

ON THE COVER:

not a drop to drink

By the middle of this century, 7 billion people could be short of water. At best, it will be 2 billion people.

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Approximately 71 percent of the Earth's surface is covered with water. Yet, by all accounts, the world is on the verge of a water crisis.

What exactly that water crisis entails, or when it will hit, depends on what part of the world you're looking at. In drought-plagued regions, such as Zimbabwe, Mauritania, and the western United States, the water crisis has already begun.

"At this point in time, the water crisis isn't global, but there are pockets of crisis," said Hugh Turrall, a theme leader and principal researcher for the International Water Management Institute in Colombo, Sri Lanka. "Right now, in most parts of the world, the crisis is one of governance. Long-term, there will be problems with scarcity around the world."

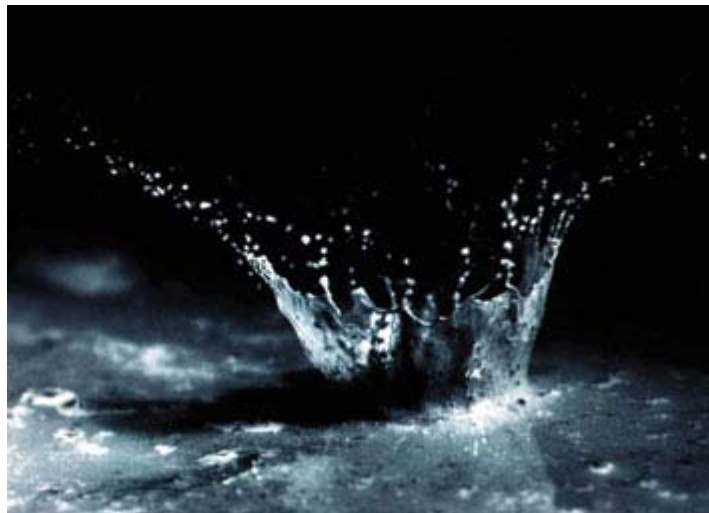
In its first World Water Development Report, Water for People, Water for Life, the United Nations concurred, stating: "Attitude and behavior problems lie at the heart of the crisis. Inertia at leadership level and a world population not fully aware of the scale of the problem means we fail to take the needed timely corrective actions." The World Water Development Report was produced by the World Water Assessment Programme, whose secretariat is hosted by Unesco.

"Of all the social and natural crises we humans face, the water crisis is the one that lies at the heart of our survival and that of our planet Earth," said Unesco's director-general, Koichiro Matsuura, in a prepared statement. "No

region will be spared from the impact of this crisis, which touches every facet of life, from the health of children to the ability of nations to secure food for their citizens."

Though water is indeed a renewable resource, to a certain extent it is also a finite one. Only 2.53 percent of the Earth's water is fresh, and some two-thirds of that is locked up in glaciers and permanent snow cover. Regionally, the distribution of that water is far from equitable. Asia is particularly hard hit, with just 36 percent of the world's water resources supporting 60 percent of the world's population, according to the U.N.'s World Water Report. Africa, though it has just 11 percent of the world's available fresh water, has a better balance since it has 13 percent of the world's population.

Freshwater resources are reduced by pollution. The U.N. report estimates that some 2 million tons of waste per day are disposed of within waters. This waste includes industrial trash and chemicals, human waste, and agricultural runoff, such as fertilizers, pesticides, and pesticide residue.



Fresh water is a drop in the bucket: Just 2.53 percent of the Earth's water is fresh. Some two-thirds of that is locked up in snow and ice.

The World Water Report estimates that global wastewater production is roughly 1,500 cubic kilometers per year. Assuming that 1 liter of wastewater pollutes about 8 liters of freshwater, the present burden of water pollution may

percent of the population of developing countries depends on polluted water sources.

Factoring in the availability of fresh water, current rates of pollution, and the potential for climate change—including a trend toward more frequent extreme weather conditions, such as floods and droughts—the World Water Report predicts that by the middle of this century, at worst, 7 billion people in 60 countries will be short of water; at best, 2 billion people in 48 countries will suffer shortages.

