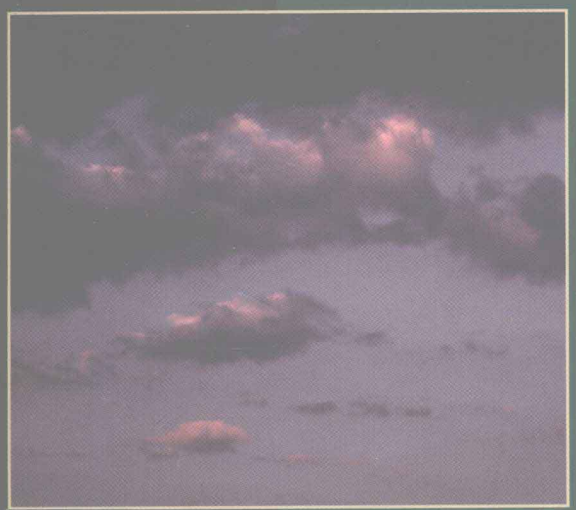
The World's Water 2000–2001

The Biennial Report on Freshwater Resources



- Water as a human right
- Water stocks and flows
- Water and food
- Desalination
- International watersheds
- Water recycling
- Dam removals
- Water events

Peter H. Gleick

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The Biennial Report on Freshwater Resources

Peter H. Gleick

Pacific Institute for Studies in Development, Environment, and Security
Oakland, California

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In 2000, Island Press celebrates its sixteenth anniversary as the leading provider of timely and practical books that take a multidisciplinary approach to critical environmental concerns. Our growing list of titles reflects our commitment to bringing the best of an expanding body of literature to the environmental community throughout North America and the world.

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The Pacific Institute for Studies in Development, Environment, and Security, in Oakland, California, is an independent, nonprofit organization created in 1987 to conduct research and policy analysis in the areas of environmental protection, sustainable development, and international security. Underlying all of the Institute's work is the recognition that the urgent problems of environmental degradation, regional and global poverty, and political tension and conflict are fundamentally interrelated, and that long-term solutions dictate an interdisciplinary approach. Since 1987, we have produced more than 60 research studies, organized roundtable discussions, and held widespread briefings for policymakers and the public. The Institute has formulated a new vision for long-term water planning in California and internationally, developed a new approach for valuing well-being in the Sierra Nevada, worked on transborder environment and trade issues in North America, analyzed ISO 14000's role in global environmental protection, clarified key concepts and criteria for sustainable water use in the lower Colorado basin, offered recommendations for reducing conflicts over water in the Middle East and elsewhere, assessed the impacts of global warming on freshwater resources, and created programs to address environmental justice concerns in poor communities and communities of color.

For detailed information about the Institute's activities, visit www.pacinst.org, www.worldwater.org, and www.globalchange.org.

THE WORLD'S WATER 2000-2001

To all those working to solve the world's water problems

Foreword

The twentieth century was one of tremendous political, demographic, economic, and technological change. Politically, the concept of world war twice came into play, and for nearly fifty years we endured the Cold War. At century's end, regional and ethnic conflicts continued to bring home the divisive nature of politics and ideology. Demographically, rapidly growing human populations and dramatic increases in consumption of resources transformed human activity into one of the most profound natural forces on Earth. The emergence of a gaping seasonal hole in the Earth's protective ozone layer demonstrated to all the interconnected nature of the world in which we now live.

Indeed, the end of the twentieth century saw the emergence of interdependence—the idea that certain problems transcend borders and link the fates of all the world's people. Accordingly, international organizations were created to begin addressing a wide range of problems, ranging from military security to legal justice to ecological and human health. Economic systems became similarly intertwined—a phenomenon that has come to be known as globalization. Finally, advances in communications, information, and transportation drew the world together as never before, transforming the roles of governments, the private sector, and nongovernmental organizations.

The world of the twenty-first century will no doubt be equally complex and surprising. But as we enter this new century, it is important that the unresolved problems and unmet challenges of the twentieth century not be forgotten. While there are many issues that must be addressed by the world community, few are as fundamental as those that surround human needs and uses of water.

