
world
WATER
vision

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world WATER vision

Making Water Everybody's Business

William J. Cosgrove and Frank R. Rijsberman
For the World Water Council

World Water Vision

World Water Council | Conseil Mondial de l'Eau

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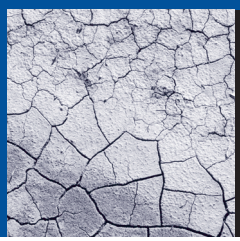
Word from the President of the World Water Council

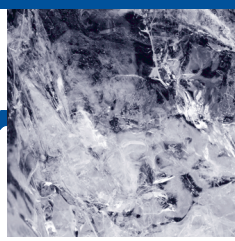
Water is life, in all forms and shapes. This basic yet profound truth eluded many of us in the second half of the 20th century. Water professionals and scientists around the world were ringing the alarm bells of an impending water crisis. Yet attempts to address some of the issues or to offer partial solutions met with limited success.

As the world population increased and urbanisation and industrialisation took hold, the demand for water kept rising while the quality continued to deteriorate. Water scarcity afflicted many more nations, and access to clean drinking water and sanitation remained poor. A decline in public financing and a rise in transboundary water conflicts made these problems worse. But awareness of the problems was limited to the few on the "inside," in the water sector. We start the new century with a water crisis on all accounts. A concerted effort and extraordinary measures are needed to face the challenges head on.

From its inception the World Water Council has understood the dimensions of the world water crisis. The Council realized that a first step towards solving this crisis is the development of a shared vision on world water for the long term. The *Long Term Vision for Water, Life, and Environment in the 21st Century*—or World Water Vision, for short—was introduced during the World Water Council's first World Water Forum in Marrakech, Morocco, in 1997. The Marrakech Declaration gave the Council the mandate to develop such a Vision. Planning and preparation went at full speed in 1997 and 1998. By the summer of 1998 preparation of the Vision commenced in earnest.

This Report is the culmination of the Vision development exercise. The monumental work was carried out under the direct responsibility of William J. Cosgrove, director, and Frank R. Rijsberman, deputy director, of the Vision Management Unit, World Water Council. We are very grateful for their tireless efforts, patience, perseverance, and diligence in managing, synthesising, and editing this text.





The World Water Council also acknowledges the tremendous support and exceptional contribution to the development of the World Water Vision by staff of the Vision Management Unit, members of the Vision Management Committee of the World Water Council, members of the Thematic and Scenario Panels, and members of the World Commission on Water for the 21st Century—the World Water Commission—and its senior advisors.

Special thanks go to Ismail Serageldin for chairing the World Water Commission and for mobilising resources and the media in support of the Vision. This work would not have been possible without the generous financial support of the government of the Netherlands. Our gratitude also goes to Bert Diphoorn, Koos Richelle, and their colleagues at the Ministry of Foreign Affairs. We acknowledge the excellent service and support provided by the Water Science Division of the United Nations Educational, Scientific, and Cultural Organization for hosting the Vision Management Unit. Many other organisations made financial, intellectual, and other contributions to the Vision, and their contributions are much appreciated.

It is not possible to list here all those who contributed professionally and with devotion to the World Water Vision. Their enthusiasm and dedication make this work a unique contribution in the history and development of the world's water resources.

This work is dedicated to the children of the world, because we did not inherit the world from our parents—we borrowed it from our children.

Mahmoud A. Abu-Zeid
President of the World Water Council
Minister of Water Resources and Irrigation
Giza, Egypt

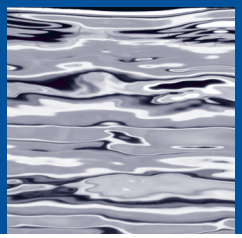
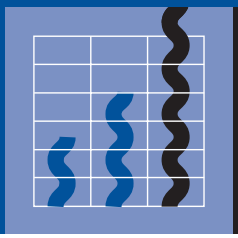
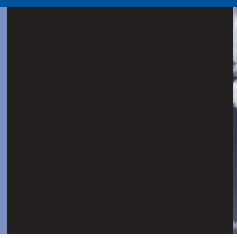
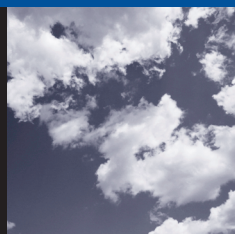
Word from the Chairman of the World Water Commission

Yes, water is life. Every human being, now and in the future, should have enough clean water for drinking and sanitation, and enough food and energy at reasonable cost. Providing adequate water to meet these basic needs must be done in an equitable manner that works in harmony with nature. For water is the basis for all living ecosystems and habitats and part of an immutable hydrological cycle that must be respected if the development of human activity and well-being is to be sustainable.

We are not achieving these goals today, and we are also on a path leading to more crises and problems for a larger part of humanity and many more parts of the planet's ecosystems. Business as usual leads us on an unsustainable and inequitable path.

To address these issues, the World Water Council convened a World Commission on Water for the 21st Century—or World Water Commission, for short—that was cosponsored by all the United Nations agencies working on water and development. I have had the privilege of chairing this distinguished Commission. I have also had the privilege of working with an excellent team, the Vision Management Unit of the World Water Council, headed by two remarkable individuals, the authors of this Report.

The World Water Vision exercise, carried out under the guidance of the World Water Commission, has involved many thousands of women and men in an extraordinary participatory exercise over an 18-month period. These people contributed to an unprecedented effort to increase awareness of the water crisis that affects billions of people already. More than 40 groups of people around the world have worked on the development of their visions of sustainable management of water in their region or sector. Their reports are published separately. Together all these people will not only increase worldwide water awareness, but will also shape public policy on water in the 21st century.

