Water: Will There Be Enough?

By Sandra Postel

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For at least three decades, Americans have had some inkling that we face an uncertain energy future, but we've ignored a much more worrisome crisis—water. Cheap and seemingly abundant, water is so common that it's hard to believe we could ever run out. Ever since the Apollo astronauts photographed Earth from space, we've had the image of our home as a strikingly blue planet, a place of great water wealth. But of all the water on Earth, only about 2.5 percent is freshwater—and two-thirds of that is locked up in glaciers and ice caps. Less than one hundredth of one percent of Earth's water is fresh and renewed each year by the solar-powered hydrologic cycle.

Across the United States and around the world, we're already reaching or overshooting the limits of that cycle. The Colorado and Rio Grande Rivers are now so overtapped that they discharge little or no water to the sea for months at a time. [1] In the West, we're growing food and supplying water to our communities by overpumping groundwater. This creates a bubble in the food economy far more serious than the recent housing, credit, or dot-com bubbles: We are meeting some of today's food needs with tomorrow's water. [2]

The massive Ogallala Aquifer, which spans parts of eight states from southern South Dakota to northwest Texas, and provides 30 percent of the groundwater used for irrigation in the country, is steadily being depleted. [3] As of 2005, a volume equivalent to two-thirds of the water in Lake Erie had been pumped out of this water reserve. Most farmers will stop irrigating when the wells run dry or the water drops so far down that it's too expensive to pump.

At the same time, climate change is rewriting the rules about how much water we'll have available and when. Climate scientists warn of more extreme droughts and floods, and of changing precipitation patterns that will make weather, storms, and natural disasters more severe and less predictable. [4] The historical data and statistical tools used to plan billions of dollars worth of annual global investments in dams, flood control structures, diversion projects, and other big pieces of water infrastructure are no longer reliable. [5]

While farmers in the Midwest were recovering from the spring flood of 2008 (in some areas the second "100-year flood" in 15 years), farmers in California and Texas fallowed cropland and sent cattle prematurely to slaughter to cope with the drought of 2009. In the Southeast, after 20 months of dryness, Georgia Governor Sonny Perdue stood outside the State Capitol in November 2007 and led a prayer for rain, beseeching the heavens to turn a spigot on for his parched state. Two years later, Perdue was pleading instead for federal aid after intense rain storms near Atlanta caused massive flooding that claimed eight lives. [6]

Although none of these disasters can be pinned directly on global warming, they are the kinds of events climate scientists warn will occur more often as the planet heats up. It's through water that we'll feel the strains of climate change—when we can no longer count on familiar patterns of rain, snow, and river flow to irrigate our farms, power our dams, and fill our city reservoirs.

In answer to the climate crisis, the economy will need to move away from fossil fuels toward solar, wind, and other non-carbon energy sources. But there is no transitioning away from water. Water has no substitutes. And unlike oil and coal, water is much more than a commodity: It is the basis of life. A human being can only live for five to seven days without water. Deprive any plant or animal of water, and it dies. Our decisions about water—how to use, allocate, and manage it—are deeply ethical ones; they determine the survival of most of the planet's species, including our own.

Shifting Course

For most of modern history, water management has focused on bringing water under human control and transferring it to expanding cities, industries, and farms. Since 1950, the number of large dams worldwide has climbed from 5,000 to more than 45,000—an average construction rate of two large dams per day for half a century. [7] Globally, 364 large water-transfer projects move 105 trillion gallons of water annually from one river basin to another—equivalent to transferring the annual flow of 22 Colorado Rivers. Millions of wells punched into the Earth tap underground aquifers, using diesel or electric pumps to lift vast quantities of groundwater to the surface.

Big water schemes have allowed oasis cities like Phoenix and Las Vegas to thrive in the desert, world food production to expand along with population, and living standards for hundreds of millions to rise. But globally they have also worsened social inequities, as poor people are dislocated from their homes to make way for dams and canals, and as downstream communities lose the flows that sustained their livelihoods.

