

# mind•full: a brainsnack for future leaders with ethical appetites

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## water quality and availability

Clean water has become increasingly scarce around the world. While over 70% of the Earth's surface is covered by water, most experts agree less than 1% of this is available to us as fresh water. We use fresh water for many essential activities: irrigation and farming, industry, energy production, sewage removal, recreation, and, of course, drinking. Water shortages arise from uneven rainfall distribution, high demand, and inefficient usage. The devastation caused to communities by drought are exacerbated by activities such as clear-cutting forests and overgrazing fields. Projects to manage water resources can have positive and negative effects. They may provide stable water supplies while flooding valuable agricultural land and displacing people and wildlife.

Water quality has become a critical issue as ground water and surface water are affected by human activities, including the use of pesticides and the production of industrial toxins. Waterborne pathogens spread disease to humans and other living beings. Animal wastes increase nutrients in surface water, which feed algal blooms that subsequently suffocate aquatic life. Without sound land use practices, sediments in surface water runoff can also destroy habitats for fish. In addition, thermal pollution from power plants can dramatically alter the ecological make-up of a lake or stream.

Water quality concerns are being addressed around the world through studies that explore better land management, advanced water treatment, and substitution of non-toxic materials in homes and in industry. While numerous small scale successes have been documented, few large scale systems have been implemented. Some claim that rising demand may dwarf any benefits gained by improved efficiency and treatment technologies unless more far reaching measures are taken.

The mission of Student Pugwash USA is to promote the socially responsible application of science and technology in the 21st century. As a student organization, Student Pugwash USA encourages young people to examine the ethical, social, and global implications of science and technology, and to make these concerns a guiding focus of their academic and professional endeavors.

The **mind•full** series encourages readers to explore crucial ethical dilemmas associated with the application of science and technology.

S T U D E N T



P U G W A S H

U S A

# go figure!

Water is both a renewable and a finite resource. Each year, Earth's water cycle renews our fresh water supply. However, that new supply is distributed unevenly throughout the planet. The Sudan, for example, receives over 150 cubic kilometers of renewable water resources per year, while Libya, which borders Sudan to the northwest, receives only 0.6 cubic kilometers and is one of the most water scarce countries on Earth, according to the World Resources Institute. Because of the uneven distribution of the Earth's fresh water supply and differing population sizes, many countries and regions find themselves without the water needed to support a reasonable standard of living.

## are you stressed out?

Hydrologists usually classify water stressed countries as those that have annual renewable water resources between 1,000 and 1,700 cubic meters per person. A water scarce country is one with annual water resources below 1,000 cubic meters. Water scarcity hinders food production, economic development, and protection of natural systems.

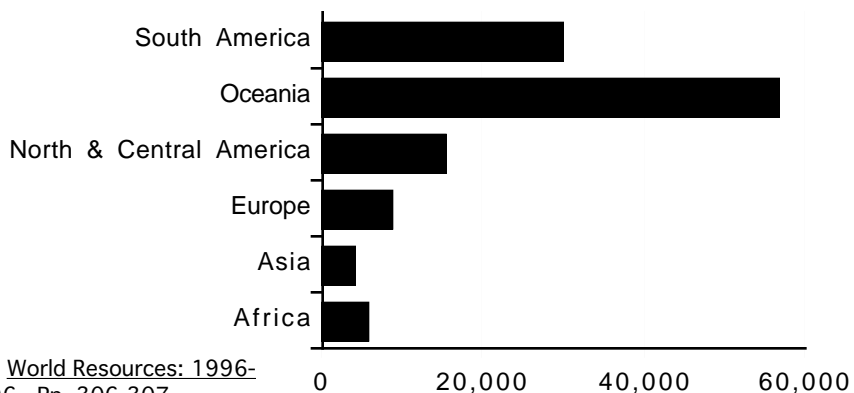
Water shortages also depend on actual use and on the efficiency with which water is used and reused. Hi-tech irrigation techniques, like those used in California, can cut water use in half. But such technological solutions can be too expensive for less developed countries.

## by selected water scarce and water stressed countries

Kuwait	103
Libya	111
Singapore	211
Saudi Arabia	254
Jordan	314
Yemen	359
Israel	382
Tunisia	443
Algeria	528
Burundi	563
Rwanda	792
Oman	892
Egypt	923
United Arab Emirates	1,047
Kenya	1,069
Morocco	1,110
South Africa	1,206
United Kingdom	1,219
Belgium	1,236
Somalia	1,459
Poland	1,464
South Korea	1,469
Haiti	1,532
Malawi	1,678
Peru	1,682

## by continent

	1995
Africa	5,488
Asia	3,819
Europe	8,576
North & Central America	15,369
Oceania	56,543
South America	29,788



Source: World Resources Institute, et. al. *World Resources: 1996-97*. New York: Oxford University Press, 1996. Pp. 306-307.

