

Looming Water Crisis

IS THE WORLD RUNNING OUT OF WATER?

In the past decade drought has marched across much of the globe, hitting China, the Mediterranean, south-east Australia and the U.S. Sun Belt. The amount of water used by humans has tripled since 1950, and irrigated cropland has doubled. About one-fifth of the world's population lacks sufficient water, a figure that could reach 40 percent by 2025 by some estimates, in part because of growing world economies. In the poorest societies more than a billion people lack access to clean water, and dirty water kills 5,000 children — enough to fill 12 jumbo jets — every day. By century's end drought is expected to spread across half the Earth's land surface due to climate change, causing hunger and higher food prices. The United Nations says it would cost an extra \$10 billion or more annually to provide clean water and sanitation for all. Some recommend privatizing water supplies, while others suggest that charging more for water to encourage conservation would help to avoid future crises.

Children play in the dried up bed of the Jialing River near the booming city of Chongqing in central China. The country's worst drought in a half-century prompted Prime Minister Wen Jiabao to warn that the crisis threatens "the survival of the Chinese nation."



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Looming Water Crisis

BY PETER BEHR

THE ISSUES

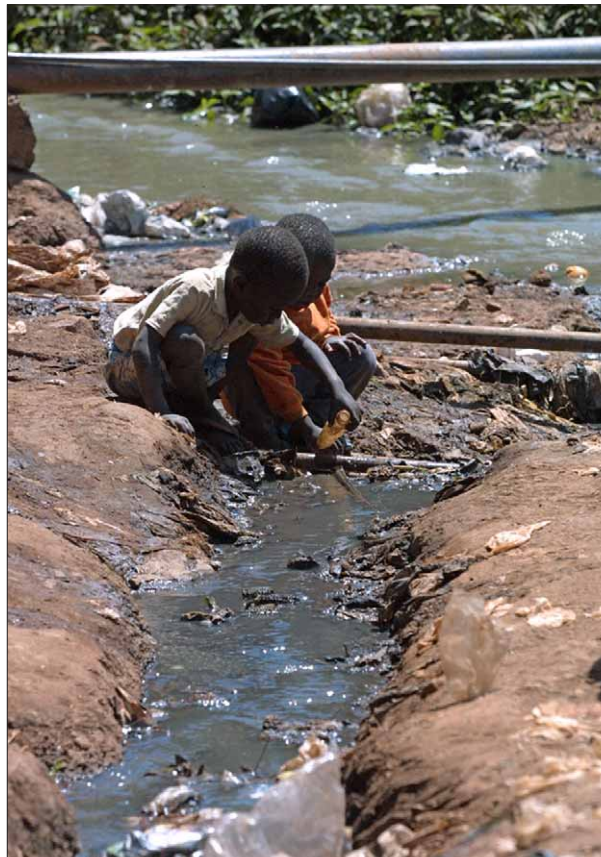
As 2007 came to a close, the steady drumbeat of headlines about China's worst drought in a half-century affirmed Prime Minister Wen Jiabao's earlier warning that the crisis threatens "the survival of the Chinese nation."¹

The alarming developments included:

- The drying up of 133 reservoirs in burgeoning Guangdong Province, leaving a quarter of a million people facing water shortages.²
- The lowest levels since 1866 on portions of the Yangtze River, restricting barge and ship traffic and reducing hydroelectric output on China's largest river, even as pollution from 9,000 industrial plants along its course jeopardizes drinking water supplies.³
- Near-record low levels in vast Lake Poyang, restricting water supplies for 100,000 people.⁴

"My house used to be by the side of the lake," villager Yu Wenchang told the Xinhua News Agency. "Now I have to go over a dozen kilometers away to get to the lake water."⁵

Similar woes are being reported across the globe, as one of the worst decades of drought on record afflicts rich and poor nations alike. While scientists hedge their conclusions about whether long-term climate change is causing the dry spell, many warn that Earth's gradual warming trend unquestionably poses a growing threat to water supplies and food production in arid regions. Already, population growth and economic expansion are straining water supplies in



Kenyan children play in raw sewage in Kibera, Nairobi's largest slum. Each year 1.8 million children — 5,000 a day — die from waterborne illnesses due to a lack of access to sanitation and clean water.

AFP/Getty Images/Simon Maina

many places, particularly in the poorest nations. But despite an unending series of international water conferences — attended by thousands of experts — no consensus has emerged on how to make adequate clean water available to all people in affordable, environmentally sustainable ways.⁶

A fifth of the world's population — 1.2 billion people — live in areas experiencing "physical water scarcity," or insufficient supplies for everyone's demands, according to a 2006 study by the International Water Management Institute that draws on the work of 700 scientists and experts. Another 1 billion face "economic scarcity," in which "human capacity or financial resources" cannot provide adequate water, the report found.⁷

While drought and expanding populations visibly affect the world's lakes and rivers, a less-visible problem also threatens water supplies. Accelerated pumping of groundwater for irrigation is depleting underground aquifers faster than they can be refreshed in densely populated areas of North China, India and Mexico. And land and water resources there and beyond are being degraded through erosion, pollution, salination, nutrient depletion and seawater intrusion, according to the institute.

A United Nations task force on water predicted that by 2025, 3 billion people will face "water stress" conditions, lacking enough water to meet all human and environmental needs.⁸ By that time, there will be 63 major river basins with populations of at least 10 million, of which 47 are either already water-stressed, will become stressed or will experience a significant deterioration in water supply, according

to a separate study by the World Resources Institute incorporating the U.N. data.⁹ (*See map, p. 30.*) *

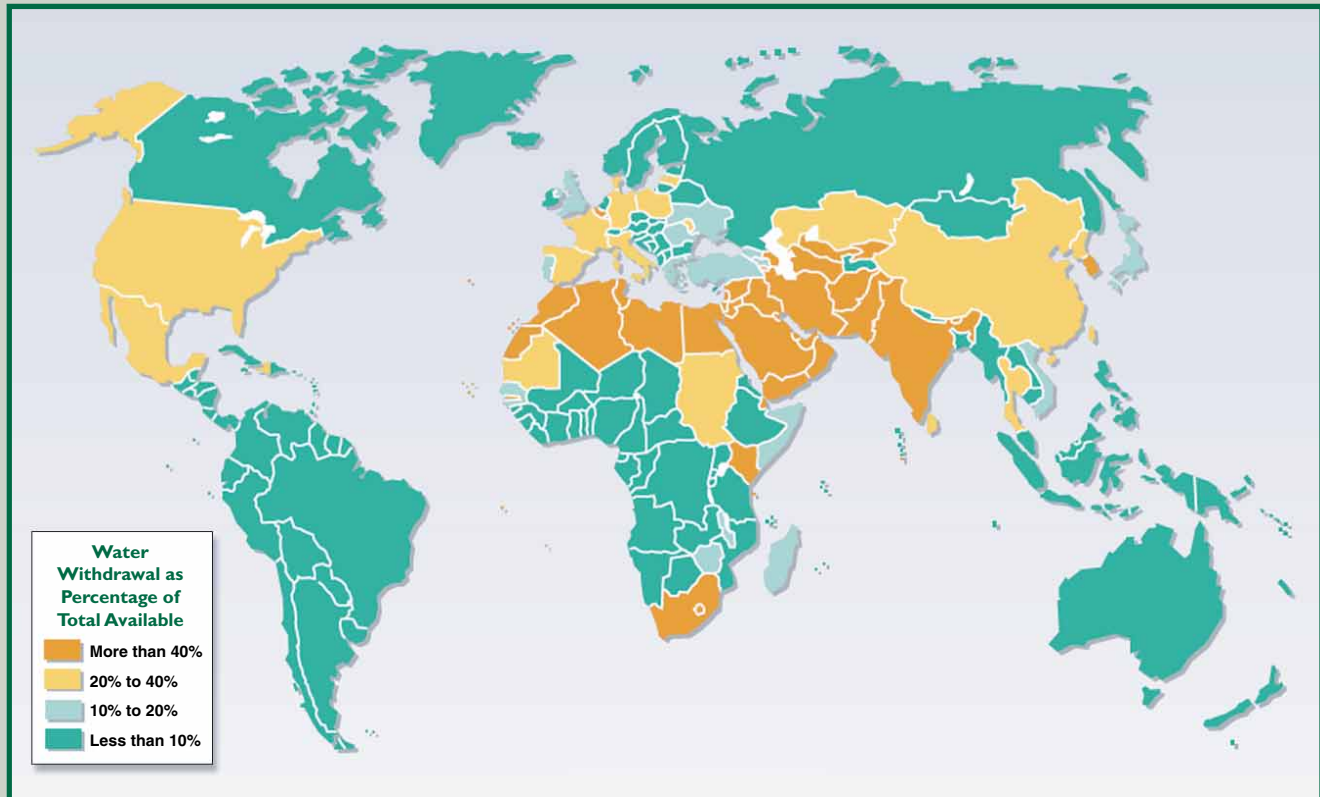
As water depletion accelerates, drought is undermining nature's capacity to replenish this essential resource, punishing the planet's midsection — from eastern Australia and northern China through the Middle East and sub-Saharan Africa to the U.S. Sun Belt, the Great Plains and northern Mexico.

* "Water stress" occurs when less than 1,700 cubic meters (448,000 gallons) per person of new fresh water is available annually from rainfall or aquifers for human use, making populations vulnerable to frequent interruptions in water supply.

Serious Shortages Projected for Many Regions

Water shortages are expected to afflict much of the Earth by 2025, as growing populations use vastly more water for daily life and farming. Areas likely to be hardest hit include China, Western Europe, the United States, Mexico and a wide swath of the globe's midsection from India to North Africa. In the most severe cases, humans are expected to use up to 40 percent of the available water, compared with the current average withdrawal, or use, rate, of 10 percent.

Projected Water-Use Rates, 2025 *



* Based on data from 1996-2000

Source: World Meteorological Organisation, Global Environment Outlook, U.N. Environment Programme, Earthscan, www.unep.org/dewa/assessments/ecosystems/water/vitalwater/21.htm#21b

In the United States, chronic alarms over depleted water resources in the Southwestern states have spread to the Southeast. The water level in giant Lake Sidney Lanier outside Atlanta has dropped about a dozen feet in this decade, causing an intense struggle among Georgia and neighboring Alabama and Florida over rights to the lake's diminished flows.¹⁰

And drought conditions worldwide are likely to worsen as the effects of

climate change are felt, many scientists warn.¹¹ Climate change is expected to expand and intensify drought in traditionally dry regions and disrupt water flows from the world's mountain snowcaps and glaciers.

Finally, a new threat to global water supplies has emerged: terrorism. "The chance that terrorists will strike at water systems is real," said Peter H. Gleick, president of the Pacific Institute for Studies in Development, Environment and Security in Oakland, Calif.¹² Mod-

ern public water systems are designed to protect users from biological agents and toxins, but deliberate contamination by terrorists could kill or sicken thousands, he said. Since the Sept. 11, 2001, terrorist attacks most major U.S. cities have sent the federal government confidential reports on the vulnerability of local water supplies, and the Environmental Protection Agency's (EPA) Water Sentinel Initiative is designing a water-contamination warning system.¹³

Perhaps the grimmest long-range prediction on water availability was issued by the Met Office Hadley Centre for Climate Prediction and Research in London. Using supercomputer modeling, the center projected that if current trends continue, by this century's end drought will have spread across half the Earth's land surface due to climate change, threatening millions of lives. Moreover, "extreme drought" — which makes traditional agriculture virtually impossible — will affect about a third of the planet, according to the group's November 2006 report.

"Even though (globally) total rainfall will increase as the climate warms, the proportion of land in drought is projected to rise throughout the 21st century," the report said.¹⁴

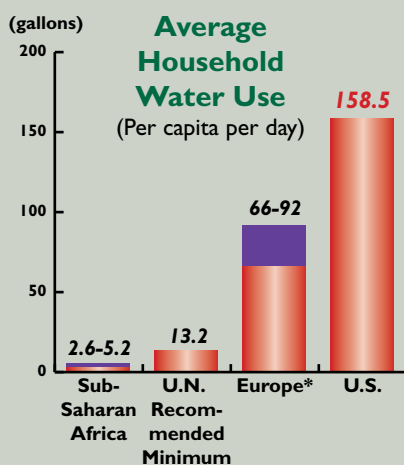
"There's almost no aspect of life in the developing countries that these predictions don't undermine — the ability to grow food, the ability to have a safe sanitation system, the availability of water," said Andrew Simms, policy director of the liberal London-based New Economics Foundation.¹⁵ The consequences will be most dire for the planet's poorest inhabitants, he added. "For hundreds of millions of people for whom getting through the day is already a struggle, this is going to push them over the precipice."

Access to safe, fresh water separates the well-off — who can treat water as if it were air — from the world's poorest, who hoard it like gold. In the United States, the average consumer uses nearly 160 gallons of water per day, summoned by the twist of a faucet. In much of Africa, women often trudge for hours to and from wells, carrying the two to five gallons per person used by the typical person in sub-Saharan Africa. (See graph, above.)¹⁶

But the lack of clean water is not only inconvenient. It can also be deadly. Each year 1.8 million children — 5,000 per day — die from waterborne illnesses such as diarrhea, according

World Water Consumption Varies

The average American uses nearly 160 gallons of water per day for drinking, cooking, bathing and sanitation — more than any other nationality and more than twice the amount used by many Europeans. People in sub-Saharan Africa use only about a quarter of the 13 gallons the United Nations sets as a minimum basic standard.



* Consumption among European countries ranges from 66-92 gallons

Source: World Water Council

to the United Nations. "That's equivalent to 12 full jumbo jets crashing every day," said U.N. water expert Brian Appleton. "If 12 full jumbo jets were crashing every day, the world would want to do something about it — they would want to find out why it was happening."¹⁷

Policymakers are trying various ways to solve the global water challenge, including contracting with private firms to operate urban water and sanitary systems, adopting new conservation technologies, enacting multinational pacts to manage regional watersheds and increasing funds for water projects in the world's poorest regions. Water ex-

perts advocate "environmental flow" policies — the release of enough water from dams to sustain the environment of rivers, wetlands and underground aquifers.¹⁸

And their efforts seem to be paying off — at least in some areas. Between 1990 and 2002, more than 1 billion people in the developing world gained access to fresh water and basic sanitation. But because of population growth, the total number of people still lacking safe water remained more than a billion, and there was no change in the number lacking basic sanitation.¹⁹

In 2003, the U.N. General Assembly designated the period from 2005 to 2015 as the International Decade for Action on "Water for Life." And the U.N.'s new Millennium Development Goals include a campaign to cut in half by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation — at a cost of more than \$10 billion per year.²⁰ Currently, governments and international agencies like the U.N. and World Bank provide only \$4 billion a year in aid for water and sanitation projects.²¹

"We will see these issues play out silently: dry rivers, dead deltas, destocked fisheries, depleted springs and wells," wrote Margaret Carley-Carlson, chairwoman of the Global Water Partnership in Stockholm, and M. S. Swaminathan, president of the Pugwash Conferences on Science and World Affairs in Chennai, India.²² "We will also see famine; increased and sometimes violent competition for water, especially within states; more migration; and environmental devastation with fires, dust, and new plagues and blights."