This Report is the tip of the iceberg. It reflects the visions of many in a single, global statement. I commend the authors. They did a superb job of producing four rapidly evolving versions of the World Water Vision in an open, transparent process through which hundreds of people reviewed their drafts and provided extensive comments. Even more, they were the engine behind the Vision exercise, shaping the process, raising funds, motivating people to participate, and believing—as I did—that the impossible ought to be done in just 18 months.

This Report and the many associated documents that it draws on were essential inputs into the deliberations of the World Water Commission and in the formulation of the recommendations contained in the Commission's report. *World Water Vision: Making Water Everybody's Business* is timely. It is authoritative. And I am convinced that it will contribute to changing our world water future.

Ismail Serageldin
Chairman
World Water Commission on
Water for the 21st Century

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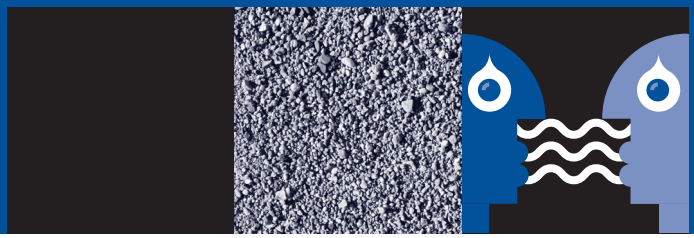
Preface

In recent years it has become evident that there is a chronic, pernicious crisis in the world's water resources. Participants at the first World Water Forum—held in Marrakech, Morocco, in 1997 and sponsored by the World Water Council—called for a World Water Vision to increase awareness of the water crisis and develop a widely shared view of how to bring about sustainable use and development of water resources. The World Water Council responded and developed the World Water Vision as its main programme.

The World Water Vision draws on the accumulated experience of the water sector, particularly through sector visions and consultations for Water for People (Vision 21; WSSCC 1999), Water for Food and Rural Development, Water and Nature, and Water in Rivers. Professionals and stakeholders from different sectors have developed integrated regional visions through national and regional consultations covering Arab countries, Australia and New Zealand, Baltic states, Canada, Central America and the Caribbean, Central Asia, China, the Danube Basin, the Mediterranean basin, the Nile basin, North America, the Rhine basin, South America, South Asia, Southeast Asia, Southern Africa, and West Africa. In addition, there were special projects on Interbasin Water Transfers; River Basin Management; A Social Charter for Water, Water, Education; and Training, Water and Tourism; and Mainstreaming Gender Issues.

The participatory process that led to the World Water Vision makes it special. Since 1998 some 15,000 women and men at the local, district, national, regional, and global levels have shared their aspirations and developed strategies for the sustainable use and development of water resources. The Internet made these consultations possible in a short timeframe. As the Vision evolved, more networks of civil society groups, nongovernmental organisations (NGOs), women, and environmental groups joined the consultations that influenced this Report. The diverse backgrounds of participants—authorities and ordinary people, water experts and environmentalists, government officials and private sector participants, academics and NGOs—offered a wide range of views. So, this is not an academic exercise—it is the start of a movement.



The participatory consultations will continue at the Second World Water Forum, being held at The Hague in March 2000. Many of the participants in the Vision exercise will have the chance to meet thousands of other interested stakeholders, including ministers from most countries, to discuss the solutions proposed in this Report and in dozens of other documents prepared as part of the Vision process. Over the coming months and years participants from the forum will develop action plans to implement the recommendations of the World Water Commission and the strategies herein.

The World Water Vision hopes to inspire women and men to overcome obstacles and achieve fundamental changes. Its message is for everybody—particularly the leaders and professionals who have the power and knowledge to help people turn visions into reality. It challenges those directly affected by the water crisis to initiate action and to call on their leaders to bring about sustainable water resource use and development.

The Vision recognises that people's roles and behaviours must change to achieve sustainable water resource use and development. The main actors will be individuals and groups in households and communities with new responsibilities for using water and water-related services. Public authorities will need to empower and support them and carry out work that households and communities cannot manage for themselves. Water professionals and environmentalists will provide these stakeholders with the information they need to participate in decisionmaking and will help implement their decisions. Working together, these groups can achieve this Vision.

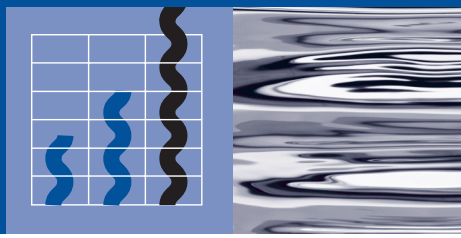
World Water Vision: Making Water Everybody's Business, prepared by the staff of the Water Vision Unit for the World Water Council, complements the many documents being published by sector and regional consultation groups. It synthesises many findings, bringing together water issues on a global scale. (The analytical parts are published separately in a document called ***World Water Scenarios: Analysis***.) The Vision exercise involved thousands of people

over an 18-month period. Women and men from around the world have participated in hundreds of meetings to formulate and discuss their local, national, regional, and sector visions for water in the 21st century. This Report is based on the visions developed in those consultations, on the documents generated by this process, and on the feedback and comments received. A listing of the partner organisations and some of the meetings, along with an overview of the background documents, is provided in the appendix.

The World Water Commission's report, signed by its members, also draws on many of these findings and exercises. But it is independent, and does not constitute a summary of these efforts. The positions on what constitutes a desirable future for water use and development at the global level, as contained in its report, were determined by the Commission in meetings at The Hague on 29–30 November 1999. This Report is intended to be consistent with the Commission's recommendations.

The analysis of current and future water resource availability and use described in chapters 2 and 3 is based largely on the work of the Scenario Development Panel (see appendix) and the modellers of the International Water Management Institute in Colombo, Sri Lanka; the International Food Policy Research Institute in Washington, D.C.; the Centre for Environmental Systems Research of the University of Kassel in Germany; the Stockholm Environment Institute, Sweden; and the Russian State Hydrological Institute in St. Petersburg. In addition, sector and regional vision documents were the sources for many boxes and analyses throughout the Report (see appendix).