While water shortages are not widespread at the present time, a large percentage of the world's population lacks access to safe drinking water. Currently, 1.1 billion people lack access to an "improved" water supply (defined as water that has been at least marginally treated to remove chemical or biological contaminants). Some 2.4 billion people lack access to adequate sanitation.

The end result is a staggering rate of infection from water-related diseases, particularly among the poor in developing countries. In 2000, roughly 2.2 million people died from water sanitation-associated diseases. An estimated 1 million more died from malaria, according to the World Water Report.

If improved water supply and basic sanitation were extended to the currently unserved population, mortality from such water- and hygiene-related diseases would be reduced by 17 percent annually. If a piped, well-regulated water supply and full sanitation were provided, the rate of disease would drop 70 percent annually, the report predicted.

WHERE THE WATER GOES

What exactly constitutes a water crisis varies greatly, according to type of environment: rural or urban community, developing or industrial nation. In rural areas, the conflict is one of agricultural overuse, groundwater contamination, and, in some parts of the world, lack of infrastructure and sanitation. In urban areas, the crisis is primarily one of insufficient water to

support the dense population. In developing nations, the primary concern is simply providing water to people, while water quality may take a backseat. In industrial nations, where the infrastructure for providing drinking water to the majority of the population is already in place, the concern turns to maintaining the level of service and the quality of the water supply.

"In developing countries, the problem is in feeding a growing population," said Turrall of the Water Management Institute. The population in developing countries is increasing at roughly 2 to 2.5 percent a year, which puts a significant strain on agriculture. "Long-term, there's going to be a need to increase food production by 40 percent in developing nations, without expanding the irrigated area," he said. This will necessitate improvements in the productivity of land and water. Developing countries will have to increase crop yield, and improve water management and usage. "There's a tremendous impetus to keep on using irrigation to offset poverty in developing countries," he said.

According to the World Water Report, irrigation accounts for 70 percent of all water usage. Industry accounts for another 22 percent of total water use, and the remaining 8 percent falls to domestic use.

Those percentages are expected to change, as the population shifts in most parts of the world from rural areas to urban. Currently, the World Water Report estimates that about 48 percent of the world's population lives in towns and cities. By 2030, that number is expected to rise to 60 percent.

Cities are generally more efficient users of water than agriculture, Turrall said. "Cities don't consume water," he said. "They typically use water and return it." But this causes its own set of problems.

Pakistan, Bangladesh, and China are heavy users of groundwater, according to Turrall, and that practice has its own problems of contamination and pollution. "When you overdraw groundwater, it degrades the quality of that water, and you see the effects down the line," he said. For example, in Bangladesh, a high level of naturally occurring arsenic, coupled with overdrafting of the

groundwater supply, has created a serious problem that the public water system is not equipped to deal with.



Many developing countries, such as Iraq (top), lack infrastructure to deliver water to people. With population increasingly moving to cities, domestic and agricultural uses, like irrigation, will compete for limited resources.

According to Sandra Postel, director of the Global Water Policy Project in Amherst, Mass., and a senior fellow at the Worldwatch Institute, overpumping is widespread in China's north-central plain, which produces some 40 percent of the nation's grain. Across a wide area, water tables have been dropping 1 to 1.5 meters a year, even as the nation's water demands continue to climb.

quality to support a larger population. However, the infrastructure is lacking to bring the water to the people, according to the Water Management Institute's Turrall. High fuel costs and inefficient pumping systems are major factors contributing to the water crisis in this part of the world.

In the western United States, the problems are largely the result of insufficient water to serve a rapidly growing population, according to Ane Deister, chair of the American Water Works Association's conservation division, and general manager of the El Dorado Irrigation District, in Placerville, Calif.

"Drought is our biggest problem in California," Deister said. "It's both an urban and agricultural problem that we need to prepare for better. At the federal level, there's a strong recognition that the impact of drought on agriculture is economically devastating."

According to the National Drought Mitigation Center's U.S. Drought Monitor, moderate to severe drought conditions have been ongoing in the West, Southwest, and Pacific Northwest. There is no end in sight to these problems, according to forecasts.