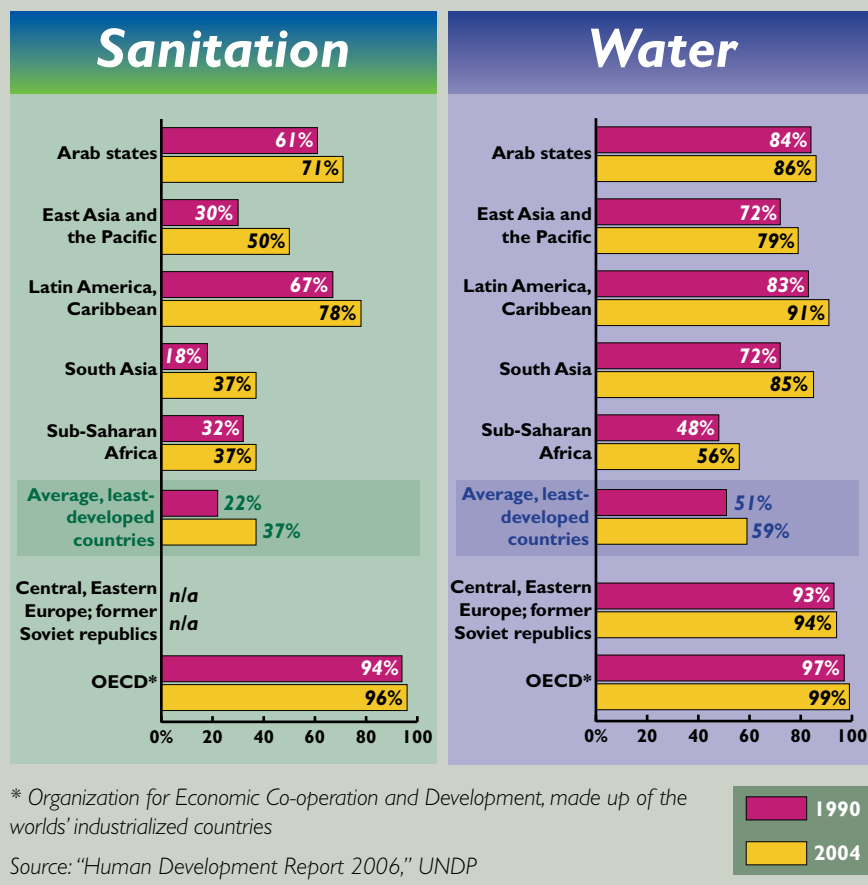
Averting that future will require fundamental changes in governmental policies and human practices governing the use, conservation and value of water, experts agree.

As water experts and policymakers discuss how to conserve and protect future water supplies, here are some of the questions they are debating:

Poorest Lag Far Behind in Access

Although progress has been made since 1990, only 37 percent of the residents in sub-Saharan Africa and South Asia had access to sanitation services in 2004. Sub-Saharan Africa lags behind the rest of the world in access to reliable sources of clean water. Meanwhile, more than 90 percent of those living in the industrialized countries, Central and Eastern Europe, Latin America, the Caribbean and the former Soviet republics had access to water in 2004.

Percentage of Population with Access to:
(1990-2004)



Are we running out of water?

Amid the growing alarm about water shortages, water expert Frank Rijsberman offers a contrarian perspective. "The world is far from running out of water," he says. "There is land and human resources and water enough to grow food and provide drinking water for everyone."²³

The issue is how efficiently water is used, says Rijsberman, former director

of the International Water Management Institute in Colombo, Sri Lanka. Every year, about 110,000 cubic kilometers * of rain falls on Earth's surface, of which humans withdraw just over 3 percent — about 3,700 cubic kilometers — from rivers and groundwater to use in cities, industries and farming. About 40,000

* 1 cubic kilometer would cover an area of about 810,000 acres with one foot of water.

cubic kilometers flows into rivers and is absorbed into groundwater, and the rest evaporates.

Much of the water used by humans is returned to watersheds as wastewater, farm runoff or discharges from energy and industrial plants, with only a small fraction used for drinking and cooking.²⁴ Irrigation claims 70 percent of total water withdrawals, 22 percent is used by industry and the rest goes for homes, personal and municipal uses.²⁵

Water isn't running out everywhere, said Canadian journalist Marq de Villiers, author of *Water: The Fate of Our Most Precious Resource*. "It's only running out in places where it's needed most. It's an allocation, supply and management problem."²⁶

It's also a demand problem: Over the past half-century, millions of people have migrated from colder, wetter, northern climates to warmer, drier, southern locales such as the American Southwest or southern France, putting new pressure on those expanding "Sun Belt" communities to build irrigation systems, tap into groundwater supplies or rechannel large amounts of river water.

Experts agree that the world should not be facing an overall water-scarcity crisis. But water supplies in much of Africa, parts of China, southern Europe, northern Mexico and the American Southwest and high plains aren't meeting demand, and climate change may be accelerating the problem, the experts say.²⁷ The issues add up to what the World Commission on Water calls the "gloomy arithmetic of water."²⁸

In addition, man has transformed most of the world's great rivers. For example, the Danube — Central Europe's "lifeline" — has been dredged, deepened, straightened, channelized and obstructed by dams and fishing weirs. It is now "a manufactured waterway," says de Villiers, with more than a third of its volume withdrawn for human use, compared to an average of about 10 percent for other rivers.²⁹

Pollution is also reducing the world's supply of potable water. In Asia, many rivers "are dead or dying," according to Rijsberman. The Musi River near India's Hyderabad technology center has become "a dwindling black wastewater stream," he writes. "[Y]et the cows that produce the curd and the dairy products for Hyderabad are bathing in that black and stinking water."³⁰ In China, 265 billion gallons of raw sewage is dumped into the Yangtze River every year.³¹

The depletion and despoiling of the world's reservoirs, rivers and watersheds also contribute to the problem. During the 20th century, more than half the wetlands in parts of Australia, Europe, New Zealand and North America were destroyed by population growth and development. The loss of wetlands increases water runoff, which exacerbates flooding, reduces the replenishment of aquifers and leaves rivers and lakes more vulnerable to pollution.³²

Aquifers — the immense storehouses of water found beneath the Earth's surface — are the largest and fastest-growing source of irrigation water. Depleting those underground rivers will have deleterious effects on the 40 percent of the planet's agricultural output that relies on irrigation from groundwater.³³ Experts say some of that water — which dates back to past ice ages — would take eons to refresh but is being consumed in less than a century.

"Large areas of China, South Asia and the Middle East are now maintaining irrigation through unsustainable mining of groundwater or over-extraction from rivers," said the U.N. "Human Development Report 2006."³⁴ The problem is widespread in Mexico, India and Russia, as well, although precise data are not available for many countries.³⁵

In his seminal 1986 book *Cadillac Desert*, the late Marc Reisner warned about the long-term effects of water policies in the Western United States, including the depletion of the giant Ogallala Aquifer, which runs south-



Dead plants in a parched field attest to the ravages of the worldwide drought in Liujiang, a county of southwest China's Guangxi Zhuang Autonomous Region, in November 2006. Nearly all of the region's 84 counties were affected by the drought, which was caused by unseasonably warm temperatures, according to the Xinhua News Agency.

AP Photo/Xinhua, He Fengjun

ward from South Dakota to Texas. It has two distinctions, he wrote, "one of being the largest discrete aquifer in the world, the other of being the fastest-disappearing aquifer in the world."³⁶

In the 1930s a farmer on the Great Plains could raise a few gallons per minute from the Ogallala, using a windmill-driven pump. After the New Deal brought electricity to the region and oil and gas discoveries provided plenty of cheap fuel, electric pumps raised 800 gallons per minute.

"All of a sudden, irrigation became very energy- and labor-efficient. You turn on the switch and let it run," says Robert M. Hirsch, associate director for water at the U.S. Geological Survey.

"There was an explosion of irrigated agriculture, particularly on the high plains, and in California."

In 1937, West Texas had 1,116 irrigation wells. Thirty years later it had 27,983. By 1977, Texas was withdrawing 11 billion gallons of groundwater a day to grow corn, cotton and other crops in what once had been part of the Great American Desert, Reisner wrote.³⁷

Now, experts say the Ogallala — a resource that could have lasted hundreds of years — will be virtually depleted within the lifetimes of today's farmers.

Yet during the optimism and opportunism that characterized development of the modern American West,

Continued on p. 35

Is Access to Clean Water a Human Right?

The question is at the heart of a global debate.

Should all humans have guaranteed access to clean water, or is water an increasingly scarce commodity that should be priced according to its value?

The question stands at the center of a global debate over threats to the world's water resources, as competition for water increases among industry, farming and households. It is also critical in efforts to protect the long-term environmental viability of rivers, lakes and aquifers.

The debate goes back at least to 1992, when an international commission on water and the environment meeting in Ireland issued the "Dublin Principles," which were later adopted by a U.N. panel. The commission concluded: "Water has an economic value . . . and should be recognized as an economic good." Only by recognizing that economic value can water "be properly conserved and allocated to its most important uses."¹

But the principle also declared it a "basic right of all human beings to have access to clean water and sanitation at an affordable price." Poor households cannot compete with industry for scarce water supplies. Nor could most farmers, who typically receive subsidized prices for irrigation water.

The U.N. Committee on Economic, Social, and Cultural Rights declared in 2002 that all people are entitled to an essential minimum amount of clean water. "Water is fundamental for life and health," it said. "The human right to water is indispensable for leading a healthy life in human dignity."²

Canadian activist Maude Barlow says, "You can't really charge for a human right; you can't trade it or deny it to someone because they don't have money." Barlow is co-author of *Blue Gold: The Battle Against Corporate Theft of the World's Water*.³

The other side in the debate argues that until water is priced and valued as a scarce resource it will be wasted and billions of dollars required annually to extend water service to the poor and fix leaking water systems will not be forthcoming. Two years before the U.N. declared clean water a human right, the World Water Council — which reflects the views of international lenders and the water-supply industry — called for "full pricing" of water to reflect its "economic, social, environmental and cultural values."⁴

Farmers in dry regions throughout the world get water at preferential rates — or at no charge at all — as a matter of government policy. But if farmers were required to pay the full price for water, they could not compete with industry, which would be willing and able to pay market price.

In industrial countries, 60 percent of the water withdrawn from freshwater sources is used by industry, mainly to generate electricity. The developing world is moving rapidly in the same direction. China's industrial water use, for example, is projected to grow fivefold by 2030.⁵

"As urban centers and industry increase their demand for water, agriculture is losing out," said the U.N. "Human Development Report 2006."⁶

And the world's poor cannot compete with either farmers or business for water at market prices, said the report. About a third of those without access to clean water live on less than \$1 a day. Twice that many live on less than \$2 a day. "These figures imply that 660 million people lacking access to [safe] water have, at best, a limited capacity to pay more than a small amount for a connection to water service," the report said. "People might lack water because they are poor, or they might be poor because they lack water." The end result is the same: a limited ability to pay for water.⁷



AP Photo/Julie Plascencia

A man protesting the privatization of water in Cochabamba, Bolivia, waves a sign saying "what is ours is ours and it cannot be taken away."

American water expert Peter H. Gleick calls for a truce in the water rights dispute in favor of problem-solving. Workshops on privatization standards and principles for implementing a human right to water "would be far more likely to produce progress," he writes.⁸

¹ "Dublin Statements and Principles," Global Water Partnership; www.gw-pforum.org/servlet/PSP?iNodeID=1345.

² Meena Palaniappan, et al., "Environmental Justice and Water," *The World's Water 2006-2007*, p. 117.

³ Jeff Fleischer, "Interview with Maude Barlow," *Mother Jones*, Jan. 14, 2005, www.motherjones.com/news/qa/2005/01/maude_barlow.html.

⁴ "Ministerial Declaration of The Hague," World Water Forum, March 22, 2000.

⁵ Palaniappan, *op. cit.*, p. 125.

⁶ See "Summary, Human Development Report 2006: Beyond scarcity: Power, poverty and the global water crisis," United Nations Development Programme, p. 17, http://hdr.undp.org/en/media/hdr2006_english_summary.pdf.

⁷ *Ibid.*, pp. 49-52.

⁸ Peter Gleick, "Time to Rethink Large International Water Meetings," *The World's Water 2006-2007*, p. 182.

Continued from p. 33

worries about future water supplies evaporated. "What are you going to do with all that water?" the late Felix Sparks, former head of the Colorado Water Conservation Board, asked in the mid-1980s. "When we use it up, we'll just have to get water from somewhere else." But today, "somewhere else" is not an answer, say authors Robin Clarke, editor of climate publications for the United Nations and World Meteorological Organization, and environmental author Jannet King. The co-authors of *The Water Atlas* insist water must be considered a finite resource.³⁸

Should water be privatized?

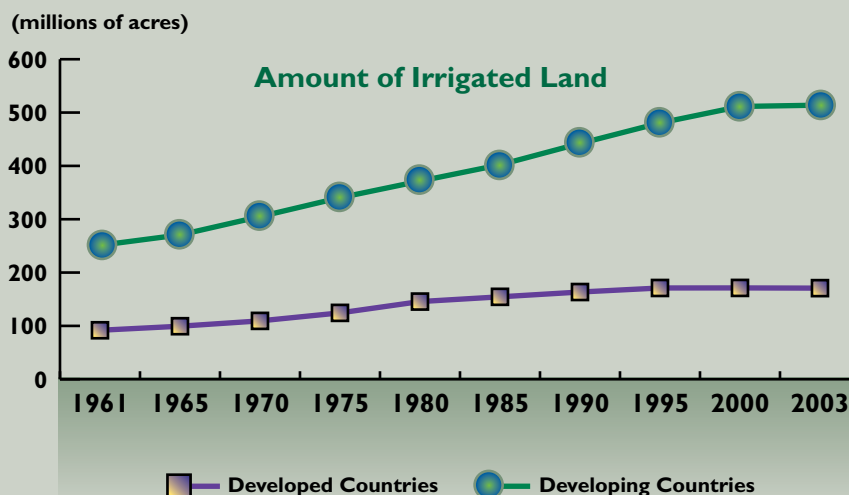
In 2000, street fighting broke out between government forces and political activists, rural cocoa farmers and residents of shantytowns on the hilly outskirts of Cochabamba — Bolivia's third-largest city. The dispute was over privatization of the city's water supplies.