The Global Water Partnership (GWP) was the key partner in the World Water Vision exercise. During the fist phase the GWP strongly supported the Vision exercise through regional committees that became the coordinators and facilitators of regional vision consultations. During



the second phase the GWP's parallel program, the Framework for Action, worked alongside the Vision exercise, took over the initiative in regions, and began to prepare action plans to achieve the Vision through a process called From Vision to Action.

William J. Cosgrove

Frank R. Rijsberman

Acknowledgements

This report went through four drafts, and many people provided more than two hundred extensive and thoughtful comments on these drafts, either as individuals or as representatives of their organisations: Jamal M. Abdo, National Water Resources Authority, Yemen; Anil Agarwal, Centre for Science and Environment; Tony Allan, School of Oriental and African Studies, University of London; Dogan Altinbilek, Ministry of Energy, Turkey; Arthur J. Askew, World Meteorological Organization; Milan Bedrich, Danube River Basin Programme; Patricio Bernal, United Nations Educational, Scientific, and Cultural Organization–Intergovernmental Oceanographic Commission; Janos Bogardi, United Nations Educational, Scientific, and Cultural Organization–International Hydrological Programme; Malia Bouayad-Agha, Vision Unit; Lucinda Boyle, Irrigation Association; John Briscoe, World Bank; Stefan Bruk, United Nations Educational, Scientific, and Cultural Organization; Margaret Catley-Carlson, World Water Commissioner; Bertrand Charrier, Green Cross International; H. Slimane Cherif, International Atomic Energy Agency; Rene Coulomb, Suez Lyonnaise des Eaux; Piers Cross, United Nations Development Programme–World Bank Water and Sanitation Program; Jean Dausset, Academie de l'Eau; Dick de Jong, International Water and Sanitation Centre; Roger de Loose, Rotary International; Charles-Lois de Maud'huy, Generale des Eaux (Vivendi); Wolfram Dirksen, German Association for Water Resources and Land Improvement; Victor Dukhovny; Farouk El-Baz, Boston University; Alan Ervine, University of Glasgow; Walter Falcon, Stanford University; Malin Falkenmark, Stockholm International Water Institute; Constantino A. Fasso, International Commission on Irrigation and Drainage; Stephen Foster, International Association of Hydrology; Jennifer Francis, International Water and Sanitation Centre; Luis Garcia, Inter-American Development Bank; Gouri Shankar Ghosh, United Nations Children's Fund; John Gladwell, Hydro Tech. International; Stela Goldenstein, Scenario Development Panel; Vincent Gouarne, World Bank; Biksham Gujja, World Wide Fund for Nature; Joyeeta Gupta, Free University, the Netherlands; Lilian Saade Hazin, International Institute for Infrastructural, Hydraulic and Environmental Engineering; Danielle Hirsch, Both ENDS; Howard Hjort, Food and Agriculture Organization; John Hodges, U.K. Department for International Development; Richard Holland, World Wide Fund for Nature; Constance Hunt, World Wide Fund for Nature; Ahmad Hussein, United Nations Educational, Scientific, and Cultural Organization, Malaysian delegation; Annelie Joki-Hubach, Both ENDS; Torkil Jonch-Clausen, Global Water Partnership–Technical Advisory Committee; Thomas M. Kimmell, Irrigation Association; Jean-Marcel Laferriere, Canadian International Development Agency; Raymond Lafitte, International Hydropower Association; Jacques Lecornu, International Commission on Large Dams; Guy LeMoigne, Senior Advisor, World Water Commission; Roberto Lenton, United Nations Development Programme; Stephen Lintner, World Bank; Robert Lytle, CH2M HILL; Chandra Madramootoo, McGill University; Ruth Meinzen-Dick, International Food Policy Research Institute; Mac Mercer, World Conservation Union; Doug Merrey, International Water Management Institute; Tony Millburn, International Water Association; Hans Mobs; Fernando Perez Monteagudo, Center for Hydraulic Research, Cuba; Chris Morry, World Conservation Union; P. Mosley; M. Edward Muckle, Green Resources Management Ltd.; Masahisa Nakamura, Lake Biwa Research Institute; Riota Nakamura, Japanese Institute of Irrigation and Drainage; Jean-Pierre Nicol, Association Francaise pour l'Etude de l'Irrigation et du Drainage; Hideaki Oda, Water for Rivers; Toshio Okazumi, Vision Unit; I.H. Olcay Unver, Southeastern Anatolia Project, Turkey; Rolph Payet, Ministry of Environment and Transport, Seychelles; Sandra Postel, Global Water Policy Project; Lin Pugh, International Information Centre and Archives for the Women's Movement; Amreeta Regmi, United Nations Development Fund for Women, South Asia; Peter Rogers, Harvard University; Salman Salman, World Bank; Barbara Schreiner, Ministry of Water Affairs and

Forestry, South Africa; Michael Schur; Senior Advisors, Water World Commission; John Soussan, University of Leeds; Hilary Sunman, Global Water Partnership Framework for Action Unit; Mark Svendsen, Water for Food; Henri Tardieu, Association Francaise pour l'Etude de l'Irrigation et du Drainage; Task Force of the Chief Executive Officer C.D. Thatte, International Commission on Irrigation and Drainage; Cecilia Tortajada, Third World Centre for Water Management; M.J. Tumbare, Zambezi River Authority; Rene Urien, Agricultural and Environmental Engineering Research, France; Isabel Valencia, Scenario Development Panel; Hans van Damme, Water Supply and Sanitation Collaborative Council; Jan Peter van der Hoek, Amsterdam Water Supply; Barbara van Koppen, International Water Management Institute; Frank van Steenbergen, Global Water Partnership Framework for Action Unit; Christine van Wijk, International Water and Sanitation Centre; Linden Vincent, Wageningen Agricultural University; Wendy Wakeman, World Bank; Water and Nature Team, World Conservation Union; Ranjith Wirasinhar, Water Supply and Sanitation Collaborative Council; and Paul Wolvenkamp, Both ENDS. While all the individuals listed provided valuable comments and corrections, they have not endorsed the Report, and all remaining errors and omissions are the responsibility of the authors. This report benefitted from the editing, design, and prepress production of Communications Development's Bruce Ross-Larson, Meta de Coquereaumont, Terry Fischer, Paul Holtz, Damon Iacovelli, Megan Klose, Daphne Levitas, and Molly Lohman and the art direction of Grundy & Northedge.

