Unmeasured Danger

America's Hidden Groundwater Crisis

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About Food & Water Watch

Food & Water Watch is a nonprofit consumer organization that works to ensure clean water and safe food. We challenge the corporate control and abuse of our food and water resources by empowering people to take action and by transforming the public consciousness about what we eat and drink. Food & Water Watch works with grassroots organizations around the world to create an economically and environmentally viable future. Through research, public and policymaker education, media and lobbying, we advocate policies that guarantee safe, wholesome food produced in a humane and sustainable manner, and public, rather than private, control of water resources including oceans, rivers and groundwater.

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Executive Summary

Farmers in the western United States are drilling ever deeper to water their crops. Mainers are concerned with lowered water levels in their wells when water bottlers come to town. Arizonans see the Santa Cruz River withering away. In communities around the country, these citizens are all seeing the effects of a decline in one of our most crucial but least understood natural resources: groundwater.

The water that settles between rocks and dirt under the earth's surface after it rains accounts for about 40 percent of our drinking and agricultural water supply. Through the watershed, it links to surface waters, which share sources of water from both above and below the ground. When it disappears, pumping through wells becomes harder and more expensive; rivers, lakes, streams and wetlands dry up; and even the land itself can cave in.

Today, our groundwater resources are disappearing in many parts of the country. In some regions, underground water levels are falling because we are pumping water through wells faster than it is naturally replaced by rainfall. This may permanently damage our aquifers' capacity to hold water, and can have broad consequences for our entire freshwater supply.

How much danger are we in? We don't know. According to the United States Geological Survey, no one has ever comprehensively studied groundwater level declines across the country. Many states collect data on a local level, but vary in how much data they collect and the resources they contribute to such projects. Even when states do collect data, local data can only provide limited information about whole aquifers, which often cross state lines.

Without scientific data on groundwater availability, state water managers cannot make sound decisions about water allocation. That is why scientists, government agencies and non-governmental organizations are asking the federal government to collect groundwater quantity and quality data on a national scale.

Because groundwater pools beneath our feet, we do not always register its absence until the effects become drastic. We cannot wait for the visible effects of groundwater depletion to kick in before taking action. The federal government must take action now by supporting nationwide groundwater data collection projects — so that we can accurately evaluate the status of our groundwater and take steps to protect it before it is too late.

Recommendations

Congress must find out what resources our nation's scientists need to comprehensively evaluate our groundwater resources, and then appropriate funds accordingly.

We'll never know the worth of water 'til the well goes dry.

–Scottish proverb

Introduction

You would probably notice if a river running through your neighborhood turned into a mud flat. And you likely wouldn't be alone. Couples strolling along the riverside would go home. Swimmers would pack up their towels. Boaters would pull up their rudders; fishermen would close their tackle boxes. Birds and frogs would migrate to wetter pastures. The fish would go with them, if they weren't already dead.

If the water pooling quietly in cracks beneath your feet withered away, however, you likely wouldn't even think about it. Not until the river ran dry, too. By then, your well would be empty, your backyard might be caving in, and you would be left wondering what had happened and how you could have failed to notice any warning signs. Yet again, you would not find yourself alone. You might, unfortunately, have plenty of company across the United States — a nation only now noticing the crucial role that groundwater plays in our lives and realizing the critical condition of our supplies.

Groundwater: A Crucial Natural Resource

Rivers, streams, lakes, the ocean — all of these bodies bring forth images that most people associate with water: flowing over or pooling on top of the earth's surface. A less obvious — but no less crucial — portion of our nation's water supply lies beneath our feet, where we cannot see it. This groundwater is simply rain or melted snow that trickled between the tiny cracks in the ground and settled between the rocks and dirt under the surface. Where there are large enough spaces between rocks or

dirt in the earth, enough water gathers that a well drilled into the ground will hit usable water. This is the groundwater that citizens and businesses can tap into for drinking, farming and industrial use.