I can think of no one who is better able to identify both our water problems and their solutions than Peter Gleick, the author of this invaluable series. I first met Gleick while I was serving the state of Colorado in the United States Senate and working on the issues of global climate change and its potential effects on U.S. water resources. Peter Gleick was then and is now the expert who is widely regarded and recognized for his work in this field. His ability to blend science and policy—all in plain English—made him an outstanding witness in hearings I helped chair for the U.S. Senate Committee on Energy and Natural Resources in the late 1980s. Not surprisingly, he has been asked to brief such policymakers as the secretary of the interior, the secretary of state, and the vice president on both domestic and international water issues.

During subsequent work on climate change as undersecretary of state for global affairs, I too found myself calling on Gleick to help sort through the potential ramifications of current and future climatic and human influences on water and its

growing relationship to the potential for dispute and conflict within and among nations.

This, the second volume of *The World's Water,* serves as a fine complement to its predecessor, which was published in 1998. This new book includes updates on such important topics as the fascinating chronology of water-related conflicts. Gleick also continues to argue cogently for more attention to be paid to one of the most basic water problems: the need to provide clean drinking water and sanitation services to the billion people who still lack them.

This theme of poverty alleviation and meeting basic human needs runs throughout Gleick's writing. In 1996 he defined and quantified a basic water requirement for all humans and argued that the provision of this water should be the top priority for international, national, and regional water policymakers. In 1998, he described the terrible human health implications of the failure to meet these basic water needs and the high economic costs of that failure. And in the very first chapter of this new book he makes a compelling argument that there is a legal and institutional human "right" to water, further raising the stakes for the water community.

But this second volume traverses other new terrain, such as the complex and critical relationship between water and food production. One of the most important concerns we face in the new century is whether or not we will be able to produce and distribute enough food to meet the needs of a growing global population. Directly related to this are the questions of whether there will be enough water to grow this food, where that water will come from, and what the social and environmental implications of that water use will be. Gleick addresses these issues perceptively and does not shy away from such controversial issues as whether certain dams ought to be removed. He describes and analyzes the trend toward the removal of dams that have outlived their usefulness or have caused so much ecological damage as to warrant their decommissioning. He also brings a clear eye to the question of the potential for desalination and water reclamation and reuse to solve water-supply problems and offers an unbiased look at the possibilities of and limitations to these solutions. Gleick concludes that both approaches have great potential and can be a part of water systems in many places, but they must be considered as only pieces of the water puzzle and not as panaceas for our problems.

One of the most valuable attributes of this series of water books is the vast amount of information and data it contains. Each of Gleick's books includes separate tables and figures with clear descriptions of the data, their limitations, and their sources. I am aware of no other single source of information about water that has the breadth and depth of information that these books have. The interested reader can find data on dams removed in the United States and elsewhere, the capacity of desalination plants around the world, the new registry of international river basins, water supply and demand by country, irrigated area, the distribution of reservoirs, and much more.

Water runs as a thread through all of our lives, connecting us to the food we eat, the ecosystems on which we depend, our climate, and to our neighbors, often determining whether we live in peace or in conflict. *The World's Water* helps to trace that thread and weaves it into a clear tapestry that informs and guides us on this critical aspect of our global future.

TIMOTHY E. WIRTH
President, United Nations Foundation

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Special thanks are also due to Todd Baldwin, my editor at Island Press. Todd somehow manages to tread the fine line between letting me do my work and letting me know that he is anxiously awaiting the next draft. He also has an uncanny ability to find the holes in my arguments or writing and the diplomatic skills needed to point them out to me in a way that makes me want to fix them, rather than throw the whole thing in the round file under my desk.

Support for *The World's Water 2000–2001* was provided by grants to the Pacific Institute for Studies in Development, Environment, and Security from the Flora Family, Horace W. Goldsmith, William and Flora Hewlett, Henry P. Kendall, and John D. and Catherine T. MacArthur foundations. I thank them for their foresight in identifying water as a central issue in the environment, development, and security arena and their willingness to support the research and policy work these books represent.

Finally, as always, I can't thank Nicki Norman enough for all she is and does.

Introduction

Large or round numbers seem to hold a special significance. We celebrate major birthdays and anniversaries and keep our eye out for numbers with lots of zeros or a repeating digit on an odometer. It was front-page news when the Earth's population reached 6 billion. Most of us remember calculating how old we would be in the year 2000. And when both the century and the millennium numbers turned over, we threw ourselves a global party.