The start-up of the World Water Vision exercise and its continuation were assured by major financial support from the Ministry of Foreign Affairs of the Netherlands, particularly through the unfailing efforts of Bert Diphoorn. Additional funding for the exercise was pledged on short notice as the process moved forward. Since early 1999 other organisations have provided financial assistance, particularly the Swedish International Development Authority, Canadian International Development Agency, and Global Environment Facility. Finland, Luxembourg, and Switzerland have also contributed support. Many other organisations have contributed indirectly—for example, through the Global Water Partnership—or contributed time and resources in kind. The World Water Vision Unit has been the guest of the United Nations Educational, Scientific, and Cultural Organization's International Hydrological Programme at its headquarters in Paris.

In an undertaking as large as the World Water Vision exercise, made possible on short notice thanks only to the tireless efforts of many people, it is impossible to properly acknowledge and thank everyone for their contributions. An overview has been provided here and in the appendix, but to all who contributed and cannot find their name, an apology—as well as a heartfelt thank you!

Making Water Everybody's Business

There is a water crisis today. But the crisis is not about having too little water to satisfy our needs. It is a crisis of managing water so badly that billions of people—and the environment—suffer badly

All life on earth has depended on water since the first single-cell organisms appeared 3.5 billion years ago—consuming energy, growing, reproducing. From that time until very recently in geological history, there was a balance between the needs of life and the available water. Humans appeared as a species less than 100,000 years ago. Sometime less than 10,000 years ago we developed stone tools, learned that we could cultivate our own food instead of just gathering it, established civilisations, and began migrating long distances.

In the past 200 years our numbers grew exponentially—more people to be fed, and more water needed by each person for economic development. In the past 100 years the world population tripled, but water use for human purposes multiplied sixfold! Today perhaps half of all available freshwater is being used for human ends—twice what it was only 35 years ago. Looked at another way, all freshwater serves human needs, because ecosystems provide goods and services to humanity beyond the obvious water for drinking, food production, and industrial uses. Think of the fish we eat, the benefits we enjoy from natural flood protection, and the water quality brought by healthy, functioning aquatic ecosystems.

Today's water crisis—and tomorrow's

There is a water crisis today. But the crisis is not about having too little water to satisfy our needs. It is a crisis of managing water so badly that billions of people—and the environment—suffer badly.

The most obvious uses of water for people are drinking, cooking, bathing, cleaning, and—for some—watering family food plots. This domestic water use, though crucial, is only a small part of the total (box 1). Worldwide, industry uses about twice as much water as households, mostly for cooling in the production of electricity. Far more water is needed to produce food and fibre (cereals, fruits, meat, cotton). We are not sure how much water

Providing six times more water now than 100 years ago has significant impacts on people and the environment

Box 1 Water—renewable and usable

- Green water—the rainfall that is stored in the soil and evaporates from it—is the main source of water for natural ecosystems and for rainfed agriculture, which produces 60% of the world's food.
- Blue water—renewable surface water runoff and groundwater recharge—is the main source for human withdrawals and the traditional focus of water resource management.
- The blue water available totals about 40,000 cubic kilometres a year. Of this, an estimated 3,800 cubic kilometres, roughly 10%, were withdrawn (diverted or pumped) for human uses in 1995.
- Of the water withdrawn, more than 2,000 cubic kilometres are consumed. The remainder is returned, usually with significant reductions in quality.

Not all renewable water resources are usable

- Of global water resources, a large fraction is available where human demands are small, such as in the Amazon basin, Canada, and Alaska.
- Rainfall and river runoffs occur in large amounts during very short periods, such as during the monsoon season in Asia, and are not available for human use unless stored in aquifers, reservoirs, or tanks.
- The withdrawal and consumption figures do not show the much larger share of the water resources "used" through degradation in quality—polluted and of lower value downstream.
- Water not used by humans generally does not flow unused to the sea. Instead it is used in myriad ways by aquatic and terrestrial ecosystems—forests, lakes, wetlands, coastal lagoons.

And:

- Even though people use only a small fraction of renewable water resources globally, the fraction is much higher in many arid and semi-arid river basins where water is scarce.
- In many tropical river basins a large amount of water is available only for short periods, so either it is not usable or massive infrastructure is required to store it for later use, with considerable social and environmental impacts.
- In many temperate zone river basins adequate water resources are distributed fairly evenly over the year but used so intensively that surface and groundwater resources become polluted and good-quality water becomes scarce.

Source: World Water Vision staff.

must remain in our ecosystems to maintain them, but indications are that we are approaching—and in many places have surpassed—the limits of how much water we can divert.

Providing six times more water now than 100 years ago has significant impacts on people and the environment. The cup is half full:

- A major investment drive, the International Drinking Water Supply and Sanitation Decade (1981–90) and its follow-up—led by national governments and supported through international organisations—ended with safe and affordable drinking water for 80% of the exploding world population and sanitation facilities for 50%.
- Major investments in wastewater treatment over the past 30 years have halted the decline in—even improved—the quality of surface water in many developed countries.
- Food production in developing countries has kept pace with population growth, with both more than doubling in the past 40 years.
- In perhaps the biggest achievement of the century, rising living standards, better education, and other social and economic improvements have finally slowed population growth.