Today, groundwater plays a major role in our daily water supply. We pump about 28 trillion gallons of water from the ground each year[1] for a variety of uses all around the country.

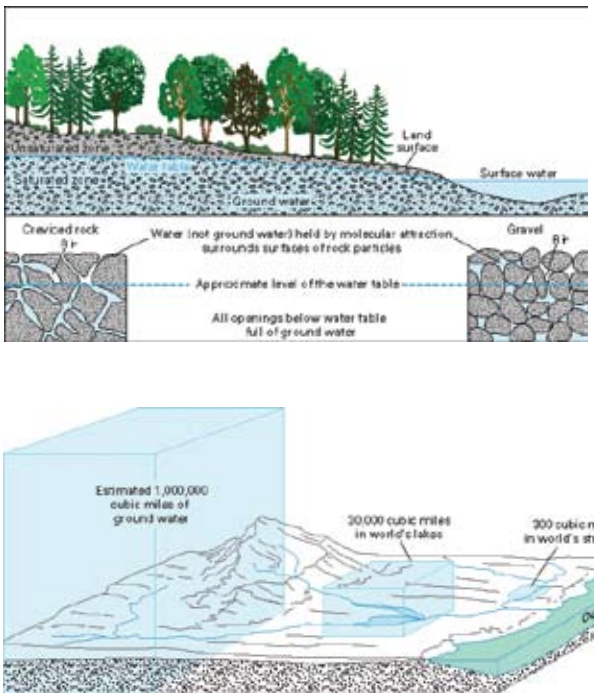
Fifteen percent of U.S. residents get water from their own sources — many of which are household wells that draw it straight from the ground.[2] The entire state of New Hampshire lies over aquifers left over from glaciers, which households can tap into directly.[3] Many public water systems, too, rely on groundwater. In New Mexico, the Albuquerque Bernalillo Water Utility Authority historically depended entirely on water from the Santa Fe Group Aquifer, and only recently began developing surface water sources.[4] Agriculture also draws on the ground, as farmers in Western states, for example, pump from the Ogallala Aquifer to water their crops. Industrial users, too, often drill their own wells for their factories.[5]

Given that groundwater makes up almost 40 percent of our public water supplies nationally, and just a little bit more than 40 percent of the water we use for irrigation,[6] one might think that we would take pains to monitor the health of the resource. In fact, we have very little scientific data on the status of our national groundwater supplies. According to the United States Geological Survey, "the extent of ground-water level declines across the United States has not been monitored or computed on a regular basis."[7]

Our Groundwater Supplies Are in Danger

Although we do not have a national dataset to prove that our groundwater resources are declining, evidence from all around the country shows that in many regions the resource is in trouble. While we cannot see water hidden under layers of soil, we can register its absence.

When groundwater sources first start declining, water levels drop. Whether private well owners, public water systems, farmers or industry, users facing dropping water levels must dig ever deeper to find water — spending more money and using more energy — or else find a new source.



The U.S. Geological Survey provides informational diagrams showing how ground water occurs in rocks (above) and a comparison of the amount of fresh water in storage (below). Source: *Ground Water*, USGS General Interest publication, available at http://pubs.usgs.gov/gip/gw/

Today, nearly every state in the country has seen a drop in groundwater levels, and some regions are worse off than others. Businesses and residents living in arid regions in the West have seen the most significant declines. For example, the High Plains Aquifer, also known as the Ogallala Aquifer, crosses South Dakota, Iowa, Nebraska, Kansas, Colorado, Oklahoma, Texas and New Mexico, and supplies water for much of the farming in the region.[8] In the last 50 years, water levels in the aquifer have dropped significantly, enough to affect the long-term capacity of the system.[9] In fact, in the past half century the aquifer has lost 65 trillion gallons of water in storage[10] — enough to supply all the homes and businesses in Washington D.C. with drinking water for more than 1,000 years.*