The year before, Cochabamba had turned its water and sanitation system over to Aguas del Tunari, a coalition of multinational and Bolivian water and engineering corporations whose biggest stakeholder was Bechtel Corp., based in San Francisco.³⁹ This was the high-water mark of a global, pro-market movement toward deregulation and privatization of state-owned monopolies in water, electricity and other services.⁴⁰ The World Bank and other international lenders had been supporting privatization strategies in hopes that investments and better management by private industry would help bring water and sanitation to more than a billion poor people whose governments couldn't or wouldn't do the job.

But Cochabamba's privatization included a costly dam and pipeline to import more water, which required sharp rate increases starting at 35 percent. Some customers' water bills doubled. Farmers outside the city, who had enjoyed free water, suddenly had to pay. The city erupted in protest,

Irrigation Doubled in Developing Nations

The amount of irrigated land more than doubled in developing countries in the past four decades, increasing faster than in the developed world. But the rate of increase for both has slowed in recent years because of heavy draws on groundwater aquifers and competition from industry for water.



Source: Peter H. Gleick, et al., "The World's Water: 2006-2007," Pacific Institute, 2006

the water company's officials fled and their contract was rescinded.⁴¹ The government reclaimed the water operations, and Cochabamba became a rallying cry against privatization and globalization for the political left.

Elsewhere, however, corporate involvement in water and sanitation system operations has not ceased. Veolia Water, a subsidiary of the French firm Veolia Environment SA — the world's largest water-services firm — signed a \$3.8 billion, 30-year, contract in 2007 to supply drinking water to 3 million residents of the Chinese river port city of Tianjin. Since 1997, Veolia has signed more than 20 water and sanitation contracts in China, and supplies more than 110 million people in 57 countries worldwide.⁴²

These projects, and smaller-scale versions in poorer nations, suggest that while the inflamed debate over water privatization continues, threats of water scarcity and climate change may help

accelerate the search for private-sector support.

The percentage of the world's population served at some level by private firms has grown from 5 percent in 1999 to 11 percent — or 707 million people — in 2007, according to *Pinsent Masons Water Yearbook*, a widely consulted summary of private-sector water projects.⁴³

Opponents of privatization argue that safe drinking water and adequate sanitation are essential human rights, obligating governments to provide them at affordable rates or free if necessary. "If it's a human need, it can be delivered by the private sector on a for-profit basis. If it's a human right, that's different," says Canadian anti-globalization activist Maude Barlow, co-author of *Blue Gold: The Battle Against Corporate Theft of the World's Water*. "You can't really charge for a human right; you can't trade it or deny it to someone because they don't have money."⁴⁴

LOOMING WATER CRISIS

Bringing in private firms to run water and sewer operations does not make the services more efficient or affordable, opponents also argue, but forces the poor to pay for corporate profits, shareholder dividends and high executive salaries. “The efficiencies don’t happen,” asserts Wenonah Hauter, executive director of Food and Water Watch, a Washington anti-globalization group. “The companies simply lay off staff members until they don’t have enough people to take care of the infrastructure. And they raise rates. We’ve seen this all over the world.” Last year Hauter’s organization issued a study claiming privatized water operations in California, Illinois, Wisconsin and New York

pears to have improved water quality in urban areas but not in rural communities, said the study. After privatization began, water bills for the poor rose about 10 percent but declined for the wealthy, reflecting a scaling back in government subsidies to poorer consumers. Similar shifts occurred in both privatized and non-privatized cities.⁴⁸

In central cities, water-rate subsidies tend to favor the wealthy and middle classes, who are usually connected to municipal water systems, while the poor often are not, says American journalist Diane Raines Ward, author of *Water Wars: Drought, Flood, Folly, and the Politics of Thirst*. And by keeping water rates artificially low, utilities typically collect only about a

privatization has declined in Latin America and sub-Saharan Africa but increased in Europe and Asia, according to the *Water Yearbook*.⁵⁰ The average contract size also has diminished since the 1990s, it said, due to a trend away from mega-contracts with multinational water companies in favor of “local and possibly less contentious contracts.”⁵¹

A U.N.-sponsored analysis cites Chile and parts of Colombia among the successful examples of collaborative water and sanitation services. In Cartagena, Colombia’s fifth-largest city, the local government retains control of the pipes and facilities and raises investment capital, but a private firm runs the service. Today, nearly all the city’s residents have water in their homes, up from only one-quarter in 1995.⁵² Chile’s water program offers subsidies to the poorest households, guaranteeing an essential minimum of supply of up to 4,000 gallons per month. Deliveries are monitored to limit cheating, and every household must have a water meter to verify usage.⁵³

Experts say the political problems of water privatization cannot be managed without effective government regulation and consumer involvement at all levels. Both elements were missing in Cochabamba but are present in Chile, the U.N. report says.⁵⁴



AP Photo/Peter Lorimer

The outlook is bleak for rancher Andrew Higham’s parched land in Gunnedah, in northwestern New South Wales, Australia, in October 2006. Scarce winter rains caused drought across much of the continent last fall and led to severely reduced wheat and barley harvests.

charged more for water than comparable publicly owned systems.⁴⁵

Privatization advocates dispute Hauter’s claims, and facts to settle the issue are illusive. A 2005 survey by the AEI-Brookings Center for Regulatory Studies found “no systematic empirical evidence comparing public and private water systems in the United States.”⁴⁶

A study by the Inter-American Development Bank of water rates in Colombia said prices charged by privatized systems were not significantly different from those charged by public systems.⁴⁷ And privatization ap-

third of their actual costs, so they don’t raise enough money to expand pipelines to unserved poor neighborhoods, she says.⁴⁹

The rural poor or those living in urban slums often must haul water home from public wells or buy it from independent merchants — delivered by truck or burro — at much higher prices. In Cairo, Egypt, for instance, the poor pay 40 times the real cost of delivery; in Karachi, Pakistan, the figure is 83 times; and in parts of Haiti, 100 times, Ward says.

In the years since Cochabamba galvanized the left against privatizing water,

Will water scarcity lead to conflicts?

In 1995 Ismail Serageldin, a World Bank vice president, predicted that “the wars of the next century will be over water.”⁵⁵

The reality has been different thus far. “Water resources are rarely the sole source of conflict, and indeed, water is frequently a source of cooperation,” writes Gleick, of the Pacific Institute for Studies in Development, Environment and Security, in the new edition of *The World’s Water 2006-2007*.⁵⁶ The survey of reported conflicts over water in the past 50 years, compiled by Oregon

State University researchers, found 37 cases of violence between nations, all but seven in the Middle East.⁵⁷

In 1964, Israel opened its massive National Water Carrier canal to carry water from the Sea of Galilee and the Jordan River to its farms and cities. Syria retaliated to maintain its access to the Jordan by starting two canals to divert Jordan flows for its uses. Skirmishes by military units and raids by the newly established al-Fatah forces escalated until Israeli air strikes halted the diversion projects. By then, Israel and the Arab League were on the road to the Six-Day War of 1967.⁵⁸

"The attacks by Syria, Egypt, and Jordan that eventually followed had many causes, but water remained a priority for both sides," says author Ward.⁵⁹

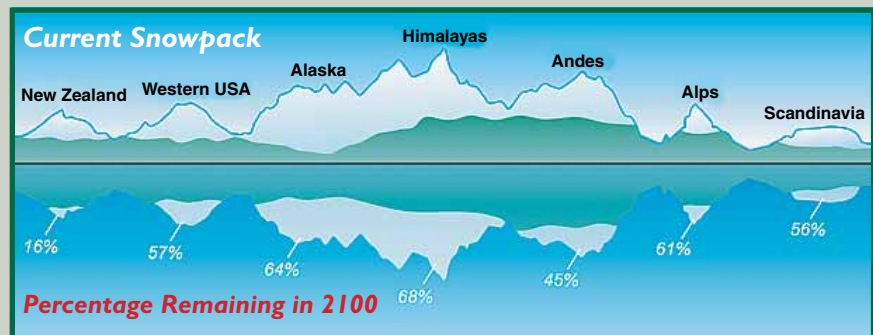
Still, more than 200 water treaties have been negotiated peacefully over the past half-century. The Partition of India in 1947, for instance, could have led to war between India and newly created Pakistan over control of the mighty Indus River basin. Instead, the two nations were brought together with World Bank support over a perilous decade of negotiations, signing the Indus Water Treaty in 1960. Three rivers were given to Pakistan, and three to India, with a stream of international financial support for dams and canals in both countries. Even when war raged between the two nations in later years, they never attacked water infrastructure.⁶⁰

"Most peoples and even nations are hesitant to deny life's most basic necessity to others," Ward wrote. Two modern exceptions occurred during the Bosnian War (1992-1996), when Serbs "lay waiting to shoot men, women and children arriving at riverbanks or taps around Sarajevo carrying buckets or bottles," and during Saddam Hussein's regime in Iraq, when he diverted the lower waters of the Tigris and Euphrates rivers to destroy the homes and livelihood of the Marsh Arabs.⁶¹

Mountain Snowpack Is Shrinking

The amount of snow covering the globe's highest mountains has been shrinking over the past half-century, upsetting crucial seasonal water flows that restock rivers, lakes, reservoirs and aquifers. Scientists think short-term climate conditions like El Niño and long-term warming caused by climate change are to blame. By century's end, only 16 percent of New Zealand's current snowpack will remain.

Snowpack Now and Projected in 2100



Source: Pacific Northwest National Laboratory, <http://picturethis.pnl.gov/picturet.nsf/by+id/AMER-6PWV.V?opendocument>.

Except for such instances, cooperation over water resources is common today, even if sometimes grudging and incomplete, says Undala Alam, a professor and specialist in water diplomacy at Britain's Cranfield University. "Turkey was releasing water for Syria and Iraq; the Nile countries are preparing projects jointly to develop the river; the Niger countries have a shared vision for the basin's development, and the Zambezi countries are working within the Southern African Development Community," she notes.⁶²

But analysts warn that growing stress on water supplies, coupled with the impact of climate change, will create combustible conditions in the coming years that will undermine collaboration over water.

There is plenty of precedence for the concern, notes Gleick, who describes the history of violence over fresh water as "long and distressing."⁶³ The latest volume of *The World's Water* lists 22 pages of historical water conflicts —

beginning in about 1700 B.C. with the Sumerians' efforts to dam the Tigris River to block retreating rebels.

In the future, climate change is expected to extend and intensify drought in Earth's driest regions and disrupt normal water flows from mountain snowcaps in Europe, North America and Central Asia. "Climate change has the potential to exacerbate tensions over water as precipitation patterns change, declining by as much as 60 percent in some areas," warned a recent report by a panel of retired U.S. generals and admirals convened by CNA, a think tank with longstanding ties to the military. "The potential for escalating tensions, economic disruption and armed conflict is great," said the report, "National Security and the Threat of Climate Change."⁶⁴

On the simplest level, the report said, climate change "has the potential to create sustained natural and humanitarian disasters on a scale far beyond those we see today." Already, it

said, Darfur, Ethiopia, Eritrea, Somalia, Angola, Nigeria, Cameroon and Western Sahara have all been hit hard by tensions that can be traced in part to environmental causes.⁶⁵ If the drought continues, the report said, more people will leave their homelands, increasing migration pressures within Africa and into Europe.⁶⁶

The impact will be especially acute in the Middle East, where about two-thirds of the inhabitants depend on water sources outside their borders. Water remains a potential flashpoint between the Israelis and Palestinians, who lack established rights to the Jordan River and receive only about 10 percent of the water used by Israel's West Bank settlers.⁶⁷ "Only Egypt, Iran and Turkey have abundant fresh water resources," the CNA report said.

The military advisers urged the United States to take a stronger national and international role in stabilizing climate change and to create global partnerships to help less-developed nations confront climate impacts.⁶⁸

Currently, there is only a weak international foundation for water collaboration, according to the U.N. Human Development report. While a 1997 U.N. convention lays out principles for cooperation, only 14 nations have signed it, and it has no workable enforcement mechanism. In 55 years, the International Court of Justice has decided only one case involving international rivers.⁶⁹

It is possible, however, that as the awareness of climate impacts on water supplies deepens, so will the urgency for governments to respond. "Unlike the challenges that we are used to dealing with, these will come upon us extremely slowly, but come they will, and they will be grinding and inexorable," said former Vice Adm. Richard H. Truly, a former astronaut who headed the U.S. National Aeronautics and Space Administration (NASA) and served as a CNA consultant.⁷⁰ "They will affect every nation, and all simultaneously." ■

China Leads World in Dam Building

China has three times as many dams as the United States and more than all the next 11 countries combined. Dams typically generate electricity, control flooding and provide water for irrigation.

Countries with the Most Dams

1. China	22,000
2. United States	6,575
3. India	4,291
4. Japan	2,675
5. Spain	1,196
6. Canada	793
7. South Korea	765
8. Turkey	625
9. Brazil	594
10. France	569
11. South Africa	539
12. Mexico	537

Source: Peter H. Gleick, et al., "The World's Water: 2002-2003," Pacific Institute, 2002

BACKGROUND

Taming Water

The ruins of irrigation canals 8,000 years old have been found in Mesopotamia.⁷¹ Remains of water-storage dams 5,000 years old survive in Egypt and Jordan. Humans have been using waterwheels for milling and threshing since the 1st century B.C., and by 1291 China had completed its Grand Canal running nearly 1,800 kilometers between Beijing and Hangzhou.⁷² Water power drove mining, metal drilling, textile and milling industries at the dawn of the Industrial Age.⁷³ In the United

States, the opening of the Niagara Falls hydroelectric power station in 1896 — built by American entrepreneur and inventor George Westinghouse and backed by financier J. P. Morgan and others — inaugurated water's use to generate electric power.⁷⁴

But these early accomplishments were dwarfed in the 20th century by nearly 100 years of massive dam projects that have transformed most of the world's major rivers. Between 1950 and 2000, the number of dams higher than 50 feet increased sevenfold — to more than 41,000 structures impounding 14 percent of the world's average river runoff.⁷⁵ By 2000, large dams were supplying nearly a fifth of all electrical power worldwide.

