $3.6-million congressional appropriation supports the research, ranging from irrigation techniques and precipitation management to animal feedlot operations.

At a USDA research station near Amarillo, Tex., scientists are compiling data that encourage Funk and other farmers to use low- or no-till techniques (such as leaving crop residue to decompose), says Nolan Clark, station director and an agricultural engineer. Other projects aim to bring high tech down home. Engineers have installed 16 wireless infrared sensors on the arm of a center-pivot system used to irrigate cotton in a research plot. The sensors are calibrated to measure leaf temperatures, allowing the plants themselves to tell computer-controlled irrigation equipment when they are thirsty. At a scientifically determined threshold, the sprinklers turn on automatically. Because these robotic irrigation systems apply water only when it is needed, in test fields they are saving two inches per crop per season, Clark says.

Evapotranspiration is another way plants can communicate with high-tech irrigation systems. Researchers are designing equipment that uses lasers to measure the turbulence caused by heat waves above crops. The greater the turbulence, the more water plants need. The laser equipment will eventually estimate daily evapotranspiration rates on a regional scale. These will be posted on the Internet, giving farmers information they can use to adjust their irrigation to the needs of their crops.

Such devices may not save dramatic amounts of water, but in West Texas, where the Ogallala is in rapid decline, they are critical. A savings of 10 to 15 percent per crop per season spread over millions of acres—"that's a significant amount of water," Clark says. "We may not make the aquifer sustainable, but we may give it another 100 years."

New Demands

Yet even as these innovations move from experimental plots to production fields, improvements in efficiency may be offset by new demands on groundwater. Bio-fuels are the latest enticement to grow corn, which garners higher profits but requires more water than most other crops. Plans to double the number of ethanol production facilities in the High Plains region are driving farmers to increase corn production despite already scarce groundwater. That could require up to 120 billion additional gallons of Ogallala water annually, according to a report by the Environmental Defense Fund (EDF).

Growing populations throughout the Great Plains region are also demanding more municipal water from the only available source: the aquifer. T. Boone Pickens, the billionaire oilman and recent alternative energy advocate, is among the entrepreneurs who have entered the domestic water market. A Texas law granting landowners unrestricted rights to the water beneath their property makes it possible for Pickens to sell groundwater from his 24,000-acre Mesa Vista Ranch in the Texas panhandle to metropolises as far away as Dallas and El Paso. The 654-mile pipeline he plans to build to El Paso would cost $2.1 billion. But with water sales priced at more than $1,000 an acre-foot, profit is waiting to be had.

Looming over these new demands for the Ogallala's finite water supply is climate change. Although precipitation in Nebraska at the northern end of the aquifer will likely increase, scientists predict the southern parts of the region will get even less than the 16 inches of annual precipitation they now receive.

In the face of these combined demands on the already overtapped aquifer, many High Plains water users are joining Funk in reassessing their futures. No matter how efficiently they use it, they know the groundwater will eventually be gone—leaving them, their communities, and most of the region high and dry. Like Funk, they are starting to make plans for a time when the Ogallala will not meet their economic needs. Some growers are joining Funk in moving to dryland farming—growing wheat and other crops that do not require irrigation. In eastern Colorado, farmers are planting hardy sunflowers, which require 30 percent less water than corn.

Other farmers are turning to native grasslands for economic alternatives. Before European settlers arrived, the billion acres of grasses that blanketed the High Plains were home to pronghorn antelope and swift fox, lesser prairie chickens and burrowing owls as well as buffalo. Blue grama, green needle grass and other drought-resistant plants thrived in the short growing season. More than half these native grasslands have been converted to crops, including nearly 25 million acres since 1982, according to a 2007 General Accounting Office study.

A return to grasslands could be a potential source of income, says Amy Hardberger, an attorney with the EDF in Austin, Tex. In a project she is coordinating, farmers are experimenting with grassland restoration on fields they have been forced to retire because of groundwater depletions. In addition to providing wildlife habitat, grasslands could be grazed by cattle or even buffalo. Hunting, ecotourism and “dude ranches” are other potential sources of income from grasslands. And once a national carbon market is established, farmers could sell credits for storing carbon in grassland soil. “This is a tough group of people,” says Hardberger, whose grandfather raised cotton near Lubbock, Tex. “They don’t want to leave their land—and they shouldn’t have to.”

Several federal government programs provide economic incentives for conservation of existing grasslands—recognizing their role in reducing erosion, sequestering carbon, and providing habitat for the lesser prairie chicken and other endangered species. But these programs often work at cross-purposes with federal price-support incentives to produce corn and other commodities. Subsidies for crops are generally higher than subsidies for grassland conservation, making the choice simple for most growers.

The contradictions in these federal programs reflect America’s ambivalence about the Ogallala Aquifer. Eventually the nation will need a strategy to end its dependence on this finite resource, says Stone, the Groundwater Trust executive. But for now, across much of the High Plains it’s business as usual: drilling and pumping water, irrigating and growing crops as if the Ogallala era will never end.

For Funk in Garden City, it already has. Using technology and foresight, he has transformed his farm into a business he believes can continue into the distant future without draining the Ogallala. “Forever? We hope so,” he says. “That’s been our goal.”

Note: This article was originally printed with the title, "Saving the Ogallala Aquifer".