Farmers are not the only folks seeing their water levels drop. Mining, too, has brought water tables in Nevada to new lows.[11] Public water systems have also registered declines. The city of Memphis, Tennessee, draws water from the Memphis Aquifer — in which water levels have dropped steadily since 1940.[12] Private well owners, too, have seen declines. In Texas, for example, homeowners noticed their

* Water storage declined 65 trillion gallons. Homes and businesses in D.C. use 135 million gallons of drinking water a day (D.C. Water and Sewer Authority). "2007 Annual Report." 2007 at 3.
65,000,000,000,000/135,000,000 = 481,481 days of water = 1,319 years of water

water levels drop when a water bottling company moved in and began pumping large quantities of water out of the ground.[13] Citizens in Maine and Michigan have also faced concerns that water levels drop when water bottlers come to town.[14]

In some places, falling water levels affect not just the quantity, but also the quality of the available groundwater. If groundwater levels drop below sea level, salt water moves in. This has already happened in Louisiana, where water levels declined so much that saltwater has begun to creep in to the aquifer that feeds Baton Rouge.[15] Residents in coastal New Jersey, too, who have depended upon groundwater since the 1800s, have abandoned entire well fields due to saltwater intrusion.[16]

While water levels in wells drop, so does the water level in surrounding streams, rivers and lakes. Whether water pools in lakes or in aquifers, it is all part of the same system — it flows from rivers into the ground, and seeps through soil back into rivers.[17] So taking too much water from the ground can impact local surface waters as well. In recent years, the Santa Cruz River in Arizona was sucked dry to quench the thirst of citizens in Tucson.[18] The Ipswich River in Massachusetts has dried up under the demands of new suburban developments.[19] Numerous lakes and wetlands in Florida — perhaps the most naturally water-rich state in the country — have dwindled to puddles due to groundwater pumping.[20] For example, a study by the northern Tampa Bay region's water management district in 1996 found that only 10 out of 153 lakes in the northern Tampa Bay region remained healthy, and groundwater pumping explained the low water levels in most of the region's 350 wetlands.[21]

At the most extreme, groundwater pumping can actually cause land to crack, depending on the geology of the region. In fact, the ground itself can cave in without the support of the water underneath.[22] This land subsidence can damage buildings and highways, and make land flood more easily.[23] First seen in Silicon Valley, California, land subsidence has been observed in regions across the West, including in the San Joaquin Valley, Las Vegas Valley and south-central Arizona.[24] Sometimes land subsidence is a gradual sinking, as in the land around Houston, Texas, which has fallen 10 feet over time.[25] Sometimes, it can appear more drastically. In Retsof, New York, and west-central Florida, for example, subsidence caused sudden sinkholes to appear in the ground.[26]

Where Did All the Water Go?

These plummeting water levels, salty freshwater wells and crashing sinkholes are not natural events. In a healthy water system, groundwater levels refill naturally when rain and snow trickle through the ground. As long as more water enters the system than leaves it, groundwater remains a sustainable source of water.

It was not until relatively recently that we developed the technology to pump water out of the ground faster than natural sources could usher it in. When we first started tapping into groundwater resources, we used windmills and other pumps that could only withdraw so much water at a time. In the 1930s, for example, drilling wells could reach 70 to 80 feet below the ground. However, in the 1940s and 1950s, high-lift turbine pumps, industrial engines, irrigation systems and cheaper electricity brought about wells that could reach 3,000 feet under the ground and pump 1,200 to 1,300 gallons per minute. In the Ogallala Aquifer, for one, water withdrawals jumped from 651 billion to 7.5 trillion gallons per year, more than 1,000 percent.[27] In some areas of the aquifer, farmers pulled out four to six feet of water a year, while only half an inch was replaced.[28] This means that in some regions the aquifer lost water nearly 100 times faster than rainfall could naturally replace it.