Dams also have been critical in the rapid expansion of irrigated farming. "Half of the world's large dams are built exclusively for irrigation, supporting about 12 to 16 percent of world food production, according to the World Commission on Dams."⁷⁶

About 12 percent of large dams were constructed specifically to provide drinking water and sanitation (and a similar percentage were built to control flooding), and many have multiple uses. Whether used for energy, community water, flood control or agriculture, dams have been a key tool of economic growth, according to the commission. Typically, however, the full consequences of such giant projects were not taken into consideration, the commission said. In the past century, the world built, on average, one large dam per day without asking whether it was getting a fair return from the \$2 trillion investment, said South African Minister of Education Kader Asmal, who chaired the commission.⁷⁷

The dam-building blitz was enabled by political bias in favor of dams. From the Aswan High Dam in Egypt to the Hoover Dam on the Colorado River, big dams have stood as pre-

Continued on p. 40

Chronology

19th Century

The industrial age and urbanization create critical need for municipal water treatment and sanitation services.

1848

The Public Health Act, followed in 1852 by the Metropolitan Water Act, lead to investments in water treatment and sanitation that dramatically reduce waterborne illnesses in Britain by the end of the century.

1876

Berlin city planner James Hobrecht starts work on drainage system and waterworks that channels sewage to fields as fertilizer. He designs similar systems for Moscow, Cairo and Tokyo.

1900-1980

Governments around the globe launch major dam construction.

1902

The Aswan Dam on the Nile River in Egypt is completed to control flooding and regulate water flow for agriculture.

1910

Chlorination begins in the United States. Typhoid fever from polluted drinking water falls from 25 deaths per 100,000 people to almost zero.

1936

Hoover Dam on the Colorado River is opened, fulfilling an agreement among Southwestern states and cities to share the river's flow.

1945

Large-scale groundwater irrigation begins expanding in the Western United States, aided by rural electrifi-

cation and innovations in pumping and irrigating technology.

1986

Major dam construction has largely stopped in the U.S. but continues in Asia.

1980s ***Britain's public utilities are sold to private firms in the late 1980s, triggering a wave of water-system privatization worldwide.***

1994

Construction begins on the Three Gorges Dam on China's Yangtze River, designed to be the largest in the world. More than 1 million people will have to be relocated as the river rises.

2000s ***Drought spreads worldwide, heightening concern about climate change's impact on water scarcity. Privatization strategies shift.***

2000

Violent public protests against higher water rates force cancellation of a water-privatization plan in Cochabamba, Bolivia. But privatization continues in China, India and other parts of the world. . . . U.N. adopts the Millennium Development Goals calling for halving the number of people without access to safe water and adequate sanitation by 2015.

2002

China approves massive South-to-North Water Diversion Project, which will eventually link the

country's four major rivers to bring water from the south to the arid north.

2005

Group of Eight industrialized nations pledge to double their aid for water, sanitation and other development projects in poorer nations by 2010.

2006

Waterborne-disease epidemics strike Karachi, Lahore and other Pakistani cities, caused by the leakage of sewage and industrial wastes into damaged water-distribution pipelines. . . . U.N. Human Development Report warns that without a major increase in investment, improvements in water and sanitation services will fall far short of the Millennium Development Goals.

2007

Multi-year drought afflicts China, the Horn of Africa, Turkey, Australia, Spain and the U.S. Sun Belt. . . . A director of the Three Gorges Project warns that rising waters behind the dam could cause "water pollution, landslides and other geological disasters," but other officials later say environmental problems will be ameliorated. . . . The Intergovernmental Panel on Climate Change predicts that freshwater resources will decrease in large river basins over the next decade due to drought. . . . Drought prompts several Australian cities to commission new desalination plants. Algeria also has a major plant in construction.

2008

The scarcity of water in key agricultural areas has contributed to soaring world prices for wheat, soybeans, corn, rice and poultry, and the trend is likely to continue this year, say agricultural forecasters.

Continued from p. 38

eminent symbols of governments' engineering prowess and the use of state power to control devastating floodwaters and feed economic expansion. "Colossal engineering works bestow big contracts and big benefits, divide up waters, hold them fast, channel them away from some and give them to others," says author Ward. "It has always been politics that start the bulldozers moving." ⁷⁸

While dams helped expand supplies of drinking water, hydropower

and irrigation water, they also attract population expansion that eventually strains the new resources. And until recently, the commission said, policy-makers have not fairly considered the damaging impact dams have on downstream rivers and aquifers and the populations that are forced to move to make room for reservoirs.

Resistance to major new dam projects emerged with the rise of the environmental movement in the 1970s, particularly in Europe and the United States, as advocates pointed to the

harm caused by dam construction. In the industrial world, "it is now more likely that a dam will be torn down than a new one will go up," says Ward.

But in China, South Asia and South America, dams are "multiplying like mushrooms," she writes. ⁷⁹ If China's new Three Gorges Dam — the world's largest hydroelectric project — had been built midway through the past century, it might have been considered one of the world's great engineering feats. The main wall of the massive, 60-story structure spanning the Yangtze River was

Empowering Women May Quench Thirst

'Should girls be kept home from school to collect water?'

For millennia, the nomadic Tuareg people have lived by herding, migrating across vast rangelands south of the Sahara Desert to water and graze their animals. But decades of drought are destroying the traditional Tuareg way of life — killing herds, drying up grazing lands and forcing many to settle in villages.

"We used to saddle the camel and put all the nice things on its back and put on our nice clothes and go," Tuareg chief Mohamed Ag Mata told a reporter last year. "We were afraid of nothing." ¹

But the changes, paradoxically, offer hope for a better existence to women and children in the male-dominated Tuareg culture — giving them access to the employment, education and social rights that will give them a greater say in community water policy.

Increasingly, educating and empowering women is seen as an effective way to expand access to clean water across the developing world. Virtually every major international organization dealing with water scarcity is calling for change in women's decision-making roles, including The World Bank, the U.N. Human Development Programme, the World Health Organization, the World Water Forum, the World Commission on Dams and the Stockholm-based Global Water Partnership.

In the developing world, the job of hauling water rests, literally, almost entirely on women's shoulders. A UNICEF study in 23 sub-Saharan countries found that a quarter of women spent 30 minutes to an hour each day collecting and carrying water, and 19 percent spent an hour or more. In Mile Gully, an impoverished rural area of Jamaica, hauling the family's water can take a woman two to five hours a day. ²

The high incidence of waterborne disease caused by the lack of clean water further burdens women in poor, rural communities, because they are the primary caregivers for the sick.

"Should a woman care for a sick child or spend two hours collecting water?" asks the latest U.N. human development report. "Should girls be kept home from school to collect water, freeing time for mothers to grow food or generate income? Or should they be sent to school to gain the skills and assets to escape poverty?" ³

But despite having to bear the greatest burden caused by a lack of water, women "play no role in the decision making for their communities," said Margaret Mwangi, a specialist in forestry and environmental issues who has worked for UNESCO. ⁴

Women's lack of property rights prevents them from having a say in how water is distributed in their provinces. Women own less than 15 percent of the world's land and in many countries cannot legally own property separately from their husbands. "Lacking rights to land, millions of women in South Asia and sub-Saharan Africa are denied formal membership rights to participate in water-user association meetings," according to the U.N. "Human Development Report 2006." ⁵ And even those who are welcomed at irrigation-association meetings often cannot find the time. "Meetings are on Friday nights. At that time, after cooking for my husband and the kids, I still have a lot of work to do around the house," said a woman in Ecuador. "Even if I go to the meeting, it's only to hear what the men have to say. Men are the ones who talk and discuss." ⁶

Unless both water and gender policies are reformed, water scarcity threatens to worsen women's plight, says the Sri Lanka-based International Water Management Institute. ⁷ Studies recommend a wide range of strategies to strengthen women's roles in gaining access to water and sanitation services, including micro-credit and micro-insurance programs that target women; training programs in rural irrigation and sanitation processes; creating rural women's councils and broadcasting radio programs on women's issues. ⁸

But gender traditions can prove hard to change. Along the Bay of Bengal coast, decision-making and financial control over irrigation systems in the Indian state of Andhra Pradesh, has been decentralized, giving more authority to local communities. Nevertheless, only 4 to 5 percent of the women surveyed in two districts believed they could influence decisions in village meetings. "Women, and particularly poor women, rarely participate," the human development report concluded.⁹

Experts say progress for women requires a push from the bottom and pressure from the top. Legislation in Uganda, for instance, requires that all agencies — from national to village levels — include at least 30 percent female representation.

"Affirmative action may not remove cultural barriers," the U.N. report said, "but it does challenge their legitimacy."¹⁰

That may even be happening among the Tuaregs, says Hadijatou, describing her new life in a village near Timbuktu in Mali. "Before, everything was given to us by the men. When you are given what you need by other people, you are dependent on them. But when you are producing what you need, you depend on nobody. So life is far better now."¹¹

¹ Richard Harris, "Drought Forces Desert Nomads to Settle Down," National Public Radio, July 2, 2007.

² Polioptro Martinez Austria and Paul van Hofwegen, "Synthesis of the 4th World Water Forum," Mexico City, 2006 p. 4, www.worldwaterforum4.org.mx/files/report/SynthesisoftheForum.pdf.

³ "Human Development Report 2006 — Beyond Scarcity: Power, Poverty and the Global Water Crisis," U.N. Development Programme, 2006, p. 87; <http://hdr.undp.org/en/reports/global/hdr2006/>.

⁴ Margaret Mwangi, "Gender and Drought Hazards in the Rangelands of the Great Horn of Africa," *Women & Environments International Magazine*, Spring 2007, p. 21.

⁵ "Human Development Report," *op. cit.*, p. 194.

⁶ *Ibid.*

⁷ David Molden, ed., "Summary," *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*, International Water Management Institute, p. 10, www.iwmi.cgiar.org/assessment/files_new/synthesis/Summary_SynthesisBook.pdf.



AP Photo/Shakil Adil

Women and girls in poor countries, like these in Pakistan, bear the greatest burden from a lack of potable water.

⁸ Austria and Hofwegen, *op. cit.*, pp. 43, 63, 96.

⁹ "Human Development Report," *op. cit.*, p. 193.

¹⁰ *Ibid.*, p. 194.

¹¹ Harris, *op. cit.*

completed in 2006, and by the end of 2008 it is expected to deliver up to 18 million kilowatts per hour — nearly a tenth of the electricity needs of China's surging economy.⁸⁰ But in today's perspective, the monumental structure symbolizes the threat of environmental destruction caused by major dam construction.

The gargantuan project's human and environmental costs have alarmed opponents. According to the Chinese government, more than a million river-side residents were forced to move as

the water rose behind the dam. The rising water levels have triggered some massive landslides on the riverbanks, and a senior government official warned last September that if such ecological and environmental dangers are not dealt with, "the project could lead to a catastrophe."⁸¹ But more recently, Chinese officials have insisted the project will be operated safely.⁸²

Some water experts still advocate new, smaller dams in developing countries to control flooding, store irrigation water and generate electricity. For instance,

most of India's rainfall occurs in about 100 hours during the monsoon season. While reservoirs capture some of these torrents, most escape to the sea.⁸³

The 4th World Water Forum in Mexico City in 2006 cited Norway as a role model for the value of dams. "Electricity from hydropower was the key factor in transforming Norway from one of the poorest countries in Europe a century ago to the industrialized and wealthy nation of today," said Anita Utseth, Norway's deputy minister for petroleum and energy.⁸⁴



Imaginechina via AP Images

China's 60-story Three Gorges Dam — the world's largest hydroelectric project — is expected to deliver up to 18 million kilowatts per hour by the end of 2008, nearly a tenth of China's electricity needs. Critics say the Yangtze River structure symbolizes environmental destruction that can be caused by major dam construction. More than a million riverside residents were forced to move as the water rose behind the dam.

As Ward notes, “In some places, if no reservoirs are built, poor people will be denied the means to improve their lives.”⁸⁵

Regulating Water

Who owns water? What rights do water users have? How should conflicts be resolved?

The globe's oldest recorded societies were formed not only for defense but also to try to control the flow of water in rivers that were crucial to farming.

Under Roman law, water resources were the property of the state, which was responsible for their development and protection. Islamic water law in the parched Middle East followed a similar path — irrigation canals and ditches had to be adequately planned and spaced to prevent infringement on others' water sources.⁸⁶

But ancient codes also recognized that landowners did not have to share well water in times of scarcity, and people living closest to rivers and lakes had first claim on their waters. “The cistern nearest to a water channel is

filled first, in the interests of peace,” said the 12th-century Jewish theologian and philosopher Maimonides.⁸⁷

Eventually, the doctrine of “riparian” rights — giving those living closest to water the first claim on its use — became merged with a “public trust” doctrine, holding that water was a common resource to be managed by the state for the common benefit. One person's use of water could not infringe on a neighbor's reasonable needs. The doctrine was embraced by many countries in Europe — including Britain, France and Spain — which then exported the principle to their colonies abroad.⁸⁸

But in the Western United States, Chile and Mexico, private water rights were recognized, particularly after the 1848 gold rush in the United States. A miner finding a gold seam would claim water from the nearest creek to wash dirt away from precious nuggets. His claim established a “first-in-time, first-in-use” priority allowing him to take as much as he needed.⁸⁹ This “prior appropriation” doctrine was a starter's gun for unchecked diversion and exploitation of water resources to create farms and cities in the arid West.⁹⁰

Of course, in most legal debates about water, individual rights are submerged by political elites, rulers and dominant factions. For instance, Senegalese law provides for a democratic distribution of irrigated lands. But in practice, tribal nobles' descendants still claim the lion's share of the land and allocate rights to powerful outsiders, including military leaders, politicians and judges.⁹¹

In Central Asia during Soviet rule, for instance, Kyrgyzstan, Tajikistan and Uzbekistan — which abut the Syr Darya and Amu Darya river basins — shared the reservoir and hydropower output from Kyrgyzstan's largest reservoir. Now, as separate states, their cooperation has virtually ended, according to a U.N. report. Kyrgyzstan is holding on to more of its reservoir volume in order to increase its hydropower ex-

ports, severely reducing irrigation flows in the other two countries. A constructive dialogue “has been conspicuously absent,” according to the U.N. Human Development Report.⁹²

Two international treaties — the Helsinki Rules of 1966, adopted by the International Law Association, and articles adopted by the U.N. International Law Commission — specify how cross-border water disputes should be resolved. Rivers that divide nations, according to the treaties — must be considered common resources, not under any one nation’s control. They also advocate a policy of “no harm” — each riparian nation has the right to “equitable utilization” of a shared water supply, and a nation’s water use should not damage its neighbors’ water needs. Prior appropriation claims are not allowed, and countries are called on to share accurate information on water resources.⁹³

Before fair water-use policies can be expected, governments must consider the needs of the poor and politically weak, whose water needs are usually greatest, says water expert Sandra Postel, director of the Global Water Policy Project in Massachusetts. That means “adding seats around the table,” she says.⁹⁴ For example, Ghana successfully expanded its water and sanitation services in recent years after water policy was decentralized, and village and district water councils were formed. The result: improved planning and more reasonable priorities for water funding, according to the U.N.⁹⁵

Misusing Water

In Mumbai’s Dharavi slum, which lies between the international airport and the city’s financial center, an estimated 1 million Indians live in huts and shanties. With only one toilet for every 1,440 people, gutters overflow with waste in the rainy season, turning the streets into open sewers.⁹⁶



AFP/Getty Images/Tony Mwanki

A Masai herdsman in Kenya's Rift Valley tends to a dying sheep in January 2006. Today 850 million people live in areas where adequate food supplies are at risk because of drought — two-thirds of them in South Asia and sub-Saharan Africa, where the impact of climate change on food production is expected to be worst.