# in control or out of it ?

Governments' attempts to manage water resources have had mixed costs and benefits. Big dams, for example, can provide stable water supplies, flood control, hydropower, and improved navigation. At the same time, such projects may flood valuable land for agriculture, people, and wildlife; serve as breeding grounds for waterborne infectious diseases; and alter the water dynamics needed for stream and estuarine fisheries. Water diversion can also lead to more concentrated pollutants in the remaining water being delivered to downstream communities.

As a result of rampant pollution in America's lakes, rivers, and streams, the United States Congress has revised the Clean Water Act several times since 1972. The act created statutory provisions to monitor and control pollution from industries and also to provide federal assistance to cities for municipal waste water treatment construction. Although the Clean Water Act has helped make many water sources in the United States clean again, many environmentalists believe we still have a long way to go. Others, however, feel that the provisions adopted in the Clean Water Act are too tough on industry and municipalities and that many of the regulations should be relaxed or replaced with more cooperative, voluntary efforts.

Most treaties that address water quality or availability between individual countries focus on the principle of equitable allocation and the rule that one country's actions affecting an international watercourse cannot harm another state significantly. Globally, there are more than 2,000 agreements relating to international watercourses. Most of these agreements are bilateral and concern specific lakes or rivers along shared boundaries. In addition, there are a small number of multilateral agreements that protect rivers, lakes, and basins that cross or border multiple boundaries. There have been recent efforts to create an international code of conduct and legal framework for shared watercourses through the United Nations International Law Commission.

## geek speak

**aquifer**—a body of permeable rock . . . that is capable of storing significant quantities of water, is underlain by impermeable material, and through which ground water moves.

**carrying capacity**—maximum population size that a given ecosystem can support for an indefinite period or on a sustainable basis.\*

**drought**—a relative term denoting a period during which rainfall is either totally absent or substantially lower than usual for the area in question, so that there is a resulting shortage of water for human use, agriculture, or natural vegetation and fauna.

**ground water**—all the water contained in the void space within rocks . . . generally taken to exclude . . . water traveling between the surface and the water-table.

**watershed (catchment)**—the area from which a surface watercourse or a ground water system derives its water.

**water-table**—The upper surface of ground water, or the level below which an unconfined aquifer is permanently saturated with water.

\* Definition taken from Daniel D. Chiras, *Environmental Science: Action for a Sustainable Future, Fourth Edition*, Redwood City, CA: The Benjamin/Cummings Publishing Company, Inc., 1994.

All other definitions are taken from *The Concise Oxford Dictionary of Earth Sciences*, Ailsa Allaby and Michael Allaby (eds.), Oxford: Oxford University Press, 1990.

# a river runs through it

## west africa

Along the Senegal River in West Africa, two decades of droughts decimated arid agriculture, livestock, and drinking water supplies in areas inhabited by a semi-nomadic population. International donors funded two large dams: one to prevent salt water intrusion and another to regulate the annual flood cycle. Since these dams allowed expansion of irrigation along the shores of the river, people from Senegal and Mauritania moved into the region to capitalize on the newly valuable agricultural land. By the late 1980s and into the 1990s, the influx of people into the region forced indigenous populations from their native lands. The dams changed the habitual flood patterns and upset traditional cropping practices, while year-round fresh water pools supported an epidemic of waterborne disease. The project's original beneficiaries experienced the negative consequences of development.

## china

In China today, urban water scarcity is a reality. The Worldwatch Institute reports that roughly 300 Chinese cities and towns have suffered water shortages in recent years. In Beijing, water use exceeds the capacity of its two main water reservoirs and is siphoning water away from surrounding farmlands in order to meet the city's growing needs. The Yellow River, which flows through some of China's most productive agricultural regions, went dry in its lower reaches for 122 days in 1995. Because demand for water from the Yellow River is greatly exceeding its capacity, crop production in the region will likely suffer. As demographic pressures force China's population onto more marginal lands, poor land-use practices could contribute to increased soil erosion and desertification, which would add millions of tons of sediments into China's major waterways. Some estimates claim that by the year 2000, China will need to build 2,000 additional waste water treatment plants in order to preserve its fresh water resources.