But it is also half empty:

- An unacceptably large part of the world population—one in five—does not have access to safe and affordable drinking water, and half the world's people do not have access to sanitation. Each year 3–4 million people die of waterborne diseases, including more than 2 million young children who die of diarrhoea.
- More than 800 million people, 15% of the world population and mostly women and children, get less than 2,000 calories a day. Chronically undernourished, they live in permanent or intermittent hunger.
- Much economic progress has come at the cost of severe impacts on natural ecosystems in most developed and transition economies. Half the world's wetlands were destroyed in the 20th century, causing a major loss of biodiversity. Many rivers and streams running through urban centres are dead or dying. Major rivers—from the Yellow River in China to the Colorado in North America—are drying up, barely reaching the sea.
- Water services—irrigation, domestic, and industrial water supply, wastewater treatment—are heavily subsidised by

While much has been achieved, today's water crisis is widespread. Continuing current policies for managing water will only widen and deepen that crisis

most governments. This is done for all the right reasons (providing water, food, jobs) but with perverse consequences. Users do not value water provided free or almost free—and so waste it. Water conservation technologies do not spread. Incentives for innovation remain weak.

- Unregulated access, affordable small pumps, and subsidised electricity and diesel oil have led to overpumping of groundwater for irrigation and to drops in groundwater tables of several metres a year in key aquifers. As much as 10% of global annual water consumption may come from depleting groundwater resources.

- In most countries water continues to be managed sector by sector by a highly fragmented set of institutions. This system is ineffective for allocating water across purposes, precludes effective participation of other stakeholders, and blocks integrated water resource management.

The conclusion: while much has been achieved, today's water crisis is widespread. Continuing current policies for managing water will only widen and deepen that crisis.

What business as usual portends: severe stress

Because of population growth, the average annual per capita availability of renewable water resources is projected to fall from 6,600 cubic metres today to 4,800 cubic metres in 2025. Given the uneven distribution of these resources, some 3 billion women and men will live in countries—wholly or partly arid or semi-arid—that have less than 1,700 cubic metres per capita, the quantity below which people start to suffer from water stress. Also by 2025 an estimated 4 billion people, or more than half the world population, will live in countries where more than 40% of renewable resources are withdrawn for human uses—another indicator of high water stress under most conditions.

Under business as usual, with present policies continuing, economic growth to 2025 in developed and transition economies tends to increase water use. But this increase can be offset by efficiency improvements and the saturation of water demands in industry and households. In addition, the amount of irrigated land stabilises, and water for irrigation is used more efficiently. As a result total water withdrawals can—and should—decline. Extrapolating current trends of water quality does not present a rosy picture, however.

In developing countries higher incomes and increased access lead to greater household water use per capita, multiplied by the greater number of people. Meanwhile, economic growth expands electricity demand and industrial output, leading to a large increase in water demanded for industry. Even though water may be used more efficiently in households and industry, increased use overwhelms these improvements. Providing food to the growing population and ending hunger remain the largest challenge in the quantities of water demanded. The result is a projected large increase in water withdrawals in the agricultural, industrial, and domestic sectors of the developing world.

Adding together the trends in developed and developing countries under business as usual increases global water withdrawals from 3,800 cubic kilometres in 1995 to 4,300–5,200 cubic kilometres in 2025. The difference largely depends on how much irrigated agriculture does or does not expand.

This increase in water withdrawals implies that water stress will increase significantly in more than 60% of the world, including large areas of Africa, Asia, and Latin America. Will this lead to more frequent and more serious water crises? Assuming business as usual: yes.

Moving from crisis to Vision

Whether the water crisis deepens and intensifies—or whether key trends can be bent towards sustainable management of water resources—depends on many interacting trends in a complex system. Real solutions require an integrated approach to water resource management.

Crucial issues that may provide levers for very different futures include:

- Limiting the expansion of irrigated agriculture.
- Increasing the productivity of water.
- Increasing storage.
- Reforming water resource management institutions.
- Increasing cooperation in international basins.
- Valuing ecosystem functions.
- Supporting innovation.

The more food we produce with the same amount of water, the less the need for infrastructure development, the less the competition for water, . . .

Table 1 Renewable water use in the World Water Vision

In our Vision the water for irrigated agriculture is drastically limited, with 40% more food produced (partly from rainfed agriculture) consuming only 9% more water for irrigation. Industrial use goes down in developed countries, but the decline is more than offset by increases in the developing world. Municipal use goes up sharply in developing countries, to provide a minimum amount for all, and down in the developed world. Recycling and increased productivity lower the ratio of water withdrawn to water consumed for all uses.

	Cubic kilometres		Percentage increase
User	1995	2025	1995–2025
Agriculture			
Withdrawal	2,500	2,650	6
Consumption	1,750	1,900	9
Industry			
Withdrawal	750	800	7
Consumption	75	100	33
Municipalities			
Withdrawal	350	500	43
Consumption	50	100	100
Reservoirs (evaporation)	200	220	10
Total			
Withdrawal	3,800	4,200	10
Consumption	2,100	2,300	10
Groundwater overconsumption	200	0	

Source: Table 4.1.

In the World Water Vision the increase in water use for irrigated agriculture has to be drastically limited, with 40% more food produced (partly from rainfed agriculture) but only 9% more water consumed for irrigation (table 1). A significant decline in industrial water use in developed countries is more than offset by increases in the developing world. Municipal use goes up sharply in developing countries, to provide a minimum amount for all, and down in the developed world. Recycling and higher productivity reduce the amount of water withdrawn to meet consumption needs for all uses.

Limiting the expansion of irrigated land

The rate of expansion of irrigated land is the most important determinant of water stress, at least the stress related to quantity. There are two contrasting views on how the trend in irrigated agriculture's expansion will continue or bend, with important stakeholders weighing in on both sides.