Such unsanitary conditions in developing countries contribute to a plague of diarrhea that not only kills an estimated 1.8 million children across the globe each year but also repeatedly sickens many times that number, leaving them malnourished and vulnerable to other diseases and keeping them from school.⁹⁷

Trachoma, spread by a fly that breeds in human feces, afflicts nearly 6 million people worldwide, causing widespread blindness. The disease “is a passport to poverty,” says the U.N.’s “Human Development Report,” because it prevents victims from working.⁹⁸

“At the start of the 21st century one in five people living in the developing world — some 1.1 billion people in all — lack access to clean water,” and nearly half the developing world has no access to adequate sanitation.⁹⁹

Some of the same conditions existed in Europe and the United States during most of the 19th century, as farm families migrated to vast urban slums. During the summer in 1858, the stench of untreated sewage in the Thames River (called the “Great Stink” by the *London Times*) forced the Parliament to close temporarily.¹⁰⁰ In the

Water Schemes Range From Monumental to Zany

Many are costly and controversial.

After wildfires devastated parts of Southern California and dry winds parched the Southwest last summer, New Mexico's Gov. Bill Richardson, a Democratic candidate for president, made a startling proposal.

"States like Wisconsin are awash in water," Richardson told the *Las Vegas Sun*, proposing that water from the Great Lakes be piped to his state. With nearly 20 percent of the world's fresh water, the five vast lakes are an irresistible target to promoters, politicians — and potentially — corporate water suppliers.

"You're going to see increasing pressure to gain access to this supply," said Aaron Packman, a professor of civil and environmental engineering at Northwestern University. "Clearly, it's a case of different regional interests competing for this water."¹

In 1985, Quebec provincial officials floated a plan to sell Canadian river water to the high plains states. The Great Replenishment and Northern Development Canal (GRAND) envisioned pumping river water from Quebec into a reservoir in Ontario. From there the water could travel by aqueduct to the Great Lakes and then by canal to the American plains. Nothing came of it.

Even grander was the North American Water and Power Alliance in the 1960s, which proposed to dam dozens of north-flowing rivers in Canada's western provinces, channeling their waters into a new reservoir 500 miles long — about the distance from Pittsburgh to Chicago — to irrigate the high plains and refill the Colorado River's flows to California. But the half-trillion-dollar price tag sank the proposal. And its environmental cost would have been "ungraspable," says Canadian journalist Marq de Villiers, author of *Water: The Fate of Our Most Precious Resource*.²

The idea still seems to stir anxieties in Canada. An off-hand remark by President George W. Bush in 2001 about the benefits of Canadian water exports to the United States caused a brief uproar, and last year Canada's Liberal Party Leader Stéphane Dion accused the government in Ottawa of trying to put the matter back on the U.S.-Canada agenda — a claim both governments denied.³

Mega-project dreams still survive in China, however, which is planning a series of canals to carry Yangtze River water thousands of miles to the Yellow River and on to the huge cities of Beijing and Tianjin.⁴

And in 2004, Israel agreed to purchase the equivalent of 35 million gallons of freshwater per day from Turkey's Manavgat River, to be shipped aboard tankers. Turkish water exports to Cyprus and other water-short destinations were also under consideration. The agreement was put on hold in 2006 after high-

er oil prices made tanker transportation uneconomical, according to both countries.⁵

And then there are the slightly zany ideas, such as Calgary entrepreneur James Cran's plan to move water by sea inside floating 5,000-ton plastic bags, or towing Arctic icebergs to distant metropolises.⁶

Most monumental water-moving schemes, however, trigger intense opposition. Gov. Richardson's proposal, for instance, is opposed by eight Great Lakes-area states and two Canadian provinces, and drew a terse, unequivocal "No" from Michigan's Democratic Gov. Jennifer Granholm.⁷



AP Photo/California Dept. of Water Resources/Dale Kolke

The monumental California Aqueduct brings vitally needed water 444 miles from to Southern California farmers and residents.

¹ Tim Jones, "Great Lakes key front in water wars," *The Chicago Tribune*, Oct. 28, 2007, www.chicagotribune.com/news/local/chi-water_bd0ct28,1,5145249.story.

² Marq de Villiers, *Water: The Fate of Our Most Precious Resource* (1999), p. 260.

³ Launce Rake, "Canadians fearful of U.S. water grab," *Las Vegas Sun*, May 28, 2006. See also Bruce Campion-Smith and Susan Delacourt, "Secret talks underway, Dion claims," *The Toronto Star*, Aug. 18, 2007, p. 18.

⁴ Diane Raines Ward, *Water Wars: Drought, Flood, Folly and the Politics of Thirst* (2002), p. 171.

⁵ Josef Federman, "Israel, Turkey put landmark water agreement into deep freeze," *The Associated Press*, April 5, 2006.

⁶ de Villiers, *op. cit.*, p. 277.

⁷ Jones, *op. cit.*

1890s Britain's infant mortality rate was about the same as Nigeria's today.

Water-treatment legislation in mid-19th-century Britain mandated creation of municipal water companies, followed

by an expansion of sanitation services after 1880. By 1910, the country's rate of infant mortality had fallen by nearly 40 percent. The critical factor for change, according to some experts,

was an extension of voting rights in Britain beyond property-owning classes to those who lacked clean water and sanitation, creating a political constituency for reforms.¹⁰¹

But the cost of expanding sanitation services in the developing world today would be immense. A study led by former International Monetary Fund President Michael Camdessus estimates that closing the sanitation services gap could cost \$87 billion over the next two decades.¹⁰²

Experts today debate which must come first in the developing world: good governance or solutions to water and sanitation needs. In *The World's Water 2006-2007*, the authors conclude that "eradicating corruption and political interference and ensuring the participation of all stakeholders will be critical to the successful governance of water."¹⁰³ The 1,320-km (820 miles) Rhine River — long called "the sewer of Europe" — was cleaned up after a 1986 industrial fire in Basel, Switzerland, allowed more than 30 tons of pesticides, dyes, mercury and other poisons to spill into the river. Millions of fish were killed, and major cities had to close their municipal water intakes. German Chancellor Angela Merkel, a former environmental minister, has called the "rebirth of the Rhine . . . one of the great environmental success stories of the century."¹⁰⁴

But to the east, the blighted Danube testifies to the damage caused by selfish, beggar-thy-neighbor policies by the nations along its 1,770-mile course. Efforts to reengineer the river began in the 16th century with projects to steer its annual floods into canals or trap them behind huge dams. Historically, vast amounts of untreated human wastes and toxic industrial effluents were also dumped into the river, a situation that worsened during the Cold War. Soviet-era bosses had no scruples about flushing wastes into rivers, and Moscow pushed Hungarian and Czech governments to divert the Danube into man-made waterways in order to speed Russian barge traffic. Parts of the project were begun, but before it went very far, the Soviet Union collapsed.

In the 1990s, a third of the Danube's flow was being taken for human use — an extraction rate that researchers warned would be unsustainable if the vast region served by the river faced continued growth and a prolonged drought.¹⁰⁵

Today the Danube nations are working toward the river's recovery, and the European Union has pledged \$3.3 billion to help.¹⁰⁶

Ocean Waters

As a last resort, some wealthy nations and cities facing serious shortages of freshwater — including the Persian Gulf states, Israel, Singapore and a handful of cities in California, Florida and Australia — have turned to desalination of the oceans' limitless resources.

More than 10,000 desalting plants were in operation or contracted for construction in January 2005, with a total capacity of 9.6 billion gallons per day. At present, however, desalination plants have the capability to provide just three one-thousandths of daily global freshwater consumption.¹⁰⁷

Governments usually subsidize up to a third of the consumer cost for desalinated water because it costs many times more than typical urban water service.¹⁰⁸ Improved technology and engineering dropped average desalination costs from \$1.60 per 264 gallons in 1990 to about 60 cents in newer plants by 2002. But construction costs have risen recently due to higher steel prices, and operating costs have climbed sharply as energy prices have risen. (Energy costs account for one-third to more than one-half of the expense of desalinating water.) The safe disposal of the brine residue from desalination remains an environmental issue that is still not well researched, according to "The World's Water" report.¹⁰⁹

Some experts believe desalination will begin to grow at double-digit rates

as water becomes scarce and prices for conventional water rise.¹¹⁰ For example, California had 20 desalination plants in the construction pipeline in 2006, which could increase California's desalination capacity 100-fold, providing about 7 percent of the freshwater the state used in 2000. ■

CURRENT SITUATION

Melting Snows

The deep snowpack covering the world's mountains in winter is a renewable gift of nature — melting in spring to restock rivers, lakes, reservoirs, aquifers and eventually flowing back into the ocean. Then evaporating ocean water turns into snowfall in the mountains, repeating the cycle. But the snowpacks have been shrinking — and melting earlier — over the past half-century, upsetting crucial seasonal water flows.¹¹¹

In parts of the Western United States, for example, the snowpack is down to 40 percent of normal. While short-term climate conditions like El Niño are partly to blame, Earth's predicted warming trend is expected to cause dramatic changes in the future. The U.S. Department of Energy's Pacific Northwest National Laboratory has forecast, for instance, that by century's end South America's Andes Mountains will have lost half of their winter snow cover, and ranges in Europe and the U.S. West nearly half.¹¹² (See figure, p. 37.)

"Our main reservoir is snow, and it's going away," says Phillip Mote, a professor of atmospheric sciences at the University of Washington in Seattle.¹¹³

The early melting is seen as an indication that climate change is already

LOOMING WATER CRISIS

affecting water scarcity. “Some of what’s happening with the early snow melts could be due to variations based on ocean circulation,” said Gregg Garfin, project manager of the University of Arizona’s Institute for the Study of Planet Earth. “But there’s a pretty large fraction that can’t be explained that way, and we think that’s due to increasing temperatures.”¹¹⁴

are 50 to 100 years away,” he said. “But it’s not. It’s happening now.”¹¹⁷

In the American Southwest — as in other arid regions of the world — drought is the biggest, most persistent enemy, but scientists are divided over how much of the current drought is due to long-term climate change.

A report by scientists at the Met Office Hadley Centre for Climate Pre-

ing “the potential seriousness of future climate change impacts if CO₂ emissions continue to increase substantially.”¹¹⁸

These judgments are still hedged. “It is quite possible that . . . climate change may be having an impact on droughts, not only in the U.S. but around the world,” says Michael J. Hayes, director of the National Drought Mitigation Center at the University of Nebraska, Lincoln. But that’s not clear yet. “I don’t think we can use what is happening today as an argument for climate change. It should open our eyes to the potential impacts that might occur.”

Looking further ahead into the century, scientists warn that drought is likely to persist over longer periods, hitting hardest at the world’s most-vulnerable arid regions.¹¹⁹

A trend toward extreme weather events, ranging from drought and high temperature to violent storms and flooding, is already evident, according to the National Center for Atmospheric Research.¹²⁰ Global warming is likely to fuel even more extreme weather, center researchers said. “There’s a two-third’s chance there will be a disaster,” says Nobel laureate Steven Chu, director of the Lawrence Berkeley National Laboratory, “and that’s in the best scenario.”¹²¹

The Southwestern United States and other regions appear headed, by mid-century, to a condition of permanent drought caused by global warming, concluded Columbia University’s Lamont-Doherty Earth Observatory, after surveying recent studies. “[G]lobal warming not only causes water shortage through early snow melt, which leads to significant water shortage in the summer over the Southwest, but it also aggregates the problem by reducing precipitation,” said Mingfang Ting, senior research scientist at Lamont-Doherty and co-author of the survey.¹²²

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AP Photo/Reed Saxon

Wildfires destroyed hundreds of homes in Malibu, Calif., last October during a severe drought, reigniting the perennial national debate about the folly of building homes in water-scarce areas.

The amount of snow melting into the Colorado River Basin has declined by 10 to 30 percent over the last 30 years, according to Brad Udall, director of the University of Colorado’s Western Water Assessment.¹¹⁵

Earlier melting has caused unseasonal spring flooding in parts of the West,¹¹⁶ while a decade of drought has left forests more vulnerable to fires and beetle infestations, said Tom Swetnam, director of the University of Arizona’s Laboratory of Tree-Ring Research. “Lots of people think climate change and the ecological responses

diction and Research — Britain’s weather office — cites evidence that rising emissions of greenhouse gases have exacerbated drought conditions during the past half-century. Greenhouse gases — the carbon dioxide, methane, nitrous oxide and ozone produced from burning fossil fuels — are causing the Earth’s temperature to rise by helping to trap the sun’s heat, creating a greenhouse effect, according to the Intergovernmental Panel on Climate Change.

“Further research is required,” said the Hadley Centre report, not-

Should water be privatized?



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no one washes a rental car” is a truism that suggests that ownership is crucial to stewardship. We also might say, “No one conserves water” for the same reason — too often it’s not clear who benefits from conserving water because it’s unclear who owns the water. As long as water’s cheap, why fix the leaky faucet or switch to an efficient irrigation system?