## washington, dc

City planners built the capital of the United States, Washington, DC, at the convergence of the Potomac and Anacostia rivers. In the 1860s, the stench of raw sewage in the rivers and adjacent wetlands was said to have been so bad that it drove President Lincoln from the White House on warm summer nights. By the mid-1970s, new sewage treatment technologies were applied in the Potomac. Soon, the striped bass populations rebounded, water quality improved, and the river was "reopened" to water recreation. Maryland, Virginia, and DC have since developed strategies to further improve water quality. Today, Washington receives its drinking water from the Potomac. While the water may be cleaner, cases of water contamination have become commonplace in our nation's capital due to old pipelines that are corroded or harbor infectious diseases.

Meanwhile, the Potomac's Anacostia tributary suffers from the accumulation of over a century's worth of toxics. While a wealth of resources were provided to clean-up the Potomac, the Anacostia River is still considered one of the nation's most polluted urban rivers. The Anacostia flows through an impoverished, predominantly African-American community. Some question whether "eco-racism" is at play in the relative clean-up efforts of the two rivers.

## scary fact

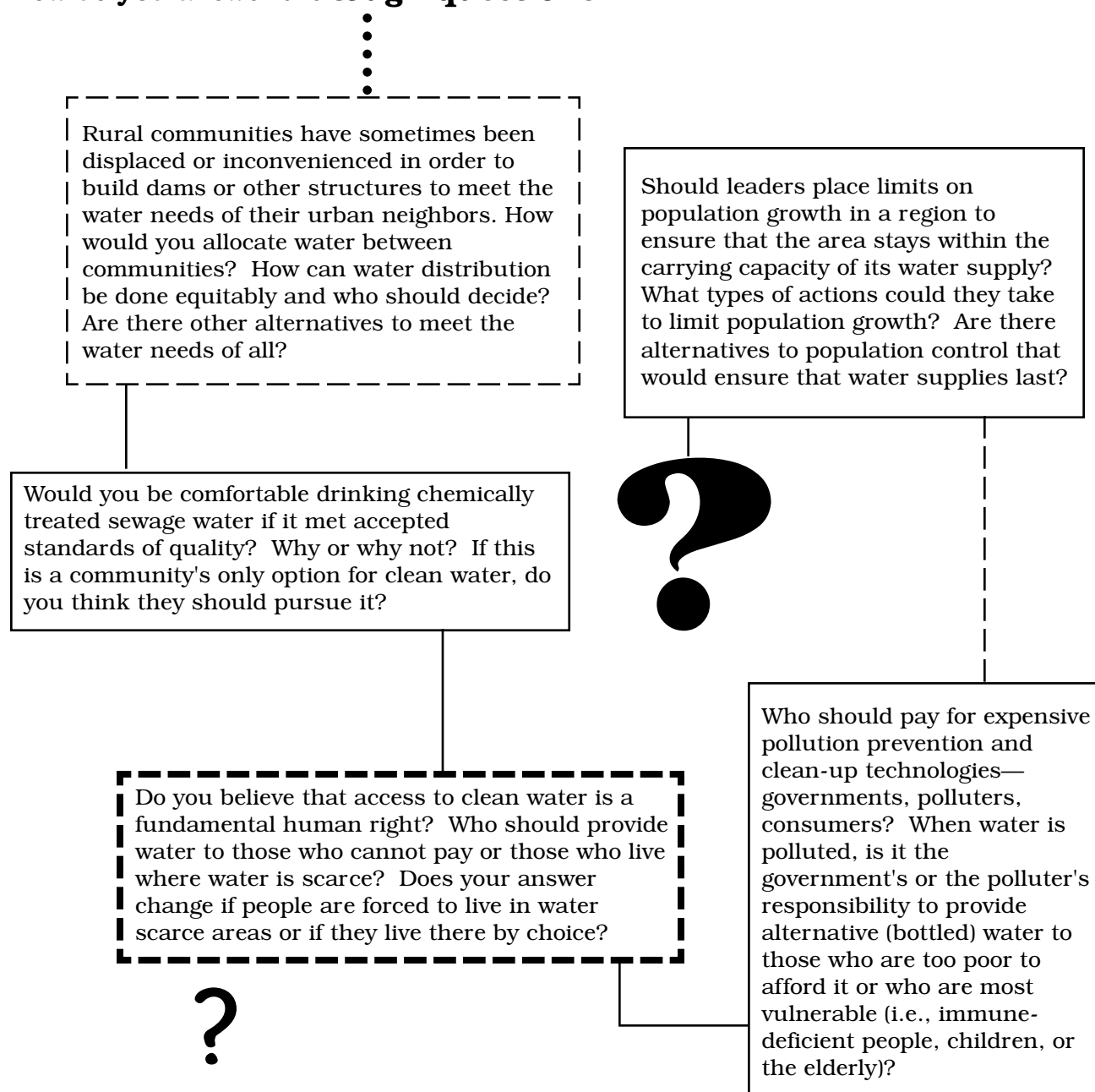
More than 10,000 children die every day from illness linked to substandard water supply and waste disposal in poor countries. Nearly all of this illness is preventable.