The conventional wisdom in agriculture, based on the need to produce food for the growing world population, is that irrigated agriculture will have to keep pace—and therefore expand by 20–30% in area by 2025. The other perspective—supported by environmentalists and by some stakeholders in agriculture—holds that a slowdown in dam building and irrigation investments, combined with the consequences of dropping groundwater tables, will limit the expansion in irrigated area to 5–10%.

Neither alternative is attractive:

- *Unattractive alternative 1.* A 30% increase in irrigated area would require major investments in water infrastructure, a large portion of which would have to involve large dams. There would likely be severe water scarcities—and serious risks of deteriorating ecosystems.

- *Unattractive alternative 2.* A strong reduction in irrigation expansion—under otherwise unchanged policies, or business as usual—will cause considerable food shortages and rising food prices.

Both alternatives—each unattractive and unsustainable—would considerably deepen today's water crisis. So there is every motivation to implement policies that make food production and water resource management more sustainable.

. . . the greater the local food security, and the more water remains for household and industrial uses. And the more that remains in nature

Making water more productive: more crop per drop

The more food we produce with the same amount of water, the less the need for infrastructure development, the less the competition for water, the greater the local food security, and the more water remains for household and industrial uses. And the more that remains in nature.

That is why the productivity of water use must be dramatically improved. Our Vision relies on meeting about half the increased demand for agricultural water use in 2025 by increasing water productivity, taking many opportunities for improving the management of water. Recycling, widely prevalent, still holds potential for saving water. Gains are also possible by providing more reliable supplies to farmers—through precision technology and feedback irrigation systems.

In the green revolution, getting more crop per drop came from introducing shorter-duration and higher-yielding crop varieties.[1] Adding fertilisers and expanding irrigation have also pushed up yields and water productivity.

How can productivity be further improved in agriculture—the largest water user? The same conditions should be introduced as elsewhere: payment for water services, accountability of managers to users, and competition among public and private suppliers. Then there are the technical and management options to improve productivity.

First, through ever better agronomic practices, the traditional focus of agricultural research:

- *Improving crop varieties.* Plant breeding, possibly aided by biotechnology, plays an important role in developing more drought resistant varieties or varieties that yield more mass per unit of water consumed by transpiration.

- *Substituting crops.* Switching to a crop that consumes less water or switching to a crop with higher economic or physical productivity per unit of transpiration.

- *Improving cultural practices.* Better soil management, fertilisation, and pest and weed control increase the productivity of land and often of water consumed.

And second, deserving more attention, through better water management:

- *Improving irrigation water management.* Better timing of water supplies can reduce stress at critical crop growth periods, increasing yields. This requires making irrigation system management responsive to the needs of farmers.

- *Using more deficit, supplemental, and precision irrigation.* With water under better control, it is possible to use more productive on-farm practices. Deficit irrigation is aimed at increasing productivity per unit of water with irrigation strategies that do not meet full evaporative requirements. Having irrigation supplement rainfall can increase the productivity of water when a limited supply is made available to crops at critical periods. Precision irrigation—using water-conservation technology as well as better information and communication technologies—can reduce non-beneficial evaporation, apply water uniformly to crops, and reduce stress.

- *Reallocating water from lower- to higher-value uses.* Shifting from agriculture to municipal and industrial uses—or from low-value to high-value crops—can increase the economic productivity or value of water.

The keys to increasing food production without a major increase in water use will likely be to increase yields in rainfed agriculture and to close the yield gap by increasing yields where they are far below their biological and technical potential. Neither of these strategic directions will be easy or cheap. But limits to the water available for agricultural expansion may well force our hand.

Increasing storage

The other half of increased demand for water for food and rural development will have to be met by developing additional water supplies. It is imperative that we find ways to develop water supplies—that is, store water for later use, with lower economic, social, and environmental costs. Under the World Water Vision an additional 150 cubic kilometres of storage will be required for irrigation by 2025. Another 200 cubic kilometres of storage might be required to replace the current overconsumption of groundwater.

Rather than relying primarily on large dam projects to provide this storage, the demand should be met using a mix of:

- Large and small dams.

- Groundwater recharge.

New techniques and institutional mechanisms are urgently needed to recharge groundwater aquifers, to avoid the disasters looming if current overdraughts continue

- Traditional small-scale water storage techniques and rainwater harvesting.

- Water storage in wetlands.

New techniques and institutional mechanisms are urgently needed to recharge groundwater aquifers, to avoid the disasters looming if current overdraughts continue. Such mechanisms will include limiting access and providing incentives to users to limit or stop overpumping. Rainwater harvesting, generally a socially attractive alternative to large construction, provides opportunities for decentralised, community-based management of water resources.

Changing the way we manage water

New institutional mechanisms are needed for managing water. Among the most vital are:

- *Pricing of water services at full cost.* Making water available at low cost, or for free, does not provide the right incentive to users. Water services need to be priced at full cost for all users, covering all costs related to operation and maintenance for all uses and investment costs for at least domestic and industrial uses. The basic water requirement needs to be affordable to all, however, and pricing water services does not mean that governments give up targeted, transparent subsidies to the poor.

- *Service-oriented management.* The focus has to be on making managers responsive to user needs. This requires a mutual dependency that can take various forms, including service agreements. The service needs and expectations of users will be influenced by the price they have to pay for services, especially when they have to pay the full cost.

- *Empowering communities, women, and men.* People's initiative and capacity for self-reliance need to be put at the centre of planning and action for water supply and sanitation. Doing so can lead to systems that encourage genuine participation by empowered women and men, improving sustainable living conditions for all—particularly women and children.