And overpumping is not the only modern change that has impacted the health of our groundwater system. As we have built up urban and suburban areas, we have paved over lands with strip malls and parking lots — surfaces that prevent water from naturally filtering through the soil. So, not only are we taking water out faster than it would naturally come in, we are slowing the natural recharge process.

Changes in human interaction with nature have impacted not just the quantity available, but also the quality of groundwater in many states. Groundwater can be a very clean, safe source of water. Water filters through dirt and

rocks before settling in aquifers, which means that many solids in the water get filtered out naturally. Yet today, groundwater is not only threatened by overpumping and depletion, but also by contamination with toxic chemicals. Septic systems and sewer lines can leak viral and bacterial pathogens into groundwater.[29] Pesticides from farms, lawns, gardens and golf courses can seep into the ground.[30] Industrial chemicals from construction and mining can also make their way into wells.[31] In fact, since all water is connected in the watershed, keeping water safe from pollution means protecting both surface and groundwater.[32]

The changes in technology and terrain that have overdrawn and polluted our groundwater have outpaced changes in our regulatory systems that are needed to protect the resource. Today we understand that in order to ensure groundwater sustainability, laws would need to make sure that water recharge and withdrawal was equal. Yet when we first began to develop regulations for groundwater use, we were not so educated.

Like most of the nation, the officials who ruled groundwater historically had little understanding of the natural resource. It was not something they could see, much less understand. As a prime example, the Supreme Court of Connecticut in 1850 declared that water, "whether moving or motionless in the earth, is not, in the eye of the law, distinct from the earth. The laws of its existence and progress, although there, are not uniform, and cannot be known or regulated. It rises to great heights and moves collaterally, by influences beyond our apprehension. These influences are so secret, changeable and uncontrollable, we cannot subject them to the regulations of law, nor build upon them a system of rules, as has been done with streams upon the surface."[33]

Due to such misunderstandings, groundwater and surface water laws developed separately in many states, without regard to how the sources are connected.[34] States even made legal distinctions between different types of water which were not based in any hydrologic principles, making different decisions depending on whether the water was rain, surface water in streams and lakes, groundwater in underground streams or still groundwater.[35]

Over the years, different state courts developed different rules for making decisions, some of which provide more protection than others. Maine and Texas still follow the English rule of capture, which states that whoever owns the land also owns the water under it. A landowner can pump as much as they can pump, without regard to how it might affect surrounding users. The Texas Supreme Court upheld this as recently as 1999. Most courts follow legal doctrines that are not quite so lax, although all leave much room for interpretation.

Today, each state's legal system is also accompanied by a set of regulations, usually enforced through the state department of the environment or another water

management agency. States have different permitting systems, reporting requirements, decision-making processes and hierarchies of groundwater users. Some states have few regulations or minimal reporting when it comes to groundwater. Many states, as they learn more about hydrology, are moving towards managing groundwater and surface water together, under a system called conjunctive use.

Although some states have begun to legislate more protection for groundwater, the resource is still poorly protected legally in much of the country. Without oversight, it is no wonder that the resource is declining.

How Much Danger Are We In?

As state water managers face dwindling groundwater resources and chemical threats, they need access to groundwater data. Without sound scientific data, we cannot really know exactly how bad off we are, much less the most reasonable steps we could take to improve the situation. Yet that is exactly where we stand in many regions.

Today, many state, local and federal government agencies work with groundwater, but because there is no coordinated national program, there are many gaps in the data that state water managers need to make informed management decisions.