**Source:** "WASH Fact Sheet, Cuantificacion de los Efectos de los Programas de Abastecimiento de Agua y Saneamiento." Environmental Health Project: Washington DC, 1992.

# (anything but a) conclusion

The increasing use and management of our fresh water resources impacts each of us every day. Improper use and poor management of water supplies can lead to shortages, the spread of disease, and unsanitary drinking water. How water is and will be allocated between communities and sectors of our society now and into the 21st century remains an important challenge. In examining these questions, we will need to think about how to balance human needs with the needs of other species in our shared ecosystems. Ensuring both the quantity and quality of fresh water will continue to be a pressing global problem.

How do **you** answer the **tough questions**



There are regulations requiring environmental impact studies before many projects can proceed. In order to ensure clean water, high standards must be implemented, enforced, and maintained. What criteria do you think should be considered in such a cost/benefit analysis or environmental impact study? For example, would you consider human health, recreation, fish productivity, or the impact on future generations of people?

Who should make decisions about water management—governments, utilities, communities? What kinds of incentives or regulations would encourage companies to prevent or clean up pollution? Who should make decisions when a body of water crosses between two countries?

How would you address the problem of upstream communities in one jurisdiction or country polluting the water used by those downstream? Do you think people living downstream have as equal a right to the water as those who live upstream?



What role should the public play in making decisions about water quality and availability? If the public is to be involved in decision making, in which forums should they be included? How would you educate the public on water issues? What role should students play in deciding the future of water allocation and cleanliness in their community and in other regions of the world?

Is water a global or local resource? Do you think there should be global regulations or standards on how to allocate and maintain clean water? How would you determine fair standards, given vastly different lifestyles and water demands?



The 1988 Dagomys Declaration of the Pugwash Council stated, "To survive, we must recognize that environmental degradation weakens the security of all." How does this statement relate to water quality and availability issues? In what ways might water affect a nation's or region's security?

## get your feet wet . . .

- *Environmental Science: Action for a Sustainable Future, 4th Ed.*, Daniel Chiras (author)—has good introductory chapters on water resources and on water pollution (chapters 10 and 17), along with regional editions for the contiguous United States. New York: Benjamin/Cummings Publishing Company, Inc, 1995.
- *Large Dams and Small People: Management of an African River*, Michael Horowitz—a video from the Institute for Development Anthropology, 99 Collier Street, PO Box 2207, Binghamton, NY 13902-2207. Note: purchase of this video is expensive (> \$100), but it is very interesting.
- *Last Oasis: Facing Water Scarcity*, Sandra Postel (Worldwatch Institute)—readable and informative. New York: W. W. Norton & Co., 1992. This book is the basis for a television documentary being shown on PBS on July 15, 1997.
- *Silenced Rivers: The Ecology and Politics of Large Dams*, Patrick McCully—a documentary, explains the history and politics of dam building worldwide and shows why large dams have become “the most controversial of technologies.” Available from International Rivers Network, 1847 Berkeley Way, Berkeley CA 94703. Tel: (510) 848-1155. E-mail: irnweb@irn.org.
- *State of the World 1996: A Worldwatch Institute Report on Progress Toward a Sustainable Society*, Lester Brown, et al.—chapters 3, 4, and 5 are particularly helpful. New York: W. W. Norton & Company, 1996.
- *Sustaining Water: Population and the Future of Renewable Water Supplies*, Population Action International—colorfully addresses issues of regional fresh water scarcity in the face of global population growth. Population and Environment Program, Population Action International, 1120 19th St, NW, Suite 550, Washington, DC 20036. Tel: (202) 659-1833. E-mail: popact@igc.apc.org.
- *Water: Opposing Viewpoints*, Carol Wekesser (editor)—provides counterpoints on tough questions regarding water supply management, pollution reduction, acid rain, and ocean pollution. A good resource for launching a roundtable on water resource issues. San Diego: Greenhaven Press, Inc, 1994.
- *Water in Crisis: A Guide to the World's Fresh Water Resources*, Peter Gleick (editor)—widely cited, contains excellent essays on key water issues. New York: Oxford University Press, 1993.
- *The Water Encyclopedia, 2nd Ed.*, Fritz Van der Leeden, et al.—contains numerous facts on water supplies and hydrology and can be found in many college libraries. Chelsea, Michigan: Lewis Publications, 1990.
- *Water Quality: A Catalog of Related Federal Programs*, General Accounting Office—a report from the US General Accounting Office, provides information about federal programs and initiatives designed to assist states, municipalities, individuals, and other entities in their efforts to protect and improve surface water and ground water threatened by pollution. Washington DC: General Accounting Office, 1996. Web site: <http://www.gao.gov>
- *Water Quality of World River Basins*, UNEP Global Environmental Monitoring System (GEMS)—uses 1976-1990 data from 82 major river basins to show how natural processes interact with human factors to create observed water quality conditions. Nairobi: United Nations Environment Programme, 1995.
- *Water Resources Management: In Search of an Environmental Ethic*, David Lewis Feldman—for those interested in the ethical side of the debate. Baltimore: Johns Hopkins University Press, 1991.