Making the ownership link is relatively easy, because water is already claimed by someone — either a municipality, individual farmers or a government agency.

In practice, however, claims compete with one another, especially when water is scarce. Miners and farmers on the Western frontier in the 19th century devised the prior-appropriation system, whereby water owners were allowed to resolve conflicts by moving water to higher-valued uses, and trades between farmers have gone on for a century.

The recent drought in the Southeast has raised a red flag about scarcity. The best mechanism for allocating water is to clarify ownership among municipal, agricultural, industrial and environmental users and allow trades. If Atlanta must buy water from lower-valued agricultural users, farmers will have an incentive to save water and sell it, and municipal consumers will face a higher price and thus an incentive to conserve.

Some worry that water markets will put undue burden on the poor while the rich continue enjoying their country club lawns. But the poor could be issued water stamps, akin to food stamps, for buying water. Or suppliers could charge less for minimum amounts of water needed for necessities and increase the price of water for luxuries.

When water rights are allocated through political processes, the poor usually do not get many of the initial rights, forcing them to purchase water if they are to get any. And data from the Chilean water markets suggest that the poor don’t fare much better when water is traded on the open market. Perhaps there should be some guaranteed survival quantity of water that is a basic human right.

The problem is not a failure of water markets, but a failure of political allocation, which will not be rectified by preventing water markets from delivering water at a profit to all, regardless of income.

As water scarcity increases in the 21st century, water bureaucracies will bring more conflict, while water markets will foster more cooperation. With this choice, it will be impossible to keep a good water market down.



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in the early 1990s, multinational corporations began to view water services as an important, new profit center — especially in the United States, where 85 percent of water utilities are public. With 1.2 billion people in the developing world lacking access to safe drinking water, the corporations lobbied the World Bank to condition its loans for water services on privatization.

Since then, numerous failed ventures have proven that the cost of privatizing water is too high. It was certainly too high for Tanzania, which terminated a 10-year contract with Biwater after two years of poor management left the government short \$3.25 million and the poorest citizens of Dar es Salaam without water. Likewise, massive rate hikes and poor management led Bolivia to end a 40-year contract with Bechtel after only a few months. Similar ventures in Argentina, the Philippines, Indonesia, South Africa and the United Kingdom also have proven unworkable.

In the United States, many municipalities have considered privatization to upgrade their aging systems, but the ventures have been plagued by corruption, high rates, poor service and public outrage. Atlanta terminated a 20-year contract with United Water 16 years early due to bungled emergency responses, boil-water alerts, discolored water and billing difficulties. In 2002, a coalition of citizens’ organizations in New Orleans defeated what would have been the largest water-privatization initiative in the United States. Meanwhile, residents of Stockton, Calif., sued the city for failing to perform a proper environmental review of the city’s water-privatization contract.

Given this abysmal track record, new solutions are necessary to meet water needs. For example, some U.S. cities have cut costs by improving internal management. Phoenix saved \$77 million by working with a labor management team to optimize staffing, organize self-directed work teams and utilize new technology. Similarly, San Diego saved \$37 million by developing a more cost-conscious management system.

Safeguarding our water systems is a vital public responsibility. Yet, shockingly, the Environmental Protection Agency estimates that each year we fall \$22 billion short of our water infrastructure spending needs. To address this funding gap, we must ensure that public utilities can upgrade and maintain their systems without turning to privatization.

At Food & Water Watch, we support a Clean Water Trust Fund to help ensure that the future of America’s water lies in publicly accountable management and secure, clean, affordable water for all.

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Wasted Water

Although Atlantans worry that falling levels in Lake Lanier are jeopardizing their drinking water, they might be surprised to learn that up to 18 percent of the city's water is being lost through leaky pipes and wastefulness.¹²³ In London, the mayor asked the Thames Water company to stanch the 238 million gallons per day being lost through old, leaky water pipes rather than build a costly desalination plant to purify Thames River water. Regulators have

design is to get rid of it as fast as you can: get it off the roof, off the street, into the storm sewers and rush it off into the ocean, never used by anybody." Extravagant water consumption continues in wealthy residential areas and in farming regions where inefficient surface and sprinkler irrigation systems waste up to 25 percent of the water they use.¹²⁶ Efficient "drip" irrigation systems — which deliver water directly onto the crops, reducing evaporation to only 5 percent — are used on less than 1 percent of irrigated lands worldwide, largely because of higher equipment costs.¹²⁷

irrigate parks and golf courses. Illinois, Florida, California, Arizona and Ohio reported the largest increases. The U.S. Geological Survey estimated that the amount of graywater used more than doubled between the 1970s and 1995.¹²⁹

Water conservation also is expanding in the construction field. In the United States, Canada, Brazil, India and three-dozen other nations, water-saving green architecture for commercial and government buildings is growing in popularity, but the large-scale use of water-conservation practices by water utilities is still "very rare," says Vickers.¹³⁰

Hirsch says policymakers must recognize that rivers and lakes need sustained flows of water to maintain their long-term environmental viability — and their full range of usefulness. Although this movement is "still in its infancy," at least 70 nations have begun programs to conserve or restore water flows in rivers.¹³¹ For example, a \$10 billion project in Florida aims to restore the natural flow of the Kissimmee River, and programs in Australia, Israel, Finland, Thailand, South Africa and Zambia would release flood waters from dams to move sediments downstream and expand plant and animal habitats.

"When given a chance, rivers often heal," write the Global Water Policy Project's Postel and Brian Richter, a staff director at the Nature Conservancy, in *Rivers for Life*.¹³² ■

"If 12 jumbo jets [full of children] were crashing every day, the world would want to do something about it. They would want to find out why it was happening."

— U.N. water expert Brian Appleton, commenting on the deaths each day of 5,000 children due to lack of access to clean water.

since approved the project because of the urgency of the shortages.¹²⁴

U.S. water systems lose an estimated 15 percent to 25 percent of their water through leakage, and older or poorly maintained networks around the world lose more than 40 percent. However, notes American water conservation consultant Amy L. Vickers, water leakage is "chronically underestimated, ignored, or treated as a tired 'Unsolved Mystery,' " by utilities.¹²⁵

In coastal cities, vast amounts of rainwater and melting snow are "basically lost," flowing into storm drains that flow out to sea, says the U.S. Geological Survey's Hirsch. "The urban

But according to Vickers and other experts, a conservation ethic is beginning to emerge, particularly where water supplies are threatened by drought. For example, aggressive conservation strategies in Boston and Albuquerque, N.M., are reducing systemwide demand by 25 and 18 percent, respectively. "A few other systems, such as New York City, have also realized substantial water savings and wastewater volume reductions that have allowed them to avert major infrastructure expansions," Vickers notes.¹²⁸

In the United States, some states have begun requiring cities to use reclaimed wastewater ("graywater") to

OUTLOOK

Thirst and Hunger

The world's population, now about 6 billion, is likely to jump by more than a third by 2050, reaching nearly

9 billion, according to the U.N.¹³³ Such a large increase will cause not only thirst but also hunger, says the International Water Management Institute. The average European uses about 13 gallons of water a day for drinking, cooking and sanitation. But the food an individual consumes in a typical day requires 800 to 900 gallons to grow.¹³⁴

“The world needs roughly 70 times more water to produce food than it needs for cities,” says Rijsberman, former director of the International Water Management Institute in Sri Lanka.¹³⁵

Since 1950, water withdrawals for human use have tripled and irrigated cropland doubled. Today, despite important increases in farming productivity, 850 million people live in areas where adequate food supplies are at risk — two-thirds of them in South Asia and sub-Saharan Africa, where the impact of climate change on food production is expected to be worst.¹³⁶

The productivity of irrigated cropland has increased dramatically in the past half-century, according to the World Bank. The production of rice and wheat, for instance, increased 100 percent and 160 percent in that period, respectively, with no increase in water use per bushel. “However, in many (river) basins, water productivity remains startlingly low,” the bank reports. Without greater agricultural productivity or major shifts in farming locations, the amount of water needed for farming will jump 70 to 90 percent by 2050, according to the assessment.¹³⁷

As food requirements continue to rise, the increase in irrigation has slowed as underground water levels have begun to recede. Farmers also face growing competition for water from industry.¹³⁸

Rijsberman predicts the average price of water used in agriculture worldwide could increase by two to three times in the coming decades, inflating



AP Photo/Carlos Osorio



National Geographic/Getty Images/James L. Stanfield

Spraying vs. Dripping

Due to evaporation, irrigation systems like this one in Lakefield Township, Mich. (top), waste up to 25 percent of the water they distribute. More expensive drip irrigation systems, like this one in Israel (bottom), lose only about 5 percent to evaporation but are used on less than 1 percent of irrigated lands worldwide.

global food prices. In addition, industries and power producers can outbid farmers for scarce water. If irrigated harvests are cut back through a lack of water or because water is diverted to industrial use, world grain prices will rise even more.¹³⁹

Policymakers still must resolve a major question about water pricing:

Should it be priced competitively, according to its value, like wheat, rice and other food commodities grown with water? A handful of governments have done just that: Chile allows landowners with water on or under their property to trade water rights to the highest bidders. Mexico, several Australian states and Cal-

ifornia also have water-trading programs.¹⁴⁰ In Texas, the flamboyant oil trader T. Boone Pickens has created a company, Mesa Water, to buy water from landowners above the Ogallala aquifer, to sell to water-short Texas cities.¹⁴¹

But many experts think trading water as a commodity is a non-starter for most governments. "There is no movement in the real world, with elected officials," says U.S. water-law expert Robert Glennon. "Water pricing is the third rail of water politics."

Another option, supported by the World Bank and others, is trading "virtual" water. That occurs when a country with scarce water or poor agricultural land concentrates on developing export goods to earn the money needed to import food from water-rich nations with productive, low-cost food producers. Such trades, which would require a lowering of agricultural trade barriers, could bring down food production costs in water-poor countries and help reduce global water consumption, according to a World Bank report. Wheat grown in India, for example, consumes four times more water than wheat grown in France. By importing maize rather than growing it, Egypt reduces its national water consumption by 5 percent.¹⁴²

But importing "virtual" water also has a downside. "In Morocco, for example, one study showed that while the nation as a whole would benefit from agricultural trade liberalization, those benefits would be concentrated on the urban population; farmers — particularly poor farmers — stood to lose," said a World Bank report.¹⁴³ For that reason, critics of expanded international trade oppose the "virtual" approach.

Other advocates call for greater reliance on rain-fed farming. Just over half of the world's food, by value,

is produced using rainfall, but this sector — dominated by poor rural farmers — has traditionally been ignored by food producers and governments in favor of major irrigation strategies.

"Upgrading rain-fed areas has high potential both for food production and for poverty alleviation," says the International Water Management Institute. Increasing small-scale rain-water storage with supplemental irrigation and better land management could produce quick output gains in these areas.¹⁴⁴

If farmers continue to depend on irrigation for 40 percent of their water, producing an acceptable diet for 2.4 billion more people in the next 30 years would require another 20 Nile Rivers or 97 Colorado Rivers, says water expert Postel. "It is not at all clear where this water is to come from."¹⁴⁵

Notes

¹ Charles C. Mann, "The Rise of Big Water," *Vanity Fair*, May 2007; Reuters, "China drought threatens water supply for millions," March 28, 2007.

² Xinhua News Agency, "Drought leaves nearly 250,000 short of drinking water in Guangdong," *People's Daily Online*, Dec. 13, 2007; <http://english.people.com.cn/90001/90776/6320617.html>.

³ Jonathan Watts, "Dry, Polluted, Plagued by Rats: The Crisis in China's Greatest Yangtze River," *The Guardian* (Britain), Jan. 17, 2008; <http://chinaview.wordpress.com/category/environment/drought/>.

⁴ Xinhua News Agency, "Climate change blamed as drought hits 100,000 at China's largest freshwater lake," *People's Daily Online*, Dec. 14, 2007; <http://english.people.com.cn/90001/90776/6321329.html>.

⁵ Chris O'Brien, "Global Warming Hits China," *Forbes.com*, Jan. 6, 2008; www.forbes.com/opinions/2008/01/04/poyang-lake-china-oped-cx_cob_0106poyang.html.

⁶ Peter H. Gleick, "Time to Rethink Large International Water Meetings," *The World's Water 2006-2007*, Island Press, p. 182; www.world-water.org/.

⁷ David Molden, ed.; "Summary," *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*, International Water Management Institute, p. 10; www.iwmi.cgiar.org/assessment/files_new/synthesis/Summary_SynthesisBook.pdf.

⁸ See "Summary, Human Development Report 2006: Beyond scarcity: Power, poverty and the global water crisis," United Nations Development Programme, p. 26, http://hdr.undp.org/en/media/hdr2006_english_summary.pdf.

⁹ Carmen Revenga, *et al.*, "Executive Summary, Pilot Analysis of Global Ecosystems: Freshwater Systems," World Resources Institute, 2000, pp. 4, 26; www.wri.org/publication/pilot-analysis-global-ecosystems-freshwater-systems.

¹⁰ Stacy Shelton, "Lake Lanier hits lowest point since its construction," *The Atlanta Journal Constitution*, Nov. 19, 2007; www.ajc.com/metro/content/metro/stories/2007/11/19/lanierlowweb_1120.html?cxntlid=homepage_tab_newstab. For background, see Mary H. Cooper, "Water Shortages," *CQ Researcher*, Aug. 1, 2003, pp. 649-672.

¹¹ M. Falkenmark, *et al.*, "On the Verge of a New Water Scarcity: A call for good governance and human ingenuity," Stockholm International Water Institute (SIWI) Policy Brief, 2007, p. 17. For background, see Colin Woodard, "Curbing Climate Change," *CQ Global Researcher*, February 2007, pp. 27-50.

¹² "Water and Terrorism," *The World's Water 2006-2007*, *op. cit.*, p. 1.

¹³ Environmental Protection Agency, "Water Sentinel Initiative," www.epa.gov/watersecurity/pubs/water_sentinel_factsheet.pdf.

¹⁴ Met Office Hadley Centre, "Effects of climate change in developing countries," November 2006, pp. 2-3, www.metoffice.gov.uk/research/hadleycentre/pubs/brochures/COP12.pdf; Michael McCarthy, "The Century of Drought," *The Independent* (London), Oct. 4, 2006, p. 1.

¹⁵ McCarthy, *ibid.*, p. 1.

¹⁶ World Water Council.