"Understanding the science of drought and preparing for it is crucial to our country's well-being," said Deister. "We need a better monitoring and prediction network so weather forecasters can communicate; we need more studies of crops that are drought resistant long-term; we need preparedness plans; and we need to educate and inform the public, who will be impacted by this crisis."

Compounding the drought problems is a reduction in the amount of surplus Colorado River water available to surrounding states. This water has been a bone of contention for California, Nevada, Arizona, Colorado, New Mexico, Utah, and Wyoming.

California has been ordered by the U.S. Department of the Interior to gradually reduce its draw of the Colorado River from 5.2 million acre-feet to 4.4 million. At press time, a proposed transfer of water from the farming communities of the Imperial Valley to the densely populated and underserved city of San Diego to offset the

loss of the Colorado River water had not been completed.

Further complicating matters, many areas of California and the rest of the United States are plagued by groundwater that is contaminated with methyl-t-butyl ether and perchlorate, both of which are potentially hazardous to humans. No federal standards yet exist for acceptable levels of either contaminant.

MTBE is a fuel oxygenate that leaches into the groundwater from faulty underground storage tanks. Santa Monica, Calif., has been identified as suffering from some of the worst MTBE contamination, according to Deister.

Perchlorate can be naturally occurring or man-made. Perch is used in solid rocket propellant, as well as in nuclear reactors and electronic tubes. Both Santa Ana and Santa Clara, Calif., have identified serious perchlorate contamination, Deister said.

SOLVING PROBLEMS

There are no easy solutions to the world's water crises, but there are some promising technologies. Desalination, in particular, has been identified as a promising technology for creating new sources of potable water.

"Desalination is an area of major interest in Southern California coastal areas, which are currently very Colorado River water dependent," Deister said. "The technology has become so much more affordable that it's a viable solution for coastal areas that need a new source of water."

Five large municipal water agencies, all based in California, have joined together to form the United States Desalination Coalition. Its goal is to ask Congress to approve legislation aimed at providing financial incentives and grants for the development of desalination treatment facilities.



Irrigation technology can be automated to use less water, making it possible to feed a growing population without stressing the environment further.

Desalination is also gaining traction in Florida, where North America's largest seawater desalination plant is under construction for Tampa Bay Water. The Brazos River Authority in Waco, Texas, also expects to begin work on a seawater desalination facility soon.

Aquifer storage and recovery offers another alternative for drought-plagued communities. The method uses aquifer formations to collect water when it is plentiful and to store it in an environmentally friendly way. It doesn't create a new supply of water, but rather stores available water efficiently. The Metropolitan Water District of Southern California has undertaken some major projects in this arena. (The Metropolitan Water District program was the subject of an article, "Putting Water Back," in the February 2003 issue.)

Water recycling and reuse are perhaps the cornerstone techniques for helping to drought-proof communities, according to Deister. "Recycling provides a safe and reliable source of water, and a good way to keep wastewater from entering the environment," she said.

Deister's own El Dorado Irrigation District, which lies midway between Sacramento and South Lake Tahoe, currently uses recycled wastewater to irrigate golf courses and public grass plots. The district also recently received approval to use the water in residential gardens.

While recycled wastewater in the United States is carefully treated and used only for non-consumable and non-hygiene-related purposes, this isn't always the case in developing countries. According to Turrall in Sri Lanka, many cities of Asia and Africa are reusing wastewater for

exposes irrigation workers and even consumers to parasites, as well as to organic, chemical, and heavy metal contaminants, according to the World Water Report.

A better alternative in agricultural developing countries is improved irrigation technology to use less water. Remote sensing, sprinkler irrigation, hydrodynamic gates on irrigation canals, and micro-irrigation kits for small farms could all go a long way to improve the efficiency of irrigation, Turrall said. Automatic controls for canal gates are already in place in Morocco, Iran, Iraq, and Pakistan. But there is still potential for improvement.

Averting a water crisis is a massive undertaking that will require a combination of conservation, new technology, and cooperation among competing interests. Contaminated water will have to be cleaned up, while further pollution is reduced. And, new sources of water will need to be found if the constantly growing demand for suitable water for drinking, farming, and industry is to be met.



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