Increasing cooperation in international basins

Nearly half the world is situated in 250–300 international river basins—rivers that cross national boundaries and whose resources are shared. Experience shows that shared water resources can be a source of cooperation rather than conflict. Most successful cooperation appears to evolve in stages:

- *Confidence building.* Countries that share international rivers usually start with low-level technical cooperation that focuses on exchange of data or jointly gathered data.

- *Cooperation.* As mutual trust and confidence increase, and as issues appear that concern all parties and can be more effectively addressed through collective action, cooperation gradually grows to a point where countries are willing to undertake joint action or allocate more significant resources.

- *International agreements.* After years of successful cooperation, lengthy negotiations are usually required to reach bilateral or regional agreements.

- *International law and alternative dispute resolution.* Once international agreements have been established, conflicts can be addressed through formal mechanisms (the judiciary or international law) or dispute resolution mechanisms (mediation or arbitration).

Valuing ecosystem functions

Much more research is needed to improve our understanding of ecosystem functions and to value the services that these systems provide. Recent global assessments of the services provided by freshwater ecosystems (watersheds, aquifers, and wetlands) for flood control, irrigation, industry, recreation, waterway transportation, and the like come up with estimates of several trillion dollars annually.

Such knowledge will allow careful assessments of the impacts of water resource use and development on ecosystems, particularly tropical ecosystems. That work needs to emphasise the river basin as the appropriate scale of management—from the forests in upper watersheds to coastal zones affected by the inflows of rivers into wetlands, lagoons, and mangrove ecosystems.

Many practices adopted to manage water for human needs—rules on extracting and sharing water, changes in cultivation and irrigation to save water for other purposes, returns to traditional and community-based water harvesting and storage methods—will also benefit ecosystems. Other measures include reducing nutrients through farm-based manure stor-

Much more research is needed to improve our understanding of ecosystem functions and to value the services that these systems provide

age, controlling silt by reducing erosion upstream, planning for joint hydropower generation and dry season irrigation, and reducing pollutants from agriculture and industry. Above all, ecosystems will be protected by integrated land and water resource management, basin by basin—along with full cost pricing for water services and management reforms for water delivery and wastewater disposal.

Supporting innovation

Increasing productivity will depend largely on innovation, through both fundamental research and the widespread dissemination and adoption of its results.

A key to this innovation will be increased awareness of water issues and the education and training of people capable of bringing about the necessary changes. Once water is appropriately valued, users and producers will have incentives to conserve it and to invest in innovation.

While pricing water is expected to be the primary way to bring in the private sector, a host of public goods aspects of water resources will continue to require public funding. Such activites range from researching staple food crops in developing countries to finding cures for tropical diseases—important to populations in markets too small to make privately funded research financially attractive.

Mobilising financial resources

Total investment in water services today—excluding direct investment by industry—is $70–80 billion a year. The largest investor in services is government—the traditional public sector, which contributes about $50 billion a year. The private sector, ranging from small water vendors to private municipal and metropolitan utilities, contributes around $15 billion. International donors contribute a further $9 billion for both water and sanitation services and irrigation and drainage.The international private sector—an investment newcomer—contributes about $4 billion a year.

We estimate that to achieve the World Water Vision, those investments will have to rise to $180 billion (table 2). Private firms—domestic and international—will be the main source of finance, and local communities will contribute much in cash and in kind. Government resources will be a smaller share in direct capital investment and maintenance costs for traditional water supply projects. This will free up public (and softer loan and grant) resources for water-related projects that supply public goods (such as flood management and environmental protection) and for subsidies to low-income and disadvantaged women and men to pay the cost of their minimum water and sanitation needs.

Table 2 Annual investment requirements for water resources

To achieve our Vision in 2025, we need to invest $180 billion a year—for a total of $4.5 trillion.

	Billions of U.S. dollars		Share (%)	
Use	1995	Vision 2025	1995	Vision 2025
Agriculture	30–35	30	43–50	17
Environment and industry	10–15	75	13–21	41
Water supply and sanitation	30	75	38–43	42
Total	70–80	180	100	100

Source: World Water Vision staff.

This explicit subsidy explains why government cash flows should remain at current levels, making total cash requirements greater than the direct investments in table 2. The role of government is to provide a regulatory and policy framework for investments to ensure financial sustainability.

Donors need to provide strategic assistance in developing policies, regulations, institutional capacity, human resources, and the technical and scientific competencies to manage the resource base and water services in a fully integrated fashion. Donors will also be important in helping countries meet basic needs and protect the environment. It is recommended that donors support integrated management and social and non-commercial uses of water.

Our Vision for water and life in 2025

By 2025 we will have achieved the three primary objectives of integrated water resource management:

- Empowering women, men, and communities to decide on the level of access to safe water and hygienic living conditions and on the types of water-using economic activities that they desire—and to organise to obtain it.

Water services will be planned for sustainability, and good management, transparency, and accountability will be standard

- Producing more food and creating more sustainable livelihoods per unit of water applied (more crops and jobs per drop), and ensuring access for all to food required for healthy and productive lives.

- Managing water use to conserve the quantity and quality of freshwater and terrestrial ecosystems that provide services to humans and all living things.

In our World Water Vision the five key actions to achieve these objectives are to:

- Involve all stakeholders in integrated management.

- Move towards full-cost pricing of all water services.

- Increase public funding for research and innovation in the public interest.

- Increase cooperation in international water basins.

- Massively increase investments in water.

How, then, will the water world look in 2025? Almost every woman and man, girl and boy in the world's cities, towns, and villages will know the importance of hygiene and enjoy safe and adequate water and sanitation. People at the local level will work closely with governments and nongovernmental organisations, managing water and sanitation systems that meet everybody's basic needs without degrading the environment. People will contribute to these services according to the level of service they want and are willing to pay for. With people everywhere living in clean and healthy environments, communities and governments will benefit from stronger economic development and better health.