¹⁷ Quoted in "Billions without clean water," March 14, 2000, BBC, <http://news.bbc.co.uk/2/hi/676064.stm>.

¹⁸ David Katz, "Going with the Flow," *The World's Water 2006-2007*, *op. cit.*, pp. 30-39.

- ¹⁹ Data Table 5, Access to Water Supply and Sanitation by Region, *The World's Water 2006-2007*, *op. cit.*, p. 258.
- ²⁰ "Synthesis of the 4th World Water Forum," August 2006, p. 23-24, www.worldwaterforum4.org.mx/files/report/SynthesisoftheForum.pdf. For background on Millennium Development Goals, see www.un.org/millenniumgoals and "U.N. Fact Sheet on Water and Sanitation," 2006, www.un.org/waterforlifedecade/factsheet.html.
- ²¹ "Human Development Report 2006," *op. cit.*, p. 8; <http://hdr.undp.org/en/reports/global/hdr2006/>.
- ²² Australian Broadcasting Corp., "Issues in Science and Technology," transcript, Sept. 22, 2007.
- ²³ Frank Rijsberman, Charlotte Fraiture and David Molden, "Water scarcity: the food factor," *Issues in Science and Technology*, June 22, 2007.
- ²⁴ *Ibid.*
- ²⁵ Sharon P. Nappier, Robert S. Lawrence, Kellogg J. Schwab, "Dangerous Waters," *Natural History*, November 2007, p. 48.
- ²⁶ Marq de Villiers, *Water: The Fate of Our Most Precious Resource* (1999), p. 267.
- ²⁷ "World hit by water shortage," *Birmingham Post*, Aug. 21, 2006, p. 10; http://icbirmingham.icnetwork.co.uk/birminghampost/news/tm_method=full%26objectid=17597105%26siteid=50002-name_page.html.
- ²⁸ "Water Resources Sector Strategy, Strategic Directions for World Bank Engagement," World Bank, 2004, p. 5, www-wds.worldbank.org/external/default/WDSCContentServer/WDSP/IB/2004/06/01/000090341_20040601150257/Rendered/PDF/28114.pdf.
- ²⁹ de Villiers, *op. cit.*, pp. 176-177.
- ³⁰ Frank R. Rijsberman, "1st Asia-Pacific Water Summit," MaximsNews Network, Oct. 8, 2007; www.abc.net.au/7.30/content/2006/s1716766.htm.
- ³¹ Diane Raines Ward, *Water Wars: Drought, Flood, Folly and the Politics of Thirst* (2002), p. 171.
- ³² Nappier, *et al.*, *op. cit.*
- ³³ "Human Development Report," *op. cit.*, p. 176. Also see Meena Palaniappan, Emily Lee and Andrea Samulon, "Environmental Justice and Water," *The World's Water 2006-2007*, *op. cit.*, p. 125.
- ³⁴ "Human Development Report," *ibid.*
- ³⁵ Palaniappan, *et al.*, *op. cit.*
- ³⁶ Marc Reisner, *Cadillac Desert, the American West and its Disappearing Water* (1986), p. 10.
- ³⁷ *Ibid.*, p. 437.
- ³⁸ *Ibid.*, pp. 10-11; also see Robin Clarke and Jannet King, *The Water Atlas* (2004).
- ³⁹ "Approaches to Private Participation in Water Services," World Bank, 2006, p. 213.
- ⁴⁰ Daniel Yergin and Joseph Stanislaw, *Commanding Heights: The Battle for the World Economy* (2004).
- ⁴¹ Juan Forero, "Multinational Is Ousted, but Local Ills Persist," *The New York Times*, Dec. 15, 2005, p. 1; also, Public Citizen, "Water Privatization Case Study: Cochabamba, Bolivia," pp. 1-2, [www.tradewatch.org/documents/Bolivia_\(PDF\).PDF](http://www.tradewatch.org/documents/Bolivia_(PDF).PDF); and Bechtel Corp. statement, "Cochabamba and the Aquas del Tunari Consortium," www.bechtel.com/assets/files/PDF/Cochabambafacts0305.pdf.
- ⁴² "European environment giant Veolia to increase investment in China to \$2.5 billion by 2013," Xinhua News Agency, Nov. 1, 2007.
- ⁴³ *Pinsent Masons Water Yearbook 2007-08*, p. xii, www.pinsentmasons.com/media/1976627452.pdf.
- ⁴⁴ Quoted in Jeff Fleischer, "Blue Gold: An Interview with Maude Barlow," *Mother Jones*, Jan. 14, 2005, www.motherjones.com/news/qa/2005/01/maude_barlow.html.
- ⁴⁵ "Economic Failures of Private Water Systems," Food & Water Watch, Dec. 2007, www.foodandwaterwatch.org/water/waterprivatization/usa/Public_vs_Private.pdf.
- ⁴⁶ Scott Wallsten and Katrina Kosec, "Public or Private Drinking Water?" AEI-Brookings Joint Center for Regulatory Studies, March 2005, pp. 2, 7; www.reg-markets.org/publications/abstract.php?pid=919.
- ⁴⁷ Felipe Barrera-Osorio and Mauricio Olivera, "Does Society Win or Lose as a Result of Privatization?" Inter-American Development Bank, Research Network Working Paper #R-525, March 2007, p. 19.
- ⁴⁸ *Ibid.*, p. 21.
- ⁴⁹ Ward, *op. cit.*, pp. 206-207.
- ⁵⁰ *Pinsent Masons Water Yearbook*, *op. cit.*, p. 3.
- ⁵¹ *Ibid.*, p. 5.
- ⁵² Paul Constance, "The Day that Water Ran Uphill," *IDB America*, Inter-American Development Bank, Dec. 9, 2007, www.iadb.org/idbamerica/index.cfm?thisid=3909&lanid=1.
- ⁵³ "Human Development Report," *op. cit.*, p. 92.
- ⁵⁴ *Ibid.*, p. 179; Ward, *op. cit.*, p. 210.
- ⁵⁵ Malcolm Scully, "The Politics of Running Out of Water," *The Chronicle of Higher Education*, Nov. 17, 2000.
- ⁵⁶ Peter H. Gleick, "Environment and Security," *The World's Water 2006-2007*, *op. cit.*, p. 189.
- ⁵⁷ "Human Development Report," *op. cit.*, p. 221.
- ⁵⁸ Benny Morris, *Righteous Victims* (2001), pp. 303-304.
- ⁵⁹ Ward, *op. cit.*, p. 174.
- ⁶⁰ *Ibid.*, p. 85.
- ⁶¹ *Ibid.*, p. 192.
- ⁶² Undala Alam, letter to the *Financial Times*, April 1, 2006, p. 6. Also see www.transboundarywaters.orst.edu/publications/related_research/Alam1998.pdf.
- ⁶³ Gleick, "Environment and Security," *op. cit.*, p. 189.
- ⁶⁴ *Security and the Threat of Climate Change* (2007), CNA Corp., p. 3; <http://securityandclimate.cna.org/>.
- ⁶⁵ *Ibid.*, p. 20.
- ⁶⁶ *Ibid.*, p. 22.
- ⁶⁷ "Human Development Report," *op. cit.*, p. 216; Clarke and King, *op. cit.*, p. 79.
- ⁶⁸ *Ibid.*, p. 47.
- ⁶⁹ "Human Development Report," *op. cit.*, p. 218.
- ⁷⁰ CNA, *op. cit.*, p. 14.
- ⁷¹ "Dams and Development: A New Framework for Decision Making," World Commission on Dams, Nov. 16, 2000, p. 8; www.dams.org/report/wcd_overview.htm.
- ⁷² Xinhua News Agency, "China's Grand Canal Queues for World Heritage Status," July 6, 2004, www.china.org.cn/english/culture/100401.htm.
- ⁷³ Terry S. Reynolds, *Stronger Than a Hundred Men: A History of the Vertical Water Wheel* (1932), pp. 32, 142.
- ⁷⁴ Jill Jonnes, *Empires of Light: Edison, Tesla, Westinghouse, and the Race to Electrify the World* (2004).
- ⁷⁵ Revenga, *et al.*, *op. cit.*, p. 12.
- ⁷⁶ World Commission on Dams, *op. cit.*, p. 9.
- ⁷⁷ *Ibid.*, p. ii.
- ⁷⁸ Ward, *op. cit.*, p. 51.
- ⁷⁹ *Ibid.*, p. 46.
- ⁸⁰ Lin Yang, "China's Three Gorges' Dam Under Fire," *Time*, Oct. 12, 2007, www.time.com/time/world/article/0,8599,1671000,00.html. Also see Bruce Kennedy, "China's Three

Gorges Dam," CNN.com, 2001, www.cnn.com/SPECIALS/1999/china.50/asian.superpower/three.gorges/.

⁸¹ Jonathan Watts, "Three Georges Dam risk to environment, says China," *The Guardian*, Sept. 27, 2007.

⁸² Xinhua Financial News, "Chinese Government Fights Back in Defense of Three Gorges Dam," Nov. 27, 2007; Jim Yardley, "China vigorously defends the Three Gorges Dam project," *The International Herald Tribune*, Nov. 28, 2007, p. 3.

⁸³ Revenga, *et al.*, *op. cit.*, p. 28.

⁸⁴ "Synthesis of the 4th World Water Forum," *op. cit.*

⁸⁵ Ward, *op. cit.*, p. 47.

⁸⁶ *Ibid.*, p. 187.

⁸⁷ de Villiers, *op. cit.*, p. 59. Also see "Islamic Water Management and the Dublin Statement," The International Development Research Center, Canada, www.idrc.ca/en/ev-93949-201-1-DO_TOPIC.html.

⁸⁸ Katz, *op. cit.*, p. 37.

⁸⁹ Robert Glennon, *Water Follies: Ground-water Pumping and the Fate of America's Fresh Waters* (2002), p. 16.

⁹⁰ *Ibid.*, p. 14.

⁹¹ "Human Development Report," *op. cit.*, p. 185.

⁹² *Ibid.*, p. 214.

⁹³ Ward, *op. cit.*, p. 188.

⁹⁴ Sandra Postel and Brian Richter, *Rivers for Life, Managing Water for People and Nature* (2003), p. 168.

⁹⁵ "Human Development Report," *op. cit.*, p. 103.

⁹⁶ *Ibid.*, p. 37.

⁹⁷ *Ibid.*, p. 42.

⁹⁸ *Ibid.*, pp. 45-46.

⁹⁹ *Ibid.*, p. 33.

¹⁰⁰ *Ibid.*, p. 29.

¹⁰¹ *Ibid.*, p. 30, citing Frances Bell and Robert Millward, "Public Health Expenditures and Mortality in England and Wales, 1870-1914," pp. 221-249.

¹⁰² Palaniappan, *et al.*, *op. cit.*, p. 131, citing the World Water Council, "Financing Water for All," Global Water Partnership, March 2004.

¹⁰³ *Ibid.*, p. 139.

¹⁰⁴ de Villiers, *op. cit.*, p. 171.

¹⁰⁵ *Ibid.*, pp. 172-177.

¹⁰⁶ *Ibid.*, p. 174; "Human Development Report," *op. cit.*, p. 219; "Future Danube Flood Actions Depend On International Cooperation," Commission for the Protection of the Danube, April 21, 2006; www.icpdr.org/icpdr-pages/pr20060421_danube_flood.htm. For background, see Brian Beary, "The New Europe," *CQ Global Researcher*, August, 2007.

¹⁰⁷ Peter H. Gleick, Heather Cooley, Gary Wolff, "With a Grain of Salt: An Update on Seawater Desalination," *The World's Water 2006-2007*, *op. cit.*, p. 55.

¹⁰⁸ *Ibid.*, pp. 68-70.

¹⁰⁹ *Ibid.*, pp. 78-79.

¹¹⁰ *Ibid.*, p. 161. General Electric Co. projects an annual growth rate of 9 to 14 percent, growing from \$4.3 billion in annual desalination expenditures in 2005 to \$14 billion in 2014.

¹¹¹ P. W. Mote, *et al.*, "Declining Mountain Snowpack in Western North America," *Bulletin of the American Meteorological Society* 86, January 2005, pp. 49-48.

¹¹² "New Century of Thirst for World's Mountains," Pacific Northwest National Laboratory, May 18, 2006, www.pnl.gov/news/release.asp?id=158.

¹¹³ Eric Bontrager, "West will need to revisit water, land management in light of global warming, experts say," *Land Letter*, Sept. 28, 2006; www.eenews.net/ll/ (subscription required).

¹¹⁴ Shaun McKinnon, "Southwest Could Become Dust Bowl, Study Warns," *The Arizona Republic*, April 6, 2007, p. 1; www.azcentral.com/arizonarepublic/news/articles/0406climate-report0406.html.

¹¹⁵ Bontrager, *op. cit.*

¹¹⁶ *Ibid.*

¹¹⁷ Shaun McKinnon, "Snow runoff: What's at Stake," *The Arizona Republic*, Nov. 25, 2007, p. 8; and Stephen Saunders and Maureen Maxwell, "Less Snow, Less Water: Climate Disruption in the West," The Rocky Mountain Climate Organization, September 2005, pp. 2, 9, 19, www.rockymountainclimate.org/website%20pictures/Less%20Snow%20Less%20Water.pdf.

¹¹⁸ "UK Government: Global drought in the 21st century," M2 Presswire, Oct. 26, 2006; www.continuitycentral.com/news02870.htm.

¹¹⁹ "Fourth Assessment Report — Climate Change 2007: Synthesis Report, Summary for Policymakers," Intergovernmental Panel on Climate Change, Nov. 17, 2007, p. 8; www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

¹²⁰ Claudie Tebaldi, Katharine Hayhoe, Julie M. Arblaster and Gerald A. Meehle, "Going to Extremes," Institute for the Study of Society and Environment, National Center for Atmospheric Research, 2006, p. 22; www.cgd.ucar.edu/ccr/publications/tebaldi_extremes.pdf.

¹²¹ Jon Gertner, "The Future is Drying Up," *New York Times Magazine*, Oct. 21, 2007; www.nytimes.com/2007/10/21/magazine/21water-t.html?_r=1&oref=slogin.

¹²² "New Study Shows Climate Change Likely to Lead to Periods of Extreme Drought in Southwest North America," Lamont-Doherty Earth Observatory, April 6, 2007, www.ldeo.columbia.edu/news-events/new-study-shows-climate-change-likely-lead-periods-extreme-drought-southwest-north-ameri.