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Such approaches also ignore water's limits and the value of healthy ecosystems. Today, many rivers flow like plumbing works, turned on and off like water from a faucet. Fish,

mussels, river birds, and other aquatic life no longer get the flows and habitats they need to survive: 40 percent of all fish species in North America are at risk of extinction.

As we face the pressures of climate change and growing water demands, many leaders and localities are calling for even bigger versions of the strategies of the past. By some estimates the volume of water moved through river transfer schemes could more than double globally by 2020. But mega-projects are risky in a warming world where rainfall and river flow patterns are changing in uncertain ways.

Such big projects also require giant quantities of increasingly expensive energy. Pumping, moving, treating, and distributing water takes energy at every stage. Transferring Colorado River water into southern California, for example, requires about 1.6 kilowatt-hours (kWh) of electricity per cubic meter (about 264 gallons) of water; the same quantity of water sent hundreds of kilometers from north to south through California's State Water Project takes about 2.4 kWh. As a result, the energy required to provide drinking water to a typical southern California home can rank third behind that required to run the air conditioner and refrigerator. [8]

Planners and policy-makers are eyeing desalination as a silver-bullet solution to water shortages. But they miss—or dismiss—the perverse irony: By burning more fossil fuels and by making local water supplies more and more dependent on increasingly expensive energy, desalination creates more problems than it solves. [9] Producing one cubic meter of drinkable water from salt water requires about 2 kWh of electricity.

Water for People and Nature

As the limitations of big-infrastructure strategies have become more apparent, a vanguard of citizens, communities, farmers, and corporations are thinking about water in a new way. They're asking, what do we really need the water for, and can we meet that need with less? The upshot of this shift in thinking is a new movement in water management that is much more about ideas, ingenuity, and ecological intelligence than it is about big pumps, pipelines, dams, and canals.

These solutions tend to work with nature, rather than against it. In this way, they make effective use of "ecosystem services"—the benefits provided by healthy watersheds and wetlands. And through better technologies and more informed choices, they seek to raise water productivity—to make every drop count.

Communities are finding, for example, that protecting watersheds is the best way to make sure water supplies are clean and reliable. A healthy watershed can do the work of a water treatment plant—filtering out pollutants, and at a lower cost to boot. New York City, for instance, is investing some $1.5 billion to restore and protect the Catskill-Delaware Watershed (which supplies 90 percent of its drinking water) in lieu of constructing a $6 billion filtration plant that would cost an additional $300 million a year to operate. [10] A number of other cities across the United States—from tiny Auburn, Maine, to Seattle—have saved hundreds of millions of dollars in avoided capital and operating costs by opting for watershed protection over filtration plants. [11]

Communities facing increased flood damage are achieving cost-effective flood protection by restoring rivers. After enduring 19 flood episodes between 1961 and 1997, Napa, Calif., opted for this approach over the conventional route of channelizing and building levees. In partnership with the U.S. Army Corps of Engineers, the $366 million project is reconnecting the Napa River with its historic floodplain, moving homes and businesses out of harm's way, revitalizing wetlands and marshlands, and constructing levees and bypass channels in strategic locations. In addition to increased flood protection and reduced flood insurance rates, Napa residents will benefit from parks and trails for recreation, higher tourism revenues, and improved habitat for fish and wildlife. [12]

Similarly, communities facing increased damage from heavy stormwater runoff can turn roofs, streets, and parking lots into water catchments. Portland, Ore., is investing in "green roofs" and "green streets" to prevent sewer overflows into the Willamette River. [13] Chicago now boasts more than 200 green roofs—including atop City Hall—that collectively cover 2.5 million square feet, more than any other U.S. city. The vegetated roofs are providing space for urban gardens and helping to catch stormwater and cool the urban environment. [14]