## check it out !

## . . . then surf the net!

- Nutrients in the Nation's Waters—Too Much of a Good Thing? David K. Mueller and Dennis R. Helsel (United States Geological Survey—summarizes findings from the National Water Quality Assessment Program)—[http://www.rvares.er.usgs.gov/nawqua/nawqua\\_home.html](http://www.rvares.er.usgs.gov/nawqua/nawqua_home.html)
- United States Geological Survey, Branch of Information Services—<http://h20.usgs.gov>
- International Rivers Network (an activist organization aimed at stopping the construction of large dam projects and promoting fresh water management projects)—<http://www.irn.org>
- Water Science and Technology Board (National Research Council—an independent advisor to the federal government on scientific and technical questions of national importance)—<http://www2.nas.edu/wstb/>
- Women's Aquatic Network (brings together individuals with interests in marine and aquatic policy, research, and legislation)—<http://cbl.cees.edu/~gottlieb/WAN/>
- Office of Water, US Environmental Protection Agency (federal government regulations and programs related to water, also provides state water quality fact sheets and other educational materials)—<http://www.epa.gov/owow>
- Universities Water Information Network (contains a substantial amount of information for those interested in water as a resource. Also contains numerous databases with easy interfaces)—<http://www.uwin.siu.edu>
- Clean Water Action (political, action-oriented group engaged in water quality issues)—<http://essential.org/cwa/>
- Water Environment Federation (organization of industries involved with water sanitation)—<http://www.wef.org>
- ECOTEC: The International Ecotechnology Network (a forum in which ecological technologies for waste treatment are discussed regularly)—<http://www.ecotech.org>
- Bannister Research & Consulting Firm (Internet domain offering several on-line resources relating to ground water)—<http://www.groundwater.com>

## cyberspace

This **mind•full** was written by Dann Sklarew with David Andersen. Dann is a member Student Pugwash USA's board of directors. He is a chapter member and PhD candidate in environmental science and policy at George Mason University. David is Student Pugwash USA's National Chapter Coordinator. Special thanks to Sandra Postel, Director, The Global Water Policy Project, for commenting on this **mind•full**. Any errors are the responsibility of Student Pugwash USA.

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## but wait, there's more!

- **mind•full: a brainsnack for future leaders with ethical appetites.** Other issues available upon request: international weapons trade, emerging infectious diseases, access and the Internet, public's role in science, future of nuclear weapons. Upcoming issues in spring 1997: disease and war, alternative energy sources.
- **Jobs You Can Live With: Working at the Crossroads of Science, Technology, and Society.** The fifth edition of the Student Pugwash USA internship directory. It highlights approximately 200 organizations that work to promote the ethical use of science and technology and provides suggestions on how to go about the internship and job search.
- **The Global Issues Guidebook.** A student-authored discussion and classroom resource on science, technology, and society issues.
- **Pugwatch.** The chapter newsletter.
- **Chapter Organizing Guide.** Provides chapter members with an A to Z guide to getting a campus-based chapter up and running.
- **Tough Questions.** Student Pugwash USA's newsletter.

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