Since groundwater is managed at a state level, not a federal one, most information that does exist on groundwater use is collected at the state or local level. States vary in how much data they collect, and the amount of resources that they contribute to such projects.[36] For example, while some states collect data, participate in regional data collection or work with the United States Geological Survey to collect data, one survey indicates that eight states have no groundwater level monitoring network at all,[37] 11 states have no groundwater quality sampling program and five states have programs that are inactive.[38]

What's more, different states use different standards and methods to collect data.[39] And, to complicate matters, aquifers lie below the ground and cross state lines, which means that local data collection gives an incomplete view of the total health of a groundwater system.[40]

Several federal agencies also collect groundwater data, but not comprehensively on a national scale. The United States Geological Survey (USGS), charged with providing the American public with data on our national water resources, collects regional groundwater data through its Groundwater Resources Program. At current funding levels, these studies would take 20 to 30 years to complete.[41]

Without sound scientific data on groundwater, we cannot really know how bad off we are, much less the most reasonable steps we could take to improve the situation. Yet because there is no coordinated national program, there are many gaps in the data that state water managers need to make informed management decisions.

In addition, the USGS National Water-Quality Assessment Program gathers data on how human actions affect water quality, including water from domestic wells and other groundwater sources, and the Environmental Protection Agency (EPA) is working to create national source water protection programs for both surface water and groundwater. Officials from both USGS and EPA, along with many other government, industry and NGO partners, are participating in a Subcommittee on Groundwater of the Advisory Committee on Water Information to advise Congress on national water policy.

One of the main recommendations of the Subcommittee on Groundwater is that the federal government implement a National Groundwater Monitoring Network. This project, if funded, would contribute to USGS' proposed National Water Census, a project through which the agency hopes to track the status of all water supplies in the United States, to help manage both groundwater and surface water simultaneously.

The Subcommittee on Groundwater still does not know how long such a study would actually take, or how much it would cost. With groundwater reserves dwindling all around the country, it is high time to find out.

Calls for Data Collection

Given the importance of the resource and our lack of information, it is no wonder that scientists and groundwater professionals around the nation are calling for increased monitoring and assessing of groundwater. The Subcommittee on Groundwater is not the only group to recommend that the federal government play a leadership role in national groundwater data collection.

The Ground Water Protection Council, in its "Call to the Nation," states, "as a nation, efforts to monitor and characterize groundwater resources with regard to quantity and quality have been sporadic and, while successful in some local jurisdictions and watersheds, largely inadequate."[42] It encourages state, local and national agencies to fill this gap in our knowledge.

The USGS Coalition, a coalition of 70 scientific organizations, has also urged the government to set aside funding for research.[43] The National Groundwater Association surveyed its 15,000 members and concluded that groundwater monitoring data, as well as quality, is one of the most useful functions the federal government could provide.[44] The John Heinz III Center for Science and Economics identified groundwater as one of the top 10 most important areas of data needed to help policymakers make sound water management decisions.[45]

This statement only added to the previous recommendations of government agencies, such as the National Research Council, which stated in 2000 that "an unmet need is a national effort to track water levels over time in order to monitor water-level declines,"[46] and the Government Accounting Office, which asked, in 2004, for better coordination of groundwater data collection.[47]

The United States Geological Survey itself has numerous times cited the need for additional studies. USGS has collected water level data for more than 100 years, but its efforts to create a comprehensive dataset have been limited by variations in local resources. Nevertheless, periodic calls have been made within the agency for such studies. In fact, more than 70 years ago, the author of one of the first national studies on groundwater levels described a need for exactly such a program. According to O.E. Meinzer in his 1935 report, this "nation-wide program should furnish a reliable basis for periodic inventories of the ground-water resources, in order that adequate provision may be made for our future water supplies."[48]

Conclusion

In 2007, the Chief of the Office of Groundwater at the United States Geological Survey noted that it is difficult to get funding for groundwater data collection because funding from Congress is largely driven by citizen demands.[49] Most citizens today may not think to push for groundwater data collection because they may not be aware of the danger. Because it lies hidden beneath their feet, groundwater problems do not become apparent to average residents until something drastic happens.

We cannot wait for a catastrophe to take action for groundwater protection. Congress must start now by finding out what resources our nation's scientists need to comprehensively evaluate the United States' groundwater resources, and then appropriate funds accordingly. Once we have this data, we can begin to enact science-based policies on a state and national level that will preserve and protect the resource for future generations.

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