Many communities are revitalizing their rivers by tearing down dams that are no longer safe or serving a justifiable purpose. Over the last decade more than 500 dams have been removed from U.S. rivers, opening up habitat for fisheries, restoring healthier water flows, improving water quality, and returning aquatic life to rivers. [15] In the 10 years since the Edwards Dam was removed from the Kennebec River near Augusta, Maine, populations of alewives and striped bass have returned in astounding numbers, reviving a recreational fishery that adds $65 million annually to the local economy. [16]

Conservation remains the least expensive and most environmentally sound way of balancing water budgets. Many cities and towns have reduced their water use through relatively simple measures like repairing leaks in distribution systems, retrofitting homes and businesses with water-efficient fixtures and appliances, and promoting more sensible and efficient outdoor water use. Motivated by a cap on groundwater pumping from the Edwards Aquifer in south-central Texas, San Antonio has cut its per capita water use by more than 40 percent, to one of the lowest levels of any Western U.S. city. [17] Even more impressive, a highly successful conservation program started in 1987 in Boston cut total water demand 43 percent by 2009, bringing water use to a 50-year low and eliminating the need for a costly diversion project from the Connecticut River. [18]

But the potential for conservation has barely been tapped. It is especially crucial in agriculture. Irrigation accounts for 70 percent of water use worldwide and even more in the western U.S., so getting more crop per drop is central to meeting future food needs sustainably. In California, more famers are turning to drip irrigation, which delivers water at low volumes directly to the roots of crops. Between 2003 and 2008, California's drip and micro-sprinkler area expanded by 630,000 acres, bringing its total to more than 2.3 million acres—62 percent of the nation's total area under drip irrigation. [19]

As individuals, we'll also need to make more conscious choices about what and how much we consume. Some products and foods—especially meat—have a high water cost. It can take five times more water to supply 10 grams of protein from beef than from rice. So eating less meat can lighten our dietary water footprint (while also improving our health). If all U.S. residents reduced their consumption of animal products by half, the nation's total dietary water requirement in 2025 would drop by 261 billion cubic meters per year, a savings equal to the annual flow of 14 Colorado Rivers. [20]

We'll need to change how we use water in and around our homes and neighborhoods. Turf grass covers some 40.5 million acres in the United States—an area three times larger than any irrigated farm crop in the country. [21] Particularly in the western United States, where outdoor watering typically accounts for 50 percent or more of household water use, converting thirsty green lawns into native drought-tolerant landscaping can save a great deal of water. Las Vegas now pays residents up to $1.50 for each square foot of grass they rip out, which has helped shrink the city's turf area by 125 million square feet and lower its annual water use by 7 billion gallons. [22, 23] Albuquerque, New Mexico, has reduced its total water use by 21 percent since 1995, largely through education and rebates to encourage water-thrifty landscapes. [24]

Energy and water are tightly entwined, and all too often public policies to "solve" one problem simply make the other one worse. For example, the 2007 congressional mandate [25] to produce 15 billion gallons of corn ethanol a year by 2015 would require an estimated 1.6 trillion gallons of additional irrigation water annually (and even more direct rainfall)—a volume exceeding the annual water withdrawals of the entire state of Iowa. [26] Even solar power creates a demand for water, especially some of the big solar-thermal power plants slated for the sunny Southwest. [27]

It's still possible to have a future in which all basic food and water needs are met, healthy ecosystems are sustained, and communities remain secure and resilient, even in the face of climate disruptions. Just as the economic crash is forcing Americans to reassess what they value financially, the water crisis requires us to pay attention to how we value and use water. Across the country, communities will need to learn to take care of the ecosystems that supply and cleanse water, to live within their water means, and to share water equitably.

Sandra Postel adapted this article for Water Solutions, the Summer 2010 issue of YES! Magazine. Sandra is director of the Global Water Policy Project, a fellow of the Post Carbon Institute and the first freshwater fellow of the National Geographic Society. She is the author of numerous books and articles, including the award-winning Last Oasis: Facing Water Scarcity, which became the basis of a PBS documentary.

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