We are living in the midst of an information revolution where numbers rule. But this revolution is a selective one, reaching only certain people with only limited information. Some numbers, and their meaning, are beyond our understanding or have such depressing implications that we tend to ignore them. Thus, while many people know Bill Gates's net worth, who knows the worth of the billion poorest people on the planet? People in richer countries know how much bottled water costs, but have no idea that it costs hundreds or even thousands of times more than pure water from their taps. We hear about the growing numbers of people with access to the Internet, but who hears about how many people suffer from lack of access to clean drinking water? Every day we hear about the NASDAQ, S&P 500, Nikkei, or Hang Seng Indexes, but why don't we hear more about the Human Development Index—a much better indicator of overall human well-being? We know immediately when people die in airplane crashes and train derailments, but who knows how many tens of thousands of children die each day from easily prevented water-related diseases? My children and their peers know by heart the names and characteristics of more than 150 make-believe creatures called Pokéman, but who knows the names of the many real creatures driven to extinction by human actions?

Water runs like a river through our lives, touching everything from our health and the health of ecosystems around us to farmers' fields and the production of the goods we consume. The story of water is a complex one, told partly by numbers, partly by real human stories, and partly by intangible, immeasurable things. *The World's Water* is an effort to tell some of this story—to offer pieces of the puzzle that will let us understand the role of water in the human equation and, conversely, the effects of humans on the hydrologic cycle that sustains us. These pieces, however, should be viewed as only part of a rapidly changing story, which is one reason why

The World's Water was designed to be produced every two years—to publish new information and data on water problems and concerns, and pose new solutions to be tried, discarded, or improved upon.

The first two reports, 1998–1999 and 2000–2001, are not meant to be viewed separately, but rather as complementary to each other. *The World's Water 1998–1999* included chapters on the changing nature of water management and the connections between water and human health, an update on large dams, reviews of the links between water and international conflict and water and climatic changes, and developments in international organizations and structures working on water problems. Extensive data on water were presented in tables not easily accessible elsewhere.

A major focus of the first report was the changing nature of water management, development, and planning—I described it as "the changing water paradigm." There are many components to this change: a shift away from sole, or even primary, reliance on finding new sources of supply to address perceived new demands; a growing emphasis on incorporating ecological values into water policy; a reemphasis on meeting basic needs for water services; and a conscious breaking of the ties between economic growth and water use. Much has happened in the world of water in the subsequent two years. I believe the evidence for a true change in the way we think about water continues to accumulate.

The World's Water 2000–2001 builds on this idea. In an analysis stimulated in part by the fiftieth anniversary of the Universal Declaration of Human Rights, the legal, moral, and institutional implications of recognizing a human right to water are presented in the first chapter. A human right to water appears to be firmly rooted in international law and the norms of expected state behavior. Acknowledging that right is an important new step in meeting unmet basic water needs for billions of people and in forcing a re-evaluation of water priorities and policies.

New information is now available on the world's stocks and flows and the first new analysis of international river basins in over 20 years is described and analyzed. In the last 20 years, the number of international rivers basins has increased from 214 to 261—just one indicator of the increasingly political nature of this vital natural resource. The first book explicitly discussed water-related conflicts; this one expands further on the history and nature of such conflicts.

The connections between water and food are addressed in detail here as concerns of food experts begin to encompass the realities of water availability. In some ways, thinking about food is undergoing a revolution similar to that in the water world. It is becoming harder and harder to bring new lands into production and to maintain the historically large annual increases in crop yields. Yet there is great potential for improving the "efficiency" with which we produce food, by changing cropping patterns, by reducing wasteful applications of resources, by cutting losses between the field and the plate, and by altering diets and the manner in which international markets function. Each of these approaches has a parallel in the debate over meeting water needs. But more importantly, the question of whether we can produce enough food to feed a burgeoning population—and get it to where it is needed—is intricately connected to the question of where and when fresh water is available. Decisions made today about water policy will affect whether people continue to be undernourished in the coming decades.

The first book reviewed the state of the world's dams and noted that the old paradigm of relying on ever larger numbers of dams to capture ever larger fractions of freshwater runoff is beginning to fail for environmental, economic, and social reasons. This book focuses on a related trend to take out or decommission dams that either no longer serve a useful purpose or have caused such egregious ecological impacts as to warrant removal. Nearly 500 dams in the United States and elsewhere have already been removed, and the movement toward river restoration is accelerating. Within a few months of the removal of the Edwards Dam in Maine in mid-1999, salmon, striped bass, alewives, and other affected fish returned to waters from which they had been absent for 162 years. Several other case studies are described in this volume, together with some ambitious proposals to remove some of the world's largest dams.