¹²³ "A Review of Water Conservation Planning for the Atlanta, Georgia Region, August 2006, prepared for the Florida Department of Environmental Protection," Pacific Institute, p. 23, www.pacinst.org/reports/atlanta/atlanta_analysis.pdf.

¹²⁴ "Report to the Secretaries of State for Communities and Local Government and Food and Rural Affairs," *The Planning Inspectorate*, Sept. 29, 2006, p. 7-8, www.communities.gov.uk/documents/planningandbuilding/pdf/319931, and www.thameswater.co.uk/UK/region/en_gb/



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content/News/News_001394.jsp?SECT=Section_Homepage_000431.

¹²⁵ Amy L. Vickers, "The Future of Water Conservation: Challenges Ahead," The Universities Council on Water Resources (UCOWR), p. 52, www.ucowr.siu.edu/updates/pdf/V114_A8.pdf. Also see Marcia Clemmitt, "Aging Infrastructure," *CQ Researcher*, Sept. 28, 2007, pp. 793-816.

¹²⁶ Clarke and King, *op. cit.*, p. 87.

¹²⁷ "Re-engaging in Agricultural Water Management — Challenges and Options," The International Bank for Reconstruction and Development/The World Bank, 2006, p. 3, web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTARD/0,,contentMDK:20858509~pagePK:210058~piPK:210062~theSitePK:336682,00.html.

¹²⁸ Vickers, *op. cit.*, p. 52.

¹²⁹ Harriet Emerson and Mohamed Lahlou, "Conservation: It's the Future of Water," National Drinking Water Clearinghouse, www.nesc.wvu.edu/ndwc/ndwc_conservationarticles.htm/harrietarticle.html.

¹³⁰ "Fact Sheet," U.S. Green Building Council, www.usgbc.org/DisplayPage.aspx?CMSPageID=222.

¹³¹ Katz, *op. cit.*, p. 32.

¹³² Postel and Richter, *op. cit.*, p. 201.

¹³³ "World Population Prospects," U.N. Department of Economic and Social Affairs, 2006, <http://esa.un.org/unpp/>.

¹³⁴ Molden, *op. cit.*, p. 1; *Birmingham Post*, *op. cit.*, p. 10.

¹³⁵ Quoted in Kerry O'Brien, "Water scarcity 'due to agriculture,'" Australian Broadcasting Corp. Transcripts, Aug. 16, 2006; www.abc.net.au/7.30/content/2006/s1716766.htm.

¹³⁶ Molden, *op. cit.*, pp. 7-8.

¹³⁷ *Ibid.*, p. 14.

¹³⁸ "Re-engaging in Agricultural Water Management," *op. cit.*, p. 38.

¹³⁹ Rijsberman, *op. cit.*

¹⁴⁰ Postel and Richter, *op. cit.*, pp. 112-117.

¹⁴¹ Jim Getz, "Kaufman County won't vote on Pickens' freshwater district: But Roberts County calls election on Pickens' pitch for freshwater district," *The Dallas Morning News*, Sept. 5, 2007.

¹⁴² "Re-engaging in Agricultural Water Management," *op. cit.*, p. 102.

¹⁴³ *Ibid.*, p. 103.

¹⁴⁴ International Water Management Institute, *op. cit.*, p. 10.

¹⁴⁵ de Villiers, *op. cit.*, p. 24.

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The CNA Corp., 4825 Mark Center Drive, Alexandria, VA 22311; (703) 824-2000; www.cna.org. A nonprofit research organization that operates the Center for Naval Analyses and the Institute for Public Research, concentrating on security, defense and other government-policy issues.

Food and Water Watch, 1616 P St., N.W., Suite 300, Washington, DC 20036; (202) 683-2500; www.foodandwaterwatch.org. A liberal research and advocacy organization focused on water resources, food security, sanitation and globalization issues.

Intergovernmental Panel on Climate Change, C/O World Meteorological Organization, 7bis Avenue de la Paix, C.P. 2300, CH-1211 Geneva 2, Switzerland; 41-22-730-8208/84; www.ipcc.ch. Intergovernmental research body.

International Water Management Institute, 127, Sunil Mawatha, Pelawatte, Battaramulla, Colombo, Sri Lanka; 94-11 2880000, 2784080; www.iwmi.cgiar.org. Research group supported by 60 governments, private foundations and international organizations.

The Met Office Hadley Centre, Met Office, FitzRoy Road, Exeter, Devon, EX1 3PB, United Kingdom; 44 (0)1392 885680; www.metoffice.gov.uk/research/hadley-centre. Britain's official center for climate-change research.

Pacific Institute, 654 13th St., Preservation Park, Oakland, CA 94612; (510) 251-1600; www.pacinst.org. A nonpartisan think tank studying development, environment and security issues.

Property and Environment Research Center, 2048 Analysis Dr., Suite A, Bozeman, MT 59718; (406) 587-9591; www.perc.org. A pro-market research and advocacy group.

Public Citizen, 1600 20th St., N.W., Washington, DC 20009; (202) 588-1000; www.citizen.org. A liberal consumer-advocacy group.

Stockholm International Water Institute, Drottninggatan 33, SE — 111 51 Stockholm, Sweden; 46 8 522 139 60; www.siwi.org. A research organization affiliated with the Swedish government.

U.N. Human Development Office, 304 E. 45th St., 12th Floor, New York, NY 10017; (212) 906-3661; hdr.undp.org/en/humandev. Publishes an annual report on health, economic and other social conditions.

U.S. Geological Survey, 12201 Sunrise Valley Dr., Reston, VA 20192; (888) 275-8747; www.usgs.gov. The government's mapping agency and research center on water resources, geology, natural hazards and other physical sciences.

World Bank, 1818 H St., N.W., Washington, DC 20433; (202) 473-1000; www.worldbank.org. Provides technical and financial assistance to developing countries.

World Water Council, Espace Gaymard, 2-4 place d'Arvieux, 13002 Marseille, France; 33 491 994100; www.worldwatercouncil.org. An international research and advocacy group of government and international agency officials, academics and corporate executives; sponsors World Water Forum every three years.

Bibliography

Selected Sources

Books

Clarke, Robin, and Jannet King, *The Water Atlas*, The New Press, 2004.

Editors at the World Meteorological Organization present a visual primer on water scarcity, sanitation shortfalls and climate impact on water resources.

de Villiers, Marq, *Water: The Fate of Our Most Precious Resource*, Stoddard Publishing Co., 1999.

A Canadian journalist provides a global overview of challenges confronting the world's water supplies.

Glennon, Robert, *Water Follies: Groundwater Pumping and the Fate of America's Fresh Waters*, Island Press, 2002.

An attorney and water-policy expert advocates new policies to preserve Western U.S. aquifers.

Olivera, Oscar, *Cochabamba! Water Rebellion in Bolivia*, South End Press, 2004.

The leader of the Bolivian protest against water privatization gives his side of the conflict.

Postel, Sandra, and Brian Richter, *Rivers for Life, Managing Water for People and Nature*, Island Press, 2003.

Experts at the Global Water Policy Project in Massachusetts (Postel) and The Nature Conservancy (Richter) chronicle the campaign to restore environmental conditions in threatened rivers.

Reisner, Marc, *Cadillac Desert, the American West and Its Disappearing Water*, Penguin Books, 1986.

This award-winning classic by a former Natural Resources Defense Council expert critiques federal land and irrigation policies and their impact on water use in the West.

Ward, Diane Raines, *Water Wars: Drought, Flood, Folly and the Politics of Thirst*, Riverhead Books, 2002.

An environmental writer reviews controversial global policies affecting dams, water treaties and other water-resource issues.

Articles

Mann, Charles C., "The Rise of Big Water," *Vanity Fair*, May 2007.

A correspondent for *Science* and *The Atlantic Monthly* explores the controversy over privatization programs for water and sanitation worldwide.

Reports and Studies

"Approaches to Private Participation in Water Services: A Tool Kit," The World Bank, 2006, http://publications.worldbank.org/ecommerce/catalog/product?item_id=4085442.

The world's major foreign-aid lender provides lessons learned from water-privatization efforts.

"Beyond scarcity: Power, poverty and the global water crisis," United Nations Development Programme, U.N. Human Development Report 2006, <http://hdr.undp.org/en/reports/global/hdr2006>.

This detailed review of worldwide water and sanitation challenges includes case studies of successes and failures.

"Comprehensive Assessment of Water Management in Agriculture: Water for Food, Water for Life," International Water Management Institute, 2006, www.fao.org/nr/water/docs/Summary_SynthesisBook.pdf.

A consulting group based in Sri Lanka reports on the impact of water scarcity on global irrigation and food production.

"Dams and Development: A New Framework for Decision Making," World Commission on Dams, 2000, www.dams.org/report.

Water experts, educators and government officials assess issues surrounding major dam construction and operations.

"IPCC Fourth Assessment Report," Intergovernmental Panel on Climate Change, 2007, www.ipcc.ch/ipccreports/ar4-syr.htm.

A scientific panel sponsored by the World Meteorological Organization and the United Nations Environment Programme issues its most recent outlook on climate change threats.

"National Security and the Threat of Climate Change," CNA Corp., December 2007, <http://securityandclimate.cna.org/report/>.

A panel of retired U.S. generals and admirals forecasts security issues that will emerge as a result of climate change.

"Synthesis of the 4th World Water Forum, Mexico City," World Water Council, 2006, www.worldwatercouncil.org/index.php?id=1386.

An international committee presents a summary of its fourth conference on water-resources issues.

Gleick, Peter H., et al., "The World's Water 2006-2007, The Biennial Report on Freshwater Resources," The Pacific Institute for Studies in Development, Environment, and Security, 2006, www.pacinst.org/publications/worlds_water/2006-2007/index.htm.

The institute's latest review of global water-resource issues includes chronologies of water conflicts and analyses of strategies for sustainable freshwater resource management.

The Next Step:

Additional Articles from Current Periodicals

Conflicts

"Climate Change Will Cause New Wars — UN," *Canberra Times*, June 22, 2007.

Changing patterns of rainfall and fights over food production could lead to potential conflicts in Africa's Sahel region and in East Asia, according to U.N. Environment Programme Executive Director Achim Steiner.

"Managing the Water Wars of the Future," *Indian Express*, May 12, 2007.

Overcoming the environmental and political difficulties of water scarcity will help manage the conflicts stemming from a lack of access to clean and safe water.

"Water is Running Out: How Inevitable Are International Conflicts?" Integrated Regional Information Networks (United Nations), Oct. 23, 2006.

Water resources are decreasing amid a growing world population and increasing water consumption, making water-related conflicts inevitable.

Baldauf, Scott, "Climate Change Escalates Darfur Crisis," *The Christian Science Monitor*, July 27, 2007, p. 1.

Competition for water in Sudan's Darfur region has long sparked conflict in the area, and is one of the main causes of the current fighting.

Moving Water

"Bangladesh, India to Hold Talks on Sharing River Water," PTI News Agency (India), July 20, 2007.

India and Bangladesh are expected to discuss water-sharing and diversion issues involving eight major trans-boundary rivers.

"China, Spain Vow to Strengthen Water Resources Utilization Cooperation," Xinhua News Agency (China), Oct. 14, 2007.

Chinese Vice Premier Hui Liangyu has promised to strengthen bilateral cooperation with Spain over water resources.

Jones, Tim, "Great Lakes Key Front in Water Wars," *Chicago Tribune*, Oct. 28, 2007, p. A1.

Eight Great Lakes-area states and two Canadian provinces have proposed a regional water compact that would prevent water diversions from the immediate region.

Privatization

Mitra, Barun, "Water Scarcity in Plenty," *Business Day (South Africa)*, March 23, 2006.

Government intervention has contributed significantly to water scarcity, while private initiatives have sustained local markets and improved access for millions.

Sasa, Mabasa, "Privatisation of Water Not the Answer," *The Herald (Zimbabwe)*, Dec. 29, 2007.

Privatizing water supplies will mean corporations report to the World Bank rather than to state governments.

Seno, Alexandra A., "Very Liquid Assets," *Newsweek*, Aug. 20, 2007.

Savvy asset-management companies have turned concerns over water shortage into burgeoning investment-fund businesses.

Wallach, Jason, "Privatizing Water and the Criminalization of Protest," *NACLA News (New York)*, July 24, 2007.

Despite corruption in El Salvador's government, citizens want the water system to be under state control rather than in private hands.

Water Supply

Doyle, Alister, "Increasing Agricultural Use a Drain on World Water Supply," *The Washington Post*, Aug. 21, 2006, p. A2.

Rising demand for irrigation in the production of food and biofuels will likely aggravate water scarcity.

Fan, Grace, "Abundant Water Makes Brazil Last Agriculture Frontier, as Scarcity Looms in Rest of World," *The Associated Press*, Aug. 24, 2006.

Abundant freshwater will help Brazil dominate global food supplies for the next several decades while water scarcity threatens the economies of other countries.

Girma, Biruk, "Poverty, Not Scarcity, to Blame for Lack of Water, Poor Sanitation — Report," *Daily Monitor (Ethiopia)*, Nov. 14, 2006.

Millions of people lack access to safe water and sanitation due to inequality and poverty, according to the U.N.

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Flamini, Roland. "Nuclear Proliferation." *CQ Global Researcher*, April 1, 2007, 1-24.

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NACLA News (New York), July 2007

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Agence France-Presse, April 2007

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The Associated Press, August 2006

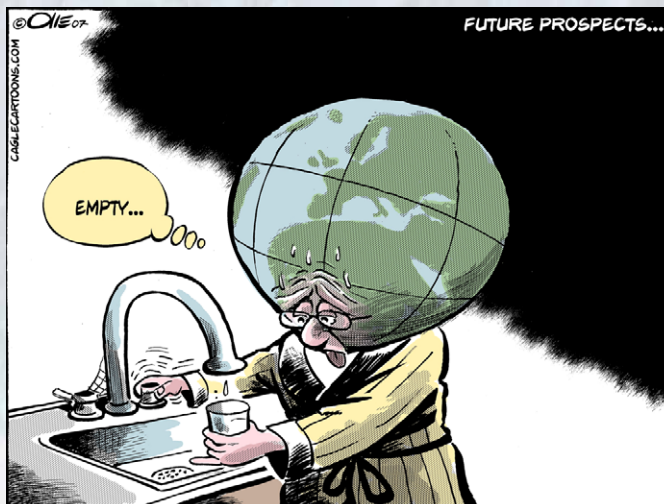
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