Empowering women and men

New management—transparent and accountable. Water services will be planned for sustainability, and good management, transparency, and accountability will be standard. Inexpensive water-efficient equipment will be widely available. Rainwater harvesting will be broadly applied. Municipal water supplies will be supplemented by extensive use of reclaimed urban wastewater for nonpotable uses (and even for potable uses in seriously water-short urban areas). On small islands and in some dry coastal areas, desalination will augment the water supply. Many cities and towns will use low- or no-water sanitation systems, managed by communities and local authorities.

Secure and equitable access to and control of resources—and fair distribution of the costs and associated benefits and opportunities derived from conservation and development—will be the foundation of food and water security. Efforts to overcome sector-oriented approaches and to integrate catchment management strategies will continue to be supported by wider social and institutional changes. At the turn of the 21stcentury many government institutions will have recognised grassroots community-based initiatives—and built extensively on this groundwork. All new central government policies and legislation will be subject to prior assessment of their impacts on various stakeholders and beneficiaries. Private and public institutions will be more accountable and oriented towards the local delivery of services. They will fully incorporate the value of ecosystem services in their cost-benefit analysis and management.

More power for communities. At local levels the empowerment of women, traditional ethnic groups, and poor and marginalised people will make local communities and weak nations stronger, more peaceful, and more capable of responding to social and environmental needs. Institutional structures, including river basin commissions and catchment committees, will actively support the equitable distribution of goods and services from freshwater ecosystems. Both husbands and wives will be voting members in water user associations in farming communities. Clear property and access rights and entitlements will ensure that individuals and organisations holding those rights meet their associated responsibilities.

Producing more food and using water more productively

Higher crop yields. Extensive field research on water management policies and institutions in developing countries early in the 21st century will have focused on bringing average yields closer to yields achieved by the best farmers. Closing the yield gap makes the rural livelihoods of poor women and men much more sustainable. Countries with a basic policy of food self-sufficiency and the capability to implement it will increase their yields and production. They will do so by increasing the productivity of water through technical and institutional innovation, up to economic and technical limits. China and India will be among them.

Drawing on technological innovations as well as traditional knowledge, large improvements will be made in agriculture. Genetically modified crops will initially have been introduced on a small scale given lack of public and political support. The

Water management in 2025 will be based on recognising the environmental goods and services that healthy catchments provide

biggest advances in food production in the century's first decade will be plant improvements through tissue culture and marker-aided selection, crop diversity (especially indigenous varieties), appropriate cropping techniques, and soil and water conservation. In 2025, as the industry has demonstrated its responsibility and gained credibility, the use of genetically modified crops will become common and greatly increase the crop reliability in drought-prone regions.

More efficient use. There will likely be a 10% increase in water withdrawals and consumption to meet agricultural, industrial, and domestic requirements. Food production will increase 40%, made possible in part because people recognise that water is not only the blue water in rivers and aquifers, but also the green water in soil. Recognition of rainfed agriculture's crucial role in the water cycle will help make it more productive while conserving aquatic and terrestrial ecosystems.

Only a small part of the water delivered to industrial and domestic uses will be consumed by evaporation—most will be returned after treatment to the ecosystems from which it is drawn. Industrial and domestic water reuse will be common, and non–water-based systems of sewage treatment and other methods of ecosanitation will be applied in many areas to reduce pollution and make full use of human waste as fertiliser. Seminatural and artificial wetlands will be used to improve polluted waters and treat domestic effluents. Countries that face water scarcities early in the century will invest in desalination plants—or reduce the water used in agriculture, transfer it to other sectors, and import more food.

Smarter investments. Investments in cleaner technologies and reduced water and wastewater use will continue to help many industries lower their production costs while reducing their effluent taxes. Development investments will be based on economic valuations and linked to compliance with the environmental assessment and management standards of the International Standards Organization 14000 series.

Conserving ecosystems

Less pollution—more recharge. Concerns about polluting groundwater through leaching nitrates and other chemicals will be addressed. Restrictions will be placed on fertilisers, pesticides, and other chemicals in recharge areas after research on maximising the rate of recharge and controlling pollution. Ideally, the recharge areas will not be used for any other purpose. But in densely population areas, land will simply be too valuable to be set aside for this single use.

Healthier catchments. Water management in 2025 will be based on recognising the environmental goods and services that healthy catchments provide. Catchments require constant maintenance, to be provided largely by local communities, for erosion control, water quality, and biodiversity conservation, among other tasks. Strategic or unique natural ecosystems will be highly valued. And conservation programmes will reflect the needs and involvement of the local communities that depend on them.

More innovation. Innovation in most areas of water resource management—supported by the best of science and traditional knowledge—will accelerate. It will also support development and management of freshwater and related ecosystems. Science and modern technologies will provide an analytical perspective to problem-solving. Traditional knowledge, the wealth of many generations of water resource management, will also be a natural part of decisionmaking. The dialogue between scientists and the holders of traditional knowledge will prompt innovation in resource management.

Better governance. Governance systems in 2025 will facilitate transboundary collaborative agreements that conserve freshwater and related ecosystems and maintain local livelihoods. Management and decisionmaking will generally take place at the most effective and efficient level, helping to set up more open dialogue, information exchange, and cooperation. Despite huge efforts, transboundary conflicts will still be the most difficult water resource conflicts to resolve in 2025.

There will still be much to do, but we will have made the progress needed to mitigate the water crisis that reigned in 2000 and to advance to sustainable water use and development.

* * *

To conclude: there is a water crisis, but it is a crisis of management. We have threatened our water resources with bad institutions, bad governance, bad incentives, and bad allocations of resources. In all this, we have a choice. We can continue with business as usual, and widen and deepen the crisis tomorrow. Or we can launch a movement to move from Vision to action—by making water everybody's business.

Note

1. "More crop per drop" is the motto of the International Water Management Institute in Sri Lanka.