As traditional approaches to the supply of water become less appropriate or more expensive, unconventional methods are receiving more attention. The concept and practice of transporting fresh water in large oceangoing plastic bags was described in the first book. Several additional approaches are described here, including large- and small-scale desalination technology, water reclamation and reuse, and techniques such as fog collection. More and more cities are discovering that wastewater can be a resource, not a liability, for purposes ranging from irrigation to drinking. Matching water demands with available waters of different quality can reduce water-supply constraints, increase system reliability, and solve costly wastewater disposal problems. Water-quality issues are also addressed in the context of the discovery of the widespread contamination of groundwater in Bangladesh and West Bengal, India, with arsenic. The laudable successes in the 1970s and 1980s in meeting the water-supply requirements of millions of Bangladeshis are now threatened by the failure to detect arsenic and to protect public health.

In one of the greatest technological embarrassments of the twentieth century, which certainly had its share of technological embarrassments, errors caused by the use of incompatible units of measure by two different groups involved in spacecraft navigation led to the destruction of the Mars Climate Orbiter spacecraft just as it reached the red planet—a $125 million dollar goof-up. The water world has its share of strange units of measure. In a modest effort to encourage students of water problems to check their work and avoid such expensive mistakes, I've included a comprehensive set of water units and conversions at the end of the Data Section. Now readers should be readily able to find the appropriate meaning (and conversions) for leagues, dekameters, feddans, acre-feet, Imperial gallons, morgen-feet, miner's inches, quinaria, and more.

The Data Section in the present volume also provides new, updated, and expanded data sets. When no new data were available, data tables from the first edition were not reproduced. For example, new data on cholera, access to clean drinking water and sanitation services, and hydroelectric capacity and production are either not available or vary little from the 1998 edition. New tables, however, have been added on water and agriculture, international river basins, basic stocks and flows of the world's water, and more. Downloadable selections from both sets of tables are posted on the Web site associated with this book: http://www.worldwater.org.

Some of the other information found in the first edition of *The World's Water* is also updated here. The chronology on water-related conflicts has been modified and expanded and now appears in the Water Briefs section. As the information available on the Internet has grown, the section on water-related Internet sites has been enlarged and updated. This list, too, is available at the above Web site.

A few readers of the first book noted the lack of a detailed discussion of food and agriculture, or flood control, or some other important issue. No doubt some readers of this edition will note the lack of a detailed discussion of water and ecosystems, or privatization, or something else. But I repeat a comment made in the introduction to the first edition: No single publication can adequately address all of the issues of interest to water experts, students, and the public. I urge readers to use these publications as stepping stones into the large, turbulent world of water, with its many different streams and pools.

PETER H. GLEICK
OAKLAND, CALIFORNIA

Contents

ONE

The Human Right to Water

If the misery of our poor be caused not by the laws of nature, but by our institutions, great is our sin.

CHARLES DARWIN

The test of our progress is not whether we add more to the abundance of those who have much; it is whether we provide enough for those who have little.

FRANKLIN DELANO ROOSEVELT

Universal access to basic water services is one of the most fundamental conditions of human development. Yet as we enter the twenty-first century, billions of people lack such access. The numbers are stark: more than 1 billion people in the developing world do not have safe drinking water, and nearly 3 billion people live without access to adequate sanitation systems necessary for reducing exposure to water-related diseases. The failure of the international aid community, nations, and local organizations to satisfy these basic human needs has led to substantial, unnecessary, and preventable human suffering. An estimated 14 to 30 thousand people, mostly young children and the elderly, die every day from water-related diseases. At any given moment, approximately one-half of the people in the developing world suffer from disease caused by drinking contaminated water or eating contaminated food (United Nations 1997b). This chapter argues that access to a basic water requirement is a fundamental human right implicitly supported by international law, declarations, and state practice. This right to water could also be considered even more basic and vital than some of the more explicit human rights already acknowledged by the international community. And a transition is underway making a right to water explicit.

As we enter the twenty-first century, governments, international aid agencies, nongovernmental organizations, and local communities must work to provide all

Portions of this chapter were published in the article "A Human Right to Water" *Water Policy*, Vol. 1, No. 5, pp. 487–503.